International Council for the
Exploration of the Sea

C.M.1987/Assess:12

REPORT OF THE WORKING GROUP ON NORTH ATLANTIC SALMON

Copenhagen, 9 - 20 March 1987

Corrigendum

Page 29: In the formula in the third paragraph, the term "$-0.00710x^2$" should be replaced by "$-0.0710x^2$".

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Copenhagen, 9 - 20 March 1987

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*General Secretary
ICES
Palægade 2-4
DK-1261 Copenhagen K
DENMARK

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0 INTRODUCTION

The Working Group on North Atlantic Salmon met at ICES headquarters from 9-20 March 1987. The following members participated:

E. Baum	USA
J. Browne	Ireland
W.G. Doubleday (Chairman)	Canada
C. Eriksson	Sweden
K. Friedland	USA
L.P. Hansen	Norway
T. Hansen	Norway
Sv.Aa. Horsted	Denmark
A. Isaksson	Iceland
H.í. Jákupsstovu	Faroe Islands
J. Møller Jensen	Denmark
G.J.A. Kennedy	UK (N. Ireland)
R.A. Lund	Norway
T.L. Marshall	Canada
D.J. Meerburg	Canada
A.L. Meister	USA
E.A. Niemelä	Finland
T.R. Porter	Canada
E.C.E. Potter	UK (England)
P.J. Rago	USA
R. Randall	Canada
D.G. Reddin	Canada
J.A. Ritter	Canada
W.M. Shearer	UK (Scotland)
M.M. Thibault	France
W. D. Watt	Canada

1 MAIN TASKS

At its 1986 Statutory Meeting, ICES resolved that the Working Group should meet at ICES Headquarters in 1987 to consider questions posed to ICES by the North Atlantic Salmon Conservation Organization (NASCO) (Appendix 1). In addition, the Chairman of ACFM requested all assessment working groups to consider the issues of "Safe Biological Limits" for exploitation of fish stocks and description of the long-term potential of fish stocks.

Fifty documents were presented to the Working Group (Appendix 2). Although many new and relevant data were presented to the Working Group, available data remain insufficient to permit the provision of complete answers to many of the questions posed. Section 5 of the report considers additional research needed to provide more complete answers to the questions posed by NASCO and ICES.

The Working Group, in reassessing its role, determined that its task was to bring together available information relative to the conservation and utilization of the Atlantic salmon resource in the North Atlantic. In recent years, the demands on the Working Group for advice to ACFM have increased with requests now from both NASCO and ICES. The Working Group has been able to provide advice by drawing upon the extensive data bases of the participating member countries. Although these data bases continue to expand, it has become increasingly difficult to provide complete answers to new and complex questions posed by NASCO and ICES. For instance, although the Working Group is able to provide much descriptive information pertaining to the fisheries and the salmon harvest, it has not been able to provide accurate estimates of non-reported catches and fishing effort, nor designate stock origins beyond continent of origin in the sea fisheries, although progress is being made with respect to the latter. Similarly, the Working Group has provided ranges in estimates of impact of the mixed-stock fisheries, although further refinement of these assessments is dependent upon new information on natural mortality rates, non-catch fishing mortality, and tag reporting rates, which seem only obtainable through further extensive and costly research efforts. This year, the Working Group has estimated the abundance of salmon at Greenland by an indirect method. Although the Working Group welcomes new methods that would enable direct estimation of abundance before and during the fisheries, it recognizes that estimates which would be useful for managing the stocks might only be acquired at great expense.

In general, the Working Group is able to answer questions pertaining to catches and the biology of the different stocks and provide general estimates of yield consequences relative to the mixed-stock fisheries. It is not, however, able to advise on appropriate catch, nor is it likely to be able to do so without new and detailed information on salmon abundance and stock composition in the fishing areas and major advances in stock forecasting capabilities. Both the development of appropriate methodologies and their required application will be costly.

1.1 Framework for Scientific Advice on Management of Salmon

In 1986 and again in 1987, the Working Group was asked by ICES to consider the concept of safe biological limits for the exploitation of Atlantic salmon in the North Atlantic. The issue was explored in a preliminary way in Anon. (1986a), where attention was drawn to criteria which might indicate whether safe biological limits for exploitation had been exceeded and to aspects of the biology of Atlantic salmon and the nature of fisheries on the species which were different from marine species.

In considering the question of catches within safe biological limits again in 1987, the Working Group considered that it would be useful to examine the question in the broader context of the framework for scientific advice on management of stocks and fisheries within which the Working Group provides advice.

In recent years, advice has been provided on the composition of catches by age and geographical origin and on the effect of the catch and age of first capture of distant fisheries on returns to home-water stocks. Such advice does not directly respond to the need for measures to conserve salmon stocks, nor to the need for a basis to share the harvest of salmon stocks among fisheries.

In theory, conservation of salmon stocks could be based on controlling exploitation in relevant fisheries to ensure an adequate spawning biomass. In practice, there are formidable obstacles to such an approach. There are hundreds of stocks of Atlantic salmon, many or most of which are vulnerable to multiple fisheries which typically exploit many stocks mixed in unknown and varying proportions. It is not practical to monitor very many stocks, and, with few exceptions, it is not feasible to forecast their abundance with the necessary precision to adjust catch levels annually.

Despite these complicating factors, the need for a systematic approach to conservation advice is evident. Given the complex nature of the problem, the Working Group considered that a special effort was required to address the framework for provision of scientific advice for the management of Atlantic salmon. Such a framework could allow the Working Group to respond more constructively and in greater depth to NASCO's need for advice. Consequently, it is recommended that three days to one week be set aside in 1988 for examination of the issues with thoroughly researched background papers and the participation of Working Group members together with other experts. This could be carried out as part of the Working Group meeting or as a special meeting sponsored by ICES. The ability of the Working Group to consider this issue would be improved if a Study Group were established to prepare data relevant to North American Commission questions and if its workload were reduced in 1988.

1.2 Nominal Catches of Salmon in Home Waters

Nominal catches of salmon in home-water fisheries for 1960-1985 are given in Table 1. Figures for 1986 are incomplete. The 1986 catches in home waters, apart from those reported by Finland, are higher than the corresponding 1985 values. The Working Group is aware of unreported catches throughout the North Atlantic. Due to the lack of data from some countries, no precise estimate was obtained. However, the Working Group considers the unreported catch to be of the order of 3,500 t for all countries.

1.3 Reported Catch in Numbers by Sea Age and Weight for Recent Years

Catch in Numbers by Sea Age and Weight for Recent ICES requested the Working Group to estimate catch by sea age for the most recent years, wherever possible. Reported national salmon catches for several countries by sea age and weight are given in Table 2. As in Table 1, catches include both wild and reared salmon. Figures for 1986 are provisional. The methods used by the different countries to break down their total catch by sea age are described in Anon.(1986a). In general, the numbers of both 1SW and MSW fish in national catches have increased compared with the corresponding 1985 values.

France

Ages were determined from scale reading of samples of rod catches from Brittany, lower Normandy and the Allier and Gaves Rivers and from commercial samples from the Gaves estuary.

Scotland

From late June onwards when 1SW and MSW fish occur together in the fishery, the majority of fishermen divide their catches between 1SW and MSW fish on the basis of weight. Fish less than 3.5 kg are normally recorded as 1SW fish. This means that in those years when 1SW fish are heavier than normal the number of fish classified as MSW could contain a proportion of 1SW fish. Thus the breakdown between 1SW and MSW could be inaccurate and the magnitude of the error could vary between years.

Ireland

The figures relating to numbers of 1SW and 2SW fish were obtained using the total weight and average weights for each sea age class.

Norway

1SW fish are taken to be fish less than 3 kg. MSW fish are equal to or larger than 3 kg. The estimates are based on total weight of the two categories and the average weight of salmon in these categories for the different counties. For two counties, there were no average weights available. The estimates for these counties are based on the average weights for the total country.

Iceland

1SW and MSW fish are separated at 65 cm in length.

Canada

The weight of 1SW and MSW salmon landed each year 1982-1986 by Canada was obtained from official nominal catches submitted to ICES. Each of these categories contains some previous spawners, usually less than 10%. The numbers of 1SW and MSW salmon are calculated using a mean weight of 2.0 kg for 1SW salmon and 4.5 kg for MSW salmon.

United States

The USA catch includes both wild and hatchery-origin salmon for the period 1982-1986. The 1985 sample for sea age was for the Penobscot River only. This sample was applied to the total Maine catch.

Faroes

The total catch in number in the Faroese fishery was derived from the catch in numbers in seven weight categories reported for individual landings. Based on monthly biological samples, these were divided into catch in numbers by sea age. In some instances, samples from neighbouring months were applied, particularly in the beginning and end of the season.

West Greenland

The numbers at age are available for the West Greenland fishery from 1982 to 1986. The numbers were derived as the product of the total number of salmon caught and the proportion of each sea age class taken in samples of commercial catches at Greenland. The total number of salmon was calculated individually for each NAFO division by dividing the catch weight by the mean weight of fish in the samples.

1.4 Natural Mortality of Salmon in the Sea

1.4.1 The effects of predation on natural mortality

A number of papers were submitted to the Working Group concerning the effects of predation on both hatchery and wild smolts. Not all of this work related to the marine environment, but for the purposes of this section, all predation from the smolt stage onwards was considered by the Working Group.

(i) Predation by land mammals

Evidence from the River Eira in Norway suggested that hatchery smolts were consumed by otter (*Lutra lutra*) and mink (*Mustela vison*). The level of this predation was considered to be small, although a separate study was referred to which indicated that mink were a serious predator on the pre-smolt stages.

(ii) Bird predation

Hatchery smolt tags were recovered from bird pellets at the River Eira in Norway implicating mergansers (*Mergus merganser* and *M. serrator*), grey heron (*Ardea cinerea*), and gulls (*Larus* spp.). There was a negative correlation between the predation rate as assessed by tag recoveries in nesting areas and the subsequent adult salmon return rate. At the Penobscot River in the USA, fish and tag recoveries from birds' stomachs and nesting areas indicated that the double crested cormorant (*Phalacrocorax auritus*) also preyed on hatchery smolts. Due to the large number of these birds present, it was believed that the level of this predation could be significant. In the River Bush, Northern Ireland an attempt to quantify the predation rate by cormorants (*P. carbo*) on salmon smolts was reported. Observations in the post-dawn period confirmed that these birds fed on smolts throughout the watershed, and evaluation of the stomach contents indicated that both hatchery and wild smolts were taken. Estimates of the level of this predation suggested that 128-238 birds above the hatchery might have consumed 63-76% of the wild smolt run and that 12-26 birds below the hatchery might have consumed 22-46% of the hatchery smolt release. It was also noted by the Group that hatchery smolts can be captured at sea by gannets (*Morus* spp.) as tags have been recovered from gannet colonies 60-90 days following smolt release.

(iii) Fish predation

Larsson (1985) found that in the Baltic area smolts had a mortality of at least 50% before reaching marine waters, and that burbot (Lota lota) and pike (Esox lucius) were the heaviest predators. A study in Norway at the mouth of the Surna River indicated that cod (Gadus morhua) caused an estimated mortality of about 25% on hatchery smolt releases (Hvidsten and Møkkelgjerd, in press). These fish ate both hatchery and wild salmon smolts, as did saithe (Gadus virens) and sea trout (Salmo trutta). In Ireland, heavy predation on reared smolts by pollack (Gadus pollachius) was recorded in the estuary of the Burrishoole River. Shark predation on adult salmon at the feeding grounds off Greenland (Templeman, 1967) and off Scotland (Balmain and Shearer, 1956) has also been recorded but not quantified. Other species are also known to prey on salmon, but further information was not presented to the members of the Working Group.

(iv) Predation by marine mammals

Killer whales (Orcinus orca), pilot whales (Globicephala malaena),beluga, dolphins, and seals are all potential predators on adult salmon. In the British Isles, salmon are known to be a food item of the grey seal (Halichoerus grypus) (Potter and Swain, 1979) and to a lesser extent of the harbour seal (Phoca vitulina) (Rae, 1968). Seals frequently damage salmon or take them from nets in Scotland. About 4% of the run on the North Esk has been observed to have seal damage. Grey seals and ringed seals (Phoca hispida) have also been found to prey on salmon in the Baltic (Søderberg, 1975).

There has been a general increase in seal abundance in recent years, due to a ban on seal hunting and a low price of seal products. Grey seal populations seem to be increasing by about 7% per year in Scotland and 12% annually off Nova Scotia, Canada. Seals have been observed in unusually great numbers in northern Norway and eastern Iceland. Abundance of harp seals is also reported to be increasing.

(v) Conclusions

The Working Group considered that the high estimated levels of predation, particularly during the smolt and post-smolt phase, could contribute considerably to the natural mortality estimates in the marine environment.

1.4.2 Estimated natural mortality rates

The estimate of natural mortality of salmon during the marine phase is of great importance in assessing the impact of distant fisheries on home-water catches and stocks.

It is safe to assume that the highest mortality in the marine life occurs shortly after entering the sea as the fish are adjusting to the new environment. At this stage, the salmon are especially vulnerable to predation by fish and birds. This vulnerability decreases as the fish adjust and grow. Doubleday et al. (1979) used the inverse weight model to derive estimates of the natural mortality of salmon from Canada and Ireland during the second year at sea. Further estimates were calculated for the River Bush assuming no growth from 1SW onwards. The model was also used to estimate natural mortality for salmon originating from the North Esk River, Scotland (Shearer, 1984). The results from these studies are shown in Table 30 of Anon.(1986a). These results overlap but tend to be lower than natural mortality estimates for sockeye and coho in the Pacific (Ricker, 1976).

Assuming a monthly natural mortality rate subsequent to the Faroese fishery of 0.01 and 100% homing of survivers, data for tagged wild salmon from River Imsa, Norway and tagged reared salmon from the Burrishoole system in Ireland suggest that the natural mortality from the time they leave the stream until the mid-point of the Faroese fishery (9-11 months) ranges between 50% and 80%.

The Working Group considered some data relevant to natural mortality of Icelandic ranched salmon during their second sea year. These fish are not exposed to a sea fishery around Iceland, although some go to West Greenland. The data were analyzed using Murphy's method (Ricker, 1975) which enables the calculation of natural mortality if sex ratios of grilse and salmon of the same smolt class differ. For these fish, the grilse are predominantly males and the salmon are predominantly females. Sex ratio of surviving fish from the smolt class just before return to home water must also be precisely known.

Since the sex ratio of surviving fish had to be deduced from the smolt sex ratio, which could be variable and was unknown, and as the method was very sensitive to changes in that ratio, it was not possible to estimate natural mortality rates using this method.

Since, however, the natural mortality in the marine phase has not been precisely estimated and values of 0.01 to 0.016 per month have been used in the Greenland assessment, the Working Group decided to illustrate the importance of the natural mortality factor in the calculations by assessing the effects of the Greenland and Faroese fisheries using monthly mortality rates of 0.01 and 0.02.

Since this was the first new attempt to estimate this very important parameter, the Working Group recommended that other approaches to this problem should be encouraged.

2 <u>QUESTIONS OF INTEREST TO THE NORTH AMERICAN COMMISSION OF NASCO</u>

2.1 <u>Acid Rain</u>

NASCO requested ICES to consider the following four questions with respect to the issue of acid rain in the North American Commission area:

A. Identify freshwater habitats which support or have supported Atlantic salmon populations and classify these habitats in relation to their vulnerability to loss of productivity of Atlantic salmon due to acidification.

B. Describe the trends in acidification of habitat identified in question A, and in the fish populations supported by those habitats.

C. Describe the influence of acidification of freshwater habitat on growth and survival of Atlantic salmon fry and parr and the implications for smolt and adult production.

D. Describe the effectiveness of mitigation measures such as liming and the extent to which these measures are in current use.

A Study Group was convened 4-6 March 1987 at Copenhagen to consider these questions.

The Working Group considered detailed responses to these questions as provided in the report of the Acid Rain Study Group (Anon., 1987a).

2.1.1 Freshwater habitats which support or have supported Atlantic salmon and their vulnerability to acidification

The Working Group adopted the Study Group's estimate that there is approximately 1,000 km^2 of riverine Atlantic salmon habitat accessible to anadromous Atlantic salmon in areas of North America. A minimum estimate of areas vulnerable to acidification was provided by those areas where mean volume-weighted annual alkalinity is known to be less than 50 μeq/l. A habitat was determined to be lost to salmon productivity when it had a mean annual volume-weighted pH of less than 5.0 and no longer had juvenile salmon present as detected by electrofishing. Approximately 50 km^2 of this habitat is classed as vulnerable to acidification, and about 10 km^2 of the vulnerable 50 km^2 does not produce wild Atlantic salmon, mainly as a result of acidification. This area is in the Canadian province of Nova Scotia, specifically in the Southern Upland geological zone. The Working Group noted that, while the absence of salmon in some streams in the "vulnerable" category may have resulted from overexploitation, as these were in many cases small populations, present pH levels in some of these streams would not permit salmon to survive, even for a short time.

2.1.2 Trends in acidification of freshwater habitat of Atlantic salmon

The Working Group noted that there is very little historical data on which to base a response to this question. For the United States, historical water chemistry data, available for two Maine rivers since 1969, showed no apparent change in acidity since that time; no historical data were available for the smaller tributary streams which were classifed as vulnerable to acidification. No historical data were available for vulnerable areas in

Newfoundland and Quebec. However, for Nova Scotia, historical water chemistry data were available for 1954-1955 for five rivers. Four of these rivers (Roseway, Medway, Mersey, and La Have) show a significant decline in pH level over a 26-year period to 1980-1981. For the Medway River, the pH declined linearly from about 5.8 in 1955 to about 5.2 in 1978. The pH decline was accompanied by declines in alkalinity and colour and increased concentration of excess sulphate and total aluminum.

Angling catch records for 10 rivers in Nova Scotia, where the current mean annual pH is less than 5.1, were used as an indication of Atlantic salmon production since 1936 when the catch records began. Atlantic salmon harvests declined in those rivers that have been acidified and, in several rivers, the runs have disappeared; the decline appears to have commenced in about 1955, though earlier declines are possible.

Watt (1987) estimated that Atlantic salmon production loss attributable to the acidification of Nova Scotian rivers is in the vicinity of 23,000 adult fish per year. The Working Group considered Watt's estimate and noted that it involved two main assumptions: that all habitat in the Southern Upland zone of Nova Scotia was equally productive per unit rearing area prior to acidification, and that the rearing area in rivers below pH 4.7 had been underestimated. The Working Group recommended examination of an alternative method of calculation which would involve comparison of the historical rates of angling harvest per unit area of the rivers classed as "vulnerable" to those not considered vulnerable. This calculation would address the question of equivalence of rearing habitat. It would be necessary to assume that anglers harvested the same proportion of the total stock from each river in the years of earliest catch record. The necessary data to complete this calculation were not available to the Working Group at its meeting.

The Working Group noted that while information was presented on the trends in acidification over years for some rivers, no information was available in the Study Group report on trends of pH within a year for any river. Data for many rivers are known to exist but were not available to the Working Group.

2.1.3 <u>Influence of acidification of freshwater habitat on growth and survival of Atlantic salmon</u>

The Working Group agreed with the Study Group's decision to broaden the scope of the original question to include the egg, alevin, and adult stages due to the implications of these stages on subsequent adult production.

The Working Group concluded that low pH can lead to mortality in several stages of the salmon life cycle; particularly vulnerable are hatching and transition to first feeding in alevins, while the water-hardened egg is relatively resistant to low pH. Mortality can also occur in parr and smolt, particularly if the pH is rapidly reduced as occurs during snow-melt in some areas.

In assessing the effect on smolt production, the Working Group noted that low pH seems not to adversely affect growth rates of surviving fish. However, due to mortalities from pH stress, parr densities, parr production, and smolt densities have all been shown to be significantly depressed. As an example, in a comparison of an acidified (pH 5.0) and a non-acidified (pH 6.1) river in close proximity in Nova Scotia, smolt production was approximately 1/6 in the acidified river even though egg densities which produced these smolts were assessed to be similar.

2.1.4 Effectiveness of mitigation measures

In North America (Nova Scotia), liming is in the experimental stage whereas in Europe (Scandinavia), liming is in current practice on a large scale. At such a scale, it has been shown to be cost effective and examples exist where the annual cost of application is exceeded by the values of salmon landed as a result of this mitigation technique. Experimental scale liming is currently being used in Nova Scotia to create deacidified refuges in small tributary streams of acidified rivers which currently have remnant salmon populations.

The main mitigative measure related to acidification, used within North America, is stocking of hatchery-reared salmon smolts and parr; this is currently taking place only within Canada (Nova Scotia) and not within the USA.

It may be possible to preserve genetic material from salmon populations that are currently threatened using techniques such as cryogenics. The Working Group noted that such techniques are not in current use and their feasibility remains to be investigated.

The Working Group noted that both liming and stocking are temporary measures and agreed with the Study Group's conclusion that the only satisfactory solution to the problem of acidification of Atlantic salmon rivers is the reduction of acid-precursor emissions at their sources. Mitigative measures such as stocking involve some risk to genetic variability if continued for a long time.

2.1.5 Recommendations

The Working Group generally endorsed the recommendations presented by the Study Group. The Working Group was not able to complete its work on the estimate of loss of Atlantic salmon. If the Study Group does not reconvene, the Working Group should be prepared to consider this question at its next meeting.

2.2 Description of Fisheries

2.2.1 Description of fisheries catching salmon originating in another country's rivers or artificial production facilities

Historically, salmon of USA origin have been harvested in Newfoundland, Labrador, Nova Scotia, New Brunswick, and, to some extent, Quebec. A description of the fisheries in Nova Scotia, Newfoundland, and Labrador was provided in Anon. (1985a).

The gear types used in Canadian fisheries are described on page 25 of Anon.(1984). The commercial fishing season for Newfoundland and Labrador in 1986 was 5 June-15 October for Statistical Areas A - I and M - O; 5 June-10 July for Statistical Areas J1, K, and L; and there was no open season in Statistical Area J2. The commercial fishery was closed in Nova Scotia, New Brunswick, and along the Gaspé and parts of the north shore of the Gulf of St. Lawrence. In Newfoundland and Labrador, there were about 3,400 fishermen licensed to fish a total of 13,000 gear units (1 unit = 50 fathoms of gill net) for salmon in 1986.

The commercial landings for Canada in 1985 and 1986 (preliminary) are given in Table 3, and the landings and licensed fishing effort for Newfoundland and Labrador commercial fisheries (1971-1986) are presented in Table 4. The Working Group noted that there was a 36% increase in landings in 1986 over 1985 and about a 6% decrease in the licensed effort. The greatest increase occurred in Statistical Areas A, B, and O. Statistical Areas C and D experienced a 19% decrease in landings from 1985. The increase in landings can at least partially be attributed to a general increase in abundance of salmon stocks in Canada, particularly for stocks of Labrador, Gulf of St. Lawrence, and Nova Scotia Atlantic coast.

2.2.2 Description of sport fisheries for Atlantic salmon in Maine, USA

Maine rivers are classified into three groups for planning purposes. Group A includes seven small rivers that have self-sustaining salmon populations and sport fisheries based primarily upon wild salmon. Group B rivers (Penobscot and St. Croix) are those where salmon restoration programmes are underway and sport fisheries are based upon stocking programmes. The Group C rivers presently have minimal sport fisheries and are scheduled for future restoration. Maine rivers with sport fisheries are shown in Figure 1.

In the Group A Maine rivers, wild salmon predominate in the sport catch because hatchery-reared salmon are only stocked to augment weak year classes. About (90%) of the sport catch on other rivers is of hatchery origin. As restoration progresses on the Group B and C rivers, the abundance of wild salmon in the sport catch is expected to increase.

Peak angling effort takes place in May and June and most activity occurs within a few kilometres of tidewater. In recent years, the total catch of salmon in Maine has ranged from 350-1,350 fish (1.3-6.4 t) annually. The sport fishery and catch on the Penobscot River frequently exceeds that of all other Maine rivers combined. Reported catches from the State of Maine for the period 1960-1986 are shown in Table 5. Catches are reported on a voluntary basis and are believed to represent about 80% of the actual rod catch based upon 1981 and 1982 surveys on the Penobscot River.

Based upon recent license sales, about 2,500-3,000 anglers fish for Atlantic salmon and 80% are Maine residents. Estimates of angler effort were obtained for the Penobscot and Narraguagus Rivers in 1981 and 1982. During those years, effort was estimated to be 26,300 and 23,200 angler days, respectively. The total statewide effort was estimated to be about 30,000 angler days, since those fisheries were believed to account for about 80% of the total at that time.

Exploitation rates for three Maine rivers have been estimated (Figures 2 and 3). Based upon the reported rod catch during the period 1960-1972, the exploitation rate on the Machias River ranged from 14 to 25%. Exploitation rates in the Narraguagus River ranged from 10 - 37% during the period 1962-1974. The average exploitation rate for those fisheries was about 20%. During the period 1977-1984, the exploitation rate on the Penobscot River ranged from 15-29%. Regulations were instituted for the Penobscot River in 1985 which reduced the exploitation rate to about 10% annually.

Most of the Atlantic salmon caught in Maine are 2SW adults on their maiden spawning migration. All other age groups each make up less than 5% of the catch in most rivers. The age composition of the St. Croix and Penobscot River catches reflects a larger grilse component due to the preponderance of hatchery-origin salmon and angling regulations which restrict the harvest of MSW salmon. The sport fishery in Maine exploits 2SW salmon to a larger degree than other age groups due to the timing of the run and the magnitude of that portion of the salmon population. 1SW salmon enter the rivers primarily after 1 August when angling conditions are less than optimal and 3SW salmon and previous spawners are small in numbers. During the period 1971-1986, the exploitation rate of 2SW salmon and all ages combined for the entire Penobscot River catch (adjusted for a reporting rate of 80%) was as follows:

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979
All ages	3.5	1.5	6.0	5.6	8.9	10.1	33.7	21.9	18.0
2SW (%)	4.4	1.6	6.5	5.7	9.1	8.6	35.5	22.0	23.2

Age	1980	1981	1982	1983	1984	1985	1986
All ages	29.1	25.1	26.7	20.3	19.7	12.2	10.9
2SW (%)	33.2	30.0	27.2	22.1	25.4	12.6	10.5

1SW salmon caught by anglers in the Penobscot River in 1985 averaged 54 cm (FL) and 1.4 kg, while 2SW salmon averaged 74 cm and 3.8 kg. 3SW salmon and previous spawners averaged 81 cm and 6.1 kg.

Angling for Atlantic salmon in Maine is strictly regulated. Directed commercial catches are prohibited and in most areas, salmon may only be retained if taken by fly fishing. The general season extends from 1 May to 15 September (15 October in the lower reaches of certain rivers) and there is a daily limit of 1 salmon and a season limit of 5, including 1SW salmon. On rivers where restoration programmes are underway, angling regulations are more restrictive than the general law (e.g., grilse only on the St.Croix River and 1 large salmon per season on the Penobscot River). In 1985, tagging of sport-caught salmon was instituted on an annual basis, and in 1987, a mandatory registration system is in effect.

2.3 Historical Catches of Salmon Originating in Rivers or Artificial Production Facilities of Another Country

ICES was asked by NASCO to provide estimates of USA-origin fish caught in Canadian waters by sea age, standardized week, locality, and gear type. Although this question has been addressed partially in two earlier reports of the Working Group (Anon., 1986a, 1986b), several factors warranted a complete reanalysis of the available data. These factors included:

1) Development of a computer data base for all tag recoveries of 1SW Maine-origin salmon from Canada and Greenland.

2) Revised estimates of numbers by sea age of tagged and untagged fish in Maine rivers. This included information on two additional Maine rivers for recent years.

3) Further refinements of parameter estimates, especially reporting rates in both interception and home-water fisheries and exploitation rates in Maine rivers.

4) Revision of the estimation model described in Anon. (1986b, p. 4-7).

The Working Group did not consider the partitioning of the data set by gear type because very few tags have been returned from gears other than gillnets.

The primary differences from earlier calculations in Anon. (1986a, 1986b) are listed below:

1) Previous estimates of numbers of 1SW fish were approximated by multiplying total recaptures for a given month and place by the monthly average composition of the tag recoveries over the period 1971-1983 (Table 14 of Anon., 1985a). Numbers given in the table are the actual number of tags reported for 1SW salmon.

2) Computerization of the data base allowed the data to be summarized by standard week and month as defined in Table 27 of Anon. (1985a). Earlier breakdowns of harvest were by calendar rather than standard month.

3) Estimates were made for the return years 1963-1986. Earlier estimates were for 1972-1985.

4) The Working Group concluded that inclusion of the St. Croix River in the estimation of the RATIO parameter was inappropriate due to the joint management and utilization of the resources within the river by the USA and Canada. Data from the St. Croix River are not included in the present calculations.

5) Catch data were provided for the Ducktrap and Saco Rivers for 1985 and 1986. These rivers were added to the computation of RATIO. Thus, catch data from 12 Maine rivers were included.

6) Earlier tables presented estimates of tag retention rates of 0.90 and 0.99. It was noted that this assumption simply scaled the estimate by a constant factor (i.e., 1.1) for any breakdown of the data. Thus, retention rate (L) was set to 0.9 for all computations.

7) Estimates of numbers by sea age and by wild vs hatchery origin of trap counts and angler harvest were refined for all Maine rivers. Changes to the previous data base (Appendix 4 of Anon., 1986a) were minor. Most changes were related to angler harvest on smaller rivers. Revised data are listed in Appendix 4.

8) Discussions regarding the estimates of angler harvest in Maine rivers, particularly those without traps, led the Working Group to reconsider the model for the RATIO estimate. Exploitation rates on two rivers with traps for the period 1960-1974 suggested that the exploitation rate (E) was 0.25 rather than 0.20 used in previous calculations. Angler survey results indicated that only 80% of the catch was reported for untagged fish. Due to the widespread knowledge within Maine of the tagging program and restoration efforts, a reporting rate for tagged fish of 0.9 was judged appropriate. Furthermore, the presence of fly-fishing-only regulations throughout Maine suggested that the hook-and-release mortality component of non-catch fishing mortality was negligible.

The estimate of tagged fish to total run size summed over all Maine rivers is defined as the RATIO parameter in the assessment model. To estimate the numerator and denominator of the expression, it is necessary to consider rivers with and without traps separately. The previous estimate of RATIO was defined as

$$\text{RATIO} = \frac{\sum_i \left[\dfrac{T'_a}{(1 - NC')R} \right] + T'_t + \sum_j \left[\dfrac{T'_a}{R'E} \right]}{\sum_i \left[\dfrac{T'_a + U_a}{(1 - NC')R'} + (T'_t + U_t) \right] + \sum_j \left[\dfrac{T'_a + U_a}{E} \right]}$$

where the index i refers to rivers with traps and index j refers to rivers without traps. All other parameters are the same as those given in Anon. (1986b) as follows:

T'_a = number of tagged 2SW salmon angled below the fish counting trap.

T'_t = number of tagged 2SW salmon counted at the fish counting trap.

NC' = non-catch fishing mortality associated with the angling catch. The Working Group assumed a value of 0.10.

R' = reporting rate of tags by anglers. A rate of 0.9 was assumed.

U_a = numbers of untagged salmon angled below the fish counting trap.

U_t = number of untagged salmon counted at the fish counting trap.

As a result of deliberations within the Group, the RATIO estimator was modified to be:

$$\text{RATIO} = \frac{\sum_i \left[\dfrac{T'_a}{R_t} + T'_t \right] + \sum_j \left[\dfrac{T'_a}{R_t\ E} \right]}{\sum_i \left[\dfrac{T'_a}{R_t} + \dfrac{U_a}{R_u} + (T'_t + U_t) \right] + \sum_j \left[\dfrac{T'_a/R_t + U_a/R_u}{E} \right]}$$

where R_t is the reporting rate for tagged fish caught by anglers and R_u is the reporting rate for untagged fish caught by anglers.

A comparison of the revised RATIO estimates (Table 6) with those given in Anon. (1986a, Table 6) shows an average decrease in the parameter of 3%. The largest changes were for 1978 (-13%) and 1979 (-15%) due largely to increased estimated untagged fish in areas without tags. Thus, even though significant differences were made in the model formulation, the net effect of the changes was minor. Because the estimates of both tag returns and run size are dominated by angler and trap catches in the Penobscot, variations in the treatment of non-trap rivers had a small effect. The revised model more realistically reflects the nature of the Maine sport fishery and makes better use of available data.

The tag recoveries and harvest estimates are summarized by standard week in Tables 7 and 8, harvest estimates by standard month in Table 9, and by year in Table 10. Although not requested by NASCO, monthly breakdowns were provided to facilitate comparisons with earlier reports. Overall, the refinement of the estimation model, underlying parameters, and input data resulted in an increase of 6% in the harvest over the comparable period. Although the temporal pattern of the catches within a year changed considerably, the pattern across years was nearly equal (Table 11).

Estimated catches in Canada ranged from 117 in 1972 to 4,596 in 1980. Catches in Canada were estimated to be below 1,000 fish before 1974. From 1981 to 1985, harvest estimates have averaged about 1,700 fish per year; corresponding run sizes averaged about 3,800. Over that period, about 33% have been taken from October to December. Most of the fall-caught fish have been reported from Statistical Areas A and B.

Estimated catches by standard week are summarized in Table 8. When tags could not be assigned to a standard week, the total number of unknowns was allocated proportionally to the observed catch distribution. This introduces a potential bias, particularly when the number of weeks in which catches are observed are low (e.g., 1972). In general, this allocation scheme did not appear to distort the temporal distribution of estimated harvests within a year.

For the first time, the Working Group estimated the harvest of 1SW Connecticut River origin salmon in Newfoundland-Labrador fisheries. Based on the returns from the Carlin tag group of the 1984 smolt class, which returned to home water in 1986 (run size = 316), the estimated harvest was 649 salmon (using the same estimation parameter applied above).

2.4 Impact of Management Measures Taken by Canada in 1984 and 1985, and Expected Impact for 1986 Measures in Reducing the Harvest of USA-Origin Salmon

Further restrictive management measures were enacted for the Canadian salmon fishery in 1986 (see Section 3.6.1) which were additional to those of 1984 and 1985. Those new measures which could reduce the harvest of USA-origin salmon in Newfoundland include the closure of the commercial salmon fishery on 15 October, the mandatory tagging of legally-harvested salmon in the commercial fishery, and a further reduction in the licensed fishing effort (Table 4). No new information was presented at this meeting relating licensed fishing effort to fishing mortality. The Working Group reiterated its previous advice that the reduction in total catch and in the harvest of USA-origin salmon attributed to reduced licensed fishing effort was expected to be less than 31% and could not be quantified (Anon., 1986b). The Working Group was not able to quantify the impact of the mandatory tagging of legally-harvested salmon in the commercial fishery, but noted that the intent of such a regulation is to reduce the illegal harvest.

To assess the combined effect of all measures taken by Canada for 1984 and 1985, the Working Group considered only the harvest of 1SW salmon of Maine origin in the Newfoundland-Labrador commercial fishery compared to the Maine run size of 2SW fish in the following year (that is, fish of the same smolt class). Other USA-origin salmon (i.e., Connecticut and Merrimack stocks) and salmon harvested as MSW fish were not considered due to the data base limitations. For the years 1967-1983, the ratio of Newfoundland harvest to home-water run size averaged 0.53; the values for 1984 and 1985 were 0.32 and 0.48, respectively (Table 12). Both harvest levels in 1985 and run size of the same smolt class increased compared to 1984. The increased harvest in 1985 was in the fall fishery (subsequent to 15 October); the total harvest in Newfoundland increased by 923 fish while the harvest subsequent to 15 October increased by 1,113 fish (Table 13). As noted in Section 3.6.1, the fall fishery in 1985 (16 t) in Newfoundland was higher than the long-term average of about 4 t. The fall fishery would not have been affected significantly by the Canadian management measures for 1984 and 1985. The Working Group was not able to draw further conclusions beyond those of last year. The declines in proportions between 1983 and both 1984 and 1985 are consistent with the management measures adopted by Canada. The Working Group could not conclude that the reductions were caused by the management measures as there have been wide fluctuations in previous years.

In addressing the question of the expected impact of the 1986 Canadian management measures, the Working Group noted that two kinds of management measures were reviewed in the past: area and seasonal closures and effort reduction. The Working Group could not quantify the effects of effort reduction, but previously quantified the area and season limitations by considering where and when Maine-origin salmon were caught in the past. In 1986, the most significant new measure adopted by Canada was the closure of the Newfoundland commercial fishery subsequent to 15 October. These fish would not be expected to be vulnerable to subsequent fisheries in Canada the following year while returning to Maine.

The Working Group noted last year that area closures and season reductions for 1984 and 1985 should have resulted in an 11% reduction in harvest of Maine-origin salmon. The new measure for 1986 would account for, on average, 29% of the 1SW Maine-origin fish in Newfoundland catches. Effort reductions may have led to other reductions but these were unquantified.

The Working Group noted that a more complete answer would require more detailed information to provide harvest estimates of MSW Maine-origin salmon throughout Canada and 1SW Maine-origin salmon in the provinces of New Brunswick and Nova Scotia. To this end, it is recommended that tag recovery information from salmon recovered in these areas be examined next year to provide improved estimates of the impact of management measures.

2.5 Tagging of Salmon

2.5.1 Salmon tags captured but not reported

The Working Group discussed several procedures that could be used to assess the proportion of external salmon tags captured but not reported. From this discussion, the following experimental designs were suggested by the Working Group:

1. Comparison of recapture rates from two methods of tagging.

   Non-reporting rates could be estimated from differences in recapture rates from external tags versus coded-wire tags from the same stock provided an estimate of tag loss rates for external tags was available.

2. Comparison of recapture rates for vessels with observers versus vessels without.

   Non-reporting rates could be estimated by placing observers on a number of vessels where they could examine catches for tagged salmon as the catch was being removed from the fishing gear. Recapture rates from the vessels with observers compared to those without would provide an estimate of the non-reporting rate. This method was used to calculate non-reporting rates in the Faroese and West Greenland fisheries.

3. Community surveys.

   Individual fishermen from a sample of communities could be interviewed to quantify the number of tags not originally reported. This method has been used to estimate non-reporting rates for seal and cod tagging experiments in Newfoundland.

The Working Group noted that some of these experiments may not provide returns for all unreported external tags since tags may be deliberately withheld. It was also noted that these experiments only apply to external tags as all coded-wire tags detected are reported.

2.5.2 Tag recovery reward systems

NASCO requested ICES to review existing tag reward systems and make recommendations on standardizing payments, national clearing house arrangements, and review cooperative tag recovery systems in the NASCO area.

There is a great deal of variation in the payment of tag rewards by the laboratories of various countries. The rewards vary by a factor of five. It was felt that it is more important to have uniformity within a country and between adjoining countries than uniformity over the entire NASCO area. There was scepticism about the validity of assuming that there would be substantial increases in return rates from modest increases in rewards. Substantial increases in rewards, however, carries the danger that spurious returns could result. There is the danger, for instance, that tags taken from smolts or from bird nests or colonies could be held over and returned at an appropriate date to obtain rewards. The Group felt that the important factors in setting a reward are the expectation of the local fishermen with respect to tag returns in general and the minimum amount required as an incentive to return tags.

The national clearing houses for microtags recovered from the Greenland and Faroese fisheries were considered to be working well at present. The only problem was the supply of release data to the clearing houses. The data are published by the ANACAT Committee too late for the identification of current tags and it is recommended that members of the Working Group forward data on microtag releases in each country to the microtag clearing houses as soon as possible after release.

There was some discussion as to the exact information sought by the question on cooperative programs (see Section 3). It was felt that the return of external and microtags by countries where they were intercepted to the country of origin was satisfactory.

The programs which involve the cooperation of more than one country in the detection of microtags such as the Canadian-American program, the West Greenland program, and the Faroese program are all operating and reporting satisfactorily and require no great modification.

2.6 Stock Identification Methods

The Working Group considered stock discrimination methods based upon image analysis of salmon scales and otoliths. Scale shape, texture, and circuli spacing were considered to have potential as high resolution discriminators for separation of salmon stocks to continent, country, and, possibly, fish farm or hatchery of origin. Although it was agreed that these methods could be used to discriminate continent of origin, there was some doubt they would be more cost effective than circuli-count techniques. Scale-image analysis might also be used to discriminate hatchery- or fish-farm-origin salmon to country of origin in the Greenland and Faroes fisheries.

Shape analysis of salmon otoliths was discussed as a possible inter-annual calibration technique for scale-based stock discriminations. Presently, an electrophoretic technique requiring muscle and liver tissue is used for this calibration. Otoliths are potentially easier to collect, preserve, and analyze than tissues, but the technique has only been evaluated qualitatively and requires more rigorous testing.

The Working Group was optimistic about image-processing techniques of stock discrimination since the material required for them is routinely collected to analyze the fishery and the technique offers potentially finer discriminations than currently achieved.

2.7 Estimation of Non-Catch Fishing Mortalities

Non-catch fishing mortality is mortality generated directly or indirectly by fishing but which is not included in the recorded catch. Referring to Anon. (1981), the Working Group identified six types of non-catch fishing mortality:

1) Predation mortality - fish caught in gear but subsequently removed by predators.

2) Drop-out mortality - fish killed by the gear but lost prior to hauling.

3) Haul-back mortality - fish killed by the gear but lost during haul back.

4) Escapement mortality - fish caught temporarily by the gear which escape but die later as an indirect result of the encounter.

5) Discard mortality - fish discarded that are dead or die as a result of handling.

6) Other mortality not appearing as recorded catch, including fish used directly by fishermen, illegal catch, or unreported local sales.[1]

In discussing possible research procedures, the Working Group noted that it is usually not possible to make separate estimates of predation, drop-out, and haul-back mortality rates. Combined mortality from all three sources can be identified by direct observation. Frequent and careful net patrols can be made marking the location of observed fish. This type of research has been successfully conducted by the United Kingdom and Norway (Anon., 1981). The Working Group noted that frequent patrols may produce biased results if increased boat activity around nets causes salmon to mesh more firmly than usual.

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[1] In addition, this category includes damaged fish that survive but have a reduced spawning ability.

Escapement mortality is difficult to estimate accurately. Net selectivity curves can be established by comparing length frequencies of landings with length frequencies from research vessel sampling. The proportion or numbers of fish encountering but escaping from the gear can then be estimated, and a mortality rate can be attributed to these fish. Mortality rate of escapees is difficult to determine. Estimates have been made in Norway by experimentation within controlled enclosures (tanks and bag-nets). Additionally, fish with net marks have been held in different environments (fresh, brackish and salt water) to determine mortality rates. In Pacific salmon studies, fish have been descaled and their subsequent vulnerabilty to predators, physiological stress, etc. has been studied. The Working Group concluded that although escapement mortality is difficult to estimate, there are some methods available that will provide rough estimates.

Numbers of salmon discarded dead may be estimated directly, but the mortality of live discards must be inferred by methods similar to those used for estimating escapement mortality. From river catch-and-release programs, mortality from angling stress has been estimated by (i) holding angled salmon in cages for observation, (ii) marking angled salmon before release and documenting their survival from counting fence observations, and (iii) observing marked caught-and-released fish with scuba gear in clear rivers.

The Working Group noted five methods of estimating illegal catch: (i) direct observation where local landings are spot-surveyed to compare actual versus reported catches, (ii) wardens or officers have attempted to buy fish undercover to see if illegal catches are available, (iii) where dead-tagging landed salmon is mandatory, the presence of non-tagged (illegal) salmon can be monitored directly, (iv) total illegal catch is estimated from observed violations in sub-areas under surveillance, and (v) interviews of fishermen or fishery officers.

Non-catch fishing mortality estimates from one area or situation may not apply in other areas.

3 QUESTIONS OF INTEREST TO THE WEST GREENLAND COMMISSION OF NASCO

3.1 The West Greenland Fishery in 1986

The reported nominal catches of salmon at West Greenland in the years 1960-1986 are given in Table 14.

The fishery in 1986 was opened on 15 August and ended on 1 December. The total catch was 960 t, 51 t more than the TAC of 909 t. The TAC agreed upon in 1986 was 850 t with an opening date of 1 August; the 909 t corresponding to the 850 t, when the opening date is 15 August. The TAC was divided as usual into two components, viz. a "free quota" of 649 t in which all fishermen with a license could take part, and a "small boat quota" of 260 t which was allocated to districts and open only for boats smaller than 30 feet. In total, 670 t were taken by small boats, and only

290 t were taken by boats bigger than 30 feet and smaller than 70 t. The free quota was taken in 10 days and was exceeded by 51 t when it was closed.

The geographical distribution of the fishery is given in Table 15. The 1986 distribution differs considerably from previous years, when the main part of the catch was taken in NAFO Divisions 1B-1E. In 1986, the biggest divisional catch was taken in Division 1F. There was a decrease in catches from south to north, the lowest being in Division 1A.

Effort data were available for 17 vessels for Divisions 1C-1F in 1986. The CPUE figures for Divisions 1D and 1E were not significantly different from each other, but both figures were larger than in Divisions 1C and 1F (Table 16).

The CPUE figures from 1986 were higher than those observed in 1970-1975 (Table 17). In addition, the CPUE figures from non-Greenlandic, but bigger, vessels in 1970-1975 were lower than those observed for the smaller Greenlandic vessels in 1975 and 1986. The reason for the differences between the two groups of vessels could be found in different fishing patterns and locations and in the way in which they operate the fishing gear. There are some indications that the small Greenlandic vessels have smaller losses of salmon in their handling of the gears than the bigger drifters operating from 1968-1975.

The very high CPUE figures from 1986 and the highest observed catches taken during the two first weeks of the fishery (see text table below) could indicate a higher abundance of salmon or/and a higher availability to the gear than in previous years.

	Nominal catches in tonnes	
Year	First week	Two first weeks
1976	147	360 (10-23 Aug)
1977	-	500 (20-23 Aug)
1978	not available	
1979	-	509 (1-14 Aug)
1980	260	711 (1-14 Aug)
1981	465	735 (15 Aug-7 Sep)
1982	470	766 (25 Aug-7 Sep)
1983	105	192 (10-24 Aug)
1984	17	58 (10-24 Aug)
1985	204	361 (1-14 Aug)
1986	509	848 (15-28 Aug)

3.1.1 Origin of salmon at West Greenland

In 1986, the Working Group recommended that protein electrophoresis of tissue samples be used to develop a data base for discriminating salmon at West Greenland. An earlier analysis showed that specific North American and European salmon stocks are characterized by different allele frequencies at six protein loci. Using this technique, 238 samples were positively identified as

North American or European. To these samples were added 81 of coded-wire microtagged and Carlin tagged salmon recovered at Greenland in 1986. Scale samples were available for these 319 fish.

These data were used to develop and obtain a discriminant function using scale characters to distinguish continent of origin of salmon caught at Greenland. The results of stepwise discriminant analysis indicated that both scale-character variables were contributing to the discriminating power of the model ($F_{1,98} = 76.45$, $p<0.0001$ for CSIS and $F_{1,97} = 6.33$, $p<0.0135$ for CSIW). The results of classifying 200 individuals from the (100 North American and 100 European) indicated a misclassification rate of 19.5%. The error rates were $\pm$ 2.5% as the actual proportion of North American to European salmon was 0.50:0.50 while the predicted proportion was 0.525:0.475. The Working Group noted that this discriminant function, unlike previous ones, was derived from salmon caught at Greenland in the appropriate season.

The results of classifying salmon in samples from commercial catches indicated that the North American proportion in 1986 was 54% (95% CL 63-45, Table 18).

Comparisons to investigate spatial and temporal trends in the proportions by continent of origin showed no temporal trends, but significant differences were noted between the proportions in some NAFO divisions. The North American proportion by NAFO division ranged from 63% in 1E to 44% in 1F.

ICES was requested by NASCO to provide estimates of the catches at West Greenland by country of origin. Recoveries from Greenland fisheries of Carlin-tagged fish released in Maine (Table 19) provided a basis for estimating the catches of Maine-origin fish. The model described in Section 2.3 was used to estimate the total and statistical area for the period 1967-1985 (Table 20). The ratio parameter for each year was taken from Table 6. Non-catch fishing mortality (NC) for the Greenland fishery was assumed to be 0.8. The reporting rate for the recovered tags varied by year, as estimated in Section 3.7.1.

Estimated total catch of Maine-origin salmon ranged from 230 to 2,875 fish in 1967 and 1974, respectively. For the period 1970-1975, the average harvest was about 1,600. Following the imposition of a quota in 1976, the catch has averaged about 1,300 fish, the difference not being significant. During this period, there was a general increase in the numbers of MSW salmon returning to Maine rivers. Much of this increase in run size can be attributed to increase in numbers of smolts stocked.

In addition, numbers of Maine-origin salmon harvested at West Greenland were estimated using the method described in Anon. (1986a, pp 8-10). This approach is based on the river-age composition of the catch of those fish designated as North American by means of discriminant analysis and hatchery smolt releases by age for the USA and Canada. Harvest estimates were made for the period 1976-1985. Overall, the estimates were about 4 times higher than comparable estimates made with the model based on Carlin-tag recoveries. The correlation between the two sets of estimates was 0.836. Variance estimates and a sensitivity analysis for the model demonstrated that the model was very sensitive to the estimated fraction of the harvest designated as North American 1-year smolts. The Working Group concluded that possible misclassifiction of river age and possible biases in the subsampling of commercial catches should be investigated further.

3.1.2 Biological characteristics

Biological characteristics were recorded from samples of commercial catches from NAFO Divisions 1B and 1D-1F in 1986 using the results of discriminant analysis to divide samples into North American and European components.

An alternative estimate of the overall proportion of North American- and European-origin salmon for the years 1982-1985 was derived by weighting division samples by catch in numbers. Pooled samples were applied to divisions with no sample. The table below gives the results:

Year	Proportion weighted by catch in number		Proportion all samples combined	
	NA	EU	NA	EU
1982	57	43	62	38
1983	40	60	40	60
1984	54	46	50	50
1985	47	53	50	50
1986	56	44	54	46

In 1986, a proportion of 56% North American origin corresponds to a catch of 513 t or 179,800 salmon from North America and 447 t or 140,300 salmon from Europe.

The compositions of fish length, weight, and ages between these two groups of fish were then compared. A summary of these data is provided in Table 21.

As previously observed, the North American 1SW salmon were significantly shorter and lighter than their European counterparts.

The sea and smolt age compositions of samples are summarized in Tables 22 and 23, respectively.

The mean smolt age of 2.86 years observed in the samples from salmon of North American origin taken in 1986 is higher than observed in 1983, 1984, and 1985 (i.e., 2.67, 2.61 and 2.74, respectively), but lower than the average mean smolt age observed during the period 1968-1981, which was 3.12 years. There are no corresponding changes in mean smolt age of European salmon (1.98 in 1986).

The sea age composition in 1986 (Table 22) of 96.2%, 3.0%, and 0.8% of 1SW, 2SW salmon, and previous spawners, respectively, differs from those found in 1983, 1984, and 1985. In those three years, the 2SW components were 8.1%, 11.6%, and 5.9%, respectively.

Based on a proportion of 56% North American origin in 1986 West Greenland salmon catches, the catch at age by continental origin is as follows:

Sea age	NA	EU	Total
1	171,000	136,800	307,800
2	17,000	2,700	9,700
PS	1,800	800	2,600
Total	179,800	140,300	320,100

3.2 Salmon Stock Abundance in the West Greenland Fishery

The Working Group estimated the abundance of the salmon population at West Greenland using information derived from the Maine Carlin-tagging data. The estimates are based on a modified VPA approach in which the fishery is assumed to take place in a single day, i.e., the natural mortality is considered negligible during the period of the fishery. The complexity of the task was increased due to an incomplete understanding of migration routes of Maine-origin salmon, the possibility of temporal variation in the Greenlandic reporting rate of recovered tags, and uncertainty about the natural mortality rate.

Comparisons of several alternative scenarios led to the assumption that Maine-origin fish present in the summer fishery at Greenland are subsequently present in the October-December fishery in Newfoundland-Labrador. Although the analysis was done using alternate natural mortality rates of 0.01 and 0.2, only the previously assumed value of 0.01 was retained when it was noted that this parameter had a negligible effect on the estimates. Evidence provided at the meeting suggested that the baseline tag-reporting rate of 0.8 at West Greenland began to decline in 1976, reached a low of 0.4 in 1980, and returned to a level of 0.8 by 1983 (see Table 24). Harvest estimates for the Canadian fall fishery were taken from Table 9. The computational algorithm is described in detail below.

X = population size at Canada just after fishery,
= run size/exp(-M x t),

where t = 8 months. The period between the midpoint of the Canadian fall fishery and the midpoint of the Maine run was 8 months - 1 November to 1 July.

Y = population size at Canada just before fishery,
= X + harvest at Canada,

Z = population size at West Greenland just after fishery,
= Y/exp(-M x t'),

where t' = 2 months. The period between the midpoint of the Greenland late summer fishery and the midpoint of the Canadian fall fishery was 2 months - 1 September to 1 November.

Q = population size at West Greenland just before fishery,
= Z + harvest at Greenland,

Exploitation rate = harvest at Greenland/Q.

The analysis produced estimates of salmon abundance between 1969 and 1985 ranging between 1.0 and 2.0 million fish of all sea ages (Table 25). Lowest estimates of abundance (about 1.0 million salmon) were determined for the three catch years when the quota could not be taken [i.e., 1978, 1983, and 1984 (Anon., 1981, 1984, 1985b)]. Estimates also indicated low abundance in 1976 and 1982.

A comparison of nominal catches with estimates of abundance suggested that exploitation at Greenland ranged from 33-54% during the pre-quota years 1969-1975 and from 11-37% since then (Table 25).

The Working Group noted that the estimates of abundance were very sensitive to the tag-reporting rate. An independent analysis suggested that this rate varied between 0.4 and 0.8 over the period 1969-1985. It was further noted that while the estimates of abundance appear reasonable relative to perceptions of abundance based on catches and catch rates, they should be viewed as preliminary.

3.3 Effects of Varying Levels of Harvest at Greenland on Subsequent Returns of Large Salmon to Home Waters

NASCO requested ICES to advise on the effects of varying levels of harvest at Greenland on subsequent returns of large salmon to home waters.

The last assessment by the Working Group on the effects of the West Greenland fishery upon subsequent stocks and yields in home waters was made in 1980 (Anon., 1981). Assessments since that time have been concentrated on estimating TACs corresponding to varying opening dates equivalent to a TAC of 1,190 t with the opening date of 10 August and assuming a 140-mm mesh size. The Working Group has been guided in these analyses by the principle of ensuring the same proportion in the catch as in the mixed stock at West Greenland between the component originating from rivers in North America and that originating from Europe.

The parameter values used to calculate the loss to home waters for salmon harvested at West Greenland are known to fluctuate between years. One of the most important factors, the mortality rate between Greenland and home waters, was discussed in Section 1.4. The Working Group used monthly natural mortality values of 0.01 and 0.02.

For the other parameters used in the calculations on the impact of the fishery at Greenland, the Working Group has not found sufficient changes or trends to warrant a new assessment, although the accuracy by which some of them are measured has to be taken into account (see Section 3.8). The Working Group noted that the continental proportion of salmon caught at West Greenland used in the previous assessment (Anon., 1981) was 0.41 North American and 0.59 European, based on estimates for 1969-1978. In its report from last year (Anon., 1986a), the Working Group based its calculations of the total impact of fisheries at Greenland on home-water stocks on a 50:50 North American/European ratio, based upon the ratio for the years 1980-1984. Figures for 1985 and 1986 do not seem to warrant a change of that basis for calculation of the total impact of catches at West Greenland.

As a basis for the assessment of the impact of the West Greenland fishery on home-water stocks, the Working Group in 1980 used a range of survival rate of 0.90-0.95 for salmon of European origin and of 0.85-0.90 for salmon of North American origin. On this basis, the Working Group found that for each tonne of European-origin salmon in the reported catch at West Greenland, 1.29-1.75 t would be lost, on average, to European home-water stocks. For the North American stocks, the loss was found to be 1.47-2.00 t for each tonne of salmon of North American origin in the reported catch at West Greenland (Anon., 1981).

The above-mentioned range of monthly mortality rate (M =0.01-0.02) applied for a period of 8 months (1 September-1 May) for European-origin salmon and of 9 months (1 September-1 June) for salmon of North American origin corresponds to survival rates of 0.92-0.85 for European-origin salmon and of 0.91-0.84 for salmon of North American origin. Keeping the other parameters (growth and non-catch fishing mortality) at the same values as in the 1980 assessment, the Working Group revised the figures for the estimated losses, as described below.

Estimated lower figures [by lowest survival rate and lowest estimate of non-catch fishing mortality rate (0.1) at West Greenland] are calculated as 1.22 t and 1.45 t for European-origin and North American-origin salmon, respectively, while estimated upper figures [highest survival and highest estimate (0.3) of non-catch fishing mortality rate] were calculated as 1.69 t and 2.02 t for European-origin and North American-origin salmon, respectively.

Thus, for each tonne of European-origin salmon in the reported catch at West Greenland, the loss to European salmon stocks is estimated to be between 1.22 and 1.69 t, while the loss to North American stocks is estimated to be 1.45-2.02 t for each tonne of North American-origin salmon in the reported catch at West Greenland.

Applying these figures to the 1986 West Greenland catch (960 t) and to the estimated continental proportions for that year (about 447 t of European-origin salmon and 513 t of North American-origin salmon, based upon the 44:56 ratio and mean weights of 3.19 and 2.89 kg, respectively, see Section 3.1), the total losses were estimated to be 545-755 t for European stocks and 744-1,036 t for North American stocks. Thus, the combined total losses are estimated to be 1,289-1,791 t.

3.4 Effects of Opening Date and Quota on Number of Salmon Caught at West Greenland

NASCO requested that the Working Group consider the effects of opening date and quota on the number of salmon caught at West Greenland. Earlier, the Working Group (Anon., 1982) had addressed this issue with respect to increasing the quota as a function of delaying the opening date. An alternative model presented to the Working Group is described below.

The basis for the model is that the average weight of salmon caught increases rapidly during the period of the fishery. Hence, a given quota can be attained with fewer fish by opening the season later, or conversely, the same number of fish could give a higher catch. The model is defined as follows:

$$N(j) = \sum_{i=1}^{K} C\ P(i)/W(j+i)$$

where:

N(j) = number of fish harvested with season beginning in week j,

j = week in which the season opens,

K = number of weeks in the fishing season,

W(j+i) = mean weight of salmon in the catch in week (j+i),

P(i) = proportion of landings in i'th week following the opening of the season,

C = total catch in kg.

Thus, the model depends upon the 1) pattern of apparent growth and 2) temporal distribution of the harvest.

An analysis of the relative frequency of weight classes by month in the 1976-1985 catches at West Greenland (data presented to Working Group in 1986) implied a daily weight gain of 19g/fish/day. Little variation in growth among years was observed. The above estimate of apparent growth is higher than that estimated in Anon.(1982). The higher value is due to the use of the weight-class data with assumed average weights, while the earlier analysis used weights of individual fish caught by research vessel.

The average fraction of total catch [P(i)] decreased linearly as the season progressed, but inter-annual variation was large, particularly early in the season. Estimated season length was 7 weeks. The regression appeared to be a valid description of the temporal progression of the fishery during an "average" year. A key assumption is that the opening date does not affect the temporal distribution of the harvest within a year. Over the range of opening dates observed since 1976, there was no consistent relation between the initial fraction harvested and the opening date. The relation between the duration of the fishery and its opening date should be assessed.

A variance estimate of the number harvested suggested that the variability associated with a one-time switch in the opening date is so high that detectable effects within one year are unlikely (Table 26). Annual variations in available stock could easily mask the effect of change in opening date. Permanent or long-term changes to later opening dates would be more likely to demonstrate a decrease in the number harvested in Greenland and a subsequent increase in home-water returns. Accuracy of the estimates would be improved with more complete historical information on the temporal and spatial progression of the fishery.

The Working Group concluded that the new analyses generally confirmed its 1982 conclusion which was based on a more detailed model that the catch level corresponding to various opening dates giving the same impact on stocks is:

$$Y = 1{,}183.79 \times 5.4398X - 0.00710X^2$$

where X is the opening date with 9 August = 0, and 1,184 t being the catch for that opening date.

3.5 Historical Catches and Sustainable Yield

In response to the request from NASCO to review historical catches of North American salmon and provide advice on possible levels of sustainable yields of North American salmon at West Greenland and in home waters, the Working Group documented catches of North American salmon in both areas (Table 27, Figure 4). Catches in North America are shown from 1910-1985 while estimates of the harvest of North American salmon at Greenland are for 1960-1985. Catches of salmon in Newfoundland and Labrador prior to joining Canada in 1949 are based on export statistics and are included in Canadian catches. Recorded catches for Canada prior to 1960 probably exclude recreational harvests. Estimates of the Greenland harvest of North American salmon were derived using average weights recorded for all salmon and those of North American origin caught in the West Greenland fishery (Table 19) and data describing the proportionate breakdown of the Greenland catch by continent of origin (Table 18). The Working Group expressed concern as to the reliability of all catch figures prior to 1970.

Sustainable yield was defined as any level of harvest that could be maintained on a continuing basis. In the context of the historical catches and also considering the complexity of the fisheries, the Working Group noted several concerns with the application of this concept to manage the North American Atlantic salmon resource. First to be noted was the large annual variation in productivity as evident in the historical catch statistics. Second, it was noted that the sea fisheries are generally harvesting a mixture of stocks among which there is considerable individual variability in productivity. Third, the Working Group noted that catches of salmon at different sea ages are not equivalent relative to their impact on return to home-water fisheries and spawning escapements. Fourth, setting a single catch level for all North American salmon would include assigning a level of catch to the Greenland fishery and thereby affecting European stocks also caught there. Finally, it was noted that application of a management system based on maintaining a sustained yield constitutes a major change from the present system whereby stocks are managed on the basis of satisfying stock conservation requirements.

The Working Group reviewed a proposal for establishing a single TAC for North American Atlantic salmon based on a review of historical catches. The 2,650-t TAC, equalling the mean of catches from 1948-1985 recorded for North American fisheries plus the estimated losses to North American stocks attributed to the West Greenland fishery, had been put forth to the Working Group as a ceiling, subject to downward adjustments based upon best available information on the status of the stocks. The Working Group noted that the concerns expressed in the previous paragraph applied in varying degrees to almost all levels of TAC and concluded that in order to satisfy stock conservation requirements, it would be necessary to set the TAC at a level that was very conservative.

3.6 Home-Water Fisheries and Stocks

3.6.1 Impact of management measures taken and proposed by states of origin on home-water catches and spawning escapements of salmon

The Working Group agreed to limit the discussion of this section to Canada and the USA, since all other countries are addressed in Section 4.2.

Changes in management measures

The Working Group noted that the management measures listed in Anon. (1986b) remain in effect. Additional measures were:

(i) Canada

Three new conservation measures were instituted in Newfoundland-Labrador in 1986:

a) The commercial salmon fishery was closed from 15 October to 31 December, the former closing date.

b) A 15-fish season limit was imposed on participants in the recreational fishery.

c) All commercially-harvested Atlantic salmon had to be tagged with market tags.

(ii) USA

A mandatory registration system to monitor catches for all MSW salmon taken by angling in Maine will take effect in 1987.

Impact of management measures

(i) Canada

The impact on spawning escapement and harvests of management measures imposed in Canada in 1984 and 1985 was described in Anon. (1986a). It was estimated that the complete closure of some fisheries resulted in a 22% reduction in landings of MSW salmon and a 3% reduction in landings of 1SW salmon (Table 16, Anon., 1986a). With regard to 1986, this would result in a decrease in harvest and an increase in spawning escapement of about 212 t of MSW and 16 t of 1SW.

The average reduction in salmon catch in the Newfoundland and Labrador commercial fishing areas due to a delayed opening of the season was estimated to be 84 t of MSW salmon and 7 t of 1SW salmon (Table 28). This is the average catch in 1981-1983 prior to 5 June in affected statistical areas. These values are 11% and 1%, respectively, of the average total commercial landings in those areas in 1981-1983 (Anon., 1986a). Thus, it is estimated that 74 t of MSW salmon and 6 t of 1SW salmon would have been affected by the delayed opening of the commercial fisheries. Some of these salmon would be subjected to fishing mortality when the season was opened, but there are insufficient data to quantify this mortality.

The average landings of salmon after 15 October (1981-1983 and 1985) was 7 t. These fish were either MSW salmon or immature 1SW salmon. Some of these salmon may be available to the fisheries in the following year; however, the majority would probably return to rivers in USA and Canada.

The impact that recent management measures have had on returns of MSW salmon to river systems and spawning escapements was further investigated by evaluating data available for the Miramichi, Restigouche, and Saint John Rivers (Table 29). In both the Restigouche and Miramichi Rivers, the estimated returns for 1983 and 1984 were less than the predicted returns; whereas in 1985 and 1986, the estimated returns, while within the 95% CL, were greater than the predicted returns. This is consistent with the management measures which would tend to reduce fishing mortality of MSW salmon for these stocks in Canadian fisheries distant from these rivers.

There may be other factors influencing the greater-than-expected returns in 1985 and 1986, such as an increase in survival at sea of 2SW salmon. Although the returns to the Saint John River in 1984 were above those predicted, the returns in 1985 and 1986 were slightly below (5% and 13%) the predicted returns. It is noted that the fishing mortality on salmon stocks of the Saint John River in Canadian fisheries outside the Saint John River is low and measures taken to reduce these fisheries would not be expected to have a measurable effect on returns to the Saint John River.

The spawning escapements and the ratio of spawners to returns increased in all three rivers in 1984 to 1986 above those observed in 1982 and 1983. These increases can be attributed to measures to reduce fishing mortality in both the commercial and recreational fisheries within, and at the mouth of, the respective rivers.

The mean ratio of MSW salmon to 1SW salmon harvests of the same smolt class for the years 1983-1985 (1.23) was significantly ($p<0.05$) lower than the mean ratio for the years 1970-1982 (2.05). This indicates that Canada is now catching fewer MSW salmon compared to previously relative to 1SW salmon catches of the same smolt class (Table 30).

The Working Group concluded that management measures taken by Canada in 1984, 1985, and 1986 reduced the harvest of salmon in Canadian fisheries, particuarly the MSW salmon.

(ii) United States

The management measures taken in 1985 to reduce the fishing mortality on MSW salmon in the Penobscot River continued in 1986. The exploitation in 1986 was about 10% compared to 22-27% prior to 1985.

3.6.2 Spawning escapements and target spawning biomass for salmon stocks occurring in the West Greenland Commission area

Canada

For most Canadian salmon stocks contributing to the salmon population in the Commission Area, there is no spawning biomass target. However, for some rivers, there is a minimum egg deposition target of 2.4 egg/m^2 of juvenile rearing habitat, exclusive of lacustrine habitat, from which the spawning requirements can be calculated.

Target egg depositions and spawning requirements together with spawning escapement and egg depositions for 1986 were available for six rivers in Canada:

River	Target deposition Eggs (10^6)	Target deposition Fish MSW	Target deposition Fish 1SW	1986 spawning escapement Eggs (10^6)	1986 spawning escapement Fish MSW	1986 spawning escapement Fish 1SW
Miramichi	132.0	23,600	22,600	210.9	28,300	77,700
Restigouche	71.4	12,200	2,600	88.0	14,800	4,600
Saint John	67.7	10,100	7,600	47.2	7,400	12,000
Nepisiguit	9.5	1,560	2,250	6.6	1,080	1,570
Margaree	6.7	1,040	580	12.8	1,980	450
La Have	4.9	600	1,620	9.5	1,420	2,410

The 1986 egg depositions were calculated utilizing sampled sex ratios, fecundities, and an estimate of spawning escapement (total river returns minus removals). On the Miramichi, Restigouche, and Saint John Rivers, the number of spawners required to achieve the target egg deposition is based on the eggs from MSW spawners. For the Nepisiguit, Margaree, and La Have Rivers, the contribution by 1SW fish is also considered in the estimate.

Total river returns were based on: mark-recapture experiments in the Miramichi, fence/fishway counts on the Nepisiguit and Saint John Rivers, angler harvest and exploitation rates on the Margaree and La Have Rivers, and angler harvest and mean spawner to angled fish ratio on the Restigouche River.

United States

For USA salmon stocks contributing to the salmon population in the Commission Area, target minimum egg deposition was assumed to be 2.4 per m^2. The number of spawners and spawning requirements are estimated for three rivers in the USA. Spawning escapement was counted at fishway traps and includes hatchery broodstock:

River	Target spawning escapement MSW females	1986 spawning escapement MSW females
Penobscot	3,000	1,750
Merrimack	1,537	53
Connecticut	4,076	170

Other countries

Target spawning biomasses were unavailable for rivers in Iceland, Ireland, Northern Ireland, France, Scotland, England and Wales and Norway. Estimates of spawning escapements in 1986 were available for the River Blanda in Iceland (1,033), the Burrishoole River in Ireland (494), the North Esk in Scotland (6,326), and the River Drammen in Norway (1,448).

Conclusion

Since little is known about target spawning biomass and spawning escapements for the rivers that contribute to the salmon population of the Commission Area, it is recommended that more information be obtained.

3.6.3 Exploitation rates in home waters for salmon stocks occurring in the West Greenland Commission area

The Working Group decided to limit discussion in this section to Canada and the USA since similar data for European rivers is presented in Section 4.3. Estimates of the exploitation rate for three North American rivers were presented.

Canada

The exploitation rate of 1SW salmon in the Conne River, Newfoundland in 1986 was calculated to be 0.28 based upon total counts of salmon entering the river and sport catches. For the Saint John River, New Brunswick, exploitation rates for 1SW and MSW salmon by the combined commercial/by-catch, Indian, and sport fisheries in 1983-1986 were calculated as a fraction of the total river returns. Neither retention of MSW fish in the sport fishery nor commercial fishing were permitted in 1984-1986. However, 10% of the hooked-and-released MSW fish are assumed to have died and are, therefore, included in the harvest. Values ranged from 0.25-0.40 for 1SW salmon and 0.29-0.62 for MSW salmon (Table 31).

United States

There is no legal commercial harvest or by-catch of Atlantic salmon in the USA, and the sport harvest is limited to Maine rivers. Estimates of exploitation of 1SW and MSW salmon in the Penobscot River were presented for the period 1982-1986 (Table 31). These estimates allow for incomplete reporting of the sport catch.

3.7 Tagging of Salmon

3.7.1 Tag recovery at West Greenland

ICES was asked by NASCO to evaluate the tag recovery and return procedures at West Greenland, to assess the accuracy and completeness of information accompanying the tag returns, and indicate methods for improving the tag recovery and return procedures.

These questions were addressed and it was noted by the Working Group that the salmon landings in West Greenland were scanned for fin clips and microtags in 1985, with coded-wire tags recovered in West Greenland being submitted to the Fisheries Laboratory, Lowestoft (UK) for decoding (Anon., 1986a). These procedures were followed during sampling of the West Greenland salmon fishery in 1986.

In 1985, a total of 14,319 salmon (5% of the West Greenland catch) were examined for fin clips and tags by Canadian and Danish scientists. In the sample, 223 (1.6%) had adipose fin clips, and microtags were detected from 36 (16%) of the fin-clipped fish.

The 1986 sampling was expanded by the Danish Government and with the addition of USA personnel. The increased effort permitted a total of 30,360 salmon (10% of the catch) to be examined at West Greenland. In this sample, 410 (1.4%) had adipose fin clips, and microtags were recovered from 70 (17%) of the fin-clipped fish (Table 32).

In 1985, 90% of the 34 microtags read were of Irish origin. Microtags recovered in 1986 were from 6 countries and apportioned as follows: 22 or 31% from UK (England and Wales), 19 (27%) from Canada, 18 (26%) from Ireland, 7 (10%) from USA, and 2 each from Iceland and Scotland. These numbers do not reflect the composition of the catches because numbers of microtags applied vary between countries (Table 33) and sampling sites varied between divisions.

The Working Group noted that the analysis of data on external tags recovered in the West Greenland fishery was proceeding and the discrepancies in numbers of USA-origin tags sent and received by the respective agencies had been resolved. The current reporting of receipt of tags between agencies and clearing houses was deemed adequate, but release data should be included in acknowledging receipt. It was further recommended that copies of correspondence to fishermen should be sent to the appropriate laboratory of the country returning the tag.

Information submitted with tag returns to Canada from West Greenland was reported as 50% complete in the best years (1974-1978), but this value had decreased to about 30% in 1984-1985 (Anon., 1986a).

External tags of Maine origin recovered in the West Greenland salmon fishery during the period 1967-1986 have been received with the recovery data at varying levels of completeness. Some information on date of recovery was provided by over 95% of the individuals returning tags, although day was missing from 36% of the returns.

Recovery location by NAFO sub-divisions has been lacking in 20% of all returns. Biological data have been reported as follows: length and weight for approximately 60% of the returns, age (scale samples) for 49% of the returns, and sex for 23% of the returns.

The Working Group discussed tag rewards in the West Greenland fishery and it was reported that the increase to D.kr. 100 in 1986 resulted in the recovery of tags that had been in the possession of fishermen for several years. It was noted that reward posters were evident throughout most of Greenland and that frequent radio announcements were made requesting tag returns. It was felt that most fishermen were aware of the reward payments. Trends in completeness of reported date of capture and length and weight data paralleled estimated trends in tag reporting rates

(Section 3.2). The Working Group pointed out the value of a tag recovery even if there is no information supplied and was unable to recommend means of improving the information provided with the tag.

External tags from Canada, USA, N. Ireland, Scotland, Norway, and Sweden were recovered at West Greenland during 1986.

Carlin tags of North American origin were recovered from all NAFO divisions in West Greenland with 54 tags of Canadian origin and 58 tags of USA origin reported. In 1985, 62% of the North American tags were recovered north of Division 1D as compared to 38% in 1986 (Table 34). There was little difference noted in the percentage of North American Carlin tags recovered by year by NAFO divisions based on the country of origin.

The Working Group estimated tag reporting rates for external tags recovered in the West Greenland fishery by comparing recapture proportions for reported tags at Greenland with expected recapture proportions estimated from catch. The method is based on the assumption that the tag recaptures at Greenland as a proportion of all tag recaptures (excluding maturing 1SW salmon) varies with the catch of salmon in the fishery. Tag recapture data and catch estimates are given in Table 35. Reporting rate estimates were calibrated against a rate of 0.8 for 1971-1973 based on a 1972 experiment (Andersen et al., 1980; Jensen, 1980). Estimates of reporting rate for the Greenland fishery from 1971-1985 are given in Table 36.

The Working Group noted the recovery in 1986 of additional tags of USA origin from East Greenland waters and the first record of a MSW salmon of USA origin to be recovered in this fishery. Carlin-tag recoveries from this fishery include 11 tags from the early 1970s and 10 recovered since August 1985.

The Working Group recommended that the proportions of Carlin tags recovered from "smoke houses" be evaluated and discussed the desirability of allocating these tags to specific NAFO divisions on the basis of proportionality.

3.7.2 Tagging programs

A discussion of the early returns of microtags, as reported to the Working Group in 1985, resulted in a recommendation that a program be initiated to scan the West Greenland catch for both micro- and external tags (Anon., 1985b). The implementation of this program by Canada and Denmark was noted (Anon., 1986b) and specific details were reported in Anon. (1986a). The Working Group noted and agreed that microtagging programs were implemented for the following purposes:

a) brood stock identification,

b) evaluation of fish culture techniques and operations,

c) determine migration patterns of wild and hatchery stocks,

d) assess exploitation in local and distant fisheries,

e) estimate contributions to mixed-stock fisheries,

f) evaluate other tagging and marking procedures (i.e.,tag loss, reporting rate),

g) evaluation of genetic performance,

h) assess escapement from fish farming facilities,

i) evaluate hatchery contributions to restoration programs.

The ANACAT Committee of ICES produces an annual listing of tagging and fin-clip programs (e.g., Anon., 1986c) as reported by member countries on a voluntary basis. The Working Group noted that some countries were not reporting and, although a delay of a year or more in the publication of tagging lists was adequate for some species, it posed a problem for salmonid stocks. An updating of the 1985 tagging list to include internal and external tags and compilation of the 1986 list was attempted. Preliminary numbers of tags applied by country are provided in Table 33. Many of the members did not have ready access to tagging data and it was noted that some microtags are applied by the aquaculture industry and might not be known or reported to this Working Group. It was further noted that in all known microtag applications in 1986, the adipose fin was routinely excised.

In excess of 600,000 microtags were applied in 1985, and preliminary listings for 1986 exceed 875,000. Carlin-tag applications increased from 200,000 in 1985 to over 375,000 in 1986 (Table 33).

It is recommended that microtag applications be reported immediately to the tag clearing houses as preliminary data, with final figures to be provided to ANACAT within the same calendar year that the tags are applied.

3.8 Accuracy of Classification by Continent of Origin and Accuracy of Age Composition Estimates

In Section 3.1, the Working Group provided estimates of the accuracy of classification by continent of origin. The accuracy of river age composition by continent of origin was also discussed. Sample size influences the precision and hence the accuracy of estimates. If a Poisson distribution is assumed for the number of river age 1 salmon in the samples taken at Green land, then a sample size of 8,000 salmon is required for an approximate 95% confidence limit of ± 10% of the estimated proportion if it is near 0.025. The sample size in 1986 would allow estimations of the proportion of river age 1 salmon to ± 20%, i.e., if the proportion of river age 1 salmon is 0.025, then the approximate CL = 2-3%. However, there could be other errors comparable in magnitude if samples are not spread out through the fishery spatially and temporally. In addition to sampling errors, fish may be inaccurately aged. Difficulty has been reported on ageing hatchery smolts. The Working Group recommended that the scale reading of river age of North American salmon be validated in collaboration with experienced readers.

4 QUESTIONS OF INTEREST TO THE NORTH-EAST ATLANTIC COMMISSION OF NASCO

4.1 Faroese Salmon Fishery

4.1.1 Composition of catches in the Faroese salmon fishery in the 1985/1986 fishery season

NASCO asked ICES to present catch statistics for the Faroese fishery and to estimate the quantity, age composition, and home-water origin of the landings and discards of salmon taken in the Faroes in the 1985/1986 fishing season. Catches of salmon from 1982-1986 are shown by calendar year and by fishing season in Table 37. The Faroese salmon fishery is the only one in the North-East Atlantic Commission area with a season extending into two calendar years.

The estimated catch in numbers by month and age group for the 1985/1986 season is presented in Table 38. The number discarded was estimated to be 1.9% of the total from a special sampling scheme in which some vessels were asked to keep fish which would otherwise be discarded. This is the lowest discard rate estimated since it was first examined in 1982/1983.

4.1.2 Distribution of catches by season and area in the Faroese fishery in relation to country of origin

No new data were available to the Working Group on recoveries of external tags in the Faroese fishery since 1985; data on tag recaptures between 1978 and 1985 were presented in Anon. (1986d) and on microtag recoveries in the 1984/1985 and 1985/1986 seasons in Anon. (1987b). The numbers of recoveries for which the recapture location was known were plotted by statistical rectangle for each country of origin in Figures 3-6 in Anon. (1986a). An analysis of the recovery locations of all tags in the fishery showed that they were taken in the rectangles associated with the highest catches. In addition, there was no significant difference between the centres of distribution of the recoveries of tags originating from smolt releases in Norway, Sweden, and UK (Scotland and England). However, recapture rates for smolts tagged in Norway and Sweden were greater than for smolts tagged in UK and Ireland which were in turn greater than for smolts tagged in Iceland.

4.1.3 Contribution of hatchery-reared salmon and fish farm escapees to the Faroese salmon fishery

The Working Group considered the report by Anon.(1987b) on the work carried out to date on the discrimination of reared and wild fish under four main headings:

i) Direct observations

Opinions had been expressed by experienced observers that some reared fish were readily distinguished from wild fish in Faroese catches, the former having heavier spotting, shorter gill covers, and more eroded or deformed fins. However, no quantitative analyses were presented at the meeting on the first two aspects, although one working paper indicated that a significant portion of the enhanced stocks also showed fin damage. The Working Group considered that many fish could be misclassified using this method due to both fin damage in ranched and wild stocks and to natural phenotypic variation. It was recommended that further tests of the technique should be carried out.

ii) Morphometric methods

Three papers were presented at the meeting describing discrimination analyses using fin measurements of wild, farmed, and ranched adult salmon. Good discrimination was demonstrated between farmed and wild fish in Norwegian and UK studies Poorer discrimination was achieved between ranched and wild fish and this was attributed to fin regeneration in the former. No independent tests of the level of discrimination between ranched and farmed fish were available and it was recommended that these comparisons be carried out. The Working Group further recommended that all fin measurements should be standardized in the future using the criteria outlined in Appendix I of Anon. (1987b).

iii) Scale analyses

It was reported in Anon.(1987b) that farmed fish showed a higher proportion of regenerated scales (78%) than wild fish (52%). Previously reported evidence also suggested that there were differences between the scales of reared and wild fish in smolt ages, summer checks, the relative widths of the freshwater zones, and the form of the transition pattern to sea growth (Anon., 1984; Antere and Ikonen, 1983). However, no further quantitative information was available on these aspects, and the Working Group recommended that additional studies be carried out.

iv) Biochemical methods

The antibiotic tetracycline and the artificial colouring, canthaxanthin, which are commonly used at fish farms, can be detected in samples from farmed fish. The Working Group noted that in one catch sample of 219 fish taken in the Faroese fishery, detection of canthaxanthin in muscle tissue indicated that at least 3% of the fish were of farmed origin. (Direct observation suggested that 13% of this sample were reared and the corresponding proportion from scale reading was 7%.)

Discussion in Anon.(1986a) covered the first three of these discrimination techniques, and the Working Group concluded that many of the problems remain unresolved. It was emphasized that to be effective, a method should be capable of distinguishing between fish which had escaped from farms after the smolt stage and those which had been released at or before the smolt stage for stock enhancement purposes. This criterion had apparently only been achieved by the biochemical analyses, where investigations were still at a preliminary stage. The Working Group endorsed the conclusions of the Study Group (Anon., 1987b) and recommended that investigations should continue into all the methods being developed to discriminate between hatchery and wild-stock components.

4.1.4 Minimum size regulations and discards

NASCO asked ICES to consider the biological effects of alternative minimum size regulations for the Faroese fishery. The current minimum landing size (MLS) in the fishery is 60 cm total length, which is equivalent to a fork length of approximately 57 cm. The Working Group addressed this question by examining the size composition of the catch at the Faroes and the discard rates in recent years. The effect of changing the MLS was assessed in terms of the estimated effects on the numbers and weight of fish discarded, numbers of salmon of each year class, and the total weight of salmon returning to all European home waters.

Since 1981, the Special Study Group on the Faroes Fishery has attempted to estimate levels of non-catch fishing mortality in the Faroese longline fishery to use in the assessment of the effects of the fishery on stocks returning to home waters. In 1981, values were based on "best guesses" and between 1982 and 1985, on data collected in the observer programme by international scientists. In the 1984/1985 and 1985/1986 seasons, arrangements were made for certain vessels to retain fish, which would normally have been discarded. The estimates of discard rates for these two seasons are probably the most reliable available because of the numbers of landings sampled. In both seasons, discard rates varied considerably between boats (3-32% in 1984/1985 and 0.6-11% in 1985/1986) and the overall discard rates were estimated to be 13.5% and 1.9%, respectively. In the 1984/1985 season, it was noted that the fishery took place over a much wider area than usual because of the high concentrations of undersized fish (Anon. 1986a). It is reasonable to suggest, therefore, that the value of 13.5% is at the top end of the probable range, while the very low estimate for the 1985/1986 season indicates that the discard rate may fall to insignificant levels in some years.

The most recent estimates of the survival rates of salmon discarded in the Faroes longline fishery are 15-20% (Anon., 1984; Anon., 1985b). Thus, the numbers and weight of fish discarded and the numbers of those surviving of estimated total catches of about 180,000 salmon in both the 1984/1985 and 1985/1986 seasons may be estimated as shown below:

Season	Discard rate (%) No.	Discard rate (%) Wt.	No. discards	Wt.(t) discards	No. surviving
1984/1985	13.5	5	~ 25,000	~ 37.5	3,750-5,000
1985/1986	1.9	0.8	~ 3,500	~ 5.3	525-700

Figure 5 shows the fork length frequency distribution of the

Faroes catches in the 1984/1985 and 1985/1986 seasons. The effect of increasing the MLS to 63 or 68 cm total length (equivalent to approximately 60 and 65 cm fork length, respectively) with respect to these seasons' catches is shown below:

	Estimated discard rates by numbers (%)		
Season	MLS 60 cm	MLS 63 cm	MLS 68 cm
1984/1985	13.5	19	36
1985/1986	1.9	6	22

The Working Group noted that removing the MLS would probably not reduce the discard rate to zero, as there might still be economic advantages in discarding small or poor quality fish if boats are restricted to catch quotas or freezer space is limited. However, the effect of landing all fish caught can be assessed using the number of fish caught, the age composition, and the discard rate in the 1984/1985 season assuming:

a) The discard rate was 13.5%, and 17.5% of those discarded survived.

b) The landed catch was 158,000 salmon.

c) Weight parameters for age classes in the fishery and on return to home waters were as given in Anon. (1986a).

d) The landings would have been the same without an MLS.

e) The instantaneous rate of natural mortality after the first year in the sea is 0.01 per month.

f) A total of 78% of fish of all ages caught would have tried to return to home waters in the same year, the remainder in the following year.

The effect of landing all fish caught in the 1984/1985 season would, therefore, have been as follows:

Age class	No. fish killed in fishery	No. fish returning to home waters
1SW	increased by 3,013	decreased by 2,280
2SW	decreased by 7,684	increased by 5,235
3SW	decreased by 739	increased by 2,170

The total weight of salmon returning to home waters would increase by about 38 t.

Assuming the discard rate in the 1984/1985 season is the maximum likely to occur while in other years the rate may be negligible, then the effect of landing all fish in any year is estimated to be from zero to the values shown above, assuming the other parameters remain unaltered. However, the age composition of the catch varies from year to year and will be related to the discard rate; this will, therefore, have a significant effect on the estimates. If the removal of the MLS did not result in all fish caught being retained, the results would be smaller than shown above.

The present legal requirement is that all fish below 60 cm total length be returned to the water.

Since the 1984/1985 season, licenses to fish for salmon have included a statement that discards should be handled gently and, where necessary, snoods should be cut leaving hooks in situ to minimize trauma.

From 1987, the Faroese Government has extended the power of the Fisheries Laboratory to close areas to salmon fishing if large numbers of small fish are present in the catches. Because of the variable nature of the discard rate, this would seem to be the best method of minimizing discards. As fish less than 60 cm have little economic value and will tend to decrease the effective catch per unit effort, fishermen have not opposed the measure.

The discard rate could, in theory, be reduced to zero by regulation. This would require fishermen to land all salmon caught regardless of quality and size. Experience from other fisheries, however, shows that discarding fish is a matter of economic consideration.

It might, in theory, be possible to improve the survival rate of discards. This, however, would imply changing the routine of the fishing operation (shorter lines, etc.) in order to have more fish alive when discarded and must, therefore, be considered impractical.

The Working Group was not able to assess the efficacy of the present methods of minimizing discards and their mortality in the Faroese fishery. Minimum size regulations may not be an effective means of reducing discards, whereas closing areas where small fish are more abundant could achieve the same result.

4.2 Home-Water Fisheries

4.2.1 Catches of salmon in the North-East Atlantic Commission area

NASCO asked ICES to present the catch statistics of the North-East Atlantic Commission salmon fisheries on an annual basis, and on a seasonal basis where the season overlaps the end of the year, distinguishing between freshwater and marine components. Catches from home-water fisheries in the area are presented in Table 1.

In the absence of a suitable definition to split the estuarine zone into freshwater and marine components, the Working Group was unable to report these catches in the categories requested by NASCO. The catches for 1984-1986 are, therefore, sub-divided, where possible, into riverine, estuarine, and marine components in Table 39.

In some countries, catch statistics are not collected in a way which easily distinguishes riverine, estuarine, and marine components. For Ireland, all drift-net catches were called marine, draft net called estuarine, and rod and trap catches were called riverine. For Northern Ireland, a similar approach was followed but rod catches are not included. Division between zones in England and Wales involved some approximations. For Scotland, the rod fishery was considered riverine, the net and coble fishery estuarine, and the bag and stake net fishery marine. The estuarine catch in Iceland includes ranched fish. All catches included hatchery-reared fish.

4.2.2 Description of salmon fisheries in the North-East Atlantic Commission area

NASCO asked ICES to provide descriptions of the home-water fisheries in the North-East Atlantic Commission area and the effects of existing, new, and proposed conservation measures on the exploitation of home-water stocks. The Working Group considered that home-water stocks were conserved by management measures laid down by various levels of regulations and that these same regulations were largely responsible for the form of the salmon fisheries as they exist today. Members from the North-East Commission area, therefore, provided descriptions of the development of management measures in their areas and their effects on the organization of the fisheries. It was noted that for all member countries represented at the Working Group meeting, except France, salmon caught in the sport fisheries could legally be sold.

Norway

Drift nets, bend nets, bag nets, stake nets, and stationary lift nets are the legal salmon gears used in salt water. In addition, there is a sport fishery with rod and line in salt water. With a few exceptions, the only legal salmon gear used in fresh water is rod and line.

Drift nets are manufactured from monofilament twine and can be operated between the baseline and the 12-mile limit. All other gears are used inside the baseline. Monofilament twine is used in bend nets, while the other nets are manufactured from spun nylon twine. The legal minimum mesh size is 58 mm knot to nearest knot (116-mm stretched mesh) and most bag nets, lift nets, and stake nets are of this size. The mesh size of bend nets can vary, and more than 70% of the drift nets have mesh sizes 65-70 mm knot to knot.

Drift nets, bag nets, bend nets, lift nets, stake nets, and rod fishing in salt water are permitted during the period 1 June-5 August. In Finnmark County, rod fishing in the sea and the bag net fishery can start 1 and 15 May, respectively. There is a weekly closed time for all nets extending from 1800 hrs on Friday to 1800 hrs the following Monday. The drift net fishermen also require a license to operate, and in 1986, a total of 582 licenses were issued. The number of drift nets which can be fished per license is restricted to 20, 35, and 50 in vessels with 1, 2, and 3 fishermen, respectively. Bend, bag, stake, and lift net fisheries belong to the owners of the adjoining land, and at present do not require a license. The river fishing is carried out mainly with rod and line. With few exceptions, river fishing can be carried out from 1 June until 1 September. The fisheries belong to the owners of the river.

In 1985, there were 20,329 drift nets, 1,726 bag nets, 5,848 bend nets, and 34 lift nets in operation in the Norwegian home-water fishery (Anon., 1986e). There were no official figures for stake nets, but these are very few and restricted to a small area in southeast Norway.

On 11 April 1986, the Norwegian government decided to regulate the salmon fishery in home waters as follows:

1) Total ban of the drift net fishery from 1989.

2) Total ban of the use of monofilaments and similar materials in salmon nets from 1988. (Drift nets excluded.)

3) Introduction of a license scheme for anchored gear (bag nets, bend nets, lift nets, and stake nets) from 1988.

4) Shortening of the fishing season for bag nets and lift nets by 16 days from 1987 (start 1 June instead of 15 May), except the bag net fishery in Finnmark County.

5) Shortening of the fishing season in rivers from 1988.

6) There is a proposal before the Norwegian Storting (parliament) to prohibit the use of mackerel set nets at sea surface level during periods of the year. The nets have to be set below the sea surface (except in the commercial fishery).

7) Total ban of river fishing on very small populations.

England and Wales

The management of salmonid fisheries is the responsibility of ten regional Water Authorities. The Salmon and Freshwater Fisheries Act, 1975 provides for the basic protection of both juvenile and adult salmon in rivers and coastal waters. The following outline controls for the fisheries are among the more important provisions:

1) All salmon fishing must be licensed.

2) Close seasons operate for all fisheries; these must have a minimum duration of 92 days for rod fisheries and 153 days for commercial fisheries (242 days for specific types of fixed gear).

3) Weekly close times apply for commercial fishing; these must be 42 or more hours.

4) A minimum mesh size of 2 inches (50 mm) knot to knot applies to all net fisheries, except where approved bylaws permit the use of smaller mesh sizes.

5) Certain methods of taking salmon are banned.

6) The migratory movements of salmon may not be willfully obstructed in coastal waters or rivers.

This legislation also enables WAs, by means of bylaws and orders approved by central government, to adapt the basic fishery controls and to specify types of gear and modes of operation in their areas.

The 1986 Salmon Act, although primarily concerned with Scottish salmon fisheries, introduced additional measures for England and Wales, which include:

1) A licensee must normally be present when the licensed net is in operation.

2) The provision for a dealer licensing system.

3) The creation of a new offense where a person handles salmon which he suspects, or it would be reasonable for him to suspect, may have been taken illegally.

4) The act reaffirms a ban on all fixed gears, but provides the means to introduce bylaws which would allow the operation of such gears in certain areas.

The table below gives details of the salmon fisheries in England and Wales in 1985:

Method	Zone	No. licenses
Drifting nets and fixed beach nets	Mainly sea	278
Seine nets	Estuary	207
Hand held nets	Estuary	383
Fixed gears	Estuary	107
Rod and line	River	~37,000

France

Commercial fishing is only allowed in the estuaries of the Loire and Adour Rivers and in freshwater sections of the Loire River (fixed nets).

Rod and line fishing is authorized within freshwater sections of all rivers with salmon populations. Since 1986, the rod and line fishing season (beginning early March) was lengthened for one month (15 June - 15 July) for some rivers. Only fly fishing was permitted during this month. Since 1987, a quota is imposed on fishermen. Each fisherman in fresh water has to buy a plastic ring before going fishing and the catch must be marked with this ring. Subsequently, the catch must be declared, and the characteristics and the scales sent to a central system.

Finland

There have been agreements between Finland and Norway concerning salmon fishing in the River Tana since 1873.

The main conservation measures are:

1) In 1873, it was forbidden to close the river totally by a weir.

2) The length of the total fishing season has been restricted since 1873.

3) The length of the weekly fishing time was set to 6 days in 1873 and 3 days in 1979 for fixed fishing gears and gillnets.

4) Minimum distances allowed between different fishing gears have increased.

5) Seine fishing is allowed today only in restricted areas compared to the beginning of this century, when it was used all over the river.

6) The use of fixed fishing gears and gillnets is limited to two gears per person who has fishing rights.

7) In 1979, fishing by all methods for one day a week was forbidden.

8) In 1979, the use of all monofilament (multimono, monotwine) material in fishing gears was forbidden.

9) In 1979, all fish planting with salmon, sea trout, and sea char was forbidden to conserve the purity of natural salmon stocks. There has been very little salmon planting since 1976.

Northern Ireland

In Northern Ireland, most of the coastal netting stations are in the form of fixed bag nets, for which 26 licenses are issued. A fixed stake net is operated in the estuary of the River Foyle and one license is issued for a commercial freshwater trapping station in the River Bann. A total of 256 other commercial licenses are issued, comprising both draft and drift nets. Most of these operate in the Foyle area (from where 50% of the catches are allocated to Northern Ireland and 50% to the Republic of Ireland). Close periods in the Foyle area are varied seasonally in response to spawning stock size, as counted through electronic counters. No other changes in regulations were implemented in the rest of Northern Ireland waters in 1986.

Scotland

In the early 1800s with the introduction of bag and stake nets, collectively called fixed engines, netting for salmon tended to move from the rivers and estuaries onto the coast. Coastal netting for salmon built up to a peak in the first half of the 1900s. However, from about 1950, there has been a steady decline, both in the number of sites fished and in the length of the season at the sites which have remained in operation. Inside estuarial limits and in fresh water, the only permissible fishing methods are net and cable and rod and line. The annual close time cannot be less than 168 days with a variation for rod and line. The actual dates can vary from district to district but are generally from the beginning of September until mid-February, although few nets are now operated before mid-April. In addition, there is a weekly close time of 42 hrs for nets, lasting from 12 noon on Saturday until 0600 hrs the following Monday, and 24 hrs for rod fishing (Sunday).

Fishing of salmon by other methods, principally drift nets, was banned in the early 1960s, and recently, both the carriage of monofilament nets by boats and the setting of any net designed to enmesh salmon have been made illegal. In addition, the Salmon Act, 1986 gave the Secretary of State for Scotland power, after due consultation, to make regulations with respect to the meshes, materials, and dimensions of nets, baits, and lures and the weekly close time. In addition, the possession of salmon which have been illegally caught, killed, or landed was made an offense, and there is provision in the Act for the introduction of a salmon dealer licensing scheme in Scotland, England, and Wales. The effects of these measures have not yet been evaluated.

Iceland

Salmon fishing in the sea has been prohibited in Iceland since 1932. At that time, there were some minor fisheries operating close to some estuaries. Since these were considered historic rights, they could not be eliminated, but there has been a drastic reduction in the number of locations and most of the remaining legal land-attached gillnet fisheries are operating in southwestern Iceland.

The freshwater exploitation is mostly by rod and line in about 80 clear-water streams, but gillnetting takes place in 3 glacial streams. The gillnet fishery is controlled by limiting the number and length of gillnets. They are also not allowed to operate more than 4 days per week. The only limitation in the sport fishery is a pre-fixed number of rods per stream, but stream owners which rent out the fishing areas may put on bag limits as well as eliminating certain lures such as spoon.

Ireland

In 1986, the Minister for Fisheries in Ireland formed a Salmon Review Group which has been reviewing the legislation and conservation of salmon in Ireland. This is a comprehensive review and will shape the future path for Irish salmon management. This group is due to present a report early in 1987.

The general regulations pertaining to Irish salmon fisheries were described in Anon.(1984) and updated in Anon.(1986a). There have been no major changes since then.

4.2.3 Effects of conservation measures on exploitation of home-water stocks

NASCO asked the Working Group to consider the effects of existing new and proposed conservation measures on the exploitation of home-water stocks.

A wide range of exploitation rates occurs in home-water fisheries in the North-East Atlantic ranging from a few percent to over 90%.

There is a large body of conservation measures regulating exploitation in the various countries. These were outlined in Anon. (1981) and have been updated each year since. Many of these measures can be expected to affect the ultimate spawning escapement. These measures include closed seasons, weekly closed times and closed areas, prohibition and definition of gears, and materials and methods of fishing. There are also regulations as to the size of boat, the sale of fish caught, and the numbers of licenses issued.

There are several problems in assessing the effects of present and future conservation measures. The catches do not necessarily reflect changes in the stocks and assessments of stocks are available from only a few rivers. The variability of marine survival makes the general assessment of conservation measures difficult unless a measure of comparative marine survival for the area being investigated is available. Finally, there is evidence that, at least in some countries, there is substantial unreported catch and, unless this can be estimated, the effects of conservation measures cannot be assessed.

Evaluating the combined effect of existing regulations is a hypothetical question requiring assumptions of the likely fate of salmon stocks in the absence of conservation measures. If NASCO wishes to have the incremental effect of a particular conservation measure investigated, a more realistic analysis could be carried out. For these reasons, the Working Group was unable to assess the effects of specific measures at this meeting.

4.2.4 Evolution of fishing gear

NASCO asked ICES to describe the historical evolution of home-water fisheries in terms of the gear used divided into riverine and marine components.

Most home-water salmon fisheries have been controlled for at least 100 years. As a result, there has been little change in the gear used except where certain methods have been banned (see Section 4.2.2). However, the introduction of synthetic netting twines in the 1960s, in particular monofilament and monoply twines, affected the operation of many netting methods. Generally. these materials made the nets stronger, longer lasting, and easier to operate. In the case of gill and drift nets, they became much more effective and could be operated sucessfully in daylight and away from the shore. This led to an increase in marine drift netting in many areas until it was brought under control by net license limitations or banned, as it has been now in some countries.

4.3 Exploitation Rates

Estimates of fishing mortality in the Faroese fishery are based on Carlin-tag returns from two rivers - the River Imsa in Norway (wild and hatchery-reared smolts) and the North Esk in Scotland (wild smolts). Estimates for home-water fisheries based on micro-tag returns of hatchery fish from the River Burrishoole in Ireland and the River Bush in Northern Ireland were also made available to the Working Group.

Norway - tagging study

In the 1986 Working Group report (Anon., 1986a), estimates of exploitation rates in the Faroese fisheries and in Norwegian home waters were presented for salmon tagged as smolts in the River Imsa, SW Norway. Tables 40 and 41 give updated figures for these wild and hatchery-reared fish.

Exploitation rates were estimated as described in Anon. (1985b).

Exploitation in the Norwegian Sea of salmon in their first sea winter is zero for wild salmon and hatchery salmon released as 1+ smolts. Exploitation of 1SW hatchery salmon released as 2+ smolts is low. This may be because 2+ reared smolts are bigger than wild and 1+ reared smolts during their first sea winter and thus more vulnerable to the longlines.

Home-water exploitation is very high both for 1SW and 2SW salmon. The exploitation rate for 2SW fish in the Faroese fishery is lower than in home waters. However, the catch in numbers of 2SW fish in the Faroese fishery can be as high as in home waters because more fish are available.

In 1986, the overall rod catch in the River Drammen was recorded and the total freshwater salmon stock was calculated using a mark-recapture technique. There is no commercial fishing for salmon in the area. The rod exploitation rate of the freshwater stock was found to be 0.52. No information was presented on the marine exploitation of the River Drammen salmon, including Norwegian coastal fisheries.

Scotland

Based on tagging experiments with wild smolts in the North Esk, Scotland, it was possible to estimate exploitation rates in the different fisheries using the same method as has been used for the River Imsa. The trap in the North Esk does not catch the total adult run, but estimates of exploitation rates based on the total run during the fishing season have been presented to the Working Group in the past (Anon., 1985b). Furthermore, counts of upstream migrants have demonstrated that 20% of the total stock migrates into the river after the fishing season has closed. It is thus possible to estimate the total annual run of tagged fish, as in Anon. (1986a).

The estimated number of tagged 2SW salmon available to the fisheries at the Faroes, North Esk, and all other fisheries combined and the estimated exploitation rates are presented in Table 42.

Ireland

The River Burrishoole in western Ireland has a facility for counting upstream and downstream migrants. Reared smolts were microtagged and released near the river mouth. Exploitation rates were calculated using the same method as described in Anon. (1985b). Microtag recoveries and calculated home-water exploitation rates are shown in Table 43.

Northern Ireland

In the River Bush, microtagged hatchery-reared 1+ and 2+ salmon smolts were released in 1985. In 1986, the Irish coastal fishery was sampled and returns to the River Bush were counted in a trap. Adjusting for declared catch and for 50% non-reported catch, it was possible to produce estimates of marine exploitation. These estimates are shown in Table 44.

5 FUTURE RESEARCH

The Working Group reviewed research needs identified in Anon. (1986a). Several of the research needs identified were removed from the list because of work having been completed and reported to the Group, and others were combined because of duplication. Research requirements identified by the Working Group and their status are summarized below.

Research needs identified in Anon.(1986b) and progress made

Research needs	Action
1. Catch and effort data.	
1.1 Newfoundland catch data by standard week from 1970-1983 are required.	Information expected at next meeting.
1.2 There is a continuing need for additional study of the relationship between licensed fishing effort and fishing mortality in Canadian fisheries.	No new information provided, but ex-expected for next meeting.

1.3 The Working Group identified data deficiencies and recommended the development of a data base to be maintained at ICES headquarters and accessible only to the Working Group. This was to include national catches of salmon and river index data from the North Esk (Scotland), Burrishoole (Ireland), Bush (Northern Ireland), Imsa (Norway, Lagan (Sweden), Kollafjördur ranching operation and Laxá in Kjös (Iceland), Western Arm Brook, Saint John and Miramichi (Canada), and Penobscot and Merrimack (USA). It was recommended that these data should be included as per Appendix V of Anon. (1985b) from samples of a minimum of 100 fish.	Data base updated.
1.4 A brief description of home-water fisheries and catches is required.	Has been described, but more information needed for some countries.
1.5 Collection of catch and effort data in the West Greenland fishery should be initiated.	Catch data available and catch rate data provided for 17 vessels only. Plans are to attempt to collect data on catch rate in the 1987 fishery.
1.6 Levels of unreported catch have not been provided for some countries and fisheries. This information is needed to fully document North Atlantic salmon catches.	Guesstimates could not be obtained for all countries. The Working Group did, however, provide a rough guesstimate representative of all countries.
1.7 Catch-at-age data were preliminary and complete data are required for all fisheries.	More complete reporting is required and expected at the next meeting.
1.8 Investigate means to improve the cost effectiveness of sampling salmon catches at West Greenland.	Desired sample sizes were suggested by the Working Group. It is essential that sampling schemes be assessed annually in advance of implementation to maximize effectiveness in relation to available personnel.

2. Exploitation rates.

2.1 Estimates of exploitation rates should be obtained for areas where they are not currently available.	Estimates were provided for Northern Ireland, USA , Canada, Norway, Ireland, Greenland, and Scotland. More information is required from all countries.
2.2 Research should be conducted to obtain information to be used on the catch rate model of Hansen (1984).	Project has been suspended.

3. Stock discrimination.

3.1 The data base of the discriminant analysis used to identify continent of origin of salmon caught at West Greenland should be tested in 1985 and every two years thereafter. Also, the data base should be extended to include scales from salmon of additional stocks known to contribute to the West Greenland fishery.	Done in both 1985 and 1986 and should be tested every year.
3.2 The accuracy of estimates of catches of North American hatchery-origin salmon by smolt age at West Greenland should be examined, and sample sizes identified.	Working Group recommended further refinement of ageing techniques used to identify North American hatchery salmon and examination of the stratification scheme used in subsampling scale materials collected at Greenland. Progress will be reported at the next meeting of the Working Group.
3.3 An attempt should be made to discriminate country of origin of salmon in both the West Greenland and Faroes commercial catches. Studies should be initiated to determine the feasibility of the scale discrimination technique to separate stocks of salmon at West Greenland and in the Faroes.	Some new information was provided. More work is required and is in progress.

3.4 Scale samples taken in the Newfoundland-Labrador commercial fisheries should be examined to determine the proportion of fish of hatchery origin (age 1 smolts or other criteria). Available data should be examined to determine the representativeness of existing samples and to determine sampling requirements to obtain estimates for the entire provincial fishery.	Nothing additional reported. Working Group considered present sampling to be inadequate.
3.5 A technique of classifying hatchery-reared salmon and those escaped from fish farms should be developed and tested.	Progress being made but further refinement of techniques is required.
4. Natural mortality.	
4.1 Research programmes to study post-smolt mortality should be continued and reported upon.	Progress being made but further work is needed on natural mortality during the entire marine phase.
5. Non-catch fishing mortality.	
5.1 Non-catch fishing mortality should be further investigated in all fisheries.	Progress made but more work is required.
5.2 The extent of by-catches and resulting mortality of Atlantic salmon in other fisheries and poaching should be evaluated. Particular attention should be given to the effect of making the retention of salmon caught in other gear illegal as in Canada.	Nothing additional reported.
5.3 Scientific evidence related to the supposed greater non-catch mortality of monofilament gill nets relative to multifilament nets should be compiled and examined.	Nothing additional reported.

6. Tagging programmes.

6.1 Additional wild smolts should be tagged in monitored rivers of the North-East Atlantic Commission area to establish exploitation rates for salmon, especially in the Norwegian Sea and Faroese area, and to provide material for stock-discriminant analysis.	Wild smolts were tagged in Norway, England, Wales, Northern Ireland, Iceland, and Scotland in 1986 and planned for 1987. Wild smolts will also be tagged in Ireland in 1987.
6.2 Salmon landings at West Greenland should be sampled for micro-tags and, insofar as possible, sampling should be carried out in accordance with the temporal and spatial distribution of landings.	Extensive sampling carried out in 1986 and planned for 1987.

The Working Group endorsed the research initiatives recommended by the Study Group on the Norwegian Sea and Faroes Salmon Fishery and generally endorsed those of the Acid Rain Study Group.

It is recommended that tag recovery information for Maine-origin salmon recovered in Canadian fisheries be examined prior to the next meeting of the Working Group to provide improved estimates of the effects of management measures implemented in Canadian fisheries.

The Working Group discussed the recommendation of the Study Group on the Norwegian Sea and Faroes Salmon Fishery that acoustic methods should be used to assess numbers and biomass of salmon in the Faroese area. A submission was reviewed at the meeting which contained a proposal for a feasibility study submitted by a firm who has carried out similar surveys in western Canada. The cost of the feasibility study was US $19,558.

There was doubt expressed that the equipment as specified in the prospectus could cover a sufficient area to detect salmon at the density they were likely to be at in the Faroese fishery. Some members were also of the opinion that further details of the surveys already carried out should be sought, particularly details confirming the accuracy of the estimates. However, for any one country to carry out such a feasibility study would be very expensive and it was important to know if these acoustic methods would work in high seas fisheries.

The Working Group recommended that in view of the relatively low cost of the survey and if the points raised could be cleared up, the survey should be carried out and paid for in the same manner as market sampling at Faroes.

Table 1 Nominal catch of SALMON in home waters by country (in tonnes round fresh weight) 1960-1986.

Year	France	Engl.+ Wales	Scotland[2]			Ireland[3]			N. Ireland[3,4]	Norway[5]			Sweden (west coast)	Finland	USSR[6]	Iceland	Canada[7]			USA	Total[8] all countr.
	T	T	S	G	T	S	G	T	T	S	G	T	T	T	T	T	S	G	T	T	T
1960	50-100	283	927	509	1,436	-	-	743	139	-	-	1,659	40	-	1,100	100	-	-	1,636	<2	7,211
1961	50-100	232	772	424	1,196	-	-	707	132	-	-	1,533	27	-	790	127	-	-	1,583	<2	6,403
1962	50-100	318	808	932	1,740	-	-	1,459	356	-	-	1,935	45	-	710	125	-	-	1,719	<2	8,483
1963	50-100	325	1,168	530	1,698	-	-	1,458	306	-	-	1,786	23	-	480	145	-	-	1,861	<2	8,148
1964	50-100	307	913	1,001	1,914	-	-	1,617	377	-	-	2,147	36	-	590	135	-	-	2,069	<2	9,268
1965	50-100	320	835	728	1,563	-	-	1,457	281	-	-	2,000	40	-	590	133	-	-	2,116	<2	8,576
1966	50-100	387	788	836	1,624	-	-	1,238	287	-	-	1,791	36	-	570	106	-	-	2,369	<2	8,475
1967	50-100	420	857	1,276	2,133	-	-	1,463	449	-	-	1,980	25	-	883	146	-	-	2,863	<2	10,417
1968	50-100	282	783	780	1,563	-	-	1,413	312	-	-	1,514	20	-	827	162	-	-	2,111	<2	8,279
1969	50-100	377	539	1,408	1,947	-	-	1,730	267	801	582	1,383	22	-	360	133	-	-	2,202	<2	8,496
1970	50-100	527	503	826	1,329	-	-	1,787	297	815	356	1,171	20	-	448	195	1,562	761	2,323	<2	8,173
1971	50-100	426	496	923	1,419	-	-	1,639	234	771	436	1,207	18	-	417	204	1,482	510	1,992	<2	7,631
1972	34	442	588	1,105	1,693	200	1,604	1,804	210	1,064	514	1,568	18	32	462	250	1,201	558	1,759	<2	8,273
1973	12	450	661	1,303	1,964	244	1,686	1,930	182	1,220	506	1,726	23	50	772	256	1,651	783	2,434	2.7	9,802
1974	13	383	578	1,063	1,631	170	1,958	2,128	184	1,149	484	1,633	32	76	709	225	1,589	950	2,539	0.9	9,554
1975	25	447	669	892	1,561	274	1,942	2,216	164	1,038	499	1,537	26	76	811	266	1,573	912	2,485	1.7	9,616
1976	9	208	328	682	1,010	109	1,452	1,561	113	1,063	467	1,530	20	66	NA	225	1,721	785	2,506	0.8	7,249
1977	19	345	369	762	1,131	145	1,227	1,372	110	1,018	470	1,488	10	59	NA	230	1,883	662	2,545	2.4	7,311
1978	20	349	781	542	1,323	147	1,082	1,230	148	668	382	1,050	10	37	NA	291	1,225	320	1,545	4.1	6,007
1979	10	261	598	478	1,075	105	922	1,097	99	1,150	681	1,831	12	26	430	225	705	582	1,287	2.5	6,356
1980	30	360	851	283	1,134	202	745	947	122	1,352	478	1,830	17	34	631	249	1,763	917	2,680	5.5	8,040
1981	20	493	843	389	1,233	164	521	685	101	1,189	467	1,656	26	44	450	163	1,619	818	2,437	6.0	7,314
1982	20	286	596	496	1,092	63	930	993	132	985	363	1,348	25	54	311	147	1,082	716	1,798	6.4	6,212
1983	16	432	672	549	1,221	150	1,506	1,656	187	957	593	1,550	28	57	436	198	911	513	1,424	1.3	7,206
1984	25	345	504	509	1,013	101	728	829	78	995	628	1,623	40	44	354	159	645	467	1,112	2.2	5,624
1985	22	361	514	399	913	100	1,495	1,595	98	923	638	1,561	45	49	-	217	540	593	1,133	2.1	5,996
1986[1]	28	394	701	473	1,174	136	1,732	1,838	109	1,041	552	1,593	54	38	-	330	750	756	1,506	1.9	7,066

S = Salmon (two or more sea winter fish). G = Grilse (one sea winter fish). T = S + G.

1 Provisional figures.

2 Salmon & grilse figures for 1962-1977 corrected for grilse error.

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

4 Not including angling catch (mainly grilse).

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

6 USSR catch mainly salmon (2 or more sea-winter fish).

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

8 French catches taken as 75 t from 1960-1971 and USA catch as 1 t from 1960-1971.

Table 2 Reported catch of SALMON in numbers and weight in tonnes (round fresh weight).

Country	Year	1SW		2SW		3SW		4SW		5SW		MSW[1]		PS		Total	
		No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt
France	1985	1,074	-	-	-	-	-	-	-	-	-	3,278	-	-	-	4,352	22
	1986	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,801	28
Scotland	1982	208,061	416	-	-	-	-	-	-	-	-	128,242	596	-	-	336,303	1,092
	1983	209,617	549	-	-	-	-	-	-	-	-	145,961	672	-	-	320,578	1,221
	1984	213,079	509	-	-	-	-	-	-	-	-	107,213	504	-	-	230,292	1,013
	1985	158,012	399	-	-	-	-	-	-	-	-	114,648	514	-	-	272,660	913
	1986	182,358	473	-	-	-	-	-	-	-	-	139,768	701	-	-	322,126	1,174
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	533,413	1,702	-	-	-	-	-	-	-	-	28,333	136	-	-	561,746	1,838
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	-	-	-	-	-	-	-	-	-	-	-	1,041	-	-	-	1,593
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	52,500	130	-	-	-	-	-	-	-	-	39,500	200	-	-	92,000	330
Canada	1982	358,000	716	-	-	-	-	-	-	-	-	240,000	1082	-	-	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	408,521	756	-	-	-	-	-	-	-	-	158,773	750	-	-	567,294	1,506

(cont'd)

Table 2 (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
USA	1982	33	-	1,206	-	5	-	-	-	-	-	-	-	21	-	182	6.4
	1983	26	-	314	1.2	2	-	-	-	-	-	316	1.2	6	-	348	1.3
	1984	50	-	545	2.1	2	-	-	-	-	-	547	2.1	12	-	609	2.2
	1985	15	-	527	2.0	2	-	-	-	-	-	529	2.0	13	-	557	2.1
	1986	70	-	466	1.8	2	-	-	-	-	-	468	1.8	3	-	541	1.9
Faroe Isl.	1982/83	10,089	-	112,403	-	24,054	-	498	-	32	-	-	-	-	-	147,076	694
	1983/84	5,784	-	129,430	-	15,055	-	59	-	-	-	-	-	-	-	149,328	786
	1984/85	360	-	137,142	-	10,759	-	-	-	-	-	-	-	1,835	-	150,114	664
	1985/86	1,917	-	162,547	-	5,480	-	87	-	-	-	-	-	7,210	-	177,241	625
W.Greenland	1982	315,532	-	17,810	-	-	-	-	-	-	-	-	-	2,688	-	336,030	1,077
	1983	90,500	-	8,100	-	-	-	-	-	-	-	-	-	1,400	-	100,000	310
	1984	78,942	-	10,442	-	-	-	-	-	-	-	-	-	630	-	90,014	297
	1985	292,181	-	18,378	-	-	-	-	-	-	-	-	-	934	-	311,493	862
	1986	307,800	-	9,700	-	-	-	-	-	-	-	-	-	2,600	-	320,100	960
Sweden	1985	13,542	39	1,012	6	-	-	-	-	-	-	1,012	6	-	-	14,467	45
(West coast)	1986	16,388	49	962	5	-	-	-	-	-	-	962	5	-	-	17,350	54
England &	1985	-	-	-	-	-	-	-	-	-	-	-	-	-	-	95,531	361
Wales	1986	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100,811	394

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

Table 3 Nominal catch in tonnes of ATLANTIC SALMON of all ages for statistical areas of Newfoundland-Labrador and Quebec N. shore commercial fisheries in 1985 and 1986. Figures for 1986 are preliminary.

Statistical area	1985	1986
Newfoundland and Labrador		
A	123.8	193.5
B	111.2	197.3
C	72.2	60.4
D	65.0	51.1
E-N	270.5	274.1
O	220.7	420.2
Quebec N. shore	69.8	75.9
Total	933.2	1,272.5

Table 4 Nominal catches (tonnes) and licensed effort (gear units) for Newfoundland and Labrador commercial ATLANTIC SALMON fishery, 1971-1986.

Year	Effort (units)	Catch (tonnes)
1971	17,320	1,577
1972	13,595	1,394
1973	16,376	2,011
1974	19,642	2,010
1975	25,181	2,043
1976	23,749	2,013
1977	21,775	1,938
1978	22,284	1,180
1979	21,169	987
1980	21,918	2,103
1981	21,032	1,910
1982	18,634	1,321
1983	19,565	1,017
1984	15,243	821
1985	13,791	863
1986	13,000[1]	1,197[1]

[1] Preliminary.
One unit of gear is equivalent to 50 fathoms of gillnet.

Table 5 Maine ATLANTIC SALMON sport fishery catches, 1960-1986. Reported catch in numbers.

Year	Dennys	East Machias	Machias	Pleasant	Narraguagus	Penobscot	Sheepscot	Others[1]	Total
1960	48	14	44	24	21	-	10	-	161
1961	104	18	130	45	110	-	13	2	422
1962	54	7	76	14	62	-	14	-	227
1963	62	2	68	22	47	-	10	-	212
1964	14	40	78	2	31	-	20	-	185
1965	22	12	58	10	38	-	20	-	160
1966	32	14	93	15	38	-	40	2	234
1967	42	8	75	10	56	-	30	-	221
1968	3	10	32	-	109	13	10	-	177
1969	30	10	45	2	22/1[2]	7	5	-	121/1
1970	49	1	45	1	58	1	6	-	161
1971	19	6	45	1	32	3	30	-	136
1972	61	4	65	1	139	4	20	-	294
1973	41	6	35	2	75	15	20	78	272
1974	49	2	36	30	64/1	26	20	26	253/1
1975	40	30	51	8	111/2	73	11	32	356/2
1976	20	20	25	1	32/3	55	10	35	198/3
1977	26	30	25	3	124/10	186/2	24	54	472/12
1978	75	59/1	105	16	133/2	322/38	35	35	780/41
1979	38	25	64/1	8	58	134/6	8	29	364/6
1980	190/20	62	79/1	5	115/4	810/33	30	51	1,342/58
1981	126/3	85	53	23	73/5	720/6	15	44	1,139/14
1982	38/3	37	56/4	20	79/6	936/3	15	34	1,215/16
1983	28	8	17/1	-	90/5	162/2	12/3	31	348/11
1984	68/1	47	33/8	1	68/3	360/27	22	10	609/39
1985	20	30/1	32	-	57/4	336/356	6	76/19	557/380
1986	15	11/2	38/6	closed	45/1	403/416	11	18/72	541/497

[1] Includes St. Croix, Union, Ducktrap, Kennebec, Androscoggin, and Saco River catches.

[2] Some catches are designated killed/released.

Table 6 Estimated Carlin-tag recoveries and run size in Maine waters. Ratio = tags to run size ratio (year i) for use in estimation of distant water harvest (year i-1).

YEAR	TAGS	RUN	RATIO
1967	0.0	946.0	0.000000
1968	149.9	661.9	0.226456
1969	6.2	633.5	0.009822
1970	10.3	787.3	0.013124
1971	58.0	637.3	0.091016
1972	285.6	1330.8	0.214573
1973	174.1	1363.4	0.127707
1974	218.8	1304.3	0.167739
1975	381.1	2182.4	0.174632
1976	158.3	1221.6	0.129613
1977	81.3	1919.6	0.042370
1978	81.9	3852.6	0.021255
1979	31.6	1773.1	0.017797
1980	0.0	5225.0	0.000000
1981	404.1	4724.4	0.085538
1982	249.8	5439.0	0.045923
1983	119.6	1788.3	0.066854
1984	52.4	2792.4	0.018781
1985	158.2	4319.0	0.036634
1986	262.2	4838.2	0.054198

Table 7 Tag returns from 1SW salmon of Maine origin in Newfoundland-Labrador by year, standard week, and statistical area. OTH = statistical areas E to N.

1967

STWK	A	B	C	D	O	OTH	UNK	TOT
26	1	1	0	0	0	1	0	3
27	0	1	0	0	0	1	0	2
28	2	2	0	0	0	0	0	4
29	1	1	0	0	1	1	0	4
30	0	0	0	0	1	0	0	1
45	0	1	0	0	0	0	0	1
46	0	1	0	0	0	1	0	2
47	0	1	1	0	0	0	0	2
48	0	2	0	0	0	0	0	2
49	0	3	2	0	0	1	0	6
50	2	0	1	0	0	0	0	3
51	1	0	0	0	0	0	0	1
UNK	0	1	1	0	2	4	0	8
TOT	7	14	5	0	4	9	0	39

1968

STWK	A	B	C	D	O	OTH	UNK	TOT
27	0	0	1	0	0	0	0	1
46	0	2	0	0	0	0	0	2
TOT	0	2	1	0	0	0	0	3

1969

STWK	A	B	C	D	O	OTH	UNK	TOT
28	0	0	0	0	0	1	0	1
31	1	0	0	0	0	0	0	1
44	1	0	0	0	0	0	0	1
TOT	2	0	0	0	0	1	0	3

1970

STWK	A	B	C	D	O	OTH	UNK	TOT
26	0	0	0	0	0	1	0	1
27	4	2	0	0	0	0	0	6
28	4	0	0	0	0	0	0	4
29	2	1	0	1	0	0	0	4
30	2	1	0	0	1	0	0	4
31	0	0	0	0	2	0	0	2
32	0	0	0	0	1	0	0	1
35	0	0	0	0	1	0	0	1
44	0	1	1	0	0	0	0	2
49	0	0	0	0	0	1	0	1
52	0	0	0	0	1	0	0	1
UNK	1	0	0	0	1	0	0	2
TOT	13	5	1	1	7	2	0	29

cont'd.

Table 7 (continued)

1971

STWK	A	B	C	D	O	OTH	UNK	TOT
23	0	0	1	1	0	0	0	2
25	0	0	0	2	0	0	0	2
27	1	4	1	0	1	0	0	7
28	1	1	0	0	0	0	0	2
29	2	0	0	0	0	0	0	2
30	0	0	0	0	2	0	0	2
33	0	0	0	0	1	0	0	1
34	0	0	0	0	1	0	0	1
35	0	0	0	0	1	0	0	1
36	0	0	0	0	3	0	0	3
38	0	0	0	0	1	0	0	1
39	0	0	0	0	1	0	0	1
43	0	1	0	0	0	0	0	1
44	0	2	0	0	0	0	0	2
45	0	2	1	0	0	0	0	3
46	0	0	1	0	0	0	0	1
47	0	3	2	0	0	0	0	5
48	0	3	2	0	0	0	0	5
49	0	0	2	0	0	0	0	2
50	0	2	0	0	0	0	0	2
UNK	0	0	0	0	1	0	0	1
TOT	4	18	10	3	12	0	0	47

1972

STWK	A	B	C	D	O	OTH	UNK	TOT
29	0	0	0	0	0	1	0	1
33	0	0	0	0	1	0	0	1
35	0	0	1	0	0	0	0	1
36	0	0	0	0	2	0	0	2
37	0	0	0	0	3	0	0	3
38	0	0	0	0	1	0	0	1
UNK	0	0	3	0	0	0	0	3
TOT	0	0	4	0	7	1	0	12

1973

STWK	A	B	C	D	O	OTH	UNK	TOT
23	1	0	1	0	0	2	0	4
24	0	2	0	0	0	2	0	4
25	0	0	0	1	1	0	0	2
27	1	0	0	0	0	1	0	2
28	2	0	0	0	0	1	0	3
30	0	0	0	0	1	0	0	1
31	0	0	0	0	1	0	0	1
33	0	0	0	0	2	0	0	2
39	0	0	0	0	1	0	0	1
44	0	1	0	0	0	0	0	1
48	1	1	0	0	0	0	0	2
UNK	1	0	0	0	1	0	0	2
TOT	6	4	1	1	7	6	0	25

cont'd.

Table 7 (continued)

1974

STWK	A	B	C	D	O	OTH	UNK	TOT
21	0	0	0	0	0	1	0	1
23	0	0	0	0	0	2	0	2
24	0	0	0	1	0	1	0	2
25	0	0	0	1	0	1	0	2
26	0	0	0	0	0	3	0	3
27	1	0	2	1	1	4	0	9
28	5	1	1	1	0	1	0	9
29	3	2	0	1	2	0	0	8
30	1	1	0	0	1	1	0	4
32	0	1	0	0	0	0	0	1
33	0	0	0	0	1	0	0	1
36	0	0	0	0	1	0	0	1
38	0	0	1	0	0	0	0	1
42	1	1	0	0	0	0	0	2
43	0	0	1	0	0	0	0	1
44	1	3	0	0	0	0	0	4
45	0	3	0	0	0	0	0	3
46	0	5	0	0	0	0	0	5
47	1	4	2	0	0	0	0	7
48	2	3	0	0	0	0	0	5
49	0	3	2	0	0	0	0	5
50	0	3	2	0	0	0	0	5
51	0	1	1	0	0	0	0	2
52	0	1	0	0	0	0	0	1
UNK	5	6	1	5	1	1	0	19
TOT	20	38	13	10	7	15	0	103

1975

STWK	A	B	C	D	O	OTH	UNK	TOT
21	0	0	1	0	0	0	0	1
23	0	1	0	0	0	1	0	2
24	0	0	2	2	0	0	0	4
25	0	0	0	0	0	1	0	1
26	0	3	1	0	0	1	0	5
27	4	2	1	0	1	2	0	10
28	4	2	0	1	1	2	0	10
29	2	3	0	1	2	1	0	9
30	2	3	1	0	2	0	0	8
31	0	0	0	1	3	0	0	4
32	1	0	0	1	1	0	0	3
33	0	1	0	0	1	0	0	2
34	0	0	0	0	1	0	0	1
35	0	0	0	0	2	0	0	2
36	0	0	0	0	3	0	0	3
37	0	0	0	0	1	0	0	1
38	0	0	0	0	1	0	0	1
40	0	0	1	0	0	0	0	1
42	0	2	0	0	0	0	0	2
43	0	2	0	0	0	0	0	2
44	1	4	0	0	0	0	0	5
45	0	3	1	0	0	0	0	4
46	3	3	0	0	0	0	0	6
47	0	2	0	0	0	0	0	2
48	0	4	2	0	0	0	0	6
49	0	0	1	0	0	0	0	1
50	0	0	1	0	0	0	0	1
UNK	1	1	1	0	1	1	0	5
TOT	18	36	13	6	20	9	0	102

cont'd.

Table 7 (continued)

1976

STWK	A	B	C	D	O	OTH	UNK	TOT
22	0	0	1	0	0	0	0	1
23	0	1	0	0	0	1	0	2
24	0	0	0	0	0	1	0	1
25	1	0	0	0	0	0	0	1
26	4	1	1	1	1	1	0	9
27	5	1	1	1	0	1	0	9
28	3	0	1	1	4	1	0	10
29	5	2	0	0	1	0	0	8
30	4	0	1	0	4	0	0	9
31	2	2	0	2	5	0	0	11
32	0	0	0	0	3	0	0	3
33	1	1	0	0	2	0	0	4
36	0	0	0	0	1	0	0	1
38	0	0	0	0	1	0	0	1
44	0	1	0	0	0	0	0	1
45	0	2	0	0	0	0	0	2
46	1	0	0	0	0	0	0	1
47	0	1	0	0	0	0	0	1
UNK	1	2	0	0	2	0	0	5
TOT	27	14	5	5	24	5	0	80

1977

STWK	A	B	C	D	O	OTH	UNK	TOT
25	1	1	0	0	0	1	0	3
26	0	0	0	0	0	1	0	1
27	2	1	0	0	0	0	0	3
28	3	1	0	0	1	0	0	5
34	0	0	0	0	1	0	0	1
36	0	0	0	0	1	0	0	1
48	0	1	0	0	0	0	0	1
UNK	0	1	0	0	0	0	0	1
TOT	6	5	0	0	3	2	0	16

1978

STWK	A	B	C	D	O	OTH	UNK	TOT
28	1	0	0	0	0	0	0	1
32	0	0	0	0	1	0	0	1
33	0	0	0	0	1	0	0	1
36	0	0	0	0	1	0	0	1
37	0	0	0	0	1	0	0	1
TOT	1	0	0	0	4	0	0	5

cont'd.

Table 7 (continued)

1980

STWK	A	B	C	D	O	OTH	UNK	TOT
20	0	0	0	1	0	0	0	1
23	0	2	0	0	0	0	0	2
24	1	4	0	0	1	1	0	7
25	10	4	1	1	2	1	0	19
26	19	2	1	1	1	2	0	26
27	27	10	2	1	11	6	0	57
28	24	9	5	1	6	7	0	52
29	9	2	1	0	7	1	0	20
30	7	3	0	0	9	2	0	21
31	2	1	0	0	5	0	0	8
32	0	0	0	0	11	0	0	11
33	1	1	0	0	6	0	0	8
34	1	0	0	0	9	0	0	10
35	0	1	0	0	1	0	0	2
36	0	0	0	0	1	0	0	1
37	0	1	0	0	1	0	0	2
38	0	1	0	0	2	0	0	3
39	0	0	0	0	1	0	0	1
42	0	0	0	1	0	0	0	1
43	0	1	0	0	1	0	0	2
44	1	6	0	0	0	0	0	7
45	0	1	1	0	0	0	0	2
46	1	6	2	0	0	0	0	9
47	1	0	0	0	0	0	0	1
49	0	5	2	0	0	0	0	7
50	0	2	1	0	0	0	0	3
51	0	0	1	0	0	0	0	1
UNK	8	10	5	0	7	1	0	31
TOT	112	72	22	6	82	21	0	315

1981

STWK	A	B	C	D	O	OTH	UNK	TOT
21	0	0	0	0	0	1	0	1
22	0	0	0	1	0	0	0	1
23	0	0	0	1	0	0	0	1
25	0	0	1	0	0	0	0	1
26	2	0	0	0	0	0	0	2
27	0	0	0	0	1	0	0	1
28	0	1	0	0	0	0	0	1
30	0	0	0	2	1	0	0	3
31	0	0	0	0	1	0	0	1
32	0	0	0	0	3	0	0	3
33	0	0	0	0	2	0	0	2
34	0	0	0	0	4	0	0	4
35	0	0	0	0	2	0	0	2
37	0	0	0	0	1	0	0	1
42	0	1	1	0	0	0	0	2
44	0	3	1	0	0	0	0	4
45	0	1	1	1	0	0	0	3
46	0	0	2	0	0	0	0	2
48	0	1	1	0	0	0	0	2
49	0	1	0	0	0	0	0	1
UNK	0	2	0	0	0	1	0	3
TOT	2	10	7	5	15	2	0	41

cont'd.

Table 7 (continued)

1982

STWK	A	B	C	D	O	OTH	UNK	TOT
24	1	0	0	0	0	0	0	1
25	1	1	2	2	0	0	0	6
26	2	1	0	2	0	1	0	6
27	4	2	2	0	0	5	0	13
28	3	3	1	0	2	3	0	12
29	0	3	0	1	2	0	0	6
30	2	4	0	0	0	0	0	6
31	1	0	1	0	3	0	0	5
32	0	0	0	0	7	0	0	7
33	0	0	0	0	3	0	0	3
35	0	0	0	0	2	0	0	2
36	0	0	0	0	1	0	0	1
38	0	0	0	0	1	0	0	1
42	2	1	0	0	0	0	0	3
44	0	1	0	0	0	0	0	1
46	1	0	1	0	0	0	0	2
47	1	2	0	0	0	0	0	3
UNK	2	3	0	1	1	0	0	7
TOT	20	21	7	6	22	9	0	85

1983

STWK	A	B	C	D	O	OTH	UNK	TOT
26	1	2	0	0	0	0	0	3
27	2	0	0	0	0	0	0	2
28	1	1	0	0	0	0	0	2
29	1	0	0	0	0	0	0	1
30	1	0	0	0	1	0	0	2
31	0	0	0	0	1	0	0	1
32	0	0	0	0	3	0	0	3
33	0	0	0	0	1	0	0	1
34	0	0	0	0	2	0	0	2
42	1	0	0	0	0	0	0	1
43	1	0	0	0	0	0	0	1
45	0	1	0	0	0	0	0	1
46	1	2	0	0	0	0	0	3
48	1	0	0	0	0	0	0	1
49	0	0	0	0	1	0	0	1
UNK	1	0	0	0	0	0	0	1
TOT	11	6	0	0	9	0	0	26

1984

STWK	A	B	C	D	O	OTH	UNK	TOT
26	0	0	0	1	0	1	0	2
27	1	0	0	0	0	0	0	1
28	0	0	1	0	1	1	0	3
29	0	1	1	1	0	0	0	3
30	1	0	0	0	1	0	0	2
31	1	0	0	0	0	0	0	1
32	0	0	1	0	1	0	0	2
33	0	0	0	0	1	0	0	1
34	0	0	0	0	6	0	0	6
35	0	0	0	0	3	0	0	3
36	0	0	0	0	2	0	0	2
41	0	1	0	0	0	0	0	1
42	1	0	0	0	0	0	0	1
44	0	1	0	0	0	0	0	1
45	0	2	0	0	0	0	0	2
46	2	0	0	0	0	0	0	2
48	0	1	0	0	0	0	0	1
49	0	1	0	0	0	0	0	1
UNK	1	0	1	0	1	1	0	4
TOT	7	7	4	2	16	3	0	39

cont'd.

Table 7 (continued)

1985

STWK	A	B	C	D	O	OTH	UNK	TOT
24	0	0	0	0	0	1	0	1
27	0	0	0	0	0	1	0	1
28	0	1	1	0	0	0	0	2
29	0	1	0	0	0	0	0	1
30	0	0	0	0	3	0	1	4
31	0	0	0	1	0	0	0	1
32	0	0	0	0	7	0	0	7
33	1	0	0	0	1	0	0	2
34	0	0	0	0	2	0	0	2
35	0	0	0	0	2	0	0	2
36	0	0	0	0	1	0	0	1
37	0	0	0	0	2	0	0	2
38	0	0	0	0	2	0	0	2
39	0	0	0	0	3	0	0	3
40	0	0	0	0	1	0	0	1
41	2	0	0	0	0	0	0	2
42	1	0	2	0	0	0	0	3
43	1	1	1	0	1	0	0	4
44	5	3	3	0	0	1	0	12
45	3	9	3	0	0	2	0	17
46	1	4	0	0	0	0	0	5
47	0	6	0	0	0	0	0	6
48	0	2	0	0	0	0	0	2
49	0	1	0	0	0	0	0	1
UNK	1	7	1	0	0	0	0	9
TOT	15	35	11	1	25	5	1	93

1986

STWK	A	B	C	D	O	OTH	UNK	TOT
24	1	0	1	0	0	0	0	2
27	1	0	0	0	0	0	0	1
28	0	1	0	0	1	1	0	3
29	2	1	0	0	0	0	0	3
30	0	0	0	0	3	0	0	3
31	0	0	0	0	1	0	0	1
32	0	0	0	0	2	0	0	2
33	0	0	0	0	1	0	0	1
34	1	0	0	0	1	0	0	2
38	0	0	0	0	1	0	0	1
TOT	5	2	1	0	10	1	0	19

UNK

STWK	A	B	C	D	O	OTH	UNK	TOT
UNK	0	0	0	0	1	1	0	2
TOT	0	0	0	0	1	1	0	2

Table 8 Estimated number of 1SW SALMON of Maine origin harvested in Newfoundland-Labrador by year, standard week, and statistical area. OTH = statistical areas E to N. PTOT = Total with UNK assigned to weeks. (Estimates rounded to nearest fish).

1967

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
26	6	6	0	0	0	6	0	19	24
27	0	6	0	0	0	6	0	13	16
28	13	13	0	0	0	0	0	25	31
29	6	6	0	0	5	6	0	24	30
30	0	0	0	0	5	0	0	5	6
45	0	6	0	0	0	0	0	6	8
46	0	6	0	0	0	6	0	13	16
47	0	6	6	0	0	0	0	13	16
48	0	13	0	0	0	0	0	13	16
49	0	19	13	0	0	6	0	38	47
50	13	0	6	0	0	0	0	19	24
51	6	0	0	0	0	0	0	6	8
UNK	0	6	6	0	10	25	0	48	
TOT	44	88	32	0	20	57	0	240	240

1968

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
27	0	0	145	0	0	0	0	145	
46	0	291	0	0	0	0	0	291	
TOT	0	291	145	0	0	0	0	436	

1969

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
28	0	0	0	0	0	109	0	109	
31	109	0	0	0	0	0	0	109	
44	109	0	0	0	0	0	0	109	
TOT	218	0	0	0	0	109	0	327	

1970

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
26	0	0	0	0	0	16	0	16	17
27	63	31	0	0	0	0	0	94	101
28	63	0	0	0	0	0	0	63	67
29	31	16	0	16	0	0	0	63	67
30	31	16	0	0	12	0	0	59	63
31	0	0	0	0	24	0	0	24	26
32	0	0	0	0	12	0	0	12	13
35	0	0	0	0	12	0	0	12	13
44	0	16	16	0	0	0	0	31	34
49	0	0	0	0	0	16	0	16	17
52	0	0	0	0	12	0	0	12	13
UNK	16	0	0	0	12	0	0	28	
TOT	204	78	16	16	85	31	0	431	431

cont'd.

Table 8 . continued

1971

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
23	0	0	7	7	0	0	0	13	14
25	0	0	0	13	0	0	0	13	14
27	7	27	7	0	5	0	0	45	46
28	7	7	0	0	0	0	0	13	14
29	13	0	0	0	0	0	0	13	14
30	0	0	0	0	10	0	0	10	11
33	0	0	0	0	5	0	0	5	5
34	0	0	0	0	5	0	0	5	5
35	0	0	0	0	5	0	0	5	5
36	0	0	0	0	16	0	0	16	16
38	0	0	0	0	5	0	0	5	5
39	0	0	0	0	5	0	0	5	5
43	0	7	0	0	0	0	0	7	7
44	0	13	0	0	0	0	0	13	14
45	0	13	7	0	0	0	0	20	20
46	0	0	7	0	0	0	0	7	7
47	0	20	13	0	0	0	0	33	34
48	0	20	13	0	0	0	0	33	34
49	0	0	13	0	0	0	0	13	14
50	0	13	0	0	0	0	0	13	14
UNK	0	0	0	0	5	0	0	5	
TOT	27	120	67	20	62	0	0	295	295

1972

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
29	0	0	0	0	0	11	0	11	16
33	0	0	0	0	9	0	0	9	12
35	0	0	11	0	0	0	0	11	16
36	0	0	0	0	17	0	0	17	24
37	0	0	0	0	26	0	0	26	37
38	0	0	0	0	9	0	0	9	12
UNK	0	0	34	0	0	0	0	34	
TOT	0	0	45	0	61	11	0	117	117

1973

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
23	9	0	9	0	0	17	0	34	37
24	0	17	0	0	0	17	0	34	37
25	0	0	0	9	7	0	0	15	16
27	9	0	0	0	0	9	0	17	18
28	17	0	0	0	0	9	0	26	28
30	0	0	0	0	7	0	0	7	7
31	0	0	0	0	7	0	0	7	7
33	0	0	0	0	13	0	0	13	14
39	0	0	0	0	7	0	0	7	7
44	0	9	0	0	0	0	0	9	9
48	9	9	0	0	0	0	0	17	18
UNK	9	0	0	0	7	0	0	15	
TOT	51	34	9	9	46	51	0	200	200

cont'd.

Table 8. continued

1974

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
21	0	0	0	0	0	8	0	8	10
23	0	0	0	0	0	16	0	16	20
24	0	0	0	8	0	8	0	16	20
25	0	0	0	8	0	8	0	16	20
26	0	0	0	0	0	25	0	25	30
27	8	0	16	8	6	33	0	72	88
28	41	8	8	8	0	8	0	74	90
29	25	16	0	8	13	0	0	62	76
30	8	8	0	0	6	8	0	31	38
32	0	8	0	0	0	0	0	8	10
33	0	0	0	0	6	0	0	6	8
36	0	0	0	0	6	0	0	6	8
38	0	0	8	0	0	0	0	8	10
42	8	8	0	0	0	0	0	16	20
43	0	0	8	0	0	0	0	8	10
44	8	25	0	0	0	0	0	33	40
45	0	25	0	0	0	0	0	25	30
46	0	41	0	0	0	0	0	41	50
47	8	33	16	0	0	0	0	57	70
48	16	25	0	0	0	0	0	41	50
49	0	25	16	0	0	0	0	41	50
50	0	25	16	0	0	0	0	41	50
51	0	8	8	0	0	0	0	16	20
52	0	8	0	0	0	0	0	8	10
UNK	41	49	8	41	6	8	0	154	
TOT	164	311	106	82	45	123	0	830	830

1975

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
21	0	0	11	0	0	0	0	11	12
23	0	11	0	0	0	11	0	22	23
24	0	0	22	22	0	0	0	44	46
25	0	0	0	0	0	11	0	11	12
26	0	33	11	0	0	11	0	55	58
27	44	22	11	0	9	22	0	108	113
28	44	22	0	11	9	22	0	108	113
29	22	33	0	11	17	11	0	94	99
30	22	33	11	0	17	0	0	83	88
31	0	0	0	11	26	0	0	37	39
32	11	0	0	11	9	0	0	31	32
33	0	11	0	0	9	0	0	20	21
34	0	0	0	0	9	0	0	9	9
35	0	0	0	0	17	0	0	17	18
36	0	0	0	0	26	0	0	26	27
37	0	0	0	0	9	0	0	9	9
38	0	0	0	0	9	0	0	9	9
40	0	0	11	0	0	0	0	11	12
42	0	22	0	0	0	0	0	22	23
43	0	22	0	0	0	0	0	22	23
44	11	44	0	0	0	0	0	55	58
45	0	33	11	0	0	0	0	44	46
46	33	33	0	0	0	0	0	66	70
47	0	22	0	0	0	0	0	22	23
48	0	44	22	0	0	0	0	66	70
49	0	0	11	0	0	0	0	11	12
50	0	0	11	0	0	0	0	11	12
UNK	11	11	11	0	9	11	0	53	
TOT	198	397	143	66	171	99	0	1075	1075

cont'd.

Table 8. continued

1976

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
22	0	0	34	0	0	0	0	34	36
23	0	34	0	0	0	34	0	67	72
24	0	0	0	0	0	34	0	34	36
25	34	0	0	0	0	0	0	34	36
26	135	34	34	34	26	34	0	296	315
27	169	34	34	34	0	34	0	303	323
28	101	0	34	34	105	34	0	307	327
29	169	67	0	0	26	0	0	262	279
30	135	0	34	0	105	0	0	273	291
31	67	67	0	67	131	0	0	333	355
32	0	0	0	0	79	0	0	79	84
33	34	34	0	0	52	0	0	120	128
36	0	0	0	0	26	0	0	26	28
38	0	0	0	0	26	0	0	26	28
44	0	34	0	0	0	0	0	34	36
45	0	67	0	0	0	0	0	67	72
46	34	0	0	0	0	0	0	34	36
47	0	34	0	0	0	0	0	34	36
UNK	34	67	0	0	52	0	0	154	
TOT	910	472	169	169	629	169	0	2518	2518

1977

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
25	67	67	0	0	0	67	0	202	216
26	0	0	0	0	0	67	0	67	72
27	134	67	0	0	0	0	0	202	216
28	202	67	0	0	52	0	0	321	344
34	0	0	0	0	52	0	0	52	56
36	0	0	0	0	52	0	0	52	56
48	0	67	0	0	0	0	0	67	72
UNK	0	67	0	0	0	0	0	67	
TOT	403	336	0	0	157	134	0	1031	1031

1978

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
28	80	0	0	0	0	0	0	80	
32	0	0	0	0	62	0	0	62	
33	0	0	0	0	62	0	0	62	
36	0	0	0	0	62	0	0	62	
37	0	0	0	0	62	0	0	62	
TOT	80	0	0	0	250	0	0	330	

cont'd.

Table 8. continued

1980

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
20	0	0	0	17	0	0	0	17	19
23	0	33	0	0	0	0	0	33	37
24	17	67	0	0	13	17	0	113	126
25	167	67	17	17	26	17	0	310	344
26	317	33	17	17	13	33	0	431	478
27	451	167	33	17	143	100	0	911	1011
28	401	150	84	17	78	117	0	846	939
29	150	33	17	0	91	17	0	308	342
30	117	50	0	0	117	33	0	317	352
31	33	17	0	0	65	0	0	115	128
32	0	0	0	0	143	0	0	143	159
33	17	17	0	0	78	0	0	111	124
34	17	0	0	0	117	0	0	134	148
35	0	17	0	0	13	0	0	30	33
36	0	0	0	0	13	0	0	13	14
37	0	17	0	0	13	0	0	30	33
38	0	17	0	0	26	0	0	43	47
39	0	0	0	0	13	0	0	13	14
42	0	0	0	17	0	0	0	17	19
43	0	17	0	0	13	0	0	30	33
44	17	100	0	0	0	0	0	117	130
45	0	17	17	0	0	0	0	33	37
46	17	100	33	0	0	0	0	150	167
47	17	0	0	0	0	0	0	17	19
49	0	84	33	0	0	0	0	117	130
50	0	33	17	0	0	0	0	50	56
51	0	0	17	0	0	0	0	17	19
UNK	134	167	84	0	91	17	0	492	
TOT	1871	1202	367	100	1065	351	0	4956	4956

1981

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
21	0	0	0	0	0	31	0	31	34
22	0	0	0	31	0	0	0	31	34
23	0	0	0	31	0	0	0	31	34
25	0	0	31	0	0	0	0	31	34
26	62	0	0	0	0	0	0	62	68
27	0	0	0	0	24	0	0	24	26
28	0	31	0	0	0	0	0	31	34
30	0	0	0	62	24	0	0	86	94
31	0	0	0	0	24	0	0	24	26
32	0	0	0	0	73	0	0	73	79
33	0	0	0	0	48	0	0	48	53
34	0	0	0	0	97	0	0	97	105
35	0	0	0	0	48	0	0	48	53
37	0	0	0	0	24	0	0	24	26
42	0	31	31	0	0	0	0	62	68
44	0	93	31	0	0	0	0	124	135
45	0	31	31	31	0	0	0	93	101
46	0	0	62	0	0	0	0	62	68
48	0	31	31	0	0	0	0	62	68
49	0	31	0	0	0	0	0	31	34
UNK	0	62	0	0	0	31	0	93	
TOT	62	311	218	156	363	62	0	1172	1172

cont'd.

Table 8. continued

1982

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
24	21	0	0	0	0	0	0	21	23
25	21	21	43	43	0	0	0	128	140
26	43	21	0	43	0	21	0	128	140
27	85	43	43	0	0	107	0	278	303
28	64	64	21	0	33	64	0	247	270
29	0	64	0	21	33	0	0	119	130
30	43	85	0	0	0	0	0	128	140
31	21	0	21	0	50	0	0	93	101
32	0	0	0	0	116	0	0	116	127
33	0	0	0	0	50	0	0	50	54
35	0	0	0	0	33	0	0	33	36
36	0	0	0	0	17	0	0	17	18
38	0	0	0	0	17	0	0	17	18
42	43	21	0	0	0	0	0	64	70
44	0	21	0	0	0	0	0	21	23
46	21	0	21	0	0	0	0	43	47
47	21	43	0	0	0	0	0	64	70
UNK	43	64	0	21	17	0	0	145	
TOT	427	449	150	128	366	192	0	1712	1712

1983

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
26	76	152	0	0	0	0	0	228	238
27	152	0	0	0	0	0	0	152	159
28	76	76	0	0	0	0	0	152	159
29	76	0	0	0	0	0	0	76	79
30	76	0	0	0	59	0	0	135	141
31	0	0	0	0	59	0	0	59	62
32	0	0	0	0	177	0	0	177	185
33	0	0	0	0	59	0	0	59	62
34	0	0	0	0	118	0	0	118	123
42	76	0	0	0	0	0	0	76	79
43	76	0	0	0	0	0	0	76	79
45	0	76	0	0	0	0	0	76	79
46	76	152	0	0	0	0	0	228	238
48	76	0	0	0	0	0	0	76	79
49	0	0	0	0	59	0	0	59	62
UNK	76	0	0	0	0	0	0	76	
TOT	837	456	0	0	532	0	0	1826	1826

1984

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
26	0	0	0	39	0	39	0	78	87
27	39	0	0	0	0	0	0	39	44
28	0	0	39	0	30	39	0	108	121
29	0	39	39	39	0	0	0	117	131
30	39	0	0	0	30	0	0	69	78
31	39	0	0	0	0	0	0	39	44
32	0	0	39	0	30	0	0	69	78
33	0	0	0	0	30	0	0	30	34
34	0	0	0	0	182	0	0	182	204
35	0	0	0	0	91	0	0	91	102
36	0	0	0	0	61	0	0	61	68
41	0	39	0	0	0	0	0	39	44
42	39	0	0	0	0	0	0	39	44
44	0	39	0	0	0	0	0	39	44
45	0	78	0	0	0	0	0	78	87
46	78	0	0	0	0	0	0	78	87
48	0	39	0	0	0	0	0	39	44
49	0	39	0	0	0	0	0	39	44
UNK	39	0	39	0	30	39	0	147	
TOT	273	273	156	78	485	117	0	1382	1382

cont'd.

able 8. continued

1985

STWK	A	B	C	D	O	OTH	UNK	TOT	PTOT
24	0	0	0	0	0	26	0	26	29
27	0	0	0	0	0	26	0	26	29
28	0	26	26	0	0	0	0	53	59
29	0	26	0	0	0	0	0	26	29
30	0	0	0	0	62	0	26	88	98
31	0	0	0	26	0	0	0	26	29
32	0	0	0	0	144	0	0	144	160
33	26	0	0	0	21	0	0	47	52
34	0	0	0	0	41	0	0	41	46
35	0	0	0	0	41	0	0	41	46
36	0	0	0	0	21	0	0	21	23
37	0	0	0	0	41	0	0	41	46
38	0	0	0	0	41	0	0	41	46
39	0	0	0	0	62	0	0	62	69
40	0	0	0	0	21	0	0	21	23
41	53	0	0	0	0	0	0	53	59
42	26	0	53	0	0	0	0	79	88
43	26	26	26	0	21	0	0	100	111
44	132	79	79	0	0	26	0	316	353
45	79	237	79	0	0	53	0	448	500
46	26	105	0	0	0	0	0	132	147
47	0	158	0	0	0	0	0	158	176
48	0	53	0	0	0	0	0	53	59
49	0	26	0	0	0	0	0	26	29
UNK	26	185	26	0	0	0	0	237	
TOT	395	923	290	26	513	132	26	2305	2305

Table 9 Estimated number of 1SW SALMON of Maine origin harvested in Newfoundland-Labrador by year, standard month, and statistical area. OTH = statistical areas E to N. (Estimates rounded to nearest fish) PTOT = as for Table 8.

1967

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	0	0	0	0	0	0
JUN	6	6	0	0	0	6	0	19	24
JUL	19	25	0	0	10	13	0	67	83
AUG	0	0	0	0	0	0	0	0	0
SEP	0	0	0	0	0	0	0	0	0
OCT	0	0	0	0	0	0	0	0	0
NOV	0	32	6	0	0	6	0	44	55
DEC	19	19	19	0	0	6	0	63	79
UNK	0	6	6	0	10	25	0	48	
TOT	44	88	32	0	20	57	0	240	240

1968

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	0	0	0	0	0	0
JUN	0	0	0	0	0	0	0	0	0
JUL	0	0	145	0	0	0	0	145	145
AUG	0	0	0	0	0	0	0	0	0
SEP	0	0	0	0	0	0	0	0	0
OCT	0	0	0	0	0	0	0	0	0
NOV	0	291	0	0	0	0	0	291	291
DEC	0	0	0	0	0	0	0	0	0
UNK	0	0	0	0	0	0	0	0	
TOT	0	291	145	0	0	0	0	436	436

1969

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	0	0	0	0	0	0
JUN	0	0	0	0	0	0	0	0	0
JUL	0	0	0	0	0	109	0	109	109
AUG	109	0	0	0	0	0	0	109	109
SEP	0	0	0	0	0	0	0	0	0
OCT	0	0	0	0	0	0	0	0	0
NOV	109	0	0	0	0	0	0	109	109
DEC	0	0	0	0	0	0	0	0	0
UNK	0	0	0	0	0	0	0	0	
TOT	218	0	0	0	0	109	0	327	327

1970

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	0	0	0	0	0	0
JUN	0	0	0	0	0	16	0	16	17
JUL	188	63	0	16	12	0	0	279	298
AUG	0	0	0	0	49	0	0	49	52
SEP	0	0	0	0	0	0	0	0	0
OCT	0	0	0	0	0	0	0	0	0
NOV	0	16	16	0	0	0	0	31	34
DEC	0	0	0	0	12	16	0	28	30
UNK	16	0	0	0	12	0	0	28	
TOT	204	78	16	16	85	31	0	431	431

cont'd.

Table 9 (continued)

1971

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	0	0	0	0	0	0
JUN	0	0	7	20	0	0	0	27	27
JUL	27	33	7	0	16	0	0	82	84
AUG	0	0	0	0	16	0	0	16	16
SEP	0	0	0	0	26	0	0	26	26
OCT	0	7	0	0	0	0	0	7	7
NOV	0	67	40	0	0	0	0	107	108
DEC	0	13	13	0	0	0	0	27	27
UNK	0	0	0	0	5	0	0	5	
TOT	27	120	67	20	62	0	0	295	295

1972

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	0	0	0	0	0	0
JUN	0	0	0	0	0	0	0	0	0
JUL	0	0	0	0	0	11	0	11	16
AUG	0	0	11	0	9	0	0	20	28
SEP	0	0	0	0	52	0	0	52	73
OCT	0	0	0	0	0	0	0	0	0
NOV	0	0	0	0	0	0	0	0	0
DEC	0	0	0	0	0	0	0	0	0
UNK	0	0	34	0	0	0	0	34	
TOT	0	0	45	0	61	11	0	117	117

1973

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	0	0	0	0	0	0
JUN	9	17	9	9	7	34	0	83	90
JUL	26	0	0	0	7	17	0	49	53
AUG	0	0	0	0	20	0	0	20	22
SEP	0	0	0	0	7	0	0	7	7
OCT	0	0	0	0	0	0	0	0	0
NOV	9	17	0	0	0	0	0	26	28
DEC	0	0	0	0	0	0	0	0	0
UNK	9	0	0	0	7	0	0	15	
TOT	51	34	9	9	46	51	0	200	200

1974

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	0	0	8	0	8	10
JUN	0	0	0	16	0	57	0	74	90
JUL	82	33	25	25	25	49	0	238	292
AUG	0	8	0	0	6	0	0	15	18
SEP	0	0	8	0	6	0	0	15	18
OCT	8	8	8	0	0	0	0	25	30
NOV	33	147	16	0	0	0	0	196	241
DEC	0	65	41	0	0	0	0	106	131
UNK	41	49	8	41	6	8	0	154	
TOT	164	311	106	82	45	123	0	830	830

cont'd.

Table 9 (continued)

1975

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	11	0	0	0	0	11	12
JUN	0	44	33	22	0	33	0	132	139
JUL	132	110	22	22	51	55	0	393	413
AUG	11	11	0	22	69	0	0	113	118
SEP	0	0	0	0	43	0	0	43	45
OCT	0	44	11	0	0	0	0	55	58
NOV	44	176	33	0	0	0	0	254	267
DEC	0	0	22	0	0	0	0	22	23
UNK	11	11	11	0	9	11	0	53	
TOT	198	397	143	66	171	99	0	1075	1075

1976

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	34	0	0	0	0	34	36
JUN	169	67	34	34	26	101	0	431	459
JUL	573	101	101	67	236	67	0	1146	1221
AUG	101	101	0	67	262	0	0	532	567
SEP	0	0	0	0	52	0	0	52	56
OCT	0	0	0	0	0	0	0	0	0
NOV	34	135	0	0	0	0	0	169	180
DEC	0	0	0	0	0	0	0	0	0
UNK	34	67	0	0	52	0	0	154	
TOT	910	472	169	169	629	169	0	2518	2518

1977

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	0	0	0	0	0	0
JUN	67	67	0	0	0	134	0	269	288
JUL	336	134	0	0	52	0	0	523	559
AUG	0	0	0	0	52	0	0	52	56
SEP	0	0	0	0	52	0	0	52	56
OCT	0	0	0	0	0	0	0	0	0
NOV	0	67	0	0	0	0	0	67	72
DEC	0	0	0	0	0	0	0	0	0
UNK	0	67	0	0	0	0	0	67	
TOT	403	336	0	0	157	134	0	1031	1031

1978

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	0	0	0	0	0	0
JUN	0	0	0	0	0	0	0	0	0
JUL	80	0	0	0	0	0	0	80	80
AUG	0	0	0	0	125	0	0	125	125
SEP	0	0	0	0	125	0	0	125	125
OCT	0	0	0	0	0	0	0	0	0
NOV	0	0	0	0	0	0	0	0	0
DEC	0	0	0	0	0	0	0	0	0
UNK	0	0	0	0	0	0	0	0	
TOT	80	0	0	0	250	0	0	330	330

cont'd.

Table 9 (continued)

1980

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	17	0	0	0	17	19
JUN	501	200	33	33	52	67	0	887	985
JUL	1119	401	134	33	429	267	0	2383	2645
AUG	67	50	0	0	416	0	0	533	591
SEP	0	33	0	0	65	0	0	98	109
OCT	0	17	0	17	13	0	0	46	52
NOV	50	217	50	0	0	0	0	317	352
DEC	0	117	67	0	0	0	0	184	204
UNK	134	167	84	0	91	17	0	492	
TOT	1871	1202	367	100	1065	351	0	4956	4956

1981

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	31	0	31	0	62	68
JUN	62	0	31	31	0	0	0	124	135
JUL	0	31	0	62	48	0	0	142	154
AUG	0	0	0	0	290	0	0	290	315
SEP	0	0	0	0	24	0	0	24	26
OCT	0	31	31	0	0	0	0	62	68
NOV	0	156	156	31	0	0	0	342	372
DEC	0	31	0	0	0	0	0	31	34
UNK	0	62	0	0	0	31	0	93	
TOT	62	311	218	156	363	62	0	1172	1172

1982

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	0	0	0	0	0	0
JUN	85	43	43	85	0	21	0	278	303
JUL	192	256	64	21	66	171	0	772	843
AUG	21	0	21	0	249	0	0	292	319
SEP	0	0	0	0	33	0	0	33	36
OCT	43	21	0	0	0	0	0	64	70
NOV	43	64	21	0	0	0	0	128	140
DEC	0	0	0	0	0	0	0	0	0
UNK	43	64	0	21	17	0	0	145	
TOT	427	449	150	128	366	192	0	1712	1712

1983

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	0	0	0	0	0	0
JUN	76	152	0	0	0	0	0	228	238
JUL	380	76	0	0	59	0	0	516	538
AUG	0	0	0	0	414	0	0	414	432
SEP	0	0	0	0	0	0	0	0	0
OCT	152	0	0	0	0	0	0	152	159
NOV	152	228	0	0	0	0	0	380	397
DEC	0	0	0	0	59	0	0	59	62
UNK	76	0	0	0	0	0	0	76	
TOT	837	456	0	0	532	0	0	1826	1826

cont'd.

Table 9 (continued)

1984

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	0	0	0	0	0	0
JUN	0	0	0	39	0	39	0	78	87
JUL	78	39	78	39	61	39	0	334	373
AUG	39	0	39	0	334	0	0	412	461
SEP	0	0	0	0	61	0	0	61	68
OCT	39	39	0	0	0	0	0	78	87
NOV	78	156	0	0	0	0	0	234	262
DEC	0	39	0	0	0	0	0	39	44
UNK	39	0	39	0	30	39	0	147	
TOT	273	273	156	78	485	117	0	1382	1382

1985

STMO	A	B	C	D	O	OTH	UNK	TOT	PTOT
MAY	0	0	0	0	0	0	0	0	0
JUN	0	0	0	0	0	26	0	26	29
JUL	0	53	26	0	62	26	26	193	215
AUG	26	0	0	26	246	0	0	299	333
SEP	0	0	0	0	164	0	0	164	183
OCT	105	26	79	0	41	0	0	252	281
NOV	237	633	158	0	0	79	0	1107	1234
DEC	0	26	0	0	0	0	0	26	29
UNK	26	185	26	0	0	0	0	237	
TOT	395	923	290	26	513	132	26	2305	2305

Table 10 Estimated number of 1SW SALMON of Maine origin harvested in Newfoundland-Labrador by year and statistical area. OTH = statistical areas E to N.

YEAR	A	B	C	D	O	OTH	UNK	TOT
1967	44	88	32	0	20	57	0	240
1968	0	291	145	0	0	0	0	436
1969	218	0	0	0	0	109	0	327
1970	204	78	16	16	85	31	0	431
1971	27	120	67	20	62	0	0	295
1972	0	0	45	0	61	11	0	117
1973	51	34	9	9	46	51	0	200
1974	164	311	106	82	45	123	0	830
1975	198	397	143	66	171	99	0	1075
1976	910	472	169	169	629	169	0	2518
1977	403	336	0	0	157	134	0	1031
1978	80	0	0	0	250	0	0	330
1980	1871	1202	367	100	1065	351	0	4956
1981	62	311	218	156	363	62	0	1172
1982	427	449	150	128	366	192	0	1712
1983	837	456	0	0	532	0	0	1826
1984	273	273	156	78	485	117	0	1382
1985	395	923	290	26	513	132	26	2305
TOT	6165	5742	1911	849	4850	1638	26	21182

Table 11 Comparison of annual estimates of harvest in Newfoundland-Labrador fisheries.

Harvest year	Previous estimate	New Estimate	% Difference
1971	341	295	-13.5
1972	210	117	-44.3
1973	212	200	- 5.6
1974	811	830	2.3
1975	965	1,075	11.4
1976	2,401	2,518	4.9
1977	774	1,031	24.9
1978	320	330	3.1
1980	4,637	4,956	6.9
1981	1,223	1,172	- 4.2
1982	1,625	1,712	5.4
1983	1,728	1,826	5.7
1984	1,185	1,382	16.6
Total	16,432	17,444	

Table 12 The ratio of the Newfoundland-Labrador harvest of 1SW ATLANTIC SALMON of Maine origin to the run size in Maine of 2SW ATLANTIC SALMON in the following year for 1967-1985.

Year I	Newfoundland-Labrador harvest - 1SW Maine-origin salmon Year I	Maine run size 2SW salmon Year I + 1	Ratio Harvest / Run size
1967	240	662	0.363
1968	436	634	0.688
1969	327	787	0.416
1970	431	637	0.677
1971	295	1,331	0.222
1972	117	1,363	0.086
1973	200	1,304	0.153
1974	830	2,182	0.380
1975	1,075	1,222	0.880
1976	2,518	1,920	1.311
1977	1,031	3,853	0.268
1978	330	1,773	0.186
1979	-	5,225	-
1980	4,956	4,724	1.049
1981	1,172	5,439	0.215
1982	1,712	1,788	0.957
1983	1,826	2,792	0.654
1984	1,382	4,319	0.320
1985	2,305	4,838	0.476

$\bar{x}$(1967-1983) = 0.532 ± 0.368.

Table 13 Harvest in the Newfoundland-Labrador ATLANTIC SALMON fishery before Standard Week 23 (4-10 June) and subsequent to Standard Week 41 (8-14 October) of Maine-origin 1SW Atlantic Salmon for the years 1967-1986.

Year	Harvest before Week 23	Harvest before Week 23 / Total harvest	Harvest after Week 41	Harvest after Week 41 / Total harvest	Total harvest
1967	-	-	135	0.563	240
1968	-	-	291	0.667	436
1969	-	-	109	0.333	327
1970	-	-	64	0.148	431
1971	-	-	144	0.488	295
1972	-	-	-	-	117
1973	-	-	27	0.135	200
1974	10	0.012	400	0.482	830
1975	12	0.011	337	0.313	1,075
1976	36	0.014	180	0.071	2,518
1977	-	-	72	0.070	1,031
1978	-	-	-	-	330
1979	-	-	-	-	-
1980	19	0.004	610	0.123	4,956
1981	68	0.058	474	0.404	1,172
1982	-	-	210	0.123	1,712
1983	-	-	616	0.337	1,826
1984	-	-	350	0.253	1,382
1985	-	-	1,463	0.653	2,305

$$\text{Mean } \frac{\text{Harvest before Week 23}}{\text{Total harvest}} = 0.006 \pm 0.014$$

$$\text{Mean } \frac{\text{Harvest after Week 41}}{\text{Total harvest}} = 0.287 \pm 0.218$$

Table 14 Nominal catches at West Greenland, 1960-1986 (in tonnes, round fish weight).

Year	Norway	Faroes	Sweden	Denmark	Greenland[4]	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[2]	960[2]	909

[1] Figures not available, but catch is known to be less than the Faroese catch.

[2] Provisional.

[3] Including 7 tonnes 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 15 Distribution of nominal catches (tonnes) taken by Greenland vessels in 1975 - 1986 by NAFO divisions according to place where landed.

Div.	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986[1]
1A	124	171	201	81	120	52	105	111	14	33	85	46
1B	168	299	393	349	343	275	403	330	77	116	124	73
1C	175	262	336	245	524	404	348	239	93	64	198	128
1D	204	218	207	186	213	231	203	136	41	4	207	203
1E	315	182	237	113	164	158	153	167	55	43	147	233
1F	185	43	46	10	31	74	32	76	30	32	103	277
1NK	-	-	-	-	-	-	20	18	-	5	-	-
Total	1,171	1,175	1,420	984	1,395	1,194	1,264	1,077	310	297	864	960
East Greenl.	+	+	6	8	+	+	+	+	+	+	7	19
Total	1,171	1,175	1,426	992	1,395	1,194	1,264	1,077	310	297	871	979

[1] Provisional figures.

Table 16 Distribution by NAFO division and time of effort, catch, and catch per unit effort in the Greenlandic drift net fishery for ATLANTIC SALMON, 1986. The data comprise the fishery by 17 vessels. (C = number of Salmon caught, f = number of nets used, and C/f = number of Salmon caught per 100 nets).

NAFO division		Week 33 Aug 15-17	Week 34 Aug 18-24	Week 35 Aug 25-31	Total Aug 15-31
1C	C	864	833	726	2,423
	f	364	696	609	1,669
	C/f	237	120	119	145
1D	C	3,155	4,280	508	7,943
	f	945	2,173	240	3,358
	C/f	334	197	212	237
1E	C	6,089	2,613	1,021	9,723
	f	1,722	1,198	416	3,336
	C/f	354	218	245	291
1F	C	147	214	48	409
	f	114	244	91	449
	C/f	129	88	53	91
1C-F	C	10,255	7,940	2,303	20,498
	f	3,145	4,311	1,356	8,812
	C/f	326	184	170	233

Table 17 Catch-per-unit-effort figures from NAFO Subarea 1 as total in 14-day periods, per year, and for non-Greenlandic and Greenland vessels, respectively. Unit number of ATLANTIC SALMON caught per 100 nets.

		Jul	Aug		Sep		Oct		Nov	
Year	Vessel	2	1	2	1	2	1	2	1	Total
1970	N-GR	64	22	37	47	51	22	28	10	35
1971	N-GR	-	83	92	78	78	59	22	14	76
1972	N-GR	-	73	42	33	19	19	16	-	42
1973	N-GR	51	47	36	33	21	19	12	-	35
1974	N-GR	44	68	75	44	51	103	-	-	62
1975	N-GR	61	121	99	56	30	38	43	-	70
1975	GR	-	-	184	83	154	81	37	-	125
1986	GR	-	-	233	-	-	-	-	-	233

Figures for 1970-1973 from Rapp. et Proc-Verbaux, Vol.176, pp.23-25.
Figures for 1974-1975 and 1986, see tables in Working Paper 24.

Table 18. Percentage (by number) of North American and European SALMON in research vessel catches at West Greenland 1969-1982 and from commercial samples 1978-1986.

		Sample size		Continent of origin (%)			
Source	Year	Length	Scales	NA	(95% CL)	E	(95% CL)
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	606	606	38	(41,34)	62	(66,59)
	1978[1]	49	49	55	(69,41)	45	(59,31)
	1979[2]	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	20,424	3,509	54	(63,45)	46	(55,37)

[1] During fishery.
[2] Research samples after fishery closed.

Table 19. Tag returns from 1SW SALMON of Maine origin in West Greenland by year and NAFO division.

YEAR	1A	1B	1C	1D	1E	1F	UNK	TOT
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	12	12	32	130
1974	8	75	95	79	31	20	49	357
1975	10	21	16	5	1	3	69	125
1976	13	11	9	3	0	0	2	38
1977	0	1	6	0	1	2	1	11
1978	0	5	2	0	0	0	2	9
1980	0	33	20	9	0	0	6	68
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	0	8	8	0	1	2	0	19
1985	2	25	6	8	0	5	9	55
1986	1	10	11	0	11	13	0	46
UNK	0	1	1	2	2	0	2	8
TOT	85	341	315	201	148	128	309	1527

Table 20. Estimated number of 1SW SALMON of Maine origin harvested in West Greenland by year and NAFO division.

YEAR	1A	1B	1C	1D	1E	1F	UNK	TOT
1967	6	62	62	50	19	12	19	230
1968	0	0	0	0	0	0	0	0
1969	0	107	321	0	107	0	107	643
1970	155	216	93	108	185	31	108	896
1971	190	223	328	374	380	393	616	2504
1972	55	44	385	66	165	55	132	903
1973	42	235	210	134	101	101	268	1090
1974	64	604	765	636	250	161	395	2875
1975	108	228	174	54	11	33	749	1356
1976	575	487	398	133	0	0	89	1682
1977	0	88	529	0	88	176	88	970
1978	0	632	253	0	0	0	253	1138
1980	0	1085	658	296	0	0	197	2236
1981	0	833	245	0	0	0	882	1960
1982	28	1178	28	28	0	56	56	1374
1983	0	75	449	0	0	0	0	524
1984	0	307	307	0	38	77	0	729
1985	52	649	156	208	0	130	234	1427
TOT	1276	7053	5361	2086	1344	1225	4192	22536

Table 21 Annual mean fork lengths and whole weights of ATLANTIC SALMON caught at West Greenland, 1969-1986. Fork length (cm); whole weight (kg). NA - North American; E - European.

	Whole weight (kg)									Fork length (cm)					
	Sea Age									Sea Age					
	1SW		2SW		PS		Total			1SW		2SW		PS	
Year	NA	E	NA	E	NA	E	NA	E	Total	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

Table 22 Sea age composition (%) from research vessel and commercial catches of ATLANTIC SALMON at West Greenland, 1969-1986.

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

Table 23 River age distribution (%) for all North American and European origin SALMON caught at West Greenland, 1968-1986.

Year	1	2	3	4	5	6	7	8
				North American				
1968	0.3	19.6	40.4	21.3	16.2	2.2	0.0	0.0
1969	0.0	27.1	45.8	19.6	6.5	0.9	0.0	0.0
1970	0.0	58.1	25.6	11.6	2.3	2.3	0.0	0.0
1971	1.2	32.9	36.5	16.5	9.4	3.5	0.0	0.0
1972	0.8	31.9	51.4	10.6	3.9	1.2	0.4	0.0
1973	2.0	40.8	34.7	18.4	2.0	2.0	0.0	0.0
1974	0.9	36.0	36.6	12.0	11.7	2.6	0.3	0.0
1975	0.4	17.3	47.6	24.4	6.2	4.0	0.0	0.0
1976	0.7	42.6	30.6	14.6	10.9	0.4	0.4	0.0
1977	-	-	-	-	-	-	-	-
1978	2.7	31.9	43.0	13.6	6.0	2.0	0.9	0.0
1979	4.2	39.9	40.6	11.3	2.8	1.1	0.1	0.0
1980	5.9	36.3	32.9	16.3	7.9	0.7	0.1	0.0
1981	3.5	31.6	37.5	19.0	6.6	1.6	0.2	0.0
1982	1.4	37.7	38.3	15.9	5.8	0.7	0.0	0.2
1983	3.1	47.0	32.6	12.7	3.7	0.8	0.1	0.0
1984	4.8	51.7	28.9	9.0	4.6	0.9	0.2	0.0
1985	5.1	41.0	35.7	12.1	4.9	1.1	0.1	0.0
1986	2.0	39.9	33.4	20.0	4.0	0.7	0.0	0.0
Total	3.3	38.7	36.2	14.8	5.7	1.2	0.1	0.0
				European				
1968	21.6	60.3	15.2	2.7	0.3	0.0	0.0	0.0
1969	0.0	83.8	16.2	0.0	0.0	0.0	0.0	0.0
1970	0.0	90.4	9.6	0.0	0.0	0.0	0.0	0.0
1971	9.3	66.5	19.9	3.1	1.2	0.0	0.0	0.0
1972	11.0	71.2	16.7	1.0	0.1	0.0	0.0	0.0
1973	26.0	58.0	14.0	2.0	0.0	0.0	0.0	0.0
1974	22.9	68.2	8.5	0.4	0.0	0.0	0.0	0.0
1975	26.0	53.4	18.2	2.5	0.0	0.0	0.0	0.0
1976	23.5	67.2	8.4	0.6	0.3	0.0	0.0	0.0
1977	-	-	-	-	-	-	-	-
1978	26.2	65.4	8.2	0.2	0.0	0.0	0.0	0.0
1979	23.6	64.8	11.0	0.6	0.0	0.0	0.0	0.0
1980	25.8	56.9	14.7	2.5	0.2	0.0	0.0	0.0
1981	15.4	67.3	15.7	1.6	0.0	0.0	0.0	0.0
1982	15.6	56.1	23.5	4.2	0.7	0.0	0.0	0.0
1983	34.7	50.2	12.3	2.4	0.3	0.1	0.1	0.0
1984	22.7	56.9	15.2	4.2	0.9	0.2	0.0	0.0
1985	20.2	61.6	14.9	2.7	0.6	0.0	0.0	0.0
1986	19.5	62.5	15.1	2.7	0.2	0.0	0.0	0.0
Total	21.5	61.9	14.2	2.2	0.3	0.0	0.0	0.0

Table 24 Summary of input parameters used to calculate the abundance of SALMON at West Greenland.

HAR YEAR i	TOT RUN i+1	GRLD CATCH (tonnes) i	MEAN WGT (kg) i	Catch in Numbers: NUMBER i	Catch in Numbers: % 1SW i	Catch in Numbers: 1SW i	Estimated Tag Reporting Rate i
1969	787	2210	3.58	617318	0.938	579045	0.8
1970	637	2146	3.28	654268	0.938	613704	0.8
1971	1330	2689	3.14	856369	0.992	849518	0.8
1972	1363	2113	3.44	614244	0.941	578004	0.8
1973	1304	2341	4.18	560048	0.938	525325	0.8
1974	2182	1917	3.58	535475	0.977	523159	0.8
1975	1221	2030	3.12	650641	0.976	635026	0.6
1976	1919	1175	3.04	386513	0.957	369893	0.6
1977[1]							
1978[2]	1773	984	3.35	293731	0.969	284626	0.4
1979							
1980	4724	1194	3.22	370807	0.978	362650	0.5
1981	5439	1264	3.17	398738	0.97	386776	0.6
1982	1788	1077	3.11	346302	0.939	325178	0.8
1983	2792	310	3.10	100000	0.905	90500	0.8
1984	4319	297	3.11	95498	0.876	83657	0.8
1985	4838	864	2.87	301045	0.938	282380	0.8

[1]No sampling of catch conducted in West Greenland in 1977.
[2]No tags released in 1978. No tag returns to home rivers in 1980.

TABLE 25 Estimated abundance of SALMON available at West Greenland for 1969 to 1985. Model assumptions are described in the text.

HARV YEAR (var)	TOT RUN	CAN Har[1]	CAN pre fish (Y)	GRLD post fish (Z)	GRLD Har	GRLD pre fish (Q)	Exploitation: Est.	Exploitation: AdjE.	Abundance: 1SW (millions)	Abundance: ALL (millions)
1969	787	109	961	981	643	1624	39.5	34.9	1.661	1.771
1970	637	64	754	769	896	1665	53.7	47.4	1.295	1.381
1971	1330	142	1583	1615	2504	4119	60.7	53.5	1.587	1.600
1972	1363	0	1477	1506	903	2409	37.4	33.0	1.752	1.861
1973	1304	28	1440	1470	1090	2560	42.5	37.5	1.401	1.494
1974	2182	402	2766	2822	2875	5697	50.4	44.4	1.177	1.205
1975	1221	348	1671	1705	1356	3061	44.2	39.0	1.628	1.668
1976	1919	180	2259	2305	1682	3987	42.1	37.2	0.996	1.040
1977[2]										
1978	1773	0	1920	1959	1138	3097	36.7	32.4	0.880	0.908
1979[3]										
1980	4724	608	5725	5841	2236	8077	27.6	24.9	1.488	1.521
1981	54	474	6366	6494	1960	8454	23.1	20.4	1.894	1.953
1982	1788	210	2147	2190	1374	3564	38.5	33.9	0.958	1.020
1983	2792	618	3643	3716	524	4240	12.3	10.9	0.832	0.919
1984	43	393	5071	5174	729	5903	12.3	10.9	0.769	0.878
1985	4838	1544	6785	6922	1427	8349	17.0	15.1	1.876	2.000

[1]Harvest total for last 3 months of year.
[2]No sampling of salmon at West Greenland in 1977.
[3]No tags released by Maine in 1978. No tag returns to home rivers in 1980.

Table 26 Estimated number of ATLANTIC SALMON caught at West Greenland as a function of opening date of the fishery. Standard deviations of the numbers caught are based on a new MEAN opening date and a ONE-TIME switch to new opening date. Estimates are based on a total catch at West Greenland of 864 t.

				Std. dev. of number caught	
Opening date	Mean weight (kg)	No. caught (thousands)	Percent reduction	New mean opening date	New one-time opening date
1 Aug	3.05	283	0.0	53	215
8 Aug	3.19	271	4.3	51	206
15 Aug	3.33	260	8.2	49	198
22 Aug	3.46	250	11.8	47	190
29 Aug	3.60	240	15.1	46	183
5 Sep	3.73	231	18.2	44	177

Table 27 Catches of North American ATLANTIC SALMON in Canada, USA, and at West Greenland, 1910 to 1985. Catches prior to 1960 are from May and Lear (1971) and since , from Anon. (1986a). Newfoundland and Labrador catches prior to joining Canada in 1949 are included in Canadian catches.

Year	Canada	USA
1910	2455	28
1911	2629	67
1912	2852	69
1913	3383	38
1914	3202	38
1915	3028	
1916	2925	28
1917	2924	
1918	2938	
1919	1990	9
1920	2019	
1921	3142	
1922	3528	
1923	3950	
1924	4291	6
1925	4330	
1926	4483	
1927	4488	
1928	3270	7
1929	3867	20
1930	6100	40
1931	5518	32
1932	4044	16
1933	4336	11
1934	3843	
1935	3688	18
1936	3483	
1937	3883	11
1938	4078	7
1939	3034	3
1940	3456	9
1941	3498	1
1942	3014	1
1943	2914	0
1944	2692	3
1945	2279	4
1946	2703	1
1947	2712	2

Year	Canada	USA	GRLD
1948	3069	<1	
1949	2923	<1	
1950	2686	<1	
1951	2337	1	
1952	2527		
1953	2338	0	
1954	1974		
1955	1348		
1956	1387		
1957	1541		
1958	1818	1	
1959	1956	<1	
1960	1636		23
1961	1583	<1	49
1962	1719	<1	95
1963	1861	<1	181
1964	2069	<1	598
1965	2116	<1	335
1966	2369	<1	532
1967	2863	<1	622
1968	2111	<1	438
1969	2202	<1	1023
1970	2323	<1	701
1971	1992	<1	780
1972	1759	<1	719
1973	2434	3	1051
1974	2539	1	741
1975	2485	2	759
1976	2506	1	457
1977	2545	2	576
1978	1545	4	402
1979	1287	3	632
1980	2680	6	603
1981	2437	6	680
1982	1798	6	551
1983	1434	1	121
1984	1112	2	153
1985	1100	2	409

Note: Blank = no information available
0 = insignificant

Table 28 Weight (tonnes) of ATLANTIC SALMON landed in the commercial salmon fishery prior to 5 June (1981-1983) and after 15 October (1981-1983 and 1985) in fisheries affected by delayed opening and early closure in 1986.

Year	Prior to 5 June		After 15 October
	MSW	1SW	Immature 1SW and MSW
1981	196	12	7
1982	26	2	2
1983	30	3	4
1984	No fishery		Data not available
1985	No fishery		16
Mean	84	7	7
(SD)	(97)	(6)	(6)

Table 29 Predicted and estimated returns of MSW ATLANTIC SALMON to the Restigouche, Miramichi, and Saint John Rivers and estimated spawning escapement, 1982-1986.

Year	Returns (R)		Spawners(S)	S/R
	Predicted	Estimated		
		Restigouche River		
1982	-	13,500	1,900	0.14
1983	13,500	11,000	1,200	0.11
1984	11,300	9,900	5,100	0.52
1985	12,200	14,600	10,200	0.70
1986	14,800	19,800	14,800	0.75
1987	21,900	-	-	-
		Miramichi River		
1982	-	24,500	6,200	0.25
1983	43,000	24,300	2,400	0.10
1984	10,000	9,800	8,300	0.85
1985	18,400	24,300	22,700	0.93
1986	28,400	30,300	28,300	0.93
1987	54,200	-	-	-
		Saint John River		
1982	-	11,800	4,800	0.41
1983	-	8,400	3,200	0.38
1984	10,400	14,700	11,900	0.81
1985	15,500	14,800	9,000	0.61
1986	13,600	11,800	7,400	0.63
1987	18,000	-	-	-

Table 30 Harvest by weight (tonnes) of 1SW (Year N) and MSW ATLANTIC SALMON (Year N+1) by Canada for the years 1970-1986.

Year N	1SW salmon (Year N)	MSW salmon (Year N+1)	Ratio MSW salmon (Year N+1) / 1SW salmon (Year N)
1969	-	1,562	-
1970	761	1,482	1.95
1971	510	1,201	2.36
1972	558	1,651	2.96
1973	783	1,589	2.03
1974	950	1,573	1.66
1975	912	1,721	1.89
1976	785	1,883	2.40
1977	662	1,225	1.85
1978	320	705	2.20
1979	582	1,763	3.03
1980	917	1,619	1.77
1981	818	1,082	1.32
1982	716	911	1.27
1983	513	645	1.26
1984	467	540	1.16
1985	593	750[1]	1.26
1986	756[1]	-	-

[1] Preliminary.

$\bar{x}$ (1970-1982) = 2.05

$\bar{x}$ (1983-1985) = 1.23

$t = 2.586$

$p < 0.05$

Table 31 Estimates of exploitation of 1SW and MSW ATLANTIC SALMON in Saint John and Penobscot Rivers, 1982-1986.

		Saint John River		Penobscot River	
Year	Sea age	Number available	Exp. rate	Number available	Exp. rate
1982	1SW	-	-	142	0.16
	MSW	-	-	3,310	0.35
1983	1SW	11,260	0.34	167	0.12
	MSW	8,430	0.62	673	0.27
1984	1SW	13,020	0.26	217	0.17
	MSW	14,720	0.29	1,324	0.31
1985	1SW	10,840	0.40	237	0.05
	MSW	14,770	0.39	2,868	0.16
1986	1SW	16,030	0.25	490	0.15
	MSW	11,830	0.37	3,736	0.12

Table 32 The number of ATLANTIC SALMON examined for microtags and periods of sampling at sites in West Greenland in 1986.

Place	NAFO Div.	Sampling period	Number salmon examined	Number adipose fin clips(%)	Number microtags tags(%)	% of AFC fish with microtags	Number untagged AFC fish(%)
Sisimut	1B	18 Aug - 1 Sep	7,308	153 (2.1)	25 (0.34)	16.3	128 (1.76)
Nuuk	1D	18 Aug -27 Aug	10,120	128 (1.3)	32 (0.32)	25.0	96 (0.98)
Paamiut	1E	15 Aug -25 Aug	7,361	63 (0.86)	8 (0.11)	12.7	55 (0.75)
Narssaq	1F	15 Aug -25 Aug	5,571	66 (1.2)	5 (0.09)	7.6	61 (1.11)
Total			30,360	410 (1.4)	70 (0.23)	17.1	340 (1.17)

Table 33 Number of micro- and Carlin tags applied to ATLANTIC SALMON by country for the years 1985-1986.

		1985		1986	
Country	Stock	Microtags	Carlin	Microtags	Carlin
N. Ireland	Hatchery	17,966	-	25,159	-
	Wild	-	-	1,166	-
Ireland	Hatchery	198,333	-	134,123	-
	Wild	3,572	-	-	-
England & Wales	Hatchery	64,698	-	120,049	-
	Wild	6,700	-	9,418	-
Scotland	Hatchery	13,145	-	13,350	2,485
	Wild	352	10,594	2,875	16,225
Norway	Hatchery	3,206	35,650	-	94,036
	Wild	-	1,780	-	1,890
Iceland	Hatchery	74,400	-	55,000	-
	Wild	2,600	-	200	-
Faroes	Hatchery	30,000	-	NA	NA
France	Hatchery	15,084	4,849	NA	NA
	Wild	-	-	NA	NA
Canada	Hatchery	29,640	75,000	70,148	92,040
	Wild	-	-	-	-
USA	Hatchery	149,248	149,898	447,287	146,873
	Wild	-	-	-	-
Others[1]	Hatchery	?	Yes	?	Yes
	Wild	?	?	?	?
Total	Hatchery	595,720	265,397	865,116	335,434
	Wild	13,224	12,374	13,659	18,115
Grand Total		608,944+	277,771	878,775+	353,549+

[1] Includes unknown number of tagged hatchery and wild salmon released in Spain, the west coast of Sweden, and USSR.

Note: All tagged fish with possible exception of "others" were marked by excision of the adipose fin.

Table 34 Numbers of North American Carlin tags of hatchery origin recovered at West Greenland 1985-1986.

	1985			1986		
NAFO Div.	Can. (%)	USA (%)	Total (%)	Can. (%)	USA (%)	Total (%)
1A	3 (8.8)	2 (3.6)	5 (5.6)	3 (5.5)	1 (1.7)	4 (3.6)
1B	13 (38.2)	25 (45.5)	38 (42.7)	9 (16.6)	10 (17.2)	19 (17.0)
1C	6 (17.6)	6 (10.9)	12 (13.5)	8 (14.8)	11 (19.0)	19 (17.0)
1D	7 (20.6)	8 (14.5)	15 (16.9)	15[1] (17.8)	12 (20.7)	27 (24.1)
1E	- -	- -	- -	11 (20.4)	11 (19.0)	22 (19.6)
1F	5 (14.7)	10 (11.2)	10 (11.2)	8 (14.8)	13 (22.4)	21 (18.7)
1NK	-[2] -	9 (10.1)	9 (10.1	- -	- -	0 -
Total (%)	34 (38.2)	89 (100%)	89 (100%)	54 (48.2%)	58 (51.8%)	112 (100%)

[1] Includes 6 Halifax tags from Division 1D that may already be counted.
[2] Unknown tags apportioned by Canada.

Table 35 Data base used to estimate reporting rates for tagged ATLANTIC SALMON recaptured at West Greenland from 1971 to 1985. Tag recaptures are from hatchery smolt releases into rivers in Maine, USA and the Saint John River, New Brunswick.

Fishery year	Catch at Grld[2]	Tag recaptures[1]					
		Maine			Saint John		
		Grld[3]	Other[4]	Total	Grld[3]	Other	Total
1971	780	381	374	755	12	16	28
1972	719	95	232	327	19	120	139
1973	1,051	132	248	380	16	35	51
1974	741	360	515	875	93	191	284
1975	759	126	266	392	23	88	111
1976	457	38	184	222	41	189	230
1977	566	11	97	108	7	182	189
1978	393	9	38	47	23	149	172
1979	639	-	-	-	84	340	424
1980	592	68	727	795	33	342	375
1981	680	41	298	339	23	119	142
1982	546	50	209	259	13	55	68
1983	121	7	79	86	1	64	65
1984	153	20	204	224	3	45	48
1985	403	54	367	421	7	42	49

1 Recaptures as maturing 1SW salmon are excluded.
2 Catch in tonnes of North American salmon at Greenland.
3 Reported recaptures as 1SW salmon at Greenland.
4 Includes reported recaptures as MSW salmon and non-maturing 1SW salmon in areas other than West Greenland.

Table 36 Reporting rate estimates for tagged ATLANTIC SALMON recaptured in the West Greenland fishery. Estimates are based on 3-year running averages of catches and tag recapture proportions.

Fishing years	Tag reporting rates		
	Maine	Saint John	Mean
1971-1973	0.8[1]	0.8[1]	0.8[1]
1972-1974	0.75	0.69	0.72
1973-1975	0.76	0.76	0.76
1974-1976	0.82	0.88	0.85
1975-1977	0.60	0.52	0.56
1976-1978	0.59	0.56	0.57
1977-1979	0.55[2]	0.52	0.54
1978-1980	0.50[2]	0.59	0.54
1979-1981	0.29[2]	0.51	0.40
1980-1982	0.39[2]	0.54	0.46
1981-1983	0.52	0.64	0.58
1982-1984	0.79	0.80	0.80
1983-1985	0.79	0.80	0.79

1 Calibration value.

2 Rate derived from smolt releases in two years only since no tagged smolt releases were made in 1978.

Table 37 Nominal catches of ATLANTIC SALMON by Faroese vessels in 1982-1985 and the seasons 1981/1982 to 1984/1985.

Year	Catch (tonnes)	Season	Catch (tonnes)
1982	960	1981/1982	884
1983	753	1982/1983	694
1984	697	1983/1984	786
1985	672	1984/1985	664
1986	628	1985/1986	625

Table 38 Catch in number by sea age class by month in the Faroese ATLANTIC SALMON fishery in the 1985/1986 season based on landing sheets and the estimated total.

Month	Sea age					
	1	2	3	4	Undet.	Total
November[1]	-	1,252	72	-	25	1,349
December	-	21,940	1,248	-	513	23,701
January	166	11,081	660	65	38	12,010
February	575	39,857	311	-	2,302	43,045
March[2]	324	20,454	154	-	1,358	22,290
April	370	15,449	1,291	-	1,095	18,205
May	-	11,634	366	-	66	12,066
Total	1,435	121,667	4,102	65	5,397	132,666
Grand total						177,241

[1] Based on the December samples.
[2] Based on the February samples.

Table 39 Nominal catches (tonnes) of ATLANTIC SALMON by zones, 1984-1986.

Country	1984			1985			1986[1]		
	River	Estuary	Marine	River	Estuary	Marine	River	Estuary	Marine
Engl.+ Wales	47	80	218	83	63	215	80	91	223
Iceland	118	37	4	136	78	6	216	100	14
Ireland	94	130	625	95	138	1,301	147	110	1,580
Finland	44	-	29[2]	49	-	-	38	-	-
France	-	-	-	16	6	-	18	10	-
N.Ireland	-	-	-	-	-	-	8	20	81
Norway	299	-	1,323	322	-	1,239	302	-	1,291
Scotland	222	333	458	287	272	353	294	440	439
Sweden	-	-	-	8	-	37	10	-	44

[1] Provisional.
[2] Taken in Norwegian Sea.

Table 40

. Estimated number of 1-sw and 2-sw salmon of the River Imsa stock available to the Norwegian Sea fishery and Norwegian home water fishery, and estimated exploitation rates. The number of salmon caught in the trap in River Imsa is considered to be the total river escapement. The estimates are based on 75% and 50% tag reporting rate in Norwegian Sea and Norwegian home waters respectively.

			1-SW					2-SW				
			Norw. Sea		Norw. home waters			Norw. Sea		Norw. home waters		
	Smolt type	No. tagged	No. of fish available	Expl. rate	No. of fish available	Expl. rate	No. in trap	No. of fish available	Expl. rate	No. of fish available	Expl. rate	No. in trap
Released	R. Imsa wild	3214	776	0.00	555	0.88	66	177	0.25	127	0.93	9
1981	R. Imsa 2+	5819	757	0.01	586	0.80	114	125	0.38	74	0.92	6
Released	R. Imsa wild	736	61	0.00	39	0.87	5	18	0.50	9	0.89	1
1982	R. Imsa 1+	5581	130	0.00	73	0.99	1	48	0.33	31	0.97	1
	R. Imsa 2+	8501	712	0.03	524	0.95	25	129	0.57	54	0.93	4
Released	R. Imsa wild	1287	211	0.00	174	0.82	31	27	0.33	17	0.94	1
1983	R. Imsa 1+	5861	27	0.00	23	0.96	1	3	0.31	2	1.00	0
	R. Imsa 2+	6052	205	0.02	172	0.93	12	19	0.47	10	1.00	0
Released	R. Imsa wild	936	150	0.00	113	0.73	30	29	0.38	17	0.82	3
1984	R. Imsa 1+	1863	40	0.00	21	0.76	5	16	0.19	12	0.83	2
	R. Imsa 2+	7445	413	0.04	335	0.86	48	43	0.40	25	0.96	1
Released	R. Imsa wild	892	91	0.00	87	0.78	19					
1985	R. Imsa 1+	9160	572	0.00	549	0.76	128					
	R. Imsa 2+	1950	84	0.00	80	0.78	18					

Table 41

Estimated number of 1-sw and 2-sw salmon of the River Imsa stock available to the Norwegian Sea fishery and Norwegian home water fishery, and estimated exploitation rates. The number of salmon caught in the trap in River Imsa is considered to be the total river escapement. The estimates are based on 75% and 70% tag reporting rate in Norwegian Sea and Norwegian home waters respectively.

			1-SW					2-SW				
			Norw. Sea		Norw. home waters			Norw. Sea		Norw. home waters		
	Smolt type	No. tagged	No. of fish available	Expl. rate	No. of fish available	Expl. rate	No. in trap	No. of fish available	Expl. rate	No. of fish available	Expl. rate	No. in trap
Released	R. Imsa wild	3214	592	0.00	416	0.84	66	142	0.32	93	0.90	9
1981	R. Imsa 2+	5819	596	0.01	452	0.74	114	105	0.46	55	0.89	6
Released	R. Imsa wild	736	48	0.00	29	0.83	5	16	0.56	7	0.86	1
1982	R. Imsa 1+	5581	98	0.00	52	0.98	1	39	0.41	22	0.95	1
	R. Imsa 2+	8501	549	0.04	382	0.93	25	115	0.63	40	0.90	4
Released	R. Imsa wild	1287	163	0.00	133	0.76	31	22	0.41	12	0.92	1
1983	R. Imsa 1+	5861	20	0.00	17	0.94	1	2	0.50	1	1.00	0
	R. Imsa 2+	6052	154	0.03	126	0.90	12	16	0.56	7	1.00	0
Released	R. Imsa wild	936	122	0.00	90	0.66	30	25	0.44	13	0.77	3
1984	R. Imsa 1+	1863	30	0.00	16	0.69	5	12	0.25	9	0.78	2
	R. Imsa 2+	7445	322	0.05	255	0.81	48	36	0.47	18	0.94	1
Released	R. Imsa wild	892	71	0.00	68	0.72	19					
1985	R. Imsa 1+	9160	448	0.00	430	0.70	128					
	R. Imsa 2+	1950	65	0.00	62	0.71	18					

Table 42 Estimated number of tagged 2SW ATLANTIC SALMON of the River North Esk stock available to the Faroes fishery, Scottish home—water fishery, and the North Esk fishery, and estimated exploitation rates.

	Faroes fishery		All other fisheries[1]		North Esk	
Year	No. of fish available	Expl. rate	No. of fish available	Expl. rate	No. of fish available	Expl. rate
1983	188	0.13	158	0.70	48	0.31
1984	267	0.11	231	0.52	111	0.35
1985	10	0.13	8	0.44	5	0.42
1986	69	0.04	65	0.42	38	0.24

[1] Mostly in Scottish home waters.

Table 43 Calculated home water exploitation rates from hatchery-reared smolts released from the River Burrishoole in Ireland, 1980-1985.

Year of smolt release	Smolt age	Exploitation	
		A	B
1980	1	39	63
1981	1	81	88
1982	2+	76	84
1983	1+	78	86
	2+	76	84
1984	1+	77	86
	2+(C)	44	61
1985	1+	73	85
	2+	79	89

A = Expanded by fishery.

B = Expanded by fishery and non-catch fishing mortality.

C = All fish released were from a grilse stock except those released in 1984 which were from 2SW wild parent stock.

Table 44 Microtag recoveries and estimated home-water exploitation rates from hatchery-reared salmon smolts released in the River Bush, Northern Ireland, 1985.

Smolt age	Number released	Estimated no. recovered		Exploitation rate home waters	
		Home waters (A)	River	A	B
1	4,625	370	129	0.74	0.81
2	13,341	979	574	0.63	0.71

(A) Adjusted for declared catch.
(B) Adjusted for 50% non-reported catch.

Figure 1 Maine rivers with ATLANTIC SALMON fisheries.

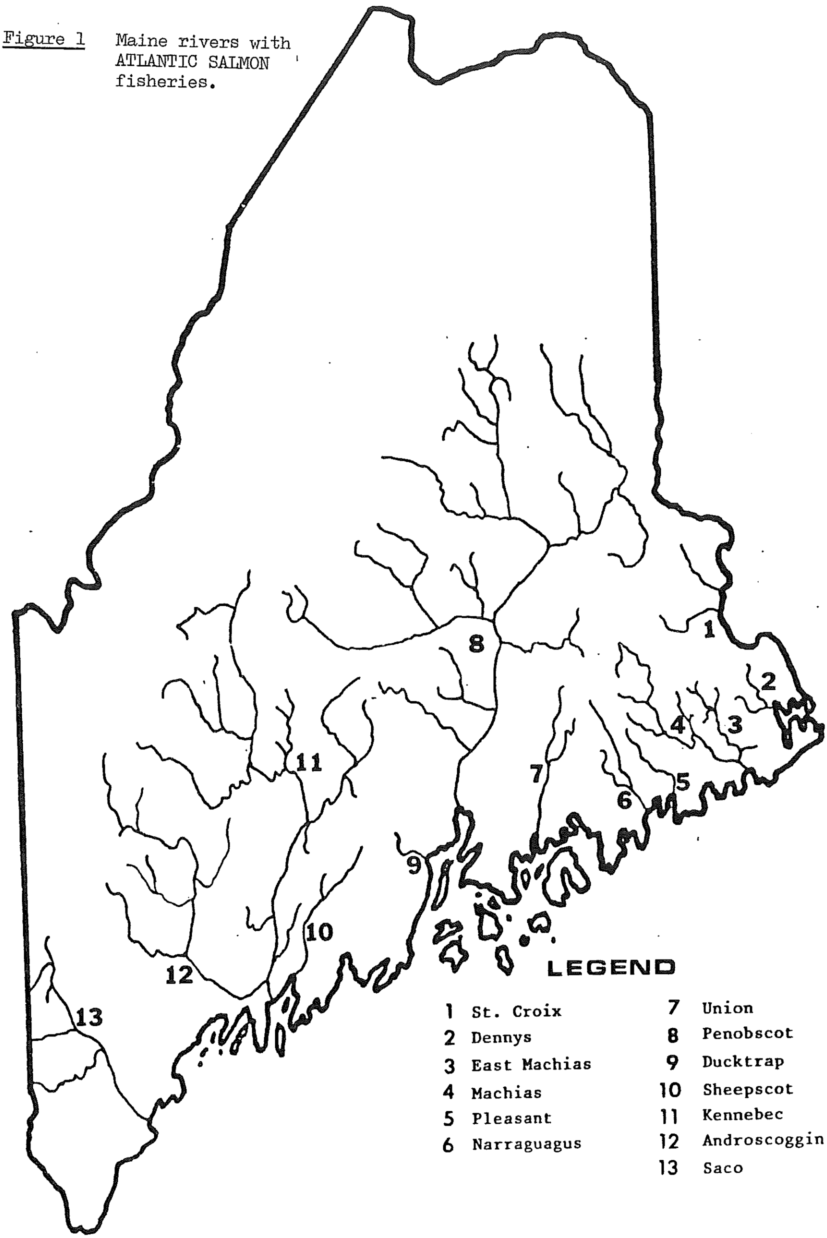


Figure 2 ATLANTIC SALMON exploitation, Narraguagus and Machias sport fisheries.

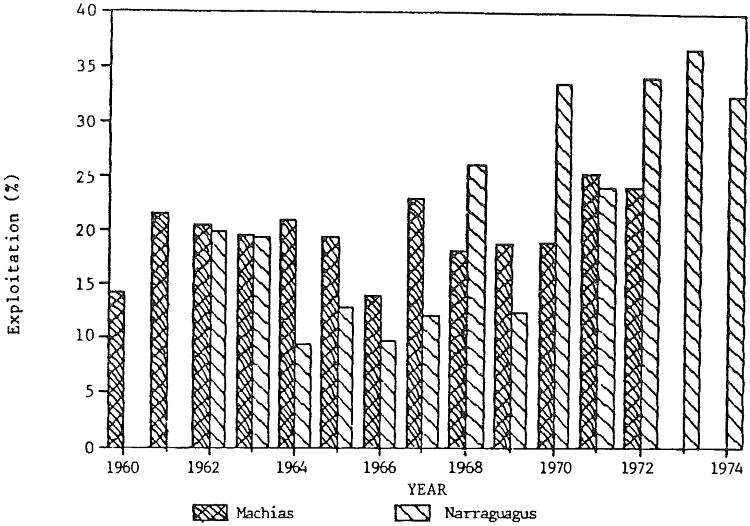
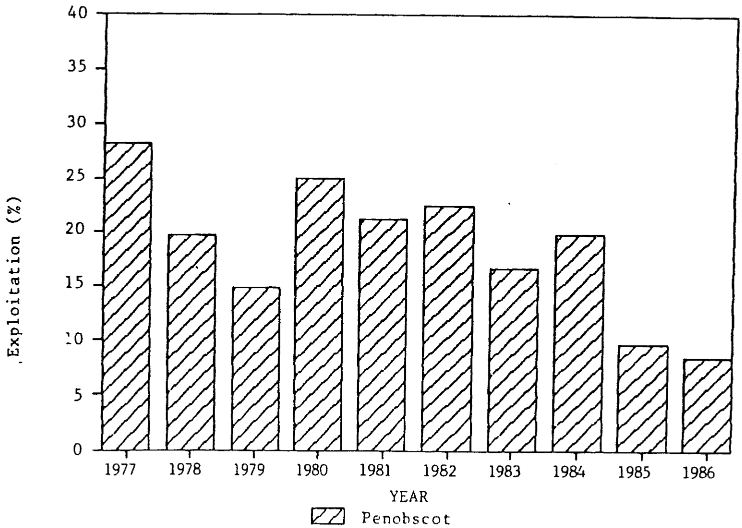


Figure 3 ATLANTIC SALMON exploitation, Penobscot River sport fishery, 1977-1986.



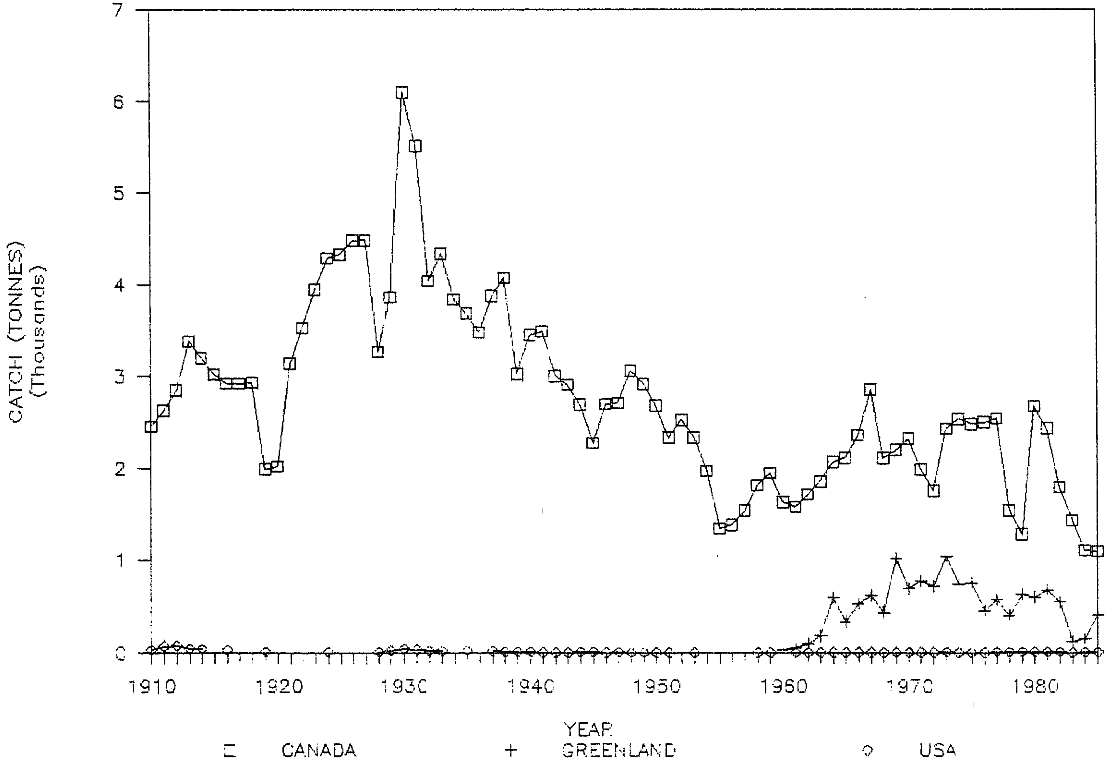
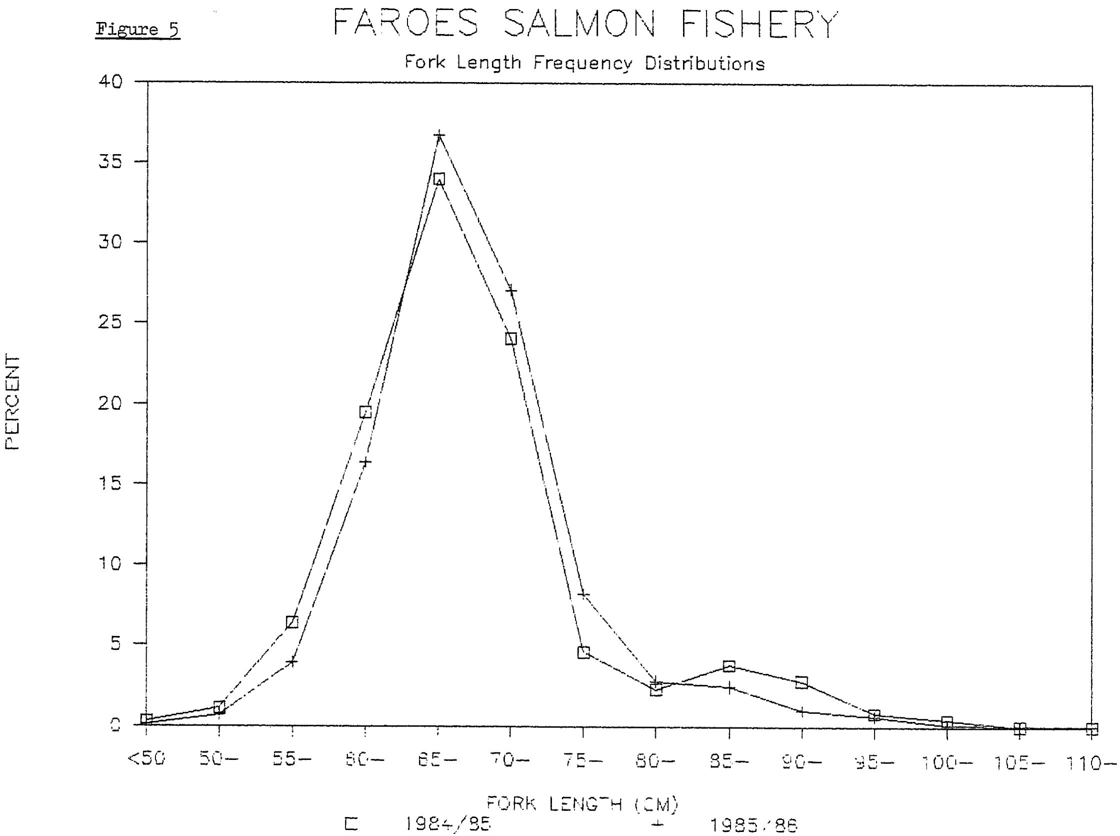


Figure 4 Catches of North American ATLANTIC SALMON in Canadian and USA fisheries and at West Greenland, 1910-1985. Canadian catches prior to 1960 are from May and Lear (1971) and since, from Anon. (1986a). USA catches prior to 1973 are from Beland (1984).

Figure 5


FAROES SALMON FISHERY
Fork Length Frequency Distributions
PERCENT
40
35
30
25
20
15
10
5
0
<50
50–
55–
60–
65–
70–
75–
80–
85–
90–
95–
100–
105–
110–
FORK LENGTH (CM)
□ 1984/85
+ 1985/86

APPENDIX 1

ICES Working Group on North Atlantic Salmon

Copenhagen, 9 - 20 March 1987

1) Call to order.

2) Adoption of Agenda.

3) Distribution of meeting documents.

4) Organization of meeting.

5) With respect to the West Greenland Commission area:

   a) describe the events in the West Greenland fishery in 1986, including regulations in effect, gears and vessels in use, temporal and geographical distribution of the fishery, and the quantity and composition of catches by continent and, if possible, country of origin (Section 3.1);

   b) provide best estimates of salmon stock abundance in the West Greenland fishery (Section 3.2);

   c) advise on the effects of varying levels of harvest at Greenland on subsequent returns of large salmon to home waters (Section 3.3);

   d) estimate the impact of management measures existing, newly taken, and proposed by States of origin of salmon occurring in the Commission area on home-water stocks and, where possible, on spawning escapements (Section 3.6.1);

   e) evaluate the tag recovery and return procedure at West Greenland, including an assessment of the accuracy and completeness of information accompanying tag returns, and indicate methods for improving the tag recovery and return procedure (Section 3.7.1);

   f) consider estimates of spawning escapement and target spawning biomass for salmon stocks occurring in the Commission area (Section 3.6.2);

   g) assess the accuracy of the classification of salmon at West Greenland as either North American or European and examine the estimates of the age composition of catches of hatchery-origin salmon at Greenland including needed sample sizes (Section 3.8);

h) assess the effects of predation on marine mortality of salmon (Section 1.4);

i) describe the tagging programmes and compile all available information of such programmes carried out by member countries (Section 3.7.2);

j) provide estimates of exploitation rates in home waters for salmon stocks occurring in the Commission area (Sections 3.6.3 and 4.3);

k) assess the natural mortality of salmon in the marine phase especially between Greenland and home waters (Section 1.4);

l) review the historical catch levels and provide advice on possible levels of sustainable yields of the North American component of salmon caught at West Greenland and at home waters (Section 3.5);

m) assess the effects of opening date and quota on the number of salmon caught at West Greenland (Section 3.4).

6) With respect to the North-East Atlantic Commission area:

a) describe the fisheries for salmon in the North-East Atlantic Commission area, assess the total exploitation exerted upon the stocks, and estimate the fishing mortality so generated:

i) for home-water fisheries divided into freshwater and marine components;

ii) for sea fisheries beyond 12 mile (Sections 1.2, 1.3, 4.1.1, and 4.2);

b) estimate the quantity, age composition, and home-water origin of the landings and discards of salmon taken in the Faroes in the 1986/1987 fishing season (Section 4.1.1);

c) present the catch statistics of the North-East Atlantic Commission salmon fisheries on an annual basis, and on a seasonal basis where the season overlaps the end of the year, distinguishing between freshwater and marine components (Section 4.2.1);

d) estimate the contribution of hatchery-reared fish and fish farm escapees to the Faroese and the home-water fisheries (Section 4.1.3);

e) assess natural mortality of salmon in the marine phase (Section 1.4);

f) analyse the distribution of catches by season and area in the Faroese fishery in relation to country of origin (Section 4.1.2);

g) consider the biological effects of alternative minimum size regulation for the Faroese fishery (Section 4.1.4);

h) describe the historical evolution of home-water fisheries in terms of gear used divided into riverine and marine components (Section 4.2.4);

i) assess the effects of predation on marine mortality (Section 1.4);

j) consider the effects of existing, new, and proposed conservation measures on the exploitation of home-water stocks (Section 4.2.3);

k) assess the efficacy of present methods of minimizing discards and mortality therefrom in the Faroese fishery (Section 4.1.4).

7) With respect to the North American Commission area:

a) provide estimates of the number, weight, age composition, and river of origin of historical catches from 1967-1985 of salmon originating in rivers or artificial production facilities of another country. These estimates should be broken down by sea-age, standardized week, locality, and gear type. The estimates should also take into consideration available information on the release and recovery of tagged salmon and catches and exploitation rates for salmon in areas where such catches occur (Section 2.3);

b) provide a description of fisheries catching salmon originating in another country's river or artificial production facility. The description should include catch, effort, exploitation rates, gear type, season, and age composition of historical catches of salmon by year (Section 2.2.1);

c) develop research procedures to assess the proportion of salmon tags captured but not reported (Section 2.5.1);

d) specify data deficiencies and necessary research programmes to address those deficiencies (Section 5);

e) estimate the impact of management measures taken by Canada in 1984 and 1985 and the expected impact of those taken in 1986 in reducing the harvest in Canadian fisheries of salmon originating in the USA (Section 2.4);

f) review existing tag reward systems and make recommendations on standardizing payments, national clearing house arrangements, and review cooperative tag recovery systems in the NASCO area (Section 2.5.2);

g) examine methods of stock identification such as scale structures to separate stocks in mixed-stock fisheries (Section 2.6);

h) provide a description of sport fisheries for Atlantic salmon in Maine, USA including effort statistics for these fisheries by river system and refine the estimates of exploitation rates for these fisheries (Section 2.2.2);

i) develop research procedures to estimate non-catch fishing mortalities in marine fisheries in Canada and the USA, and in the Maine sport fisheries (Section 2.7).

8) With respect to the issue of acid rain in the North American Commission area:

a) identify freshwater habitats which support or have supported Atlantic salmon populations and classify these habitats in relation to their vulnerability to loss of productivity of Atlantic salmon due to acidification (Section 2.1.1);

b) describe the trends in acidification of habitat identified in question a), and in the fish populations supported by those habitats (Section 2.1.2);

c) describe the influence of acidification of freshwater habitat on growth and survival of Atlantic salmon fry and parr and the implications for smolt and adult production (Section 2.1.3);

d) describe the effectiveness of mitigation measures such as liming and the extent to which these measures are in current use (Section 2.1.4).

9) Provision of advice for management of stocks "within safe biological limits" (Section 1.1).

10) Future research and progress on research recommendations (Section 5).

11) Other business.

12) Adoption of report.

APPENDIX 2

Documents Submitted to the Working Group

1) Saila, S.B. and T.L. Ong. A Pattern Recognition Approach to Stock Identification of Atlantic Salmon Based on Scale Characteristics.

2) Tómasson, T., A. Ísaksson, and S. Óskarsson. Ocean mortality of ranched salmon during the second year in the sea, Smolts released 1979-1982.

3) Reddin, D.G., and P.B. Short. Length, Weight and Age Characteristics of Atlantic salmon (Salmo salar L.) of North American and European Origin Caught at West Greenland in 1986.

4) Reddin, D.G. Estimation of Sample Sizes for West Greenland Sampling Program-Part I.

5) Reddin, D.G., and P.R. Downton. Commercial Samples Collected from Newfoundland Fishery, 1981-1985 as a Contribution to ICES Biological Sampling Database.

6) Reddin, D.G., E. Verspoor, and P.R. Downton. An Integrated Phenotypic and Genotypic Approach to Discriminating Atlantic Salmon.

7) Reddin, D.G. and P.B. Short. Identification of North American and European Atlantic Salmon (Salmo salar L.) Caught at West Greenland in 1986.

8) Marshall, T.L., D.K. MacPhail and A. Francis. Data-base - Atlantic salmon of the Saint John River, N.B.

9) Marshall, T.L. Recapture of Canadian-Tagged Atlantic Salmon Outside Homewaters, 1980-1986.

10) Marshall, T.L. and J.A. Ritter. Numbers of Canadian 1-year smolts with the potential to contribute to Greenland fisheries.

11) Ritter, J.A., T.L. Marshall, and A.L. Meister. Estimation of Reporting Rates for Tagged Atlantic Salmon Recaptured in the Greenland Fishery.

12) Potter, E.C.E., D.G. Reddin, K.D. Friedland and I.C. Russell. Preliminary results of microtag recovery programme at West Greenland in 1986.

13) Potter, E.C.E. Salmon tagging programmes in England and Wales.

14) Potter, E.C.E. Discrimination between wild, farmed and stocked Atlantic salmon using fin measurements.

15) Potter, E.C.E. Comparison of fin damage between tagged and untagged salmon in the Faroes catch.

16) Scott, A. and E.C.E. Potter. Management and evolution of salmon fisheries in England and Wales.

17) Rago, P.J., K.D. Friedland, and D.G. Reddin. Estimation of Harvest of Hatchery-reared USA-origin Atlantic Salmon in West Greenland, 1976-1985.

18) Rago, P.J. Potential Consequences of Opening Date and Quota on the Harvest of Salmon at West Greenland.

19) Friedland, K.D. TAC Level for North American Salmon Stocks Based on Historical Catch Levels.

20) Friedland, K.D. and A.L. Meister. Evaluation of the Completeness of USA-Maine Origin Carlin Tag Recovery Information in Greenland.

21) Friedland, K.D. and D.G. Reddin. Recoveries of Coded Wire Micro Tags in Newfoundland and Labrador during the 1986 Fishing Season.

22) Friedland, K.D. and S.G. Rideout. Estimated Harvest of USA-Connecticut River Origin 1-SW Salmon in Canada and Greenland in 1985.

23) Meister, A.L. Tagged Atlantic Salmon of USA Origin Recovered in East Greenland 1970-1986.

24) Møller-Jensen, J. The West Greenland Salmon Fishery, 1986.

25) Møller-Jensen, J. What happens to the USA-Salmon in the North Atlantic Ocean?

26) Beland, K.F. Maine's Atlantic Salmon Sport Fisheries.

27) Dube, N.R., and A.J. Godin. Evaluation of Double-Crested Cormorant Depredation Upon Hatchery-Reared Atlantic Salmon Smolts Released in the Penobscot River, Maine.

28) Baum, E.T. Summary of Maine Atlantic Salmon Homewater Returns (Carlin Tagged and Untagged) By River, Method of Capture, Sea Age and Origin, 1967-1986.

29) Lund, R.A., I. Nordhuus, and L.P. Hansen. Discrimination between wild and reared Atlantic Salmon in four commercial Salmon fisheries on the Norwegian coast using fin measurements.

30) Hansen, L.P. Exploitation of Atlantic Salmon by rods in River Drammenselv 1986.

31) Hansen, L.P. The Norwegian salmon fishing in home waters; historical evolution and new conservation measures.

32) Reitan, O., N.A. Hvidsten, and L.P. Hansen. Bird predation on hatchery reared Atlantic salmon smolts, Salmo salar L., released in the River Eira, Norway.

33) Hansen, L.P. and B. Jonsson. River Imsa as an Index River.

34) Lund, R.A. and L.P. Hansen. Biological characteristics of Atlantic Salmon from coastal fisheries at Kvaløya and Kolgrov, Western Norway.

35) Hansen. L.P. Estimates of exploitation rates of Atlantic Salmon released as smolts in River Imsa, SW Norway 1981-1985.

36) Heggenes, J., and R. Borgstrom. Effect of Mink (Mustela vison) Predation on Cohorts of Juvenile Atlantic Salmon (Salmo salar) and Brown Trout (S. trutta) in Three Streams.

37) Hvidsten, N.A. and P.I. Møkkelgjerd. Predation on salmon smolts, Salmo salar L., in the estuary of the River Surna, Norway.

38) Hvidsten, N.A. An analysis of the cod predation on tagged salmon smolts in the estuary of the River Surna, Norway.

39) Crozier, W.W. and G.J.A. Kennedy. Marine survival and exploitation of R. Bush hatchery salmon (Salmo salar L.) as assessed by microtag returns to 1986.

40) Stirling, J. and G.J.A. Kennedy. Preliminary investigations on fin sizes in wild and ranched salmon as a discriminant factor in R. Bush stocks.

41) Kennedy, G.J.A. Predation by Cormorants (Phalacrocorax carbo L.) on wild and hatchery salmon smolts (Salmo salar L.)

42) Browne, J. and D.J. Piggins. Exploitation of Reared Salmon Released into the Burrishoole River System (1986).

43) Browne, J. and D.J. Piggins. The Burrishoole as an Index River.

44) Browne, J. Mean Weight of Salmon in Irish Drift Net Fishery.

45) Porter, R. River Index Data for Newfoundland Region, Canada.

46) Porter, R. Distribution of Recaptured Atlantic Salmon outside Homewater Zones in Canada.

47) Porter, R. Atlantic Salmon commercial catch Newfoundland and Labrador 1985-1986.

48) Randall, R.G. ICES Data Base. Data from Miramichi River, New Brunswick, and Western Arm Brook, Newfoundland.

49) Thibault, M. Atlantic Salmon in France for 1986.

50) Windsor, M. Tagging Report for NASCO Council.

APPENDIX 3

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APPENDIX 4

List of input parameters by river and year (i + 1) used to estimate run size and tag returns of 2SW salmon to Maine rivers. Symbols are defined in the text.

1967

River	Ta	Ua	Tt	Ut
Penobscot	0	0	0	0
Union	0	0	0	0
Narraguagus	0	30	0	225
Pleasant	0	8	0	0
Machais	0	58	0	186
East Machias	0	8	0	0
Dennys	0	42	0	0
Kennebec	0	0	0	0
Androscoggin	0	0	0	0
Sheepscot	0	27	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1968

River	Ta	Ua	Tt	Ut
Penobscot	0	13	0	0
Union	0	0	0	0
Narraguagus	49	50	59	130
Pleasant	0	0	0	0
Machais	4	26	32	112
East Machias	0	10	0	0
Dennys	0	3	0	0
Kennebec	0	0	0	0
Androscoggin	0	0	0	0
Sheepscot	0	9	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1969

River	Ta	Ua	Tt	Ut
Penobscot	0	7	0	43
Union	0	0	0	0
Narraguagus	2	15	3	99
Pleasant	0	2	0	0
Machais	0	39	1	174
East Machias	0	10	0	0
Dennys	0	30	0	0
Kennebec	0	0	0	0
Androscoggin	0	0	0	0
Sheepscot	0	5	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1970

River	Ta	Ua	Tt	Ut
Penobscot	0	1	0	125
Union	0	0	0	0
Narraguagus	3	51	3	76
Pleasant	0	1	0	0
Machais	0	44	4	176
East Machias	0	1	0	0
Dennys	0	49	0	0
Kennebec	0	0	0	0
Androscoggin	0	0	0	0
Sheepscot	0	5	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1971

River	Ta	Ua	Tt	Ut
Penobscot	0	3	26	62
Union	0	0	0	0
Narraguagus	4	28	15	53
Pleasant	0	1	0	0
Machais	5	38	7	113
East Machias	0	6	0	0
Dennys	0	19	0	0
Kennebec	0	0	0	0
Androscoggin	0	0	0	0
Sheepscot	0	27	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1972

River	Ta	Ua	Tt	Ut
Penobscot	1	3	199	118
Union	0	0	0	0
Narraguagus	10	119	25	141
Pleasant	0	1	0	0
Machais	12	51	36	150
East Machias	0	4	0	0
Dennys	0	61	0	0
Kennebec	0	0	0	0
Androscoggin	0	0	0	0
Sheepscot	0	18	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1973

River	Ta	Ua	Tt	Ut
Penobscot	1	14	158	119
Union	0	72	0	0
Narraguagus	0	71	0	86
Pleasant	0	2	0	0
Machais	0	35	0	0
East Machias	0	6	0	0
Dennys	0	40	0	0
Kennebec	0	0	15	13
Androscoggin	0	0	0	0
Sheepscot	0	18	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1974

River	Ta	Ua	Tt	Ut
Penobscot	4	20	201	292
Union	0	2	0	11
Narraguagus	0	48	0	90
Pleasant	0	27	0	0
Machais	1	31	0	0
East Machias	0	2	0	0
Dennys	0	43	0	0
Kennebec	2	0	0	0
Androscoggin	0	0	0	0
Sheepscot	0	18	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1975

River	Ta	Ua	Tt	Ut
Penobscot	20	49	350	507
Union	0	8	0	48
Narraguagus	0	105	0	0
Pleasant	0	6	0	0
Machais	0	46	0	0
East Machias	0	28	0	0
Dennys	0	40	0	0
Kennebec	2	0	0	0
Androscoggin	0	0	0	0
Sheepscot	0	10	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1976

River	Ta	Ua	Tt	Ut
Penobscot	12	29	145	399
Union	0	20	0	138
Narraguagus	0	29	0	0
Pleasant	0	1	0	0
Machais	0	23	0	0
East Machias	0	16	0	0
Dennys	0	13	0	0
Kennebec	0	2	0	0
Androscoggin	0	0	0	0
Sheepscot	0	9	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1977

River	Ta	Ua	Tt	Ut
Penobscot	21	157	58	348
Union	0	48	0	174
Narraguagus	0	110	0	0
Pleasant	0	3	0	0
Machais	0	23	0	0
East Machias	0	28	0	0
Dennys	0	26	0	0
Kennebec	0	0	0	0
Androscoggin	0	0	0	0
Sheepscot	0	22	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1978

River	Ta	Ua	Tt	Ut
Penobscot	17	278	63	1244
Union	0	9	0	138
Narraguagus	0	129	0	0
Pleasant	0	16	0	0
Machais	0	95	0	0
East Machias	0	59	0	0
Dennys	0	75	0	0
Kennebec	0	0	0	0
Androscoggin	0	0	0	0
Sheepscot	0	32	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1979

River	Ta	Ua	Tt	Ut
Penobscot	5	127	26	521
Union	0	9	0	29
Narraguagus	0	58	0	0
Pleasant	0	8	0	0
Machais	0	66	0	0
East Machias	0	25	0	0
Dennys	0	36	0	0
Kennebec	0	6	0	14
Androscoggin	0	0	0	0
Sheepscot	0	7	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1980

River	Ta	Ua	Tt	Ut
Penobscot	0	736	0	1852
Union	0	24	0	173
Narraguagus	0	112	0	0
Pleasant	0	5	0	0
Machais	0	55	0	0
East Machias	0	58	0	0
Dennys	0	190	0	0
Kennebec	0	3	0	0
Androscoggin	0	0	0	0
Sheepscot	0	27	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1981

River	Ta	Ua	Tt	Ut
Penobscot	62	569	169	1672
Union	3	24	151	106
Narraguagus	0	69	0	0
Pleasant	0	23	0	0
Machais	1	46	0	0
East Machias	1	76	3	11
Dennys	0	117	0	0
Kennebec	0	13	0	0
Androscoggin	0	0	0	0
Sheepscot	0	14	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1982

River	Ta	Ua	Tt	Ut
Penobscot	53	854	182	2852
Union	0	7	0	111
Narraguagus	0	68	0	0
Pleasant	0	14	0	0
Machais	0	48	0	0
East Machias	0	37	0	0
Dennys	0	29	0	0
Kennebec	2	20	0	0
Androscoggin	0	0	0	0
Sheepscot	0	14	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1983

River	Ta	Ua	Tt	Ut
Penobscot	18	122	93	523
Union	0	5	0	115
Narraguagus	0	82	0	0
Pleasant	0	0	0	35
Machais	0	17	0	0
East Machias	0	8	0	0
Dennys	0	28	0	0
Kennebec	1	15	0	0
Androscoggin	1	0	1	17
Sheepscot	0	14	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1984

River	Ta	Ua	Tt	Ut
Penobscot	4	315	48	1127
Union	0	0	0	37
Narraguagus	0	67	0	0
Pleasant	0	1	0	15
Machais	0	25	0	0
East Machias	0	42	0	0
Dennys	0	61	0	0
Kennebec	0	1	0	0
Androscoggin	0	0	0	86
Sheepscot	0	20	0	0
Ducktrap	0	0	0	0
Saco	0	0	0	0

1985

River	Ta	Ua	Tt	Ut
Penobscot	20	297	136	2617
Union	0	1	0	78
Narraguagus	0	57	0	0
Pleasant	0	1	0	27
Machais	0	24	0	0
East Machias	0	30	0	0
Dennys	0	20	0	0
Kennebec	0	0	0	0
Androscoggin	0	0	0	20
Sheepscot	0	5	0	0
Ducktrap	0	15	0	0
Saco	0	58	0	0

1986

River	Ta	Ua	Tt	Ut
Penobscot	11	329	250	3361
Union	0	0	0	54
Narraguagus	0	43	0	0
Pleasant	0	0	0	19
Machais	0	32	0	0
East Machias	0	11	0	0
Dennys	0	15	0	0
Kennebec	0	0	0	0
Androscoggin	0	0	0	79
Sheepscot	0	10	0	0
Ducktrap	0	12	0	0
Saco	0	3	0	33