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REPORT OF THE WORKING GROUP ON NORTH ATLANTIC SALMON

Dublin, Ireland, 5-12 March 1992

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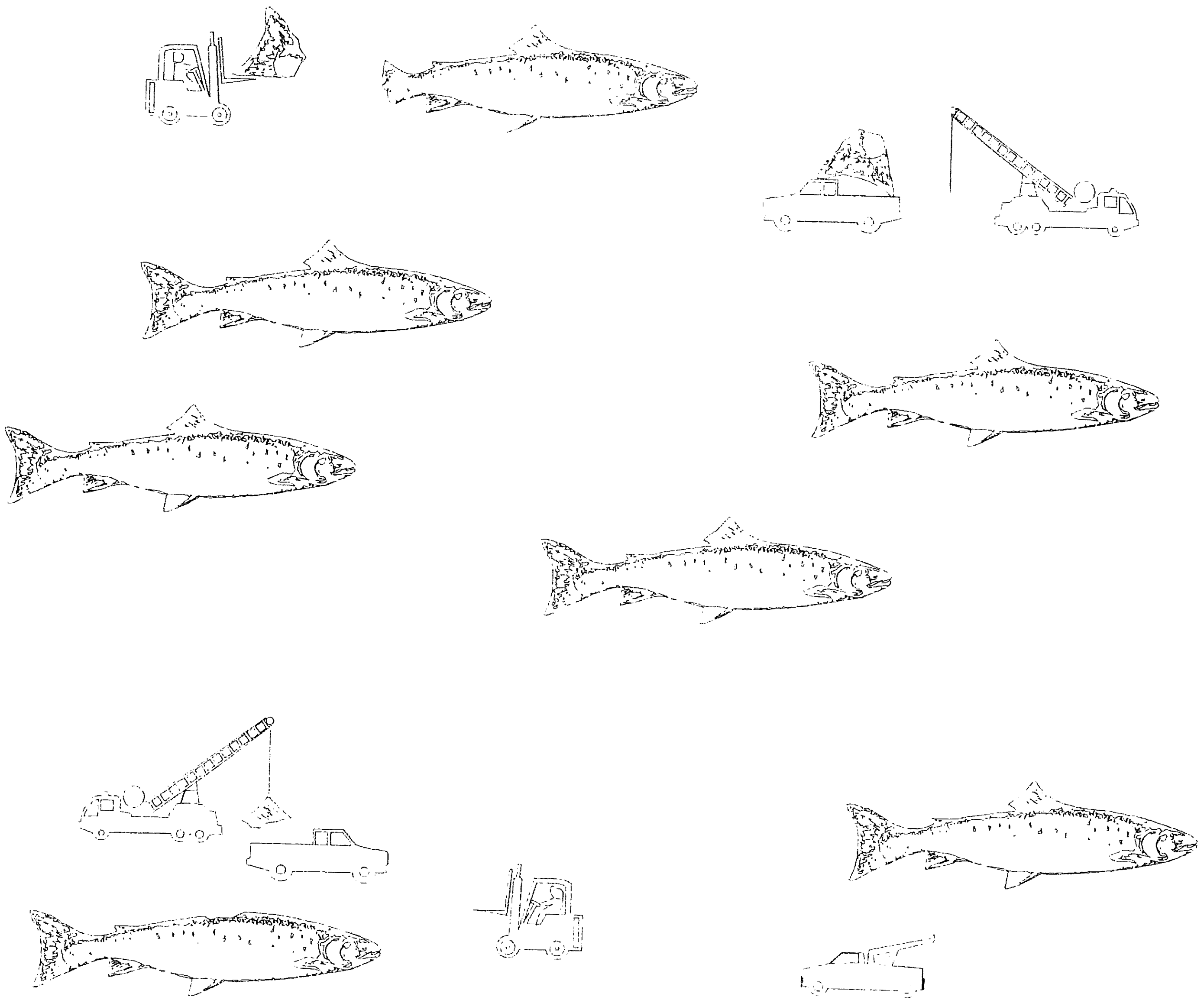

Run Reconstruction Modelling

CONTENTS

1 INTRODUCTION

1.1 Main Tasks

At its 1991 Statutory Meeting, ICES resolved (C.Res. 1991/2:7:3) that the Working Group on North Atlantic Salmon (Chairman: Dr. K. Friedland) should meet in Dublin, Ireland from 5-12 March 1992 to consider questions which include those posed to ICES by NASCO (Appendix 1).

Two Study Groups and one Workshop met prior to the Working Group and submitted reports: The Study Group on the Norwegian Sea and Faroes Salmon Fishery, the Study Group on the North American Salmon Fisheries, and the Workshop on Salmon Assessment Methodology.

The Working Group considered a further 23 papers submitted by participants (Appendix 2). References cited in the report are given in Appendix 3.

1.2 Participants

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2 CATCHES OF NORTH ATLANTIC SALMON

2.1 Nominal Catches of Salmon

Total nominal catches of salmon reported by country in all fisheries for 1960-1991 are given in Table 2.1.1, and nominal catches in homewater fisheries for 1960-1991 are given in Table 2.1.2.

Catch statistics in the North Atlantic area also include fish farm escapees and in the North-East area ranched fish. The updated total catch for 1990 of 4,890 t is 1,003 t less than the total catch in 1989 of 5,893 t. Total landings for 1990 were the lowest recorded and show decreases for several countries. Figures for 1991 (4,031 t) are provisional, but it appears likely that the final data will still show a decrease from 1990. This is the fifth year in which the total catch has decreased from the previous year. The decline in the catch of wild stocks may be greater than suggested by the catch statistics because of the inclusion in the statistics of increasing catches of fish farm escapees and ranched fish.

The lack of information on fishing effort presents major difficulties in interpreting the catch data of any one year and also in comparing catches of different years. Management plans in several countries are designed to decrease catches. The trends in catch data will be discussed in Section 3.

2.2 Catches in Numbers by Sea Age and Weight

Reported nominal salmon catches for several countries by sea age and weight are summarized in Table 2.2.1. As in Tables 2.1.1 and 2.1.2, catches in some countries include both wild and reared salmon and fish farm escapees. Figures for 1991 are provisional. The methods used by the different countries to break down their total catch by sea age are described in Anon. (1986 and 1987).

2.3 Unreported Catches

2.3.1 Unreported catches within commission areas

Unreported catches by year and commission area, as estimated by the Working Group, are presented in Table 2.3.1 except for the West Greenland Commission Area which are unavailable. The total unreported catch in 1991 was estimated to be 1,682 t; a decrease of 29% from the five year mean of 2,377 t (Table 2.3.1). Unreported catch estimated for the North-East Commission area was 1,555 t in 1991; a decrease of 30% from the five year mean, 1987-91. Unreported catches estimated for the North American Commission was 127 t in 1991; a decrease of 32% from the six year mean of 187 t. The estimates of non-reported catches in previous Working Group Reports were provisional and have been revised in Table 2.3.1. Consequently, it is impossible to derive estimates for the West Greenland Commission by subtraction of values reported in this report from those previously reported values. However, total non-catch fishing mortalities, which include unreported catches, have been estimated for the West Greenland Commission area (range of values 0.1 to 0.3).

2.3.2 Unreported catches in international waters

The 1989/90 estimate of unreported catch in international waters in the North East Atlantic Commission area has been updated to reflect new information. The unreported catch is estimated to be between 180 t and 350 t.

Activity in this area was greatly reduced in 1990/91 with only one or two vessels thought to have been operating. The catch in this area may have been between 25 and 100 t (Anon. 1992b). There are no known catches of salmon in international waters in either the North American Commission Area (Anon. 1992a) or the West Greenland Commission Area.

3 STATUS OF STOCKS OCCURRING IN COMMISSION AREAS

3.1 Organization of Stock Status Information

At its 1991 meeting, the Working Group (Anon 1991a) recommended that participants bring long-term datasets that could be considered as indicators of stock status and sustainability. The information that follows consists of data that have been presented at previous Working Group meetings, with additional data that were tabled at the 1992 meetings of the Study Group on North American Salmon Fisheries and the Study Group on the Norwegian Sea and Faroes Salmon Fishery. The Working Group attempted to present information on stock status in a more comprehensive fashion and to depict trends where they occur.

3.2 Eastern North Atlantic

3.2.1 Measures of abundance

Catches

The total nominal landings of salmon in the north east Atlantic during the period 1960 to 1991, including the European fraction of the Greenland catch, are provided in Figure 3.2.1.1. The landings increased from more than 5,000 t in 1960, peaked at nearly 9,000 t in the beginning of the 1970s, and decreased towards 1991 when the landings were about 3,500 t, the lowest during the period.

Trends in total nominal catches by weight (cf. Table 2.1.1) were analyzed by country from 1960 to 1991, and during the period 1976 to 1990 using linear regression (Table 3.2.1.1). In the first period, the catches decreased significantly by year in Norway, Russia, N. Ireland and Scotland, whereas there was a significant ($P<0.05$) increase in catches in Iceland. In Finland, France, Ireland and Sweden, no trends were apparent. During the last 15 years, there was a significant decline in catches in Norway and Scotland, but an increase in Sweden.

In Iceland, the increased landings can be explained by increased salmon ranching efforts. For example, in 1991, 76 % of the total landings consisted of ranched fish.

Although a number of different regulatory measures to decrease harvest have been introduced in several countries, the declines in landings probably reflect reduced abundance of wild salmon stocks. In Norway, the reduction in abundance of wild salmon is greater than the catch data show because of increasing catches of escapees from fish farms in recent years. Reasons for a reduced abundance of salmon may be numerous and complex. In some countries catches are not representative of stock abundance, as in some years a large part of the salmon run takes place outwith the fishing season.

Trend analyses of grilse/salmon ratio for the two periods 1960-1990 and 1976-1990 were performed using linear regression (cf. Table 2.1.2). No significant trends could be detected.

An approach to analyse Scottish catches of 1SW and MSW salmon separately was provided. Catch statistics from Scottish salmon fisheries have been collected since 1952. Figure 3.2.1.2 shows the annual all-gear 1SW, MSW and 1SW+MSW catches in numbers expressed as percentage difference from the 1952-1990 mean. Both 1SW and MSW groups show declines since the mid 1970s. In the case of the 1SW salmon, catches relative to the long-term mean were low throughout the 1950s and early 1960s. In the late 1960s, catches peaked since when they have declined, falling below the long term mean from 1976 and returning to levels similar to those recorded in the 1950s. In contrast, MSW salmon catches remained above the long-term mean until 1977. Since then, they have shown a steady decline, particularly the component caught between January and April. Changes over time in the catch of both 1SW and 2SW cannot be explained by changes in net or rod effort alone and are believed to reflect changes in abundance.

The Working Group recommends that further analyses of long-term catch data be carried out.

Smolt counts

Time series of total or estimated production of wild smolts were available from 5 rivers. Using linear regressions they were analyzed for trends (Table 3.2.1.2). In the Burrishoole a negative trend was evident over the last 22 and 10 years, respectively. The number of wild smolts leaving the River Imsa increased over the past 10 years. There were no significant trends in the other rivers.

3.2.2 Escapement

Time series of total or estimated runs of adults were available for 10 rivers. Using linear regression, trends were estimated for the entire time period for adult counts in the different rivers, and for the last 10 years of the time series (Table 3.2.2.1). The number of adults entering the River Burrishoole decreased significantly over the past 22 years. On the River Högvadsån in Sweden the salmon run showed an increased trend over the last 38 years. This is due to mitigation, as this river has large problems with acidification. In the River Ponoy, where records are available over the past 26 years, the number of salmon ascending the river increased at a marginal level. Over the last 10 years no trends were detected in any of the rivers.

A preliminary analysis indicated significant correlations of total counts of salmon between several rivers in UK and Ireland, and between two Russian rivers. This may indicate that the forces determining adult returns to freshwater are similar within the same geographical areas. The Working Group recommends that the analysis be carried out with returns broken down to smolt and sea year-classes.

3.2.3 Survival indices

Significant correlations of estimated post smolt survival between hatchery reared and wild salmon from the River Imsa, and for survival of hatchery reared and wild fish to the River Burrishoole were detected. Long-time series of hatchery smolts could then be used as indices of survival for wild smolts in the same river. Table 3.2.3.1 provides analyses of time series of estimated post smolt survival of hatchery smolts from the Rivers Burrishoole, Bush, Imsa and Lagan, and of wild smolts from the River Imsa. Furthermore, similar analyses were carried out for survival of wild and hatchery reared fish back to the River Burrishoole. No significant trend could be detected in any group over the entire period of observation. However, similar analyses over the last 10 years revealed a significant decrease in post smolt survival of hatchery reared smolts from the River Lagan and a significant increase in survival of hatchery reared salmon back to the Burrishoole.

3.3 Western North Atlantic

Several short-term and a few long-term datasets for North American stocks were available to the Working Group. These datasets consisted of commercial and recreational catches, estimates of returns and adult counts at fishways, and smolt survival rates for Canadian and USA rivers (*Anon.*, 1992a).

3.3.1 Measures of abundance

Short-term

Counts of small and large salmon by Salmon Fishing Area (SFA) (Figure 3.3.1.1) obtained at fishways and counting fences in Canada since 1974 are provided in Tables 3.3.1.1, 3.3.1.2, 3.3.1.3 and 3.3.1.4. Counts of small salmon at 12 of 13 fishways or fences on systems in insular Newfoundland in 1991 were down from the 1984-1989 mean. In 11 of 13 cases, the few large salmon counted in Newfoundland were below the 1984-1989 mean. In the Maritime Provinces, counts of small salmon were below the mean at all 3 fishways (in SFA 20, 21, 23); counts of large salmon declined at 2 of 3 fishways. Counts of small salmon in Québec increased over the 1984-1989 mean at 2 of 4 fishways; counts of large salmon were below the mean at all 4 fishways.

The percent change between commercial landings of small and large salmon and recreational landings in Canada for 1991 is compared to recent 5-year averages in Figure 3.3.1.2. Commercial and recreational landings of small salmon in 1991 were as much as 90 % below the 5-year average. Commercial landings of large salmon in 1991 showed similar trends, while recreational landings of large salmon in Quebec declined in 6 of 10 SFAs. The percent change in egg deposition between 1991 and previous years in rivers of many of the management areas suggest that low catches infer low spawning escapement.

Total catches in 1991 in Maine (USA) rivers with salmon runs that are primarily of wild origin were the lowest recorded in the available time series of data and 81% below the 1967-1986 average (*Anon.*, 1992a). Similarly, the catch of 2SW salmon of wild origin has steadily declined since 1980 (Figure 3.3.1.3). These data suggest that low catches were due to low salmon abundance in recent years.

Stock status in Canada may be summarized as follows for grouped management areas:

<u>Labrador, East and South Coast Newfoundland (SFAs 1-11)</u>: The total abundance, as inferred from catch statistics and monitoring facilities, of small and large salmon in SFAs 1 to 11 was well below average.

There are several factors that may have contributed to the overall low abundance of salmon in SFAs 1-11. In northern areas, there appeared to be low egg depositions in 1984-85. In SFAs 4-11, the exceptionally low water levels and high water temperatures in 1987 may have resulted in high mortalities of juvenile salmon. Also the smolt-to-small salmon survival in 1989, 1990 and 1991 was below the survival rates observed in 1987 and 1988 for two rivers (one in SFA 9 and the other in SFA 11).

<u>West Coast Newfoundland, Gulf New Brunswick and Gulf Nova Scotia (SFAs 12-18)</u>: Recreational catch of small salmon and returns to the counting facility at Torrent River indicated that abundance in SFAs 12-14

was about one-half of the previous 5 years. Returns of small salmon in 1991 relative to the previous 5 years were low in SFA's 15-16. In SFA 18 there were greater returns of large salmon particularly in the fall compared to the previous five year mean although less than in 1990. In SFA 16, estimates of returns of large salmon were the largest of the past 5 years.

Atlantic Nova Scotia, Bay of Fundy Nova Scotia, and New Brunswick (SFAs 19-23): Counting facility and river spawner counts indicated, with one exception, that returns of wild small and wild large salmon were lower than either those of 1990 or the 1986-1990 mean.

Gaspé, PQ (Q1-Q4): Counting facility, river spawner counts and catch statistics show that 1991 small salmon returns were below 1990 and about the same as the 1986-90 mean; large salmon returns were about the same as 1990 and the 1986-1990 mean.

North Shore, PQ (Q5-Q9): Counting facility and catch statistics show that 1991 small salmon returns were above average in the western part of this area and below average in the eastern part; large salmon returns were below 1990 returns but about equal to the 1986-90 mean.

Anticosti and Ungava PQ (Q10-Q11): Catch statistics and spawner counts for area Q10 and catch statistics for area Q11 reveal that both small and large salmon returns were lower than 1990 and the 1986-90 mean.

Long-term

Long-term commercial landings in Canada by province and in Greenland is shown in Figure 3.3.1.4. Abundance of salmon is inferred to have been low at the turn of the century and in the 1950s. Reduced harvests in the last 20 years are in part a result of harvest restrictions designed to increase spawning escapement to many Canadian rivers. Trends in counts of small salmon at fishways and fences and an estimate or run-size in Canada for the period 1974-1991 are shown in Figure 3.3.1.5. These data suggest that while the abundance of small salmon was generally increasing during the period 1974-1985, that trend has been reversed during the past 5-6 year period. Trends in large salmon abundance (Figure 3.3.1.6), the important contributor to egg deposition in most mainland rivers, generally show a downward trend.

In Section 5.3.1, abundance of Canadian salmon that contribute to the West Greenland fishery is estimated for the years 1983-90 (N1 in Table 5.3.1.2). Abundance is estimated to have ranged from about 217,000 - 588,0000 1SW fish destined to be 2SW during this period, peaking in 1986 and declining in recent years (Figure 5.3.1.6).

3.3.2 Escapement

Assessments are available for 16 Atlantic salmon stocks in Canada. Many of these stocks are newly assessed this year, as spawning targets in terms of egg requirements have now been defined for many Newfoundland rivers. Spawning requirements are determined using the following standards: 2.4 eggs/sq m of fluvial habitat and 368 eggs/hectare of lacustrine habitat. Annual estimates of run size and spawning escapements relative to a target spawning requirement are provided for the Restigouche (SFA 15), Miramichi (SFA 16) and Saint John (SFA 23) in New Brunswick, Margaree (SFA 18) and LaHave (SFA 21) in Nova Scotia and Conne River (SFA 11) in Newfoundland (Table 3.3.1.5) and rivière de la Trinité (Q7), Québec as in previous years (Anon 1990a). New stocks assessed include Grand (SFA 19) and Liscomb (SFA 20) rivers in Nova Scotia and, in Newfoundland, Gander (SFA 4), Terra Nova (SFA 5), Middle Brook (SFA 5) Rocky (SFA 9), Biscay Bay (SFA 9), Northeast (SFA 10) and Humber (SFA 13) rivers (Table 3.3.1.5).

Estimates of egg depositions in 1991 may have approximated (rivière de la Trinité) or exceeded (Miramichi, Margaree and Northeast) target egg requirements in four rivers. On the remaining 12 assessed rivers, egg depositions were below target requirements, some by as much as 70% below (Table 3.3.1.5). In the Miramichi River, 40% of the large salmon were repeat spawners, the highest proportion or number on record. Reasons for shortfalls in target egg deposition vary by river systems and include effects of low water levels on juvenile survival in 1987, natural cycles, low pH, and increased marine mortality.

The percent change in total egg depositions for monitored rivers in Canada during 1991 is compared to the 1986-1990 average in Figure 3.3.1.2. Egg depositions were as much as 70% below average in 12 rivers, while 10-15% increases were noted in 2 rivers.

Spawning escapements to most rivers of the western North Atlantic were generally low as inferred from low catches and counts of salmon at monitoring facilities, and estimated egg depositions (Figures 3.3.1.2 and 3.3.1.5).

In Section 5.3.1, abundance of Canadian salmon that contribute to the West Greenland fishery is estimated for the period 1983-90 (Table 5.3.1.2). The difference between estimates of total 2SW returns in rivers (R2) and the catch of 2SW salmon in rivers provides an estimate of the spawning escapement of 2SW salmon:

Year	2SW Spawners (000's)
1984	92.2
1985	104.6
1986	131.5
1987	108.3
1988	125.9
1989	113.4
1990	119.0
1991	99.0

The target number of 2SW spawners for Canada is estimated to be between 150,000 - 200,000 2SW fish.

3.3.3 Survival indices

Estimates of survival of wild smolts to 1SW returns for 5 rivers and hatchery smolts to 1SW returns for 3 rivers in Canada are shown in Figure 3.3.3.1. Survival of hatchery smolts released in the Penobscot River (USA) to 1SW and MSW returns to the river is also shown.

While large annual variations in survival between years is common, many stocks have exhibited trends of reduced marine survival in recent years. Survival of wild smolts from the rivers de la Trinité and Bec-Scie in Quebéc, appears to be increasing; however, wild smolt survival in Western Arm Brook, Conne River, and the Northeast River, Placentia, Newfoundland show a decreasing trend. All three of the Canadian hatchery stocks assessed exhibit flat or declining smolt survival trends. For the Penobscot River in the USA, survival of hatchery smolts to 1SW return has remained relatively constant, while survival to return as MSW salmon has been declining for the past decade (Figure 3.3.3.1). The increasing incidence of 1SW salmon returns to the Penobscot River in recent years may thus be explained by a decrease in survival of MSW salmon as opposed to an increase in survival of 1SW salmon.

While poor smolt survival years are not uniformly exhibited by all stocks, it is evident that smolt survival for many stocks is lower than in previous years.

3.4 Summary Stock Status

3.4.1 North-East Atlantic Commission

The decline of catches in several countries in the North-East Atlantic Commission Area suggest reduced abundance of wild salmon in recent years. The Working Group examined a number of fishery-independent measures of abundance, but was unable to detect a similar pattern of decline in stocks as noted in the catch data. There were no consistent trends in smolt production or adult counts at the facilities examined over recent decades, except in the River Burrishoole where a downward trend could be detected. The fishery-independent data series examined were few and may not be representative of national stocks.

3.4.2 West Greenland Commission

Although not measured precisely, it is believed that the most abundant European stocks in West Greenland originate from the UK and Ireland. It appears that the abundance of some of these stocks has declined in recent years. Similar declines in abundance have been noted in many North American stocks that contribute to the West Greenland fishery. The decline in catch and fishery-independent measures of abundance in North America, and the decline in catch beyond the expectation that would have resulted from effort reduction in Europe, suggest there is no reason to expect that the status of stocks that contribute to the West Greenland fishery will improve in the near future.

3.4.3 North American Commission

The abundances of both small and large salmon, as indicated by adult returns and commercial and recreational catches, generally show a downward trend during the last 5-6 years. Similarly, spawning escapements to many rivers of the western North Atlantic were generally low, as inferred from commercial and recreational catches, adult counts at monitoring facilities, and estimated spawning escapements and egg depositions. While large annual variation in smolt survival between years is common, many stocks in the western North Atlantic have exhibited reduced marine survival in recent years. The reasons for low abundance, reduced spawning escapements, and lower smolt survival differ among river systems and include: adverse environmental conditions in homewaters (e.g., low river discharges and high water temperatures, etc. which affect smolt production), inadequate egg depositions, and increased marine mortality.

4 FISHERIES IN THE NORTH-EAST ATLANTIC COMMISSION AREA

4.1 Description of the Fisheries at Faroes

4.1.1 Gear and effort

The gear in use in the Faroese fishery did not change in 1991.

In recent years, the effort in the salmon fishery has continued to decline, and in the 1990/1991 season only 8 out of 13 licenses were used. The maximum permitted number of licenses is 26. The licensed vessels were allowed to fish from 1 November to 20 December and 3 January to 12 April (one vessel below 20 GRT was allowed to fish from 1 November to 20 December and 12

January to 30 April).

Only 2 vessels started fishing early in November, but after some good catches 40 nm north-west of the Faroes during November, the remainder joined in, resulting in high effort until the Christmas closure. Due to poor weather in January, only 2 vessels went out fishing, and catches were low. Fishing effort then increased during February and early March but dropped off again in late March and April.

A total of 369 sets was fished in the 1990/91 season, 23% of the permitted maximum of 1600.

In the 1990/91 season, no fishery took place outside the Faroese EEZ (Figure 4.1.1.1). The fishery followed the normal pattern, beginning close to the islands and moving in a north-easterly direction out to the fishery limit during the season.

In 1991, the Faroese salmon quota was bought out by various interested parties. As a result, the Faroese boat owners will receive financial compensation for the agreed salmon quota during the next three seasons (1991/92 to 1993/94). No catches will be made in the Faroes EEZ other than by the research vessel operating under the direction of the Faroese Fisheries Laboratory.

4.1.2 Catches and discards

The total nominal catch in the Faroes fishery in the 1990/91 season was 202 t. This is 162 t less than in the previous season and considerably lower than the catches reported for the 1981/82 to 1986/87 seasons, but similar to the catch reported in 1987/88 (Table 4.1.2.1). As in other recent seasons, good catches were taken in December, but landings were poor in January due partly to bad weather (Table 4.1.2.2). However, unlike in previous years, the landings remained poor for the remainder of the season. The catches in number by statistical rectangle for the whole season are shown in Figure 4.1.2.1.

The catch for the calendar year 1991 was only 95 t (Table 4.1.2.1). This included 13 t caught in December 1991 by the research vessel operating in the Faroes area during the 1991/92 season.

No data are available on the numbers of farmed fish taken in the fishery because appropriate data (e.g., fin measurements or sufficient scale samples) were not collected in the market sampling programme.

Three samples of discards were collected during the fishing season and discard rates ranged from 9.9 to 16.1% ; the overall estimate was 14.8%. This is at the high end of the range observed in the seasons 1982/83 to 1989/90 (Table 4.1.2.3). No clear trend is apparent for the time series. The discard samples in the 1990/91 season represent approximately 8% of the total landings for the fishery. However, as the samples were all taken late in the season, they may not be truly representative of the total catch. Discard sampling by month in the last two seasons indicates a decreasing trend in the proportion of discards as the season progresses. The discard rate of 14.8% should therefore be considered as a minimum estimate for the 1990/91 season.

4.1.3 Catch per unit effort

The catch in number per 1000 hooks (CPUE) by statistical rectangle for the whole season is shown in Figure 4.1.3.1. The CPUE values for November and December were the among the highest recorded at this time of year since 1981/82. However, the CPUE fell markedly in February and remained fairly low for the rest of the season (Table 4.1.3.1). In the 1990/91 season, no fishing took place outside the Faroes EEZ (Table 4.1.3.2).

The CPUE for the season increased in the 1988/89 and 1989/90 seasons, but fell slightly in the 1990/91 season, although these three values are the highest in the time series (since 1981/82) (Table 4.1.3.1). There is no clear relationship between the catch and the CPUE for the past 10 seasons.

The highest catch rates were observed close to the islands in November and December, and as the season progressed, the fishery moved north-east towards the fishery limit.

4.1.4 Biological composition of the catch

The sea age distribution of landings at Faroes by month in 1990/91 is shown in Table 4.1.4.1. These distributions have been determined from the length distributions of 1744 salmon measured during the season using the length splits shown below; the length splits for previous years are shown for comparison.

Sea age class	Season				
	1986/1987	1987/1988	1988/1989	1989/1990	1990/1991
1SW - 2SW	-	58 - 59 cm	57 - 58 cm	55 - 56 cm	57 - 58 cm
2SW - 3SW	85 - 86 cm	83 - 84 cm	84 - 85 cm	83 - 84 cm	84 - 85 cm
3SW -	102 - 3 cm	113 - 4 cm	-	-	-

The sea age distribution by fishing season in the Faroes is shown in Table 4.1.4.2. In the 1990/91 season, practically all the catch comprised 2SW fish (91%), with only 1% of 1SW fish and 8% of 3SW fish. These values lie within the ranges observed in previous seasons.

The proportion of the catch in the two smallest size classes (up to 3 kg) was lower in 1990/91 than in the previous four seasons, while the proportion in the larger categories increased. It is not known whether this reflects a change in the origin of the catch in the Faroes fishery or a change in growth rates in the sea.

No smolt age composition of the Faroes catch was obtained in the 1990/91 season.

4.1.5 Origin of the catch

Data on microtag recoveries in the Faroes fishery were updated for the 1990/91 season (Table 4.1.5.1). Table 4.1.5.2 shows the derivation of raising factors for the 1981/82 to 1990/91 seasons, and Table 4.1.5.3 gives the estimated total numbers of tagged fish killed in the fishery (including discards) by sea age class and the catch rates per 1000 fish tagged. Data for UK(England and Wales) are based mainly on parr tagging. The figures for previous seasons have been modified to take account of an error in the way they were estimated. For all countries the recovery rates per 1000 fish tagged were within the ranges previously observed.

A total of 135 external tags was recovered in the Faroes fishery in 1990/91 of which 116 were from Norway, 16 were from Sweden and 3 were from Scotland. Both the microtag and external tag recovery data confirm previous observations of the relative rates at which stocks from different countries were represented in the fishery.

4.1.6 Exploitation rates in the Faroese fishery

The estimates of extant exploitation rates in the Faroes fishery on several stocks from Norway, Sweden and UK(Scotland) are summarised in Table 4.1.6.1.

The exploitation of hatchery stocks from the Drammen (Norway) and Lagan (Sweden) have shown similar changes with levels being quite low in the 1986/87 and 1987/88 seasons but higher in 1985/86 and in the two most recent seasons. The two Norwegian hatchery stocks (Drammen and Imsa) showed opposite trends, with the exploitation rate on the Drammen stock falling in 1990/91 after a 2 year peak while that on the Imsa stock rose after a 3 year trough. The exploitation rates on wild fish from the Imsa and North Esk have been very much lower in the past 5 years than previously although there was a slight rise for 2SW fish in 1990/91. There is no clear relationship between the trends for individual stocks and the catches recorded in the fishery.

4.2 Description of Homewater Fisheries

4.2.1 Gear and effort

No changes in the regulations affecting salmon fishing gear in 1991 were reported for any countries except Norway and Scotland. In Norway, the use of monofilament nets was banned for catching anadromous salmonids. In Scotland there were changes in the regulations affecting gear or fishing period for rod and line fisheries in four rivers.

Fishing effort was thought to have been reduced in France, Ireland, UK (Northern Ireland), UK (England and Wales), UK (Scotland), Russia and Sweden. Factors affecting this reduction are thought to have included perceived reductions in stock abundance and weather conditions (e.g., early freezing in Russia and low river flows in most other countries). The following additional changes in effort were also reported:

France: On the lower parts of the main rivers of Brittany and Normandy the angling season was extended for one month for fly fishing only.

Iceland: The set net fisheries on the Hvita in Borgarfjordur were rented and thus not operated.

Russia: The operation of several net fisheries was modified to increase the escapement.

UK (England and Wales): Short-term netting restrictions were in operation on four rivers. The closed area around the River Esk (Yorkshire) was enlarged, reducing the area available to beach nets.

4.2.2 Catches and catch per unit effort

Revised estimates of total nominal catches of salmon by country were available for the 1990 fishery and provisional estimates for the 1991 fishery (Table 2.1.1). Catches of ranched fish and fish farm escapees are included in these statistics. Data for 1991 for Ireland, Norway and UK (Scotland) are incomplete.

The provisional total catch for the 1990 fishery was only 56% of the final declared catch. Accordingly, the provisional 1991 catch of 2826 t for the North-East Atlantic Commission area is likely to increase considerably. The 1991 figure is much lower than the averages for the previous 5 and 10 years (4,735 and 4,911 t, respectively), reflecting decreases in most countries, especially France, Ireland, UK (Northern Ireland), UK (England and Wales), UK (Scotland) and Russia, although catches for Finland, Iceland and Sweden were above the 10-year average. Specific information was provided as follows:

Finland: the 1991 catch was the highest since the mid-1970s; this is believed to be partly attributable to the coastal netting restrictions in place in Norway.

France: The catch was similar to the 1990 catch but was believed to be limited by later entry of fish to freshwater and poor fishing conditions due to drought.

Iceland: The catch was over twice the 10 year average, reflecting the increasing contribution of ranched salmon (estimated at 76%) to the fisheries. Recent improvements in marine survival of ranched fish have also contributed to the increased catch.

Norway: Catches in 1991 were low, as in the previous two years, probably reflecting reduced effort due to the management measures in coastal fisheries.

Russia: Catches were lower than any in the previous 30-year period. This largely reflects the reduced exploitation rates on several stocks.

UK (England and Wales): The low catches (57% of the 5-year average) were influenced by prolonged low flows and a reduction in effort, partly as a result of regulatory changes and partly in response to poor catches.

UK (Northern Ireland): The provisional catch of 55 t was the lowest on record and was only 53% of the previous 5 year average. Reduced catches generally reflected the poor conditions for drift netting and reduced fishing effort resulting from perceived low of abundance of fish.

UK (Scotland): The total nominal catch in 1990 was 30% less than that in 1989 and the provisional 1991 catch showed a further considerable decline. Fishing effort has been reduced as a result of the buy-out of netting stations and also in response to perceived low stock abundance.

Catch-per-unit-effort data were available for various salmon fisheries in Wales [UK (England and Wales)]. These indicated that in 1991, CPUE in most net fisheries was reduced relative to average values for the period 1986-90. Catch-per-unit-effort data were also available for rod fisheries in the River Conwy. Average CPUE in 1991 (0.015 salmon per hour) was lower than the range for the previous 5 years (0.020-0.045) but not as low as in 1984 (0.012), which, like 1991, had been a very dry year. No other CPUE data were available.

4.2.3 Composition of the catch

Reported national salmon catches by sea age for several countries in the North-East Atlantic Commission area are summarised in Table 2.1.2. These data include estimates derived from scale sampling and from the weight composition of the catch. Specific information on age composition was provided as follows:

France: The proportion of 1SW fish (39%) fell within the range for the last four years (29% - 77%) but was lower than the average (50%).

Iceland: In 1991, grilse in the fishery were smaller than usual and males predominated.

Norway: The proportion of 1SW fish in the catch by numbers (65%) was similar to 1990.

Russia: As in 1989-90, 1SW fish were the predominant age group (70%). The increase in this proportion from earlier years is a result of a ban on the Pechora river fishery, which formerly contributed 50% to the total Russian catch and where MSW fish predominated.

UK (England and Wales): The proportion of 1SW fish in the catch in 1991 (61%) was lower than in previous years, suggesting poor marine survival of the 1990 smolt year class. No reliable data are yet available for 1991.

UK (Scotland): The proportion of 1SW fish in the catch fell from an average of 60% in 1986-89 to 48% in 1989 reflecting the apparent poor survival of the 1989 smolt year class. The slight increase to 54% in 1991 was caused by the reduction in MSW catches not a recovery in 1SW catches.

4.2.4 Origin of the catch

Table 4.2.4.1 indicates the origin of the salmon catches in each country based upon recoveries of tags over a number of years. Double crosses indicate the principal component of the catch and single crosses other significant contributions. Rare recoveries of one country's tags in another country are indicated by dashes and were assumed to indicate very minor contributions to catches. It is apparent that there is normally a pattern of interchange between neighbouring countries, although this exchange may not always be even. It must be noted that this table reflects the relative size of national stocks. Countries with small stocks are unlikely to contribute significantly to a fishery targeting mainly other larger stocks. The table does not indicate the proportion of fish originating from a given country that are caught in other countries.

Table 4.2.4.2 shows estimated contributions of ranched and farmed fish to national catches. In this context, ranching is defined as the release into the wild of reared smolts with the intention of attempting to harvest all returning adults. Releases of reared fish to enhance wild stocks or compensate for lost wild production are therefore ignored.

The only country in the North-East Atlantic Commission area known to be ranching in this way is Iceland, where ranched fish comprised 76% of the catch in 1991. However, in France there is a small experimental ranching exercise. In addition, 14 t of the catch in Sweden comprised fish that have been released for mitigation purposes, but are not expected to contribute to wild spawning populations.

The only countries in which farmed fish are thought to make a significant contribution to fisheries are Norway and UK (Scotland). In Norway, where extensive surveys have been undertaken since 1988, farmed fish appear in both marine and freshwater fisheries. Estimates of the proportion of farmed fish in various Norwegian fisheries were highly variable between sites but indicate that the proportion of farmed salmon was much lower in samples taken in fresh water than in coastal areas. The proportion of farmed fish in the catch seems to have been relatively constant in the period 1989-91.

In UK (Scotland), sampling in 1990 indicated that most of the reared fish caught in fisheries had escaped or been lost from sea cages. In 1991, however, sampling on the west coast revealed that most of the farm-origin fish were derived from losses or releases of smolts or parr. On the east coast, where the incidence of farm escapees was low, most of the farm origin fish were adult escapees.

In all other countries, farmed fish are thought to form only a very minor (or negligible) part of the catch.

4.2.5 Exploitation rates

Estimated exploitation rates in homewaters for monitored stocks in Ireland, UK (England and Wales), UK (Northern Ireland) and UK (Scotland) are summarised in Table 4.2.5.1 and similar data from Iceland, Norway, Russia and Sweden are shown in Table 4.2.5.2. The patterns observed for different stocks are very variable. Exploitation on the River Drammen and Lagan stocks (hatchery reared fish) were higher than average in 1991 while the rates for the North Esk (UK (Scotland)) and Imsa (Norway), and for hatchery-reared fish on the River Bush (UK (Northern Ireland)), were lower. For most other stocks (including wild fish from the River Bush) rates were similar to those estimated for 1990. On the Russian rivers, fishing traps are operated every day and the exploitation rates are adjusted by altering the proportion of days on which the catch is released or killed. Exploitation rates were reduced in 1991 to protect spawning stocks.

4.2.6 Effects of recent management measures in Norway

Full details of the management measures introduced in Norway in 1989 are given in Anon. (1990a), Appendices 2 and 3.

The impact of the measures on catches in Norwegian homewaters in 1989 and 1991 is shown in Table 4.2.6.1. In the period 1982-1988, the total nominal catch of salmon fluctuated between 1,076 and 1,623 t. It decreased to 905 t in 1989, 930 t in 1990 and 885 t in 1991, probably as a result of the new management measures. In 1989, 1990, and 1991, the marine catches of salmon were 488 t, 514 t and 471 t, respectively, which is much lower than for 1982-1988, when this catch varied between 841 t and 1,324 t. The catch in the marine salmon fisheries, excluding drift netting, was close to the average for this period.

It is likely that the ban on drift netting in 1989 has resulted in a larger number of salmon being available to the other marine homewater fisheries. The additional regulation of these fisheries has probably resulted in a substantial increase in freshwater escapement suggested by increased catches in freshwater. In 1989, 1990 and 1991, the freshwater catch accounted for 46%, 45% and 47% of the total nominal catch respectively, compared to between 18 and 27% over the years 1982-1988. Increased freshwater escapement is also suggested by the reduction in marine exploitation rates on most components of the River Imsa salmon stock during 1989-1991. This was not the case for salmon of the River Drammen stock, however, because drift net exploitation on this stock has always been low.

The salmon fishery on the west coast of Norway intercepts stocks from Finland, Russia and the Swedish west coast on their return to their home rivers. Exploitation in Norway on 1SW fish tagged as smolts on the River Lagan in 1989, 1990, and 1991 was lower (average 1%) than in 1985-88 (average 7%) (Table 4.2.6.2). This suggests that the management measures introduced in Norway in 1989 also benefitted Swedish west coast stocks.

The frequency of net-marked salmon entering a river may also give information about changes in netting effort on the migration route. The proportion of net-marked salmon has been recorded in several Norwegian rivers since 1978. In most of these rivers, sampling took place from 1978 to 1986 and was then re-established in 1990 and 1991. Table 4.2.6.3 shows un-weighted means of the proportion of net marked salmon in angling catches from 12 rivers in the period before the extensive homewater regulations were introduced, and the un-weighted means of the proportion of net-marked salmon in the same rivers in 1990 and 1991. In all except one river, the proportion of net-marked salmon recorded in 1990 and 1991 was much lower than the un-weighted means during the period 1978-1988. The reduced proportion of net-marked fish may be accounted for by the management measures introduced in the Norwegian homewater fishery in 1989.

4.3 By-Catches of Fish, Birds and Mammals in Drift-Net Fisheries

Drift-net fisheries are currently operated by six countries in the NEAC area; France, Finland, Ireland, Norway, UK (England and Wales) and UK (Northern Ireland). These fisheries also target migratory trout (*Salmo trutta*), which are not, therefore, regarded as a by-catch.

France: Drift-nets are used in two estuarine fisheries targeting a variety of fish species. There is no information to indicate that any by-catches occur in these fisheries.

Finland Drift-nets are operated in freshwater in the Tana River. Seals (*Phoca vittulina*) are reported to have been caught in this fishery very rarely. Pike have also been recorded as by-catch. It should be noted that there is no information for the Norwegian portion of this fishery.

Ireland: Drift-nets are used extensively around the coast of Ireland and account for 70-80 % of the reported salmon catch. There is very little information available on the by-catch of other species but this is considered to be extremely small. Species which may become entangled include bass (*Dicentrarchus labrax*), guillemots (*Uria algae*) and harbour porpoises (*Phocoena phocoena*). Recent reports indicate that the level of seal predation on salmon in drift-nets has increased in recent years, but despite this, there have been no reports of seals becoming entangled in the nets. The incidence of porpoise capture is extremely low although these animals are regularly recorded in Irish waters.

UK (England and Wales): A total of 328 salmon drift-nets is used to fish for migratory salmonids in England and Wales; all nets are less than 550 m in length and about half of them target almost entirely migratory trout. Data on by-catches are only available for the fishery on the north-east coast of England, where 143 nets are used.

Very few fish other than salmonids are caught by these nets, but small numbers of mackerel are taken, and other species including bass and grey mullet may be seen very occasionally.

Despite frequently being seen around nets, grey seals (*Halichoerus grypus*) are rarely caught in the drift nets because they can break the netting. Harbour porpoises occasionally become entangled in the drift-nets, but because the fishermen have to remain in attendance of the gear they are normally able to release them before they are seriously harmed. Scientific observers worked on four vessels in the Northumbria Region throughout the 1976 and 1977 season, and on three in the Yorkshire Region throughout the 1979 season. These observers saw four porpoises entangled in nets (three in 1976 and one in 1979) all of which were released alive.

Drift-nets rely upon being relatively difficult to see in order to catch fish, and for this reason diving birds can become caught. Guillemots, razorbills (*Alca torda*) and very occasionally puffins (*Fratercula arctica*) are caught. Once again, the netsmen endeavour to remove them alive. No data are available on the numbers killed.

By catches as a result of "ghost fishing" are not a problem in the English drift-net fishery, where nets are rarely lost or abandoned.

UK (N.Ireland): A total of 117 drift-nets were licensed in Northern Ireland in 1991. No quantitative information on the by-catch is available for this or any other year, but it is known that porpoises and guillemots are occasionally caught.

5 FISHERIES RELEVANT TO THE WEST GREENLAND COMMISSION

5.1 Description of the Fishery at West Greenland, 1991

In 1991, the fishery at West Greenland (NAFO subarea 1) was opened on 5 August and ended in November, although the official closing date was 31 December. The total nominal catch was 437 t (Tables 5.1.1 and 5.1.2), which is 210 t more than in 1990, when the total landings were 227 t.

The TAC for 1991 was set unilaterally at 840 t, and divided into a "free" quota of 373 t and a "small boat" quota of 467 t. Because the landings in 1991 were small, this arrangement had no practical implications.

The geographical distribution of the fishery in 1991 (Table 5.1.2) differs little from previous years. The landings in NAFO Divisions 1A and 1B were again low, whereas, landings in NAFO Divisions 1C, 1E and 1F were high, with highest figures in Division 1F.

The salmon fishery in Greenland is a small boat fishery and is executed in inshore and coastal areas. Approximately 80% of the total landings were taken by boats smaller than 30 feet. No information on effort is available for 1991, but the landings during the two first two weeks is given for 1980 to 1991 (see text table below).

The nominal landings during the first two weeks, 1980-1991 (in tonnes).

Year	First week	First two weeks
1980	260	711 (1 - 14 Aug)
1981	465	735 (15 - 28 Aug)
1982	470	766 (25 Aug - 7 Sep)
1983	105	192 (10 - 23 Aug)
1984	17	58 (10 - 23 Aug)
1985	204	361 (1 - 13 Aug)
1986	509	848 (15 - 28 Aug)
1987	439	737 (25 Aug - 7 Sep)
1988	219	337 (25 Aug - 7 Sep)
1989	131	219 (18 - 31 Aug)
1990	12	38 (1 - 14 Aug)
1991	114	191 (5 - 18 Aug)

5.1.1 Composition and origin of the catch, 1991

The Working Group examined the composition and origin of salmon caught at West Greenland based on discriminant analysis of scale samples from NAFO Divisions 1C, 1D, 1E. The database used to develop the discriminate function consisted of 788 North American and 788 European known-origin salmon collected at West Greenland from 1980 to 1991. There were insufficient numbers (36) of salmon of known-origin identified in the 1991 sampling to develop a discriminant function solely on the 1991 samples. Three discriminant functions were used - one for salmon with river age 1, one for salmon with river age 2, and one for salmon with river age 3 and older.

Scale samples which were independent of the discriminant analysis database and weighted to 1991 river-age distributions at West Greenland were used to test the discriminant functions. The results indicated an overall misclassification rate of 19.5% and error rates of ± 3.3%, based on prior probabilities of 0.5. This database and the discriminant function were accepted by the Working Group for examination of the 1991 West Greenland fishery. The Working Group expressed concern over the lack of suitable test samples of known origin salmon collected from the Greenland fishery in 1991. Scale samples should be collected from 2SW salmon in home waters in 1992 and used as a database to recalculate the continental proportions in 1991.

The results of classifying salmon in samples from commercial catches in 1991 indicated that the North American proportion was 65% (95% CL = 69, 61), and the European proportion was 35% (95% CL = 39, 31) (Table 5.1.1.1). In 1991, 52% of the catch was taken at the same time as the samples compared to 26% in 1990, 73% in 1989, 62% in 1988, and 85% in 1987. Although the per cent coverage improved over 1990, the catch samples are not as representative as those taken during to 1987-89. In 1991, 3.1% of the catch was sampled for determination of continental proportions compared to 5.8% in 1990, 8.0% in 1989, 3.8% in 1988 and 4.5% in 1987. This suggests that the samples may be representative of catches taken during the same period, but may not be representative of the entire fishery. Table 5.1.1.1 shows the variability in the proportions of North American and European salmon in the fishery since 1969.

An alternative estimate of the overall proportion of North American and European-origin salmon for the years 1982-1990 was derived by weighing NAFO division samples by catch in numbers. Information from the nearest NAFO Division was applied to divisions with no samples. The table below gives the results:

Year	Weighted by catch in numbers				Percentage of all samples combined	
	NA		EU		NA	EU
	%	Wt(t)	%	Wt(t)		
1982	57	-	43	-	62	38
1983	40	-	60	-	40	60
1984	54	-	46	-	50	50
1985	47	-	53	-	50	50
1986	59	537	41	423	57	43
1987	59	556	41	411	59	41
1988	42	439	58	544	43	57
1989	55	179	45	158	56	44
1990	74	168	26	59	75	25
1991	63	267	37	170	65	35

In 1991, the estimated number of fish caught was 102,966 from North America and 60,934 from Europe for a total of 163,901. The time series of catches by number, 1982 - 1991, is provided in Table 5.1.1.2.

As in previous years, there were no temporal or spatial trends in the proportions of fish by continent; significantly higher proportions of North American salmon were observed in Divisions 1C and 1D than in 1E:

NAFO Div.	Nominal catch (t)	% N. American origin	% European origin
1A	22	*	*
1B	21	*	*
1C	109	67	33
1D	31	71	29
1E	106	52	48
1F	148	*	*

* not sampled

Information on country of origin can be derived from recoveries of tags (both Carlin and coded-wire) at Greenland in 1991. Salmon landings at Greenland were again scanned in 1991 for adipose finclips and coded-wire tags (CWTs) using procedures similar to those in previous years.

In 1991, a total of 7,357 salmon (4.5% of the West Greenland catch) was examined for adipose finclips and CWTs by Canadian, USA, and Danish scientists. In the sample, 121 (1.64%) had adipose finclips, and CWTs were recovered from 37 (30.6%) of the finclipped fish (Table 5.1.1.3). Thus, the overall proportion of the catch sample that had CWTs was 0.50%, compared to 0.84% in 1990, 0.64% in 1989, 0.50% in 1988, and 0.58% in 1987. The proportions of fish having adipose fin clips and CWTs sampled at each port did not differ from a uniform distribution (χ^2 = 2.8 and 0.4, respectively). Thus, in 1991, the distribution of adipose fin clips and microtags were evenly distributed throughout the fisheries, similar in occurrence to the distribution in 1988. In most other years since 1985 the proportions of the fish having adipose fin clips and CWTs decreased in the fishery from north to south. This pattern particularly holds true for North American-origin tagged salmon; whereas European salmon appears to generally be more evenly distributed throughout the NAFO Divisions (Table 5.1.1.4).

In 1991, 37 CWTs were recovered in 1991 and apportioned by country as follows: (70%) USA, (5%) Canada, (5%) Ireland, (8%) England and Wales, (5%) Iceland (3%) Scotland, and (3%) from Northern Ireland (Table 5.1.1.5). All of these tags came from 1SW salmon, most having been released as hatchery-reared smolts in 1990; although two were tagged as wild smolts in England and Wales, in 1990. Recoveries of tagged salmon from Canada and European countries are too few in number to identify differences in distribution in the fisheries. However, the proportions of USA-origin microtagged fish were evenly distributed throughout the fisheries sampled.

The contribution by various countries to the 1991 West Greenland harvest cannot be determined at this time due to differential survival of stocks tagged, as well as the proportion of coded-wire tagged fish relative to total smolt production in each country.

Carlin tags (13) of USA origin were recovered in the 1991 West Greenland fishery; further information is provided in Section 5.1.3. Carlin tags of other national origin are known to have been recovered at West Greenland, but data are not available at this time.

The Working Group considered an estimate of the number of Maine salmon harvested at West Greenland in 1991 using the proportional harvest method (Anon., 1989a). In this method, the number of 1SW North American salmon of river age 1 in the West Greenland fishery are apportioned by the relative production of age 1 smolts by Maine and Canadian hatcheries the year before. The contribution to the Greenland harvest of other US origin (i.e., Merrimack, Connecticut) smolts was considered low. The proportional harvest method was used to provide a current year estimate of the harvest.

Input data for the method are shown in Tables 5.1.1.6 and 5.1.1.7. The estimate of the North American harvest given in Table 5.1.1.7 differs slightly from that given in Table 5.1.1.4 because it is derived in a different way. The difference is small, however, and in order to maintain consistency in the method between years, the estimate has not been adjusted. Based on this method, the estimate of Maine salmon harvested at Greenland in 1991 was 3,757 (Table 5.1.1.8). From 1978 to 1991 the harvest estimates of Maine-origin salmon in the West Greenland fishery ranged from 2,350 to 33,351 salmon. With the exception of 1978 and 1982 the standard error around the estimate was less than 10% of the mean and averaged about 7% of the mean. A sensitivity analysis was conducted of the harvest estimate and indicated that most of the variability in the harvest estimate comes from the variation in the estimated number of river age 1 salmon of North American origin. Previously, the Working Group (*Anon.*, 1986) noted that the tendency of scale readers would be to classify river age 1 salmon as river age 2. Therefore, an increase in precision of the classification would probably result in an increase in the harvest estimate.

The Working Group reviewed information on the use of a "neural network" as an alternative technique to determine the continental origin of salmon caught at West Greenland from scale characters. The same data sets were used to develop and test the discriminant function and a neural network, and the results were compared. The neural network was set up with the four input variables (river age, age, fork length, and scale *circuli* counts) separated into discrete classes in order to provide 33 input neurons; the 2 output neurons corresponded to North American and European; and the network was given 17 hidden layer neurons. The neural network gave a more accurate classification (85.8% correct) of samples of North American and European groups than the discriminant analysis (80.3% correct). The Working Group concluded that the neural network technique looks promising and may offer an alternative to the discriminate analysis. Its application should be further investigated. The neural network has the advantage that it can use a larger number of input variables. Several disadvantages were noted: there is some subjectivity in the data pre-processing; learning algorithms vary between software implementations, and learning is sensitive to ordering of the data and tolerance settings.

The Working Group recommends that the neural network methodology undergo further testing using simulation data sets and run parallel with discriminant function analysis. Specifically, the Neural Network should be evaluated with respect to its:

1. sensitivity of classification success with respect to the order of input observations,

2. sensitivity of classifications success to category boundaries applied to the input parameters,

3. ability to discriminate simulated samples drawn from underlying distributions with known parameters,

4. relationship to traditional statistical methods, particularly log linear models for categorical data.

5.1.2 Biological characteristics of the harvest

Biological characteristics (length, weight, and age) were recorded from samples of commercial catches from NAFO Divisions 1C, 1D, and 1E in 1991 using the results of discriminant analysis to divide samples into North American and European components. A summary of these data is provided in Table 5.1.2.1.

As previously observed, North American 1SW salmon were significantly shorter and lighter than their European counterparts, both overall and on an individual NAFO Division basis. Two sea-winter salmon of North American origin were not different in length but were lighter than European-origin salmon both overall and between NAFO Divisions at the 5% level of significance.

The sea age composition in 1991 (Tables 5.1.2.2 and 5.1.2.3) of 94.7% 1SW, 4.9% MSW, and 0.3% previous spawners indicated that there were proportionately fewer 1SW salmon and more MSW salmon than in 1990. In 1991, the 1SW components for both North American (95.6%) and European (93.4%) salmon were lower than their respective components in 1990.

Based on 63% North American salmon by number in the 1991 West Greenland salmon catches, the catch at age by continental origin was as follows:

Sea age	NA	EU	Total
1	98,126	56,972	155,098
2	4,285	3,859	8,144
PS	602	104	706
Total	102,966	60,935	163,901

The mean smolt age of salmon of North American origin has varied more than that of European fish (Table 5.1.2.4). There are no trends in the mean smolt ages of European-origin salmon between 1968-1991. The proportion of North American-origin river age 1 salmon has been increased steadily from 2% in the 1986 samples to 8.8% in the 1990 samples. In 1991, it decreased to 5.2%. In 1991, samples (<1.0%) of salmon thought to be fish farm escapees were found in the Greenland catches. The decrease in numbers of North American salmon of river age 4 years and older from the mean value of 22.0% from 1968-90 to 17.8% in 1991 suggests that either production or migration of salmon from the northerly portion of the range in North America has decreased.

5.1.3 Historical data on tag returns and harvest estimates

There are three main methods for estimating the harvest of USA-origin salmon in the fishery at West Greenland (Anon., 1989a). One of these methods, the proportional harvest model (updated in Section 5.1.2) provides estimates for the current fishery year. Two other approaches, the Carlin tag harvest model and the CWT harvest model, rely on the fraction of tags in the homewater run in the following year. Therefore, the Carlin and CWT methods can only provide estimates in the year after the fishery.

Carlin tag method

The parameters in the Carlin tag harvest model for 1SW salmon remain as reported in the previous assessment

(Anon., 1991a). The 2SW harvest estimates were not updated this year as there were no 2SW tags (Maine-origin) returned from the fishery in 1991. All 1SW returns in year i are raised to harvest estimates with the ratio of tagged to untagged 2SW returns in homewaters in year i + 1 (RATIO). RATIO values are shown in Table 5.1.3.1. For 1991, the estimates of tags and run size were 29 tags and 2057 fish, respectively. The relatively low numbers of tags in the run resulted in the 2nd lowest RATIO parameter used in the harvest model time series (RATIO for 1991 = 0.0138). This means that each tag reported accounts for a large number of fish. Only harvest for an assumed passage efficiency of 85% is presented.

A number of tags (30) were returned in 1991 from Greenland without information as to year of recapture. These tags were presumably caught mostly as 1SW fish in the year following release. These tags were not developed into estimates of harvest however as they are assumed to form part of the pool of "unreported" tags for previous years and are already accounted for in the harvest estimate by the reporting rate factor.

The updated time series of tag returns from Maine-origin 1SW salmon in West Greenland can be found in Table 5.1.3.2. Tag returns (to date) for the 1991 fishery total 13 tags with the largest recovery occurring in NAFO Division 1C. Estimated harvest of 1SW salmon in West Greenland is summarized by year for 85% passage efficiency in Table 5.1.3.3. The harvest estimates for the 1990 fishery totalled 1,525 salmon at 85% efficiency and are primarily distributed in NAFO Divisions 1B to 1E. This estimate of 1525 fish in 1990 is about 60% lower than the estimate of harvest for 1989 (which was the highest recorded) and about 17% lower than the previous 10-year mean of 1843 fish.

CWT method

In 1990, CWTs from USA-origin salmon, including fish from the Connecticut, Merrimack and the Penobscot rivers, were recovered in West Greenland. Using the methodology in *Anon.* (1988a), the Working Group estimated harvests based on the CWT sampling programs at both West Greenland and in home waters. Ratios of CWT tagged to untagged 2SW salmon (RATIO) returning to the Connecticut, Merrimack and Maine rivers in 1991 were 0.757, 0.210 and 0.213, respectively (Table 5.1.3.4).

As not all weeks or areas of the fishery were sampled, assumptions concerning the numbers of tags caught in those weeks and areas were again necessary (Anon., 1989a). In 1991, the Working Group recommended that the various stratification procedures of the CWT sampling be investigated (*Anon.*,1991a). Three stratification strategies were considered, each producing different levels of harvest for the three stock groups (Maine, Connecticut, and Merrimack):

1. area stratification with no stratification over time.

2. area stratification with time stratified into early and late segments.

3. area stratification with the highest resolution time stratification that the data would allow.

Variability in the harvest estimate generally increased with the number of strata involved in the estimates and, as well, with increased number of strata, the percentage of the catch examined decreased, in some cases down to only 1 %. The Working Group agreed to adopt the following criteria concerning post-stratification strategies which would be used to develop harvest estimates: 1) the strategy with the maximum number of strata that does not result in an increase in the estimate variability;and 2) the strategy that pools sampling units with adjacent units so that no individual stratum has less than 2% of the catch examined. Following these criteria, a post-stratification strategy was selected for the Maine stocks and then the same strategy was applied to the estimate for the Merrimack and Connecticut stocks. Harvest estimates for the 1SW component of these three stocks for 1990 at West Greenland were 231 for Connecticut, 1070 for Merrimack and 1613 for Maine. Past estimates of harvest and the coefficient of variation are given in Table 5.1.3.5. Estimates for the Connecticut and Merrimack stocks in 1990 were the highest of the four year series while for Maine the estimates were lowest. The various estimates of harvest are shown graphically in Figures 5.1.3.1 and 5.1.3.2.

The harvest of Maine-origin salmon at West Greenland decreased in 1990 from the previous year, as estimated by the three methods (Figure 5.1.3.1). The proportional harvest method in 1989 and 1990 provided estimates of harvest of Maine-origin fish which were significantly higher than the CWT method (Figure 5.1.3.2). As escapees from North American aquaculture facilities could increase the estimates provided by the proportional harvest method, the Working Group recommended further investigation of this possible explanation of the discrepancy between the two methods.

5.1.4 Patterns of stock composition in the harvest

The North Atlantic Salmon Working Group has been requested with respect to Atlantic salmon in the West Greenland Commission area to examine historical data on stock composition for the presence of predictable patterns (trends) in the proportion of North American and European origin salmon in catches at West Greenland.

The continental proportions of Atlantic salmon caught at West Greenland for NAFO Divisions 1A to 1F combined have already been shown in Table 5.1.1.1. The estimates are divided by research vessel catches (1969 to 1982) and commercial catches (1978 to 1991). The method of assessment is outlined in Section 5.1.1. A higher proportion of North American salmon has been indicated from the sampling program for recent years (1989-1991).

Distribution by continent and country as inferred by microtag return rates

The recovery rates of microtagged salmon from the West Greenland fishery per 1,000 fish examined and the continental distribution in each year is shown in Table 5.1.1.4 and Figure 5.1.4.1.

The proportion of tags recovered per 1,000 fish examined is generally higher for salmon of North American origin than for European salmon. Similar proportions were observed in 1986 for NAFO Divisions 1B, 1D and 1E in 1986, 1E in 1989 and a higher European component was noted in the recoveries in 1E in 1990. Two distinct north-south trends were observed for the N. American data in 1989 and 1990. A less distinct trend was noted in 1986. This trend was not consistent over the other years or for the distribution of European tags in any year.

The distribution of recaptures and recovery rates of microtagged salmon from the different countries for the period 1986-1991 is shown in Table 5.1.4.1. For North American origin fish the general trend appears to indicate a higher proportion of microtagged fish in the north decreasing to the south. This trend may also apply to fish of Irish origin. No clear pattern emerges for fish from England and Wales and insufficient returns have been recorded for other countries to indicate differences in distribution.

Trend analysis of the stock composition

The data on stock composition used in the analysis came from the reports of the Working Group on North Atlantic Salmon (Anon. 1991a). It consists of the North American proportion landed by NAFO division by week, 1983-1990. Results for European proportions can be inferred from the proportion of the North American component of the catch.

Trend analysis of the proportional data was carried out on arcsine-transformed data using SAS Procedures for General Linear Models and Regression. Residuals were examined by plots of residuals on year, on predicted values, on North American proportions and on rank of the dependent variable. Analyses of combined catch and proportional data was done by multivariate analysis of variance. Trend analysis was completed using the standardized coefficients from the ANOVA.

Table 5.1.4.2 shows the results of trend analysis for data collected from 1986 to 1990. Analysis of temporal trends shows that out of 15 series analyzed only 2 were significant. This result could be anticipated by chance alone. The spatial analysis shows that out of 25 series analyzed, 14 were significant; a much higher number than would be expected by chance alone. Further analysis is warranted on these trends.

ANOVA was used to analyze a model of proportional data with year, week and NAFO division as covariates. The North American proportion was significant at less than 5% only for the year effect (Table 5.1.4.3). The North American proportion was not significantly affected by week or NAFO division effect. The standardized coefficients show the relative magnitude of the annual differences in the North American proportion (Figure 5.1.4.2). Not only have there been differences between years, but, when tested for temporal trends by regression analysis the standardized coefficients showed an increasing linear trend with the highest proportion occurring in 1990. By inference it can be assumed that the proportion of European origin salmon in the catch has decreased. This trend was also noted in the analysis of the continental proportions of salmon in the sampling program.

The significant YEAR/NAFO effect (Table 5.1.4.3) indicates that the spatial patterns of catches over years are variable so therefore no predictable annual pattern of catch by NAFO division can be shown.

The recoveries of micro-tagged salmon indicated a north-south trend for tagged North American stocks in some years, with greater numbers in the Northern NAFO Divisions. This trend was not as evident for the distribution of European tags. Analysis of proportional continental-origin derived from scale characters indicated to consistent north-south distribution of North American or European components. However, in recent years there was an increase in the North American Component at West Greenland.

5.2 Description of Homewater fisheries

European homewater fisheries

Tagging experiments have demonstrated that all countries listed in the National Catch Tables (2.1.1.1) contribute fish to the West Greenland fishery.

However, stocks from these countries contribute to the fishery to differing extents, both because the proportion of MSW salmon in the stocks varies and because of differences in their migratory behavior in the sea. Although the relative contributions have not been estimated precisely, MSW stocks from UK, Ireland and France are thought to contribute to the fishery at a higher rate than Scandinavian stocks.

MSW salmon stocks have been in decline in many parts of Europe for at least the last 20 years. The extent of the change varies, but catches in some rivers which used to support mainly MSW salmon are now mainly 1SW fish [e.g., Rivers Exe and Eden in UK (England and Wales)].

The closure of the Norwegian drift net fishery has had beneficial effects on other fisheries in Norway, Finland, Russia, and Sweden. The catch in Finland was the highest since the mid-1970s, but exploitation rates were decreased on several rivers in Russia in 1991 to provide increased spawning escapement. Rivers in Sweden, along with many in UK, Ireland and France have experienced low flows in 1990 and 1991, and these have had adverse affects on catches.

The marine survival of several monitored European stocks has been low in some recent years, particularly for the 1989 and 1990 smolt year classes. This appears to have been reflected more widely in the poor catches of 1SW fish in 1990 and both 1SW and 2SW fish in 1991. Additional information on fisheries in the North-East Atlantic is contained in Section 4.

North America Homewater Fisheries

The Canadian homewater fisheries consist of commercial, recreational, and native food fisheries. There were about 3,300 commercial fishermen licensed to fish for salmon primarily with shore-fast set gillnets. The 1991 fisheries were under quota management with either quotas set for specific salmon fishing areas or for individual fishermen. The total commercial landings in Canada during 1991 were 512 t. Recreational fisheries occurred in all Canadian Atlantic provinces. Anglers were permitted to fish only with artificial flies and were restricted by daily and seasonal retention limits. Retention of salmon of lengths >63 cm was permitted only in Quebec and Labrador. Some rivers had specific quotas. In 1991 there were about 282,700 rod days of fishing effort which resulted in a catch of 132 t of salmon. Several native groups were permitted to fish for salmon for food in four provinces (Quebec, New Brunswick, Nova Scotia, and Newfoundland and Labrador). The total harvest in all of these fisheries was 29 t. Commercial fisheries in Canada harvest salmon of USA origin.

The USA homewater fisheries consist only of recreational fisheries in the state of Maine. Anglers were permitted to fish only with artificial flies. There were daily and seasonal retention limits. In 1991, there were 3,157 licensed anglers and a harvest of 238 salmon.

Additional details describing the homewater fisheries are provided in Sections 6.1 and 6.2.

5.3 Stock Abundance and Exploitation at West Greenland

To answer the questions posed by NASCO, the Working Group developed and applied a continental run-reconstruction model to estimate abundance of North American salmon at West Greenland (Section 5.3.1). Data necessary to complete this task were available for the fishery years 1983 to 1990 at West Greenland. The "top-down" constraints model in *Anon.* (1991a) was improved to include an additional constraint related to catches of grilse in Canada during the same year as the fishery in Greenland. Model outputs also were used to derive a range of abundance estimates for North American and European stocks at West Greenland prior to the fishery.

Abundance estimates for North American stocks were then used to define a range of estimates of pre-fishery abundance. A simple model was developed to illustrate the effects of various combinations of catches on the numbers of fish returning to spawn in North America (Section 5.3.2). The effects of these catch combinations were illustrated for varying levels of pre-fishery abundance for 1SW salmon destined to return as 2SW spawners.

The implementation of postulated safe catches for various levels of abundance would depend on some pre-season indices of abundance of salmon in the Greenland fishery area. These are considered in Section 5.3.3

5.3.1 Determining abundance of North American and European salmon at West Greenland

Application to North American Stocks

The schematic diagram of the continental run-reconstruction model for North America is given in Figure 5.3.1.1. The purpose of this model is to estimate the population of non-maturing 1SW salmon (i.e., salmon destined to return as 2SW spawners) and to estimate fishery area exploitation rates for West Greenland. Prior to commencement of the Canadian and Greenland fisheries, the population of non-maturing 1SW can be modelled as three distinct groups. The first group will be exploited in the Newfoundland-Labrador commercial fisheries, primarily in SFAs 1-7 and 14a. Because this group is similar in mean size to the maturing 1SW salmon (i.e., grilse returns) it is assumed that the fishery area exploitation rates on non-maturing 1SW salmon are similar to the maturing component in these Salmon Fishing Areas. The second group will be exploited in West Greenland. Available evidence suggests that this group has limited exchange with the group exploited in Newfoundland-

Labrador (see *Anon.*, 1991a for review). The third group consists of salmon which are unavailable to any fishery prior to return to home waters. Tag recovery information and test fisheries in East Greenland and the Labrador Sea suggest that some fraction of the population is unavailable to any fishery. Following the fisheries, these three groups return about 10 months later to Canadian homewaters where they are exploited as maturing 2SW salmon in commercial fisheries in SFAs 1-13, 14a and 14b, and in recreational fisheries in rivers.

The primary difficulty in the construction of a run-reconstruction model for North American stocks is that the population is simultaneously fished in Canada and West Greenland. Development of fishery area exploitation rates is confounded by an inability to estimate the fraction of the stock present in either fishery. Another difficulty is that the precise age structure of Canadian catches is not estimated annually. Instead, catches are reported as numbers of fish in "small" and "large" size categories. Various sampling programs conducted by Canada however, do allow approximate estimates of the age structure from the known size structure of the catch. The continental run reconstruction model incorporates the uncertainty in estimates of catches, returns to rivers, and known constraints on exploitation rates in Canada to derive a constrained set of exploitation rates which are consistent with the observable data.

The theoretical basis of the model is describe in *Anon.* (1992c). To facilitate application of the model to North America, key variables are defined in Table 5.3.1.1.

Constraints on Proportions and Exploitation

The parameters P, FU, Ec(i), and Eg(i) are all constrained to the [0, 1] interval and $0 < P+FU < 1$. Mathematically the constraints can be written

(1) $0 < P < (1\text{-}FU)$

(2) $0 < FU < 1$

(3) $0 < Ec(i) < 1$

(4) $0 < Eg(i) < 1$

The proportion of the 2SW population returning from Greenland, defined as 1-P-FU, is also constrained to the [0, 1] interval from Eq. 1 and 2. In addition, the parameters P, Ec(i), and Eg(i) are constrained by the estimated number of returns and catches of 2SW salmon in year (i+1), the estimated range of catches of non-maturing salmon in year i, and the observed numbers of returns in the year i. These relationships are illustrated below.

Constraint 1: Range of Non-maturing 1SW catch in Canada in year (i)

Canadian commercial catches are reported as numbers and weight of fish in "Small" and "Large" size categories. Salmon less than 2.7 kg whole weight are graded as small and salmon > 2.7 kg are graded as large salmon. Small salmon comprise both maturing and non-maturing 1SW salmon. Large salmon are primarily MSW salmon but some maturing and non-maturing 1SW salmon are also present. Low numbers of previous spawners may also be present in either size category. Let $H_S(i)$ and $H_L(i)$ be defined as the number of small year i. Raw catch data and return estimates are summarized in Table 5.3.1.2a.

The number of non-maturing 1SW salmon harvested in year i ($Hc1_{nm}(i)$) depends on the fraction of 1SW salmon present in the "large" market category (q) and the fraction of 1SW salmon that are immature (f_imm).

(5) $Hc1_{nm}(i) = f\_imm^*(H_S(i) + q\ H_L(i))$.

Note that Eq. (5) assumes that all "small" salmon are 1SW fish. Estimates of fractions of non-maturing salmon present in the Labrador-Newfoundland catch were presented in Anon. (1991a). Actual estimates of the immature fraction for the entire fishery have not been developed, but sample estimates suggest a range for f_imm between 0.1 and 0.2. Similarly, the sea-age composition of the "large" market category is not known with precision. An assumed plausible range of q between 0.1 and 0.3 was examined. Under these assumptions the maximum number of observed non maturing 1SW salmon in year i would be

(6) $Hc1_{nm,\ max}(i) = f\_imm_{max}{}^*(H_S(i) + q_{max}\ H_L(i))$

where $f\_imm_{max} = 0.2$ and $q_{max} = 0.3$.

Similarly, the minimum value of $Hc1_{nm}(i)$ is

(7) $Hc1_{nm,\ min}(i) = f\_imm_{min}{}^*(H_S(i) + q_{min}\ H_L(i))$

where $f\_imm_{min} = 0.1$ and $q_{min} = 0.1$.

From the run-reconstruction model, Hc1(i) can be expressed as a function of Ec(i) and P; call this predicted value ${}^{hat}c1(i)$. Then

(8) $H^{hat}c1(i) = Ec(i)/(1\text{-}Ec(i))^*P^*(R2(i+1)/S1 + Hc2(i+1))/S2$

The feasible range for Ec(i) and P must yield predicted numbers of nonmaturing 1SW salmon ($H^{hat}c1(i)$) between $Hc1_{nm,min}(i)$ and $Hc1_{nm,max}(i)$. Thus the first constraint on the domain of admissible values is

(9) $Hc1_{nm,min}(i) < H^{hat}c1(i) < Hc1_{nm,max}(i)$

The estimated number of non-maturing salmon present in the Canadian commercial landings was estimated by restricting the landings only to those Salmon Fishing Areas (SFA) in which non-maturing 1SW salmon (NM_1SW) are believed present in sizable numbers. Therefore, only catches from SFAs 1-7, 14b were included in the estimates of $H_S(i)$ and $H_L(i)$. Minimum predicted values of $H^{hat}c1(i)$ were estimated using $R2_{min}(i+1)$ and $Hc2_{min}(i+1)$. Maximum predicted values of $H^{hat}c1(i)$ were estimated using $R2_{max}(i+1)$ and $Hc2_{max}(i+1)$ (Table 5.3.1.2b).

By substituting Eq. 8 into 9, it is possible to write Ec(i) as a function of P. The upper range of feasible values of Ec(i) for any P is given by

(10) $Ec(i) = Hc1_{nm,max}(i)/(Hc1_{nm,max}(i) + P * Amin)$

where $Amin = (R2_{min}(i+1)/S1 + Hc2_{min}(i+1))/S2$. Conversely, the lower range of feasible values for Ec(i) for any P is given by

(11) $Ec(i) = Hc1_{nm,min}(i)/(Hc1_{nm,min}(i) + P * Amax)$

where $Amax = (R2_{max}(i+1)/S1 + Hc2_{max}(i+1))/S2$. Equations 10 and 11 define a band of feasible P and Ec(i) values as shown in Figure 5.3.1.2.

Constraint 2: Range of Estimated 2SW Returns and Catches in Year (i+1)

The observed catches of non-maturing 1SW salmon in Canada and Greenland have implications for the total catch of 2SW salmon and returns to rivers in year i+1. As shown in Anon. (1992c)

(12) $(R2(i+1)/S1 + Hc2(i+1))*(1-FU) = (Tga1(i) + Tca1(i))*S2$

The post-fishery populations of 1SW salmon in Greenland (Tga1(i)) and Canada (Tca1(i)) can be expressed in terms of their exploitation rates as follows:

(13) $Tga1(i) = Hg1(i)/Eg(i) - Hg1(i)$, and

(14) $Tca1(i) = Hc1(i)/Ec(i) - Hc1(i)$.

Substituting Eq. 13 and 14 into Eq. 12 yields,

(15) $[(R2(i+1)/S1 + Hc2(i+1)) * (1- FU)]^{hat} = ((Hg1(i)/Eg(i) - Hg1(i)) + (Hc1(i)/Ec(i) - Hc1(i)))*S2$

Where the "hat" superscript indicates that this is a predicted value, deduced from the values of Eg(i) and Ec1(i).

Minimum and maximum observed values of the left hand side of Eq. 12 can be derived from the estimated observed range of 2SW runs in year i+1 $[R2_{min}(i+1), R2_{max}(i+1)]$ and projections of the range in numbers of 2SW salmon caught in year i+1 $[Hc2_{min}(i+1), Hc2_{max}(i+1)]$ (see Table 5.3.1.2b). The minimum and maximum numbers of 2SW salmon caught in year (i+1) are

(16) $Hc2_{min}(i+1) = H_L(i+1) * (1-q_{max})$, and

(17) $Hc2_{max}(i+1) = H_L(i+1) * (1-q_{min})$,

respectively. Minimum estimates of 2SW returns to Canadian rivers were estimated by summing the spawning runs reported for some rivers, the total recreational catch and the numbers of salmon counted in traps and at counting fences. The uncertainty in the range of these values led to low and high estimates, $R2_{min}$ and $R2_{max}$, respectively. Thus the range of values predicted in the left hand side of Eq. 15 must lie between estimates of the observed values of R2(i+1) and Hc2(i+1) as illustrated below:

(18) $\{A\} < [(R2(i+1)/S1 + Hc2(i+1)) * (1- FU)]^{hat} < \{B\}$

where $\{A\} = [(R2_{min}(i+1) + Hc2_{min}(i+1))*(1-FU)]$, and

$\{B\} = [(R2_{max}(i+1) + Hc2_{max}(i+1))*(1-FU)]$.

By substituting the right hand side of Eq. 15 into Eq. 18, the exploitation rate in Canada can be written as a function of the exploitation rate in Greenland. The plot of this constraint is shown in Figure 5.3.1.3.

Constraint 3: Range of Estimated Returns of 1SW Salmon in Year (i)

The final constraint on the derived exploitation rates relates to the exploitation on non-maturing 1SW salmon in year i and subsequent returns to rivers in the same year. If the Ec(i) applies equally to non-maturing and maturing 1SW salmon in SFAs where they are simultaneously fished, then the projected run of 1SW salmon (grilse) is defined as

(19) $R^{hat}{}_{1(i)} = (Hc1_{mat}(i)/Ec(i) - Hc1_{mat}(i)) * S1$

The minimum and maximum values of Eq. 19 occur when $Hc1_{mat}(i)$ is at its respective minimum and maximum values. Thus

(20) $R^{hat}{}_{1min}(i) = (Hc1_{mat,min}(i)/Ec(i) - Hc1_{mat,min}(i)) * S1$

(21) $R^{hat}_{1max}(i)$ =
$(Hc1_{mat,max}(i)/Ec(i) - Hc1_{mat,max}(i)) * S1$

where

(22) $Hc1_{mat,\,max}(i)$ =
$(1\text{-}f\_imm_{min})*(H_S(i) + q_{max}\, H_L(i))$,

and

(23) $Hc1_{mat,\,min}(i)$ =
$(1\text{-}f\_imm_{max})*(H_S(i) + q_{min}\, H_L(i))$,

where $f\_imm_{min} = 0.1$, $f\_imm_{max} = 0.2$, $q_{min} = 0.1$, and $q_{max} = 0.3$.

The observed range for grilse returns for SFAs 3-7, and 14a is denoted as $[R1_{min,obs}(i)$ {SFA 3-7,14a}, $R1_{max,obs}(i)$ {SFA 3-7,14a}]. Because Eq. 20 and 21 are functions of Ec(i) only, the minimum and maximum values of exploitation rates on 1SW salmon in Canada can be expressed as constants by rearranging Eq. 20 and 21 and substituting the minimum and maximum values of $Hc1_{mat}(i)$ from Eq. 22 and 23. Thus the maximum exploitation rate in Canada, consistent with observed grilse returns and consistent with numbers of maturing 1SW salmon in the catch in SFAs 3-7, and 14a, is given as:

(24) $Ec_{max}(i)$ =
$Hc1_{mat,max}(i)\ /(R1_{min,obs}(i)/S1 + Hc1_{mat,max}(i))$

Similarly, the minimum exploitation rate consistent with the observed catches and runs is

(25) $Ec_{min}(i)$ =
$Hc1_{mat,\,min}(i)\ /(R1_{max,obs}(i)/S1 + Hc1_{mat,min}(i))$

These constraints are illustrated in Figure 5.3.1.2 as the upper and lower horizontal lines.

Graphical Analysis of Topdown Constraints Model

The constraint equations presented above, represent a system of nonlinear equations which collectively define a feasible range of values for exploitation rates in Greenland and the fraction of the stock available to each fishery. Fortunately, the system of equations can be depicted graphically in the Ec x P and the Ec x Eg planes. The purpose of this section is to illustrate the general properties of the constraints and to derive fishery-area exploitation rates.

To illustrate the estimation of Greenland exploitation rates, the data for the 1988 fishery are presented; the fraction of the population unavailable to any fishery is assumed to be 0.30. The first step is to plot relationships among the model parameters in the Ec x P plane (Figure 5.3.1.2). The vertical constraint corresponds to Eq. 1 where P < 1-FU. The horizontal constraints correspond to Eq. 24 and 25 and are related to the constraints on exploitation in Canada derived from observed returns of maturing 1SW salmon in year i. Finally, the implications of the estimated numbers of non-maturing salmon in year i catches (i.e., Eq. 10 and 11) are shown in the upper and lower curved lines, respectively (Figure 5.3.1.2).

The relationship between the exploitation rates in year i in Canada and Greenland for observed total catches and returns in year i+1 are described in Eq. 15 and 18 and plotted in Figure 5.3.1.3. The upper line corresponds to exploitation rates when Hc1(i) is at its maximum value and R2(i+1) and Hc2(i+1) are at their minimum values. Conversely, lower line corresponds to exploitation rates when Hc1(i) is at its minimum value and R2(i+1) and Hc2(i+1) are at their maximum values. As the constraints on 1SW returns (Eq. 24 and 25) are independent of Eg(i), they can be superimposed on Figure 5.3.1.3 to constrain exploitation rates in Greenland as shown by the arrows. Thus the maximum feasible range of Eg(i) $\{Eg_{max}(i), Eg_{min}(i)\}$ is constrained by the observed range of returns and catches in year i+1, the observed range of returns of 1SW salmon in Canada in year i, and the assumed fraction of the population unexploited by any fishery (FU). For the 1988 fishery with FU=0.30, the estimate feasible range of Eg(i) was {0.37, 0.55}.

The range of exploitation rates in Greenland, $\{Eg_{max}(i), Eg_{min}(i)\}$, can be used to parameterize a set of contour curves for Eg in the Ec x P plane. By definition, the exploitation rates in Canada and Greenland are:

(26) $Eg(i) = Hg(i)/((1\text{-}P\text{-}FU)*A + Hg(i))$,

and

(27) $Ec(i) = Hc1_{nm}(i)/(P*A + Hc1_{nm}(i))$,

where $A = (R2(i+1)/S1 + Hc2(i+1))/S2$. Solving for A in Eq. 26 and substituting into Eq. 27 yields Ec(i) as a function Eg(i) and P as shown below:

(28) $Ec(i) = Hc1_{nm}/((P/(1\text{-}P\text{-}FU)) *$
$(Hg(i)/Eg(i) - Hg(i)) + Hc1_{nm}(i))$

Eq. 28 can be used to generate contour curves for Eg in the Ec x P plane by substituting values of Eg between Eg_{max} and Eg_{min} into Eq. 28. Because $Hc1_{nm}(i)$ also has minimum and maximum observed values the full set of level curves for Eg must incorporate this measure of uncertainty as well. These relationships are shown in Figures 5.3.1.4 and 5.3.1.5. In each graph, the upper and lower curves correspond to level curves for $\{Eg_{max}(i), Eg_{min}(i)\}$. Note that feasible values of Eg and Ec do not exist for values of P greater than 1-FU.

Figures 5.3.1.4 and 5.3.1.5 can be superimposed on Figure 5.3.1.2 to illustrate the feasible range of exploitation rates within the polygon defined in Figure 5.3.1.2. For the 8 years of data examined, Eq. 28 does not appear to constrain exploitation rates, but it does act to restrict the range of feasible P values.

Estimation of Exploitation and Abundance

The graphical method of analysis described above was used to estimate feasible ranges of exploitation rates for Canada and Greenland for 1983 to 1990 fishery years (Table 5.3.1.3). The average minimum and maximum exploitation rates for Canada were 57 and 70% respectively. For Greenland the average minimum and maximum exploitation rates depend on the FU parameter. When the fraction unavailable (FU) was assumed to be 0.05, the average minimum and maximum exploitation rates in Greenland were 25 and 36%, respectively. Exploitation rates in 1983 and 1984 were particularly low, an observation consistent with the low catches in those years. Exploitation rates between 1985 and 1988 were about twice as high (about 30 to 50%); during these years the quota acted to restrict harvests in Greenland. Estimates for 1989 and 1990 are somewhere between the 1983-4 and 1985-8 periods. The 1983-4 and 1989-90 fisheries were unaffected by the quota, suggesting low abundance in the West Greenland area.

When the FU parameter is assumed to 0.3 the estimated range of exploitation rates in Greenland increases over the entire period (Table 5.3.1.3). The same general patterns described above still apply, with low rates in 1983 and 1984, higher rates ranging between 40 to 58% during the period 1985-88, and intermediate levels in 1989-90. Further examination of environmental factors that may have led to variations in relative abundance of salmon in these fisheries is warranted.

The total estimated abundance of all non-maturing 1SW salmon of North American origin (Figure 5.3.1.6) shows a marked decline since 1986. Estimates in Figure 5.3.1.6 were obtained simply by reconstructing the population for minimum and maximum values of R2(i+1), Hc2(i+1), $Hc1_{nm}(i)$ and Hg(i) (see Table 5.3.1.2b, and Eq. 1 in Section 5.3.2). Thus, these estimates represent the entire extant stock. While the data do not indicate abundance by fishing region, the estimates illustrate an over two-fold range of pre-fishery abundance in an 8 year period.

The total estimated abundance of all salmon in the West Greenland area can be estimated by dividing the total catch by the minimum and maximum values of exploitation rates $\{Eg_{min}(i), Eg_{max}(i))$. The derived range of abundance estimates (Figure 5.3.1.7) suggest a general downward trend since 1985, regardless of whether FU=0.05 or 0.30. Peak abundance in 1985 probably ranged from 800,000 to 1 million non-maturing salmon of all sea ages (mostly 1SW). Trends for European and North American stocks appear to be more erratic, but both stock complexes exhibit very low abundance in 1989 and 1990 (Table 5.3.1.3).

Derived ranges of P, i.e., the fraction of the stock in Canada, show little trend over time (Figure 5.3.1.8). A relatively small proportion of the 2SW returns appear to return from Canadian fisheries on non-maturing 1SW salmon. Model results suggest that most of the 2SW returns come either from Greenland or are unavailable to any fishery. The relative proportions returning from Canada (P), Greenland (1-P-FU) are contingent on the assumed fraction of the stock unavailable (FU). Model results can suggest upper bounds on FU but actual estimates may be impossible to obtain. Analysis of marine environmental conditions, however, may allow imputation of feasible values. In view of the important questions raised by these model results, the Working Group recommended further assessment. In particular, an examination of potential causative environmental factors is warranted.

Discussion

The derived estimates of fishery area exploitation rates apply collectively to most of the North American stocks that frequent the West Greenland area. To the extent that different stocks have different migration patterns, the period of residence within the fishery would determine the actual rate of exploitation on that stock. Fish that reside within the fishery for longer periods would have greater exploitation rates.

This modelling approach could be applied to specific stocks when data are available. The modellng approach has been applied to all Canadian stocks which have a significant proportion of MSW spawners. For these data, the derived exploitation rates apply to the entire group of stocks and therefore represent an average rate for that fraction (i.e., 1-P-FU) of the population available to Greenland. The input data could be further disaggregated to incorporate stock complexes, such as northern and southern Canada rivers. Further disaggregation for specific stocks would be possible when specific harvest data were available (e. g., Maine-origin salmon). The important point is that the scope of inferences regarding fishery area exploitation rates would necessarily be reduced. Application to northern and southern Canadian stocks could however, highlight important differences in exploitation rates relevant to improving future management decisions. Potential applications of this refinement are highlighted in Section 5.3.2.

In light of the potential application of this approach to interpret historical patterns of abundance and exploitation rates, the Working Group recommends that total return and catch data be assembled for years (i.e., fishery years) prior to 1983.

Application to European Stocks

The Working Group considered ways to apply similar models to the European stocks exploited at West Greenland. Because of the nature of the fisheries, the constraints model cannot be applied directly. The Working Group therefore considered a preliminary estimate of the abundance of non-maturing 1SW salmon in the sea at the time of the West Greenland fishery based upon a run-reconstruction approach. Catches of 2SW salmon in homewater fisheries were used to estimate the numbers of 2SW fish returning to each country. These were then used to estimate the numbers that would have been alive in the previous year.

Maximum and minimum estimates of the numbers of non-maturing 1SW salmon alive at the time of the West Greenland fishery for each European country [T1g(max) and T1g(min)] were calculated using the following formulae:

$$T1g(max) = Hm / q / (1\text{-}R) / Exp(-Mt) / E(max)$$

$$T1g(min) = Hm / q / (1\text{-}R) / Exp(-Mt) / E(min)$$

where:

Hm = harvest of MSW fish in homewaters in year i+1;
R = average non-reporting rate for all European countries;
q = proportion of Hm that comprises 2SW fish;
M = natural monthly mortality rate for 1SW salmon in the sea;
t = months from West Greenland fishery to homewater fishery;
E(max) = maximum likely mean exploitation rate on 2SW fish in homewaters;
E(min) = minimum likely mean exploitation rate on 2SW fish in homewaters;

The assessment was carried out for 1990 catches in homewaters. This gave estimates of the numbers non-maturing 1SW European salmon alive before the 1989 West Greenland fishery of between 915,000 and 1,242-,000 salmon (Table 5.3.1.4). Table 5.3.1.2b gives a range of estimates of the total abundance of salmon in the West Greenland fishery area in 1989 from 317,351 to 618,000. Using the proportion of European salmon estimated to be in the catch that year (44%), the numbers of European fish in the area is estimated to be between 139,635 and 271,920. This therefore suggests that between 11% and 30% of all the non-maturing 1SW European salmon were in the fishery area in 1989.

It is important to note, however, that there is a marked difference in the proportions of the stocks from the northern and southern countries that go to the West Greenland area. The Working Group recommended that further analyses be carried out to examine the different contributions of stocks from different areas to the West Greenland fishery.

5.3.2 Modelling interactive effects between abundance and exploitation rates at West Greenland in relation to achievement of North American spawning targets

The pre-fishery abundance of North American non-maturing 1SW salmon (i.e. 2SW spawners) can be estimated by applying the run-reconstruction model to total returns and catches for Canada. The term "pre-fishery" refers to the population size prior to commencement of the Canadian and Greenland fisheries. This population estimate does not include individuals of the same smolt class which mature and return as 1SW spawners. The estimated pre-fishery abundance of non-maturing 1SW salmon in fishery year (i) is defined herein as N1(i), and estimated as:

(1) $N1(i) = (R2(i+1)/S1 + C2(i+1))/S2 + C1(i) + G1(i)$

where

G1(i) Catch of 1SW salmon in Greenland in year i

C1(i) Catch of non-maturing 1SW salmon in Canada in year i

R2(i+1) 2SW Spawners to Canadian rivers in year i+1

C2(i) Total Catches of 2SW salmon in Canada in year i+1

S1 Survival rate between the fishery on C2(i+1) and returns R2(i) to the river

S2 Survival rate between the midpoint of the C1(i) and G1(i) fisheries and the C2(i+1) fishery.

Estimates of total pre-fishery abundance of 1SW salmon destined to return as 2SW spawners are presented in Figure 5.3.1.6.. Data for 1983 to 1990 are presented in Table 5.3.1.2b.

In the analyses which follow, S1 represents the application of a constant annual mortality rate (M=0.12) over a period of 2 months. The parameter S2 corresponds to an annual M of 0.12 applied over a period of 10 months. For notational simplicity, the subscripts on G1, C1, C2, R2, and N1 will be dropped in the following paragraphs.

Equation 1 can be rearranged to express R2 as a function of C1, G1, and C2 for varying levels of N1. To illustrate potential utility of the approach, various combinations of catches (G1, C1, and C2) on estimated numbers of spawners were computed for various levels of N1. Results illustrate that a wide variety of catches would allow equivalent numbers of spawners to return.

The target number of spawners necessary to achieve conservation objectives can be called R2_target. The Working Group considered a provisional estimate of R2_target of about 175,000 which represents the sum of target spawning requirements for all Canadian rivers. At low levels of pre-fishery non-maturing 1SW abundance (N1 = 200,000; Figure 5.3.2.1) there would be insufficient numbers of spawners (R2) to allow harvest in either Canada or West Greenland. At moderate (N1=400,000) and higher (N1=600,000) levels of abundance (Figures 5.3.2.2-3) a range of catch allocations among fisheries (C1 vs G1) or years (G1,C1 vs C2) would permit sufficient numbers of spawners within "safe biological limits", provided that targets for component stocks met. Based on observed projections since 1983 (Figure 5.3.1.6), a reasonable range of N1 values is 200,000 to 600,000 salmon.

The Working Group identified several problems with using abundance and exploitation information to provide management advice, especially in relation to spawning targets. Although the combined target spawning requirements for Canadian rivers is probably between 150,000 and 200,000 2SW salmon, meaningful catch advice to provide sufficient spawning escapement for individual stocks is not readily available due to the varying proportions of stocks contributing to the fisheries. Previously, the Working Group (*Anon.*, 1982, 1984) advised that "it is not possible at the present time to estimate and advise on a single TAC which would maintain homewater stocks and safeguard the spawning within safe biological limits". *Anon.* (1984) further advised that regulation by a single TAC would not seem to be a practical method to adequately ensure spawning escapement within safe biological limits for stocks which are, in part, harvested in mixed stock fisheries.

The present Working Group, however, noted that if current catches are adversely affecting the total stock, then reductions in catches would benefit the population as a whole. Benefits to specific stocks however, could not be predicted. Development of a TAC that would reduce catches when stocks are low would provide means of indicating when catch reductions are biologically justified. Present methods for setting catch levels irrespective of population size pose an even greater risk to the total population during periods of low stock abundance. Future management advice could be improved as additional information on particular stocks became available.

The Working Group considered two approaches for improving catch advice. Spawning targets could be improved by taking known individual river spawning targets and scaling these up regionally to identify a minimum overall North American target. Another alternative would be to group North American 2SW-producing stocks into "stock complexes" based on river age distributions and evaluate their contribution to catches in Canada and Greenland. The Working Group recommended that both approaches to improvements be evaluated and reviewed at its next meeting.

A significant problem with providing catch advice based on average abundance levels is that it does not account for differences among stocks in productivity or their contributions to fisheries, and hence ability to sustain particular levels of exploitation. This generates a risk of driving already weak stocks further downwards, while under-exploiting stocks of higher productivity.

The general principles relating the productivity of stocks to their ability to withstand exploitation are illustrated in Figure 5.3.2.4. Salmon stocks differ widely in their natural productivity. In addition, human influences on salmon rearing habitat may have reduced the productivity of some systems. In Figure 5.3.2.4, the vertical axis shows the number of returning adult fish that would be produced for each spawner in the previous generation, in the absence of exploitation. This value will vary between stocks and thus determines the position of the stock on the horizontal axis.

Stocks lying at point Eo are just self-sustaining in that each spawner will only produce one returning adult fish, leaving no extras available to be harvested. To the left of this point lie stocks that cannot produce enough spawners and are thus not self sustaining. Such stocks could not exist naturally, however some have been reduced to this condition by factors damaging the river habitat; these stocks can now only be maintained by stocking. To the right are rivers that are producing more fish each generation than are required for adequate spawning and can therefore tolerate exploitation without declining. Most salmon rivers are thought to fall in this latter group.

The effect of exploitation is to reduce the number of adults returning to spawn. Thus a fixed level of exploitation on a wide range of stocks is illustrated by the dotted line in the figure. This has the effect of putting a greater proportion of stocks beyond the point at which they are under threat or are not self sustaining.

The real position will clearly be more complex than this for a number of reasons. Among the most important of these is that the productivity of a particular system is likely to alter between years. In addition, mixed stock fisheries will normally exploit different stocks at different levels.

Unless exploitation occurs only in rivers, any mixed stock fishery will increase the risk of over exploiting individual stocks. The relevant scientific issue, in the context of current management practices on mixed stock fisheries, is to reduce the risk to less productive stocks and stocks that contribute greater relative proportions to the fisheries. Without an extensive tagging program, river-specific stocks cannot be identified in the mixed stock fishery at Greenland or elsewhere. Thus, any level of exploitation in the mixed stock fishery potentially poses problems for some stocks. Figures 5.3.2.1-3 illustrate the tradeoffs that are necessary to achieve numbers of spawners in home waters equal to the combined spawning requirements of all stocks. These tradeoffs apply in general, but not to specific stocks.

Identifying specific times and areas where vulnerable stocks are present in the fishery could provide protection, but analyses to date have not revealed predictable patterns for any North American stock. Alternatively, excessive exploitation on the 1SW component, when it occurs, can be compensated by reductions in catches on the maturing 2SW returns. The feasibility of this approach depends on the magnitude of the exploitation on the 1SW component. In addition, feasibility also depends on non-biological factors related to desired allocation of catches among fisheries.

Future refinement of this approach would include assessment of the relative risks associated with errors in the prediction of N1 and application of the model to groups of stocks, e.g., northern and southern Canadian stocks.

5.3.3 Indices of abundance at West Greenland

The Working Group examined information from Canada which may provide a pre-season index of abundance of North American fish at West Greenland. Information on 1SW returns to several Canadian rivers, catches of small salmon in Canadian waters and survival rates of hatchery 1SW salmon to some Canadian rivers were examined in relation to part or whole season measures of abundance in the Greenland fishery. Among several significant relationships, (Anon. 1992a), the predictor judged to have the greatest management potential was the count of "small" salmon in the Millbank trap on the Miramichi River. If the statistical prediction error of this relationship were shown to be sufficiently small, then 1SW numbers in this trap could provide a pre-season index of abundance of 1SW Canadian salmon in the Greenland fishery. The significance of the relationship ($P=0.001$) suggests that variations in the magnitude of post-smolt survival exceeds the variability in proportion of fish maturing as 1SW salmon. Thus, variations induced in the regression line by interannual fluctuations in maturity and variations in smolt production are not sufficient to obscure the underlying relationship. This means that in the Miramichi stock, the overall rate of return for a smolt class is dominated by post-smolt mortality rather than variations in maturation rates.

The Working Group considered information from catches of small salmon in southern Labrador (SFAs 2 & 3) that could be used to predict current year abundance at West Greenland. The relationship of numbers of North American river age 4 and older caught in the first two weeks of fishing at West Greenland on catch in number of small salmon in Labrador was significant at less than the 5 % level of significance ($R^2=0.66$, $F=17.8$, $P=0.002$). In order for this relationship to be of use to management as an index of abundance of salmon at Greenland, a data series of catches of small salmon in Labrador up to a specific date would have to be developed.

Another concern with the use of pre-season indices is that they apply only when management measures have not altered the basic underlying relationship with measures of abundance in Greenland. For example, closure of a major fishery could confound the interpretation of data obtained from remaining fisheries.

Factors influencing potential indices of abundance of European 1SW salmon at West Greenland were evaluated by the Working Group. Potential indices were thought to fall into two main groups; those related to the production of juveniles or smolts; and those based on estimates of the abundance of 1SW salmon. Run-reconstruction modelling on monitored stocks was used to examine the relative variation in post-smolt survival and the proportion of salmon maturing at 1SW. This demonstrated that among European stocks variability in the proportion of a stock maturing at 1SW was low in comparison to the variation in post-smolt survival (Table 5.3.3.1).

These results suggest, but do not confirm, that returns of maturing 1SW salmon to some European rivers could serve as indices of the abundance of non-maturing 1SW in the sea at the time of the West Greenland fishery. It was felt that many European stocks would be unlikely to provide a pre-season index of abundance at West Greenland due to the 1SW returns being spread over the middle and latter parts of the year and being very variable. However, the Working Group recommended that data from fisheries, river counts and traps be examined further to evaluate this possibility.

An alternative approach, involving use of early season daily catches in the Greenland fishery as an index of abundance, was considered by the Working Group. If catches during the early part of the season are correlated to abundance, then the rate at which catch accumulates might be used to indicate potential abundance in the same season, and thus be used for catch advice. However, it was thought that as catches are dependant on several factors in addition to abundance, catch alone might not be a suitable index of current season abundance. The Working Group recommended that further investigation of past patterns of abundance and distribution of early season catches be carried out. Preliminary assessment of this approach (*Anon.*, 1992a) for 4 years of daily catch data (1987-1990) suggested that within season forecasts of abundance were not sufficiently accurate to provide meaningful advice. However, this assessment examined daily catch patterns for each year individually. A more rigorous approach, using all the data to develop predictive relations, would be useful. Application of the method of Noakes (1989) is recommended. Preparation and analysis of all available daily catch information, prior to the next meeting of the Working Group, is recommended.

5.3.4 Exploitation of Maine-origin (USA) salmon

Extant Exploitation Rates

In (*Anon.*, 1990a), a model to calculate extant exploitation rates of 1SW and 2SW Maine-origin salmon was presented. These calculations were updated by including the 1990 Greenland and Newfoundland catches and 1991 homewater returns (Tables 5.3.4.1-5.3.4.3). The extant exploitation rates for 1SW Maine salmon in 1990 were lower than in the previous year but still higher than the long-term average. The extant exploitation rates for 2SW salmon in 1990 were higher than the average for the time series.

Fishery area exploitation on 1SW Maine origin salmon at Newfoundland and West Greenland

Fisheries for non-maturing 1SW salmon of North American origin salmon occur simultaneously in West Greenland and Canada. Exploitation rates in these fisheries depend on what proportion of the extant stock is vulnerable to each fishery. Assuming that the population of 1SW Maine-origin salmon is available to only the Newfoundland and West Greenland fisheries, estimates of exploitation rates are presented in Table 5.3.4.4. A monthly natural mortality rate of 0.01 was used in all cases. Two assumed levels of reporting are included; where the Carlin adjustment of 1.0 is used, the reporting rate is that which has been used in Section 5.1.3, and where the Carlin adjustment of 2.0 is used, the reporting rates are halved. Varying levels of P between 0.1 and 0.9 (the proportion of stock migrating from Canada) are evaluated.

The values calculated for 1990 show exploitation in Canada and Greenland are unchanged compared to the previous year. The effects of different reporting rates of Carlin tags and different proportions of the stock population available to each fishery, are presented in Figure 5.3.4.1 and these indicate the possible range of fishery area exploitation in 1987-1990.

Estimates of exploitation rates for Maine stocks in Canada and Greenland are generally higher than those estimated by the continental run reconstruction model presented in Section 5.3.1. Those estimates of fishery area exploitation rates are based on the aggregate behaviour of many hundreds of stocks. Maine stocks are near the southern boundary of Atlantic salmon habitat and are likely have different migration routes than the major Canadian stocks. As exploitation in fisheries are dependent upon fishing effort and residency of fish with the area, differences among stocks are to be expected. Comparisons of tag recoveries and harvest estimates between Maine stocks with other North American stocks could provide useful information on different vulnerabilities of individual stocks to fisheries.

5.4 Advice on Catch Levels at West Greenland

The Working Group was asked to propose and evaluate methods to estimate possible catch levels based upon maintaining adequate spawning biomass. The problems of estimating the total allowable catch (TAC) for salmon have been examined by the Working Group (*Anon.*, 1982, 1984, 1986, 1988a). The general concerns about the difficulties of applying a TAC are expressed in Section 5.3.2. Although advances have been made in our understanding of population dynamics of Atlantic salmon and the exploitation occurring in the fisheries, the concerns about the implications of application of TACs to mixed stock fisheries are still relevant. The corollary of previous concerns is that reductions in catches, provided via an annually adjusted TAC would, in principle, reduce mortality on the population as a whole. Benefits that might accrue to particular stocks would be difficult to demonstrate, in the same way that detriments to individual stocks are difficult to identify.

The Working Group considered how the predictive measures of abundance, outlined in Section 5.3, could be implemented to give annual catch advice. The aim of advice would be to limit catch to a level that would facilitate achieving overall spawning escapement equivalent to the sum of spawning targets in individual North American and European rivers (when the latter have been defined). To achieve the desired level of exploitation, for a given level of predicted abundance, either a TAC could be fixed or some form of effort limitation introduced.

Although a TAC would limit total catch, it will concentrate the fishing mortality on the stocks in the fishing area up to the time when the various boat quotas are filled. If different stocks enter and leave the fishery area at different times, this could increase the risk of certain stocks being more heavily exploited than others.

Effort limitation would, in theory, provide a greater range of options for management, such as season length restrictions, regulating number of boats or licenses or close periods in the fishery. However, it was felt that the diversity of boat types and sizes and their large numbers this would make effort limitation difficult in practice, particularly because no reliable data exist on the relationship between effort and exploitation in the fishery.

The methodology employed in Section 5.3.3 simply defines the tradeoffs in catches of non-maturing 1SW salmon in Canada and Greenland and 2SW catches in Canada in the following year. In particular, it defines a set of feasible combinations that may ensure that an overall spawning target is met. The advice for any given year is dependent on obtaining a reliable predictor of total non-maturing 1SW abundance for North American stocks. Since pre-fishery abundance for year i is the sum of the catches in year i and catches plus returns in year i+1, the advice for year i+1 fisheries (2SW) could be improved by updating the prediction conditioned on the 1SW catches in year i. For the 1983-1990 data the regression between total 2SW returns plus 2SW catches in year and total 1SW catches had a coefficient of determination of 0.76. More importantly, the standard error of the prediction was 25,000 fish. Hence, management corrections for 2SW catches may be possible.

In contrast, prediction of pre-fishery abundance of 1SW salmon destined to return as 2SW salmon is much more difficult, as described in previous sections. One possibility would be to use simple trend analysis of the abundance data in Figure 5.3.1.6 to project future abundance. Such predictions could have wide prediction intervals and it would be important to proceed cautiously by using the lower range of predicted abundance levels for management decisions. Further analysis of the error structure of the N1 abundance estimates might provide a means of imputing error bounds on the projections. In turn, these error bounds could be incorporated into the catch advice and expressed in terms of the likelihood of achieving spawning targets. Some portion of the stock will receive excess numbers of spawners while others will be under seeded. However, the above approach could provide improved safeguards, particularly if applied to smaller geographical groupings of stocks (stock complexes) as suggested by the Working Group in 1988 (Anon. 1988a).

5.5 By-catches in the Greenland Salmon Drift-Net Fishery

By-catch information for the West Greenland salmon drift-net fishery is not routinely recorded. The only information available was collected during research investigations.

Information on by-catch at West Greenland comes from three sources:

1) Canadian research cruises in Greenland waters during the fishing seasons over the period 1969 to 1982 collected information about by-catches.

2) In 1972 from August to October when the Joint ICES/ICNAF Salmon Tagging Experiment at West Greenland 1972 took place, the by-catch information from four research vessels and from eight commercial vessels was obtained (Christensen and Lear, 1977). On the basis of catch-per-unit-effort of by-catches by these commercial vessels, estimates have been derived on numbers of individuals of various species captured by non-Greenlandic vessels fishing for salmon in 1972. The most numerous by-catches of seabirds were murres (*Uria lomvia*), dovekie (*Plautus alle*), greater shearwater (*Puffinus gravis*), black guillemot (*Cepphus grylle*) and Atlantic Puffin (*Fratercula arctica*). Cod (*Gadus morhua*) was the only fish species taken in significant quantities as by-catches. Harbour porpoise (*Phocoena phocoena*) and seals were the only marine mammals taken frequently.

3) Piatt and Reddin (1984) provided an analysis of seabird by catches in the salmon drift-nets during the fishing season in the beginning of the 1980s.

The by-catch rates derived from the research vessels in the 1970s and in 1980s as reported by Christensen and Lear (1977) and Piatt and Reddin (1984) are not applicable to the present fishery. The fishing pattern in the Greenlandic salmon drift-nets fishery has changed considerably since the 1970s. There are no longer large drift-net vessels; therefore, the salmon fishing now takes place mostly close to the shore or in the fjords. Since the beginning of the 1980s, the fishery has operated in more southerly areas than before.

5.6 Adequacy of Sampling Program at West Greenland

The sampling program at Greenland started in its present form in 1985. The purpose is to sample the fishery as adequately as possible both geographically and temporally. Also, the sample sizes have to be of sufficient size to permit establishment of a reliable data base. As the sampling program is planned in detail before the fishing season, it must draw on the experiences from earlier years. Furthermore, the sampling program is limited to its present size by the amount of money allocated to it by the governments concerned. At present the sampling is carried out by three sampling teams, one in each of three NAFO divisions, during two-four week periods in the beginning of the fishing season.

The adequacy of the program was discerned by examining the percent of the catch taken during the sampling program and the percent of catch sampled for fork lengths and CWTs (Table 5.6.1). The percent of the catch sampled from 1985-91 has ranged from 25.6% to 92.1%. A particularly low coverage occurred in 1990 when the catch was low and did not peak early in the season.

The Working Group discussed several ways of improving the sampling program. Scenario 1 in the text table below shows the impact of adding one or two weeks to the present program of sampling in three NAFO Divisions. Scenario 2 was achieved by dropping a NAFO Division and adding a team to another site after the first teams have left.

Percent of catch in sampling period

Year	Present	Scenario 1		Scenario 2
		Present		
		+1wk	+2wk	
1985	80.0	88.8	93.9	97.9
1986	92.1	94.5	97.1	99.2
1987	79.3	84.7	89.2	89.2
1988	67.1	74.8	96.3	96.3
1989	74.7	81.9	86.8	98.2
1990	25.6	37.3	58.6	86.9
1991	51.9	61.7	68.4	86.8

If the objective was to sample during the period when 80% of the catch was taken then it could only be achieved by Scenario 2. Unfortunately, this would result in poorer coverage over NAFO Divisions. An analysis of temporal and spatial differences in proportions of salmon of North American origin occurring within each fishing season since 1969 was presented. This analysis showed very few indications of temporal changes, while on the other hand significant results occurred in more than 50% of all analyses concerning spatial variations. This would suggest that scenario 2 is inferior to scenario 1 as it has poorer coverage over NAFO Divisions. It should also be pointed out that it is not always possible to sample small catches at the tail end of the fishery due to the logistics of plant operation.

The sampling program may influence the reporting rate of external tags. It was of particular concern if the reporting rates within and outside the sampling period were different (Table 5.6.2). There was no indication that the reporting rate was always higher within or outside the sampling period. In 1986 and 1988, the reporting rates outside the sampling periods were significantly higher than within the sampling periods. This was contrary to expectations and no good explanations could be found. However, in 1986 the sampling teams encouraged reporting of Carlin tags and this may have contributed to an increased reporting rate at the end and after the sampling season. Considering the low number of tags it seems likely that any non-random distribution of tagged salmon may have considerable impact on the results. Furthermore, the date when the landings are recorded does not always coincide with the actual catch date.

The proportion of the catch examined for CWTs has varied in the range 4.46-13.26% of total catch, while the absolute numbers examined varied between 6,410-30,360. The lowest numbers occurred in 1990 and 1991. The Working Group considered this to be of potential concern as low numbers of CWTs recovered will contribute to a decrease in the current database regarding the number of salmon with known origin. It may therefore be worthwhile to try to increase the number of salmon examined for CWTs.

In all other aspects the present sampling program was considered adequate, as long as the catch peaks early in the fishing season.

5.7 Effectiveness of Management Measures

Over the past 16 years, the fishery at West Greenland has been managed by a TAC which has ranged from 840 t to 1265 t (Table 5.1.1). In seven years the full quota has not been taken and so the management measures have not restricted the effect of the fishery on stocks returning to homewaters. For the remaining years, it has not been possible to estimate the catch that would have been taken in the absence of a quota control. As a result, the effect of the quota on stocks returning to homewaters is not known.

In the past eight years the quota has been fairly stable (between 840 and 935 t). Over the same period, exploitation is estimated to have remained at a relatively constant level of approximately 30-45% (Table 5.3.1.3). As a result, the catch has varied with the abundance of stocks in the area. Data from homewater fisheries (Section 3) suggest that many stocks have been in decline in this period and this is particularly evident in the MSW component of the stocks.

6 FISHERIES RELEVANT TO THE NORTH AMERICAN COMMISSION

6.1 Description of Fisheries in Canada

The following were new management measures for commercial fisheries in 1991:

1) In 1991, quotas for the Newfoundland commercial salmon fishery were lower by the following amounts in these Salmon Fishing Areas (SFAs, Figure 3.3.1.1) of Newfoundland: SFA 3 (35 t), SFA 4 (22 t), and SFA 13 (10 t). The quotas in 1990 and 1991 are shown in Table 6.1.1. Salmon Fishing Area 1 had an allowance of 80 t, the same as 1990; an allowance is an estimate of expected catch and not a limitation on allowable harvest. In other SFAs, quotas remained as in 1990. Monitoring of the quotas was conducted by Fisheries Officers who were in contact with buyers and fishermen on a weekly or daily basis.

2) In the Québec commercial fishery, the quota in Q7 was reduced by 34% (from 2755 to 1809 fish), commensurate with a reduction in a number of licenses under a buy-back program. In Q8 and Q9, the quota and fishing seasons remained essentially the same as they were in 1990.

The following were new management measures for recreational fisheries in 1991:

1) The seasonal bag limit for the recreational fishery of Newfoundland-Labrador was reduced from 15 to 10 fish. For conservation reasons, most rivers in SFAs 22 and 23 (Inner Bay of Fundy) were not opened to recreational fishing.

A more detailed description of other aspects of the commercial fisheries was provided in *Anon.* (1985) and updated annually by the Working Group.

The total salmon landings for Canada in 1991 were 679 t (Table 2.1.2); this is the lowest recorded landing in the 1960-91 data set. The landings of small salmon (318 t) in 1991 were 25% below the 1990 landings (425 t) and 51% below the previous 5-year mean (653 t). The landings (361 t) of large salmon in 1991 were 26% below the landings of large salmon in 1990 (486 t) and 47% below the previous 5-year mean (688 t). Of the total Canadian landings by weight, 25% were in Québec, 68% in Newfoundland and Labrador, and 8% in the Maritime Provinces. The recreational fisheries harvested 20%, commercial fisheries 75%, and the native food fisheries 4% of the total landings by weight (Table 6.1.2). The decline in total commercial landings from 1596 t in 1987 to 512 t in 1991 was spread over all Salmon Fishing Areas of Newfoundland and Labrador and the Québec North Shore (Table 6.1.1). Landings in Newfoundland and Labrador of 434 t in 1991 were the lowest recorded for the data sets (1910-1970) provided by May and Lear (1971) and 1971-91 (Table 6.1.3). Landings in 1990 were the second lowest in the data sets. A description of the commercial, recreational, and native fisheries, in 1991, in Atlantic Canada are provided in the North American Study Group Report (Anon. 1992a).

The landings in the commercial (in weight) and in the recreational fisheries (in numbers) in 1991 by SFA and comparisons to the mean landings, 1984-89, are provided in Tables 6.1.4, and 6.1.5, respectively, and in Figures 3.3.1.2. Historical commercial and recreational landings are presented in Figure 6.1.1. Analyses of the effects of the 1991 quotas are contained in Section 6.4.

The commercial landings of small and large salmon, by weight, declined from the mean landings 1984-89 throughout Newfoundland and Labrador SFA 1 to 14 (Table 6.1.4 and Figure 3.3.1.2). The early closure in SFAs 3, 5, 6, 7, 8, 9, 10, 11 and 13 contributed to the decrease in landings. However, low abundance of salmon also appears to be a contributing factor, particularly in SFAs 1, 2 and 4. Severe ice conditions along the coasts of NE Newfoundland and Labrador interfered with fishing activities which may also have been a contributing factor to low landings. In these areas catches of large salmon were about three weeks later in 1991 than average while small salmon catches were approximately one and a half weeks later. This apparent delay in migration timing may also be related to the unusually cold ocean water temperatures.

The landings of small and large salmon in Q7 and Q8, the Québec North Shore, decreased from the mean landings 1986-1990, but remained steady in Q9 (Table 6.1.4 and Figure 3.3.1.2). The declines in large salmon catch in Q7 (25%) may be related to the reductions in quotas and removal of fishing licenses.

The recreational landings of large salmon declined in all Salmon Fishing Areas except Q2, Q3, Q5, and Q8 (Table 6.1.5 and Figure 3.3.1.2). Similarly, declines were experienced in small salmon in all SFAs, except SFA 3, 18, Q2, Q3, Q5, Q6, and Q9 (Table 6.1.5 and Figure 3.3.1.2).

6.1.1 Composition and origin of the catch, 1991

Salmon of Canadian and USA origin were captured in the fisheries of Newfoundland and Labrador, in 1991, as evidenced by recaptures of tagged 1SW salmon from both countries. Salmon with coded wire tags (CWT) were recovered during sampling at 12 commercial fishing ports in SFAs 2, 3, and 4. Samplers scanned over 19,000 fish (about 21% of the total catch in these SFAs) for the presence of adipose fin clips and CWTs. Of this sample, 159 fish had adipose fin clips and 120 fish had CWTs (Table 6.1.1.1). As in 1990, the highest percentage of CWT-positive salmon were observed at Harbour Deep (SFA 3) with an occurrence rate (2.5%) nearly twice as great as any other fishing port. Overall, the presence of CWT-positive salmon was 2.8-fold greater in 1991 than in 1990.

Ninety-seven percent of the 120 CWTs recovered were from USA rivers. In contrast to previous years, most tag recoveries were from the Connecticut River (74), with recaptures of 29 from the Penobscot River and 13 from the Merrimack River. Canadian-origin tags came from the Saint John River, NB (3) and St. Jean, Québec (1). The differences in numbers of recoveries among river systems do not necessarily imply differential exploitation because of the differences in relative numbers of tags at large, and the location and time of sampling. The Working Group noted apparent spatial and temporal clustering of tag recoveries and recommended additional analyses to discern broad-scale migration patterns.

Fourteen Carlin tags from Maine-origin salmon were reported from Canadian fisheries during 1991. Twelve of these tags came from fishermen in SFA 3; tags were also reported from SFAs 4 (1) and 5 (1). Estimates of harvest of USA-origin salmon captured in the 1991 fisheries will not be available until after the 1992 returns to homewaters.

6.1.2 Historical data on tag returns and harvest estimates

Carlin-based estimates for Canada

The Working Group updated the time series of tag returns and harvest estimates of Maine-origin 1SW and 2SW salmon in Newfoundland and Labrador. Tag returns for Maine-origin 1SW salmon can be found in Table 6.1.2.1. There were two tag returns from fisheries prior to 1991, but neither of these tags could be assigned to the fishery in a specific year due to incomplete recovery information.

It was noted that the two tags recovered in SFA 11 in 1990 were reported to be from salmon caught after the season was closed. One tag was from a salmon caught in a cod trap, the other was from a salmon caught with marine angling gear.

Neither the structure of the harvest model nor its parameter values were changed from the previous assessment in Anon. (1991a). Updated values and the new data for the 1991 run size used to calculate the RATIO parameter can be found in Anon. (1992a). Estimates for tags and total run size of 2SW salmon to Maine rivers, using a fishway efficiency of 85%, are presented in Table 5.1.3.1. For 1991, the estimates of tags and run size were 29 tags and 2,057 fish, respectively. The relatively low number of tags in the run resulted in second lowest RATIO parameter used in the harvest model time series (RATIO for 1991 = 0.0138), with only 1969 (0.0104) being lower.

Estimated harvests of 1SW salmon in Newfoundland and Labrador are summarized by year for 85% fish passage efficiency in Table 6.1.2.2. The total harvest of 780 Maine-origin salmon in the 1990 fishery was distributed primarily in SFAs 2-4. The 1990 harvest estimate is lower than the 1989 estimate, but is still higher than those observed for the period 1986 through 1988. There was one 2SW salmon tag return from the 1991 fishery. The tag was recovered in SFA 3 and represented a harvest of 103 fish. Updated values for 1SW:2SW ratios and ratios of harvest to run size of 2SW salmon are presented in Table 6.1.2.3. The grilse to salmon ratio for the 1989 smolt class is 0.318 which continues the trend of relatively high grilse returns that began in 1986.

Detailed summaries of the tag returns and harvests for 1SW and 2SW salmon in mainland Canada (Anon., 1990b) are not presented in this assessment since there were no new tag returns for these areas and age groups.

CWT-based estimates for locations sampled

The Working Group considered harvest estimates of Maine-origin stocks in Newfoundland and Labrador derived from CWT- and Carlin-tagged salmon for areas sampled. Estimates based on Carlin tags for the 1990 fishery were calculated identically to the methods used in other reports of Carlin-derived harvest estimates (*Anon.*, 1987; *Anon.*, 1990a). CWT harvest estimates were computed identically to the methods used in Anon. (1990a). To compute the tag raising factor for the 1990 CWT recoveries the following input data were used:

	2SW salmon
Run Estimate	2057
Total CWT	438
CWT at the trap	334
Angled CWT	45
Untagged at the Trap	1343
Untagged Angled	145

From these data, the CWT to run ratio was 0.213 and the raising factor for tags was 4.696. The estimated numbers of tags for sample strata in the fishery was first raised for non-catch fishing mortality (*Anon.*, 1989b) and then raised to total harvests for the strata. Comparative harvest estimates based on CWT and Carlin tag recoveries were calculated for the communities, statistical sections, and salmon fishing areas sampled. The estimates ranged from 0 fish in some communities to a total of 379 for SFA 4 (Table 6.1.2.4). Coefficients of variation (CV) could not be calculated for most community estimates because scanning exceeded the reported catch in some strata. CVs for salmon fishing area estimates were 6%. The ratio of harvest estimation methods (Carlin/CWT) was greater than 1.0 for the salmon fishing area estimates, but this comparison was made with a recovery of relatively few Carlin tags.

As previously noted in *Anon.* (1989a), scanning samples of landings that are not sorted by size category and incompatibilities between the scanning samples and catch statistics are potential sources of bias in the harvest model. These potential sources of bias are more problematic for the community level harvest estimates than the pooled estimates for statistical sections or salmon fishing areas.

6.1.3 Exploitation rates

No new information on exploitation rates in commercial fisheries was available to the Working Group. Exploitation rates in the recreational fisheries have been estimated using mark/recapture techniques in the Miramichi River (SFA 16), the Margaree River (SFA 18) and the Humber River (SFA 13). Exploitation rates from the Miramichi River and the Margaree River which were reported in *Anon.* (1991a) had been adjusted for estimates of reporting rate and tag loss. Since reporting rates are difficult to estimate and in some cases, are entirely dependent upon the estimates of angling catch from different sources, it was considered informative to review the unadjusted rates which represent the actual available data for comparison with the adjusted rates.

Atlantic salmon from all three rivers were captured in tidal waters and marked with individually numbered, blue Carlin tags, attached with stainless steel wire. In 1991, a total of 787 small (<63 cm) and 520 large salmon were marked and released from the three rivers. The unadjusted reporting rates were calculated as the tags returned by anglers to total marks released. Adjusted rates were calculated to account for reporting rate and tag loss. Exploitation rates for large salmon apply to hooked and released fish and may not necessarily apply to retained catches. For the Miramichi River, the exploitation rate based on the estimated angling catch to the estimated returns to the Millbank trap were calculated for comparison. Returns to Millbank trap were estimated using counts of marked and unmarked fish at several counting facilities upstream.

The exploitation rates for early and late runs of small and large salmon in 1991 were similar to those previously observed (Table 6.1.3.1):

- exploitation rate varied on an annual basis in all the rivers,
- exploitation rates on late run small and large salmon are less than on the early run,
- exploitation rate on large salmon is less than that on small salmon,
- combined reporting rate and tag loss factors tend to be about 50% in most of the fisheries.

The exploitation rates obtained using the estimates of angling catch to estimated returns to the river for the Miramichi River are substantially higher than the unadjusted values and are similar to the 0.38 to 0.55 previously estimated. The very high exploitation rate of hooked and released large salmon (0.21 to 0.70) calculated using the angling catch to total returns estimate probably relates to the difficulty associated with the collection of reliable estimates of hooked and released fish.

6.2 Description of Fisheries in United States of America

There were no new management measures instituted in the USA during 1991. The sport catches (number of fish killed), unadjusted for reporting rate, of Atlantic salmon by sea age in Maine rivers, in 1991, were as follows:

	Number of Atlantic Salmon				Total	Total
River	1SW	2SW	3SW	PS	1991	1990
St. Croix	2	(grilse only)			2	2
Dennys	1	6	0	0	7	33
E. Machias	2	3	0	0	5	48
Machias	2	0	0	0	2	2
Pleasant	(catch and release only)				0	0
Narraguagus	1	20	0	1	22	51
Union	0	0	0	0	0	0
Penobscot	40	148	1	3	192	431
Ducktrap	0	0	0	0	0	3
Sheepscot	0	4	0	0	4	9
Kennebec	0	4	0	0	4	46
Saco	0	0	0	0	0	16
Other (Marine)	0	0	0	0	0	1
Total	48	185	1	4	238	642
(1990 Total)	(52)	(562)	(12)	(16)	(642)	

Recreational catches of Atlantic salmon were about 63% lower in 1991 than in 1990. The decreased catch was attributed to smaller runs of salmon and slightly (4%) lower license sales. The number of salmon caught and released in Maine rivers exceeded the number caught and killed. The catches in USA rivers are believed to be of USA-origin.

The average exploitation rate on salmon on all age classes in the Penobscot River was 11.5% which is slightly lower then the exploitation rate (13.5%) observed in 1990. These estimates were based upon the fish passage efficiency (0.85) and reporting rate (0.80) adopted by the Working Group in previous years. The exploitation rates on wild salmon were about twice that on hatchery salmon.

	Hatchery	Wild
1SW	0.16	0.30
2SW	0.08	0.17

This difference is consistent with previous observations (Anon. 1990a) and related to earlier run timing of wild salmon into the Penobscot River.

6.3 Description of Fisheries in France (Islands of St. Pierre and Miquelon)

Catch of salmon for the Islands of St. Pierre and Miquelon in 1991 was 1 t (Table 2.1.1). There were 13 professional fishermen and 37 recreational fishermen in 1989. Tag returns from previous years indicate that salmon of Canadian and USA-origin have been caught in the fisheries of St. Pierre and Miquelon

6.4 Evaluation of the Effects of Quota Management Measures Taken in 1990 and 1991 in Newfoundland-Labrador Commercial Fisheries on Stocks and Fisheries in the Commission Area

The Newfoundland and Labrador commercial salmon fishery was under quota management in 1990 and 1991. The quotas, in tonnes, were set by Salmon Fishing Area (SFA) (Table 6.4.1, Figure 3.3.1.1). The fishing season in both 1990 and 1991 began on June 5 and closed in each SFA when the quota was reached or October 15 as in previous years. The quota was controlled by weekly and daily monitoring of landings by Fisheries Officers. In 1990, quotas were attained in 8 SFAs (4, 5, 6, 8, 10, 11, 13 and 14) resulting in closing dates in these fisheries, ranging from June 21 to July 25. In 1991, quotas were attained in 9 SFAs (3, 5, 6, 7, 8, 9, 10, 11, and 13) with closing dates ranging from June 29 to September 23. A preliminary evaluation of the effects of the quota management in 1990 was reported in *Anon.* (1991a,b). That evaluation is up-dated with final catch data and estimates of harvest of 1SW salmon of Maine-origin in 1990, and preliminary catch data for 1991.

6.4.1 Effects on Canadian stocks and fisheries

The quantities of large and small salmon affected by the early closure of the fisheries were evaluated by applying the closure date in each SFA, in 1990 and 1991, to the temporal distribution of the landings in each SFA and year, 1984-89. Thus, the landings in each SFA were divided into two periods. The landings in period 1 represent the total landings which would have occurred if the closure dates in 1990, 1991 had been applied in years 1984-89; whereas, the landings in period 2 represent the amount of landings which would not have been caught. The minimum, maximum and mean percents of the landings in period 2 were calculated and applied to the landings in the corresponding SFA in 1990 and 1991.

For 1990, the estimated total mean weight (79 t) of small salmon is about twice the estimated weight (39 t) of large salmon which were not caught due to the early closure of the fisheries (Table 6.4.1.1). The estimated mean numbers of fish not caught were 41,600 small salmon and 8,600 large salmon (Table 6.4.1.2).

The mean predicted weight of small salmon not caught in 1991 is 21 t and for large salmon is 9 t (Table 6.4.1.1). These weights are equivalent to about 12,600 small salmon and 2,500 large salmon (Table 6.4.1.2).

The minimum and maximum effect of the quotas on the fisheries in all SFAs combined was estimated by: examining the temporal distribution of the total landings, 1984-89, for SFAs closed in 1990 and 1991; selecting the year of lowest (1989) and highest (1985) landings in period 2; and, applying the percent of the landings in period 2 to the total landings in 1990 and 1991. The results are given below.

	Not caught all SFAs	Small (t)	Small No.	Large (t)	Large No.
1990	Min	52	27,400	27	5,700
	Max	383	174,100	97	19,700
1991	Min	14	7,900	4	1,000
	Max	55	32,100	24	6,000

It took longer to reach the quotas in most SFAs in 1991 than in 1990 even though the quotas were similar or lower in 1991 (Table 6.4.1). The total landings were also lower in 1991 suggesting that the total population size in 1991 was less than in 1990. Other factors which may have contributed to the later closing dates were: a delay in migration timing experienced due to the adverse ocean conditions; and, reduced fishing effort at the beginning of the fishing season due to the presence of ice. The estimated average numbers of small (12,600) and large (2,500) salmon not caught in 1991 is about 70% less than the estimated numbers of small (41,600) and large (8,600) salmon not caught in 1990 (Table 6.4.1.2). In both years the quota had the greatest effect in reducing the numbers of small salmon caught in SFAs 10, 11 and 13 (Table 6.4.1.2). The largest reduction in large salmon occurred in SFA 11 in both 1990 and 1991 (Table 6.4.1.2).

In both 1990 and 1991, the quota had a greater effect on proportionally reducing the catch of small salmon than large salmon in most SFAs (Table 6.4.1.1). This difference in reduction was expected because the large salmon tend to migrate earlier along the coast than small salmon.

Analysis of the description of the composition of the fisheries, 1969-75 by Pippy (1982) indicates that in SFAs 3 to 14, after July 15, the majority of the salmon in these SFAs were of Newfoundland and Labrador-origin. Some of the salmon not caught due to the closure will be non maturing and would not return to rivers until the following year. Also some of the salmon which were not caught in a SFA due to the closure of the fishery may have been caught in an adjacent fishery which was still open.

There are insufficient data to quantify the composition of the stocks or estimate the additional escapements in the many rivers that may have benefitted from the early closures. Some of the additional salmon entering the rivers due to the early closure would be harvested in the angling fishery. The quantity harvested will vary among river systems due to differing exploitation rates (Anon 1990b) and annual variation in stock size. There are presently no measures of total stock size.

6.4.2 Effects on USA stocks

Sufficient information was only readily available to assess the effects of the 1990 quotas on the harvest of the 1SW salmon of Maine-origin. Impacts of the 1991 quotas on 1SW Maine-origin salmon can not be assessed until 1992 when estimates of the harvest of Maine-origin salmon in the 1991 fisheries will be available. The numbers of 1SW Maine-origin salmon which were not caught due to the earlier closures were estimated by examining the estimates of the weekly harvests, June 5 to October 15, each year, 1984-89; the harvests which had not been assigned to a SFA or week were not included. The harvest in each SFA each year, 1984-1989, (Table 6.4.2.1) was divided into 2 periods using the date the fisheries were closed in each SFA in 1990. The percent of the total harvest (period 1+2) which was caught in period 2 was computed by SFA and SFAs combined. The mean percent is the total number of salmon caught in period 2 divided by the total catch in period 1+2. The mean percentage of the harvest, in period 2, for all SFAs combined, over years, was applied to the total estimates of harvest of 1SW salmon of Maine-origin, 1990, in the 8 SFAs which were closed prior to October 15 to give an estimate of the numbers of salmon not killed due to early closure of the fisheries in 1990. The above calculations were repeated using the date the fisheries were closed in each SFA in 1991 to compute the average number of salmon and the percentage of the total harvest which would not have been caught, 1984-89.

The percent of the harvest of 1SW Maine-origin salmon which would not have been harvested in the Newfoundland-Labrador commercial fisheries if the closure date for each SFA in 1990 was applied in 1984-89 varied from 0% to 100% depending on SFA and year (Table 6.4.2.2). The small numbers of salmon harvested and the high variability in the percent of the harvest which could be affected by the closure makes it difficult to estimate the effects of the closure on Maine-origin salmon. The average percentage of the harvest which would not have been caught in SFAs 4, 5, 6, 8, 10, 11, 13, and 14 for all years 1984-89 is 42% (S.D. 22.81) (Table 6.4.2.1). An estimate of 221 (95% C.L. 65 - 589) 1SW Maine-origin salmon would not have been caught due to the closure of the fisheries in these SFAs. It is not possible to determine how many additional 2SW salmon actually returned to Maine rivers in 1991 due to the annual variability in returns to the rivers (Anon, 1991b).

The mean percent harvest on 1SW Maine-origin salmon which would not have been caught if the 1991 closure dates were in effect, 1984-89, is 16% (Table 6.4.2.2), 63% less than using the 1990 closure dates (Table 6.4.2.1). This difference suggests that the quotas in 1991 were less effective in proportionally reducing the harvest than in 1990.

6.5 By-catches of Fish, Birds and Marine Mammals in Salmon Drift-net Fisheries

The Working Group is not aware of any legal or illegal drift-net fisheries for salmon in the North American Commission area.

7 INVENTORY OF PARASITES AND DISEASES BY COUNTRY

The Working Group reviewed the Report of the Working Group on Pathology and Diseases of Marine Organisms (WGPDMO, Anon. 1992e). The WGPDMO was asked by ICES to prepare an inventory of parasites and diseases of wild and reared salmon by country and to report to the North Atlantic Salmon Working Group.

WGPDMO presented qualitative data from Faroes, France, Iceland, Ireland, Norway and Scotland (Table 7.1). A large number of different diseases was identified originating from virus, bacteria, fungi, protozoans, monogeans, trematodes, cestodes, nematodes, achanthocephalans, crustaceans, molluscans and leeches. It was noted that there were considerable problems with compiling and presenting these data. The WGPDMO expressed that the inventory was incomplete and potentially misleading, and stressed that these data should only be used with full awareness of the following constraints:

(1) The information more likely reflects the amount of research activities in this field rather than the actual situation.

(2) Many reports are single observations often in individual fish.

(3) The record of a disease/parasite does not necessarily mean that it is still present.

(4) Unless a disease/parasite has been specifically looked for, its absence from the list for a particular country, or in farmed or wild fish, cannot be taken as evidence of its absence.

(5) The compilation of the data were not made on the same basis in all countries.

(6) There is controversy regarding the specific identification of some pathogens/parasites and, consequently, records of a particular example from different countries may in reality refer to different infections.

The Working Group noted the limitations of the inventory presented and endorsed the recommendation given by the WGPDMO: "NASCO should take note of the limitations of this inventory and its vulnerability to misinterpretation and the WGPDMO urges caution in its use. For example, the circumstances of pathogen/parasite detection and diagnosis must be taken into account in assessing the relative degrees of significance of the listed examples."

8 REPORT OF THE WORKSHOP ON SALMON ASSESSMENT METHODOLOGY

The Workshop on Salmon Assessment Methodology (Anon., 1992c) met in Dublin (Ireland) from the 2-4 March 1992 with the main task of reviewing and reporting on assessment methodologies. A further task was to standardize the ageing nomenclature used for Baltic and Atlantic salmon.

Models were used to assess stocks in 3 main areas, the Baltic and the Northeast and Northwest Atlantic. The questions to be addressed and the data available in these areas dictates the types of models that can be used. The models currently in use or under consideration were described by assessment area.

A full description and specification of each model was provided and sensitivity analysis was provided where appropriate. A summary chapter provides a quick reference guide for the models and details some of the perceived advantages and disadvantages associated with them.

To help in understanding the underlying need for the various models, an overview of the life history of the salmon, the fisheries, and the general management philosophy by area was given. Some terminology was also defined where the possibility for confusion existed.

With regard to the question of standardizing the ageing nomenclature used for Baltic and Atlantic salmon, the participants found that there were valid reasons for using the existing nomenclature mainly associated with the differences in the times of the execution of the fisheries. It was felt that a change would lead to considerable confusion and could not be recommended. A table showing equivalent ages was provided to help in comparing ages in each area.

9 PRODUCTION OF FARM SALMON

The production of farmed salmon by several countries, as reported to the Working Group (Table 9.1), was 217,569 t in 1991. This represents a small decrease of 6,661 t on the 1990 figure (Figure 9.1), mainly due to lower production in Norway. Total farm production was more than 50 times the nominal wild catch.

10 COMPILATION OF TAG RELEASES AND FIN-CLIP DATA FOR 1991

Data were provided by Working Group members on the prescribed form and have been compiled as a separate report (Anon., 1992d). In excess of 1.76 million microtags (CWTs) and 0.33 million external tags were applied to Atlantic salmon released in 1991 (Table 10.1). In addition, 1.63 million salmon were finclipped, 1.45 million with adipose finclip only. Thus, more than 3.72 million marked fish were released.

11 RESEARCH

11.1 Progress on Data Requirements and Research Needs

The Working Group reviewed the requirements for future meetings (Section 13.3) and progress on data requirements and research needs (Section 13.1) in Anon. (1991a). The progress made to date is noted for all items of Section 13.3 (Anon. 1991a) and those outstanding items (no. 8-11 below) from Section 13.1 (Anon. 1991a) which remain relevant.

1. The Working Group expressed concern over the fact that a substantial portion of the CWT estimate of Maine-origin fish harvested in the West Greenland fishery was based on a limited number of tag recoveries and recommended that the method of stratification of CWTs over weeks and areas in which there was no scanning be re-investigated.

Task completed.

2. The Working Group endorsed the recommendations of the Workshop on Identification of Fish Farm Escapees and Wild Salmon and also noted that further research on otoliths may lead to the development of techniques to identify fish escaping at the smolt stage. The Working Group also suggested that methods of artificially marking otoliths of farmed fish, such as with oxytetracycline or by the deliberate introduction of growth zones (e.g., by temperature variation) should be investigated.

No progress.

3. The analysis of the reporting rate for Maine-origin Carlin tags in relation to catch-per-unit-effort for the first two weeks of the West Greenland fishery should be made for other tagging programmes.

No progress.

4. Error estimates for the Carlin harvest estimates of Maine origin salmon in Greenland should be derived if possible.

No progress.

5. Studies should be conducted to investigate the incidence of fish farm escapees in the catch at West Greenland.

Task completed.

6. With respect to the 'bottom-up' run-reconstruction models for countries of the North-East Atlantic, further attempts should be made to refine each national model before 1992. Further, it was agreed that all members should review their tagging experiments and consider what additional data would be required to improve the reliability of their national model.

Little progress reported at Study Group.

7. The bias-corrected catch-weighting technique by size category is the preferred method for determining the number of North American and European salmon captured in West Greenland. Existing catch-weighted estimates (by size category) are not bias-corrected and the Working Group recommended that this be done for as many years as possible for the next meeting.

Some progress made.

8. The Working Group requires further work on biochemical techniques, incorporating additional samples, and suggests that this methodology merits further investigations for country of origin.

No new progress reported.

9. The Working Group noted that no effort data were available from the West Greenland fishery in 1989 and recommends that in future years estimates of effort be provided for the 'small' and 'large' boat components, and for individual fishermen who might cooperate in the daily completion of catch/effort logbooks.

No new information tabled, but there is an expectation that data will be tabled in the future.

10. The possibility of obtaining data on weight categories recorded by the factories at West Greenland should be investigated.

No new information obtained.

11. The Working Group recommends that for 1990--1991, countries should develop run reconstruction models of their stocks for discussion at Study Groups and input to a North Atlantic model at the Working Group.

Significant progress was again made in run reconstruction modelling (Section 5) and the Working Group recommends continued development.

11.2 Progress on Recommendations from 1991

1. The Working Group considered a series of indicators of stock status and sustainability which could be used to advise managers of Atlantic salmon stocks. Members reported on numerous time series of data on catches, spawning escapement, stock-specific exploitation rates, etc., which have not been previously utilized by the Working Group in the preparation of their report. Trends over time in raw, normalized, smoothed--normalized (3-year moving averages) and river-combined smoothed-normalized data provided graphic outputs which captured trends potentially useful in future Working Group reports and reports of ACFM. The Working Group recommended that participants bring these additional data bases in electronic format for review at future meetings. The Working Group chairman, in collaboration with the chairmen of the two Study Groups, will undertake to standardize the format prior to the 1992 meetings.

Considerable progress made.

2. The Chairmen of the North Atlantic Salmon Working Group and the Baltic Salmon and Trout Working Group discussed a number of topics of interest to both Groups with the intention of holding a Workshop.

Workshop on salmon assessment methodology held March 2-4, 1992.

3. Tag recoveries are crucial for the improvement of models being developed to assess the West Greenland and Faroes fisheries. The Working Group recommends that an effort be made to improve and increase screening for tags in the catches, especially in West Greenland.

Progress reported.

4. The Working Group was encouraged by the substantial advances in the discrimination of continent of origin of salmon at Greenland. It was recommended that the investigations continue and that the technique with the lowest miss-classification and error rate be used to discriminate continent of origin of the salmon in the 1991 fishery at Greenland. Specific recommendations are:

i) Ongoing investigations into scale character variables require a larger data set; the inter--circuli spacings data set looks the most promising of the 5 data sets examined but the analysis should be restricted to single combinations of variables so as to avoid collinearity; pattern recognition and the efficacy of Fourier coefficients should be investigated.

ii) Work should continue on discriminant and maximum likelihood techniques, especially the possible use of a quadratic discriminant analysis which may perform better than the linear discriminant analysis.

iii) Samples should be collected to establish the reliability of the rDNA technique to identify salmon collected at Greenland as North American or European.

iv) Investigation of neural networks should continue.

Progress reported on neural networks.

5. Further to the development of techniques to determine the state of maturity of 1SW salmon caught in fisheries it is recommended that:

i) samples be obtained to test the hypothesis that gonadal and somatic growth are equal;

ii) data from the Miramichi River and Norwegian cage experiments be used to test the assumption that there are no differences in GSI between stocks or over time and that Conne estuary and Labrador Sea samples are representative of maturing and non-maturing salmon, respectively;

iii) known maturity samples be collected over time and maturity rates be catch-weighted to test the assumption that there are no timing differences in GSI and maturity over the weeks of the fishery.

No progress made.

6. The Working Group was encouraged by new progress into a "top-down" run reconstruction model which was used to constrain the bounds on possible exploitation rates in the West Greenland fishery. The Working Group recommended that work should be done to analytically derive the range of exploitation rates implied by the set of constraints and to examine longer time series of data,particularly for periods prior to major fishery restrictions in Greenland and Canada. Such analyses might detect the effects of management measures, trends in recruitment and patterns of exploitation.

Significant progress reported at meeting.

7. In addition to the experimental design proposed by the Study Group on Genetic Risks, the Working Group suggests that several less comprehensive experiments might be carried out. These would examine relative performance of farmed and wild salmon at various life stages and would contribute specific information. There is scope for laboratory-based inter-comparisons of genetic and behaviourial interactions between farmed and wild salmon. These would be viewed as complementary to field experiments and could yield useful information that could not otherwise be obtained.

No progress reported.

11.3 Requirements for Future Meetings

1. Nominal catches by country (Table 2.1.1) do not in themselves provide insight into their potential to contain intercepted salmon of another country. It was agreed that nominal catch of salmon reported by country would be more meaningful if the existing time series and future reporting could be separated into coastal and estuarine/freshwater components.

2. The Working Group developed and applied a continental run reconstruction model to estimate abundance of North American salmon at West Greenland. Abundance estimates for North American stocks were then used to define a range of estimates of pre-fishery abundance and exploitation rates. The interactive effects between abundance and exploitation rates at West Greenland were then modelled in relation to achievement of North American spawning targets. The Working Group recommended that: i) with the potential of the approach to interpret historical patterns of abundance and exploitation rates, that total return and catch data be assembled

for fishery years prior to 1983, ii) that further analyses be carried out to examine the different contributions of stocks from different areas to the West Greenland fishery, iii) that future refinement of this approach should include assessment of the relative risks associated with errors in the prediction of pre-fishery abundance and application of the model to groups of stocks (e.g., river age 4 and older, and river age 3 and younger).

3. The Working Group also examined information from Canada and West Greenland which may provide an estimate of pre-fishery and in-season abundance at West Greenland. The Working Group recommended that: i) 1SW data from fisheries, river counts and traps in Europe be examined for pre-season predictors, and, ii) that all available daily catch data (by small and large boats) from the West Greenland fishery be examined with more rigorous statistical procedures e.g., probability distribution functions for an in-season predictor.

11.4 Research Programs

1. The identification of North American and European fish in West Greenland in 1991 was again hindered by the lack of a suitable test sample of fish of known origin and the high misclassification rates associated with the historical database used to form the discriminant function. As in earlier years, scale samples should be collected from 2SW salmon in home-waters in 1992 and forwarded to D.Reddin, Canada.

2. The Working Group noted the importance of continuing the scientific research and monitoring in the Faroes fishery area and expressed an interest in seeing the results from the current research program.

11.5 Future Meeting

The Working Group enthusiastically congratulated John Browne, his colleagues and staff from the Fisheries Research Centre and many Irish friends on their enthusiastic provision of cheerfulness, cooperation and a splendid meeting facility and working environment. Go raibh maith agibh!

The Working Group recommended, that unless invitations were tendered to, and acceptable to the General Secretary and the Chairman of Working Group, that the Working Group meet at ICES headquarters, in 1993, preferably in late March.

12 RECOMMENDATIONS

1. The Working Group endorsed the recommendations of the Study Group on the North American Salmon Fisheries, the Study Group on the Norwegian Sea and Faroes Salmon Fishery, and the Workshop on Salmon Assessment Methodology (Appendix 4).

If there is a requirement by ICES for the Study Group on North American Salmon Fisheries to meet in 1993, the Working Group encouraged national agencies to: consider the adoption of graphic methods to depict measures of central tendency, trends etc.; investigate stock-recruit relationships for naturally spawning fish in the Penobscot and Saint John rivers and to examine forecast models for MSW salmon in an attempt to explain observed recent decreases in the numbers of MSW salmon and increases in the numbers of 1SW salmon returning to some Canadian rivers.

The Study Group on the Norwegian Sea and Faroes Salmon Fishery should be renamed the Study Group on North East Atlantic Salmon Fisheries, thereby recognizing the discontinuation of commercial salmon fishing by Faroese boat owners within the Faroes EEZ through the 1993/94 season and the continuing need to collate information on homewater fisheries. The new Study Group should meet at ICES headquarters for 4 days immediately prior to the meeting of the Working Group on North Atlantic Salmon to compile relevant data including that from 1989 and 1990 smolt releases for the run-reconstruction model.

2. The Working Group concluded that the neural network analysis may offer an alternative to the discriminant analysis of separating stocks of North American and European salmon at West Greenland. The Working Group recommends that the neural network methodology undergo further testing using simulation data sets run parallel with discriminant function analysis. Specifically, the neural network should be evaluated with respect to its: i) sensitivity of classification success with respect to the order of input observations, ii) sensitivity of classification success to category boundaries applied to the input parameters, iii) ability to discriminate simulated samples drawn from underlying distributions with known parameters, iv) relationship to traditional statistical methods, particularly log linear models for categorical data.

3. A considerable number of USA tags have recently been returned from West Greenland without year-of-capture data. Virtually all tags could be safely assigned a year of capture on the basis of smolt-release information. The Working Group suggested an investigation of the assumptions used to set non-reporting rates that would be violated if these tags were now used in the Carlin tag method of estimating Maine origin salmon at West Greenland.

4. The Working Group noted that increasingly larger proportions of the landings at West Greenland are taken by boats smaller than 30 feet. The Working Group recommended that changes in fleet characteristics be considered as a means of adjusting non-catch fishing mortality for use in the proportional harvest model.

5. The Working Group endorsed a recommendation for a Working Group memeber, L. W. Stolte (not in attendance), to develop and implement a video/slide exchange program between interested parties in Atlantic salmon producing countries. The exchange could focus on techniques and installations for salmon culture, fish passage, harvest, juvenile stocking, etc. The content could be reviewed in the context of a scientific critique. Working Group participants volunteering to be the contact person(s) for their country are astericked in Appendix 5.

6. The Working Group noted recent declines in marine survival of Atlantic salmon. No data were formally tabled at the Working Group that related survival and causality, although it was apparent that several investigations were on-going. The Working Group encouraged these investigations, especially those that examined causality of survival patterns of stock complexes at large in the North Atlantic. Investigations should include the use of historical data to determine trends in stock status, comparability of trends between stocks of different river systems that can be ascribed similar migration patterns, and the examination of biological/environmental factors that could explain variation in abundance.

7. The Working Group made considerable progress in efforts to analyze and present time series of data so as to identify trends descriptive of the status of stocks. Additional data sets were made available which had not previously been utilized. Much data remains to be examined. In addition to techniques used to examine/depict trend analysis in this report, the Working Group recommended consideration of the Lowess technique and the diagnostics of "route regression" to assist in the identification, grouping and testing of similarities/differences of trends in time-series data.

8. The Working Group examined the adequacy of the sampling program at West Greenland and recommended that sampling be maintained within the 3 NAFO Divisions and that the duration of sampling within one or two of these locations be extended by one or two weeks.

Table 2.1.1 Nominal catch of SALMON by country (in tonnes round fresh weight), 1960-1991 (1991 provisional figures).

Year	Canada (4)	Den.	Faroes	Finland	France	East Grld.	West Grld.	Iceland	Ireland (1)	Norway (3)	Russia	St. P & M.	Sweden (W. C.)	UK E. & W.	UK Scotland	UK N.I.(1,2)	USA	Others (5)	Total
1960	1636	-	-	-	-	-	60	100	743	1659	1100	-	40	283	1443	139	1	-	7204
1961	1583	-	-	-	-	-	127	127	707	1533	790	-	27	232	1185	132	1	-	6444
1962	1719	-	-	-	-	-	244	125	1459	1935	710	-	45	318	1738	356	1	-	8650
1963	1861	-	-	-	-	-	466	145	1458	1786	480	-	23	325	1725	306	1	-	8576
1964	2069	-	-	-	-	-	1539	135	1617	2147	590	-	36	307	1907	377	1	-	10725
1965	2116	-	-	-	-	-	861	133	1457	2000	590	-	40	320	1593	281	1	-	9392
1966	2369	-	-	-	-	-	1370	106	1238	1791	570	-	36	387	1595	287	1	-	9750
1967	2863	-	-	-	-	-	1601	146	1463	1980	883	-	25	420	2117	449	1	-	11948
1968	2111	-	5	-	-	-	1127	162	1413	1514	827	-	20	282	1578	312	1	403	9755
1969	2202	-	7	-	-	-	2210	133	1730	1383	360	-	22	377	1955	267	1	893	11540
1970	2323	-	12	-	-	-	2146	195	1787	1171	448	-	20	527	1392	297	1	922	11241
1971	1992	-	-	-	-	-	2689	204	1639	1207	417	-	18	426	1421	234	1	471	10719
1972	1759	-	9	32	34	-	2113	250	1804	1568	462	-	18	442	1727	210	1	486	10915
1973	2434	-	28	50	12	-	2341	256	1930	1726	772	-	23	450	2006	182	2.7	533	12746
1974	2539	-	20	76	13	-	1917	225	2128	1633	709	-	32	383	1708	184	0.9	373	11941
1975	2485	-	28	76	25	-	2030	266	2216	1537	811	-	26	447	1621	164	1.7	475	12209
1976	2506	-	40	66	9	<1	1175	225	1561	1530	772	2.5	20	208	1019	113	0.8	289	9536
1977	2545	-	40	59	19	6	1420	230	1372	1488	497	-	10	345	1160	110	2.4	192	9495
1978	1545	-	37	37	20	8	984	291	1230	1050	476	-	10	349	1323	148	4.1	138	7650
1979	1287	-	119	26	10	<1	1395	225	1097	1831	455	-	12	261	1076	99	2.5	193	8089
1980	2680	-	536	34	30	<1	1194	249	947	1830	664	-	17	360	1134	122	5.5	277	10080
1981	2437	-	1025	44	20	<1	1264	163	685	1656	463	-	26	493	1233	101	6	313	9929
1982	1798	-	865	54	20	<1	1077	147	993	1348	354	-	25	286	1092	132	6.4	437	8634
1983	1424	-	678	57	16	<1	310	198	1656	1550	507	3	28	429	1221	187	1.3	466	8731
1984	1112	-	628	44	25	<1	297	159	829	1623	593	3	40	345	1013	78	2.2	101	6892
1985	1133	-	566	49	22	7	864	217	1595	1561	659	3	45	361	913	98	2.1	-	8095
1986	1559	-	530	38	28	19	960	310	1730	1598	608	2.5	54	430	1271	109	1.9	-	9248
1987	1784	-	576	49	27	<1	966	222	1239	1385	564	2	47	302	922	56	1.2	-	8142
1988	1311	-	243	34	32	4	893	396	1874	1076	419	2	40	395	882	114	0.9	-	7716
1989	1139	-	364	52	14	<1	337	278	1079	905	359	2	29	296	895	142	1.7	-	5893
1990	911	13	315	59	15	<1	227	426	586	930	315	2	33	338	624	94	2.4	-	4890
1991	679	3.3	95	69	13	4	438	519	422	885	215	1	38	199	395	55	0.8	-	4031

1. Catch on River foyle allocated 50% Ireland and 50% Northern Ireland.

2. Not including angling catch (mainly grilse).

3. Before 1966, sea trout and sea charr included (5% total).

4. Includes estimates of some local sales and by-catch.

5. Includes catches in Norwegian Sea by vessels from Denmark, Sweden, Germany, Norway and Finland.

Table 2.1.2 Nominal catch of SALMON in homewaters by country (in tonnes round fresh weight), 1960-1991 (1991 provisional figures).
S = Salmon (2SW or MSW fish). G = Grilse (1SW fish). T = S + G.

	Canada(5)			Finland			France	Ice-land	Ireland(2)			Norway(4)			Russia	Swe-den (W.C.)	UK E.&W.	UK N.I. (2,3)	UK Scotland			USA	Total (6)
Year	Lg	Sm	T	S	G	T	T	T	S	G	T	S	G	T	T	T	T	T	Lg	Sm	T	T	T
1960	-	-	1636	-	-	-	-	100	-	-	743	-	-	1659	1100	40	283	139	971	472	1443	1	7144
1961	-	-	1583	-	-	-	-	127	-	-	707	-	-	1533	790	27	232	132	811	374	1185	1	6317
1962	-	-	1719	-	-	-	-	125	-	-	1459	-	-	1935	710	45	318	356	1014	724	1738	1	8406
1963	-	-	1861	-	-	-	-	145	-	-	1458	-	-	1786	480	23	325	306	1308	417	1725	1	8110
1964	-	-	2069	-	-	-	-	135	-	-	1617	-	-	2147	590	36	307	377	1210	697	1907	1	9186
1965	-	-	2116	-	-	-	-	133	-	-	1457	-	-	2000	590	40	320	281	1043	550	1593	1	8531
1966	-	-	2369	-	-	-	-	106	-	-	1238	-	-	1791	570	36	387	287	1049	546	1595	1	8380
1967	-	-	2863	-	-	-	-	146	-	-	1463	-	-	1980	883	25	420	449	1233	884	2117	1	10347
1968	-	-	2111	-	-	-	-	162	-	-	1413	-	-	1514	827	20	282	312	1021	557	1578	1	8220
1969	-	-	2202	-	-	-	-	133	-	-	1730	801	582	1383	360	22	377	267	997	958	1955	1	8430
1970	1562	761	2323	-	-	-	-	195	-	-	1787	815	356	1171	448	20	527	297	775	617	1392	1	8161
1971	1482	510	1992	-	-	-	-	204	-	-	1639	771	436	1207	417	18	426	234	719	702	1421	1	7559
1972	1201	558	1759	-	-	32	34	250	200	1604	1804	1064	514	1578	462	18	442	210	1013	714	1727	1	8317
1973	1651	783	2434	-	-	50	12	256	244	1686	1930	1220	506	1726	772	23	450	182	1158	848	2006	2.7	9844
1974	1589	950	2539	-	-	76	13	225	170	1958	2128	1149	484	1633	709	32	383	184	912	716	1628	0.9	9551
1975	1573	912	2485	-	-	76	25	266	274	1942	2216	1038	499	1537	811	26	447	164	1007	614	1621	1.7	9676
1976	1721	785	2506	-	-	66	9	225	109	1452	1561	1063	467	1530	772	20	208	113	522	497	1019	0.8	8030
1977	1883	662	2545	-	-	59	19	230	145	1227	1372	1018	470	1488	497	10	345	110	639	521	1160	2.4	7837
1978	1225	320	1545	-	-	37	20	291	147	1082	1229	668	382	1050	476	10	349	148	781	542	1323	4.1	6482
1979	705	582	1287	-	-	26	10	225	105	922	1027	1150	681	1831	455	12	261	99	598	478	1076	2.5	6312
1980	1763	917	2680	-	-	34	30	249	202	745	947	1352	478	1830	664	17	360	122	851	283	1134	5.5	8073
1981	1619	818	2437	-	-	44	20	163	164	521	685	1189	467	1656	463	26	493	101	834	389	1223	6	7317
1982	1082	716	1798	-	-	54	20	147	63	930	993	985	363	1348	364	25	286	132	596	496	1092	6.4	6265
1983	911	513	1424	-	-	57	16	198	150	1506	1656	957	593	1550	507	28	429	187	672	549	1221	1.3	7274
1984	645	467	1112	-	-	44	25	159	101	728	829	995	628	1623	593	40	345	78	504	509	1013	2.2	5863
1985	540	593	1133	-	-	49	22	217	100	1495	1595	923	638	1561	659	45	361	98	514	399	913	2.1	6655
1986	779	780	1559	28	10	38	28	310	136	1594	1730	1042	556	1598	608	54	430	109	745	526	1271	1.9	7737
1987	951	833	1784	35	14	49	27	222	127	1112	1239	894	491	1385	564	47	302	56	503	419	922	1.2	6598
1988	633	677	1310	26	8	34	32	396	141	1733	1874	656	420	1076	419	40	395	114	501	381	882	0.9	6573
1989	590	549	1139	17	35	52	14	278	132	947	1079	469	436	905	359	29	296	142	464	431	895	1.7	5190
1990	486	425	911	24	35	59	15	426	-	-	586	545	385	930	315	33	338	94	423	201	624	2.4	4333
1991(1)	361	318	679	-	-	69	13	519	-	-	422	538	347	885	215	38	199	55	242	154	396	0.8	3491

S=salmon (2SW or MSW fish). G=grilse (1SW fish). T=S+G. Sm=small. Lg=large.

1. Provisional figures

2. Catch on River Foyle allocated 50% Ireland and 50% N. Ireland.

3. Not including angling catch (mainly grilse).

4. Before 1966, sea trout and sea charr included (5% total).

5. Includes estimates of some local sales and by-catch, some fish in "G" column are non-maturing.

Table 2.2.1 Reported catch of SALMON in numbers and weight in tonnes (round fresh weight). Catches reported for 1991 are provisional. Some countries divide 1SW from MSW salmon based on weight.

Country	Year	1SW		2SW		3SW		4SW		5SW		MSW!		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	1,731
	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	176,145	318	-	-	-	-	-	-	-	-	75,084	361	-	-	251,229	679
Faroe Islands	1982/1983	9,086	-	101,227	-	21,663	-	448	-	29	-	-	-	-	-	132,453	625
	1983/1984	4,791	-	107,199	-	12,469	-	49	-	-	-	-	-	-	-	124,508	651
	1984/1985	324	-	123,510	-	9,690	-	-	-	-	-	-	-	1,653	-	135,776	598
	1985/1986	1,672	-	141,740	-	4,779	-	76	-	-	-	-	-	6,287	-	154,554	545
	1986/1987	76	-	133,078	-	7,070	-	80	-	-	-	-	-	-	-	140,304	539
	1987/1988	5,833	-	55,728	-	3,450	-	0	-	-	-	-	-	-	-	65,011	208
	1988/1989	1,351	-	86,417	-	5,728	-	0	-	-	-	-	-	-	-	93,496	309
	1989/1990	1,560	-	103,407	-	6,463	-	6	-	-	-	-	-	-	-	111,430	364
	1990/1991	631	-	52,420	-	4,390	-	8	-	-	-	-	-	-	-	57,442	202
Finland	1990	13,460	24	-	-	-	-	-	-	-	-	5,240	35	-	-	18,700	59
	1991																
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	1,351	4	-	-	-	-	-	-	-	-	1,296	6	-	-	2,647	10
	1990	1,886	5	2,186	9	146	1	-	-	-	-	-	-	-	-	4,218	15
	1991	1,362	3	1,935	6	190	1	-	-	-	-	-	-	-	-	3,487	13
Iceland	1982	23,026	58	-	-	-	-	-	-	-	-	18,119	89	-	-	41,145	147
	1983	33,769	85	-	-	-	-	-	-	-	-	24,454	113	-	-	58,223	198
	1984	18,901	47	-	-	-	-	-	-	-	-	22,188	112	-	-	41,089	159
	1985	50,000	125	-	-	-	-	-	-	-	-	16,300	94	-	-	66,300	217
	1986	67,300	174	-	-	-	-	-	-	-	-	22,300	136	-	-	89,600	310
	1987	42,550	114	-	-	-	-	-	-	-	-	18,840	108	-	-	61,390	222
	1988	112,000	288	-	-	-	-	-	-	-	-	19,000	108	-	-	133,500	396
	1989	70,817	158	-	-	-	-	-	-	-	-	20,037	115	-	-	90,854	278
	1990	98,241	-	-	-	-	-	-	-	-	-	34,267	-	-	-	132,508	426
	1991	141,062	-	-	-	-	-	-	-	-	-	28,731	-	-	-	169,793	519

cont'd.

Table 2.2.1 (cont'd)

Country	Year	1SW		2SW		3SW		4SW		5SW		MSW!		PS		Total	
		No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt
Ireland	1980	248,333	745	-	-	-	-	-	-	-	-	39,608	202	-	-	287,941	947
	1981	173,667	521	-	-	-	-	-	-	-	-	32,159	164	-	-	205,826	685
	1982	310,000	930	-	-	-	-	-	-	-	-	12,353	63	-	-	322,353	993
	1983	502,000	1,506	-	-	-	-	-	-	-	-	29,411	150	-	-	531,411	1,656
	1984	242,666	728	-	-	-	-	-	-	-	-	19,804	101	-	-	262,470	829
	1985	498,333	1,495	-	-	-	-	-	-	-	-	19,608	100	-	-	517,941	1,595
	1986	498,125	1,594	-	-	-	-	-	-	-	-	28,335	136	-	-	526,450	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	975
	1990	-	-	-	-	-	-	-	-	-	-	-	-	-	-	194,785	586
	1991	-	-	-	-	-	-	-	-	-	-	-	-	-	-	144,374	422
Norway	1981	221,566	467	-	-	-	-	-	-	-	-	213,943	1,189	-	-	435,509	1,656
	1982	163,120	363	-	-	-	-	-	-	-	-	174,229	985	-	-	337,349	1,348
	1983	278,061	593	-	-	-	-	-	-	-	-	171,361	957	-	-	449,442	1,550
	1984	294,365	628	-	-	-	-	-	-	-	-	176,716	995	-	-	471,081	1,623
	1985	299,037	638	-	-	-	-	-	-	-	-	162,403	923	-	-	461,440	1,561
	1986	264,849	556	-	-	-	-	-	-	-	-	191,524	1,042	-	-	456,373	1,598
	1987	235,703	491	-	-	-	-	-	-	-	-	153,554	894	-	-	389,257	1,385
	1988	217,617	420	-	-	-	-	-	-	-	-	120,367	656	-	-	337,984	1,076
	1989	220,170	436	-	-	-	-	-	-	-	-	80,880	469	-	-	301,050	905
	1990	192,500	385	-	-	-	-	-	-	-	-	91,437	545	-	-	286,466	930
	1991	173,500	347	-	-	-	-	-	-	-	-	92,759	538	-	-	266,259	885
Russia	1987	97,242	-	27,135	-	9,539	-	556	-	18	-	-	-	2,521	-	139,011	564
	1988	53,158	-	33,395	-	10,256	-	294	-	25	-	-	-	2,937	-	100,065	419
	1989	78,023	-	23,123	-	4,118	-	26	-	-	-	-	-	2,187	-	107,477	359
	1990	70,595	-	20,633	-	2,919	-	101	-	-	-	-	-	2,010	-	96,258	315
	1991	40,603	-	12,458	-	3,060	-	650	-	-	-	-	-	1,375	-	58,146	215
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	33,000	-	-	-	-	-	-	-	-	-	18,000	-	-	-	51,000	199

Table 2.2.1 (cont'd)

Country	Year	1SW No.	1SW Wt	2SW No.	2SW Wt	3SW No.	3SW Wt	4SW No.	4SW Wt	5SW No.	5SW Wt	MSW! No.	MSW! Wt	PS No.	PS Wt	Total No.	Total Wt
UK	1982	208,061	416	-	-	-	-	-	-	-	-	128,242	596	-	-	336,303	1,092
(Scotland)	1983	209,617	549	-	-	-	-	-	-	-	-	145,961	672	-	-	320,578	1,221
	1984	213,079	509	-	-	-	-	-	-	-	-	107,213	504	-	-	230,292	1,013
	1985	158,012	399	-	-	-	-	-	-	-	-	114,648	514	-	-	272,660	913
	1986	202,861	526	-	-	-	-	-	-	-	-	148,398	745	-	-	351,259	1,271
	1987	164,785	419	-	-	-	-	-	-	-	-	103,994	503	-	-	268,779	922
	1988	149,098	381	-	-	-	-	-	-	-	-	112,162	501	-	-	261,260	882
	1989	174,941	431	-	-	-	-	-	-	-	-	103,886	464	-	-	278,827	895
	1990	68,135	169	-	-	-	-	-	-	-	-	76,650	374	-	-	144,785	543
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	1.6
	1990	52	0.1	562	2.2	12	-	-	-	-	-	-	-	16	-	642	2.3
	1991	48	0.1	185	0.7	1	-	-	-	-	-	-	-	4	-	238	0.8
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	80,589	-	2,772	-	-	-	-	-	-	-	-	-	713	-	84,074	227
	1991	155,098	384	8,144	49	-	-	-	-	-	-	-	-	706	4	163,901	438

!MSW includes all sea ages >1, when this cannot be broken down.

Table 2.3.1 Guess-estimates of unreported catches in tonnes within national EEZs in the North-East and North American Commissions of NASCO. Unreported catches for West Greenland Commission are unavailable.

Year	Unreported catches North-East	North American	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
Mean	2,216	187	2,377

Table 3.2.1.1 Trend analysis of total catches of salmon in home waters for last 30 years.

Country	Time period years	Average catch tonnes	Coeff. var. %	Slope	Corr. Coeff.	Prob. level
		Complete Time Series				
Finland	19	49	29	- 0.48	-0.19	0.43
France	19	20	38	0.14	0.10	0.67
Iceland	31	207	38	6.28	0.73	<0.01
Ireland	31	1,395	31	-5.19	-0.11	0.56
Norway	31	1,546	20	-18.95	-0.56	<0.01
Sweden	31	28	40	0.17	0.13	0.74
Russia	31	588	31	-9.81	-0.49	<0.01
UK (England)	31	358	21	0.99	0.12	0.52
UK (Scotland)	31	1,356	28	-31.52	-0.75	<0.01
UK (N.Ireland)	31	189	53	-7.87	-0.71	<0.01
		Last Fifteen Years				
Finland	15	46	24	-0.01	-0.03	0.99
France	15	20	36	0.43	0.26	0.35
Iceland	15	249	32	8.93	0.49	0.06
Ireland	15	1,231	32	-2.82	-0.03	0.90
Norway	15	1,424	21	-35.58	-0.52	0.04
Russia	15	514	25	-12.20	-0.42	0.11
Sweden	15	29	48	2.35	0.75	<0.01
UK (England)	15	347	21	3.63	0.22	0.42
UK (Scotland)	15	1,049	18	-25.90	-0.63	0.01
UK (N.Ireland)	15	114	27	-1.36	-0.20	0.48

Table 3.2.1.2. Results of the regression analyses of wild smolt counts with year of migration.

Country and river	Time period years	Mean	Coeff. var. %	Slope	Corr. coeff.	Prob. level
IRELAND						
Burrishoole	22	9,328	39	-474	-0.84	<0.01
	10	3,804	55	-529	-0.72	0.01
NORWAY						
Imsa	10	1,152	47	114	0.57	0.05
UK (N. Irl)						
Bush	10	10,694	59	-479	-0.25	0.52
UK (Scot)						
Girnock Burn	25	2,320	29	-22	-0.07	0.23
	10	2,006	33	-60	-0.34	0.57
N. Esk	20	175,350	29	-398	0.25	0.77
	7	180,143	22	3,158	0.21	0.45

Table 3.2.2.1. Results of the regressions of adult counts against year.

	Complete time series						Last 10 years				
River	Time period years	Average count number	Coeff. var. %	Slope	Corr. coeff.	Prob. level	Average count number	Coeff. var. %	Slope	Corr. coeff.	Prob. level
England Severn	12	2,324	57	-98	-0.27	.40	2,059	63	20	0.05	.90
Ireland Burrishoole	22	713	52	-48	-0.70	.00	486	27	-5	-0.13	.72
N. Ireland Bush	19	2,181	38	-40	-0.33	.17	1,923	42	92	0.34	.33
Norway Imsa	10	41	59	3	0.33	.35	41	59	3	0.33	.35
Russia Ponoy	26	21,467	51	525	0.37	.08	24,232	39	948	0.30	.40
Russia Tuloma	40	6,665	43	57	0.23	.15	8,039	28	176	0.24	.51
Scotland Girnock Burn	26	134	52	-2	-0.26	.19	121	61	4	0.17	.64
Scotland North Esk	11	8,472	23	-11	-0.02	.96	8,417	24	22	0.03	.93
Wales Dee	16	3,126	61	6	0.01	.96	3,076	71	59	0.08	.82
Sweden Hogvadsan	38	412	91	17	0.51	.01	865	50	19	0.14	.71

Table 3.2.3.1. Regression analysis of postsmolt-survival with year.

River(1)	Time period years	Average postsmolt survival %	Coeff. var. %	Slope	Corr. coeff.	Prob. level
		POSTSMOLT SURVIVAL ENTIRE SERIES				
Burrishoole Ireland R	11	11.4	61	0.59	0.28	0.39
Bush N.Ireland R	8	11.1	39	-0.46	-0.27	0.52
Imsa Norway R	9	6.7	57	0.15	0.12	0.76
Imsa Norway W	9	13.6	42	-0.32	-0.15	0.69
Lagan Sweden R	25	13.0	24	-0.07	-0.24	0.24
		Last 10 years				
Lagan Sweden R	10	12.1	29	-1.02	-0.79	0.01
		RETURN TO RIVER WHOLE SERIES				
Burrishoole Ireland R	21	2.3	62	0.03	0.13	0.76
Burrishoole Ireland W	21	7.5	37	-0.03	-0.22	0.58
		Last 10 years				
Burrishoole Ireland R	10	2.5	46	0.25	0.67	0.04
Burrishoole Ireland W	10	7.4	38	0.39	0.42	0.22

1. R= reared, W= wild

Table 3.3.1.1. Counts of small salmon from fishways and counting fences in insular Newfoundland 1974-91 by Salmon Fishing Area (SFA); also shown are means, standard deviations (SD), and coefficients of variation (CV).

	Fishways									Counting fences				
	SFA 4			SFA 5			SFA 9	SFA 10	SFA 11	SFA 4	SFA 9			SFA 11
Year	1A	1B	2	3	4	5	6	7	8	9	10	11	12	13
1974	2538		857	770a		162		223						
1975	9218	5531		1119a		778		186a						
1976	3991	2935				335		294						
1977	6148	4300				371								
1978	3790	2704	755	1403	810	436		390						
1979	6715	3925	404a	1350a	569	455		454						
1980		4597	997	1712	843	420		433						
1981	8114a	4264	2459	2414	1115	619		334a						
1982	7605a	2796	1425	1281	963	625		86a					133	
1983		2952a	978	1195	1210	853		233			2330		272	
1984	17219	6300a	1081	1379	1233	904		419			2430	89	359	
1985	16652	5985	1663	904	1557	960		384			1377a	124	170	
1986	9697	3072	1064	1036	1051	726		725	211		2516	158	296	7515
1987	9014	2327	493a	914	974	570	80	325a	155a		1302a	91	368	9687
1988	8974	3433	1562	772	1737	795	313	543	149		1695	97	205a	7118
1989	7192	1694	596	496	1138	668	168	706	175	7743	889a	62	441	4469
1990	6629	1057	328a	745	1149	410a	401	551	208	7520	1657	71	307a	4321
1991	5245	1060	245	562	873	311a	211	353	46a	6445	394	99	218	2086
1974-83														
Mean	5400.0	3881.5	1245.2	1601.0	918.3	505.4		337.8						
SD	2434.5	1001.2	637.1	494.9	230.3	211.3		101.4						
CV	45.08	25.79	51.16	30.91	25.08	41.81		30.02						
N	6	8	6	5	6	10		6						
1984-89														
Mean	11458.0	3302.2	1193.2	916.8	1281.7	770.5	187.0	555.4	178.3		2213.7	103.5	326.8	7197.2
SD	4326.9	1643.5	430.9	291.9	301.3	146.3	117.7	157.8	31.1		451.2	33.2	101.6	2140.8
CV	37.76	49.77	36.11	31.84	23.51	18.99	62.94	28.41	17.44		20.38	32.08	31.09	29.74
N	6	5	5	6	6	6	3	5	3		3	6	5	4

1 Exploits River
   (a) Bishop's Falls
   (b) Gt. Rattling Brook
2 Gander River (Salmon Brook)
3 Middle Brook
4 L. Terra Nova River
5 U. Terra Nova River
6 Rocky River
7 Northeast River (Placentia)
8 Grand Bank Brook
9 Gander River
10 Biscay Bay River
11 Northeast Brook (Trepassey)
12 Colinet River
13 Conne River

a Partial counts: not included in means

Table 3.3.1.2. Counts of large salmon from fishways and counting fences in insular Newfoundland 1974-91 by Salmon Fishing Area (SFA); also shown are means, standard deviations (SD), and coefficients of variation (CV).

	Fishways									Counting fences				
	SFA 4			SFA 5			SFA 9	SFA 10	SFA 11	SFA 4	SFA 9			SFA 11
Year	1A	1B	2	3	4	5	6	7	8	9	10	11	12	13
1974	411		9	77a		121		9						
1975	1439	505		9a		52		36a						
1976	460	117				37		56						
1977	581	271				262								
1978	303	81	52	16	20	89		32						
1979	277	124	6a	54a	170	30		37						
1980		426	15	91	39	17		34						
1981	1695a	514	33	39	90	28		62a						
1982	181a	122	18	20	19	8		36a					116	
1983		302	12	75	57	76		22			88		43	
1984	529	111a	38	57	107	98		44			83	33	97	
1985	183	38	26	27	112	60		0			21a	41	42	
1986	355	174	12	15	140	58		39	4		101	30	31	397
1987	310	41	9a	19	56	38	1	16a	2a		106a	30	55	498
1988	147	10	24	14	206	45	6	11	2		61	19	16a	418
1989	89	14	24	19	142	51	9	15	7	473	104a	18	81	319
1990	122	15	7a	13	144	34a	17	25	15	508	71	9	50a	361
1991	99	40	2	14	114	26a	16	8	7a	670	35	13	18	87
1974-83														
Mean	578.5	270.0	23.2	48.2	65.8	72.0		31.7						
SD	435.7	185.7	16.4	33.4	57.5	75.5		15.7						
CV	75.32	68.78	70.69	69.29	87.39	104.86		49.53						
N	6	8	6	5	6	10		6						
1984-89														
Mean	268.8	55.4	24.8	25.2	127.2	58.3	5.3	21.8	4.3		81.7	28.5	61.2	408.0
SD	161.2	67.7	9.2	16.3	49.6	21 1	4.0	18.9	2.5		20.0	8.7	27.4	73.6
CV	60.31	122.20	37.10	64.68	38.99	36.19	75.47	86.70	58.14		24.48	30.53	44.77	18.04
N	6	5	5	6	6	6	3	5	3		3	6	5	4

1 Exploits River
   (a) Bishop's Falls
   (b) Gt. Rattling Brook
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7 Northeast River (Placentia)
8 Grand Bank Brook
9 Gander River
10 Biscay Bay River
11 Northeast Brook (Trepassey)
12 Colinet River
13 Conne River

a Partial counts: not included in means

Table 3.3.1.3. Counts of wild Atlantic salmon at fences (Western Arm Brook) and fishway traps in Salmon Fishing Areas 14, 20, 21, and 23. Numbers in parentheses indicate number of salmon returning to Western Arm Brook before removals for Torrent River transfer.

Year	SFA 14				SFA 20		SFA 21		SFA 23	
	Western Arm Brook		Torrent		Liscomb		LaHave		Saint John	
	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
1974	299(399)	4	38	3			29	2	3,389	4,775
1975	393(631)	1	191	25			38	5	5,725	6,200
1976	420(520)	0	341	47			178	23	6,797	5,511
1977	341	3	789	33			292	25	3,504	7,247
1978	285	1	971	21			275	67	1,584	3,034
1979	1,578	0	1,984	39	60	0	856	67	6,234	1,993
1980	430	3	792	63	111	0	1,637	288	7,555	8,157
1981	447	1	2,101	97	76	6	1,866	366	4,571	2,441
1982	387	3	2,112	523	252	10	799	256	3,932	2,262
1983	1,141	4	2,007	442	520	15	1,129	213	3,623	1,712
1984	117	0	1,805	288	606	48	2,043	384	7,353	7,011
1985	162	1	1,553	30	507	87	1,343	638	5,331	6,391
1986	252	0	2,815	90	736	117	1,579	584	6,347	3,656
1987	378	1	2,505	68	1,614	88	2,529	532	5,097	3,088
1988	102	1	2,065	41	477	76	2,464	380	8,062	1,930
1989	414	1	1,339	54	532	75	2,087	511	8,417	3,854
1990	124	0	2,296	82	955	44	1,861	596	6,486	3,163
1991	233	1	1,415	73	586	38	495	236	5,415	3,639
Mean 1974-83	616	2	1,133	129	204	6	710	131	4,691	4,333
Mean 1986-90	254	0.6	2,204	67	863	80	2,104	521	6,882	3,138

Table 3.3.1.4 Counts of Atlantic salmon at fishways 1975-91 in areas Q3 and Q7, Quebec.

	Q7		Q3					
	de la Trinité		Matane		Madeleine		Mitis	
Year	Small	Large	Small	Large	Small	Large	Small	Large
1975			943	1487			66	159
1976			1067	1393	115	155	90	165
1977			1189	1078	77	70	83	170
1978			807	2571	56	374	77	133
1979			1540	725	93	57	281	141
1980	1144	156	1466	2102	81	79	193	387
1981	1892	367			313	146	270	151
1982	2173	828			259	317	114	563
1983	891	461			96	167	46	157
1984	1663	421	876	931	74	392	239	236
1985	1008	519	762	1003	156	301	181	378
1986	1364	546	2364	1397	359	439	636	451
1987	1115	514	1018	2290	406	951	225	557
1988	1324	760	692	2086	499	781	477	314
1989	1744	441	1218	923	482	926	338	428
1990	1637	460	1270	1520	452	932	528	282
1991	1306	496	1586	1354	461	671	329	327
Mean								
75-83	1525	453	1169	1559	136	171	136	225
86-90	1437	544	1312	1643	440	806	441	406

Table 3.3.1.5. Estimated numbers of wild returning and spawning Atlantic salmon, egg depositions, ratios of large salmon spawners to returns and fraction of target egg deposition attained in 16 rivers in Atlantic Canada. Empty cells mean no prediction available. Bold numbers are target spawners and eggs.

Year	Returns (10^3) Small	Large	Predicted Large	Spawners (10^3) Small	Large	Eggs (10^6)	Large Spawners/ Large Returns	Eggs/ Target Eggs
Restigouche River - SFA 15								
TARGET				**2.6**	**12.2**	**71.4**		
1982	8.0	11.2		2.0	1.8	10.9	0.16	0.15
1983	3.4	10.2	13.5	0.6	1.4	8.7	0.14	0.12
1984	10.9	7.8	11.3	1.3	3.1	18.6	0.40	0.26
1985	7.0	10.0	12.2	2.5	6.3	37.4	0.63	0.52
1986	10.7	14.1	14.8	3.8	8.8	52.6	0.63	0.74
1987	10.0	10.2	21.9	3.5	5.9	35.0	0.58	0.49
1988	13.5	12.7	12.9	4.7	8.2	49.3	0.65	0.69
1989	6.7	10.6		2.3	6.2	37.1	0.58	0.52
1990[2]	10.2-17.1	10.5-16.4		4.3-10.1	6.3-11.3	37.9-68.0	0.65[5]	0.53-0.95
1991[2]	5.9-9.8	8.6-13.6		2.5-5.9	5.1-9.3	30.4-55.5	0.64[5]	0.43-0.78
Miramichi River[1] - SFA 16								
TARGET				**22.6**	**23.6**	**132.0**		
1982	80.4	30.8		52.0	12.3	109.8	0.40	0.83
1983	25.2	27.9	43.0	10.8	7.5	48.1	0.27	0.36
1984	29.7	15.1	10.2	14.9	13.7	77.0	0.91	0.58
1985	60.8	20.7	18.4	37.8	19.1	130.0	0.92	0.98
1986	117.5	31.3	28.4	85.4	29.2	226.4	0.93	1.72
1987	84.8	19.4	54.2	58.8	17.1	175.9	0.88	1.33
1988	121.9	21.7	36.4	86.3	20.0	189.3	0.92	1.43
1989	75.2	17.2	-	44.4	14.6	124.1	0.84	0.94
1990	83.4	28.6	-	59.5	26.6	191.2	0.93	1.45
1991	60.9	29.9	26.0	45.6	28.1	200.6	0.94	1.52
Saint John River[1] above Mactaquac Dam - SFA 23								
TARGET				3.2	**4.4**	**29.5**		
1982	7.8	6.5		4.9	2.3	16.5	0.35	0.56
1983	5.8	4.0		3.7	1.3	8.5	0.33	0.29
1984	9.8	10.9	6.2	7.2	7.2	39.5	0.66	1.34
1985	8.5	11.3	10.5	4.5	6.3	36.3	0.56	1.23
1986	8.8	6.9	8.8	5.9	3.5	26.1	0.51	0.88
1987	9.2	4.8	11.0	7.0	2.8	19.7	0.58	0.67
1988	10.2	3.5	8.0	7.8	1.7	12.9	0.48	0.44
1989	10.9	4.5	7.1	7.5	3.5	24.7	0.77	0.84
1990	8.8	4.1		6.1	3.2	22.4	0.78	0.76
1991	8.8	5.3		5.7	3.5	24.2	0.66	0.82

Table 3.3.1.5. (Continued)

Year	Returns (10^3) Small	Large	Predicted Large	Spawners (10^3) Small	Large	Eggs (10^6)	Large Spawners/ Large Returns	Eggs/ Target Eggs
LaHave River above Morgan Falls - SFA 21								
TARGET[7]				--	--	--		
1983	1.1	0.2		1.1	0.2	2.0	1.00	
1984	2.0	0.4	0.2[3]	2.0	0.3	3.1	0.75	
1985	1.3	0.6	0.3[3]	1.3	0.4	3.4	0.67	
1986	1.6	0.6	0.4[3]	1.6	0.4	4.1	0.67	
1987	2.5	0.5	0.4[3]	2.5	0.4	4.9	0.80	
1988	2.5	0.4	0.7[3]	2.4	0.3	4.4	0.75	
1989	2.1	0.5		2.1	0.4	4.3	0.80	
1990	1.9	0.4		1.9	0.3	3.3	0.75	
1991	0.5	0.2		0.4	0.2	1.4	0.73	
Margaree River[1] - SFA 18								
TARGET				**0.6**	**1.0**	**6.7**		
1983	0.2	0.5		0.1	0.3	1.8	0.60	0.27
1984	0.4	0.4		0.2	0.3	2.0	0.75	0.30
1985	0.6	0.8		0.4	0.8	5.3	1.00	0.79
1986	0.8	2.0		0.5	2.0	12.9	1.00	1.93
1987	1.5	4.0		1.1	4.0	25.9	1.00	3.87
1988	2.2	1.7		1.6	1.7	11.1	1.00	1.65
1989	0.8	2.3		0.6	2.3	16.9	1.00	2.17
1990	1.0	11.1		0.7	11.1	71.7	1.00	10.7
1991	1.9	3.5		1.5	3.5	21.9	1.00	3.3
Conne River - SFA 11								
TARGET				**4.0**	-	**7.8**		
1986	8.3	0.4		5.4	0.4	11.3	0.65[4]	1.45
1987	10.2	0.5		7.8	0.5	16.7	0.77[4]	2.14
1988	7.6	0.4	7.9.8.8	5.6	0.4	12.4	0.74[4]	1.59
1989	5.0	0.3	6.2-6.8	3.6	0.3	8.0	0.72[4]	1.03
1990	5.4	0.4	6.8-7.9	3.8	0.4	8.7	0.70[4]	1.12
1991	2.4	0.1	4.5-5.3	2.1	0.1	4.0	0.88[4]	0.51

Table 3.3.1.5. (Continued)

Year	Returns (10^3) Small	Large	Predicted Large	Spawners (10^3) Small	Large	Eggs (10^6)	Large Spawners/ Large Returns	Eggs/ Target Eggs
Rivière de la Trinité - SFA Q7								
TARGET				**1.0**	**0.5**	**2.7**		
1982	2.4	0.3		1.6	0.2	1.2	0.66	0.44
1983	0.9	0.5		0.7	0.5	2.5	1.00	0.93
1984	1.8	0.5		1.4	0.4	2.2	0.80	0.81
1985	1.1	0.6		0.9	0.4	2.2	0.67	0.81
1986	1.6	0.6		1.1	0.4	2.3	0.67	0.85
1987	1.3	0.6		0.8	0.4	2.6	0.67	0.96
1988	1.6	0.8		1.0	0.7	4.5	0.88	1.67
1989	1.9	0.5		1.3	0.3	2.3	0.60	0.85
1990	1.9	0.5		1.2	0.4	2.6	0.80	0.96
1991	1.3	0.5		1.0	0.4	2.4	0.77	1.04
Humber River - SFA 13								
TARGET				**18**	**6**	**27.7**		
1987	12.3	0.9		9.2	0.9	16.1		0.58
1988	16.2	1.1		12.1	1.1	12.4		0.77
1989	4.9	0.3		3.7	0.3	2.9		0.23
1990	12.2	0.9		9.2	0.9	16.0		0.58
1991	5.7	0.4		4.3	0.4	7.5		0.27
Gander River - SFA 4								
TARGET				**22**	**-**	**46.2**		
1989	7.7	0.45		6.6	0.45	16.3		0.35
1990	7.7	0.51		6.6	0.51	16.5		0.36
1991	6.7	0.67		5.6	0.67	15.1		0.33
Rocky River - SFA 9								
TARGET				**0.9**	**-**	**3.4**		
1987	0.08			0.2[9]		0.8		0.23
1988	0.3			0.3		1.2		0.36
1989	0.2			0.2		0.7		0.20
1990	0.4			0.4		1.6		0.47
1991	0.2			0.2		0.9		0.26

Table 3.3.1.5. (Continued)

Year	Returns (10^3) Small	Returns (10^3) Large	Returns (10^3) Predicted Large	Spawners (10^3) Small	Spawners (10^3) Large	Eggs (10^6)	Large Spawners/ Large Returns	Eggs/ Target Eggs
Terra Nova River - SFA 5								
TARGET[8]				**7.1**	**-**	**14.3**		
1986	1.5	0.14		1.0	0.14	2.7		0.19
1987	1.4	0.06		0.9	0.06	2.2		0.15
1988	2.1	0.21		1.7	0.21	4.3		0.30
1989	1.4	0.14		1.1	0.14	2.9		0.20
1990	1.5	0.14		1.1	0.14	2.9		0.20
1991	1.1	0.11		0.8	0.11	2.2		0.16
Middle Brook - SFA 5								
TARGET				**1.01**	**-**	**2.34**		
1986	1.0	0.015		0.76	0.015	2.10		0.90
1987	1.1	0.019		0.87	0.019	2.11		0.90
1988	1.3	0.014		0.63	0.014	1.54		0.66
1989	0.6	0.019		0.46	0.019	1.18		0.50
1990	1.1	0.013		0.72	0.013	1.74		0.74
1991	0.8	0.014		0.49	0.014	1.20		0.51
Biscay Bay River - SFA 9								
TARGET				**1.11**	**-**	**2.95**		
1986	2.7	0.10		2.18	0.10	6.14		2.08
1987	1.4	0.11		1.17	0.11	3.52		1.19
1988	1.8	0.06		1.33	0.06	3.74		1.26
1989	1.0	0.10		0.81	0.10	2.56		0.87
1990	1.7	0.07		1.32	0.07	3.78		1.28
1991	0.4	0.04		0.40	0.04	1.16		0.39
Grand River[10] (above fishway) - SFA 19								
TARGET[8]				0.54	-	1.1		
1988	0.70	-		0.74	-	-		1.36[4]
1989	0.60	-		0.45	-	-		0.83[4]
1990	0.62	-		0.44	-	-		0.83[4]
1991	0.44	-		0.35	-	-		0.64[4]
Liscomb River - SFA 19								
TARGET[7]				-	-	-		
1985	0.8	0.14		0.7	0.1	1.74		
1986	1.7	0.22		1.5	0.2	3.52		
1987	2.4	0.14		2.1	0.1	4.25		
1988	1.0	0.12		0.9	0.1	2.06		
1989	0.9	0.15		0.8	0.1	2.02		
1990	1.6	0.07		1.4	0.05	2.67		
1991	0.8	0.06		0.7	0.04	1.58		

Table 3.3.1.5. (Continued)

Year	Returns (10^3) Small	Large	Predicted Large	Spawners (10^3) Small	Large	Eggs (10^6)	Large Spawners/ Large Returns	Eggs/ Target Eggs
Northeast River (Placentia Bay) - SFA 10								
TARGET				0.22	-	0.72		
1986	0.88	0.039			0.65	0.039	2.49	3.46
1987	0.35	0.016			0.32	0.016	1.09	1.52
1988	0.64	0.011			0.45	0.011	1.50	2.09
1989	0.81	0.015			0.60	0.015	2.00	2.77
1990	0.70	0.025			0.53	0.025	1.81	2.51
1991	0.37	0.008			0.35	0.008	1.16	1.61

1 Hatchery and wild origin.
2 Range of estimates provided for Restigouche and Margaree rivers in 1990 and 1991.
3 Prediction does not adjust for increased counts resulting from release of MSW fish from angling.
4 Small salmon spawners/small salmon returns.
5 Mean value
6 Target for the entire river system (including areas under enhancement).
7 No targets determined for acid-stressed rivers.
8 Target for complete river.
9 Incl. a transfer of 124 female spawners to this river.
10 All size groups combined.

Table 4.1.2.1 Nominal landings of Atlantic salmon by Faroes vessels in years 1982-1990 and the seasons 1981/1982 - 1990/1991.

Year	Catch (t)	Season	Catch (t)
1982	606	1981/1982	796
1983	678	1982/1983	625
1984	628	1983/1984	651
1985	566	1984/1985	598
1986	530	1985/1986	545
1987	576	1986/1987	539
1988	243	1987/1988	208
1989	364	1988/1989	309
1990	315	1989/1990	364
1991[1]	95	1990/1991[1]	202

[1]Preliminary catch.

Table 4.1.2.2 Catch in number of salmon by month in the Faroes fishery for the seasons 1983/1984 to 1990/1991.

Season	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
1983/1984	8,680	24,882	12,504	26,396	32,712	12,486	6,849	0	124,508
1984/1985	5,884	20,419	14,493	24,380	26,035	25,471	19,095	0	135,776
1985/1986	1,571	27,611	13,992	50,146	25,968	21,209	14,057	0	154,554
1986/1987	1,881	19,693	5,905	15,113	35,241	21,953	39,153	1,365	140,304
1987/1988	4,259	27,125	5,803	9,387	9,592	4,203	4,642	0	65,011
1988/1989	17,019	24,743	2,916	4,663	12,457	31,698	-	-	93,496
1989/1990	13,079	40,168	5,533	11,282	11,379	29,504	570	-	111,425
1990/1991	6,921	28,972	3,720	7,996	6,275	3,557	-	-	57,442

Table 4.1.2.3 Estimation of discard rates in the Faroes fishery 1982/1983 to 1990/1991.

Season	No. of samples	Number sampled	No. <60cm	Discard rate %	Range %
1982/1983	7	6,820	472	6.9	0 - 10.4
1983/1984	5	4,467	176	3.9	-
1984/1985	12	9,546	1,289	13.5	3 - 32
1985/1986	7	14,654	286	1.8	0.6 - 13.8
1986/1987	13	39,758	2,849	7.2	0 - 71.3
1987/1988	2	1,499	235	15.6	-
1988/1989	9	17,235	1,804	10.7	0.4 - 31.9
1989/1990	5	16,375	1,533	9.4	3.6 - 18.5
1990/1991	3	4,615	681	14.8	9.9 - 17.5

Table 4.1.3.1 Catch of salmon in number per unit effort (1,000 hooks) by month in the Faroes longline fishery south of 65°30'N in the seasons 1981/1982 - 1990/1991.

Season	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Season
1981/1982	-	38	41	49	58	51	34	-	46
1982/1983	19	120	-	61	50	39	36	40	48
1983/1984	85	80	86	58	45	28	26	-	51
1984/1985	38	38	32	32	37	39	40	-	36
1985/1986	64	52	68	54	48	78	61	-	56
1986/1987	31	43	34	44	70	111	102	-	64
1987/1988	56	51	-	47	34	25	22	-	43
1988/1989	63	80	48	68	61	76	-	-	71
1989/1990	81	86	38	56	87	77	-	-	76
1990/1991	81	97	-	35	39	51	-	-	67

Table 4.1.3.2 Catch of salmon in number per unit effort (1,000 hooks) by month in the Faroes longline fishery north of 65°30'N in the seasons 1981/1982 - 1990/1991.

Season	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Season
1981/1982	-		72	69	73	64	65	-	69
1982/1983	-	-	-	-	68	41	-	54[1]	60
1983/1984	102[1]	-	-	-	34[1]	-	-	-	70
1984/1985	-	-	-	46	31	37	43	-	37
1985/1986	-	-	-	-	38[1]	82	84	-	80
1986/1987	-	-	67[1]	64	77	-	94	-	77
1987/1988	48	68	73	71[1]	31[1]	32[1]	-	-	65
1988/1989	-	-	-	-	71[1]	-	-	-	71
1989/1990	-	-	-	-	-	103	-	-	103
1990/1991	-	-	-	-	-	-	-	-	-

[1]Data from less than 6 sets.

Table 4.1.4.1 Percentage sea age distribution of samples by month in the 1990/1991 season determined by fork length method, see text for details.

Month	Sea age			Total
	1	2	3+	
Nov/Dec	1.4	96.4	2.2	100.0
Jan	0	88.4	11.6	100.0
Feb	1.5	81.5	17.0	100.0
Mar	0	77.5	22.5	100.0
Apr	0.5	88.5	11.0	100.0
Weighted mean	1.0	90.7	8.3	100.0

<u>Table 4.1.4.2</u> Catch in number by sea age class by fishing seasons in the Faroes salmon fishery since 1983/1984.

Season	Sea Age								Total
	1	%	2	%	3	%	4	%	
1983/1984	5,142	3	136,418	86	16,401	10	59	0	157,961
1984/1985	381	0	138,375	92	11,358	8	0	0	150,114
1985/1986	2,021	1	169,462	96	5,671	3	87	0	177,241
1986/1987	71	0	124,628	95	6,621	5	75	0	131,395
1987/1988	5,833	9	55,728	86	3,450	5	0	0	65,011
1988/1989	1,351	1	86,417	92	5,728	6	0	0	93,496
1989/1990	1,560	1	103,407	93	6,463	6	0	0	111,430
1990/1991	631	1	52,420	91	4,390	8	0	0	57,442
Total	16,990	2	866,855	92	60,082	6	221	0	944,148

Table 4.1.5.1 Number of microtags recovered at Faroes from European countries.

Season	Country of origin	Discards Recovery	1SW1	2SW	Total
1981/1982	Ireland	1	-	2	3
	UK (Scotland)	-	-	2	2
1982/1983	Ireland	4	2	2	8
	UK (Scotland)	-	-	1	1
1983/1984	UK (Scotland)	-	-	1	1
1984/1985	Iceland	2	-	-	2
	Ireland	15	-	3	18
	UK (Scotland)	3	-	-	3
	Raising Factors	16.4	3.55	3.55	
1985/1986	Ireland	8	-	5	13
	Faroe Islands	-	-	3	3
	UK (England and Wales)	-	-	1	1
	Raising Factors	10.7	3	3	
1986/1987	Faroe Islands	-	-	29	29
	Ireland	8	-	1	9
	UK (England and Wales)	1	-	5	6
	UK (N. Ireland)	4	-		4
	UK (Scotland)	2	-	1	3
	Raising Factors	3.8	3	3	
1987/1988	Faroe Islands	-	-	20	20
	Iceland	-	1	-	1
	Ireland	3	1	4	8
	UK (England and Wales)	1	-	3	4
	Raising Factors	51.4	2.7	2.7	
1988/1989	Canada	1	-	-	1
	Faroe Islands	2	-	-	2
	Iceland	-	-	15	15
	Ireland	17	-	2	19
	UK (England and Wales)	2	1	13	16
	UK (N. Ireland)	-	-	1	1
	UK (Scotland)	2	-	2	4
	USA	-	-	1	1
	Raising Factors	6.1	1.8	1.8	
1989/1990	Faroe Islands	-	-	30	30
	Ireland	14	-	3	17
	UK (England and Wales)	3	1	5	9
	Raising Factors	7.5	2.3	2.3	
1990/1991	Faroe Islands	-	-	2	2
	Iceland	-	-	1	1
	Ireland	3	-	-	3
	UK (England and Wales)	1	-	4	5
	UK (N. Ireland)	1	-	-	1
	UK (Scotland)	1	-	1	2
	Raising Factors	14.6	3.8	3.8	

Table 4.1.5.2 Calculation of the raising factors for the microtag data from the Faroes fishery 1984/85 to 1990/91

YEAR OF FISHERY	NO. TRIPS	A TOTAL SAMPLE	B NO. OF DISCARD	C DISCARD RATE % B/A*100	D TOTAL LANDED	E TOTAL DISCARD C*D/(100-C)	F DISCARD RAISING FACTOR E/B	G TOTAL OBSERVED	H 1SW AND 2SW RAISING FACTOR D/G
1984/85	12	9,546	1,289	13.5	135,776	21,196	16.4	38,276	3.55
1985/86	7	14,654	268	1.8	154,554	2,879	10.7	52,186	2.96
1986/87	13	39,758	2,849	7.2	140,304	10,830	3.8	47,347	2.96
1987/88	2	1,499	235	15.7	65,011	12,087	51.4	24,160	2.69
1988/89	9	17,235	1,804	10.5	93,496	10,930	6.1	51,562	1.81
1989/90	5	16,375	1,533	9.4	111,425	11,509	7.5	48,352	2.30
1990/91	3	4,615	681	14.8	57,442	9,944	14.6	14,902	3.85

Table 4.1.5.3 Estimated numbers of discards, 1SW and 2SW microtagged salmon caught in the Faroese fishery from smolt releases between 1984 and 1990 (year of fishery for 2SW is n+1).

Year of migration yr(n)	Country of origin	Number released	Discards yr(n)	1SW yr(n)	Number in catch All SW yr(n)	2SW yr(n+1)	Total	Rec./rel x 10
1984	Faroe Islands	19,620	-	-	-	9	9	0.46
	Ireland	260,816	246	-	246	15	261	1.00
	N. Iceland	72,352	33	-	33	-	33	0.45
	UK (Engl.+ Wales)	39,780	-	-	-	3	3	0.08
	UK (Scotland)	30,040	49	-	49	-	49	1.64
1985	Faroe Islands	30,079	-	-	-	87	87	2.89
	Ireland	220,000	86	-	86	3	89	0.40
	UK (Engl.+ Wales)	53,347	-	-	-	15	15	0.28
	UK (Scotland)	13,497	-	-	-	3	3	0.22
1986	Faroe Islands	43,000	-	-	-	54	54	1.26
	Ireland	143,866	30	-	30	11	41	0.29
	UK (Engl.+ Wales)	177,071	4	-	4	8	12	0.07
	UK (N. Ireland)	26,320	15	-	15	-	15	0.58
	UK (Scotland)	16,217	8	-	8	-	8	0.47
1987	Ireland	162,189	154	3	157	4	161	0.99
	N. Iceland	27,978	-	3	3	27	30	1.06
	UK (Engl.+ Wales)	195,373	51	-	51	23	75	0.38
	UK (N. Ireland)	20,145	-	-	-	2	2	0.09
	UK (Scotland)	20,876	-	-	-	4	4	0.17
	USA	640,400	-	-	-	2	2	0.00
1988	Canada	13,322	6	-	-	-	6	0.45
	Faroe Islands	43,481	12	-	12	69	81	1.87
	Ireland	165,841	104	-	104	7	111	0.67
	UK (Engl.+ Wales)	189,913	12	2	14	12	26	0.13
	UK (Scotland)	31,331	12	-	12	-	12	0.39
1989	Faroe Islands	26,943	-	-	-	8	8	0.28
	Ireland	185,439	105	-	105	-	105	0.57
	N.Iceland	85,452	-	-	-	4	45	0.04
	UK (Engl. & Wales)	256,342	23	2	25	15	40	0.16
	UK (Scotland)	30,288	-	-	-	4	4	0.13
1990	Ireland	153,821	44	-	44	NA	44	0.28
	UK (Engl. & Wales)	250,024	15	-	15	NA	15	0.06
	UK (N. Ireland)	29,875	15	-	15	NA	15	0.49
	UK (Scotland)	41,390	15	-	15	NA	15	0.35

NA = not available

Table 4.1.6.1 Estimated exploitation rates of 1SW and 2SW salmon in the Faroes fishery. Reporting rates for external tag recoveries assumed to be as follows: Faroese fishery 75%, North Esk area 100%, elsewhere in Scotland 75%, Norwegian home water fisheries 50% and Sweden 65%

Exploitation Rates %

	Norway						Scotland			Sweden	
	R. Drammen		R. Imsa				North Esk			R. Lagan	
	Hatchery		Wild		Hatchery		Wild			Hatchery	
Season	1SW	2SW	1SW	2SW	1SW	2SW	1SW	2SW	3SW	1SW	2SW
1981/1982			0	-	1	-	0	0	0		
1982/1983			0	25	2	38	<1	12	0		
1983/1984			0	50	1	45	0	14	25		
1984/1985	5	-	0	33	2	39	0	8	13	0	
1985/1986	0	30	0	38	0	30	<1	5	0	3	22
1986/1987	0	3	0	13	1	28	0	6	0	2	0
1987/1988	0	6	0	5	1	21	0	0	0	0	9
1988/1989	0	36	0	3	0	10	5	0	0	0	13
1989/1990[1]	0	45	0	5	0	15	3	0	0	1	21
1990/1991	0	24	0	13	0	40	<1	5	0	1	20

[1]Provisional exploitation rate estimates.

Table 4.2.4.1. Origin of catches of salmon in homewater fisheries.
++ = principal component of the catch
+ = other significant contributions
- = occurence

	Catch in Country								
Origin of Catch	Rus	Fin	Nor	Swe	Fr	UK E&W	UK Scot	UK NI	Ire	Ice
Russia	++	-	+							
Finland		++	+							
Norway		+	++	+		-	-		-	
Sweden			+	++						
France					++					
UK (E&W)			-	-	-	++	+	+	+	
UK (Scot)						+	++	+	+	
UK (NI)						-	+	++	+	
Ireland			-	-	-	-	+	+	++	
Iceland			-							++

Table 4.2.4.2 Estimated catches (in tonnes round fresh weight) of wild, farmed and ranched salmon in homewater fisheries in 1991

Country	Catches of salmon			
	Wild	Farmed	Ranched	Total
Finland	68	<1	0	69
France	>12	0	<1	13
Iceland	122	3	394	519
Ireland	<422	+	0	422
Norway	692	26 (FW) 167 (Sea)	0	885
Russia	215	0	0	215
Sweden	23	1	14[1]	38
UK (E&W)	199	0	0	199
UK (NI)	54	<1	0	55
UK (Scot)	384	12	0	396

[1]Fish released for mitigation and not expected to contribute to spawning stocks.

Table 4.2.5.1 Estimated exploitation rates (in %) of salmon in homewater fisheries in Ireland and UK. Reporting rates for external tags shown below.

	Ireland	UK(Engl+Wales)			UK(N.Ireland)				UK(Scotland)	
	Burrishoole HR (all ages)	Itchen Wild all ages		Test	R. Bush Wild	R. Bush W/HR	HR1+	HR2+	North Esk[2] Wild	
Year	1SW	net	rod	rod	1SW	2SW	1SW	1SW	1SW	2SW
1985	82						93	-	23	35
1986	85						82	75	40	29
1987	75				69	46	94	77	29	37
1988	76				65	36	72	57	35	37
1989	82	9	45	29	89	60	92	83	25	26
1990	54	19	49	37	61	38	63	70	37	37
1991(1)	65	-	-	26	65	43	57	46	10	15
Average	74			30	70	45	79	68	28	31

(1) Provisional figures.
(2) In-river netting only.

Reporting rates for external tags:

Faroes 75%

Table 4.2.5.2 Estimated exploitation rates (in %) of salmon in homewater fisheries in Iceland, Norway, Russia, and Sweden. Reporting rates for external tags shown below.

	Iceland	Norway						Sweden		Russia	
	R.Ellidaar wild	R.Drammen HR[2]		R.Imsa Wild		HR[2]		Lagan[3] HR(2+)		R. Ponoy Wild	R. Kola Wild
Year	1SW	1SW	2SW	1SW	2SW	1SW	2SW	1SW	2SW	All sea ages	All sea ages
1985		57	-	73	94	81	100	81		47	77
1986	34	81	50	79	82	78	90	93	82	50	91
1987		64	52	56	95	83	95	78	25	48	87
1988		70	47	51	80	78	91	73	82	77	84
1989	41	40	59	65	74	44	65	76	84	78	84
1990	44	5	40	60	42	52	68	80	82	50	80
1991[1]	37	64	70	41	74	54	69	90	92	20	58
Average	39	57	53	62	77	67	83	82	81	53	80

[1]Provisional figures.
[2]HR in R. Drammen and R. Ims are pooled groups of 1+ and 2+ smolts.
[3]Assuming 50% exploitation in the river brood stock fishery

Reporting rates for external tags:

Faroes 75%
Norwegian net fisheries 50%
Sweden 65%

Table 4.2.6.1 Nominal catches in Norwegian homewaters 1982-1991 (t round weight) broken down to drift net fishery, marine fishery excluding drift nets (other nets) and freshwater fishery and the proportion of the total catch taken in freshwater.

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Drift nets	590	826	866	667	795	552	527	0	0	0
Other nets	469	418	458	572	497	461	314	488	514	471
Freshwater	289	306	299	322	306	372	235	417	416	414
Proportion in freshwater	0.21	0.20	0.18	0.21	0.19	0.27	0.22	0.46	0.45	0.47
Total	1,348	1,550	1,623	1,561	1,598	1,385	1,076	905	930	885

* Provisional data

Table 4.2.6.2 Exploitation in Norwegian fisheries of 1SW salmon from the River Lagan (Sweden).The estimates are based on 75% and 50% tag reporting rates in the Norwegian Sea and Norwegian homewaters, respectively.

Year of fishery	1SW
1985	5%
1986	6%
1987	5%
1988	11%
1989	0%
1990	2%
1991	1%

Table 4.2.6.3 Frequency of net marks on Atlantic salmon in 10 Norwegian rivers sampled during 1978-1988 and in 1990-1991 (unweighted mean).

River %	1978-1988				1990-1991			
	Number of sampling years	Total number of fish examined	Net marks %	Range %	Number of sampling years	Number of fish examined	Net marks %	Range
R. Rupperfjord	7	4,812	29	18-45	1	165	29	-
R. Malselv	9	2,590	44	12-75	2	319	29	26-31
R. Vefsna	8	2,220	33	16-58	1	102	12	-
R. Namsen	9	4,036	25	12-36	2	367	10	4-15
R. Stjordal	4	889	43	32-63	2	237	15	6-24
R. Orkla	2	132	71	66-76	1	73	19	-
R. Orsta	7	2,094	73	48-90	1	138	20	17-23
R. Gaular	5	1,522	37	23-56	2	241	22	16-27
R. Etne	7	3,883	36	27-52	1	61	8	-
R. Suldal	7	1,025	18	8-43	2	505	2	1-3
R. Imsa	11	2,886	16	6-47	2	1,007	5	4-5
R. Figgjo	4	950	24	12-38	2	381	13	9-16

Table 5.1.1 Nominal catches at West Greenland, 1960-1991 (in tonnes, round fish weight).

Year	Norway	Faroes	Sweden	Denmark	Greenland[5]	Total	Quota
1960	-	-	-	-	60	60	-
1961	-	-	-	-	127	127	-
1962	-	-	-	-	244	244	-
1963	-	-	-	-	466	466	-
1964	-	-	-	-	1,539	1,539	-
1965	-[1]	36	-	-	825	861	-
1966	32	87	-	-	1,251	1,370	-
1967	78	155	-	85	1,283	1,601	-
1968	138	134	4	272	579	1,127	-
1969	250	215	30	355	1,360	2,210	-
1970	270	259	8	358	1,244	2,146[3]	-
1971	340	255	-	645	1,449	2,689	-
1972	158	144	-	401	1,410	2,113	-
1973	200	171	-	385	1,585	2,341	-
1974	140	110	-	505	1,162	1,917	-
1975	217	260	-	382	1,171	2,030	-
1976	-	-	-	-	1,175	1,175	1,190
1977	-	-	-	-	1,420	1,420	1,190
1978	-	-	-	-	984	984	1,190
1979	-	-	-	-	1,395	1,395	1,190
1980	-	-	-	-	1,194	1,194	1,190
1981	-	-	-	-	1,264	1,264	1,265[5]
1982	-	-	-	-	1,077	1,077	1,253[5]
1983	-	-	-	-	310	310	1,190
1984	-	-	-	-	297	297	870
1985	-	-	-	-	864	864	852
1986	-	-	-	-	960	960	909
1987	-	-	-	-	966	966	935
1988	-	-	-	-	893	893	-
1989	-	-	-	-	337	337	900
1990	-	-	-	-	227	227	924
1991	-	-	- -	-	437	437[2]	840

[1] Figures not available, but catch is known to be less than the Faroese catch.
[2] Provisional.
[3] Including 7 t caught on longline by one of two Greenland vessels in the Labrador Sea early in 1970.
[4] For Greenlandic 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-Greenlandic catches from 1969-1984 were taken with drift nets.
[5] Quota corresponding to specific opening dates of the fishery.

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 5.1.2 Distribution of nominal catches (tonnes) taken by Greenland vessels in 1977-1991 by NAFO divisions according to place where landed.

Div.	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991[1]
1A	201	81	120	52	105	111	14	33	85	46	48	24	9	3	22
1B	393	349	343	275	403	330	77	116	124	73	114	100	28	18	21
1C	336	245	524	404	348	239	93	64	198	128	229	213	81	99	109
1D	207	186	213	231	203	136	41	4	207	203	205	191	73	44	31
1E	237	113	164	158	153	167	55	43	147	233	261	198	75	34	106
1F	46	10	31	74	32	76	30	32	103	277	109	167	71	29	148
1NK	-	-	-	-	20	18	-	5	-	-	-	-	-	-	-
Total	1,420	984	1,395	1,194	1,264	1,077	310	297	864	960	966	893	337	227	437
East Greenl.	6	8	+	+	+	+	+	+	7	19	+	4	-	-	4
Total	1,426	992	1,395	1,194	1,264	1,077	310	297	871	979	966	897	337	227	441

[1] Provisional figures.
+ Small catch <0.5 t.
- No catch.

Table 5.1.1.1. Percentage (by number) of North American and European salmon in research vessel catches at West Greenland (1969-1982) and from commercial samples (1978-1991).

Source	Year	Sample size		Continent of origin (%)			
		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	(74,57)
	1971	247	247	34	(40,28)	66	(72,50)
	1972	3,488	3,488	36	(37,34)	64	(66,63)
	1973	102	102	49	(59,39)	51	(61,41)
	1974	834	834	43	(46,39)	57	(61,54)
	1975	528	528	44	(48,40)	56	(60,52)
	1976	420	420	43	(48,38)	57	(62,52)
	1977	-	-	-	(-)	-	(-)
	1978[2]	606	606	39	(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)
	1981	-	-	-	(-)	-	(-)
	1982	443	443	47	(52,43)	53	(58,48)
Commercial	1978	392	392	52	(57,47)	48	(53,43)
	1979	1,653	1,653	50	(52,48)	50	(52,48)
	1980	978	978	48	(51,45)	52	(55,49)
	1981	4,570	1,930	59	(61,58)	41	(42,39)
	1982	1,949	414	62	(64,60)	38	(40,36)
	1983	4,896	1,815	40	(41,38)	60	(62,59)
	1984	7,282	2,720	50	(53,47)	50	(53,47)
	1985	13,272	2,917	50	(53,46)	50	(54,47)
	1986	20,394	3,509	57	(66,48)	43	(52,34)
	1987	13,425	2,960	59	(63,54)	41	(46,37)
	1988	11,047	2,562	43	(49,38)	57	(62,51)
	1989	9,366	2,227	56	(60,52)	44	(48,40)
	1990	4,897	1,208	75	(79,70)	25	(30,21)
	1991	5,011	1,347	65	(69,61)	35	(39,31)

[1]CI - Confidence Interval calculated by method of Pella and Robertson (1989) for 1984-1986 and by binominal distribution for the others)
[2]During fishery.
[3]Research samples after fishery closed.

Table 5.1.1.2. The numbers of North American and European Atlantic salmon caught at West Greenland from 1982 to 1991. Number are rounded to the nearest hundred fish.

Year	Numbers of Salmon Caught NA	E
1982	192,200	143,800
1983	39,500	60,500
1984	48,800	42,200
1985	143,500	161,500
1986	188,300	131,900
1987	171,900	126,400
1988	125,500	168,800
1989	65,000	52,700
1990	62,400	21,700
1991	103,000	60,900

Table 5.1.1.3 The number and percentage of fin-clipped and microtagged Atlantic salmon observed during the sampling programme at West Greenland in 1991.

SAMPLING SITE (sampling period)	NAFO DIV.	NO. SALMON EXAMINED Weight category				NO. AFC's OBSERVED Weight category				% AFC'S	NO.CWT's RECOVERED Weight category				% CWT's	% AFC's with CWT's	No.untagged AFC Fish	% untagged
		<3 Kg	3-5 Kg	>5 Kg	Total	<3 Kg	3-5 Kg	>5 Kg	Total		<3 Kg	3-5 Kg	>5 Kg	Total				
MANIITSOQ (10-28 Aug)	1C	3688	131	52	3871	67	5	0	72	1.86	17	1	0	18	0.46	25.0	54	1.39
NUUK (14-23 Aug)	1D	2232	64	28	2324	29	1	0	30	1.29	12	0	0	12	0.52	40.0	18	0.77
PAAMIUT (13-25 Aug)	1E	983	34	17	1162	16	1	0	19	1.64	6	1	0	7	0.60	36.8	12	1.03
TOTAL		6903	229	97	7357	112	7	0	121	1.64	35	2	0	37	0.50	30.6	84	1.14
%		95.49	3.17	1.34		94.12	5.88	0			94.59	5.41	0					

AFC = Adipose fin clip.
CWT = Coded wire microtag.

Table 5.1.1.4 Distributions of recaptures and recovery rates (per 1000 fish examined) of microtagged salmon from Europe and N.America caught in the West Greenland fishery, 1986-1991

SCANNING YEAR	No. Scanned by NAFO Division					
	1A	1B	1C	1D	1E	1F
1986	-	7308	-	10120	7361	5571
1987	-	6073	-	9263	6139	3572
1988	522	7410	-	9884	2523	2258
1989	-	3654	-	7591	4343	-
1990	-	-	1156	3827	1427	-
1991	-	-	3871	2324	1162	-

N.AMERICAN RECOVERIES

	TOT. RECS	No. Recovs by NAFO Division					
		1A	1B	1C	1D	1E	1F
1986	26	-	10	-	11	4	1
1987	103	-	33	-	43	11	16
1988	81	2	25	-	40	12	2
1989	72	-	31	-	34	7	-
1990	46	-	-	16	29	1	-
1991	28	-	-	14	9	5	-

	Recovery rate (per 1000 fish)					
	1A	1B	1C	1D	1E	1F
1986	-	1.4	-	1.1	0.5	0.2
1987	-	5.4	-	4.6	1.8	4.5
1988	3.8	3.4	-	4.0	4.8	0.9
1989	-	8.5	-	4.5	1.6	-
1990	-	-	13.8	7.6	0.7	-
1991	-	-	3.6	3.9	4.3	-

EUROPEAN RECOVERIES

	TOT. RECS	No. Recovs by NAFO Division					
		1A	1B	1C	1D	1E	1F
1986	22	-	9	-	10	3	0
1987	43	-	13	-	18	7	5
1988	29	1	10	-	11	6	1
1989	27	-	10	-	10	7	-
1990	8	-	-	1	3	4	-
1991	6	-	-	3	1	2	-

	Recovery rate (per 1000 fish)					
	1A	1B	1C	1D	1E	1F
1986	-	1.2	-	1.0	0.4	0.0
1987	-	2.1	-	1.9	1.1	1.4
1988	1.9	1.3	-	1.1	2.4	0.4
1989	-	2.7	-	1.3	1.6	-
1990	-	-	0.9	0.8	2.8	-
1991	-	-	0.8	0.4	1.7	-

A dash represents no scanning undertaken.

Table 5.1.1.5 Mean lengths, weights and distributions of recaptures at West Greenland in1991 of microtagged salmon from different release areas. Recovery rates per 1000 fish examined are also given in parenthesis for each NAFO division.

COUNTRY	RELEASE SITE	NUMBER RELEASED	RELEASE STAGE	TOT. NO. RECOVS.	RECOVS. BY NAFO DIV. 1C	1D	1E
USA	Connecticut R.		HS	4	2	2	0
	Penobscot R.		HS	19	10	6	3
	Merrimack R.		HS	3	2	0	1
	Total	875,306	HS	26	14	8	4
	Recovery rate			3.5	3.6	3.4	3.4
CANADA	Nepisiguit R.		HS	1	0	1	0
	Stewart Brook, N.B.		HS	1	0	0	1
	Total	74,329 30,384	HS WS	2	0	1	1
	Recovery rate			0.3	0	0.4	0.9
IRELAND	Castleconnell R.		HS	1	1	0	0
	R. Lee		HS	1	0	0	1
	Total	151,469 16,789	HS WS	2	1	0	1
	Recovery rate			0.3	0.3	0	0.9
ENGLAND & WALES	R. Wear		WS	2	1	1	0
	R. Taff		HS	1	0	1	0
	Total	241,361 8,663	HS/HP WS	3	1	2	0
	Recovery rate			0.4	0.3	0.9	0
ICELAND	Hraunsfjordur		HS	1	0	1	0
	Bruara		HS	1	1	0	0
	Total	405,305 6,000	HS WS	2	1	1	0
	Recovery rate			0.3	0.3	0.4	0
SCOTLAND	Girnock Burn	33,460 7,930	HS WS	1	0	0	1
	Recovery rate			0.1	0	0	0.9
N.IRELAND	R.Bush	27,076 2,799	HP WS	1	1	0	0
	Recovery rate			0.1	0.3	0	0

KEY: '90 HS = 1990 Hatchery smolt release.
'90 WS = 1990 Wild smolt release.
'90 HP = 1990 Hatchery parr release.

Table 5.1.1.6 Summary of input data for harvest calculations: Releases by smolt age for Maine and Canada.

Release Year	Maine Rivers 1-YR (U1)	Maine Rivers 2-YR (U2)	Ratio Total: 1-YR	Smolt Multiplier f1*f2	Canada 1-Yr (C1)
1975	15758	153577	10.75	3.809	28700
1976	60229	242468	5.03	1.980	92636
1977	128885	245608	2.91	1.403	138000
1978	168033	135014	1.80	1.007	132900
1979	98693	272585	3.76	2.342	59800
1980	399903	282001	1.71	1.295	126300
1981	24695	232348	10.41	2.098	97800
1982	135007	259674	2.92	1.525	123700
1983	367605	170277	1.46	0.916	219200
1984	657722	137203	1.21	0.871	254800
1985	612548	108598	1.18	0.838	247400
1986	723400	55000	1.08	0.661	452800
1987	637536	82759	1.13	0.662	449300
1988	850900	87100	1.10	0.708	472500
1989	524300	80200	1.15	0.571	533954
1990	644100	33100	1.05	0.537	617353

*Canadian smolt releases adjusted to include estimated "smolts" that contribute to West Greenland.

Table 5.1.1.7 Summary of input data for harvest calculations: Mean weights, landings,proportion North American stock, and the fraction of river age 1 harvest in Greenland.

YEAR i	Grld CATCH mt Q	Mean Weight (kg) W	Std Dev Weight (kg) $SD(W)$	Prop. NA Origin p_{na}	Sample Size for Prop. n	Number of NA 1-yr in sample n_1	Harvest Estimates - Grld no. C	Harvest Estimates - North American Total $p_{na}C$
1976	1175	3.04	0.98	0.44	275	1	386513	170066
1977	1420	3.21	0.96	0.43	576	2	442023	190070
1978	984	3.35	0.88	0.45	449	12	293731	132546
1979	1395	3.34	1.19	0.45	1358	57	417665	187949
1980	1194	3.22	0.88	0.53	1111	65	370807	194674
1981	1264	3.17	0.89	0.48	1109	39	398738	189401
1982	1077	3.11	0.96	0.57	446	6	346302	197392
1983	310	3.10	0.98	0.40	779	24	100000	40000
1984	297	3.11	1.14	0.54	1368	66	95498	51569
1985	864	2.87	0.86	0.47	1410	72	301045	141491
1986	960	3.03	0.85	0.59	1786	36	316832	186931
1987	966	3.16	0.74	0.59	1714	69	305696	180361
1988	893	3.18	0.77	0.40	1025	53	280818	112327
1989	337	2.87	0.89	0.56	1025	80	117422	65756
1990	227	2.69	0.83	0.75	1025	90	84387	63290
1991	440	2.65	0.92	0.65	771	40	166038	107925

Table 5.1.1.8. Harvest estimates in numbers of Maine salmon in West Greenland using the proportional harves model. Estimates include a non-catch fishing mortality rate of 0.2.

Year	Total NA 1-Yr	Total Maine RA 1+2	Std Err	Mean-2SE	Mean+2SE	100 SE/Mean
1976	1,237	5,889	3,130	-371	12,149	53.15
1977	3,820	9,456	1,345	6,766	12,146	14.22
1978	3,542	6,213	861	4,492	7,935	13.85
1979	7,889	9,930	430	9,070	10,790	4.33
1980	11,390	33,351	1,305	30,741	35,961	3.91
1981	6,661	10,789	618	9,553	12,026	5.73
1982	2,656	6,965	1,623	3,719	10,212	23.31
1983	1,232	2,350	194	1,962	2,738	8.25
1984	2,488	2,851	111	2,629	3,073	3.89
1985	7,225	7,867	286	7,296	8,439	3.63
1986	3,768	3,950	240	3,469	4,430	6.08
1987	7,261	6,006	224	5,558	6,455	3.73
1988	5,808	4,812	219	4,374	5,249	4.55
1989	5,132	4,547	153	4,241	4,853	3.37
1990	5,557	3,968	123	3,722	4,214	3.10
1991	5,599	3,757	212	3,333	4,182	5.65

Table 5.1.2.1 Annual mean fork lengths and whole weights of Atlantic salmon caught at West Greenland, 1969-1991. Fork length (cm); whole weight (kg). NA = North American; E = European.

Year	Whole weight (kg)									Fork length (cm)					
	Sea age									Sea age					
	1SW		2SW		PS		Total		Total	1SW		2SW		PS	
	NA	E	NA	E	NA	E	NA	E		NA	E	NA	E	NA	E
1969	3.12	3.76	5.48	5.80	-	5.13	3.25	3.86	3.58	65.0	68.7	77.0	80.3	-	75.3
1970	2.85	3.46	5.65	5.50	4.85	3.80	3.06	3.53	3.28	64.7	68.6	81.5	82.0	78.0	75.0
1971	2.65	3.38	4.30	-	-	-	2.68	3.38	3.14	62.8	67.7	72.0	-	-	-
1972	2.96	3.46	5.85	6.13	2.65	4.00	3.25	3.55	3.44	64.2	67.9	80.7	82.4	61.5	69.0
1973	3.28	4.54	9.47	10.00	-	-	3.83	4.66	4.18	64.5	70.4	88.0	96.0	61.5	-
1974	3.12	3.81	7.06	8.06	3.42	-	3.22	3.86	3.58	64.1	68.1	82.8	87.4	66.0	-
1975	2.58	3.42	6.12	6.23	2.60	4.80	2.65	3.48	3.12	61.7	67.5	80.6	82.2	66.0	75.0
1976	2.55	3.21	6.16	7.20	3.55	3.57	2.75	3.24	3.04	61.3	65.9	80.7	87.5	72.0	70.7
1977	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1978	2.96	3.50	7.00	7.90	2.45	6.60	3.04	3.53	3.35	63.7	67.3	83.6	-	60.8	85.0
1979	2.98	3.50	7.06	7.60	3.92	6.33	3.12	3.56	3.34	63.4	66.7	81.6	85.3	61.9	82.0
1980	2.98	3.33	6.82	6.73	3.55	3.90	3.07	3.38	3.22	64.0	66.3	82.9	83.0	67.0	70.9
1981	2.77	3.48	6.93	7.42	4.12	3.65	2.89	3.58	3.17	62.3	66.7	82.8	84.5	72.5	-
1982	2.79	3.21	5.59	5.59	3.96	5.66	2.92	3.43	3.11	62.7	66.2	78.4	77.8	71.4	80.9
1983	2.54	3.01	5.79	5.86	3.37	3.55	3.02	3.14	3.10	61.5	65.4	81.1	81.5	68.2	70.5
1984	2.64	2.84	5.84	5.77	3.62	5.78	3.20	3.03	3.11	62.3	63.9	80.7	80.0	69.8	79.5
1985	2.50	2.89	5.42	5.45	5.20	4.97	2.72	3.01	2.87	61.2	64.3	78.9	78.6	79.1	77.0
1986	2.75	3.13	6.44	6.08	3.32	4.37	2.89	3.19	3.03	62.8	65.1	80.7	79.8	66.5	73.4
1987	3.00	3.20	6.36	5.96	4.69	4.70	3.10	3.26	3.16	64.2	65.6	81.2	79.6	74.8	74.8
1988	2.83	3.36	6.77	6.78	4.75	4.64	2.93	3.41	3.18	63.0	66.6	82.1	82.4	74.7	73.8
1989	2.56	2.86	5.87	5.77	4.23	5.83	2.77	2.99	2.87	62.3	64.5	80.8	81.0	73.8	82.2
1990	2.53	2.61	6.47	5.78	3.90	5.09	2.67	2.72	2.64	62.3	62.7	83.4	81.1	72.6	78.6
1991	2.42	2.54	5.82	6.23	5.15	5.09	2.57	2.79	2.65	61.6	62.7	80.6	82.2	81.7	80.0

Table 5.1.2.2 Sea age composition (%) from research vessel and commercial catch samples of Atlantic salmon at West Greenland, 1969-1991.

Year	Type	1SW	MSW	PS
1969	Research	93.8	4.9	1.3
1970	Research	93.8	4.1	2.1
1971	Research	99.2	0.4	0.4
1972	Research	94.1	5.6	0.3
1973	Research	93.8	4.4	1.8
1974	Research	97.7	1.7	0.6
1975	Research	97.6	2.0	0.4
1976	Research	95.7	2.6	1.7
1977	No observations	-	-	-
1978	Research	96.9	1.1	1.1
1979	Commercial	96.6	2.1	1.3
	Research	96.7	1.8	1.5
1980	Commercial	97.5	2.2	0.3
	Research	98.4	1.1	0.5
1981	Commercial	97.0	2.5	0.6
1982	Commercial	93.6	6.0	0.5
	Research	95.3	2.4	2.2
1983	Commercial	90.5	8.1	1.4
1984	Commercial	87.6	11.6	0.7
1985	Commercial	93.8	5.9	0.3
1986	Commercial	96.2	3.0	0.8
1987	Commercial	97.0	2.0	1.0
1988	Commercial	97.4	1.7	0.9
1989	Commercial	93.8	4.6	1.6
1990	Commercial	95.9	3.2	0.9
1991	Commercial	94.7	4.9	0.3

Table 5.1.2.3 The sea age composition of samples from commercial catches at West Greenland, 1985-1991.

Year	Sea age composition (%)					
	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	6.4	0.2

Table 5.1.2.4 River age distribution (%) for all North American and European origin salmon sampled at West Greenland, 1968-1991.

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	4.0	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
Total	4.1	38.6	35.1	15.3	5.8	1.0	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	64.5	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	0.1	0.1	0.2
1983	34.7	50.2	12.3	2.4	0.3	0.2	0.0	0.0
1984	22.7	56.9	15.2	4.2	0.9	0.0	0.0	0.0
1985	20.2	61.6	14.9	2.7	0.6	0.0	0.1	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	0.1	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	0.0	0.0	0.0
1991	20.9	47.4	26.3	4.2	1.2	0.0	0.0	0.0
Total	20.7	61.3	15.3	2.4	0.3	0.0	0.0	0.0

Table 5.1.3.1 Estimated Carlin tag recoveries and run size in Maine rivers. Ratio of tag to run size of 2SW salmon in homewaters. Ratio (year i) for use in estimation of distant water harvest (year i-1).

Year	Tags	Run	RATIO
1967	0	1019	0.0000
1968	168	729	0.2307
1969	7	690	0.0104
1970	13	856	0.0155
1971	68	687	0.0985
1972	318	1449	0.2197
1973	206	1448	0.1425
1974	215	1411	0.1520
1975	450	2345	0.1920
1976	184	1341	0.1374
1977	97	2025	0.0478
1978	97	4145	0.0233
1979	36	1878	0.0190
1980	0	5662	0.0000
1981	470	5122	0.0918
1982	284	6023	0.0472
1983	138	1930	0.0716
1984	61	3045	0.0202
1985	185	4855	0.0381
1986	309	5568	0.0555
1987	119	2397	0.0498
1988	319	2855	0.1118
1989	190	2946	0.0646
1990	172	4370	0.0393
1991	29	2057	0.0138

Table 5.1.3.2. Carlin tag returns from 1SW salmon of Maine origin in West Greenland by year and NAFO division. (99 = NAFO division unknown)

YEAR	1A	1B	1C	1D	1E	1F	99	TOTAL
1967	1	10	10	8	3	2	3	37
1969	0	1	3	0	1	0	1	6
1970	10	14	6	7	12	2	7	58
1971	29	34	50	57	58	60	94	382
1972	5	4	35	6	15	5	12	82
1973	5	28	25	16	13	12	32	131
1974	8	75	95	79	32	20	48	357
1975	10	22	16	5	1	3	70	127
1976	13	11	9	3	0	0	3	39
1977	0	1	6	0	1	2	1	11
1978	0	5	2	0	0	0	2	9
1980	0	37	20	9	0	0	6	72
1981	0	17	5	0	0	0	18	40
1982	1	42	1	1	0	2	2	49
1983	0	1	6	0	0	0	0	7
1984	1	9	9	0	1	3	0	23
1985	4	25	7	8	0	5	9	58
1986	1	10	15	17	11	18	0	72
1987	2	30	52	43	29	10	0	166
1988	1	29	24	28	20	4	0	106
1989	4	14	44	22	14	8	0	106
1990	1	2	6	4	2	0	0	15
1991	0	1	10	1	0	1	0	13
Unk	2	16	39	8	14	3	5	87
TOTAL	98	438	495	322	227	160	313	2053

Table 5.1.3.3. Estimated harvest of 1SW salmon of Maine origin in West Greenland by year and NAFO division. (99 = NAFO division unknown)

YEAR	1A	1B	1C	1D	1E	1F	99	TOTAL
1967	6	61	61	49	18	12	18	226
1969	0	91	273	0	91	0	91	545
1970	143	200	86	100	171	29	100	828
1971	186	218	320	365	371	384	602	2446
1972	49	39	345	59	148	49	118	809
1973	46	259	231	148	120	111	296	1212
1974	59	549	696	579	234	147	352	2615
1975	102	225	164	51	10	31	716	1299
1976	510	431	353	118	0	0	118	1529
1977	0	81	483	0	81	161	81	886
1978	0	592	237	0	0	0	237	1066
1980	0	1134	613	276	0	0	184	2207
1981	0	811	238	0	0	0	858	1908
1982	26	1100	26	26	0	52	52	1283
1983	0	70	418	0	0	0	0	488
1984	37	332	332	0	37	111	0	849
1985	101	633	177	203	0	127	228	1469
1986	28	283	424	480	311	509	0	2035
1987	25	377	654	541	365	126	0	2087
1988	22	632	523	610	436	87	0	2309
1989	143	501	1576	788	501	287	0	3797
1990	102	203	610	407	203	0	0	1525
TOTAL	1585	8823	8841	4799	3098	2221	4051	33418

Table 5.1.3.4. The estimated number of CWTs and total number of fish in the 2SW run, and the RATIO used to raise tag recoveries to harvest estimates.

	Maine			Merrimack			Connecticut		
Year	CWT	Run	RATIO	CWT	Run	RATIO	CWT	Run	RATIO
1988	603	2855	0.211	13	54	0.241	93	94	0.989
1989	634	2946	0.215	3	79	0.038	58	106	0.547
1990	456	4370	0.104	110	219	0.502	226	262	0.863
1991	438	2057	0.213	69	329	0.210	153	202	0.757

Table 5.1.3.5. CWT harvest estimates for USA stocks. Harvest is in numbers and CV is coefficient of variation.

	MAINE		MERRIMACK		CONNECTICUT	
YEAR	HARVEST	CV	HARVEST	CV	HARVEST	CV
1987	5571	10	51	51	51	69
1988	3882	13			76	55
1989	2857	13	243	21	115	22
1990	1613	26	1070	35	231	39

Table 5.1.4.1. Distributions of recovery rates (per 1000 fish examined) of microtagged salmon from different countries caught in the West Greenland fishery, 1986-1991.

		TOTAL	RECOVERY RATE (PER 1000 FISH)					
COUNTRY	YEAR	TAGS	1A	1B	1C	1D	1E	1F
USA	1986	7		0.8		0.1	0.0	0.0
	1987	82		4.3		3.8	1.1	3.9
	1988	58	1.9	2.5		3.0	2.1	1.1
	1989	70		8.5		4.3	1.4	
	1990	37			10.4	6.3	0.7	
	1991	26			3.6	3.4	3.4	
CANADA	1986	19		0.5		1.0	0.5	0.2
	1987	21		1.2		0.9	0.7	0.6
	1988	23	1.9	1.0		1.0	1.0	1.1
	1989	2		0.0		0.1	0.2	
	1990	9			3.5	1.3	0.0	
	1991	2			0.0	0.4	0.9	
IRELAND	1986	18		1.1		0.8	0.3	0.0
	1987	24		1.0		1.0	1.0	0.8
	1988	17	1.9	0.8		0.7	0.5	1.1
	1989	12		1.6		0.7	0.2	
	1990	3			0.9	0.3	0.7	
	1991	2			0.3	0.0	0.9	
ENGLAND &WALES	1986	22		0.8		1.1	0.1	0.7
	1987	17		1.2		0.9	0.0	0.6
	1988	8	0.0	0.3		0.2	1.0	0.0
	1989	12		0.5		0.5	1.4	
	1990	2			0.0	0.3	0.7	
	1991	3			0.3	0.9	0.0	
SCOTLAND	1986	2		0.0		0.2	0.0	0.0
	1987	2		0.0		0.1	0.2	0.0
	1988	1	0.0	0.1		0.0	0.0	0.0
	1989	2		0.3		0.1	0.0	
	1991	1			0.0	0.0	0.9	
ICELAND	1986	2		0.1		0.0	0.1	0.0
	1988	3	0.0	0.1		0.2	0.0	0.0
	1990	3			0.0	0.3	1.4	
	1991	2			0.3	0.4	0.0	
N.IRELAND	1989	1		0.3		0.0	0.0	
	1991	1			0.3	0.0	0.0	

Notes: Empty cells represent no scanning.

Years in which no tags were recovered from a particular country were not included.

Table 5.1.4.2 Trend analysis for North American proportions at Greenland

	TEMPORAL			SPATIAL		
Year	NAFO Div	R squared	Sig.	NAFO Div	Z-Value	Sig.
1990	1B	0.87	NS	1C vs 1D	-0.02	NS
	1D	0.29	NS	1C vs 1E	-5.19	< 0.01
				1D vs 1E	-5.16	< 0.01
1989	1B	0.02	NS	1B vs 1D	-2.35	< 0.01
	1D	0.01	NS	1B vs 1E	-7.83	< 0.01
	1E	0.01	NS	1D vs 1E	-2.36	< 0.01
1988	1B	0.07	NS	1A vs 1B	-1.41	NS
	1D	0.4	< 0.05	1A vs 1D	-3.10	< 0.05
	1E	0.19	NS	1A vs 1E	-1.50	NS
				1A vs 1F	-0.50	NS
				1B vs 1D	-2.10	< 0.05
				1B vs 1E	-0.10	NS
				1B vs 1F	0.80	NS
				1D vs 1E	2.10	< 0.05
				1D vs 1F	2.40	< 0.05
				1E vs 1F	0.80	NS
1987	1B	0.72	< 0.05	1B vs 1D	-	NS
	1D	0.02	NS	1B vs 1E	-	< 0.05
	1E	0.31	NS	1B vs 1F	-	< 0.05
	1F	0.15	NS	1D vs 1E	-	< 0.05
				1D vs 1F	-	< 0.05
				1E vs 1F	-	< 0.05
1986	1B	0.44	NS	1B vs 1D	-	NS
	1D	0.18	NS	1B vs 1E	-	NS
	1E	0.06	NS	1D vs 1E	-	NS

Table 5.1.4.3 Results of ANOVA on catches on North American Proportion of catch, 1983 - 1990.

Dependant Variable: ARCNA

Source	DF	Sum of Squares	Mean Square	F Value	Prob.
Model	33	1.53744	0.04659	3.43	0.0001
Error	154	2.08882	0.01357		
Corrected Total	187	3.62627			

R-Squared	C.V.	Root MSE	ARCNA Mean
0.423974	20.89814	0.116464	0.55729

Dependant Variable: ARCNA

Source	DF	Type III SS	Mean Square	F Value	Prob.
YEAR	7	0.88756	0.12679	9.35	0.0001
NAFO	5	0.12785	0.02557	1.89	0.1000
WEEK	7	0.04000	0.00571	0.42	0.8879
YEAR*NAFO	14	0.42298	0.03021	2.23	0.0090

Table 5.3.1.1. Definition of key variables used in continental run-reconstruction model for North America.

Variable	Definition
i	Year of the fishery on 1SW salmon in Greenland and Canada.
i+1	Year of return to Canada for 2SW salmon.
T2(i+1)	Total population size of 2SW salmon prior to fishery in home waters in year i+1
Hc2(i+1)	Harvest of 2SW salmon in Canada in year i+1
Hc2(i)	Harvest of 2SW salmon in Canada in year i
Hg1(i)	Harvest of 1SW salmon in Greenland in year i
P	fraction of extant population available to fishery in Canada
FU	fraction of population not available to any fishery (e.g., Labrador Sea or Irminger Sea)
1-P-FU	fraction of extant population available to fishery in Greenland in year i
Ec(i)	exploitation rate on 1SW salmon in Canada in year i
R2(i+1)	total 2SW run to rivers in Canada in year i+1
R1(i)	total 1SW run to rivers in Canada in year i
M	Natural mortality rate (.12/yr).
t1	time between the midpoint of the Canadian fishery and return to river.= 2 months
t2	time between the midpoint of Greenland fishery and return to Canada = 10 months.
S1	Survival of 2SW salmon between the homewater fishery and return to river {exp(-M t1)}
S2	Survival of 1SW salmon between the Greenland fishery and 2SW homewater fishery. {exp(-M t2)}
H_S(i)	Number of "Small" salmon caught in Canada in year i; fish < 2.7 kg
H_L(i)	Number of "Large" salmon caught in Canada in year i; fish > 2.7 kg
f_imm	Fraction of 1SW salmon that are immature, i.e., non-maturing; range = 0.1 to 0.2
q	Fraction of 1SW salmon present in the Large size market category; range = 0.1 to 0.3

Table 5.3.1.2

a) Summary of catch and returns (numbers) by size class (Small, Large) for Canada. Partitioning of catches by Salmon Fishing Area (SFA) is related to known migration patterns of 1SW salmon and to availability of grilse return estimates.

		NonMat 1SW Component		Mat 1SW Component		Grilse Returns		2SW Catches		Total 2SW Returns	
	{SFA}	{1-7, 14b}		{3-7,14a}		{3-7, 14a}		{1-7, 14b}	{8-14a}	All Canada	
Year	Grld Catch	H_Small	H_Large	H_Small	H_Large	Min	Max	H_Large	H_Large	Min	Max
(i)	(i)	(i)	(i)	(i)	(i)	(i)	(i)	(i+1)	(i+1)	(i+1)	(i+1)
1983	33240	166033	100965	132705	57663	57210	85815	87742	15135	88434	146349
1984	38910	123674	87742	104118	44540	62730	94095	70970	24383	97074	166799
1985	139230	178719	70970	140635	36975	70677	106015	107561	22036	122089	209043
1986	171740	222641	107561	164490	48996	65707	98560	146242	19241	105162	177538
1987	173680	281771	146242	217558	67072	41550	62325	86047	14763	117132	199477
1988	116760	198484	86047	138316	36449	75280	112920	85319	15577	103710	178279
1989	60690	172861	85319	128838	37576	31520	47280	59334	11639	103664	186349
1990	61710	104788	59334	80383	31847	50753	76130	38450	9155	93453	156633
	[G1]					[R1_min]	[R1_max]	[H_L(1-7)]	[H_L(8-14)]	[R2_min]	[R2_max]

b) Summary of estimated catch and return data by sea age class for Canada. See text and designated equations for details on computation.

	{SFA 1-7, 14a}		{SFA 3-7, 14a}		{SFA 3-7, 14a}		{SFA 1-13, 14a, 14b}		{SFA 1-13, 14a, 14b}		2SW Catch	Pre-fishery nonmaturing	
Year	1SW Non Maturing (i)		1SW Maturing (i)		Grilse Returns (i)		2SW Harvest (i+1)		2SW Returns (i+1)		in River	1SW abundance (N. Amer)	
(i)	min	max	min	max	min	max	min	max	min	max	(i+1)	min	max
1983	17613	39265	110777	135004	57210	85815	76554	94103	88434	146349	25149	234176	339870
1984	13245	29999	86858	105732	62730	94095	74062	88256	97074	166799	27302	242368	352641
1985	18582	40002	115466	136555	70677	106015	97329	118841	122089	209043	34092	401662	543922
1986	23340	50982	135512	161270	65707	98560	121610	150859	105162	177538	33061	446870	587628
1987	29640	65129	179412	213912	41550	62325	74996	92205	117132	199477	32417	416955	563383
1988	20709	44860	113569	134326	75280	112920	75300	92364	103710	178279	27583	336458	462707
1989	18139	39691	106076	126100	31520	47280	53173	65040	103664	186349	26026	253312	380279
1990	11072	24518	66854	80943	50753	76130	36070	43760	93453	156633	26056	216965	309436
	{Eq.7}	{Eq.6}	{Eq.23}	{Eq.22}			{Eq.16}	{Eq.17}					
	[C1_min]	[C1_max]			[R1_min]	[R1_max]	[C2_min]	[C2_max]	[R2_min]	[R2_max]		[N1_min]	[N1_max]

[N1_min] = ([R2_min] / S1 + [C2_min]) / S2 + [C1_min] + [G1]

[N1_max] = ([R2_max] / S1 + [C2_max]) / S2 + [C1_max] + [G1]

where S1=exp(-0.12*2/12) and S2=exp(-0.12*10/12)

Table 5.3.1.3. Exploitation rates and population abundance estimates of salmon at West Greenland; derived from constraints model.

Year	Fract.	Exploitation				Proportion of		W. Grld	Prop.	Estimated Range of Abundance of Salmon at West Greenland					
	Unavail	Canada		Greenland		Stock in Canada		Catch	N. Amer	Total Population		N. American Stocks		European Stocks	
(i)	(FU)	Ec_min	Ec_max	Eg_min	Eg_max	P_min	P_max	HG1	f_na	Ng_min	Ng_max	Nna_min	Nna_max	Neu_min	Neu_max
1983	0.05	56	70	12	19	6	14	100000	40	526316	833333	210526	333333	315789	500000
1983	0.3	56	70	16	25	6	13	100000	40	400000	625000	160000	250000	240000	375000
1984	0.05	48	63	13	21	5	13	95500	50	454762	734615	227381	367308	227381	367308
1984	0.3	48	63	17	28	5	12	95500	50	341071	561765	170536	280882	170536	280882
1985	0.05	52	66	29	42	5	12	301050	50	716786	1038103	358393	519052	358393	519052
1985	0.3	52	66	36	51	5	11	301050	50	590294	836250	295147	418125	295147	418125
1986	0.05	58	71	34	46	2	11	316830	57	688761	931853	392594	531156	296167	400697
1986	0.3	58	71	41	55	3	11	316830	57	576055	772756	328351	440471	247703	332285
1987	0.05	74	84	37	49	2	9	305700	59	623878	826216	368088	487468	255790	338749
1987	0.3	74	84	44	58	2	8	305700	59	527069	694773	310971	409916	216098	284857
1988	0.05	50	64	30	45	4	17	280820	43	624044	936067	268339	402509	355705	533558
1988	0.3	50	64	37	55	3	17	280820	43	510582	758973	219550	326358	291032	432615
1989	0.05	69	80	19	29	2	8	117420	56	404897	618000	226742	346080	178154	271920
1989	0.3	69	80	24	37	2	7	117420	56	317351	489250	177717	273980	139635	215270
1990	0.05	47	62	23	36	3	14	85980	75	238833	373826	179125	280370	59708	93457
1990	0.3	47	62	29	46	3	14	85980	75	186913	296483	140185	222362	46728	74121

Table 5.3.1.4. Estimation of the number of potential 2SW salmon in the sea after the West Greenland fishery in 1989

Country	1990 Hm	q	E (min)	E (max)	t	S1	T1g (min) (000s)	T1g (max) (000s)
S.Europe:								
UK(Sc)	54416	0.8	0.25	0.40	8	0.92	179	286
UK(E&W)	33533	1	0.30	0.50	8	0.92	110	183
UK(NI)	30745	0.1	0.40	0.80	8	0.92	6	13
Ireland	30000	0.95	0.30	0.40	8	0.92	117	156
France	2186	1	0.40	0.50	8	0.92	7	9
N.Europe:								
Norway	92759	0.7	0.60	0.70	10	0.90	155	181
Sweden	3133	0.8	0.70	0.90	10	0.90	5	6
Finland	5240	0.7	0.60	0.80	10	0.90	8	10
Russia	20633	1	0.55	0.65	10	0.90	53	63
Iceland	18253	1	0.25	0.50	8	0.92	60	120
Faroes	103407	1	1.00	1.00	4	0.96	163	163

Extant stock of N.Europe (ex F. catch + Iceland) =	221	260
Extant stock of S.Europe (ex F. catch + Iceland) =	419	647
Total	863	1,190
Harvest of 2SW European fish at WG =	52	
Total number of 1SW European salmon in the sea before the West Greenland fishery =	915	1242

M= 0.01
R= 0.34

Table 5.3.3.1. Variability in estimates of the proportion of salmon maturing at 1SW and post-smolt survival for monitored rivers in the North east Atlantic using the run reconstruction model.

Pm1 - Proportion maturing at 1SW

	R.Imsa			R.Drammen		N.Esk	R.Bush
Year	W	H 1+	H 2+	H1+	H2+	W	H
1980							
1981	0.68	0.50	0.76			0.64	
1982	0.59	0.83	0.73			0.74	
1983	0.81	0.48	0.86			0.73	
1984	0.65	0.68	0.84	0.23	0.45	0.64	
1985	0.63	0.78	0.84	0.39		0.71	0.97
1986	0.36	0.84	0.83	0.62		0.52	0.97
1987	0.65	0.85	0.87	0.33	0.55	0.71	0.97
1988	0.88	0.63	0.96	0.38		0.79	0.97
1989	0.59				0.57	0.69	0.97
1990							
Mean	0.65	0.70	0.84	0.39	0.44	0.69	0.97
S.D.	0.16	0.15	0.07	0.14	0.13	0.07	0.00

PS - Post smolt survival

	R.Imsa			R.Drammen		N.Esk	R.Bush	Burrishoole
Year	W	H 1+	H 2+	H1+	H2+	W	H	H
1980								0.04
1981	0.31	0.03	0.16			0.06		0.09
1982	0.11	0.01	0.11			0.09		0.08
1983	0.20	0.03	0.04			0.04	0.06	0.03
1984	0.16	0.11	0.07	0.17	0.13	0.04	0.15	0.17
1985	0.20	0.08	0.06	0.11		0.05	0.18	0.26
1986	0.13	0.16	0.07	0.12		0.06	0.10	0.07
1987	0.33	0.14	0.12	0.02	0.05	0.03	0.12	0.15
1988	0.19	0.06	0.13	0.02		0.02	0.12	0.19
1989	0.12				0.04	0.03	0.11	0.06
1990							0.06	0.11
Mean	0.19	0.08	0.10	0.09	0.08	0.05	0.11	0.11
S.D.	0.07	0.05	0.04	0.07	0.06	0.02	0.04	0.07

H = Hatchery reared
W = Wild

Table 5.3.4.1. Summary of input data for estimation of exploitation rates for Maine origin Atlantic salmon.

Year (i)	Run2 (i+1)	GH2 (i+1)	CH2 (i+1)	USAC (i+1)	NN2 (i+1)	GH1 (i)	CH1 (i)	RUN3 (i+2)	RUN1 (i)
1967	729	18	50	0	161	226	242	19	24
1968	690	135	274	0	274	0	411	18	36
1969	856	0	92	0	92	545	277	17	14
1970	687	100	135	14	14	828	398	49	44
1971	1449	77	12	7	52	2446	295	13	32
1972	1448	118	66	30	20	809	105	59	43
1973	1411	65	9	28	38	1212	220	28	99
1974	2345	73	65	30	7	2615	755	5	116
1975	1341	0	8	0	0	1299	1014	16	231
1976	2025	0	90	30	60	1529	2230	32	98
1977	4110	80	61	0	0	878	933	4	161
1978	1878	0	59	0	0	1066	309	33	847
1980	5107	61	135	0	0	2200	4607	41	1148
1981	6003	143	144	30	60	1901	1137	15	315
1982	1915	104	31	0	20	1273	1586	16	271
1983	3025	69	0	0	0	485	1689	8	388
1984	4830	0	95	0	0	844	1322	24	337
1985	5563	51	66	0	0	1468	2274	52	711
1986	2397	0	0	0	0	2035	533	7	950
1987	2870	38	49	13	0	2086	584	8	896
1988	2946	22	61	44	0	2308	393	21	1267
1989	4370	36	28	0	0	3797	1722	5	654
1990	2057	0	103	0	0	1525	780	0	301

KEY Run2 = Estimated total run of 2SW salmon to Maine rivers
GH2= Harvest of 2SW salmon in Greenland
CH2= Harvest of 2SW salmon in Canada
USAC= Harvest of 2SW salmon in USA coastal waters
NN2 = Non- Newfoundland 2SW harvests
GH1= Harvest of 1SW salmon in Greenland
CH1= Harvest of 1SW salmon in Canada
RUN3 = Estimated total run of 3SW salmon to Maine Rivers
RUN1 = Estimated total run of 1SW salmon to Maine Rivers

Table 5.3.4.2. Estimated exploitation rate of 1SW salmon for the extant population of Maine origin stocks. Only columns with 0.00 unaccounted for are true "extant" exploitation rates.

Natural Mortality	0.12	0.12	0.12	0.12	0.24	0.24	0.24	0.24
Fraction Unaccounted	0	0	0.1	0.1	0	0	0.1	0.1
Adjusted Carlin	1	2	1	2	1	2	1	2
1967	0.30	0.41	0.32	0.43	0.28	0.38	0.30	0.41
1968	0.21	0.26	0.23	0.28	0.19	0.24	0.21	0.26
1969	0.41	0.54	0.44	0.57	0.38	0.51	0.41	0.54
1970	0.52	0.63	0.55	0.66	0.49	0.60	0.52	0.63
1971	0.60	0.74	0.63	0.76	0.58	0.71	0.60	0.73
1972	0.32	0.45	0.34	0.48	0.29	0.42	0.32	0.45
1973	0.45	0.60	0.47	0.62	0.42	0.57	0.45	0.60
1974	0.54	0.69	0.57	0.71	0.52	0.67	0.54	0.69
1975	0.60	0.75	0.63	0.77	0.58	0.73	0.60	0.75
1976	0.60	0.74	0.63	0.76	0.57	0.71	0.60	0.73
1977	0.28	0.42	0.30	0.45	0.25	0.40	0.28	0.42
1978	0.38	0.55	0.41	0.57	0.36	0.52	0.38	0.55
1980	0.53	0.69	0.56	0.71	0.51	0.66	0.53	0.69
1981	0.30	0.45	0.32	0.47	0.28	0.42	0.30	0.44
1982	0.55	0.70	0.58	0.72	0.52	0.67	0.55	0.69
1983	0.39	0.55	0.41	0.58	0.36	0.52	0.38	0.55
1984	0.28	0.43	0.30	0.46	0.26	0.41	0.28	0.43
1985	0.37	0.53	0.39	0.56	0.34	0.51	0.37	0.53
1986	0.49	0.66	0.52	0.68	0.46	0.63	0.49	0.66
1987	0.45	0.61	0.47	0.63	0.42	0.58	0.44	0.61
1988	0.44	0.60	0.47	0.63	0.41	0.57	0.44	0.60
1989	0.53	0.69	0.55	0.71	0.50	0.66	0.53	0.69
1990	0.49	0.65	0.52	0.67	0.46	0.62	0.49	0.65
Average: Time Series	0.43	0.59	0.45	0.61	0.40	0.56	0.43	0.59
Average: Last Ten Years	0.44	0.58	0.46	0.60	0.41	0.55	0.43	0.58

Table 5.3.4.3. Estimate exploitation rate of 2SW salmon for the extant population of Maine origin stocks. Only columns with 0.00 unaccounted for are true "extant" exploitation rates.

Natural Mortality	0.12	0.12	0.12	0.12	0.24	0.24	0.24	0.24
Fraction Unaccounted	0	0	0.1	0.1	0	0	0.1	0.1
Adjusted Carlin	1	2	1	2	1	2	1	2
1968	0.76	0.87	0.78	0.88	0.74	0.85	0.76	0.86
1969	0.95	0.98	0.96	0.98	0.95	0.97	0.95	0.98
1970	0.83	0.91	0.84	0.92	0.81	0.90	0.83	0.91
1971	0.81	0.90	0.83	0.91	0.79	0.89	0.81	0.90
1972	0.86	0.92	0.87	0.93	0.85	0.92	0.86	0.92
1973	0.74	0.85	0.76	0.86	0.72	0.83	0.74	0.85
1974	0.70	0.83	0.72	0.84	0.68	0.81	0.70	0.83
1975	0.96	0.98	0.96	0.98	0.96	0.98	0.96	0.98
1976	0.31	0.47	0.33	0.50	0.29	0.45	0.31	0.47
1977	0.72	0.83	0.74	0.85	0.69	0.82	0.72	0.83
1978	0.97	0.98	0.97	0.99	0.97	0.98	0.97	0.98
1980	0.62	0.76	0.64	0.78	0.59	0.74	0.62	0.76
1981	0.81	0.90	0.83	0.91	0.79	0.89	0.81	0.90
1982	0.94	0.97	0.95	0.97	0.94	0.97	0.94	0.97
1983	0.88	0.94	0.89	0.94	0.87	0.93	0.88	0.94
1984	0.89	0.94	0.90	0.95	0.87	0.93	0.89	0.94
1985	0.78	0.88	0.80	0.89	0.76	0.86	0.78	0.88
1986	0.67	0.80	0.69	0.82	0.64	0.78	0.67	0.80
1987	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1988	0.91	0.95	0.92	0.96	0.90	0.95	0.91	0.95
1989	0.78	0.88	0.80	0.89	0.76	0.86	0.78	0.88
1990	0.92	0.96	0.93	0.96	0.91	0.95	0.92	0.96
Average: Time Series	0.76	0.82	0.77	0.83	0.75	0.81	0.76	0.82
Average: Last Ten Years	0.76	0.84	0.78	0.85	0.75	0.83	0.76	0.84

Table 5.3.4.4. Estimates of exploitation rates for the reduced model in the fisheries of Newfoundland-Labrador and West Greenland for varying levels of P, the fraction of the stock migrating from Canada, (1-P, is fraction from Greenland) and for two levels of adjustment for reporting rate of Carlin tags.
The fraction of the stock unaccounted for is assumed to be 0.0 for these estimates.

	Carlin Adjustment=1.0 Evaluation of P-fraction						Carlin Adjustment=2.0 Evaluation of P-fraction					
Year	Can.	Grld.	Can.	Grld.	Can.	Grld.	Can.	Grld.	Can.	Grld.	Can.	Grld.
(i)	0.1	0.9	0.5	0.5	0.9	0.1	0.1	0.9	0.5	0.5	0.9	0.1
1967	0.75	0.24	0.37	0.36	0.25	0.73	0.86	0.38	0.54	0.53	0.40	0.85
1968	0.84	0.00	0.52	0.00	0.37	0.00	0.91	0.00	0.68	0.00	0.54	0.00
1969	0.74	0.39	0.37	0.53	0.24	0.85	0.85	0.56	0.54	0.69	0.39	0.92
1970	0.84	0.54	0.51	0.68	0.37	0.91	0.91	0.71	0.68	0.81	0.54	0.96
1971	0.65	0.63	0.27	0.75	0.17	0.94	0.79	0.77	0.42	0.86	0.29	0.97
1972	0.40	0.36	0.12	0.50	0.07	0.83	0.57	0.53	0.21	0.67	0.13	0.91
1973	0.58	0.46	0.22	0.61	0.14	0.88	0.74	0.63	0.36	0.75	0.24	0.94
1974	0.74	0.53	0.37	0.67	0.24	0.91	0.85	0.69	0.54	0.80	0.39	0.95
1975	0.87	0.49	0.58	0.63	0.43	0.90	0.93	0.66	0.73	0.78	0.60	0.95
1976	0.91	0.43	0.67	0.57	0.52	0.87	0.95	0.60	0.80	0.73	0.69	0.93
1977	0.67	0.17	0.29	0.28	0.19	0.66	0.8	0.30	0.45	0.43	0.31	0.79
1978	0.60	0.36	0.23	0.50	0.14	0.84	0.75	0.53	0.37	0.67	0.25	0.91
1980	0.89	0.30	0.62	0.43	0.47	0.79	0.94	0.46	0.76	0.61	0.64	0.88
1981	0.63	0.24	0.25	0.36	0.16	0.74	0.77	0.39	0.41	0.53	0.28	0.85
1982	0.88	0.40	0.60	0.54	0.45	0.86	0.94	0.57	0.75	0.70	0.62	0.92
1983	0.83	0.14	0.50	0.22	0.36	0.59	0.91	0.24	0.67	0.36	0.53	0.74
1984	0.71	0.15	0.33	0.24	0.22	0.61	0.83	0.26	0.50	0.38	0.35	0.76
1985	0.79	0.21	0.42	0.32	0.29	0.70	0.88	0.34	0.60	0.49	0.45	0.82
1986	0.67	0.46	0.29	0.60	0.18	0.88	0.80	0.63	0.44	0.75	0.31	0.94
1987	0.65	0.42	0.27	0.56	0.17	0.87	0.79	0.59	0.42	0.72	0.29	0.93
1988	0.55	0.44	0.19	0.58	0.12	0.87	0.71	0.61	0.32	0.74	0.21	0.93
1989	0.78	0.46	0.42	0.61	0.28	0.89	0.88	0.63	0.59	0.76	0.44	0.94
1990	0.77	0.42	0.41	0.57	0.28	0.87	0.87	0.60	0.58	0.73	0.43	0.93
AVG	0.73	0.36	0.38	0.48	0.27	0.78	0.84	0.51	0.54	0.63	0.41	0.86
AVG1	0.73	0.33	0.37	0.46	0.25	0.79	0.84	0.49	0.53	0.62	0.39	0.88

AVG is average for entire time series. AVG10 is average for last 10 years.

Table 5.6.1. Catch and number of salmon sampled for fork length and CWTs during the sampling program at West Greenland, 1985-91.

Year	Catch tonnes	Sampling Period Stweeks	% of catch in sampling period	No. of fish sampled for fork length	% of catch sampled for fork length	No. of fish sampled for CWTs	% of catch sampled for CWTs
1985	864	31-34	80.0	13,272	4.48	14,319	4.83
1986	960	33-35	92.1	20,394	6.39	30,360	9.52
1987	966	31-36	79.3	13,425	4.39	25,047	8.20
1988	893	33-38	67.1	11,047	3.93	22,327	7.95
1989	337	33-35	74.7	9,366	7.97	15,588	13.26
1990	227	31-33	25.6	4,897	5.70	6,410	7.45
1991	437	32-34	51.9	5,011	3.03	7,357	4.46

Table 5.6.2. Recoveries of Carlin tags from USA within and outside the sampling period. Binomial test of whether the reporting rate within and outside the sampling period are different.

Year	No. of Carlin tags in sampling p.	No. of Carlin tags outside sampling p.	% of Carlin tags within sampling p.	% of catch within sampling p.	Prob. of no diff. in reporting rate within and outside sampling p.
1985	27	6	81.8	80.0	0.79
1986	55	10	84.6	92.1	0.03
1987	112	33	79.3	77.2	0.54
1988	44	41	51.8	67.1	<0.01
1989	59	17	77.6	74.7	0.56
1990	3	11	21.4	25.6	0.99
1991	5	5	50.0	51.9	0.90

Table 6.1.1. Nominal catch in tonnes of Atlantic salmon of all ages for Salmon Fishing Areas of Newfoundland and Labrador and Quebec commercial fisheries in 1986-91. Numbers in parentheses are catch totals in numbers of fish. Catches for 1991 are preliminary.

Salmon Fishing Areas	1986	1987	1988	1989	1990		1991	
					Catch	Quota	Catch	Quota
1	89	75	65	76	30	80[a]	7	80[a]
2	308	407	292	213	149	200	79	200
3	192	369	192	151	136	155	108	120
4	200	180	104	133	93	100	52	78
5	61	60	39	37	24	25	18	25
6	54	48	25	27	17	20	19	20
7-11	167	137	82	108	82	82	70	82
13-14	159	212	174	122	87	95	81e	75
Q7-Q9	85	97	89	79	64		77	
	(21,802)c	(23,525)c	(22,863)c	(20,525)c	(19,272)	(30,060)b	(21,601)	(28,359)b
Q11	15d	11d	9d	1d	1	15	1	15
	(2,794)	(2,212)	(1,647)	(245)	(225)		(277)	
Total	1329	1596	1071	947	683		512	

a Allowance.
b Quota was in numbers.
c Quotas for 1986 to 1989 were 33,125 per year.
d Quota was 15t each year.
e 17 tonnes of SFA 14 catch was monitored as part of SFA 2 quota.

Table 6.1.2. Preliminary catches of Atlantic salmon in Canada in 1991 (in kg round fresh weight).

	Small Salmon (kg)	Small Salmon (%)	Large Salmon (kg)	Large Salmon (%)	Total (kg)	Total (%)
QUEBEC						
R	11,140	3.5	60,363	16.7	71,503	10.5
N	152	0.0	15,983	4.4	16,135	2.4
C	6,210	2.0	72,190	20.0	78,400	11.5
Total	17,502	5.5	148,536	41.1	166,038	24.5
NFLD						
R	28,637	9.0	300	0.1	28,937	4.3
N	486	0.2	0	0.0	486	0.1
C	229,992	72.4	203,128	56.2	433,120	63.8
Total	259,115	81.6	203,428	56.3	462,543	68.1
NB						
R	31,637	10.0	0	0.0	31,637	4.7
N	2,469	0.8	7,701	2.1	10,170	1.5
C	0	0.0	0	0.0	0	0.0
Total	34,106	10.8	7,701	2.1	41,807	6.2
NS						
R	6,195	2.0	0	0.0	6,195	0.9
N	774	0.2	1,527	0.4	2,301	0.3
C	0	0.0	0	0.0	0	0.0
Total	6,969	2.2	1,527	0.4	8,496	1.2
PEI						
R*	0	0.0	0	0.0	0	0.0
N	0	0.0	0	0.0	0	0.0
C	0	0.0	0	0.0	0	0.0
Total	0	0.0	0	0.0	0	0.0
TOTAL						
R	77,609	24.4	60,663	16.8	138,272	20.4
N	3,881	1.2	25,211	7.0	29,092	4.3
C	236,202	74.3	275,318	76.2	511,520	75.3
Total	317,692	100.0	361,192	100.0	678,884	100.0

R = Recreational
N = Native Food
C = Commercial
* No catch statistics collected.

Table 6.1.3. Nominal catches (tonnes) in Newfoundland and Labrador commercial Atlantic salmon fishery, 1971-91. Catches for 1991 are preliminary.

Year	Small	Large	Total[a]	Quota[b]
1971	-	-	1577	-
1972	-	-	1394	-
1973	-	-	2011	-
1974	-	-	2010	-
1975	750	1294	2043	-
1976	632	1380	2013	-
1977	533	1404	1938	-
1978	274	907	1180	-
1979	494	495	987	-
1980	809	1295	2103	-
1981	676	1233	1910	-
1982	578	743	1321	-
1983	417	611	1028	-
1984	332	465	797	-
1985	470	411	881	-
1986	608	622	1230	-
1987	705	780	1485	-
1988	511	461	972	-
1989	431	436	867	-
1990	284	334	618	677
1991	230	203	434	600

[a] Differences between total and sum of small and large are due to rounding.
[b] Excludes an allowance of 80 t for SFA 1.

Table 6.1.4. Preliminary landings, in tonnes, of Atlantic salmon harvested in the commercial fisheries in Atlantic Canada, 1991. Comparisons are made to the average landings, 1984-89.

SFA	Small		Large		Total	
	Weight(t)	% Change 1984-89	Weight(t)	% Change 1984-89	Weight(t)	% Change 1984-89
1	2	-90	5	-90	7	-90
2	41	-53	38	-77	79	-69
3	52	-48	56	-41	108	-45
4	26	-70	25	-54	52	-63
5	12	-62	6	-74	18	-67
6	12	-54	6	-63	19	-55
7	6	-12	6	-53	12	-39
8	3	-74	4	-66	7	-70
9	5	-25	1	-50	5	-44
10	12	-52	6	-40	18	-49
11	8	-70	20	-21	28	-46
12	0	0	0	0	0	0
13	25	-35	4	-80	29	-50
14	26	-39	26	-37	52	-38
15-23	0	0	0	0	0	0
Q1-6	0	0	0	0	0	0
Q7	<1	-85[1]	7	-25[1]	7	-30[1]
Q8	<1	-64[1]	29	-19[1]	29	-21[1]
Q9	6	4[1]	35	-2[1]	41	-1[1]
Q10	0	0	0	0	0	0
Q11	0	-	1	-	1	-81[1]

[1] Percent change from 1986-90.
NA=Not Available.

Table 6.1.5. Preliminary landings, in numbers, of Atlantic salmon harvested in the recreational fisheries in Atlantic Canada, 1991. Comparisons are made to the average landings, 1986-90.

SFA	Small		Large		Total	
	Numbers	% Change 1986-90	Numbers	% Change 1986-90	Numbers	% Change 1986-90
1	29	-96[1]	1	-99[1]	30	-96[1]
2	1,122	-48[1]	27	-87[1]	1,149	-52[1]
3	1,316	18[1]	0	0	1,316	18[1]
4	4,892	-46[1]	0	0	4,892	-46[1]
5	2,048	-35[1]	0	0	2,048	-35[1]
6	186	-50[1]	0	0	186	-50[1]
7	36	-64[1]	0	0	36	-64[1]
8	11	-89[1]	0	0	11	-89[1]
9	560	-69[1]	0	0	560	-69[1]
10	230	-82[1]	0	0	230	-82[1]
11	1,853	-65[1]	0	0	1,853	-65[1]
12	644	-30	0	0	644	-30
13	5,188	-17	0	0	5,188	-17
14	4,717	-24	49	-69	4,766	-24
15	2,894	-46	0	0	2,899	-46
16	10,049	-39	0	0	10,049	-39
17[3]	-	-	0	0	-	-
18	1,230	3	0	0	1,230	3
19	446	-46	0	0	446	-46
20	1,414	-40	0	0	1,414	-40
21	558	-85	0	0	558	-85
22	10	N/A[2]	0	0	10	N/A[2]
23	1,945	-43	0	0	1,945	-43
Q1	1,124	-2	2,555	-15	3,679	-11
Q2	435	16	1,605	16	2,040	16
Q3	795	11	1,298	23	2,093	18
Q4	0	-	0	-	0	-
Q5	55	62	108	184	163	126
Q6	364	29	465	-16	829	-1
Q7	631	-42	476	-22	1,107	-35
Q8	755	-14	3,587	35	4,342	23
Q9	1,152	0	109	-81	1,261	-27
Q10	244	-47	559	-14	803	-27
Q11	576	-47	380	-54	947	-50

[1] Percent change from 1984-89, quota started 1990.
[2] Season closed on all rivers in area.
[3] No catch statistics collected.

Table 6.1.1.1. The number of salmon examined for CWTs, periods of sampling and origin of tags recovered in Canada, 1991.

Location	Sampling Period	Number Examined	Adipose Clipped	Percent Clipped	Origin		Total CWT	Percent CWT
					Canada	USA		
Campbellton	6/25-8/7	294	2	0.68	0	0	0	0.00
Conche	6/29-8/12	3653	44	1.20	1	40	41	1.12
Croque	7/19-8/6	2256	25	1.11	1	20	21	0.93
Englee	6/17-8/2	1472	5	0.34	0	1	1	0.07
Fogo	7/1-8/8	425	4	0.94	0	0	0	0.00
Fox Harbour	7/16-8/7	1114	3	0.27	0	0	0	0.00
Goose Cove	7/18-7/20	6458	4	0.06	0	4	4	0.06
Harbour Deep	7/8-7/31	1084	38	3.51	2	25	27	2.49
Leading Tickles	7/2-7/17	65	7	10.77	0	1	1	1.54
Musgrave	7/12-7/17	33	0	0.00	0	0	0	0.00
Shoe Cove	7/4-7/29	1529	21	1.37	0	19	19	1.24
Twillingate	6/23-7/19	778	6	0.77	0	6	6	0.77
Total		19161	159		4	116	120	
Average				1.75				0.69

Table 6.1.2.1. Carlin tag returns from 1SW salmon of Maine origin in Newfoundland and Labrador by year and Salmon Fishing Area. (99=unknown area)

	SFA															
YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	99	TOT
1967	3	1	7	14	5	0	4	0	1	1	2	0	0	0	2	40
1968	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	3
1969	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	3
1970	5	2	13	5	1	1	0	1	0	1	0	0	0	0	0	29
1971	10	2	4	18	10	3	0	0	0	0	1	0	0	0	0	48
1972	6	1	0	0	4	0	0	0	0	0	0	1	0	0	0	12
1973	6	1	6	4	1	1	1	3	1	0	0	0	0	1	0	25
1974	0	5	19	38	13	10	5	3	3	3	0	1	0	3	0	103
1975	16	4	18	36	13	6	1	4	1	2	0	0	0	1	0	102
1976	18	6	26	14	5	5	0	0	0	3	2	0	0	1	0	80
1977	2	1	6	5	0	0	0	0	0	1	1	0	0	0	0	16
1978	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	5
1980	55	24	112	72	22	6	0	3	2	3	12	0	0	3	1	315
1981	14	0	2	10	7	5	1	0	1	0	0	0	0	1	0	41
1982	14	7	20	21	7	6	1	0	0	1	4	0	2	2	0	85
1983	8	1	11	6	0	0	0	0	0	0	0	0	0	0	0	26
1984	12	4	7	7	4	2	1	0	0	1	1	0	0	0	0	39
1985	20	3	15	36	11	1	3	2	0	0	0	0	0	2	1	94
1986	3	5	6	2	1	0	0	1	0	0	0	0	0	3	0	21
1987	14	2	16	4	6	2	0	2	1	1	0	0	0	0	1	49
1988	8	2	5	0	1	0	1	0	0	1	1	0	0	1	0	20
1989	25	5	10	6	4	1	1	1	0	1	0	0	0	0	0	54
1990	0	2	2	2	0	0	0	0	0	0	2	0	0	0	0	8
1991	0	0	12	1	1	0	0	0	0	0	0	0	0	0	0	14
unk	2	0	1	1	0	0	1	1	0	0	1	0	0	1	0	8
TOT	245	78	321	304	117	49	20	22	10	19	27	2	2	19	5	1240

Table 6.1.2.2. Estimated harvest of 1SW salmon of Maine origin in Newfoundland and Labrador by year and Salmon Fishing Area. (99=unknown area)

	SFA															
YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	99	TOT
1967	14	5	43	87	31	0	25	0	6	6	12	0	0	0	12	242
1968	0	0	0	274	137	0	0	0	0	0	0	0	0	0	0	411
1969	0	0	185	0	0	0	0	92	0	0	0	0	0	0	0	277
1970	56	23	188	72	14	14	0	14	0	14	0	0	0	0	0	398
1971	51	10	26	117	65	20	0	0	0	0	7	0	0	0	0	295
1972	47	8	0	0	40	0	0	0	0	0	0	10	0	0	0	105
1973	44	7	56	38	9	9	9	28	9	0	0	0	0	9	0	220
1974	0	29	141	283	97	74	37	22	22	22	0	7	0	22	0	758
1975	129	32	187	374	135	62	10	42	10	21	0	0	0	10	0	1014
1976	418	139	777	418	149	149	0	0	0	90	60	0	0	30	0	2230
1977	95	48	368	307	0	0	0	0	0	61	61	0	0	0	0	940
1978	234	0	75	0	0	0	0	0	0	0	0	0	0	0	0	309
1980	666	291	1744	1121	343	93	0	47	31	47	187	0	0	47	16	4631
1981	330	0	61	303	212	151	30	0	30	0	0	0	0	30	0	1147
1982	217	109	399	419	140	120	20	0	0	20	80	0	40	40	0	1603
1983	441	55	779	425	0	0	0	0	0	0	0	0	0	0	0	1700
1984	350	117	262	262	150	75	37	0	0	37	37	0	0	0	0	1329
1985	400	60	386	926	283	26	77	51	0	0	0	0	0	51	26	2288
1986	67	112	172	57	29	0	0	29	0	0	0	0	0	86	0	552
1987	139	20	204	51	77	26	0	26	13	13	0	0	0	0	13	580
1988	138	34	111	0	22	0	22	0	0	22	22	0	0	22	0	393
1989	708	142	364	218	146	36	36	36	0	36	0	0	0	0	0	1722
1990	0	161	207	207	0	0	0	0	0	0	207	0	0	0	0	780
TOT	4544	1400	6736	5960	2078	857	305	388	123	390	673	17	40	349	66	23926

Table 6.1.2.3. Estimated total run size of 1SW and 2SW salmon returning to Maine rivers and estimated harvests of 1SW salmon in Newfoundland and Labrador fisheries. All run size and harvest estimates are computed assuming 85 percent fish passage efficiency.

Year i	Run 1SW i	2SW i+1	1/2SW Ratio	Harvest i	Harvest /2SW Run Ratio
1967	100	729	0.138	242	0.332
1968	24	690	0.035	411	0.595
1969	36	856	0.041	277	0.324
1970	14	687	0.021	398	0.579
1971	44	1449	0.030	295	0.204
1972	32	1448	0.022	105	0.072
1973	43	1411	0.030	220	0.156
1974	99	2345	0.042	758	0.323
1975	116	1341	0.086	1014	0.756
1976	231	2025	0.114	2230	1.101
1977	98	4145	0.024	940	0.227
1978	161	1878	0.086	309	0.165
1979	251	5662	0.044	NA	NA
1980	847	5122	0.165	4631	0.904
1981	1148	6023	0.191	1147	0.191
1982	315	1930	0.163	1603	0.831
1983	271	3045	0.089	1700	0.558
1984	388	4855	0.080	1329	0.274
1985	337	5568	0.061	2288	0.411
1986	711	2397	0.297	552	0.230
1987	950	2855	0.333	580	0.203
1988	896	2946	0.304	393	0.134
1989	1267	4370	0.290	1722	0.394
1990	654	2057	0.318	780	0.379

NA=Not Available since no smolts were tagged in 1978.

Table 6.1.2.4. CWT and Carlin tag based harvest estimates for sampled areas in Canada, 1990.

LOCATION (1)	CATCH	SCAN	HARVEST CWT	HARVEST CARLIN	CWT CV	METHODS RATIO
COMMUNITIES						
GOOSE COVE (SS 3)	4710	5135	7.8	0.0	56	
CROQUE (SS 3)	2253	1752	14.8	0.0		
CONCHE (SS3)	5876	1567	0.0	0.0		
ENGLEE (SS 4)	2575	1936	22.9	0.0	24	
HARBOUR DEEP (SS 4)	669	545	37.8	0.0	12	
SHOE COVE (SS 6)	5214	4746	36.7	103.0		0.36
LEADING TICKLES (SS 6)	708	593	15.3	0.0		
TWILLINGATE (SS 7)	1093	1112	0.0	0.0		
FOGO (SS 8)	503	864	2.7	0.0		
MUSGRAVE HARBOUR (SS 9)	88	99	0.0	0.0		
FOX HARBOUR (SS 52)	856	1566	0.0	0.0		
STATISTICAL SECTIONS						
SS 3	10556	6887	33.3	0.0	18	
SS 4	18329	4048	137.2	103.0	7	1.33
SS 6	16086	5339	173.8	103.3	9	1.68
SS 6 + UNK			173.8	206.6	9	0.84
SS 7	16086	1112	0.0	0.0		
SS 8	2953	864	16.1	0.0	22	
SS 9	4573	99	0.0	0.0		
SS 52	9708	1566	0.0	80.3		
SALMON FISHING AREAS						
SFA 3	40408	10935	200.4	103.3	6	1.94
SFA 4	35615	7414	378.6	103.3	6	3.66
SFA 4 + UNK			378.6	206.6	6	1.83

(1) UNK indicates Carlin estimates include tags of unknown recovery date.

Table 6.1.3.1. Exploitation rates from the recreational fisheries for Atlantic salmon from several Gulf Region rivers. Unadjusted and adjusted rates are based on mark/recapture techniques. Adjusted rates account for reporting rate and tag loss estimates. Exploitation rate on large salmom are for hook and release fish. N/A = insufficient data for estimation.

River	Size	Year	Number Tagged	Unadjusted Rate Early	Unadjusted Rate Late	Unadjusted Rate Combined	Adjusted Rate	Angling/ Returns
Miramichi (SFA 16)	Small (<63cm)	1986	1587	0.10	0.05	0.09	0.20	0.22
		1987	1103	0.09	0.02	0.08	0.17	0.24
		1988	1278	0.15	0.14	0.15	0.30	0.25
		1989	833	0.10	0.05	0.10	0.20	0.32
		1990	693	0.12	0.09	0.17	0.38	0.26
		1991	559	0.10	0.04	0.08	0.16	0.19
	Large	1986	400	0.04	0.05	0.04	N/A	0.46
		1987	275	0.01	0.02	0.01	N/A	0.62
		1988	241	0.02	0.03	0.03	N/A	0.47
		1989	206	0.03	0.02	0.03	N/A	0.70
		1990	338	0.04	0.05	0.05	N/A	0.33
		1991	317	0.04	0.02	0.03	N/A	0.21
Margaree (SFA 18)	Small (<63cm)	1988	173		0.08		0.16	
		1989	78		0.05		0.10	
		1990	120		0.11		0.19	
		1991	164	0.15			0.19	
	Large	1988	155		0.04		0.08	
		1989	347		0.04		0.07	
		1990	217		0.08		0.13	
		1991	203	0.12			0.17	
Humber (SFA 13)	Small (<63cm)	1990	214	0.13			0.25	
		1991	64	0.16			N/A	

Table 6.4.1. Quotas, closing date and nominal landings for the commercial fisheries, SFA, 1-14 in 1990 and 1991. The commercial fisheries opened June 5 in all SFAs. The landings for 1991 are preliminary.

	1990			1991		
SFA	Quota (t)	Date Closed	Landings (t)	Quota (t)	Date Closed	Landings (t)
1	a	Oct. 15	30	a	Oct 15	7
2	200	Oct. 15	149	200	Oct 15	79
3	155	Oct. 15	136	120	Sep 23	108
4	100	July 25	93	78	Oct 15	52
5	25	July 7	24	25	Jul 25	18
6	20	July 14	17	20	Jul 21	19
7	15	Oct. 15	12	15	Jul 27	12
8	10	July 21	9	10	Jul 26	7
9	7	Oct. 15	7	7	Jul 13	5
10	25	June 30	24	25	Jul 11	18
11	25	June 21	30	25	Jun 29	28
12	0	not open	0	0	not open	0
13	35	July 3	43	25	Jul 6	29
14	60	July 14b	44	50	Oct 15	52
Total	677		618c	600		434c

a Allowance of 80 t.
b Southern Labrador re-opened July 20-July 30.
c Includes landings in SFA 1 which did not have a quota.

Table 6.4.1.1. Estimates of small and large salmon by weight which were not harvested in (a) 1990 and (b) 1991 due to the early closure of the commercial fisheries. Number in parenthesis is the percent of the harvest which would not have been caught, 1984-89 if the season was closed on the same date as in 1990 in (a) and 1991 in (b).

SFA	Harvest (t)	Predicted Weight (t) not Caught Min	Max	Mean (%)
(a) 1990				
Small Salmon				
4	62	5	20	10 (14)
5	15	4	17	9 (38)
6	10	2	10	5 (31)
8	4	<1	<1	<1 (11)
10	18	10	39	16 (47)
11	9	5	71	14 (60)
13	29	8	30	13 (31)
14	25	4	46	11 (31)
Total	172			79
Large Salmon				
4	31	5	10	6 (17)
5	10	1	5	3 (24)
6	7	<1	5	2 (21)
8	5	<1	<1	<1 (5)
10	6	1	6	3 (31)
11	21	3	51	13 (39)
13	14	2	8	4 (22)
14	19	3	16	7 (27)
Total	113			39
(b) 1991				
Small Salmon				
3	52	<1	<1	<1 (<1)
5	12	<1	3	2 (11)
6	12	1	7	3 (20)
7	6	<1	<1	<1 (5)
8	3	<1	<1	<1 (6)
9	5	1	5	2 (32)
10	12	3	5	4 (24)
11	8	2	11	4 (36)
13	25	4	17	6 (21)
Total	135			21
Large Salmon				
3	56	<1	3	<1 (1)
5	6	<1	<1	<1 (9)
6	6	<1	3	1 (15)
7	6	<1	1	<1 (7)
8	4	<1	<1	<1 (3)
9	1	<1	1	<1 (26)
10	6	<1	3	1 (14)
11	20	1	12	5 (19)
13	4	<1	2	<1 (17)
Total	109			9

Table 6.4.1.2 Estimates of numbers of small and large salmon which were not harvested in (a) 1990 and (b) 1991 due to the early closure of the commercial fisheries. Number in parenthesis is the percent of the harvest which would not have been caught, 1984-89 if the season was closed on the same date as in 1990 in (a) and 1991 in (b).

SFA	Harvest (Numbers)	Predicted Numbers not Caught Min	Max	Mean (%)
(a) 1990				
Small Salmon				
4	32,648	2,647	10,508	5,429 (14)
5	8,018	2,321	9,285	4,932 (38)
6	5,187	1,075	5,135	2,383 (31)
8	2,525	201	455	295 (11)
10	10,283	5,641	22,727	9,225 (47)
11	4,845	2,567	38,106	7,310 (60)
13	16,638	4,411	16,490	6,944 (29)
14	12,216	2,086	20,000	5,035 (29)
Total	92,358			41,553
Large Salmon				
4	6,940	1,112	2,226	1,408 (17)
5	2,603	361	1,236	816 (24)
6	1,534	182	1,364	461 (21)
8	1,100	20	175	57 (5)
10	1,825	390	1,832	805 (31)
11	4,354	708	10,686	2,742 (39)
13	3,239	423	1,682	988 (23)
14	3,608	601	2,997	1,338 (27)
Total	25,203			8,615
(b) 1991				
Small Salmon				
3	27,722	11	78	25 (<1)
5	6,781	400	1,513	837 (11)
6	6,926	643	3,783	1,749 (20)
7	3,187	71	266	172 (5)
8	1,904	94	194	122 (6)
9	3,080	504	3,202	1,425 (32)
10	6,533	1,515	2,921	2,071 (24)
11	4,158	1,057	5,750	2,276 (35)
13	15,688	2,274	9,960	3,895 (20)
Total	75,979			12,572
Large Salmon				
3	13,696	43	772	189 (1)
5	2,066	124	320	205 (9)
6	1,726	130	927	316 (15)
7	1,534	40	301	109 (7)
8	959	8	64	25 (3)
9	176	6	227	61 (26)
10	1,859	134	775	300 (14)
11	4,616	279	2,669	1,098 (19)
13	871	77	321	168 (16)
Total	27,503			2,471

Table 6.4.2.1. Estimates of numbers of 1SW salmon of Maine origin which would not have been harvested in the Newfoundland-Labrador commercial fisheries, 1984-89, if the fisheries were closed each year on the same day that the fisheries were closed in 1990. The number in parenthesis is the percentage of the total numbers of 1 SW Maine-origin salmon caught in SFA.

SFA	Date fish closed in 1990	Year 1984	1985	1986	1987	1988	1989	Mean (%)
4	Jul 25	37 (50)	0	0	0	0	0	6 (8)
5	Jul 07	111 (100)	77 (100)	0	4 (6)	0	36 (33)	38 (58)
6	Jul 14	37 (50)	26 (100)	0	2 (7)	0	0	11 (52)
8	Jul 24	0	0	0	0	0	0	0
10	Jun 30	5 (14)	0	0	13 (100)	0	36 (100)	9 (50)
11	Jun 21	37 (100)	0	0	0	0	0	6(100)
13	Jul 03	0	0	0	0	0	0	0
14	Jul 14	0	52 (100)	86 (100)	0	22 (100)	0	27(100)
Total		227 (68)	155 (60)	86 (43)	19 (11)	22 (50)	72 (18)	97(41.7)
							SD	80.9 22.81

Table 6.4.2.2. Estimates of numbers of 1SW salmon of Maine origin which would not have been harvested in the Newfoundland-Labrador commercial fisheries, 1984-89, if the fisheries were closed each year on the same day that the fisheries were closed in 1991. The number in parenthesis is the percentage of the total numbers of 1 SW Maine-origin salmon caught in SFA.

SFA	Date fish closed in 1991	1984	Year 1985	1986	1987	1988	1989	Mean (%)
3	Sep 23	37 (25)	77 (75)	0	0	0	0	19 (13)
5	Jul 25	37 (33)	51 (66)	0	0	0	0	15 (22)
6	Jul 21	5 (7)	26 (100)	0	0	0	0	5 (25)
7	Jul 27	0	0	0	0	0	0	0
8	Jul 26	0	0	0	0	0	0	0
9	Jul 13	0	0	0	0	0	0	0
10	Jul 11	0	0	0	13 (100)	0	0	2 (12)
11	Jun 29	37 (100)	0	0	0	0	0	6 (100)
13	Jul 6	0	0	0	0	0	0	0
Total		116 (29)	154 (60)	0	13 (4)	0	0	47 (15.5)
							SD 69.27	24.56

Table 7.1 Inventory of Parasites and Diseases of Wild and Reared Salmon in Countries at the West Greenland and N.E. Atlantic Commissions Areas of NASCO

Diseases	BELGIUM	CIS	DENMARK	ENGLAND	FAROES	FINLAND	FRANCE	GREENLAND	ICELAND	IRELAND	NETHERLANDS	NORWAY	SCOTLAND	SPAIN	SWEDEN
A. <u>Viral Diseases</u>															
VHS					0		0		0	0		0	0		
IHN					0		0		0	0		0	0		
IPN					F		F		0	F		FW	FW		
Viral papilloma										WF		FW	FW		
VEN/EIBS					F		0			F		FW	F		
Swim bladder tumor										0			F		
B. <u>Diseases of unknown etiology</u>															
Pancreas Disease					0		F			F		F	F		
ISA							0					F			
Epitheliocystis									F						

Diseases	BELGIUM	CIS	DENMARK	ENGLAND	FAROES	FINLAND	FRANCE	GREENLAND	ICELAND	IRELAND	NETHERLANDS	NORWAY	SCOTLAND	SPAIN	SWEDEN
C. <u>Bacterial diseases</u>															
Aeromonas salmonicida					FW		F		F	WF		FW	FW		
Aeromonas sp. (motile)					F		F		F	WF		FW	FW		
Renibacterium salmoninarum					F		0		WF	0		FW	FW		
Yersinia ruckeri					0		0		F	F		F	F		
Vibrio sp.					F		F		F	WF		FW	FW		
V. anguillarum					F		F		F	WF		FW			
Vibrio salmonicida					F		0		0	0		F	F		
Flexibacter columnaris							F			F		FW	FW		
Flexibacter sp.					F										
Pseudomonas sp.					F				F	WF		F	F		
Serratia sp.										0			F		
Lactobacillus sp.									F						
Mycobacterium sp.									F						

F = Found in farmed fish.
W = Found in wild fish.
0 = Looked for but not found.
Blank = No records.

Diseases	BELGIUM	CIS	DENMARK	ENGLAND	FAROES	FINLAND	FRANCE	GREENLAND	ICELAND	IRELAND	NETHERLANDS	NORWAY	SCOTLAND	SPAIN	SWEDEN
D. <u>Fungal infections</u>															
Ichthyophonus hoferi							0			W			W		
Exophiala salmonis							F		F	F		F	F		
Phoma herbarum							0			F		F	FW		
Saprolegnia parasitica										WF					
Saprolegnia sp.							WF			WF		FW	FW		
Saprolegnia diclina										0			F		
Dermocystidium sp.												FW	F		
Paecilomyces farinosus										0			F		
Phialophora sp.										F			F		

Diseases	BELGIUM	CIS	DENMARK	ENGLAND	FAROES	FINLAND	FRANCE	GREENLAND	ICELAND	IRELAND	NETHERLANDS	NORWAY	SCOTLAND	SPAIN	SWEDEN
E. <u>Protozoan infections</u>															
Myxobolus neurobius													W		
Myxidium truttae													W		
Myxidium oviforme												W	W		
PKX organism (probable myxosporid)										F		FW	F		
Ichthyobodo (Costia) necatrix					FW								FW		
Ichthyophthirius multifiliis							F		F	F		FW	FW		
Hexamita sp.					F		F			FW		F	F		
Trichodina sp.									F	F		F	FW		
Leptotheca sp.							F			FW		FW	FW		
Epistylis sp.													F		
Apiosoma sp.					F							FW	F		
Scyphidia sp.												FW	FW		
Chilodonella cyprini										F		FW	FW		
Trichophyra sp.										F		FW	F		
										F		FW			

F = Found in farmed fish.
W = Found in wild fish.
0 = Looked for but not found.
Blank = No records.

Diseases	BELGIUM	CIS	DENMARK	ENGLAND	FAROES	FINLAND	FRANCE	GREENLAND	ICELAND	IRELAND	NETHERLANDS	NORWAY	SCOTLAND	SPAIN	SWEDEN
F. <u>*Monogeneans*</u>															
Gyrodactylus derjavini										0		FW	FW		
Gyrodactylus truttae										0		0	FW		
Gyrodactylus salaris										0		FW	0		
Discocotyle sagittata												W	W		
G. <u>*Trematodes*</u>															
Crepidostomum farionis										W		W	W		
Diplostomum spathaceum										W		W	W		
Diplostomum sp.										FW		W	W		
Apatemon sp.													W		
Phyllodistomum simile													W		
Hemiurus sp.												W	W		
Derogenes sp.												FW	W		
Lecithaster sp.													W		
Brachyphallus sp.													W		
Tetracotyle sp.												W	W		

Diseases	BELGIUM	CIS	DENMARK	ENGLAND	FAROES	FINLAND	FRANCE	GREENLAND	ICELAND	IRELAND	NETHERLANDS	NORWAY	SCOTLAND	SPAIN	SWEDEN
H. <u>*Cestode infections*</u>															
Cyathocephalus truncatus												W	W		
Diphyllobothrium ditremum larvae										W		W	WF		
Diphyllobothrium dendriticum larvae										WF		W	WF		
Diphyllobothrium sp. larvae										W			W		
Eubothrium crassum										WF		FW	WF		
Hepatoxylon sp. larvae													W		
I. <u>Nematode infections</u>															
Anisakis sp. larvae										W		W	W		
Hysterothylaceum sp. (larvae and adults)												FW	W		
Capillaria salvelini													W		
Capillaria sp.													W		
Metabronema sp.													W		
Rhabdochona salvelini													W		
Rhabdochona sp.												W	W		
Cystidicola farionis													W		
Cystidicoloides sp.													W		

F = Found in farmed fish.
W = Found in wild fish.
0 = Looked for but not found.
Blank = No records.

Diseases	BELGIUM	CIS	DENMARK	ENGLAND	FAROES	FINLAND	FRANCE	GREENLAND	ICELAND	IRELAND	NETHERLANDS	NORWAY	SCOTLAND	SPAIN	SWEDEN
J. *Acanthocephalan* infections															
Neoechinorhynchus rutili													W		
Echinorhynchus truttae													W		
Pomphorhynchus laevis													W		
Acanthocephalus lucii													W		
K. Crustacean infections															
Lepeophtheirus salmonis					FW		F		F	WF		FW	WF		
Caligus elongatus					FW		F		F	WF		FW	WF		
Salmincola salmonea												FW	W		
L. Molluscan infections															
Margaritifera margaritifera										F		FW	F		
(glochidia)												FW	F		
Mytilus edulis															
M. Leech infections															
Hemiclepsis marginata													W		

F = Found in farmed fish.
W = Found in wild fish.
0 = Looked for but not found.
Blank = No records.

Table 9.1 Production of farmed salmon in the North Atlantic area
(in tonnes round fresh weight), 1980-1991.

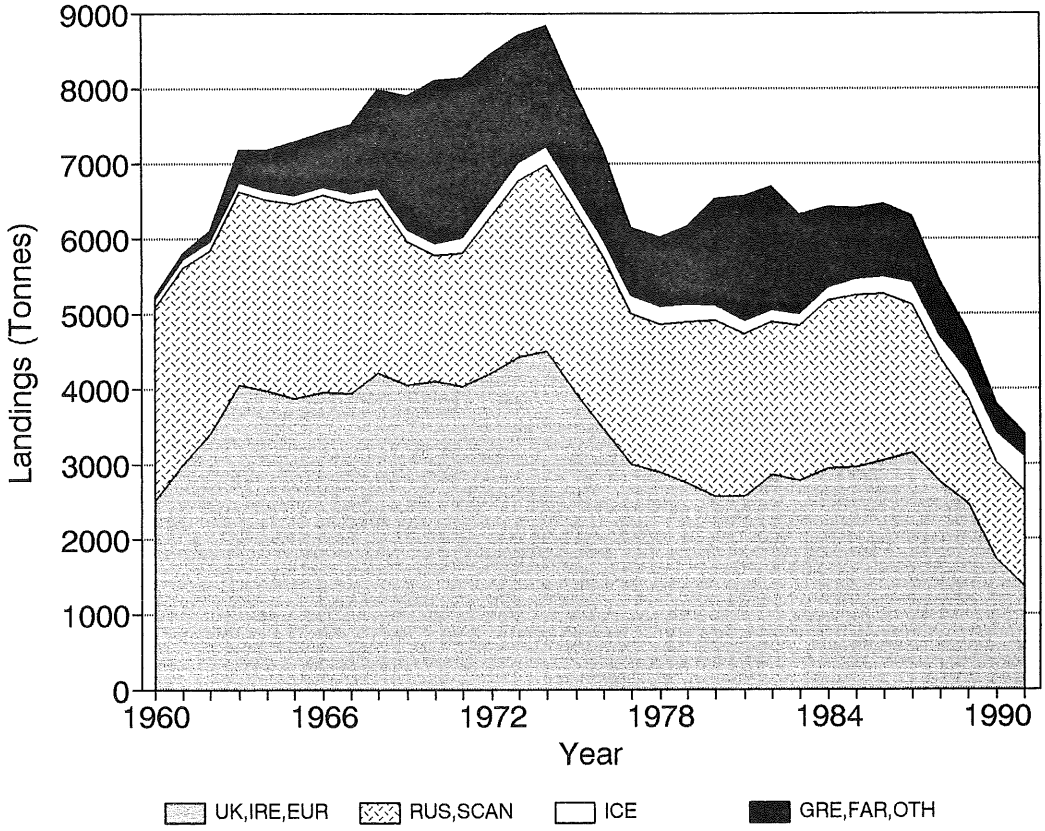
Year	Scotland	Norway	Iceland	Canada	N.Irel.	Faroe Is.	USA	Russia	Ireland	Total
1980	598	4153		11					21	4783
1981	1133	8422		21					35	9611
1982	2152	10266		38		70			100	12626
1983	2536	17000		69		110			257	19972
1984	3912	22300		227		120			385	26944
1985	6921	28655	91	359		470			700	37196
1986	10338	45675	123	672		1370			1215	59393
1987	12721	47417	490	1334		3530	365		2232	68089
1988	17951	80371	1053	3542		3300	455		4700	111372
1989	28553	114866	1480	5865		8000	905		5068	164737
1990	32350	157944	2800	7810	60	13000	2086	5	8175	224230
1991	40593	140000	2566	9395	100	15000	3650	0	6265	217569

Table 10.1 Number of microtags, external tags and finclips applied to Atlantic Salmon by countries for 1991

Country	Stock	Micro-tags[3]	External tags	Untagged Fish: Adipose clip only	Untagged Fish: Other finclip combination	Comments
Canada	H[1]	104,614	54,789	881,520	27,906	33,027 ext tagged
	W[2]	31,456	4,429	918	1,826	were adipose clipped.
Denmark	H	-	5,890	61,000	58,300	
	W	-	-	-	-	
France	H	21,476	1,746	32,680	500	Ext. includes 468 VI tags.
	W	-	617	-	-	
Iceland	H	295,115	8,407	-	-	Microtags include 5066 with no adipose clip.
	W	7,780	-	-	-	Ext. includes 7,430 VI tags.
Ireland	H	468,441	-	-	-	
	W	2,711	-	-	-	
Norway	H	-	172,443	9,500	-	Ext. includes 54,579
	W	-	4,540	-	-	adipose clipped.
Russia	H	-	2,000	379,200	-	All ext. tagged had
	W	-	-	-	-	adipose clips.
Spain	H	38,864	-	-	-	
	W	-	-	-	-	
Sweden	H	-	9,682	31,487	-	1,971 ext. tagged were
	W	-	249	-	-	adipose clipped.
UK (Eng&Wales)	H	232,728	-	56,973	-	Microtags include 10,359
	W	8,816	1,432	-	-	with no adipose clip.
UK (Scotland)	H	32,714	275	-	-	4,813 ext. tagged had
	W	13,038	9,522	-	3,855	adipose clipped or punched.
UK (N. Ireland)	H	33,496	-	-	-	
	W	2,824	-	-	-	
USA	H	465,781	50,074	-	85,760	All fin clipped only had
	W	824	41	-	-	right ventral clipped.
Total	H	1,693,229	305,306	1,452,360	172,466	
	W	67,449	20,830	918	5,681	
Grand Total		1,760,678	326,136	1,453,278	178,147	

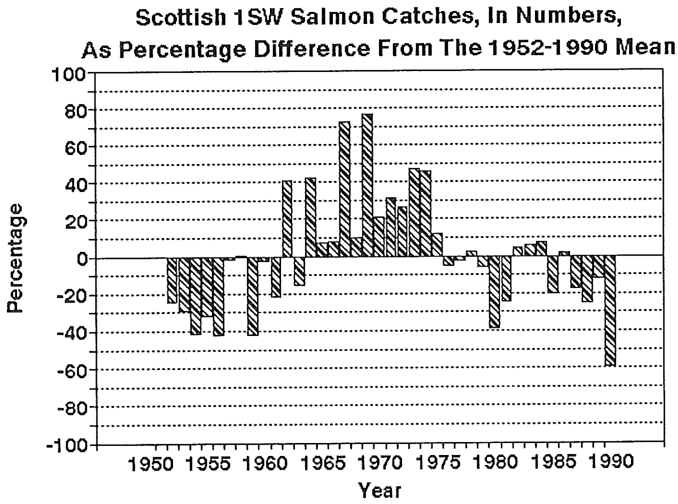
1 Hatchery origin
2 Wild origin
3 Micro-tagged fish are also adipose clipped unless otherwise noted

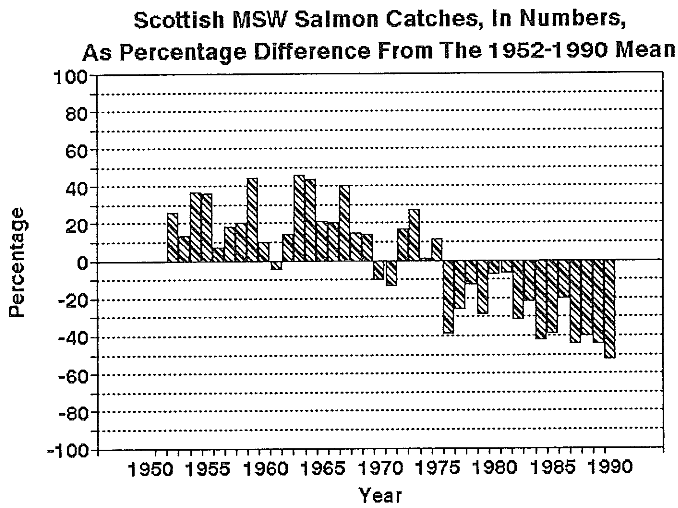
Figure 3.2.1.1. Total landings of European stocks in home and distant water fisheries.

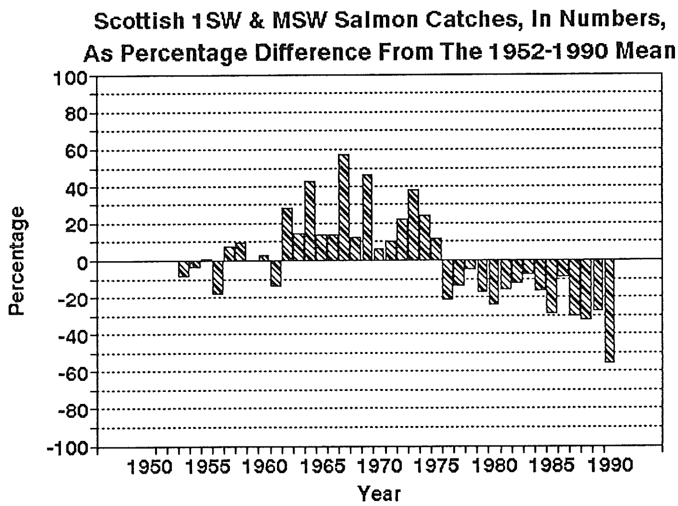


UK,IRE,EUR=United Kingdom, Ireland, mainland Europe
RUS,SCAN=Russia, Scandinavia
ICE=Iceland
GRE,FAR,OTH=European component of Greenland, Faroes, others

Figure 3.2.1.2


Scottish 1SW Salmon Catches, In Numbers,
As Percentage Difference From The 1952-1990 Mean
100
80
60
40
20
0
-20
-40
-60
-80
-100
Percentage
1950 1955 1960 1965 1970 1975 1980 1985 1990
Year


Scottish MSW Salmon Catches, In Numbers,
As Percentage Difference From The 1952-1990 Mean
100
80
60
40
20
0
-20
-40
-60
-80
-100
Percentage
1950 1955 1960 1965 1970 1975 1980 1985 1990
Year


Scottish 1SW & MSW Salmon Catches, In Numbers,
As Percentage Difference From The 1952-1990 Mean
100
80
60
40
20
0
-20
-40
-60
-80
-100
Percentage
1950 1955 1960 1965 1970 1975 1980 1985 1990
Year

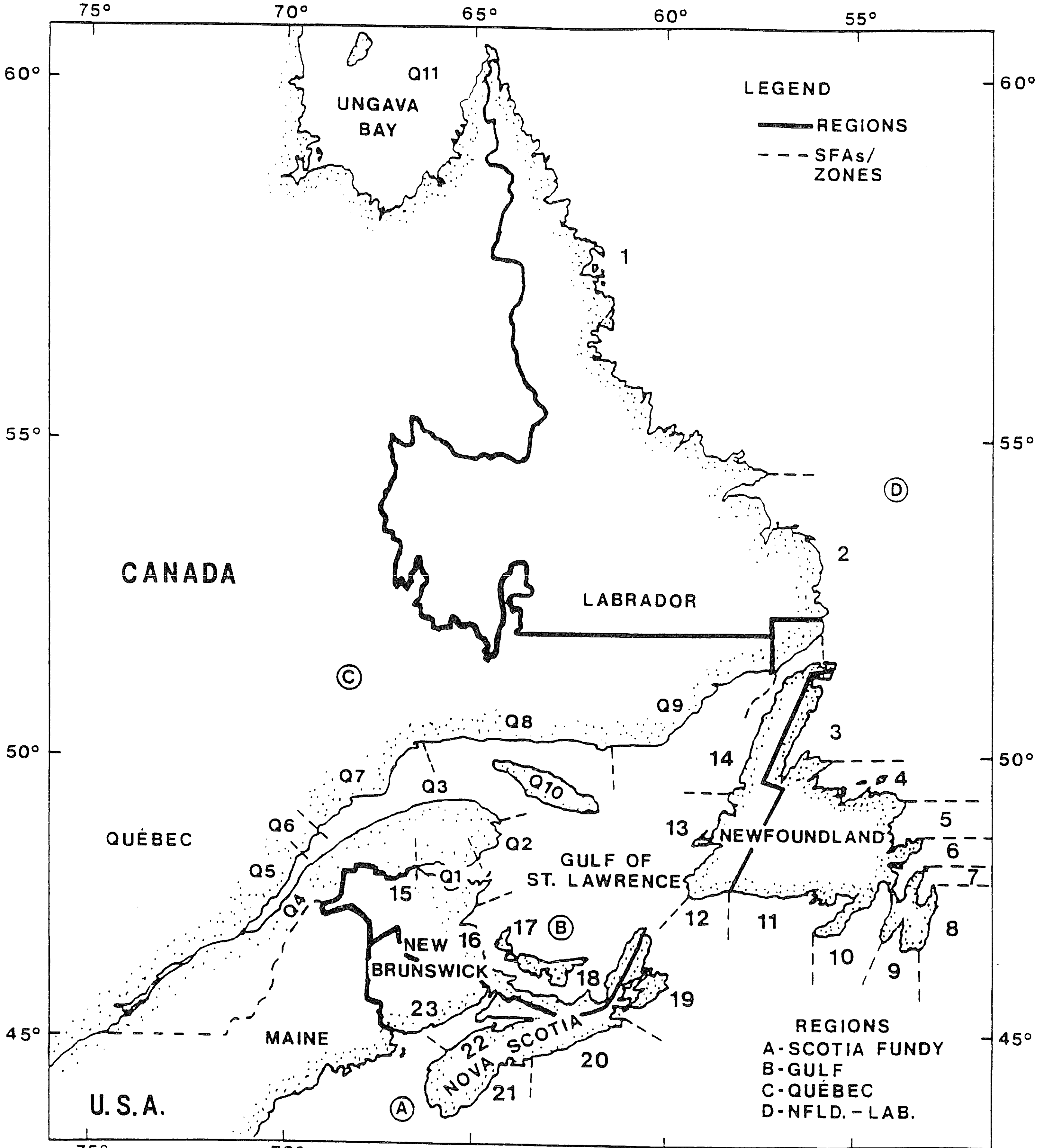
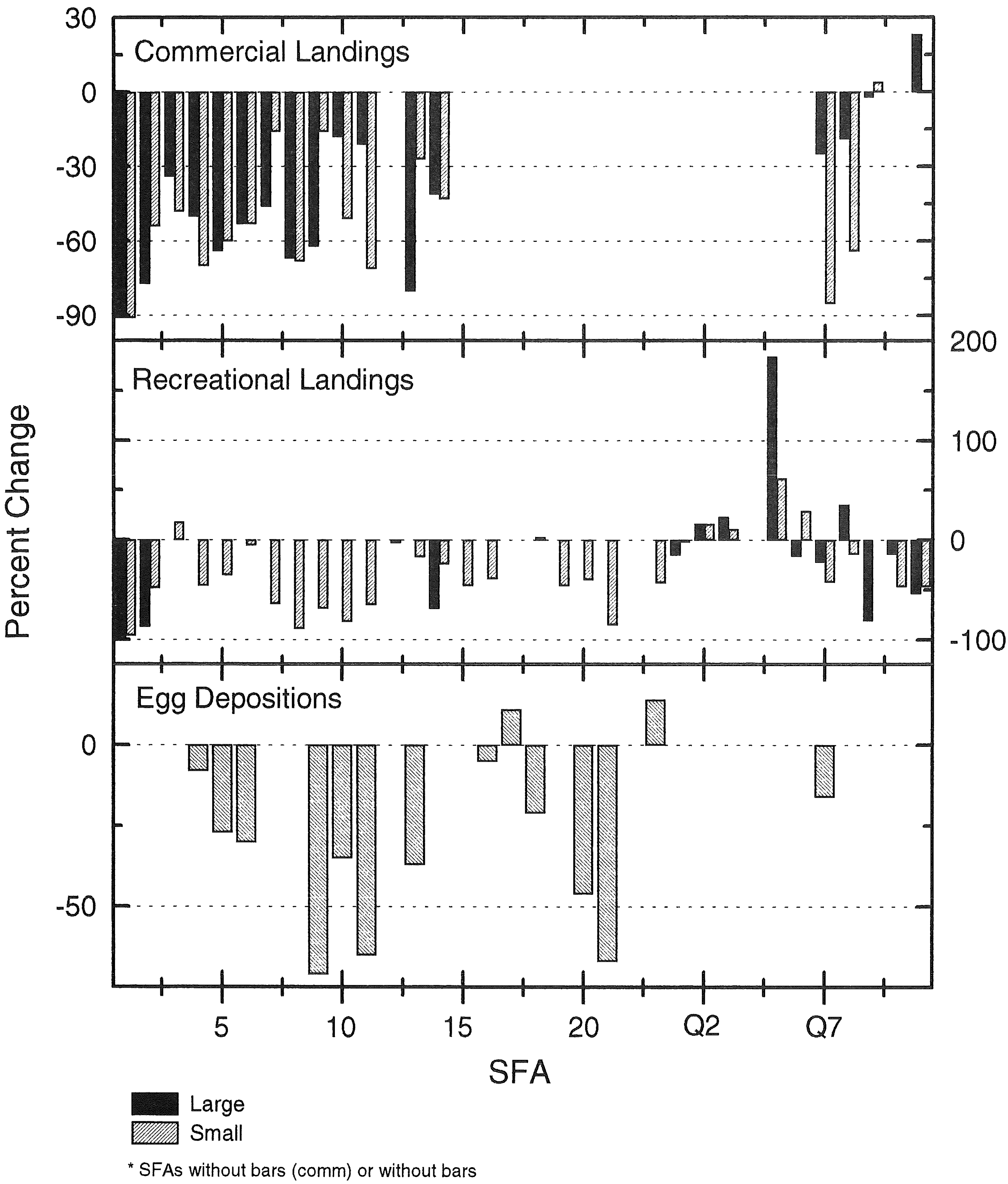


Figure 3.3.1.1. Map of Eastern Canada showing Salmon Fishing Areas (SFA).

Figure 3.3.1.2. Percent change between harvest of salmon in 1991 and the average for 1986-1990 (comm) and 1984-89 (rec) in SFAs or zones of Canada. Percent change in 1991 egg depositions from 1986-90 is for specifc rivers.*



* SFAs without bars (comm) or without bars for large salmon (rec) had no fisheries.

Figure 3.3.1.3. Recreational harvest of Atlantic salmon in the wild run rivers of Maine (USA). Limited to 2SW salmon harvest for five rivers: Dennys, E. Machias, Machias, Narraguagus, and Sheepscot.

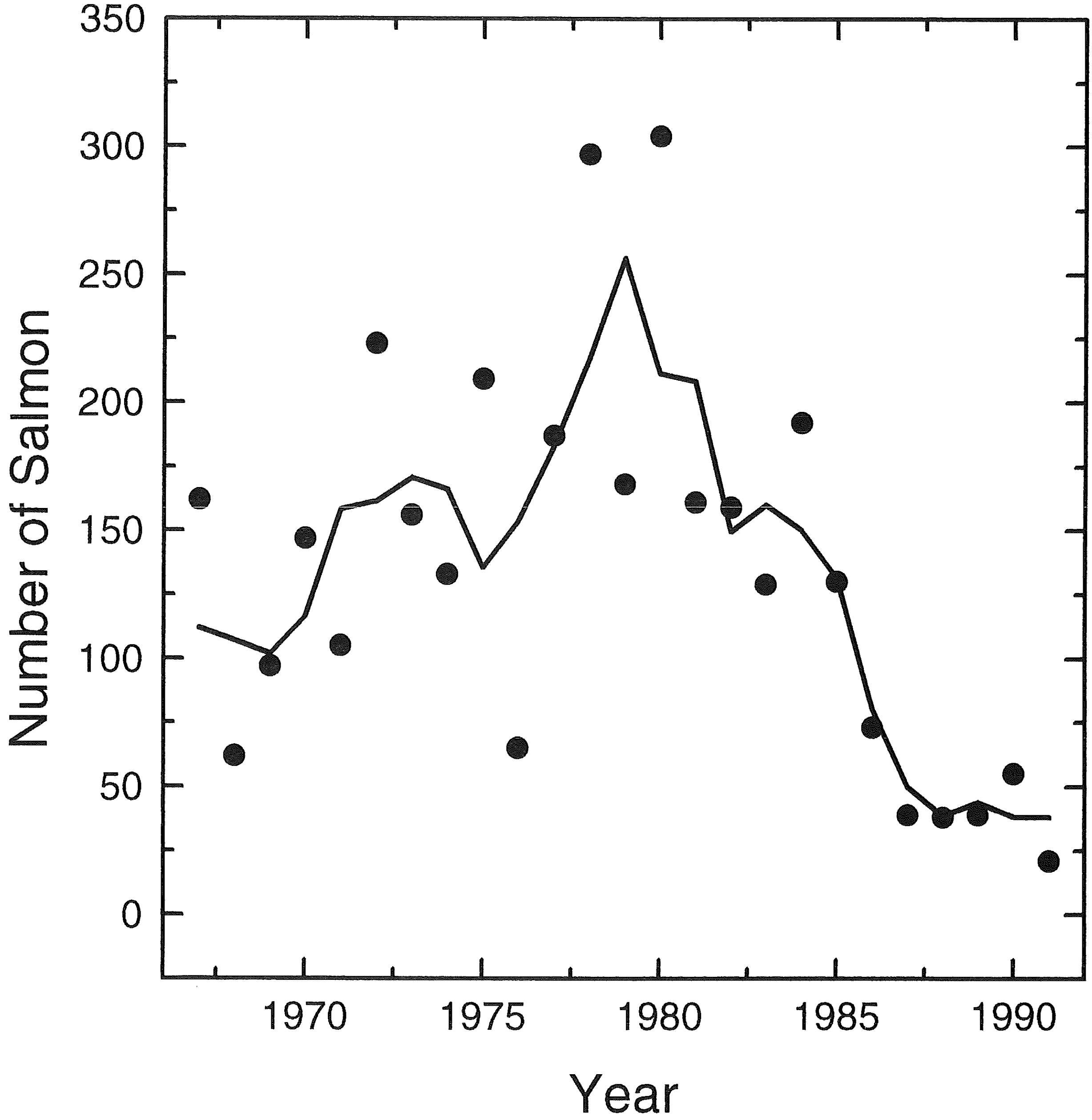
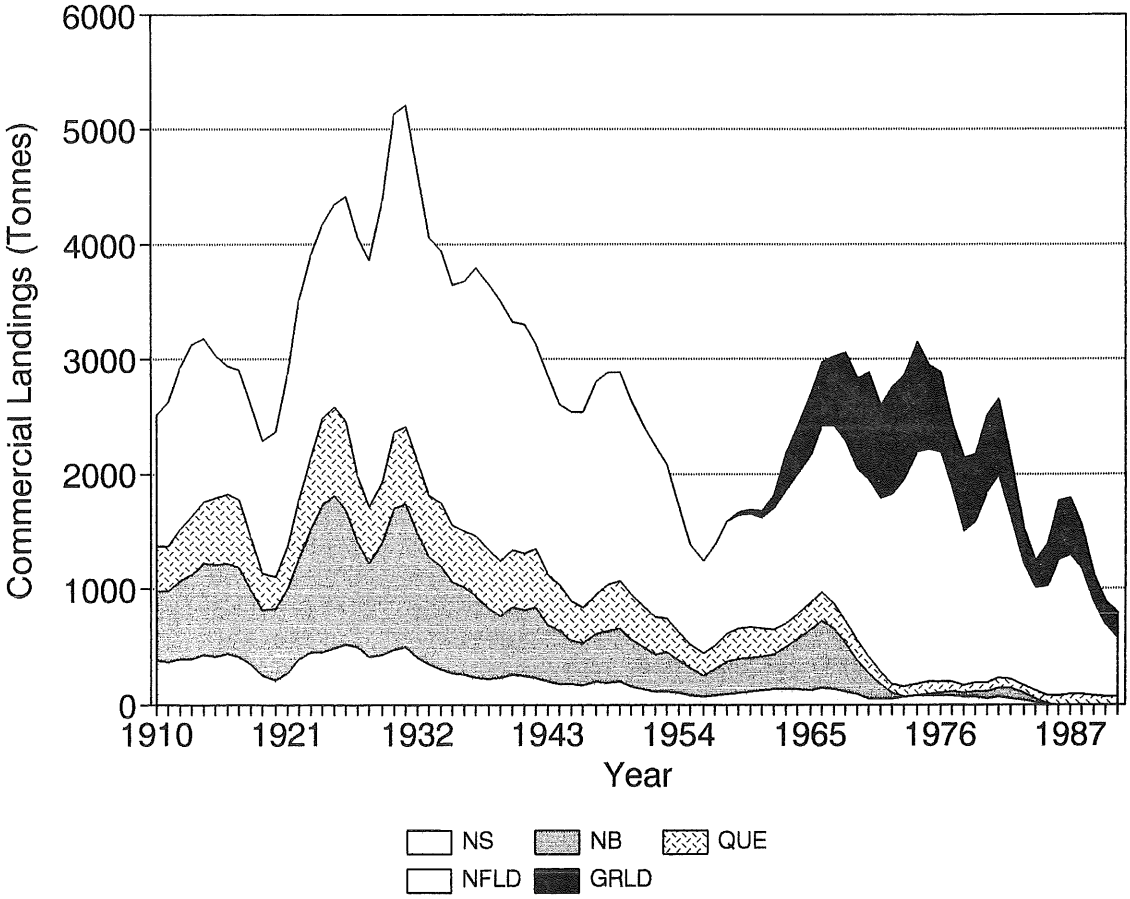


Figure 3.3.1.4. Commercial landings of Canadian origin salmon in home and distant water fisheries.



NS=Nova Scotia
NB=New Brunswick
QUE=Quebec
NFLD=Newfoundland-Labrador
GRLD=North American component of Greenland

Figure 3.3.1.5. Smoothed Z-scores of counts and estimates of small salmon ascending 15 rivers in Canada.

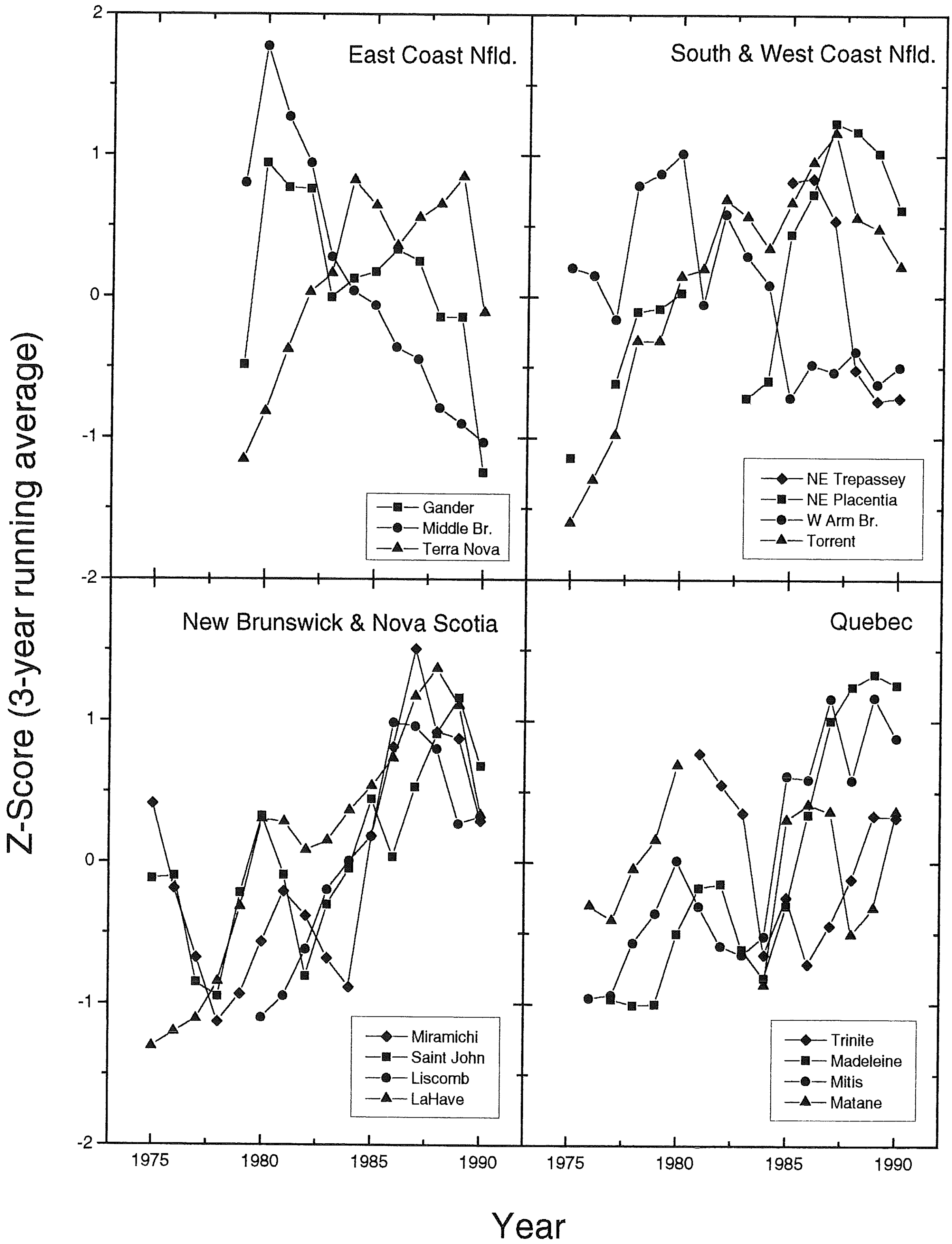


Figure 3.3.1.6. Smoothed Z-scores of counts and estimates of large salmon ascending 14 rivers in Canada.

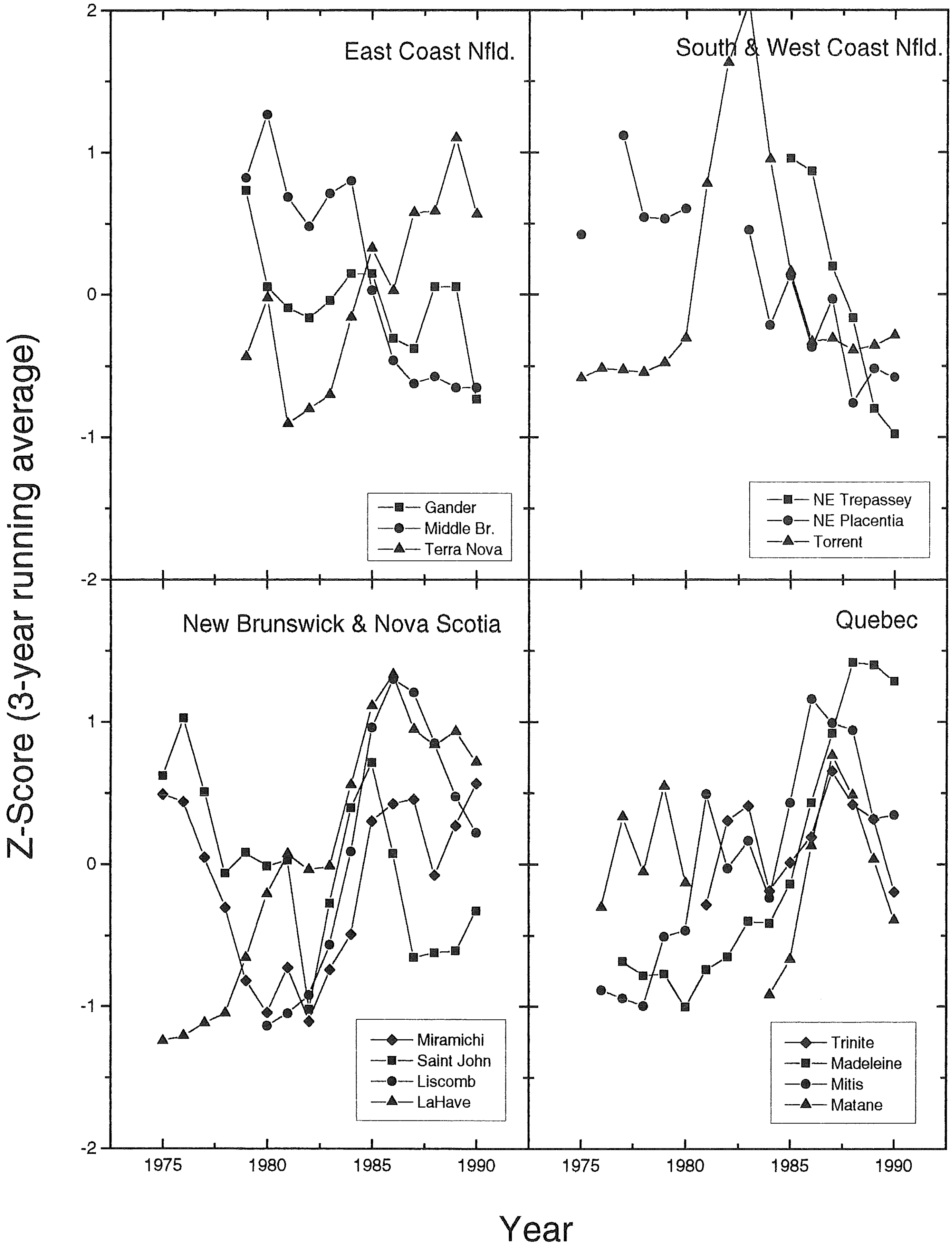


Figure 3.3.3.1. Indices of smolt survival for Western North Atlantic salmon. Top: Wild smolts Canada, Middle: Hatchery smolts Canada, Bottom: Penobscot River hatchery smolts. Data smoothed by three year means.

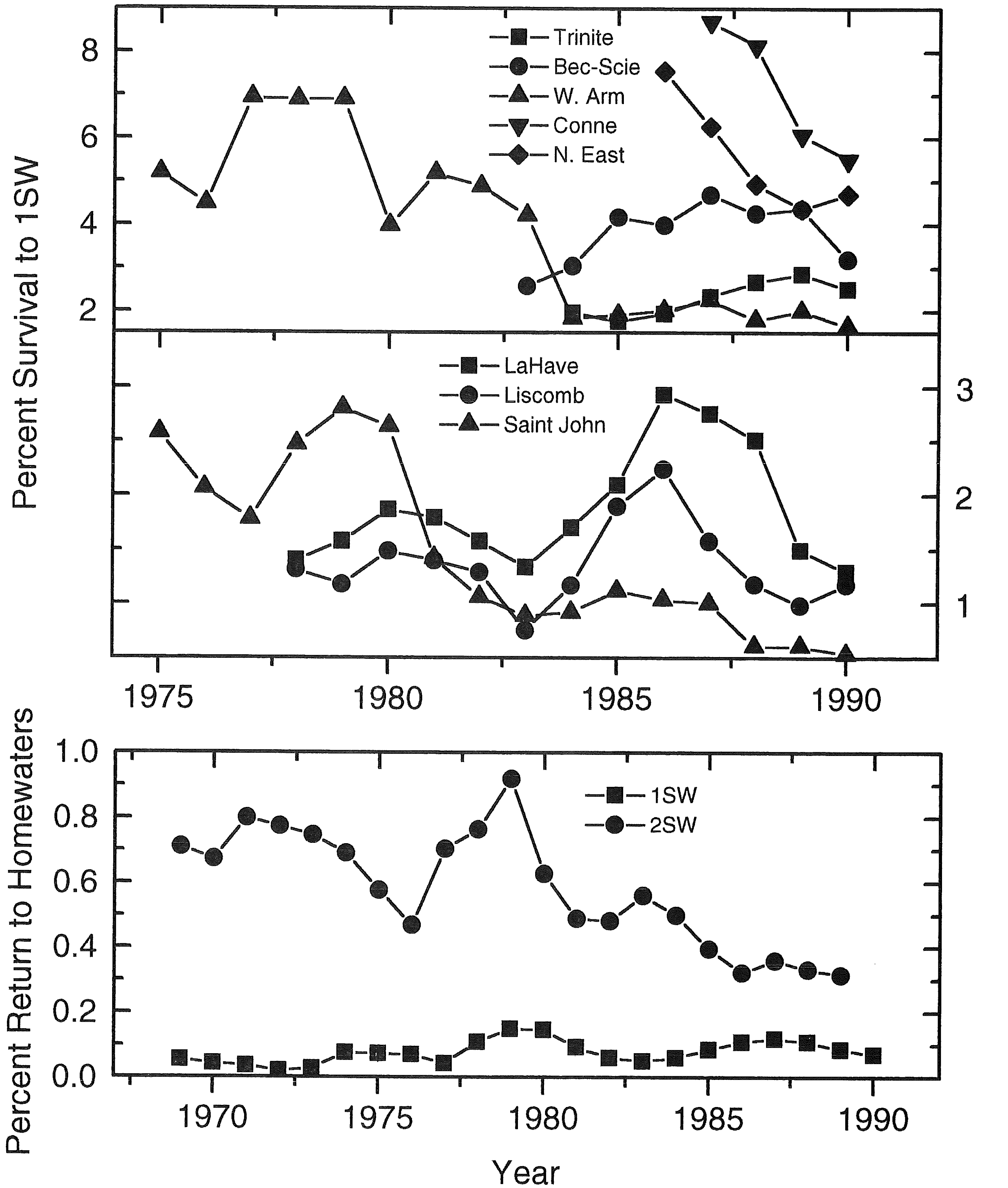


Figure 4.1.1.1 The Faroe Exclusive Economic Zone (EEZ).

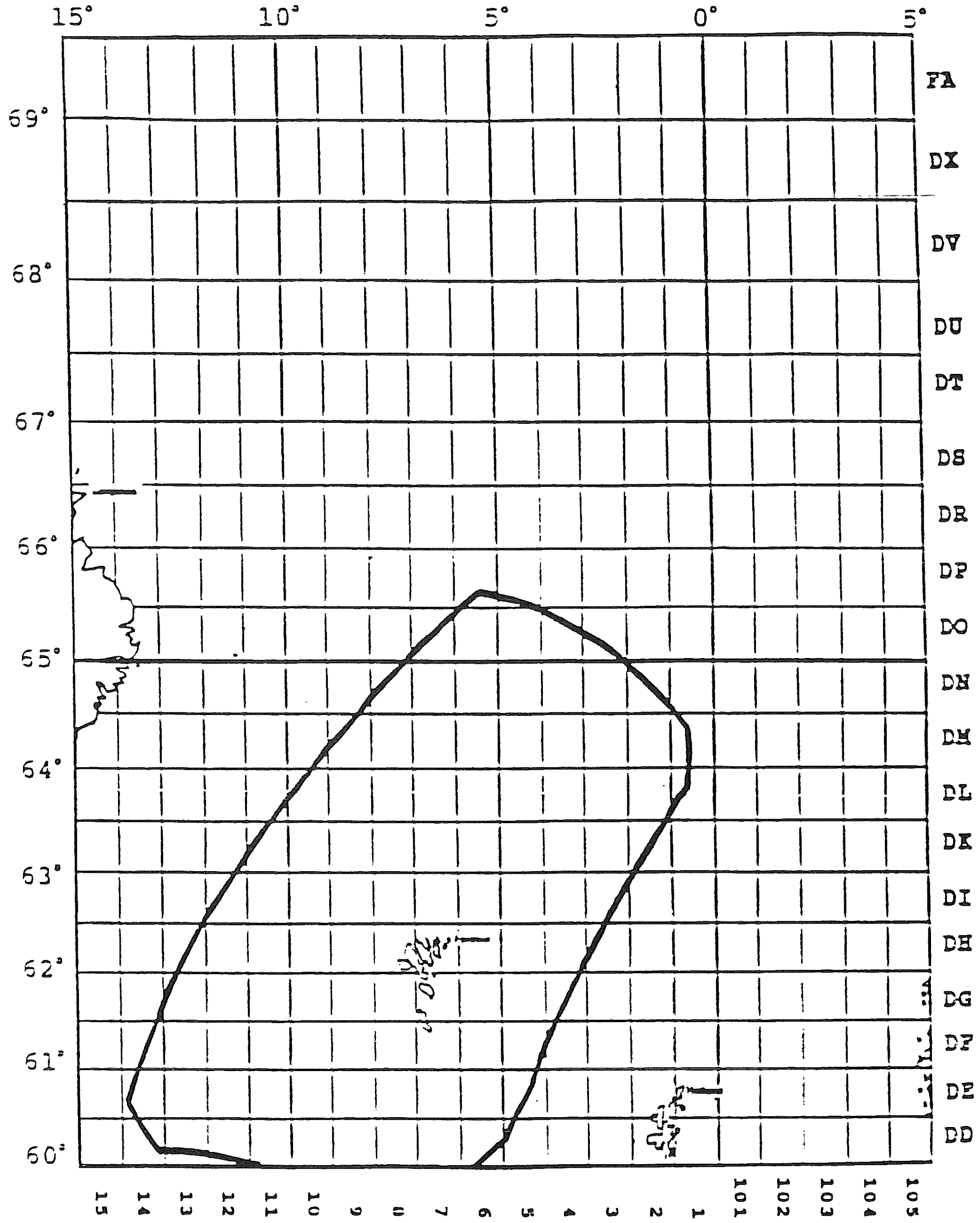


Figure 4.1.2.1. Catch of salmon in number/10 by statistical rectangle from logbooks in the 1990/1991 season.

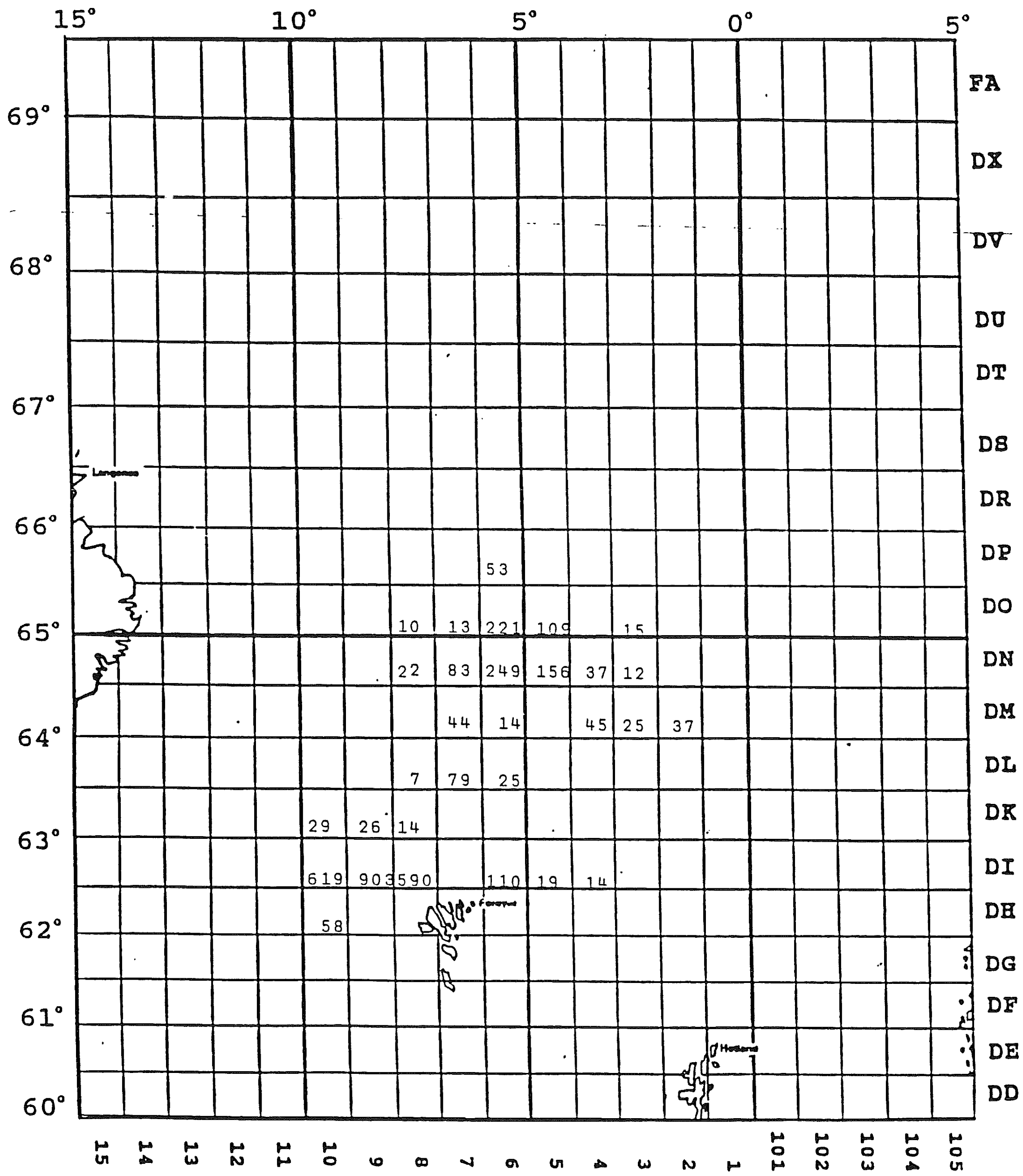


Figure 4.1.3.1. Catch per unit of effort (1000 hooks) of salmon by statistical rectangle from logbooks in the 1990/1991 season.

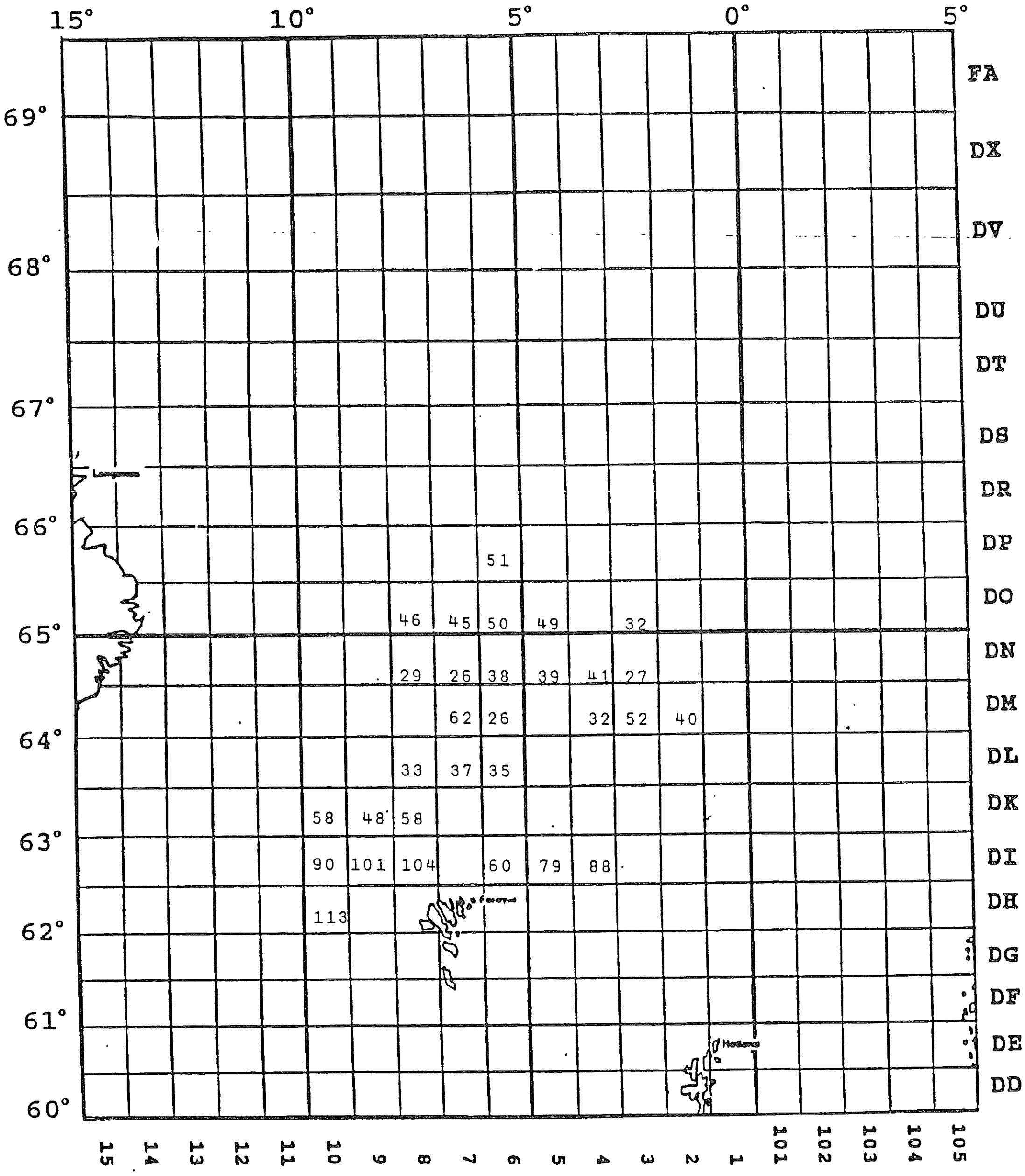


Figure 5.1.3.1. Comparison of harvest estimates for Maine-origin (USA) salmon at West Greenland.

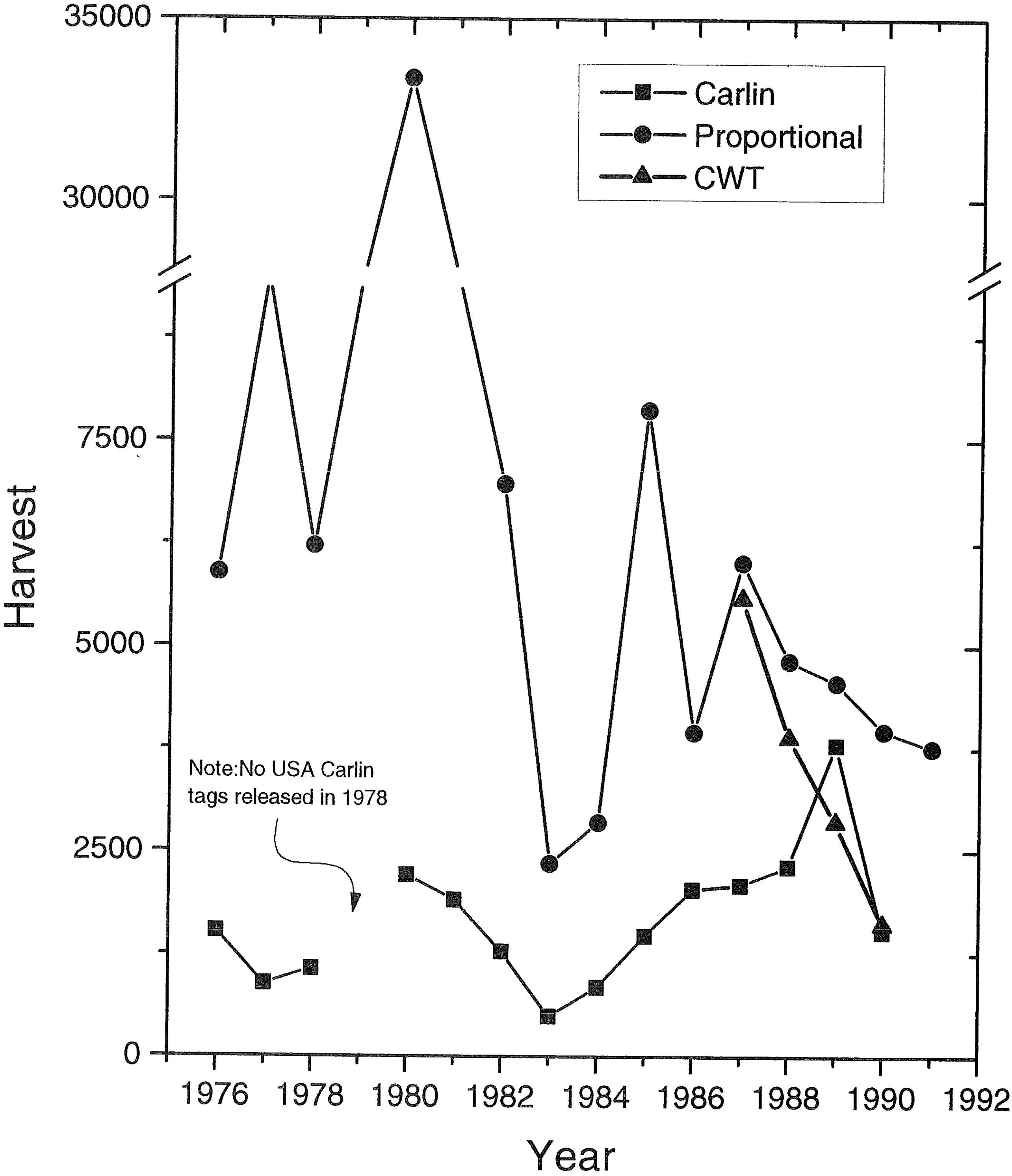


Figure 5.1.3.2. Harvest with confidence limits for 1987-90.

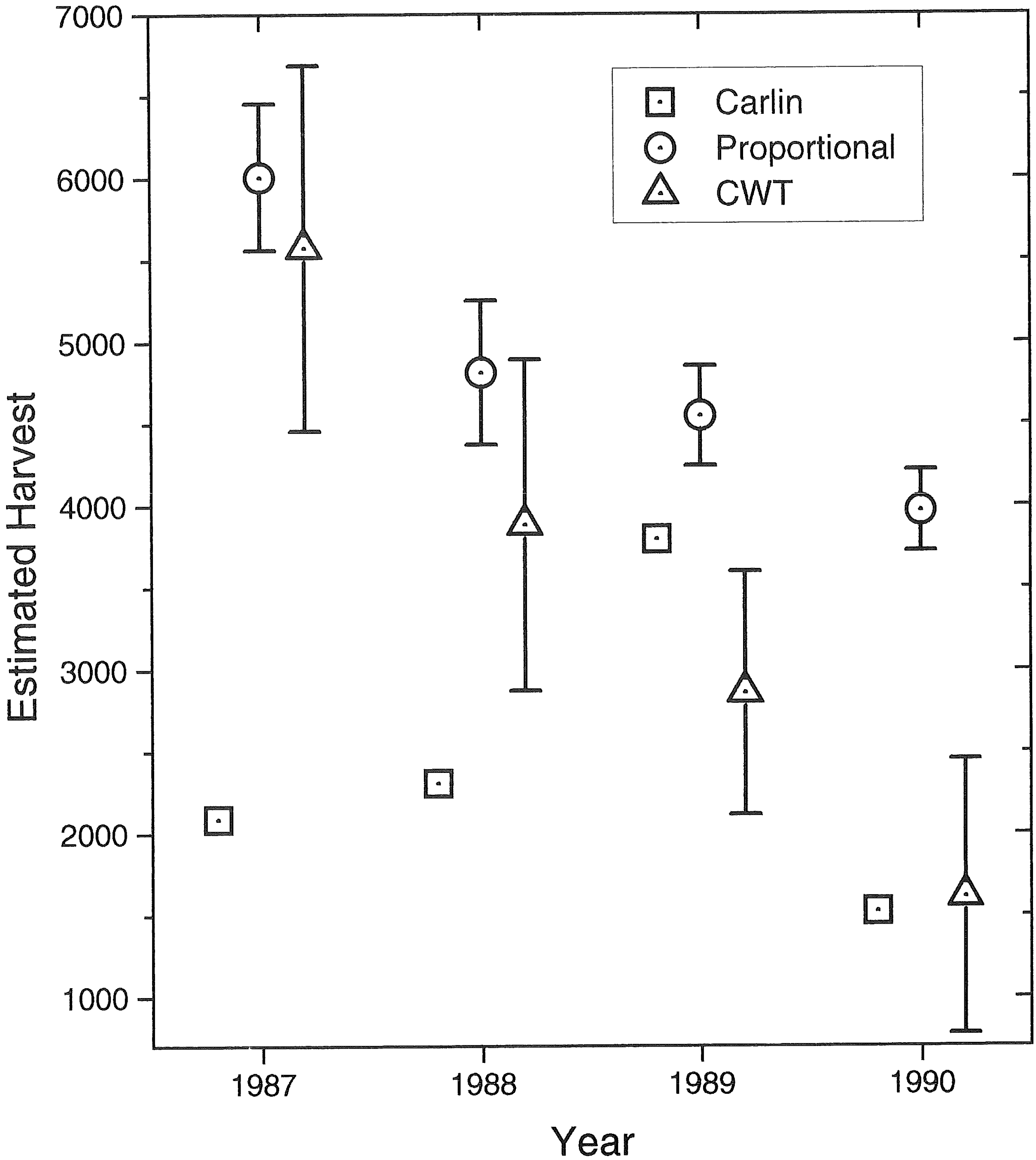


Figure 5.1.4.1. Recovery rate of European and North American origin microtags at West Greenland.

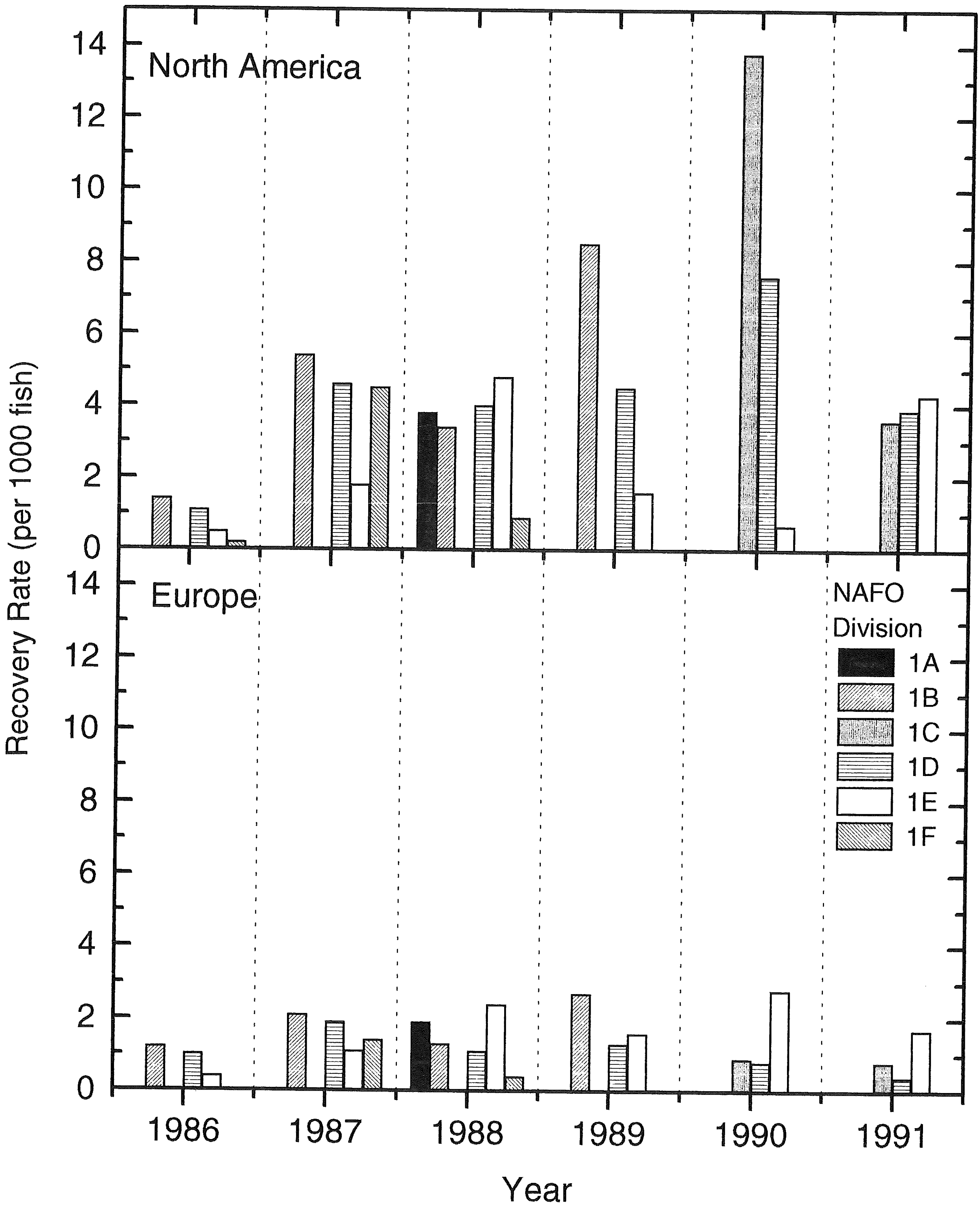


Figure 5.1.4.2. North American proportions standardized to 1990.

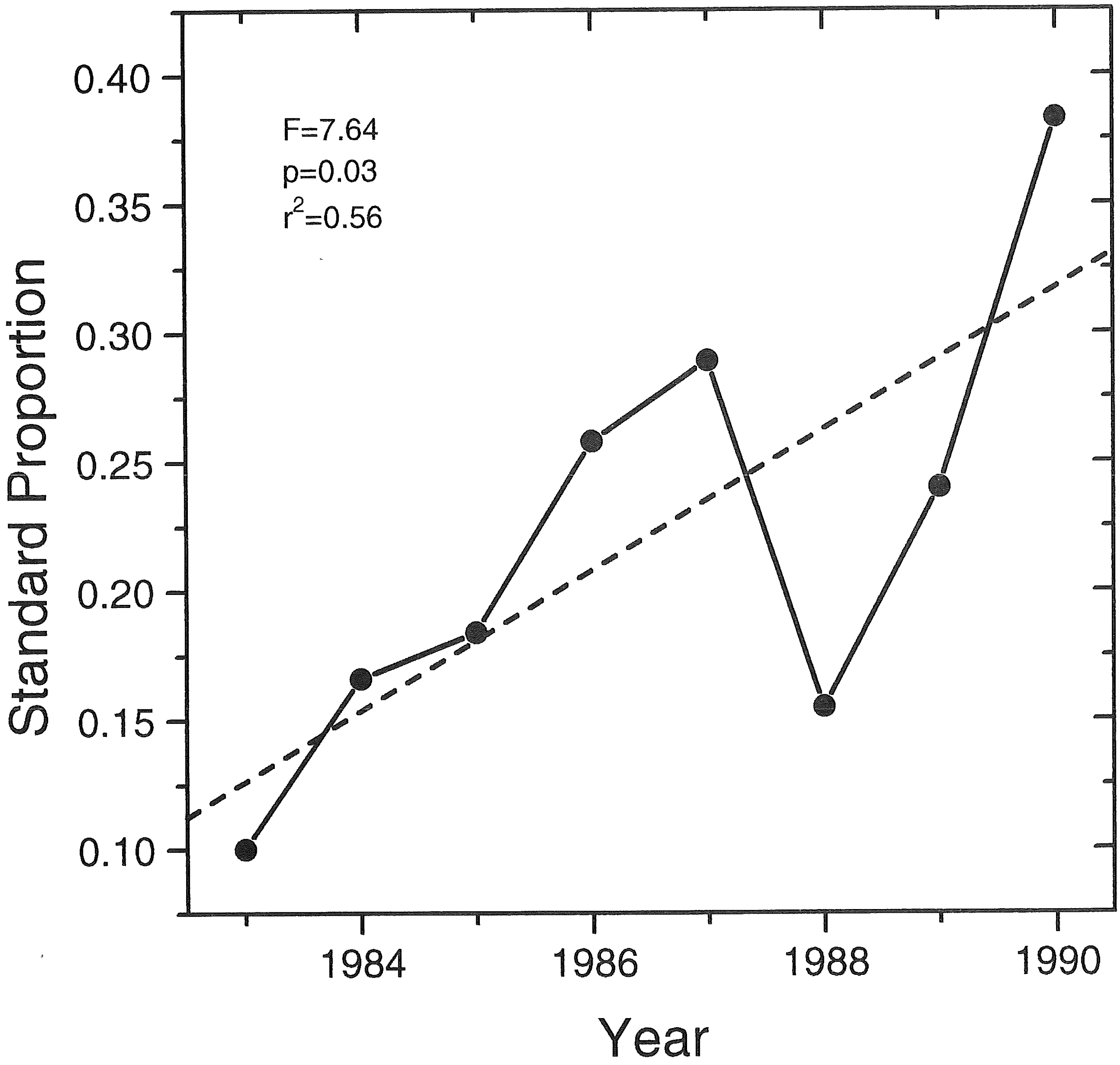


Figure 5.3.1.1. Schematic diagram of run-reconstruction model for North American Atlantic salmon populations.

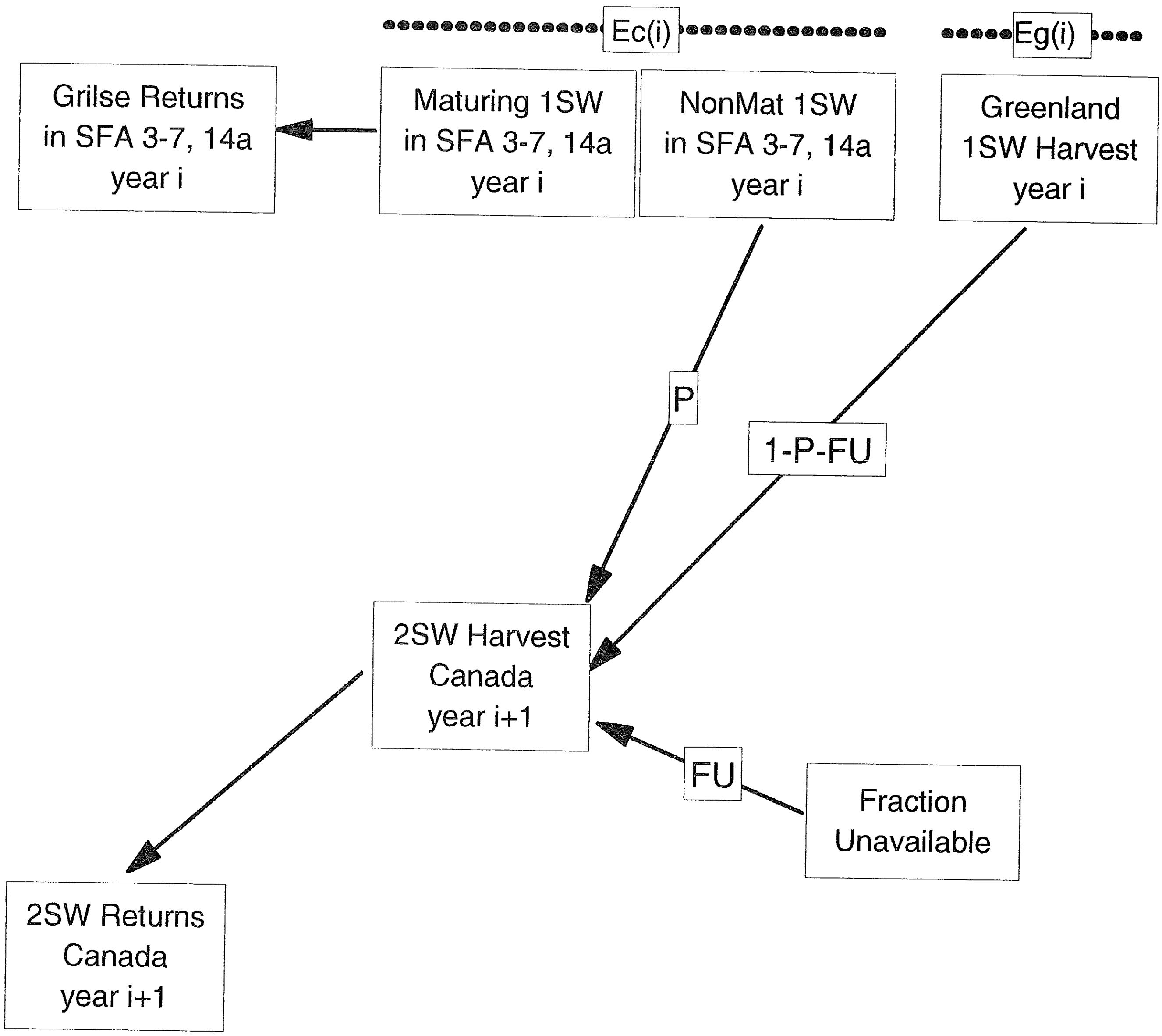


Figure 5.3.1.2. Feasible range of Canadian exploitation rates (Eg(i)) and proportion of stock returning from Canada (P) based on estimated ranges of 1SW returns and catch of non-maturing 1SW salmon in year i.

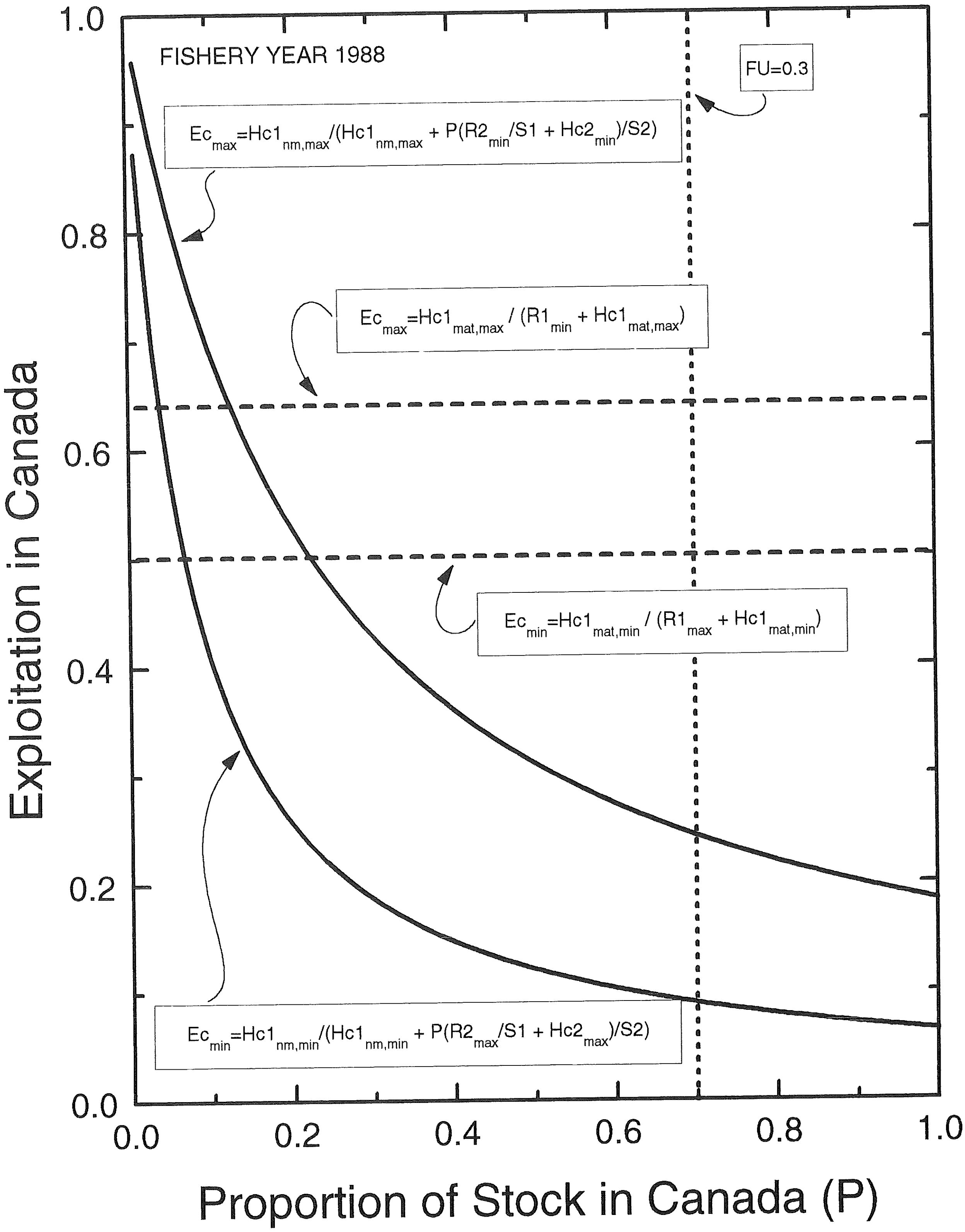


Figure 5.3.1.3. Feasible range of exploitation rates in Canada (Ec(i)) versus Greenland (Eg(i)) in year i as constrained by estimated ranges of total 2SW returns and harvests of 2SW salmon in Canada in year i+1.

[A and B] Lower and upper bounds for Exploitation rate in Greenland based on upper and lower bounds of grilse exploitation in Canada, respectively. Equations for A and B are presented in Figure 5.3.1.2.

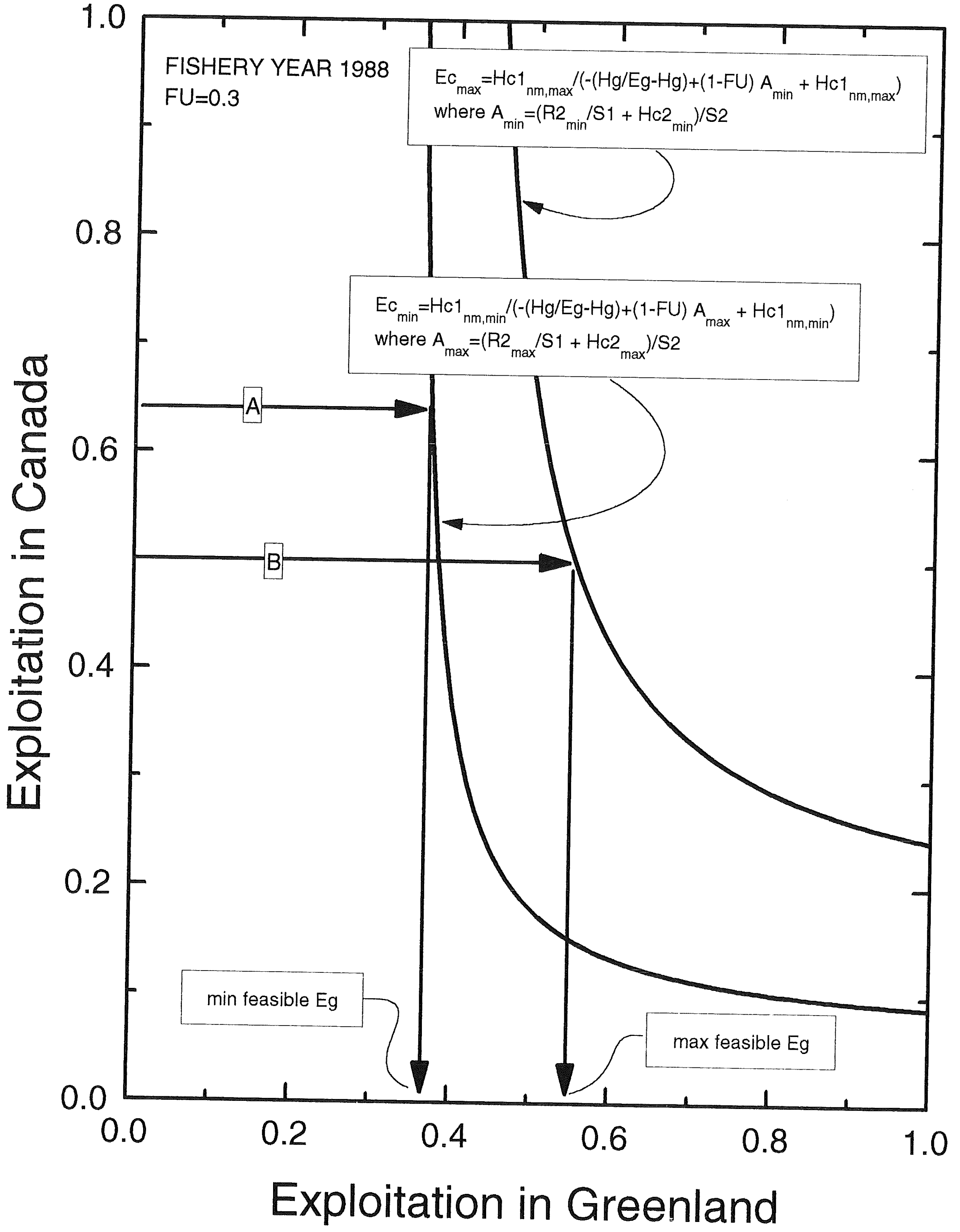


Figure 5.3.1.4. Contour curves of Greenland exploitation rate (Eg(i)) based on maximun values of $Hc1_{nm,max}$. Upper and lower bounds of Eg(i) taken from Figure 5.3.1.3.

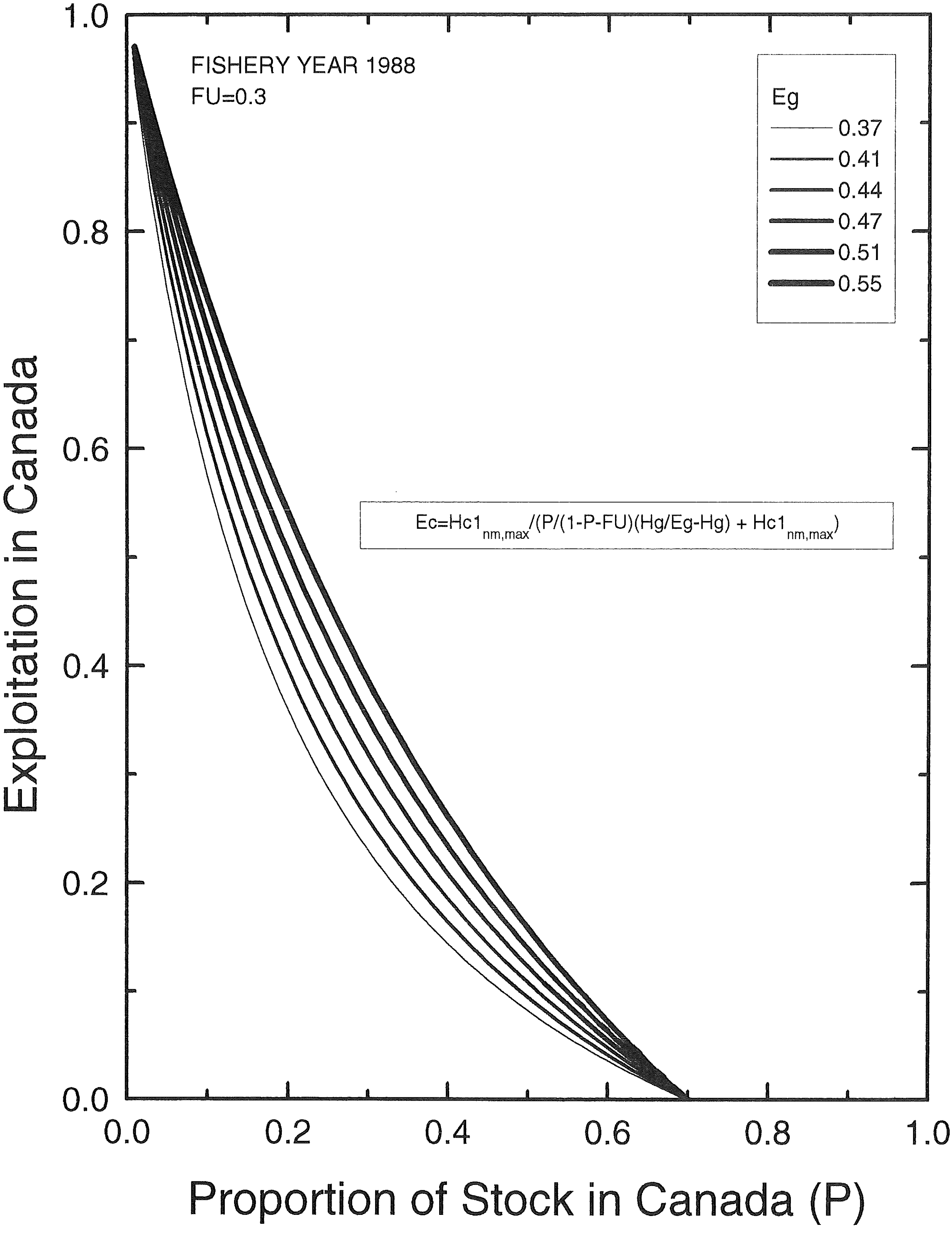


Figure 5.3.1.5. Contour curves of Greenland exploitation rate (Eg(i)) based on minimum values of $Hc1_{nm,min}$. Upper and lower bounds of Eg(i) taken from Figure 5.3.1.3.

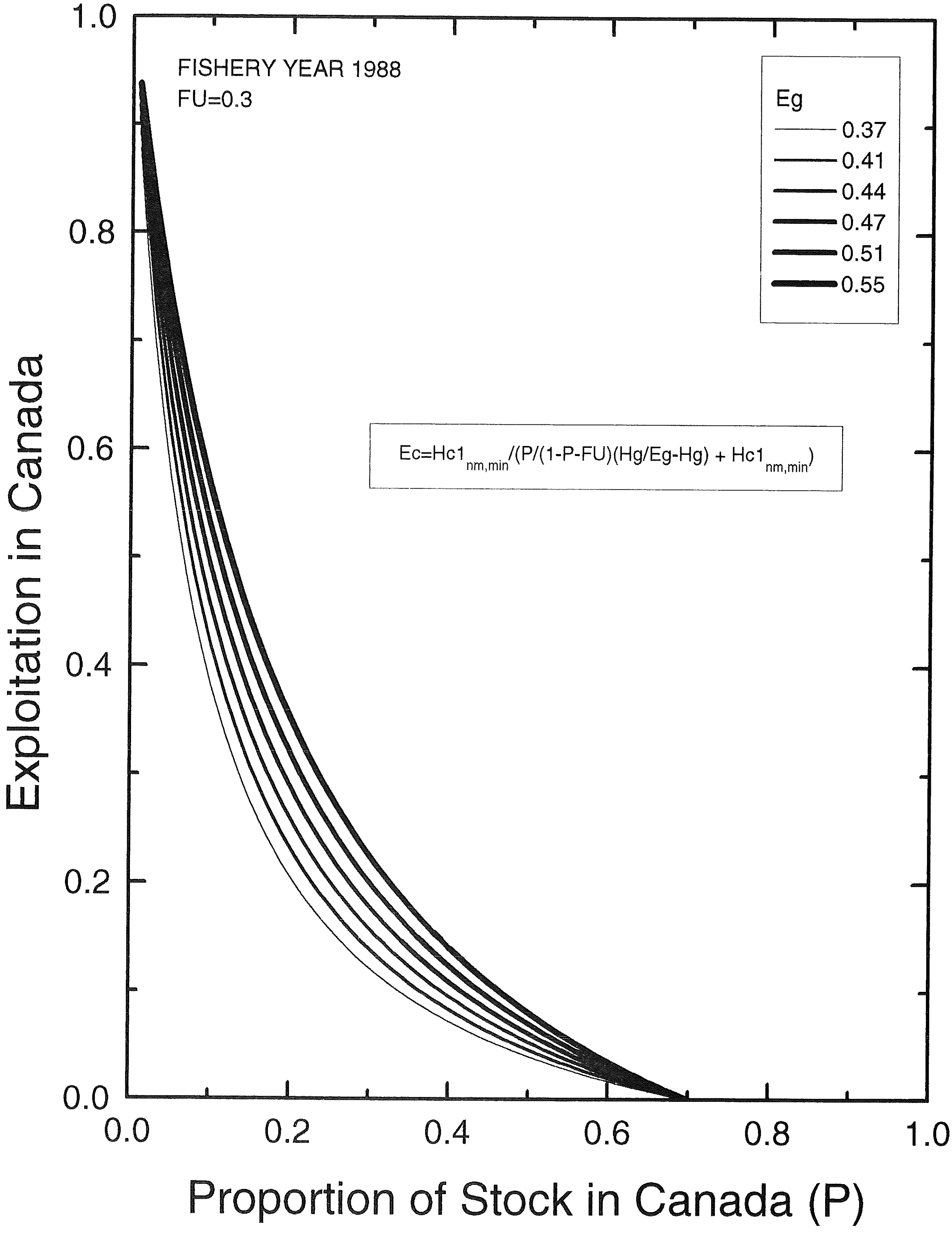


Figure 5.3.1.6. Estimated pre-fishery abundance (year i) of 1SW salmon of North American origin destined to return as 2SW fish in year (i+1). Estimate includes all salmon regardless of location.

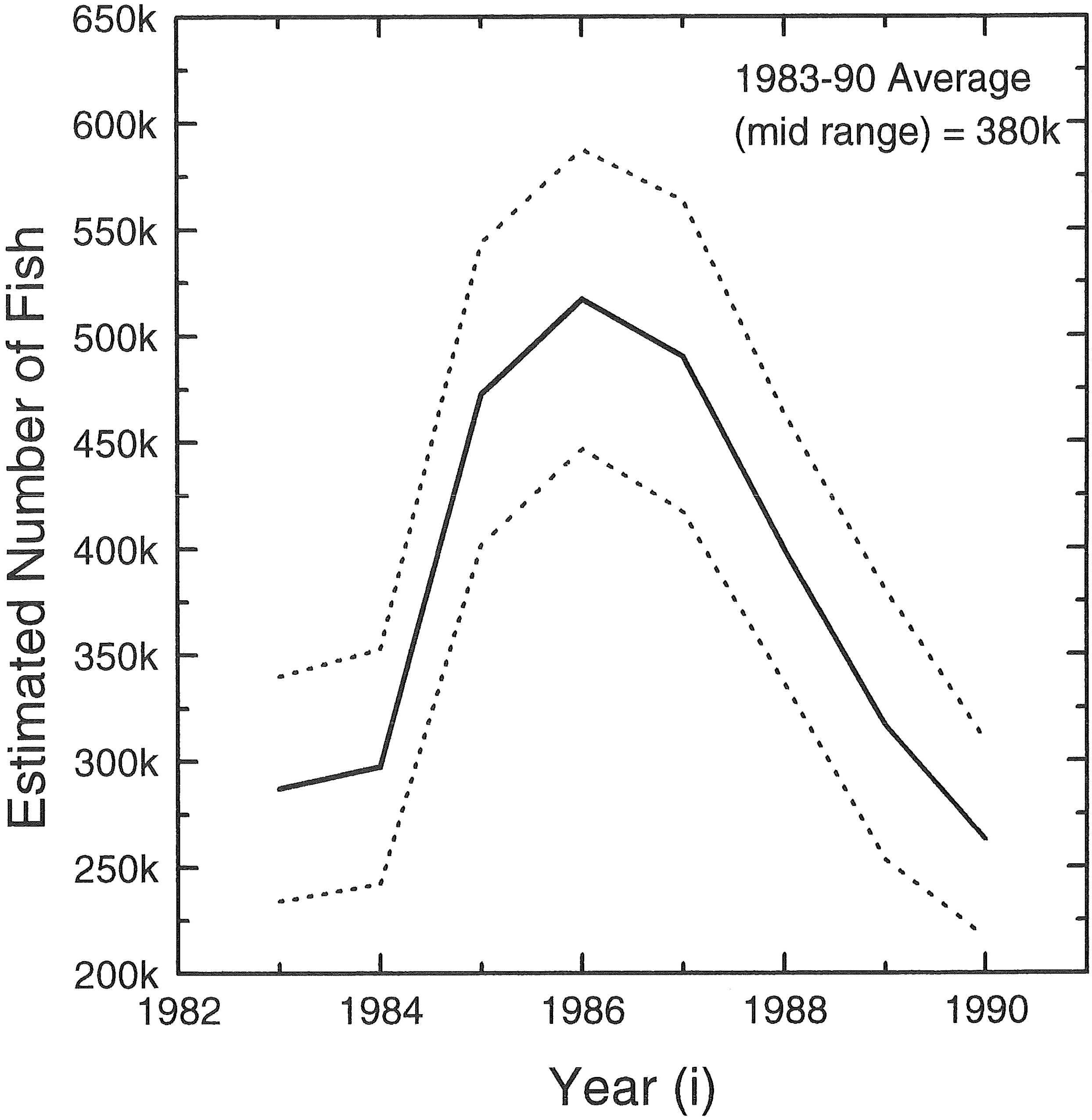


Figure 5.3.1.7. Estimated total abundance of salmon in the West Greenland area prior to the commencement of the fishery. Estimate includes both North American and European stocks and all sea ages.

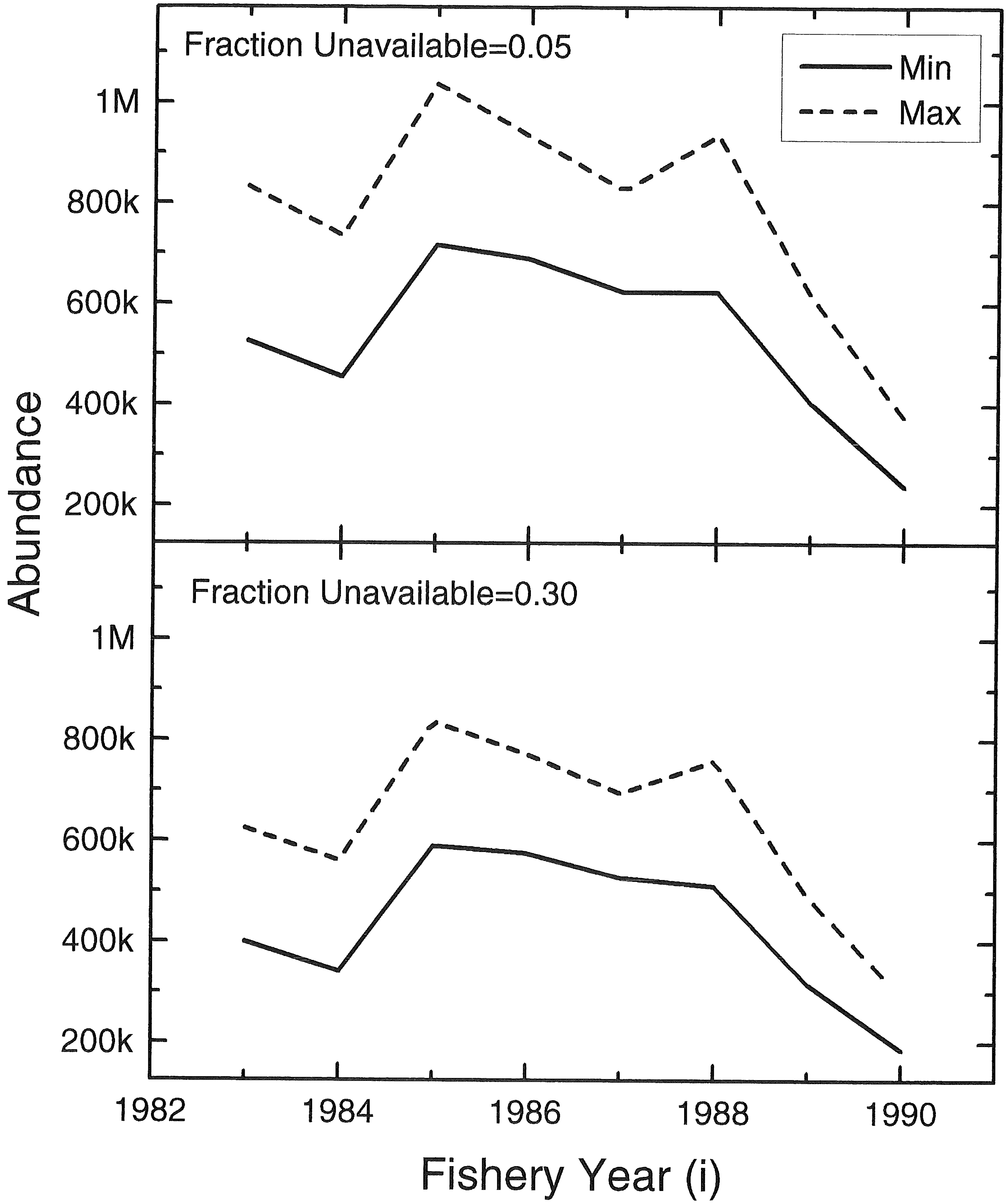


Figure 5.3.1.8. Estimated range of proportions (P) of North American salmon returning from Canadian fisheries. The proportion returning from Greenland is defined as 1-P-FU where FU is the fraction of the stock unavailable to any fishery.

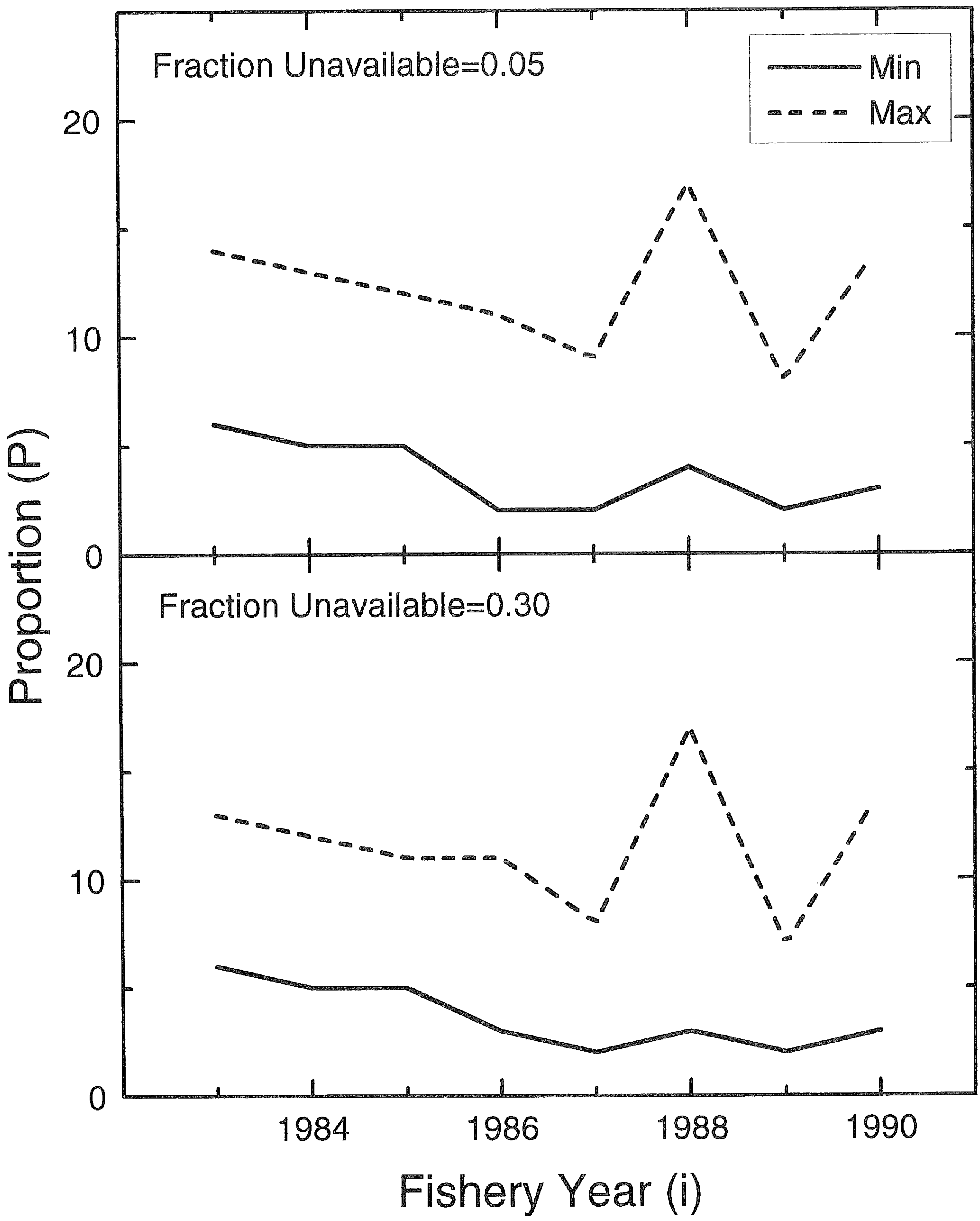


Figure 5.3.2.1. Predicted number of spawners remaining after fisheries on non-maturing 1SW salmon in Canada (C1) and Greenland (G1) and 2SW salmon in Cananda (C2). Pre-fishery abundance of 1SW salmon destined to return as 2SW spawners is 200,000 fish.

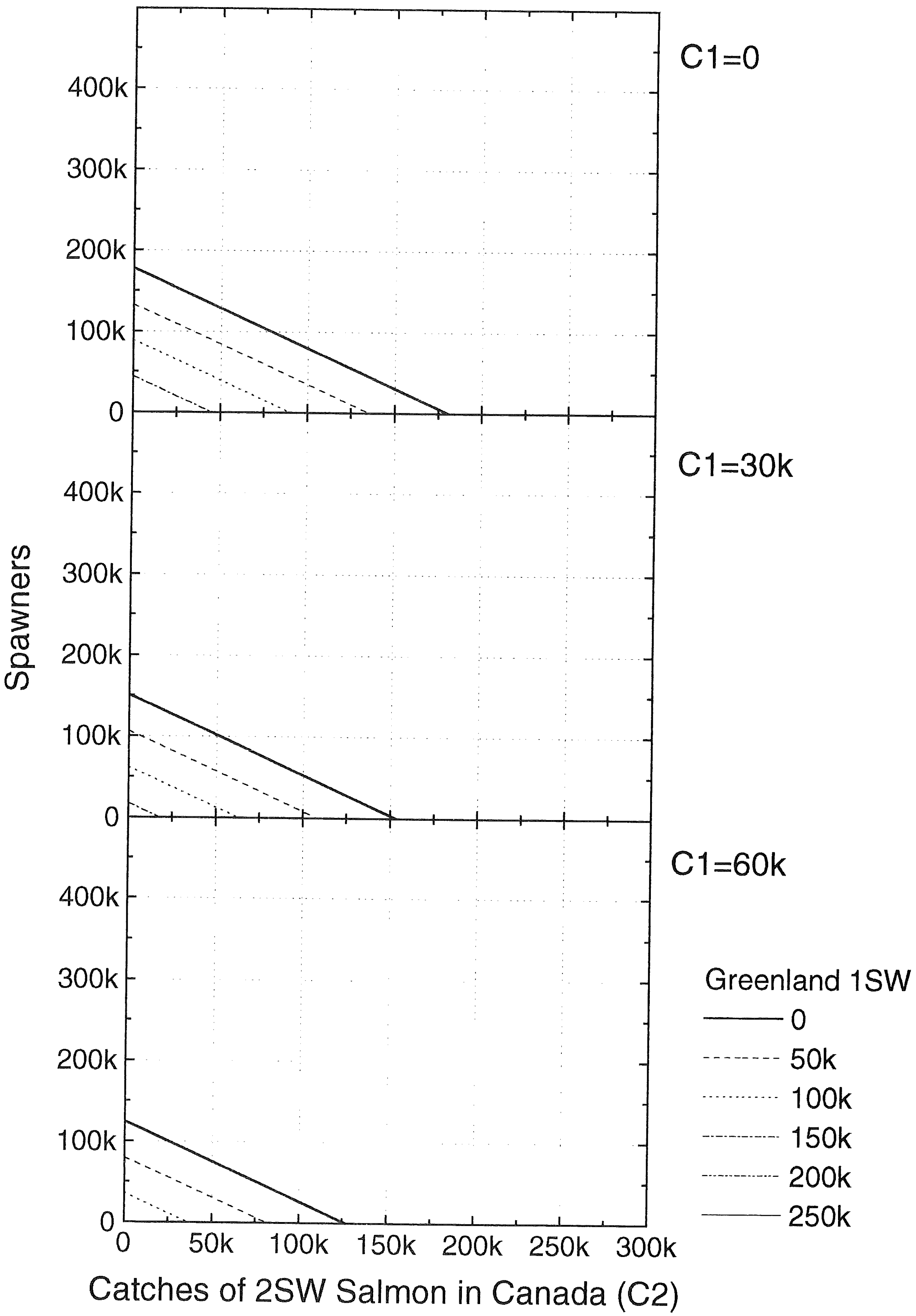


Figure 5.3.2.2. Predicted number of spawners remaining after fisheries on non-maturing 1SW salmon in Canada (C1) and Greenland (G1) and 2SW salmon in Cananda (C2). Pre-fishery abundance of 1SW salmon destined to return as 2SW spawners is 400,000 fish.

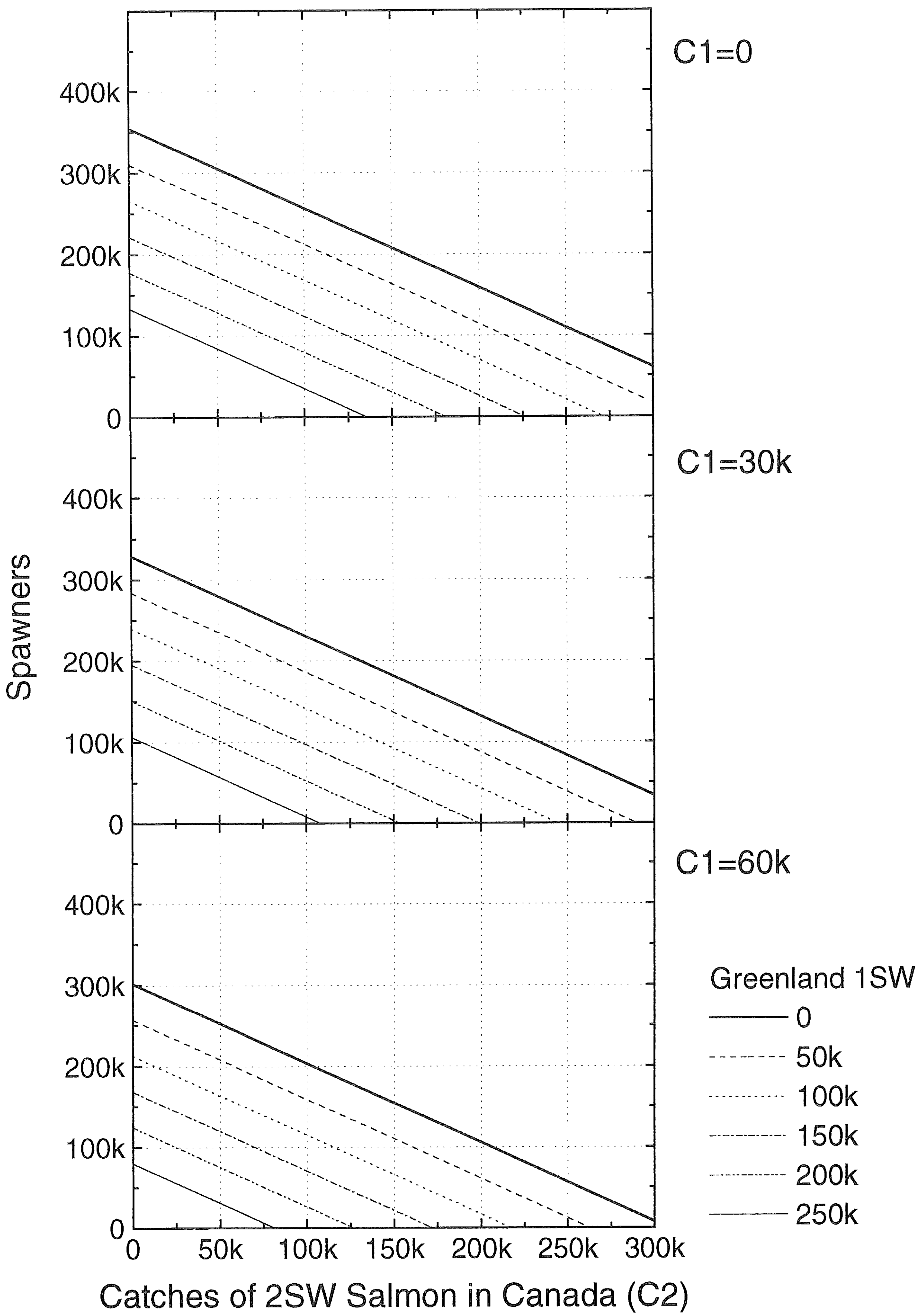


Figure 5.3.2.3. Predicted number of spawners remaining after fisheries on non-maturing 1SW salmon in Canada (C1) and Greenland (G1) and 2SW salmon in Cananda (C2). Pre-fishery abundance of 1SW salmon destined to return as 2SW spawners is 600,000 fish.

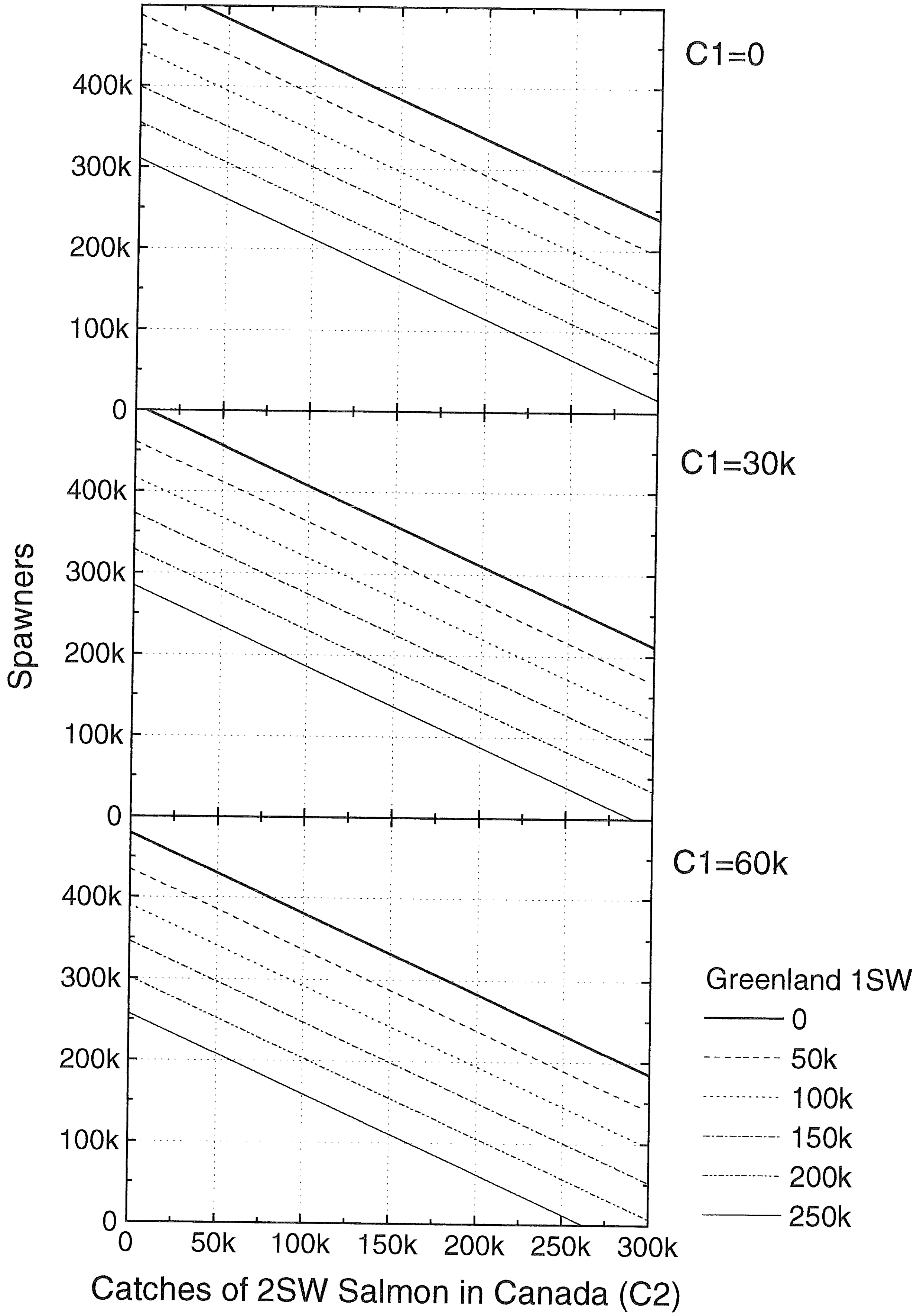


Figure 5.3.2.4. Relationship between stock and recruitment and stock condition.

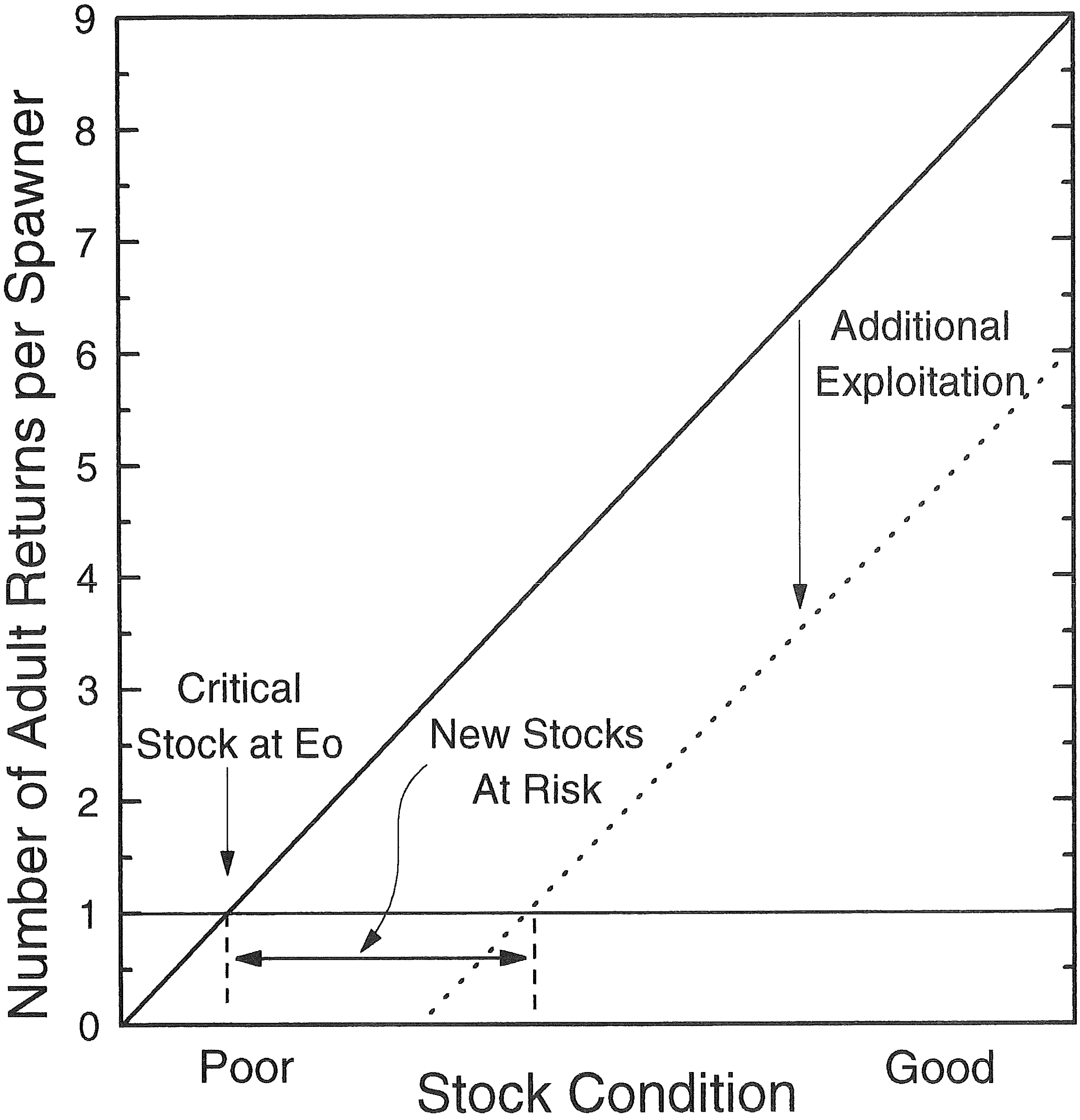


Figure 5.3.4.1. Effect of Carlin tag reporting rate and proportion of Maine origin stocks available to the fisheries in Greenland and Canada. Upper line of each panel represents fishery area exploitation with a tag reporting rate adjustment of 2; lower line, reporting rate is unadjusted. Midpoint represents average of the perimeter values.

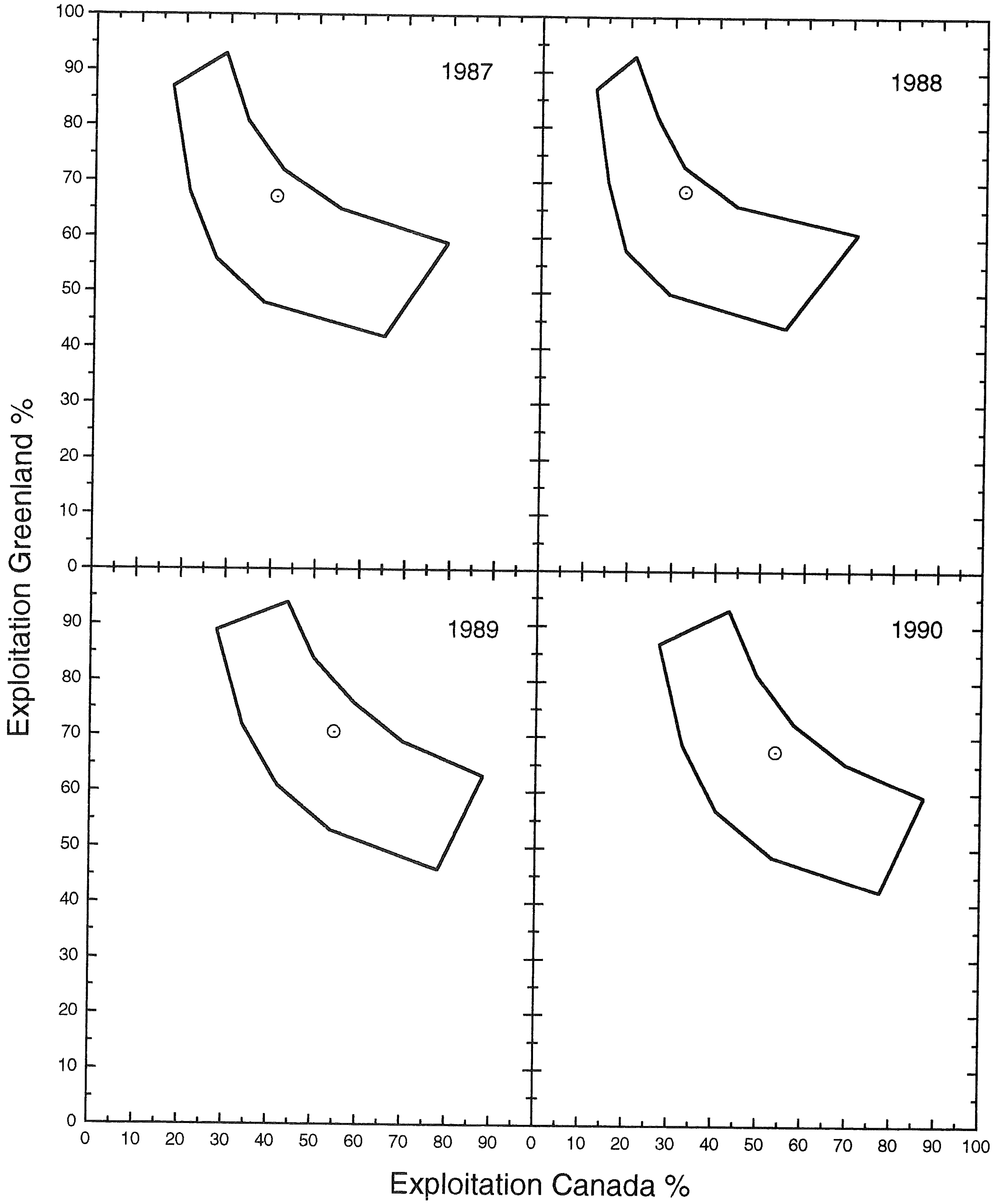
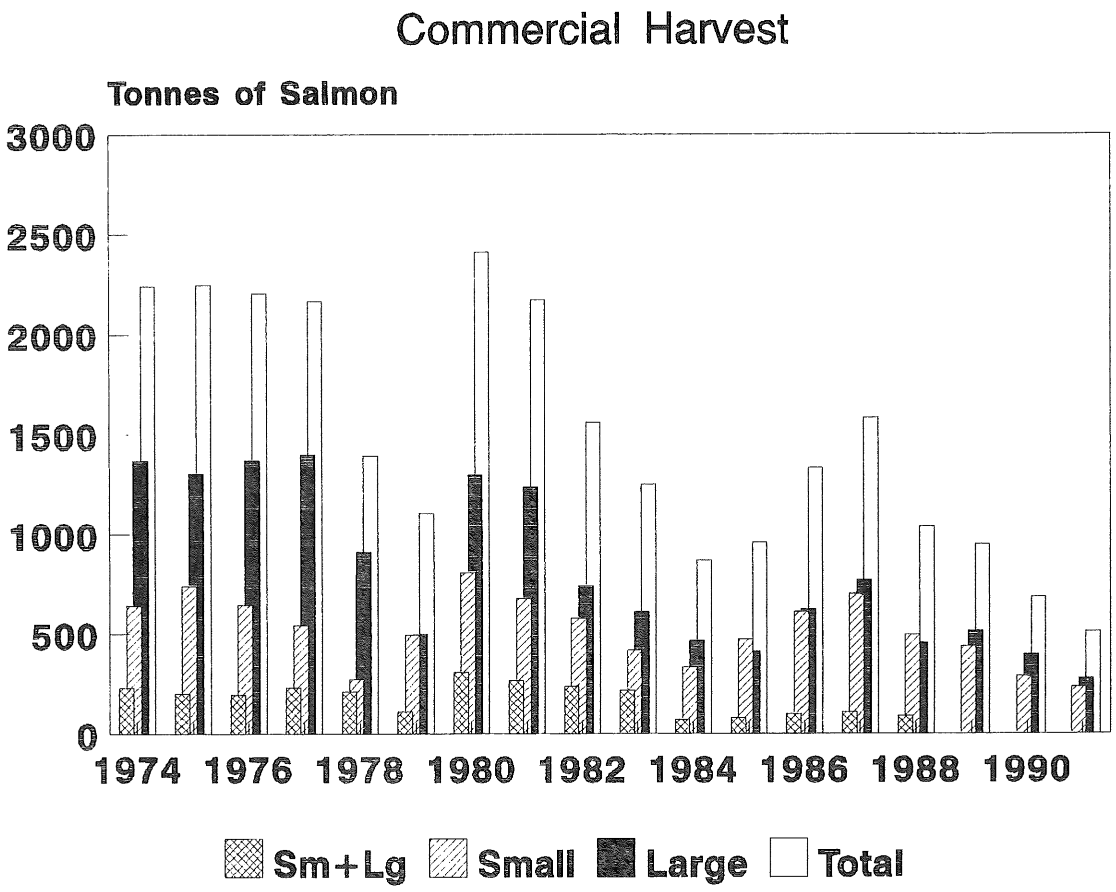


Figure 6.1.1. Canadian landings of Atlantic salmon, 1974-1991.



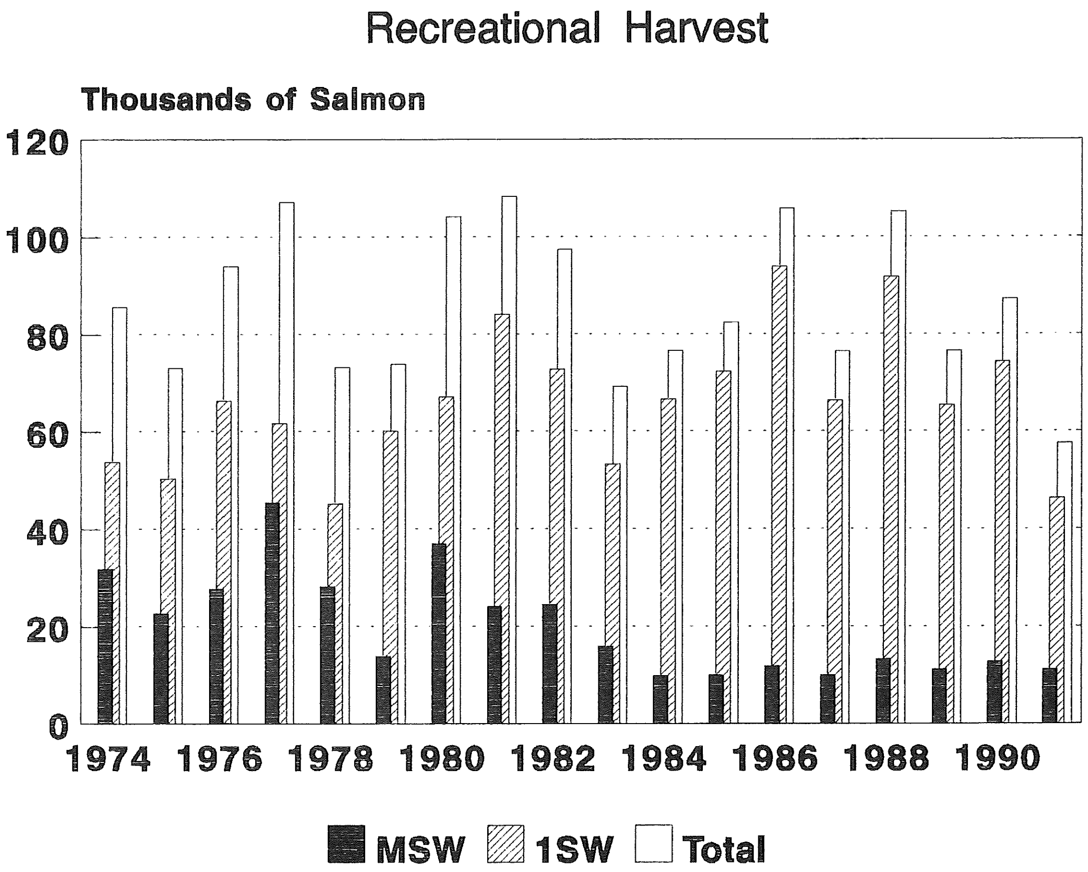
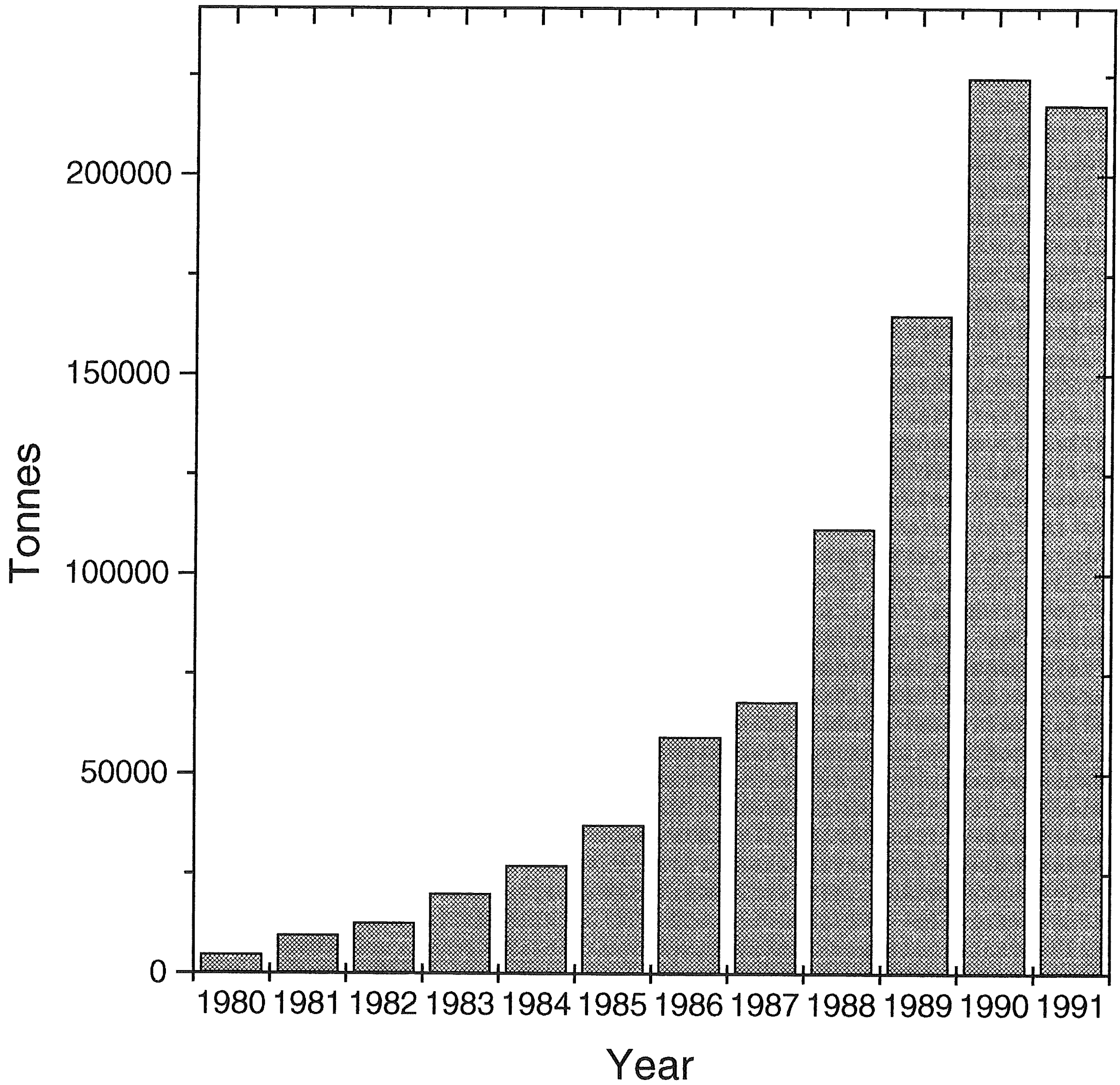


Figure 9.1. Production of farmed salmon in the North Atlantic area.



APPENDIX 1

TERMS OF REFERENCE

(C. Res. 1991/2:7:5 The Working Group on North Atlantic Salmon (Chairman: Dr. K. Friedland, USA) will meet in Dublin, Ireland from 5-12 March 1992 to:

1. With respect to Atlantic salmon in each Commission area, where relevant:

   a) describe the events of the 1991 fisheries with respect to catches, gear, effort, composition and origin of the catch (including escapees and sea ranched fish), and rates of exploitation;

   b) describe the status of the stocks occurring in the Commission area;

   c) begin a time series of aggregate estimates of all unreported catches, including those taken in international waters (the latter should be provided separately);

   d) specify data deficiencies and research needs;

   e) evaluate the by-catches of fish, birds and marine mammals in the salmon drift-net fisheries.

2. With respect to the West Greenland Commission, propose and evaluate methods to estimate:

   a) abundance of salmon in the area of the fishery at the time it operates;

   b) total abundance of stocks exploited by the fishery wherever they are;

   c) possible catch levels based upon maintaining adequate spawning biomass;

   d) some index based on the rivers which make a major contribution to the West Greenland fishery.

3. Evaluate the following management measures on the stocks and fisheries occurring in the respective Commission areas:

   a) regulations introduced into the Norwegian salmon fisheries in 1989;

   b) quota management measures taken in 1990 and 1991 in the Newfoundland and Labrador commercial salmon fisheries.

4. With respect to Atlantic salmon in the Northeast Atlantic Commission and West Greenland Commission areas, provide an inventory of parasites and diseases of wild and reared salmon by country.

5. With respect to Atlantic salmon in the West Greenland Commission area, evaluate the effects which management of the West Greenland fishery has had on stocks in homewaters.

6. With respect to Atlantic salmon in the NASCO area, provide a compilation of microtag, finclip, and external tag releases by ICES Member Countries in 1991.

7. With respect to Atlantic salmon in the West Greenland Commission area, examine historical data on catches and stock composition for the presence of predictable patterns and evaluate the adequacy of sampling programmes to estimate stock compositions by area and time period.

APPENDIX 2

DOCUMENTS SUBMITTED TO THE WORKING GROUP

1. Dunkley, D.A. Report of the United Kingdom (Scotland) for 1991.

2. Reddin, D.G. Evaluations of trends in North American proportion at Greenland.

3. Reddin, D.G. and L.T. Marshall. Index of abundance for the Greenland Fishery.

4. Reddin, D.G. Identification of North American and European Atlantic Salmon (Salmo Salar L.) caught at West Greenland in 1991.

5. Reddin, D.G. 1991 Database for discrimination at Greenland.

6. Reddin, D.G. and P.B. Short. Lenght, Weight, and Age Characteristics of Atlantic Salmon (Salmo Salar L.) of North American and European Origin Caught at West Greenland in 1991.

7. Reddin, D.G. Environmental conditions in the Northwest Atlantic.

8. Møller Jensen, J. The Salmon Fishery at West Greenland 1991.

9. Russell, I.C., E.C.E. Potter, D.G. Reddin and K.D. Friedland. Recoveries of coded wire microtags from salmon caught at West Greenland in 1991.

10. Potter, E.C.E., L. Kell and D.G. Reddin. The use of a neutral network to distinguish North American and European Salmon (Salmo Salar L.) using scale characteristics.

11. Friedland, K.D., L.W. Stolte, T.F. Meyers and E.T. Baum. Estimated Harvest of USA-Origin 1-SW Salmon in Greenland in 1987-1990.

12. Friedland, K.D., P.J. Rago and E.T. Baum. Carlin Tag returns and harvest estimates of USA Origin Salmon in Greenland, 1967-1991.

13. Stolte, L.W. Development and implementation of a Video exchange program between the Atlantic Salmon producing Countries.

14. Rago, P.J. and K.D. Friedland. Marine exploitation of maine Atlantic Salmon stock.

15. Rago, P.J. Continental run reconstruction models for Atlantic Salmon: application to North America and West Greenland.

16. Rago, P.J., D.G. Reddin and K.D. Friedland. Harvest estimation procedures for USA Salmon stocks: proportional Harvest method.

17. Baum, E.T. Diseases and /or disease agents of Atlantic Salmon in the USA.

18. Anon. Report of the Study Group on the North American Salmon Fisheries.

19. Anon. Report of the Study Group on the Norwegian Sea and Faroes Salmon Fishery.

20. Anon. Report of workshop on salmon assessment methods.

21. Marshall, L.T. Database - Scotia Fundy Region, Canada.

22. Rago, P.J. Methods of Trend Analysis.

23. Anon., 1991. Extract of the report of the Working Group on Pathology and diseases of Marine Organisms.

APPENDIX 3

REFERENCES

Anon. 1982. Report of Meeting of the Working Group on North Atlantic Salmon. ICES Headquarters, Copenhagen, 13-16 April 1982. ICES, Doc. C.M. 1982/Assess:19.

Anon. 1984. Report of Meeting of the Working Group on North Atlantic Salmon. Aberdeen, 20 April - 4 May 1984. ICES, Doc. C.M.1984/Assess:16.

Anon. 1985. Report of Meeting of the Working Group on North Atlantic Salmon. St. Andrews, New Brunswick, Canada, 18-20 September 1984. ICES, Doc. C.M.1985/Assess:5

Anon. 1986. Report of the Working Group on North Atlantic Salmon, Copenhagen, 17-26 March 1986. ICES, Doc. C.M.1986/Assess:17.

Anon. 1987. Report of the Working Group on North Atlantic Salmon. Copenhagen, 21-31 March 1988. ICES, Doc. C.M.1988/Assess: 16

Anon. 1988a. Report of the Working Group on the North Atlantic Salmon. Copenhagen, 21-31 March 1988. ICES Doc. C.M.1988/Assess:16

Anon. 1988b. Report of the Study Group on the North American Salmon Fishery. St. John's, Newfoundland, 1-4 March 1988. ICES, Doc. C.M. 1988/M:4

Anon. 1989a. Report of the Working Group on North Atlantic Salmon, Copenhagen, 15-22 March 1989. ICES, Doc. C.M.1989/Assess:12

Anon. 1989b. Report of the Study Group on the North American Salmon Fishery, Leetown, W.Va. USA, 28 February - 3 March 1989. ICES, Doc. C.M. 1989/M:3

Anon. 1990a. Report of the Working Group on North Atlantic Salmon, Copenhagen, 15-22 March 1990. ICES, Doc. C.M.1990/Assess:11.

Anon. 1990b. Report of the Study Group on the North American Salmon Fishery, Halifax, Nova Scotia, 26 February - 2 March 1990. ICES, Doc. C.M. 1990/M:3

Anon. 1991a. Report of the Working Group on North Atlantic Salmon. Copenhagen, 14-21 March 1991. ICES, Doc. C.M.1991/Assess:12.

Anon. 1991b. Report of the Study Group on the North American Salmon Fishery, Leetown, West Virginia, USA, 25 February - 1 March 1991. ICES Doc. C.M.1991/M:6

Anon. 1992a. Report of the Study Group on the North American Salmon Fisheries. St. John's, Newfoundland, Canada. 17-21 February 1992. ICES, Doc. C.M.1992/M:3.

Anon. 1992b. Report of the Study Group on the Norwegian sea and Faroes Salmon Fishery. Dublin, 28 February - 1 March 1992. ICES, Doc. C.M. 1992/M:4

Anon. 1992c. Report of the Workshop on Salmon Assessment Methodology. Dublin, 2-4 March 1992. ICES, Doc. C.M. 1992/M:8

Anon. 1992d. ICES Compilation of Microtag, Finclip and External Tag Releases in 1991. ICES, Doc. C.M.1992/M:9

Anon. 1992e. Report of the Working Group on Pathology and Diseases of Marine Organisms. Copenhagen, 2-5 March 1992. ICES, Doc. C.M.1992/F:2

Christensen, O. and Lear, W.H. 1977. By-catches in salmon drift-nets at West Greenland in 1972. Meddelelser om Grönland, bd 205, nr 5. Denmark.

May, A.W. and Lear, W.H. 1971. Digest of Cana dian Atlantic salmon catch statistics. Fish res. Board Can. Tech. Rep. 270, 106p.

Noakes, D.J. 1989. A non-parametric approach to generating inseason forecasts of salmon returns. Can. J. Fish. Aquat. Sci. 46:2046-2055.

Pella, J.J. and Robertson, T.L. 1979. Assessment of composition of stock measure mixtures. Fish. Bull. 77: 387-398.

Piatt, J.F. and Reddin, D.G. 1984. Recent trends in the West Greenland salmon fishery, and implications for Thick-billed Murres. In: Marine birds: Their feeding ecology and commercial fisheries relationships. Ed. D.N. Nettleship, G.A. Sanger and P.F. Springer. Ministry of Supply and Services, Canada, 1984.

Pippy, J. (Chairman). 1982. Report of the Working Group on the Interception of Mainland Salmon in Newfoundland. Can. Ms. Rep. Fish. Aquat. Sci. 1654: x + 196p.

APPENDIX 4

RECOMMENDATIONS FROM STUDY GROUPS AND WORKSHOPS

Recommendations of the Study Group on the Norwegian Sea and Faroes Salmon Fishery

1. The Study Group on the Norwegian Sea and Faroes Salmon Fishery should be re-established as the Study Group on North East Atlantic Salmon Fisheries.

2. The new Study Group should meet in Copenhagen for 4 days immediately prior to the meeting of the Working Group on North Atlantic salmon in 1993 to compile relevant data. [If additional questions are posed the meeting should be extended to 5 days.]

3. Data should be provided to re-run the national run-reconstruction model for 1989 and 1990 smolt releases, and a sensitivity analysis should be prepared.

Recommendations of the Study Group on North American Salmon Fisheries

1. The Study Group noted apparent spatial and temporal clustering of the 1991 CWT recoveries from the Canadian fishery and recommended additional analyses to discern broad scale migration patterns.

2. Details of river returns and spawners (by sea-age), egg deposition and target egg depositions have now been provided for 19 stocks/stock complexes in the North American Commission Area. The Study Group recommended that data for all stocks be formatted similar to that of Table 2.2.3.1 of this report.

3. Numerous tabulations of catch, effort, run-size and sea-survival have been provided to infer the present status of stocks and recent/past trends. The Study Group encouraged national agencies to consider the adoption of graphic methods to depict measures of central tendency, trends etc., in their data.

4. Little or no progress was reported on several "requirements" itemized in Anon. (1991b). These topics remain relevant to the development and refinement of models to estimate stock abundance and exploitation rates in marine fisheries. The Study Group again recommended:

   a. Investigation of stock-recruitment relationships for naturally spawning fish in the Penobscot and Saint John rivers.

   b. Examination of forecast models for MSW salmon in an attempt to explain observed recent decreases in the numbers of MSW salmon and increases in the numbers of 1SW salmon returning to some Canadian and USA rivers.

   c. Evaluation of relationships between redd counts and spawning populations and its applicability for North American rivers.

   d. Estimation of maturation rates in the Newfoundland-Labrador salmon fishery (for details, see Sec. 5.2, No. 9 in Anon. 1991b).

5. If there is a requirement by ICES for the Study Group to meet in 1993, it is recommended that the meeting occur in Leetown W. VA. prior to the meeting of the Working Group on North Atlantic Salmon.

Recommendations of the Workshop on Salmon Assessment Methodology

1. It was recommended that contacts established during the workshop should be maintained. When further development or refinements take place, a further workshop could be considered. A further workshop could be considered if a special topic or theme warranted review.

APPENDIX 5

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