REPORT OF THE

TENTH ANNUAL MEETING

OF THE COUNCIL

7-11 JUNE 1993

EDINBURGH, UK

PRESIDENT:	MR BØRRE PETTERSEN (NORWAY)
VICE-PRESIDENT:	MR DAVID MEERBURG (CANADA)
SECRETARY:	DR MALCOLM WINDSOR

CNL(93)49

CONTENTS

CNL(93)49

REPORT OF THE TENTH ANNUAL MEETING OF THE COUNCIL OF THE NORTH ATLANTIC SALMON CONSERVATION ORGANIZATION 7-11 JUNE 1993, BALMORAL HOTEL, EDINBURGH, UK

1. OPENING SESSION

1.1 The President, Mr Børre Pettersen, opened the meeting and welcomed delegates to Edinburgh for the Tenth Annual Meeting of the Council (Annex 1).

1.2 The representatives of Canada, Denmark (in respect of the Faroe Islands and Greenland), the European Economic Community, Finland, Iceland, Norway, the Russian Federation, Sweden and the United States of America made opening statements (Annex 2).

1.3 The President expressed appreciation to the Members for their statements and closed the Opening Session.

1.4 A list of participants is given in Annex 3.

2. ADOPTION OF AGENDA

2.1 The Council adopted its agenda, CNL(93)46, (Annex 4).

3. SPECIAL SESSION - ICES/NASCO/IBSFC DIALOGUE

3.1 At its Ninth Annual Meeting the Council agreed to co-sponsor a Dialogue Meeting on Atlantic Salmon with the International Council for the Exploration of the Sea and the International Baltic Sea Fishery Commission. This meeting, entitled "Atlantic Salmon: A Dialogue", was held as a Special Session of the Council during 7-8 June and allowed a frank exchange of views between the scientists, managers and users of the resource. A report of the main items raised at the meeting was presented to the Council, CNL(93)38, (Annex 5). It was agreed that many of the issues raised were already on the Agenda of the Council and that the remaining issues would be brought to the Council by the Secretary at future meetings.

4. ADMINISTRATIVE ISSUES

4.1 Secretary's Report

The Secretary made a report, CNL(93)5, to the Council on the status of ratifications of and accessions to the Convention, membership of the regional Commissions, possible topics for Special Sessions, project work, the Headquarters Agreement and the external relations of the Organization. Reports were also made on the Audited Accounts for 1992, CNL(93)6, and receipt of contributions for 1993, CNL(93)7.

At its Seventh Annual Meeting the Council reviewed the conditions of attendance at its meetings by non-government observer organizations, and amended the conditions for a two-year trial period. During this period statements would be permitted in the Council but only at sessions designated as "Special Sessions". The Secretary reported that during this two-year trial period, covering the Eighth and Ninth Annual Meetings, the NGO's had brought benefits to the Organization and a number of options concerning the future attendance by these organizations was presented. The Council considered the future role of non-government observers to NASCO. It welcomed the attendance by these organizations at its meetings which had been of mutual benefit, and decided to extend from 1994 the rights of the NGO's so as to include attendance at the Commission meetings. The new arrangements would be for a two year trial period. The representative of Denmark (in respect of the Faroe Islands and Greenland), while welcoming the new arrangements, requested that NGO's who attended NASCO meetings, and who published articles arising from those meetings, should send copies of these articles to the Secretary.

4.2 Report of the Finance and Administration Committee

The Chairman of the Finance and Administration Committee presented the report of the Committee, CNL(93)9. He congratulated the Secretary and his staff on the management of the Organization's financial affairs. Upon the recommendation of the Committee, the Council took the following decisions:-

(a) To appoint Coopers and Lybrand of Edinburgh as auditors for the 1993 accounts;

(b) To accept the audited 1992 annual financial statement, CNL(93)6;

(c) To adopt a budget for 1994 and to note a forecast budget for 1995, CNL(93)47, (Annex 6).

The Council thanked the Chairman of the Committee, Mr Arni Isaksson, for his work and that of the Committee.

4.3 Reports on the Activities of the Organization

The Council adopted a Report on the Activities of the Organization in 1991/1992, CNL(93)42, for publication. The Council also adopted a report to the Parties, CNL(93)11, in accordance with Article 5, paragraph 6, of the Convention.

5. SCIENTIFIC, TECHNICAL, LEGAL AND OTHER INFORMATION

5.1 Scientific Advice from ICES

The representative of ICES presented the report of the ICES Advisory Committee on Fishery Management (ACFM) to the Council, CNL(93)13, (Annex 7). The President thanked the Chairman of the ACFM for his valuable work in presenting the report to the Council.

5.2 Report of the Standing Scientific Committee

At its Ninth Annual Meeting the Council established a Standing Scientific Committee to assist the Council and Commissions in effectively formulating their request for scientific advice. The Chairman of the Committee presented a draft request for scientific advice from ICES. Upon the recommendation of the Committee, the Council adopted a decision to request scientific advice from ICES, CNL(93)50, (Annex 8).

5.3 Catch Statistics and their Analysis

The Secretary introduced a statistical paper presenting the official catch returns by the Parties for 1992 and historical data by Party for the period 1960-1992, CNL(93)15, (Annex 9).

At its Seventh Annual Meeting the Council had agreed that the establishment of a minimum standard for catch statistics was desirable and at its Ninth Annual Meeting a draft minimum standard was agreed as a basis for consultations with the Parties. During the year this consultation process had been completed and a number of minor amendments to the minimum standard had been incorporated. After small amendments to the draft, there was unanimous support for the minimum standard which was adopted by the Council, CNL(93)51, (Annex 10). Due to some difficulty in bringing in the new arrangements in some countries, it was agreed that the adoption of the standard could be phased in so that all Parties had achieved it for the 1995 statistics.

5.4 Salmon Tagging and the NASCO Tag Return Incentive Scheme

The Secretary presented a summary of tag release data, CNL(93)18, (Annex 11) from the information submitted by ICES.

The Secretary reported on the NASCO Tag Return Incentive Scheme, CNL(93)19, (Annex 12) during the fourth year of its trial period. A total of 1839 tags had been entered into the 1993 draw which was 4.2% more than in the previous year and 49% higher than in the first year of the Scheme. During 1992 favourable publicity for the work of national governments and of the Organization had again been received as a result of the Scheme and the need to return scientific tags had been widely publicised. At its Ninth Annual Meeting the Council had accepted an offer from the US to fund the Scheme for a further year covering tags returned during 1993. The Council considered the future of the Scheme and decided that, after the current period of funding by the US, it would continue the Scheme, with a review after three years, and that the cost of $13,600 would be borne by the Organization from its own resources.

The President announced that the draw for the Tag Return Incentive Scheme was made by the Auditor at NASCO Headquarters on 28 May. He announced that the winner of the $2500 Grand Prize was P L Williams, 2 Richmond Road, Wrexham, Clwyd, UK. The Council offered its congratultions to the winner.

5.5 Database of Salmon Rivers in the North Atlantic

The Secretary presented a progress report, CNL(93)20, (Annex 13) on the establishment of a database of salmon rivers flowing into the Convention area. Information had been received from four Parties and incorporated into the database, which contains details of more than nine hundred rivers. Of these rivers, 8.1% had lost their natural stocks of salmon and 16.1% were considered threatened with loss. For these threatened rivers the most commonly identified problems included deterioration of water quality (including acidification); water regulation and abstraction; diseases and parasites; introductions and transfers (including escaped farmed fish) and high marine mortality and over-exploitation (including illegal fishing). This valuable project will provide an audit of salmon rivers at the end of the 20th century and help to record the progress made, in accordance with the Convention, towards the conservation, restoration and enhancement of wild stocks. The President encouraged the Parties to provide the information to the Secretary as soon as possible so that a more complete review could be presented to the Council at its next annual meeting.

5.6 Review of International Salmon Related Literature Published in 1992

The Council considered a review of the literature concerning Atlantic salmon published during 1992, CNL(93)21, which had been prepared in accordance with Article 13, paragraph 2 of the Convention.

5.7 Laws, Regulations and Programmes

The Secretary presented a report on the Laws, Regulations and Programmes database, CNL(93)22.

5.8 Economic Value of Atlantic Salmon

The Secretary presented a review, CNL(93)23, (Annex 14) of studies on the economic value of Atlantic salmon which had been published since the last annual meeting. This review also included, in table form, details of the economic value of salmon which had been presented to the Council previously. These studies demonstrate the high value of the wild Atlantic salmon resource not only to the users but to the population at large.

6. CONSERVATION, RESTORATION, ENHANCEMENT AND RATIONAL MANAGEMENT OF SALMON STOCKS

6.1 Measures Taken in Accordance with Articles 14 and 15 of the Convention

The Secretary presented a report on the returns made under Articles 14 and 15 of the Convention, CNL(93)24, (Annex 15).

6.2 Fishing for Salmon in International Waters by Non-Contracting Parties

(a) Protocol for Non-Contracting Parties

The Secretary presented a report CNL(93)25, (Annex 16) on progress in implementing the Protocol. All NASCO Parties had made representations to Panama and Poland urging them to adhere to the Protocol. A response had been received from the Government of Poland, CNL(93)39, (Annex 17). Canada, the European Community, Norway and the United States reported on the progress they had made with the Protocol. Nevertheless, there were still vessels from both countries fishing for salmon in international waters, (see (CNL(93)40), and it was agreed that diplomatic efforts should be intensified. The situation would be reviewed at the Eleventh Annual Meeting.

(b) Actions Taken in Accordance with the Resolution

The Secretary presented a report, CNL(93)26, (Annex 18) detailing progress on actions taken in accordance with the Resolution on Fishing for Salmon on the High Seas adopted by the Council at its Ninth Annual Meeting. This review contained information on the sightings of vessels fishing for salmon in international waters; scientific and technical data on the fishery; information on landings and transhipments and details of actions taken to establish contact with other international organizations with an interest in the area. The Secretary indicated that he would continue with the tasks laid down in the Resolution.

(c) Other Actions

The Council considered a report, CNL(93)27, (Annex 19) of the International Meeting on Surveillance of Fishing for Salmon in International Waters, which had been held at NASCO Headquarters in March. The meeting brought together coastguards and fisheries protection organizations from those North-East Atlantic countries which had provided information to the Organization in relation to salmon fishing in international waters. The objective of the meeting was to examine the methods of surveillance and the scope for improvements, where appropriate, through international cooperation. A number of recommendations were made concerning a specific salmon fishing surveillance project, on longer-term cooperation, on sources of information from the military and from ports, on publicity and on future communication of information. The Council endorsed the recommendations on possible areas of international collaboration presented in document CNL(93)27 and asked the Secretary to proceed with appropriate action in accordance with the recommendations.

The Secretary presented a report, CNL(93)28, on other possible actions in relation to fishing for salmon in international waters. These possible actions arose from recommendations from the Special Meeting on Fishing for Salmon in International Waters held in 1992. They included the possible use of the Laws, Regulations and Programmes database to produce model regulations; the possibility of seeking compensation from flag States for salmon taken in international waters and the use of certificates of origin.

The Council decided that the main actions should be diplomatic pressure, increased cooperation on surveillance and the collection and dissemination of information on the fishery and that the other actions should not be pursued for the time being.

6.3 Salmon in the Freshwater and Marine Environments

(a) Impacts of Salmon Aquaculture

At its Eighth Annual Meeting the Council adopted "Guidelines to Minimise the Threats to Wild Salmon Stocks from Salmon Aquaculture" for use by the Parties on a voluntary basis. These had been widely circulated and had been well received. Since the adoption of these guidelines our knowledge of the occurrence and behaviour of farmed salmon in the wild has increased considerably. The Secretary presented a review, CNL(93)29, (Annex 20) summarising the available information on the impacts of aquaculture. It is now known that farmed fish occur on the marine feeding grounds, in fisheries and on the spawning grounds of wild salmon. In some rivers up to 90% of the fish are of farmed origin and inter-breeding has been demonstrated. While the Guidelines are still relevant, the new information suggests the need for stronger measures as a matter of priority. The President indicated that to uphold the requirements of the NASCO Convention a precautionary approach would seem appropriate. The Council set up a committee to look at this issue and adopted its report, CNL(93)52, (Annex 21). This report proposed that specific questions on the impacts be addressed to ICES and that a NASCO Working Group be established under the chairmanship of the Secretary to consider how aquaculture may be conducted in a way that is designed to remove adverse impacts on the wild stocks.

(b) The Influence of the Marine Environment

The Secretary presented a review, CNL(93)30, (Annex 22) of recent information, arising from the Fourth International Atlantic Salmon Symposium, on the influence of the marine environment on the salmon. The Symposium had recommended that research be undertaken "to understand the cause of marine mortalities other than fishing and to monitor its occurrence... " and a letter had subsequently been received from the Atlantic Salmon Trust and Atlantic Salmon Federation requesting NASCO to encourage cooperation in such research. The representative of Canada supported the need for further research in order to improve our understanding of the causes of marine mortality and referred to the request for scientific advice from ICES which included questions concerning the migration and distribution of Atlantic salmon.

(c) Introductions and Transfers

The Secretary presented a review of the impacts of introductions and transfers, CNL(93)31, (Annex 23). This review referred to the initiatives of the North American Commission in agreeing protocols for the introduction and transfer of salmonids and in preparing an inventory of proposed introductions and transfers so that these may be reviewed by that Commission. In the light of the risks involved in stock movements the Council agreed that there was a case for following up the initiatives of the North American Commission in the North-East Atlantic Commission. In this way the Council would be aware of planned introductions throughout the Convention area.

(d) Long-Term Trends in Abundance

The Council considered the utility of long-term catch records as an indicator of trends in salmon abundance, CNL(93)32, (Annex 24). While the need for care in interpreting such statistics was recognised, it was agreed that it would be useful to review the available literature and to examine the availability of new data sets so that the present period of low abundance could be assessed in an historical perspective.

(e) Diseases and Parasites

The Secretary presented a report, CNL(93)33, (Annex 25) on the spread of the parasite *Gyrodactylus salaris* within the North-East Atlantic Commission area. The spread of this parasite highlights the dangers of international stock movements. In Norway, the parasite has been recorded in 37 river systems. This parasite has recently been identified in northern Finland and in the White Sea area of Russia, giving rise to concern about the important northern salmon rivers.

(f) Other Factors

6.4 **Reports on Conservation Measures Taken by the Three Regional Commissions**

The Chairman of each of the three regional Commissions reported to the Council on their activities.

7. <u>OTHER BUSINESS</u>

7.1 The President referred to the appointment of the Secretary. The Council decided to extend the appointment of the Secretary for a five-year period until 1 July 1998.

7.2 The Secretary referred to a further communication from the United Nations concerning large scale pelagic drift netting, CNL(93)35. The Council asked the Secretary to respond on behalf of the Organization indicating that NASCO is unaware of any such fishing activity within the Convention area.

7.3 The representative of Sweden referred to the actions being taken in regard to a Swedish vessel which had been observed fishing for salmon in international waters, during 1992, in contravention of the Convention.

8. DATE AND PLACE OF NEXT MEETING

8.1 The Council confirmed its acceptance of the invitation to hold its Eleventh Annual Meeting in Oslo, Norway from 6-10 June 1994.

8.2 The Council agreed that its Twelfth Annual Meeting be held in Edinburgh from 5-9 June 1995 but attempts would be made to put this meeting back by one or two weeks.

9. DRAFT REPORT OF THE MEETING

9.1 The Council agreed a draft report of the meeting, CNL(93)36.

10. PRESS RELEASE

10.1 The Council adopted a press release, CNL(93)48, (Annex 26).

ANNEX 1

OPENING STATEMENT MADE BY THE PRESIDENT

Ladies and Gentlemen:

First I would like to welcome you to this the Tenth Annual Meeting of NASCO, though we are only nine years old. It is an honour and a pleasure for me to serve as your President and I feel sure that we can continue the excellent work carried out under the Presidency of my predecessor, Allen Peterson, who I am glad to see is with us this week in good health. As you know I am a relative newcomer to NASCO but I would like to pay tribute to the progress made in international cooperation through our Organization in the few years since NASCO has been established. It is very pleasant for me to feel that we already have this constructive atmosphere and I will do all in my power to maintain it. Before I ask each delegation to make an Opening Statement I want to stress to you all that we live at a time when there are many new threats to the species which we are here to manage and conserve. For example, in the history of the salmon since the last Ice Age there has probably never been an event like the sudden growth of fish farming; acidification of rivers, which has been a major threat to the salmon in freshwater for decades, and neither Panamanian nor Polish vessels fished for salmon on the high seas. For this reason the Secretary and I have re-structured the Agenda so that it focuses on the threats to the species and necessary actions to meet the threats.

Now, we seem to have entered a period of low abundance for the salmon and we do not know whether this is a natural phenomenon or whether some of these changes are already having an impact. I must tell you, Ladies and Gentlemen, that I believe that we must take extreme care, we must assume the worst and act accordingly. We should accept the precautionary principle.

I think it would only be fair of me to say, however, that whereas the interceptory fisheries in the Faroes, in Greenland, in Canada and indeed, and I turn to our Russian friends, in Norway, are now at a very much reduced level such fisheries probably now take less than 10% of the world catch and although we must still cooperate closely to monitor and control these fisheries at reasonable levels, as we shall be doing this week, there are many other threats which could dwarf the present impacts of the interception fisheries.

So I would very much like you to help me in making progress at this meeting on ensuring adherence to the Protocol, on improved international collaboration to ensure better surveillance by coastguard authorities, on maintenance and developing initiatives to safeguard wild salmon from the impacts of aquaculture, on controlling the spread of diseases and parasites internationally and on agreeing regulatory measures in the Commissions and on further advancing the science on which our conservation measures are based. I would like to see our new Standing Scientific Committee function smoothly so that the very important aspect of the scientific questions we ask ICES can be carefully considered. I would also like to make progress with re-assessing the role of our friends in the Non-Government Observer Organizations and I would like to see us cooperate so as to improve the comparability of the catch statistics that are presented here each year.

The Secretary and I will be working closely with delegations to see that we can make progress on these issues and I know that our Vice-President, Dave Meerburg, is equally concerned to help us to cooperate.

I thank you for your attention to these few remarks and I will now call on the Representatives to make their Opening Statements.

ANNEX 2

OPENING STATEMENT MADE BY THE REPRESENTATIVE OF CANADA

Mr President, Distinguished Delegates, Observers, Ladies and Gentlemen:

It is a pleasure for the Canadian delegation to participate in the Tenth Annual Meeting of the North Atlantic Salmon Conservation Organization and the Special Session Dialogue Meeting with the International Council for the Exploration of the Sea (ICES) and the International Baltic Sea Fishery Commission (IBSFC). We compliment all of those who have worked so hard on the excellent arrangements.

Canada's commitment to conservation is well known in NASCO, as is our commitment to NASCO itself and its important role in the rational management of North Atlantic salmon. Canada will continue to work for progress on its concerns for restoration and conservation of depleted salmon stocks, for accurate reporting, for control of interceptions of salmon on the high seas, and for implementation of truly effective measures to protect salmon stocks.

Canada has invested heavily, and for many years, in salmon conservation and restoration. We have reduced our commercial fishery very substantially and strengthened conservation regulations for recreational fishermen. At last year's Annual Meeting we described in detail the implementation for 1992 of the most drastic measures ever taken to protect the salmon stocks. These measures have been effective. The total Canadian harvest was substantially reduced from 711 tonnes in 1991 to 470t in 1992. The commercial catch portion of this amount was reduced by 55% from 533t in 1991 to 241t in 1992. This reflects the moratorium on commercial salmon fishing imposed throughout the island of Newfoundland in 1992. The commercial salmon quota in Labrador was reduced from 215t in 1991 to 193t in 1992 and, for 1993, it is being reduced again to 98t - another reduction of over 50% in one year.

Canada believes that we must agree in NASCO to implement immediate similar restraint in the West Greenland fishery and achieve a meaningful reduction in West Greenland interceptions of Canadian origin salmon.

As we said last year, Canada recognizes that there are northern communities which, for subsistence or economic reasons, depend significantly on salmon. In Canada's case, there are constitutional obligations to our aboriginal people that must be met. The contribution of salmon to these communities' livelihood has been reduced and threatened by the deterioration of the stocks.

The West Greenland quota of 840t which applied for 1988 through 1990 is a symbol of the importance of the salmon fishery in healthier times. However, quotas were not agreed to in 1991 and 1992, although the West Greenland commercial catch fell to 472t in 1991 and 237t in 1992.

The new ICES scientific advice being presented to this meeting is rather compelling. The stock abundance has deteriorated seriously. Canada believes this scientific advice must be recognized in the establishment of an appropriate quota for the 1993 fishery. If we can agree on such a quota this year, then we can continue our serious efforts to reach agreement on scientifically-based quotas for 1994 and beyond.

Canada believes that real progress can be made in NASCO if this Organization is treated as a long term partnership. Indeed, such a partnership should be not only between the countries represented around this table, but also between the Atlantic salmon itself and all those who are involved in its use and management. Those who share the salmon that migrate through West Greenland waters understand the dependence of northern communities and the need for alternatives to their continued dependence on this threatened resource.

As most of you appreciate, Canada shares a special concern with NASCO about the importance of controlling predatory fishing on the high seas. We were pleased with the adoption at last year's Annual Meeting of the Protocol Open for States not Party to the Convention, but are disappointed that Poland and Panama have not yet become signatories. We shall continue working in cooperation with all members to obtain those signatures. We shall also keep working to improve control of high seas interceptions with the addition of effective measures for inspection and verification.

We are looking forward to a productive Tenth Annual Meeting.

Thank you.

OPENING STATEMENT MADE BY THE REPRESENTATIVE OF DENMARK (IN RESPECT OF THE FAROE ISLANDS AND GREENLAND)

Mr President, Distinguished Delegates, Observers, Ladies and Gentlemen:

The basic points of view of this delegation are well-known and do not need to be repeated. It is fair to say that on some occasions this delegation has felt rather lonely in defending an interest which is different from the interests of other NASCO parties.

We were, therefore, very encouraged by the discussions at the Dialogue Meeting and especially want to echo the support from that meeting for the principles of environmental sustainability, integrated resource management and partnership.

The awareness of the points of view of different partners is one especially important factor and necessary ingredient if we are to reach solutions and agreement in this Organization on a fair share basis.

On an anniversary it is customary not only to reflect on the past, but also to try to look into the future.

The contributions at the Dialogue Meeting certainly gave food for thought as does our own agenda.

Are we to see a future where NASCO will regulate the offshore fisheries in the Greenland and Faroe Islands fisheries zone, but regulations will have no practical value, because the resulting allocations will be sold in buy-out schemes?

At the same time the factors really affecting the wild stocks of salmon will be regulated in different fora. I am referring to acid rain, habitat degradation, fish farming and regulation and control of the homewater fisheries.

However, in conclusion, this delegation was encouraged by the feeling of partnership and sharing of information from the successful Dialogue Meeting. This presents a fitting prologue to our deliberations.

OPENING STATEMENT MADE BY THE REPRESENTATIVE OF THE EUROPEAN ECONOMIC COMMUNITY

Mr President, Distinguished Delegates, Observers, Ladies and Gentlemen:

The Community delegation is looking forward to participating in what will be the Tenth Annual Meeting of NASCO. We may all have some vague recollection of our own 10 year birthday - a sense of being important, yet being keenly aware that there is an awful lot more to be learned. NASCO should feel the same way. The Organization can already point to a number of achievements, but important challenges lie ahead.

The Dialogue Meeting in which we have just participated clearly demonstrated how complex are the issues facing this Organization in the years to come. The Dialogue Meeting offered an excellent opportunity for everyone with an interest in salmon to exchange ideas and to develop a better understanding of the facts of the life of salmon and of the different points of view held by those who wish to conserve and exploit the salmon resource. The Dialogue Meeting thus most appropriately marked the transition from the first decade of the existence of NASCO into the next. The birthday party has come to an end. There are working days ahead.

NASCO was basically set up to deal with the various interests of the users groups of salmon. One of the main lessons to be learned from the Dialogue Meeting was that such an approach is much too narrow for today. We must deal not only with users groups but also with producers groups of which Mother Nature is just one. It is in this perspective that we must consider the three principles which were stressed by Mr Magnus Magnusson in his keynote address to the Dialogue Meeting:

- environmental sustainability
- integrated resource management and
- partnership.

The Dialogue Meeting gave us an opportunity to consider two different scenarios: the Baltic and the North Atlantic.

In the Baltic the wild salmon only make up a small percentage of the salmon at sea. There is no experience to draw upon regarding the possibilities for maintaining the wild salmon stocks under such extreme circumstances. In the North Atlantic the relationship between wild and artificially reared salmon at sea is at present different. But will artificially reared salmon gradually replace the wild salmon as we know it today? Is there a point of no-return where the process can no longer be reversed? Will we know when we approach such a point of no-return or will we only know too late that we have passed it?

These are some of the questions we need to address within NASCO. The Community delegation with interests in the Baltic as well as in the North Atlantic is keen to participate in this work.

A special aspect of this complex of issues is the spread of diseases from salmon farming into the rivers which host the wild salmon. Much more needs to be done also in this field. The effects of different types of pollutants on the life of salmon must also be analysed.

One of the main tasks of this Annual Meeting will be to adopt management measures for the fisheries taking place in Greenland and Faroe Island waters. These measures MUST reflect adequately the state of the salmon stocks concerned. They should be based on the evidence which has been supplied to us by ICES. The responsibility which NASCO has for establishing such regulatory measures is clearly spelled out in the text of the Convention. Negotiation may be difficult but the Community is committed to finding a result.

It will also fall upon this Annual Meeting to conduct a first evaluation of the various initiatives taken at last year's Annual Meeting concerning fishing for salmon in international waters by non-contracting Parties. The Community has organised and participated in diplomatic demarches vis-a-vis such non-contracting Parties. It is therefore disturbing to learn that at least two of the vessels which used to fish in international waters have resumed this activity.

Mr Chairman, we have a heavy agenda in front of us and only a few days left to accomplish our task. The Community delegation wish you well in chairing your first Annual Meeting and are looking forward to working under your guidance.

Thank you, Mr Chairman.

OPENING STATEMENT MADE BY THE REPRESENTATIVE OF FINLAND

Mr President, Distinguished Delegates, Observers, Ladies and Gentlemen:

I have the feeling that in many respects the work of NASCO has been more important than earlier expected. Salmon stocks are facing greater threats than were envisaged a few years earlier in the North-East Atlantic. We will meet greater challenges to combat with fish diseases such as *Gyrodactylus*, with uncontrolled fishing performed by non-contracting Parties and particularly with the threat of genetic disorders caused by aquaculture.

The work and importance of NASCO must be emphasised and acknowledged further since wild salmon stocks are endangered in several ways. Regarding aquaculture, NASCO has issued the "Guidelines to Minimize the Threats to Wild Salmon Stocks from Salmon Aquaculture". In our opinion these guidelines serve their purpose well, but we have doubts whether they have been put in practice. The production of farmed salmon has increased dramatically in the last few years and is now about 50 times greater than the annual catch of wild salmon. If no action is taken very soon along the lines mentioned in the "Guidelines" the wild salmon stocks will be subject to genetic disorders and fish diseases.

Finland is very concerned about salmon farming in the Teno fjord since there are plans to expand this activity. In principle salmon farming should be prohibited in the vicinity of important salmon rivers. This is not the case today. Fortunately another measure has been developed to safeguard genetic strains from pollution, namely sterilisation of eggs intended for farming. This procedure performed by heating is easy, cheap and effective. We urge that this method should be applied as soon and as widely as possible.

Regarding the Teno river salmon stock, it seems necessary to enhance conservation measures to keep the stock at as high a level as possible. Therefore fishing outside the river in Teno fjord should be restricted further. Finland and Norway have initiated negotiations in order to achieve better protection for wild salmon in the river itself.

Fishing of salmon in the Convention area by vessels flying flags of States not party to the Convention is a serious problem threatening to undermine our efforts to manage salmon stocks properly. This fishing must cease. Using the Protocol for Non-Contracting Parties as a basis, some joint diplomatic action of Member States should be taken to improve the situation.

Mr President, I hope that this meeting, which in fact is the tenth anniversary, will help us to find ways to solve our problems in managing our common wild salmon stocks properly.

Thank you Mr President.

OPENING STATEMENT MADE BY THE REPRESENTATIVE OF ICELAND

Mr President, Distinguished Delegates, Observers, Ladies and Gentlemen:

It is with particular pleasure that the Icelandic delegation participates in this Tenth Annual Meeting of our Organization here in Edinburgh. We can now look back and value the effort of our work in our infant years and look forward to our teenage years of even closer cooperation on the conservation of the salmon stocks in the North Atlantic.

As regards the situation in Iceland the recreational salmon catches have improved significantly in 1992 over the previous year. The average increase, to be found primarily in the grilse component, was about 30 percent. However, off our northeast coast, where catches have been particularly depressed, the rise was about 123 percent, attributable, we believe, both to improved oceanic conditions and to the cessation of commercial fishing off the Faroe Islands as well as in the small area of the high seas outside the jurisdictions of Norway, the Faroes and Iceland. Returns from ocean ranching also improved in 1992, although the viability of the industry is by no means secure.

We are pleased to report that the Icelandic Parliament, the Althing, is now reviewing our salmon and trout law, aiming at even better conservation and management measures. Most of the NASCO guidelines with respect to salmon farming have already been implemented in Iceland, and we strongly urge all our fellow NASCO member countries to do the same in order to relieve present worldwide concerns as to the potential threats of salmon farming to wild stocks.

Iceland wishes to compliment Canada, the United States and Norway for their splendid efforts with respect to promulgating salmon management plans and enlightened conservation measures with regard to the wild Atlantic salmon. On the other hand, Iceland has grave concerns for the lack of such efforts and measures, especially in the UK, Ireland and Greenland. Salmon, as they must come to accept, is an international creature travelling set routes, and so with continued use of deadly monofilament nets and other hightech means to maximize catches, the species may well become extinct in certain areas within the next two decades.

Iceland is also concerned about unreported catches of salmon in many of the member countries. We have received estimates approaching a total of 2,000 metric tons from the ICES working group, more than five times the total current high seas catch. In the hope of resolving this serious problem, the North Atlantic Salmon Fund (NASF) in Iceland is now proposing to host an International Symposium on Poaching and Illegal Fishing, and co-sponsorships of NASCO and ICES would be highly appreciated.

EC representation in NASCO, instead of participation by individual salmon-producing and salmon-exploiting nations, is of particular concern to Iceland, especially in the light of current developments in EC membership. There seems to be a lack of contact between NASCO representatives and the user groups and we feel that better dialogue and results could be achieved, if countries with salmon interests were represented directly.

We must accept that despite our best efforts, we have faced over 20 years of decline in wild salmon stocks. Though 1992 saw an improved trend in Iceland, Finland, France, Ireland, Sweden, Northern Scotland, Ireland, U.S.A. and Canada, we can only imagine the state of affairs without improved management efforts in some countries, the purchase of quotas and reduced high seas pirate fishing.

Particular attention must be paid to the inexcusable activities of pirate fishermen and their confederates. As recently as January 1993, Polish authorities finally admitted their role in the laundering of illegally-netted salmon. Some 36 metric tons of salmon were landed in the port of Kohlberg, Poland, and were then trans-shipped to buyers, probably smokehouses, in Switzerland. Two pirate vessels, the Brodal registered in Panama and Netanya registered in Sweden, were observed fishing illegally last year in international waters by the Norwegian Coast Guard. One of those vessels has already been spotted this year by Norwegian authorities.

Although the captain of the Swedish vessel eventually admitted to his illegal activities, Swedish authorities played down the case and fined the boat's owner a mere GBP 650. It is sad that Sweden, being a leading nation in salmon research and restoration, would in this instance turn such a blind eye to the crimes of its citizens.

From the evidence presented in the ICES working group reports, we now have indisputable evidence of serious decline in wild salmon stocks. It is therefore critical that Greenland and the Faroe Islands, in order to participate fully in the worldwide effort to stabilize, restore and enhance the stocks, recognize that their quotas will have to be reduced to reflect the present stock crisis. This year it is crucial for the future of the wild Atlantic salmon.

As we all know, NASCO has failed in the previous two years to set quotas for the Greenland fishery. This has happened in spite of the poor state of most contributing Atlantic salmon stocks, as described in various scientific reports, that have been made public and widely disseminated among the countries of origin as well as to those engaged in fisheries for salmon on the feeding grounds. In spite of this, driftnetting persists in Britain and Ireland and the Association of Hunters and Fishermen in Greenland (KNAPK) demanded last year not less than a full 840 metric ton quota, apparently failing to recognize that such a quota would exceed the total number of salmon present off the West Greenland coast.

We therefore suggest that NASCO representatives must be more diligent in disseminating the information essential to their governments for making informed and enlightened decisions and to inform affected user groups of the rationale behind, and indeed the necessity for, those decisions.

Iceland feels very strongly that all NASCO nations should take drastic steps now to improve their individual salmon management strategies to pave the way for considerable international efforts in conservation, research and restoration projects, before it becomes too late.

OPENING STATEMENT MADE BY THE REPRESENTATIVE OF NORWAY

Mr President, Distinguished Delegates, Observers, Ladies and Gentlemen:

Allow me to make some general remarks about NASCO itself, and the main issues it will need to deal with.

Nearly ten years on, NASCO is well established as the international forum for the conservation and management of salmon in the North Atlantic. The Organization's achievements are not insignificant. The quality of the scientific work under NASCO is widely recognised. The knowledge of the salmon stocks - upon which prudent management decisions are to be taken - has been progressively improved over the past ten years.

NASCO itself - and its member states - have made important advances in the monitoring and regulation of the salmon fishery. There is close interplay between NASCO itself and national management authorities.

Dialogue between scientists and policy makers has been strengthened. The sessions of yesterday and today have been valuable.

Knowledge is key to the efficient working of NASCO and the fulfilment of its objectives. But we need to put what we know to good advantage, and to respond to the challenges, as we see them. In this respect the Secretariat is providing good guidance, and should be complimented.

There is conclusive evidence of depletion to salmon stocks. We need to respond to this evidence with due urgency.

All parties must assume responsibility to correct the situation. Sustainable management of salmon stocks can only be achieved through overall balanced policies, also to include the interceptory fishery.

My delegation hopes that realistic and workable solutions can be found, and we will support any effort designed to promote compromise and a rightful sharing of the present burden between interested parties.

It must remain a key priority of NASCO to prevent non-contracting Parties from undermining the effectiveness of management decisions taken by NASCO. Unauthorised salmon fishing in international waters must be discontinued. Non-member states must be further encouraged to sign the protocol, to prevent counter-productive high seas salmon fisheries. We note the efforts of the Secretariat in this respect, but also note that diplomatic approaches have so far been largely ineffective. Norway is resolved to continue its separate national efforts to bring unauthorised salmon fisheries to an end, and would encourage all Parties to join in the effort.

My country has recently adopted a new provision in the Penal code establishing a maximum prison sentence of 6 years for illegal harvesting of threatened species. This provision can, when certain conditions are met, also be applied to cases where extensive and illegal interceptory salmon fishing has taken place. The application of this provision in the context of salmon presupposes that this fish is deemed by the Courts to be a threatened species. May I also add, and this is a general rule, that the exercise of Norwegian jurisdiction vis-a-vis foreign nationals fishing in international waters can only take place if the offender is present or resident in Norway.

May I suggest that Norwegian legislation in this area may provide an effective approach, to be studied by all Parties.

A new Norwegian Act relating to the salmon fishery has recently come into force. Its most important provision is a general ban against salmon fishing unless otherwise stated. The Act will be valuable to safeguard national salmon stocks.

NASCO will need to extend its work to combat the threat to salmon stocks posed by disease. In particular the impact of the *Gyrodactylus salaris* parasite should be urgently reviewed, and appropriate measures discussed. I can inform you that Norway and Finland have started. Finland has mentioned bilateral talks about how to address the problem and prevent the spread of this parasite in the High North.

The impact of acid rain on salmon stocks should be given appropriate attention. The problem clearly seems to be on the increase, causing damage to rivers on the West Coast of Norway.

NASCO should encourage further development of scientific cooperation between NASCO members states - also on a bilateral basis - where appropriate.

Mr President, the tasks are manyfold. My delegation is committed to seeking effective solutions in accordance with the letter and spirit of our Charter.

Thank you.

OPENING STATEMENT MADE BY THE REPRESENTATIVE OF THE RUSSIAN FEDERATION

Mr President, Distinguished Delegates, Observers, Ladies and Gentlemen:

On behalf of the Russian delegation I would like to greet all participants to the Annual NASCO Meeting and to wish this representative conference a successful week's work.

This last year, and I believe many of you will agree with me, was difficult and intense. In Russia, as we see it, it was a turning point for the concept, established over decades, of harvesting of Atlantic salmon resources. Thanks to assistance from various governmental and non-governmental organisations, working under the aegis of NASCO in different countries, and invaluable support from our respected Secretary, Dr Malcolm Windsor, recreational fishing for salmon is now proceeding rapidly. In fact recreational fishing now occurs in all Russian salmon rivers, where both indigenous people and foreign tourists are active participants. I avail myself of the opportunity now to express once again our sincere gratitude to all who have rendered help in this development.

Russia has stated that it wants to see a reduction, and eventually complete closure, of sea fisheries for salmon. And we still adhere to this idea, especially with the information we now have available. The closure of drift-net fishing for salmon near the Norwegian coast and reduction of fishing effort in the Faroese economic zone have had most favourable effects on the numbers of salmon in Russian watercourses, and particularly in the Barents Sea rivers. In this respect we believe that NASCO's work can hardly be over-estimated.

In its activities NASCO pays much attention to legislative work. In this connection I should like to inform you that a draft of a new Russian Law on fisheries is presently under consideration in the Russian Parliament. Much emphasis is placed on anadromous fish, which are in federal ownership. Along with this local administrations are endowed essential power. We hope that this Law will help contribute to eliminating the legislative vacuum, which presently exists, and allow us to bring our fisheries regulations, including those relevant to Atlantic salmon fishing, into line with established international standards.

As a conclusion, I should like to congratulate once again all present at this opening of our meeting and wish you a fruitful and productive meeting.

Thank you for your attention.

OPENING STATEMENT MADE BY THE REPRESENTATIVE OF SWEDEN

Mr President, Distinguished Delegates, Observers, Ladies and Gentlemen:

The migration of the North Atlantic Salmon Conservation Organization has now taken it back to the beautiful city of Edinburgh with the NASCO Headquarters and this city may, as stated earlier, be regarded "the state of origin". For a decade now, or twice the life-span of the salmon, NASCO has been working on management and regulatory measures of salmon fisheries.

The Swedish Delegation is of the opinion that the very recent Dialogue Meeting clearly indicated the amount of attention which the salmon species deserves.

In the Swedish Opening Statement last year it was mentioned that the Swedish catches of salmon along the west coast in 1991 had reached pre-1989 levels. In 1992 the catch increased even more or by almost 30% up to 49 tonnes. There may be different factors behind this increase. In the ACFM Report it is concluded that the regulations introduced in the Norwegian homewater fisheries in 1989 have benefitted Swedish west coast stocks. In addition the cessation of fishing activities at Faroes might have had some positive effects. It might also be that an increased number of farmed escapees have been caught, which is an alarming sign in view of the fact that there are still some aboriginal Swedish stocks. At the Swedish west coast there are no salmon aquaculture plants.

In the work of NASCO several severe threats to the salmon stocks appear. In Council Document CNL(93)29 the present knowledge on impacts of aquaculture is presented. Some new information is now available and this new information gives rise to real concern. Farmed fish now occur on the marine feeding grounds, in fisheries and on the spawning grounds of wild salmon. In some rivers up to 90% of the fish are of farmed origin and interbreeding between farmed and wild fish occurs. Furthermore, fish diseases and parasites are introduced to wild stocks. The view of the Swedish Delegation is that we have to uphold the requirement of the NASCO Convention to conserve the wild stocks. This obligation is fully in line with the UN Convention on Biological Diversity.

Another serious threat to the wild salmon stocks is the on-going acidification of lakes and rivers. It would not be presumptuous to say that Sweden has the broadest experience of liming surface waters in both scientific and practical terms. This experience will be used to optimize future liming in Sweden and may also be used in other countries where liming is needed to mitigate the effects of acidification. During earlier NASCO meetings the Swedish Delegation presented figures on the high costs for maintaining viable salmon stocks in acidified west-coast rivers.

Strengthened measures to end fishing for salmon in international waters in the North Atlantic Ocean were adopted during the Ninth Annual Meeting of this Organization. There are, however, observations that this fishery still continues. The Swedish Delegation therefore welcomes the report of the international meeting on surveillance of fishing for salmon in international waters.

Mr President, the threats to the wild salmon stocks mentioned above give rise to concern. It may however be said that NASCO is well prepared to discuss and tackle such problems and the Swedish Delegation therefore thinks that there are good reasons for optimism.

Thank you Mr President.

OPENING STATEMENT BY THE REPRESENTATIVE OF THE UNITED STATES OF AMERICA

Mr President, Secretary Windsor, Ambassador Agustsson, Delegates, Ladies, and Gentlemen:

I note the commonality of expressions of concern among the Parties, but never before have I heard opening statements so meaningful and powerful. Perhaps the fervour of the statements, with a purpose and a sense of commitment greater than exhibited at past meetings, bode well for the meeting being held in Edinburgh.

Speaking last, it is difficult to find anything more to say. But, perhaps speaking last I can attempt to summarize these concerns from a United States perspective.

First, let me say the United States is pleased to join you at this Tenth Annual Meeting of NASCO and its Commissions. We welcomed the opportunity to host last year's meeting in Washington, but there is an old saying that, "There is no place like home", and for NASCO, Edinburgh is home. We always feel welcome here, and, somehow, talking about salmon just seems to come naturally in these surroundings.

But, this year we must do more than talk about salmon. It has been ten years since the Diplomatic Conference in Reykjavik was concluded. NASCO has accomplished much since that time, but many of the hopes and aspirations that emanated from ratification of the Convention remain unfulfilled. The inescapable truth is that most salmon stocks are in no better condition today than they were in 1983, and for many stocks, their condition is much worse. If our concerns about the future of Atlantic salmon were strong enough to bring us to an agreement ten years ago, then those same concerns should be even more motivational today.

One objective was to stop the high seas, unregulated fishing of salmon. Yet, despite our efforts, we will, again, this week have to address this problem. I am sure it is disappointing to all of us to hear that re-flagged vessels continue to flagrantly fish on the high seas for salmon in open defiance of the Convention. If this practice is to stop, all Parties will have to address the problem with an urgency perhaps not shown in the past.

Ten years ago, during drafting of the Convention, we paid scant attention to the developing salmon aquaculture industry. Today, we can ill afford not to pay attention. We are challenged with the spread of devastating diseases and parasites. Cultured salmon are invading spawning grounds at an alarming rate. Our wild fisheries for salmon are being contaminated with fish farm escapees and fish released in sea ranching enterprises. There may be no greater threat to the long-term well being of wild Atlantic salmon than that posed by the explosive growth of Atlantic salmon aquaculture and sea ranching. Addressing these problems and conflicts will ultimately prove to be our greatest challenge.

This year, Mr President, we must address one of NASCO's own failings - our inability to properly address the fishery at West Greenland. This is of immediate concern. Shall we live up to the spirit that brought us together in 1983? Or shall we continue the charade of the last few years? Frustration on the part of member Parties is great, but nowhere as near as pronounced as it is outside NASCO. The mere fact that private sector organizations are getting involved directly in the matters of this fishery, speaks volumes about NASCO's impotence. Will we continue to let this problem fester and become a cancer that eats away at the very viability of NASCO? We know the problem, we have the information to deal with it, but that is not enough. The will to constructively address this problem has to come from within. Perhaps in the pleasant and friendly atmosphere of Edinburgh, working under the powerful presence of the Castle, we may be able to rekindle the spirit of 1983, and find the strength necessary to satisfy the hopes and aspirations of that time.

Finally, Mr President, I thank you for your very kind remarks addressed to me. I can speak from experience that you can count on the Parties and delegates to help you make this meeting successful, and I personally look forward to working under your leadership.

ANNEX 3

TENTH ANNUAL MEETING OF THE COUNCIL
BALMORAL HOTEL, EDINBURGH, SCOTLAND
7-11 JUNE 1993

LIST OF PARTICIPANTS

* Denotes Head of Delegation

CANADA

*MR JEAN E HACHE	Representative Department of Fisheries and Oceans, Ottawa, Ontario
DR WILFRED CARTER	Representative Atlantic Salmon Federation, St Andrews, New Brunswick
MR JEAN-PAUL DUGUAY	Representative Gaspé, Quebec
DR JOHN M ANDERSON	Atlantic Salmon Federation, St Andrews, New Brunswick
MR RICHARD HEGAN	Department of Fisheries and Oceans, Ottawa, Ontario
MR GLEN JEFFERSON	Department of Fisheries & Oceans, Halifax, Nova Scotia
MR JIM B JONES	Department of Fisheries and Oceans, Moncton, New Brunswick
MR KEN JONES	Department of Fisheries and Oceans, Ottawa, Ontario
MR DAVID MEERBURG	Vice-President of NASCO Department of Fisheries and Oceans, Ottawa, Ontario
MR REX PORTER	Department of Fisheries and Oceans, St Johns, Newfoundland

DENMARK (IN RESPECT OF THE FAROE ISLANDS AND GREENLAND)

*MR KJARTAN HOYDAL	Representative Faroese Home Government, Torshavn
MR EINAR LEMCHE	Representative Greenland Home Rule Government, Copenhagen Office

MR PAAVIARAQ HEILMANN	The Organization of Hunters & Fishermen in Greenland, Nuuk
MR JENS MOELLER JENSEN	Greenland Fisheries Research Institute, Copenhagen
MRS AMALIE JESSEN	Department of Fisheries, Greenland Home Rule Government, Nuuk
MR JASPUR KRUSE	Felagid Laksaskip, Faroe Islands
MR SIVERTH D LARSEN	The Organization of Hunters & Fishermen in Greenland, Nuuk
MR SOFUS POULSEN	Faroese Commercial Attaché, Aberdeen
MR ANTHON SIEGSTAD	The Organization of Hunters & Fishermen in Greenland, Nuuk

<u>EEC</u>

*MR HENRIK SCHMIEGELOW	<u>Representative</u> Commission of the European Communities, Brussels
MR ERNESTO PENAS	<u>Representative</u> Commission of the European Communities, Brussels
MR JESPER KAAE	Royal Danish Embassy, London
MR ALEXANDER ZAFIRIOU	Council of Ministers, Brussels
MS MARIA ARAGON	Ministry of Agriculture, Fisheries and Food, Madrid, Spain
MR MICHAEL BREATHNACH	Central Fisheries Board, Dublin
MR JOHN BROWNE	Department of the Marine, Dublin
DR ANTHONY BURNE	Ministry of Agriculture, Fisheries and Food, London
MR DAVID DICKSON	Scottish Office Agriculture and Fisheries Department, Edinburgh
MR DAVID DUNKLEY	Scottish Office Agriculture and Fisheries Department, Montrose
DR PADDY GARGAN	Central Fisheries Board, Dublin
MRS PAM JARVIS	Ministry of Agriculture, Fisheries and Food, London

DR GUY MAWLE	National Rivers Authority, Bristol
MR ADRIAN MCDAID	Permanent Representation of Ireland to the EC, Brussels
MR JOHN O'CONNOR	Department of the Marine, Dublin
MR TED POTTER	Ministry of Agriculture, Fisheries and Food, Lowestoft
MR BOB WILLIAMSON	Scottish Office Agriculture and Fisheries Department, Edinburgh

<u>FINLAND</u>

*MR PEKKA NISKANEN	<u>Representative</u> Ministry of Agriculture and Forestry, Helsinki
MR EERO NIEMELA	<u>Representative</u> Finnish Game and Fisheries Research Institute, Helsinki

<u>ICELAND</u>

*MR HELGI AGUSTSSON	<u>Representative</u> Icelandic Ambassador to the United Kingdom, London
MR ARNI ISAKSSON	<u>Representative</u> Institute of Freshwater Fisheries, Reykjavik
MR ORRI VIGFUSSON	North Atlantic Salmon Fund, Reykjavik

<u>NORWAY</u>

MR BØRRE PETTERSEN	<u>President of NASCO</u> Ministry of the Environment, Oslo
*MR SVEIN MEHLI	<u>Representative</u> Directorate for Nature Management, Trondheim
MR MARIUS HAUGE	<u>Representative</u> Royal Ministry of Fisheries, Oslo
MR STEINAR HERMANSEN	<u>Representative</u> Ministry of the Environment, Oslo
DR LARS PETTER HANSEN	Norwegian Institute for Nature Research, Trondheim
MR GEORG RIEBER-MOHN	Ministry of the Environment, Oslo

RUSSIAN FEDERATION

*DR ALEXANDER SOROKIN	Representative PINRO, Murmansk
MR BORIS N KOTENEV	Representative VNIRO, Moscow
MR GUENRIKH BOROVKOV	Committee of Russian Federation on Fisheries, Moscow
MS ELENA SAMOILOVA	PINRO, Murmansk

SWEDEN

*DR INGEMAR OLSSON	Representative National Board of Fisheries, Göteborg
MR KARL-ERIK BERNTSSON	Representative National Board of Fisheries, Göteborg

USA

*MR ALLEN PETERSON	Representative National Marine Fisheries Service, Woods Hole, Massachusetts
MR DAVID EGAN	Representative Connecticut River Atlantic Salmon Commission, Guilford, Connecticut
MR CLINTON TOWNSEND	Representative Maine Council of the Atlantic Salmon Federation, Canaan, Maine
DR VAUGHN ANTHONY	National Marine Fisheries Service, Woods Hole, Massachusetts
MR EDWARD T BAUM	Maine Atlantic Sea Run Salmon Commission, Bangor, Maine
MS JANE CLEAVES	Atlantic Salmon Federation, Brunswick, Maine
DR KEVIN FRIEDLAND	National Marine Fisheries Service, Woods Hole, Massachusetts
DR JAMIE GEIGER	US Fish and Wildlife Service, Hadley, Massachusetts
MR ROBERT A JONES	Connecticut River Salmon Association, S. Windsor, Connecticut

MR ARTHUR NEILL	National Marine Fisheries Service, Woods Hole, Massachusetts
MR RICHARD ROE	National Marine Fisheries Service, Gloucester, Massachusetts
DR DEAN SWANSON	National Marine Fisheries Service, Silver Springs, Maryland
MR STETSON TINKHAM	Department of State, Office of Fisheries Affairs, Washington DC

ICES

DR EMORY D ANDERSON	International Council for the Exploration of the Sea, Copenhagen
DR ROGER BAILEY	International Council for the Exploration of the Sea, Copenhagen
DR FREDRIC M SERCHUK	National Marine Fisheries Service, Woods Hole, Massachusetts

NON-GOVERNMENT OBSERVERS

DR FREDERIC MAZEAUD	AIDSA
LT COL G D B KEELAN MR ROBERT C CLERK	Association of Scottish District Salmon Fishery Boards
ADMIRAL JOHN MACKENZIE DR DEREK MILLS	Atlantic Salmon Trust
MR JIM MAXWELL MR RICHARD BEHAL	Federation of Irish Salmon and Sea-Trout Anglers
MR ALAN HOLDEN	Institute of Fisheries Management
MR BJORNULF KRISTIANSEN	Norwegian Farmers Union and Norske Lakseelver (Norwegian Salmon Rivers)
MR CHRISTOPHER POUPARD MR THOMAS A F BARNES	Salmon & Trout Association
MR WILLIAM BROWN MR ALASTAIR HUME	Scottish Anglers National Association

MR IAN MITCHELL MR WILLIAM SHEARER	The Salmon Net Fishing Association of Scotland
MR ROBERT J HAUGHEY MR NEWELL McCREIGHT	Ulster Angling Federation

SECRETARIAT

DR MALCOLM WINDSOR	Secretary
DR PETER HUTCHINSON	Assistant Secretary
MISS MARGARET NICOLSON	PA to Secretary
MRS THERESA GAWTHORNE	PA

ANNEX 4

CNL(93)46
TENTH ANNUAL MEETING OF COUNCIL
7-11 JUNE 1993
BALMORAL HOTEL, EDINBURGH, SCOTLAND, UK

AGENDA

1. Opening Session

2. Adoption of Agenda

3. Special Session - ICES/NASCO/IBSFC Dialogue

4. Administrative Issues

4.1 Secretary's Report

4.2 Report of the Finance and Administration Committee

4.3 Reports on the Activities of the Organization

5. Scientific, Technical, Legal and Other Information

5.1 Scientific Advice from ICES

5.2 Report of the Standing Scientific Committee

5.3 Catch Statistics and their Analysis

5.4 Salmon Tagging and the NASCO Tag Return Incentive Scheme

5.5 Database of Salmon Rivers in the North Atlantic

5.6 Review of International Salmon Related Literature Published in 1992

5.7 Laws, Regulations and Programmes

5.8 Economic Value of Atlantic Salmon

6. Conservation, Restoration, Enhancement and Rational Management of Salmon Stocks

6.1 Measures Taken in Accordance with Articles 14 and 15 of the Convention

6.2 Fishing for Salmon in International Waters by Non-Contracting Parties

(a) Protocol for Non-Contracting Parties
(b) Actions Taken in Accordance with the Resolution
(c) Other Actions

6.3 Salmon in the Freshwater and Marine Environments
(a) Impacts of Salmon Aquaculture
(b) The Influence of the Marine Environment
(c) Introductions and Transfers
(d) Long-Term Trends in Abundance
(e) Diseases and Parasites
(f) Other Factors

6.4 Reports on Conservation Measures Taken by the Three Regional Commissions

7. Other Business

8. Date and Place of Next Meeting

9. Draft Report of the Meeting

10. Press Release

ANNEX 5

CNL(93)38

REPORT OF THE ICES/NASCO/IBSFC DIALOGUE MEETING "ATLANTIC SALMON: A DIALOGUE" 7-8 JUNE 1993, BALMORAL HOTEL, EDINBURGH, SCOTLAND, UK

CNL(93)38

REPORT OF THE ICES/NASCO/IBSFC DIALOGUE MEETING "ATLANTIC SALMON: A DIALOGUE" 7-8 JUNE 1993, BALMORAL HOTEL, EDINBURGH, SCOTLAND, UK

1. INTRODUCTION

1.1 At its Ninth Annual Meeting the Council agreed to hold a Dialogue Meeting, in cooperation with ICES and IBSFC, in order to promote an exchange of views between the Scientists, the Administrators and Managers, and the Commercial and Recreational fishermen. This meeting was held at the Balmoral Hotel, Edinburgh, during 7-8 June 1993, and formed a Special Session of the Tenth Annual Meeting of NASCO. Scientists, managers and user group representatives from the North Atlantic and Baltic areas attended the meeting.

2. OPENING SESSION

2.1 The President of NASCO, Mr Børre Pettersen (Norway), opened the Tenth Annual Meeting and welcomed delegates to Edinburgh. Opening statements were also made by the Chairman of the IBSFC, Mr Pekka Niskanen (Finland), and the President of ICES, Mr David de G Griffith. Mr Griffith chaired the meeting.

3. KEYNOTE ADDRESS

3.1 Mr Magnus Magnusson (Scottish Natural Heritage) presented the Keynote Address entitled "The Salmon".

4. REVIEWS

4.1 The following review papers were presented:

Dr Kevin Friedland: "History of salmon fisheries and management in the North Atlantic".

Mr Curt Eriksson: "The Baltic salmon".

4.2 Following these two presentations the speakers compared the scientific and management regimes in the Baltic and North Atlantic.

5. THE SCIENTISTS

5.1 The following scientific papers were presented:

Mr Ted Potter: "Is scientifically based management of salmon possible in the Atlantic area?".

Mr Sakari Kuikka: "Can wild Baltic salmon be driven to extinction?"

6. THE MANAGERS

6.1 The following management papers were presented:

Mr Einar Lemche: "The host-state perspective - seen from Greenland".

Mr Jean E Haché: "Atlantic salmon - a Canadian management perspective".

Mr Stefan de Maré: "The Baltic salmon - a Swedish management perspective". This paper was presented by Mr Karl-Erik Berntsson.

Mr Markku Aro: "The management of the Baltic salmon - the Finnish perspective".

7. THE USERS

7.1 The following papers were presented by representatives of the user groups:

Dr John M Anderson: "Hope renewed - a better way to manage Atlantic salmon".

Mr Bjornulf Kristiansen: "Management challenges and economic interests of riparian owners in Norway".

Mr Robert M Clerk: "The fisherman - the salmon's best friend".

Mr Birger Rasmussen: "Fishing yield of Baltic Sea salmon in relation to fishing methods and restocking".

Mr Paviaaraq Heilmann: "The Greenland fishermen's perspective - seen from KNAPK".

8. THE DIALOGUE

8.1 Following the formal presentations there was an extended period of discussion in which there was a frank exchange of views. The following is a summary, not in any order, of some points that emerged from this dialogue:

Principles

- The need for international cooperation and adoption of the precautionary principle in order to arrest the present decline in the wild salmon was stressed.

- Salmon management involves finding an acceptable compromise, which does not jeopardise the salmon or its environment, through adherence to the principles of environmental sustainability, integrated resource management and partnership.

- The need for cooperation in sharing the resource was stressed.

- All users of the resource have good faith interest in maintaining healthy, viable salmon stocks.

- There are a large number of competing user interests but the priority should be the long term well being of the fish stocks.

- There is a need to recognise the legitimate interests of all user groups. The need for sacrifices by all users of the resource was stressed in order to allow recovery of the stocks to a state where the resource can be shared.

Objectives

- The scientists would wish to see a clearer statement of objectives including a definition of the term conservation in the NASCO context.

The Stocks

- There has been a decline in abundance in both the Baltic and North Atlantic stocks in recent years. In the North Atlantic this decline appears to be due to a reduction in marine survival. In the Baltic the main decline is due to high exploitation of the wild fish in mixed stock fisheries and diseases.

- Stocks in the North Atlantic are not considered to be threatened with extinction although a number of potentially serious threats including habitat loss, loss of genetic integrity and pollution confront the resource. In the Baltic it is believed that there is a real threat of extinction to the wild stocks. The question was raised as to how this could happen without objections from scientists and managers.

Threats

- There is real concern both in the North Atlantic Ocean and the Baltic about the impacts of salmon cage culture on the wild stocks.

- Serious disease problems causing very high levels of mortality in the wild stocks have been experienced in both Baltic (M74 disease) and North-East Atlantic (*Gyrodactylus salaris*) rivers.

- The need for careful use of hatchery stocks according to internationally agreed guidelines and for assessments of the impacts of hatchery releases was stressed.

Representation

- The wish of user groups to be represented within the EC delegation to NASCO was raised.

- Concern was expressed by some user groups about the loss of the national aspects of salmon because of the way that the EEC member states were represented in NASCO. The situation would be even more marked if Norway, Sweden and Finland were to join the European Community.

- Non-government observer organizations wish to be able to participate more fully in NASCO meetings.

Research

- The need to identify target spawning escapements for all salmon rivers and for multi-species assessments was recognised.

- Research priorities should focus on the impacts of salmon farming, diseases and parasites and acid rain, and on the marine phase of the life-cycle.

- Real time management of the resource would be facilitated by studies of salmon at sea and techniques for stock identification.

- The desirability of the scientific advice being free from political influences was recognised.

- The need for socio-economic aspects of fisheries management to play a larger part in the management process was stressed.

Communication

- The need for the scientists to communicate their findings clearly to the managers was stressed.

- The idea of video presentations by delegations on the lifestyle of dependent fishing communities was mentioned.

9. The full proceedings of the Dialogue Meeting will be produced by ICES during 1994 and a copy will be sent to all those who participated.

Secretary
Edinburgh
10 June 1993

ANNEX 6

COUNCIL

CNL(93)47

OUTLINE OF 1994 BUDGET AND 1995 FORECAST BUDGET AND SCHEDULE OF CONTRIBUTIONS

NORTH ATLANTIC SALMON CONSERVATION ORGANIZATION
1994 BUDGET AND 1995 FORECAST BUDGET (Pounds Sterling)

SECTION	DESCRIPTION	EXPENDITURE	
		BUDGET 1994	FORECAST 1995
1	STAFF RELATED COSTS	154370	162070
2	TRAVEL AND SUBSISTENCE	31750	27030
3	CONTRIBUTION TO ICES	28890	30330
4	CONTRIBUTION TO WORKING CAPITAL FUND	0	0
5	MEETINGS	6700	19220
6	OFFICE SUPPLIES, PRINTING AND TRANSLATIONS	30670	38890
7	COMMUNICATIONS	11390	11950
8	HEADQUARTERS PROPERTY	18100	16090
9	OFFICE FURNITURE AND EQUIPMENT	7750	8130
10	AUDIT AND OTHER EXPENSES	8900	9340
	TOTAL	298520	323050

		REVENUE	
11	CONTRIBUTIONS - CONTRACTING PARTIES	296070	315550
12	MISCELLANEOUS INCOME - INTEREST	10000	10000
13	STABILISATION	-16250	-2500
14	SURPLUS OR DEFICIT(-)FROM 1992	8700	0
	TOTAL	298520	323050

NASCO BUDGET CONTRIBUTIONS FOR 1994 AND FORECAST BUDGET CONTRIBUTIONS FOR 1995 (Pounds sterling)

CATCH (tonnes)	PARTY		BUDGET 1994	FORECAST 1995
470	CANADA		34718	37002
	DENMARK	(FAROE ISLANDS)		
		(GREENLAND)		
260		(TOTAL)	23615	25169
1461	EEC		87112	92843
78	FINLAND		13993	14913
590	ICELAND		41062	43764
850	NORWAY		54808	58414
161	RUSSIAN FEDERATION		18381	19590
49	SWEDEN		12460	13279
1	USA		9922	10575
3920	TOTAL		296070	315550

Contributions are based on 1992 catches as advised by the Parties. Column totals can be in error by a few pounds due to rounding.

COUNCIL

CNL(93)13

REPORT OF THE ICES ADVISORY COMMITTEE ON FISHERY MANAGEMENT

CNL(93)13

REPORT OF THE ICES ADVISORY COMMITTEE ON FISHERY MANAGEMENT

Source of Information: Report of the North Atlantic Salmon Working Group, March 1993 (ICES, Doc. C.M.1993/Assess:10).

1. INFORMATION OF INTEREST TO ALL COMMISSIONS OF NASCO

1.1 Catches of North Atlantic Salmon

Total nominal catches of Atlantic salmon by country, in all fisheries 1960-1992, are given in Table 1.1.1.

The total catch reported for all fisheries (3,996 t) and for homewater fisheries (3,720 t) in 1992 are shown in the text table below. The decline in the catch of wild salmon may be greater than suggested by the total due to the inclusion of fish farm escapees and ranched fish in the North-East Atlantic. Management plans in several countries are designed to decrease catches in the sea.

Catch (t)

Year	1987	1988	1989	1990	1991	1992[1]
Total	8,142	7,716	5,893	4,937	4,124	3,996
Homewater	6,598	6,573	5,086	4,333	3,549	3,720

[1]Preliminary

The lack of information on fishing effort makes it difficult to use the catch data as any indicator of stock size.

1.2 Unreported Catches

1.2.1 Unreported catches within commission areas

Unreported catch for the North-East and North American Commission areas were 1,825 t and 137 t, respectively, in 1992.

Unreported catches (t)

Year	1987	1988	1989	1990	1991	1992
North-East	2,554	3,087	2,103	1,779	1,555	1,825
North America	234	161	174	111	127	137

1.2.2 Unreported catch in international waters

The catch during the 1991/1992 season in the area north of the Faroe Islands EEZ is believed to be between 25 and 100 t which is similar to the figure for the 1990/1991 season.

1.3 Status of Stocks

The status of Atlantic salmon stocks was evaluated over long and short time periods by examining national catch, survival, and escapement data and data from monitored rivers where available. Information on the fisheries is provided in the sections of interest to each Commission.

1.3.1 Eastern North Atlantic

Short term stock status

Comparison of stock abundance indices for 1992 indicates some improvement relative to the previous 2 years. There is no evidence of a reduction in juvenile production in monitored rivers and adult escapement appears to have been generally higher in 1992. It must be noted, however, that the effects on juvenile production of poor 1SW adult runs in 1990 and 1991 will not be fully felt until 1993 and 1994 and even later in rivers with older smolt ages.

Examination of fishery-independent indices of abundance (marine survival to coastal waters) indicated improved 1SW survival from the 1991 wild smolt year class for most monitored stocks. This was reflected in improved return rates to freshwater. Survival of 1SW hatchery-reared fish to coastal waters was more variable than for wild fish in 1992, having increased for some strains and decreased for others relative to 1991. In general, 1SW hatchery return rates to freshwater were lower in 1992 than in 1991.

In general 2SW survival rates were poor for wild and hatchery-reared fish returning in 1992, indicating that they were probably affected by conditions which caused poor 1SW survival of the 1990 smolt year class in many areas.

The continuing presence of significant numbers of farmed fish in catches of several countries makes it difficult to assess the status of wild stocks.

Long term stock status

There is some suggestion of positive trends in freshwater productivity over an 8 year period, though stocks known to be affected by acidification and other specific factors were not tested. Adult escapement was without trend over a 10 year period in many rivers.

Fishery-independent indices of survival of wild smolts indicated no trend in survival to coastal waters over a 5 year period; however, survival to rivers has generally increased over an 11 year period (Figure 1.3.1.1). In contrast, survival of hatchery smolts to homewaters showed a downwards trend (Figure 1.3.1.2).

Data examined by ACFM suggest that abundance and catches were much higher in the northeast Atlantic during the early 1970s and that they have declined ever since. It is likely that high natural abundance in the 1970s led to increased exploitation (including establishment of high seas fisheries). High exploitation, once established, coincided with and probably contributed to, a decline in abundance for many stocks. In response to perceived and actual lower abundances, fishing effort has declined in most fisheries, with management measures contributing to reductions in catch. At the end of the 1980s poor natural marine survival in many areas compounded the low stock situation. However, improved natural survival combined with low exploitation rates may contribute to an improved stock status.

Spawning targets

ACFM considered that status of stocks in the North-East Atlantic could best be appraised by considering adult escapement (in terms of ova depositions) evaluated against spawning targets. Ideally, biologically based spawning targets could be set for each river system, such that the target for each would represent the number of ova required to optimise smolt and/or production from that system. This would not only provide a baseline against which annual ova depositions could be compared, but allows for the possibility that estuarine and in-river fisheries for single stocks could be managed to crop only adults in excess of the target spawning number. Targets should be set sufficiently high to allow compensation for density-independent variation.

Several significant factors need to be taken into account in setting and expressing individual river targets, such as variation in the sex ratio of spawners, changing fecundity through time and changing 1SW:MSW ratios, and the desired sea age composition of the spawning adults.

1.3.2 Western North Atlantic

Abundance

The most useful datasets for the assessment of stock status in the Northwest Atlantic now consist of estimates of returns and adult counts at fishways, and smolt survival rates for Canadian and USA rivers. The moratorium on the commercial salmon fishery in insular Newfoundland and reductions in bag limits and imposition of quotas in many of the recreational fisheries have reduced the ability to infer stock status from most of the commercial and many of the recreational catch data series. One index that is still of some utility is the catch of 2SW salmon of wild origin in Maine rivers which has steadily declined since 1980 (Figure 1.3.2.1). These data suggest that low salmon abundance was a factor in contributing to the low salmon catches in recent years.

Trends in counts of small salmon at fishways and fences and an estimate of run-size for 21 rivers in Canada for the period 1974-1992 suggest that while the abundance of small salmon was generally increasing during the period 1974-1985, that trend was reversed during the period 1985-1991. In 1992 the abundance of small salmon in some areas of insular Newfoundland increased, apparently due to the closure of the Newfoundland fishery. Trends in large salmon abundance, the important contributor to egg deposition in most mainland rivers, generally show a downward trend. However, the abundance of large salmon on the East and West Coasts of Newfoundland in 1992 appears to have increased.

The abundance of non-maturing, North American origin stocks peaked in 1975 and has been steadily declining ever since (Figure 1.3.2.2).

Escapement

Estimates of egg depositions in 1992 may have approximated (rivière de la Trinité and Restigouche) or exceeded (Miramichi, Margaree, Northeast, Humber, Gander, Middle and Biscay Bay) target egg requirements in nine rivers. The percent change in total egg depositions for monitored rivers in Canada during 1992 is compared to the 1987-1991 average in Figure 1.3.2.3. Egg depositions were above average in 10 rivers, as much as 300% in one case, while 60-75% decreases were noted in 2 rivers. The noticeable increases in egg depositions in some areas are probably the result of reductions in marine exploitation in Canada during 1992.

The abundance of North American salmon that contribute to the West Greenland fishery is estimated for the period 1974-1991. The difference between estimates of total 2SW returns in rivers and the catch of 2SW salmon in rivers provides an estimate of the spawning escapement of 2SW salmon. The estimated number of 2SW spawners to North American Rivers has shown a downward trend since 1980 (Figure 1.3.2.4).

Survival indices

Estimates of survival of wild smolts to 1SW returns for 5 rivers and hatchery smolts to 1SW returns for 3 rivers in Canada are shown in Figure 1.3.2.5. Survival of hatchery smolts released in the Penobscot River (USA) to 1SW and MSW returns to homewaters is also shown. While large annual variation in survival between years is common, many stocks continue to exhibit trends of reduced marine survival over time. While poor smolt survival years are not uniformly exhibited by all stocks, it is evident that smolt survival for many stocks is lower than in previous years.

Spawning targets

Composite estimates for 2SW spawning targets were developed for salmon rivers in the USA, and Canadian SFAs 1 to 23 and Quebec Zones Q1 to Q11. The overall target number of 2SW spawners in North America is 196,306. Most (84%) of the North American target number of spawners is required for rivers in Canada. This target of about 200,000 2SW spawners has almost certainly not been achieved since 1974 even though production of these stocks is estimated to have been as high as 650,000-950,000 over the same time period (Figure 1.3.2.2). A significant portion of this spawning deficit has been in US rivers which are under restoration. Canadian 2SW spawning requirements of about 165,000 fish have not been met when one considers either the minimum or midpoint of the spawner estimates although the maximum estimates exceeded the spawning target in 6 of the 19 years (Figure 1.3.2.4).

Summary

The status of the North American stock complex was evaluated with data on spawning escapement, adult returns, and recreational catch. The moratorium on commercial fishing on the island of Newfoundland had the expected effect of improving the runs and escapement of both small and large salmon in that region. However, these counts were exceeded in pre-moratorium years suggesting that abundance of these stocks is still low. Gulf and Quebec region stocks displayed variations in stock status with most rivers showing improvement and others suggesting low abundance relative to the previous year which was one of the worst on record. The largest river of the region, the Miramichi, is meeting or exceeding its escapement target. The stocks in the Scotia-Fundy Region continue to show low abundance. USA salmon production remains hatchery dependent. Abundance in USA stocks has not increased in spite of increased stocking, suggesting that survival is poor. The mixture of stock conditions does not give a clear depiction of the stock complexes' ability to sustain harvests. It is necessary to consider the total abundance of the North American stock complex and trends in this abundance to determine the likelihood of recruitment over-fishing.

1.3.3 West Greenland Commission

Although not measured precisely, it is believed that the most abundant European stocks in West Greenland originate from the UK and Ireland. It appears that the abundance of some of these stocks has declined in recent years. Similar declines in abundance have been noted in many North American stocks that contribute to the West Greenland fishery. The decline in catch and fishery-independent measures of abundance in North America, and the decline in catch beyond the expectation that would have resulted from effort reduction in Europe, suggest that the abundance of fish available to the West Greenland fishery remains low.

1.3.4 Causes of apparent reduced survival

Atlantic salmon population dynamics are frequently investigated in two distinct phases: freshwater and marine. Variation in freshwater survival rates is generally well documented and thought to be a major factor regulating abundance in many river systems. Atlantic salmon marine life history and, in particular, mortality during the marine phase has not been investigated nearly as thoroughly. It is, however, thought that salmon survival is highly dependent on the productivity of the marine environment and the availability of suitable prey during their marine life. Salmon, similarly to other marine fish species, are intricately woven into the ecological system of the ocean.

Estuarine and coastal effects

Estuarine/coastal mortalities are a result of factors that influence smolt survival upon passage into estuarine and nearshore marine ecosystems. Atlantic salmon smolts face a physiologically stressful osmotic challenge, temperature stress, changing predator populations, or variable feeding conditions when entering the marine environment.

Oceanic effects

It is difficult to separate mortality on Atlantic salmon populations occurring in estuarine/coastal areas from mortality occurring in the ocean. In principle, oceanic effects are those that affect Atlantic salmon over a wide geographic range or in more confined areas, where mixed stocks of salmon are feeding. Oceanic effects are difficult to study as the time and cause of mortality is very obscure, thus exploratory analyses using correlation between survival, abundance and growth with oceanographic and hydrographic factors, pelagic prey and predator abundance are commonly used.

Marine survival

Evidence of oceanic effects on survival can be obtained from observed similarities in survival among stocks. There may exist a common pattern of return rates for groups of stocks suggesting that there are common factors controlling survival (Figure 1.3.4.1). Coherence in the estimated survival rates of stocks spanning a wide geographical range suggests that a dominant cause of mortality acts on the stocks when they are coincident in place and time. Consequently, fall and winter become likely periods, since stocks are mixed then.

The coherence in marine survival rates observed in monitored stocks is further supported by the trends in abundance for the North American stock complex. The time series of pre-fishery abundance of 1SW non-maturing salmon for North American stocks is provided in Figure 1.3.2.2. Many features in this time series reflect the likely impact of changes in survival rate observed for the individual stocks that were monitored over the same time period. For example, poor survival of the 1977 smolt class followed by good survival of the 1978 smolt class would have resulted in low abundance of fish in 1978 and high abundance the following year. This is exactly what is observed in the abundance time series. In addition, both the survival rate and abundance time series show decreasing trends through the 1980s and early 1990s.

Smolt condition factor

The interplay between marine and riverine environments is exemplified in recent investigations of two Newfoundland rivers. First, the salmon stocks in two distinct river systems seem to be affected similarly by marine events resulting in low survival. Secondly, the relationship between smolt condition and marine survival suggests that growth and survival in riverine and marine environments is linked. These observations need to be confirmed by further work.

Ocean climate

Climatic and oceanographic factors seemed to exert great influence on the variability in abundance of stocks of Atlantic salmon on the northern coast of Iceland. A study demonstrated coherence in yield of salmon stocks on the north coast of Iceland, where stocks tend to fluctuate together as if controlled by a common external marine factor. Several periods of low abundance have been identified in that area, usually related to adverse marine conditions. Periods of low abundance occurred during periods of the dominance of the East Greenland current, as opposed to the Gulf stream, in northern Icelandic waters.

Marine growth

Observations in Iceland have indicated a direct relationship between the abundance of salmon and the abundance of prey species, such as capelin. It seems likely that such factors could also be related to growth of salmon.

There is an indication that reduction in marine growth may be associated with a reduction in survival. The return rate for a monitored stock in North America was significantly correlated to only the winter growth period, suggesting that annual recruitment is determined during the winter of the first year at sea. This observation is consistent with those made for other monitored North American stocks identifying the winter period as critical to survival.

The size of 1SW salmon in the West Greenland fishery has shown a declining trend from the early sixties to the present (Figure 1.3.4.2, similar trends noted for length). This may be indicative of reduced marine survival of those fish. Comparison of stock abundance and mean length (Figures 1.3.4.3 and 1.3.4.4) at West Greenland indicates a significant relationship between the two for European stocks which indicates that the size of fish may be related to survival and abundance.

Marine habitat

The areas of suitable post-smolt marine habitat has been declining in recent years in areas of the Atlantic Ocean. To assess the potential effects of decreasing suitable winter habitat on North American stocks, a time series of catch and the first principal component scores of habitat were compared (Figure 1.3.4.5). This relationship suggests that the winter period is critical to the survival and production of North American stocks. A similar comparison was made for European stocks (Figure 1.3.4.6).

In summary, the available evidence suggests that the size and numbers of returning adult salmon are influenced by smolt condition factor, growth during the marine phase and factors affecting the marine environment and the available habitat. The strong correlations between marine survival and the above factors do not necessarily imply cause and effect.

1.4 Production of Farmed Salmon

The reported production of farmed salmon was 220,862 t in 1992. Total farm production was more than 55 times the nominal wild catch.

Production ('000 t)

Year	1987	1988	1989	1990	1991	1992
Production	68	111	174	229	237	221

1.5 Compilation of Tag Releases and Fin-Clip Data for 1992

In excess of 1.84 million microtags (CWTs) and 0.33 million external tags were applied to Atlantic salmon released in 1992. In addition, 2.32 million salmon were finclipped, 2.23 million with adipose finclip only. Thus, more than 4.49 million marked fish were released.

1.6 Recommendations

1. ACFM recommends that broadly based studies should be in place on:

   Development of stock identification methodologies.

   Stock recruitment relationships, forecast models, and models to study stock complexes.

   The survival and growth patterns in stock complexes in the North Atlantic.

2. ACFM recommends that the Working Group should now focus on questions based on investigations relevant to methodologies, causal mechanisms of stock dynamics, conservation, and man-induced threats to wild salmon stocks. Examples of generic questions for which answers might be developed in the 1990s include:

   i) Advise on target and critical spawning levels for Atlantic salmon stocks of the North Atlantic.

   ii) Evaluate biological and environmental variables which provide interpretation of trends of salmon abundance in the North Atlantic.

   iii) Evaluate recent changes in the abundance of wild, farmed and ranched salmon at large and, where possible, indicate the impacts that these fish may have on the abundance of wild stocks.

   iv) Document grilsification, describe potential mechanisms and assess the impact that grilsification may have on stock abundance and future spawning requirements.

3. ACFM recommends:

   i) That a study group should meet to update techniques to identify the impact of ranched fish on wild stocks and assess recent laboratory-based and behavioural research;

   ii) That a workshop be convened to consider available stock and recruit data, methodologies and, where possible, their standardization, for the development of target egg and adult spawner requirements.

2. INFORMATION OF INTEREST TO THE NORTH-EAST ATLANTIC COMMISSION

2.1 Description of the Fisheries at Faroes

2.1.1 Gear and effort

There was no commercial fishery in the Faroes during the 1991/1992 salmon season due to the buy-out of the Faroes quota by various interested parties for the years 1991-1993. Only one research vessel operated during the fishing season, under the direction of the Faroes Fisheries Laboratory. The gear in use did not change in 1992. A total of 52 sets was fished by this vessel during 6 trips in the 1991/1992 season.

2.1.2 Catches and discards

No commercial fishery took place in 1991/1992. Catches for research purposes in the 1991/1992 season were 31 t and the preliminary catch for the calendar year 1992 was 23 t. A total of 8,464 fish was caught of which 782 were less than the permitted 60 cm total length. The discard rate from the catch ranged from 2.5 to 15.7%, and the overall estimate was 8.8%.

Catch (t)

Year	Catch	Season	Catch
1987	576	1986/1987	539
1988	243	1987/1988	208
1989	364	1988/1989	309
1990	315	1989/1990	364
1991	95	1990/1991	202
1992[1]	23	1991/1992	31

[1]Research vessel

2.1.3 Catch per unit effort

The CPUE on the research vessel in the first part of the season was very high and, as in 1988/1989, it remained high during February and March and dropped off in April.

2.1.4 Composition of the catch

Recent observations have shown that escaped reared fish are numerous in catches in the Faroes area. As a part of the sampling programme of Atlantic salmon in the long-line research fishery at Faroes, fish were examined in order to estimate the occurrence of reared salmon in the fishery. Recent observations are presented in the text table below:

Season	Time	N	%
1989/1990	Feb 1990	73	44
1990/1991	Dec 1990	99	42
1991/1992[1]	Dec 1991	119	36
	Feb 1992	158	48
	Mar 1992	79	25
	Apr 1992	98	28

[1]Research vessel

The methodology used to discriminate between wild and reared fish tends to underestimate the proportion of reared fish, in particular those which escaped at the freshwater stage, or at an early marine stage.

Wild fish were significantly larger and of older sea age than the reared fish. However, when compared within sea age groups, reared 1SW fish were significantly larger than wild 1SW fish, whereas among the 2SW and 3SW groups, the wild fish were larger.

2.1.5 Origin of the catch

Coded wire tags (CWT) were recovered principally from Irish salmon originating from Shannon River hatchery releases. Individual tags were also recovered from 3 rivers in UK England and Wales and 2 rivers in Scotland. One French origin tag was recovered; this is the first French microtag recovery although Carlin tags have been recovered in the past. The number of external tags recovered from fish tagged in Norway and Sweden was lower than in previous years.

2.1.6 Exploitation rates in the Faroes fishery

Exploitation rates in 1991/1992, after the cessation of the commercial fishery, were below 5% for all stocks. This was considerably lower than the average for the preceding five year period. The exploitation on the Norwegian Drammen and Imsa hatchery 2SW fish decreased from an average of 21 and 23% to 2 and 1% respectively.

	Exploitation					
Season	86/87	87/88	88/89	89/90	90/91	91/92
Drammen	3	6	36	45	13	2
Imsa (w)	13	5	3	5	13	4
Imsa (h)	28	21	10	15	36	1
N. Esk	6	0	0	0	2	0
Lagan	0	9	13	21	18	3

2.2 Description of Homewater Fisheries

2.2.1 Gear and effort

There were no reported changes in the fishing methods and gear used in 1992 for any countries. Long-term changes in effort were examined for selected gears. The data available from France, Norway, UK (England and Wales), UK (N. Ireland) and UK (Scotland) all indicate a decrease in the numbers of gear units used. In Norway the decrease has been particularly marked with the closure of the drift net fishery in 1989. In Ireland, effort in commercial fisheries appears to have decreased while rod licences increased. It must be emphasized that these data cannot be used to estimate CPUE and may not be comparable between countries.

2.2.2 Origin of the catch

Table 2.2.2.1 indicates the origin of the catch in each country based on recoveries of tags over a number of years. It must be noted that the table may reflect the relative size of the national catches and does not imply the proportion of the stock from a given country which is taken in another country's catches.

The first text table in Section 2.2.3 shows the estimated contributions of ranched and farmed fish to national catches in 1992.

Ranching is carried out on a large scale by Iceland. Ranched fish comprised 76% of the total catch in 1991 and 70% in 1992. In addition 14 t in 1991 and 24 t in 1992 of the Swedish catch were made up of fish which had been released but were not expected to contribute to wild spawning populations.

Farmed fish make a significant contribution to the catches of Norway, Faroes and UK (Scotland). The proportion of farmed fish in Norwegian catches has remained relatively stable in the period 1989-1992. The proportion of farmed fish in freshwater catches is much lower than in catches at sea because farmed fish enter freshwater later than wild fish.

While farmed fish are present in most fisheries except Russia and France the exact contribution is not known. Levels of between 7 and 20% farmed fish have been reported from some catches in regional fisheries (coastal and estuarine) in Ireland. In most other countries, farmed fish are thought to form only a very minor (or negligible) part of the catch.

2.2.3 Exploitation rates

A comparison of exploitation rates for different stocks does not show any obvious similarities, except that hatchery stocks are often more heavily exploited than wild stocks. This is the case even when wild and reared fish originate from the same stock, as is the case for the River Bush and River Imsa stocks (see second text table in Section 2.2.3).

The levels of exploitation in 1992 seemed to be about average in most cases, except for the Russian River Ponoy where the exploitation was reduced. In 1991 and 1992 it was decided to reduce the exploitation rate in the River Ponoy in order to increase spawning stocks and make more fish available for the developing recreational fishery.

Estimated catch (in t round fresh weight) of wild, farmed and ranched salmon in homewater fisheries in 1992

Country	Catches of salmon				
	Wild	Farmed		Ranched	Total
Faroes	20	11		0	31
Finland	77	<1		0	78
France	20	0		0	20
Iceland	176	+		412	590
Ireland	<628	+		2	630
Norway	651	26	(FW)		
		173	(Sea)		850
Russia	161	0		0	161
Sweden	24	1		24	49
UK (Engl. & Wales)	195	0		0	195
UK (N. Ireland)	147	1		3	151
UK (Scotland)	502	23		0	525

An illegal fishery of considerable magnitude occurs in many of the Russian rivers. The illegal fishery was estimated to catch 15% of the spawning stock in River Varzuga, 25% in River Pechora and 26% in River Umba. There is no clear sign that the illegal fishery is changing in size from year to year.

Preliminary 1992 homewater fishery (H/W) exploitation rates in comparison to average exploitation rates

Location	(River, H/W)	1SW	2SW	All ages
		1992 (average)	1992 (average)	1992 (average)
Iceland	(Ellidar, W)	48(41)		
Ireland	(Burrishoole, H)	68(73)		
Norway	(Drammen, H)	- (56)	51(51)	
Norway	(Imsa, W)	57(58)	76(77)	
Norway	(Imsa, H)	67(66)	91(83)	
Russia	(Ponoy, W)			11(48)
Russia	(Kola, W)			77(81)
Russia	(Tuloma, W)			45(49)
Sweden	(Lagan, H)	73(81)	100(84)	
UK (Engl. & Wales)	(Itchen, net)			9(17)
UK (Engl. & Wales)	(Itchen, rod)			27(42)
UK (Engl. & Wales)	(Test, rod)			25(31)
UK (N. Ireland)	(Bush, W)	56(68)	32(43)	
UK (N. Ireland)	(Bush, H)	74(78)	75(69)	
UK (Scotland)	(N. Esk)	28(28)	27(30)	

W = wild; H = hatchery

2.2.4 Effects of recent management measures in Norway

The impact of the recent management measures on catches in Norwegian home waters in 1989-92 is shown below.

Catch (t)

	1986	1987	1988	1989	1990	1991	1992
Drift	795	552	527	0	0	0	0
Other	497	461	314	488	514	470	427
Freshwater	306	372	235	417	416	407	423
Proportion in freshwater	.19	.27	.22	.46	.45	.46	.50

It is likely that the ban on drift netting in 1989 has resulted in a larger number of salmon being available to other marine homewater fisheries. The additional regulations in these fisheries has probably resulted in a substantial increase in freshwater escapement suggested by increased catches in freshwater despite the fact that freshwater fisheries also have been regulated by extending the annual closed time and that fishing for salmon has been totally banned in several rivers.

The frequency of net-marked salmon entering a river will also give information about changes in netting effort on the migration route. In all except one river the proportion of net-marked salmon recorded in 1990-1992 was much lower than unweighted means during the period 1978-1988. The reduced proportion of net-marked fish may be accounted for by the management measures introduced in the Norwegian homewater fishery in 1989.

The salmon fishery on the Norwegian coast intercepts stocks from Sweden, Finland and Russia on their way back to their home rivers. Exploitation in Norway on 1SW fish tagged as smolts in the River Lagan, Sweden in 1989, 1990, 1991 and 1992 was lower (average 1%) than in 1985-1988 (average 7%). It is concluded that the regulations introduced in the Norwegian homewater fishery in 1989 benefited Swedish west coast stocks. Catch per angler-season and catch per angler-day in the Tana River, Finland has shown a significant increase in the period 1989-1992 compared to 1985-1988, thus suggesting a direct benefit to Finnish stocks. The escapement into 3 Russian rivers (Kola, Ponoy and Zap.Litca) showed a significant increase during the period 1989-1992 compared to 1985-1988.

In summary, the Norwegian management measures have resulted in: **i)** a significant decrease in the homewater exploitation rates in some Norwegian index river stocks; **ii)** a significant increase in freshwater catches in Norway; **iii)** a significant increase in CPUE in Finland; **iv)** a significant decrease in interception of Swedish tagged fish; **v)** a significant increase in escapement into 3 Russian rivers.

2.3 By-catch and Mortality of Salmon in Non-directed Fisheries

The landing of salmon caught in fisheries targeting other species is illegal in most countries in the North-East Atlantic Commission area except France, where it is authorized, and Sweden, where landing is allowed during the regular fishing season. In some of the countries where the by-catch cannot be landed legally, and in France where they are not consistently requested, these catches are included in the estimates of unreported catches.

By-catch in shore-based gillnets, purse seines and pelagic trawls is considered to be negligible and this is supported by information from research vessel cruises. In Iceland, the authorities are currently negotiating the closure in June and July of the fishery for male (small) lumpsuckers in order to protect salmon. In Norway, fishing experiments with mackerel gillnets showed a relatively high catch efficiency also for small salmon.

ACFM noted a report from NASCO in which information was given on the incidental catch of salmon in a pelagic trawl fishery for mackerel and horse mackerel during June to August 1991 in international waters close to the Norwegian EEZ. It was not possible with the information available to determine whether such catches are regular occurrences.

2.4 Indicators of Trends in Abundance of Salmon in the North-East Atlantic

Several biological and physical indicators can potentially be used to predict the abundance of salmon stocks in subsequent years. Most common are population estimates conducted at various points in the salmon's lifecycle, both in fresh and salt water.

Freshwater assessments

Biological indices used in freshwater include catches, run or escapement counts (spawning targets), estimates of egg, fry or parr abundance as well as smolt counts. These methods tend to be less costly than marine assessments and have thus been used to some extent in all countries bordering the North Atlantic. These methods give good estimates of the utilization of the rearing capacity in individual rivers and smolt counts can in some cases be a good indicator of grilse and salmon abundance in subsequent years.

Marine assessments

Methods used to predict salmon abundance through assessments during the marine phase include test fishing at various stages, acoustic surveys and prediction of non-maturing 1SW salmon from returning 1SW salmon in home waters. In some cases, oceanographic and meteorological factors, as well as the abundance of prey and possibly predatory species could be used to improve predictive ability. It has been noted that good salmon years in certain parts of Iceland seem to coincide with high catches in the capelin fishery.

Acoustic assessments

Acoustic methods have been used to estimate the abundance of pelagic fish for decades. Some difficulties have been encountered in estimating salmon abundance with these methods as the salmon feed close to the surface and are widely dispersed.

Forecasts of salmon abundance from 1SW returns

The abundance of 1SW fish can potentially be used as a rough predictor of the abundance of 2SW salmon in the following year. The method was first used in the Pacific to predict sockeye salmon abundance from the returns of jacks (1SW males) the previous year. Run reconstruction models have in the past indicated that age of maturity is one of the more stable biological parameters in salmon.

2.5 Effects of the NASCO Tag Return Incentive Scheme

No quantitative analyses of the effects of the scheme have been carried out. The main reasons are the small numbers of external tags used and insufficient awareness of fishermen about the NASCO lottery in most participating countries.

2.6 Effects of the Cessation of Fishing Activity at Faroes

The predicted increase in the numbers of fish returning to homewaters in 1992 as a direct result of cessation of fishing activities at Faroes would be approximately:

Wild 1SW	3,400
Wild 2SW	34,400
Farmed	22,000

These fish will probably have contributed to homewater fisheries in most salmon producing countries in the north-east Atlantic. However, it is unlikely that it will be possible to demonstrate a significant change in catches after a single year. The majority (perhaps 60-80%) of the wild fish caught at Faroes are thought to originate from Scandinavian, Finnish and Russian stocks and thus the greatest impact should be seen in the fisheries of these countries. These increased catches would, therefore, have represented the following proportions of the recorded homewater catches:

Wild 1SW	~ 1%
Wild 2SW	6 - 13%
Farmed	10- 22%

Such small increases over the entire north east Atlantic area, but affecting mainly Scandinavian, Finnish and Russian stocks have been within the annual variation of catches in these countries and will not represent a statistically significant increase.

The cessation of fishing would have the expected effect of reducing exploitation at Faroes to about 10% of levels in the previous three seasons. For stocks with sufficient tag returns, the exploitation observed in the 1991/92 season was significantly lower than in previous seasons.

3. INFORMATION OF INTEREST TO THE WEST GREENLAND COMMISSION

3.1 Description of the Fishery at West Greenland, 1992

In 1992, the fishery at West Greenland (NAFO Sub-area 1) was opened on 1 August and ended in November, although the official closing date was 31 December. The total nominal catch was 237 t which is 235 t less than in 1991, when the total landings were 472 t.

Quota and catch (t)

Year	1987	1988	1989	1990	1991	1992
Quota	935	-	900	924	840	-
Catch	966	893	337	274	472	237[1]

[1] Preliminary

No TAC was set for 1992, but the decision was to observe the landings after the first fourteen days of the fishery, and in the event of these being high compared to previous years, a TAC would be implemented. Because of small landings a TAC was never put into force.

The nominal landings during the first fourteen days, 1990-1992 (in tonnes)

Year	First seven days	First fourteen days	Dates
1980	260	711	01 - 14 Aug
1981	465	735	15 - 28 Aug
1982	470	766	25 Aug - 07 Sep
1983	105	192	10- 23 Aug
1984	17	58	10- 23 Aug
1985	204	361	01 - 14 Aug
1986	509	848	15 - 28 Aug
1987	439	737	25 Aug - 07 Sep
1988	219	337	25 Aug - 07 Sep
1989	131	219	18 - 31 Aug
1990	12	38	01 - 14 Aug
1991	115	208	05 - 18 Aug
1992	36	60	01 - 14 Aug

3.1.1 Composition and origin of the catch, 1992

Commercial catches in 1992 were composed of 54% North American (95% CL = 57,50), and 46% European (95% CL = 50, 43).

An alternative estimate of the overall proportion of North American- and European-origin salmon for the years 1982-1992 was derived by weighting NAFO Division samples by catch in numbers. Information from the nearest NAFO Division was applied to divisions with no samples. The table below gives the results:

Year	Weighted by catch in numbers				% of all samples	
	NA		EU			
	%	Wt (t)	%	Wt (t)	NA	EU
1982	57	-	43	-	62	38
1983	40	-	60	-	40	60
1984	54	-	46	-	50	50
1985	47	-	53	-	50	50
1986	59	537	41	423	57	43
1987	59	556	41	411	59	41
1988	42	349	58	544	43	57
1989	55	179	45	158	56	44
1990	78	213	22	62	75	25
1991	63	290	37	183	65	35
1992	45	108	55	129	54	46

ACFM is concerned about the lack of a suitable test sample of scales of known origin salmon for the discriminant analysis.

In 1992, the estimated number of fish caught was 38,500 from North America and 46,800 from Europe for a total of 85,300.

An estimate of the number of Maine-origin salmon harvested at West Greenland in 1992 using the proportional harvest method was 1,950 fish.

The incidence of reared Atlantic salmon in the catches at West Greenland was examined from scales taken from salmon sampled in the 1991 fishery. Reared salmon were observed in very low frequency (1.1%). An additional 2.6% of the number of fish examined could not be accurately classified although they showed similar scale characteristics to fish which had been released as smolts from hatcheries.

3.1.2 Biological characteristics of the harvest

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

The sea age composition in 1992 of 94.4% 1SW, 5.5% MSW, and 0.2% previous spawners indicated that there were proportionately fewer 1SW salmon and more MSW salmon than in 1991.

3.1.3 Historical data on tag returns and harvest estimates

The Carlin tag based harvest estimates of 1SW Maine-origin salmon for the 1991 fishery totalled 1,871 fish.

Carlin harvest estimate of Maine-origin salmon

Year	1986	1987	1988	1989	1990	1991
Harvest	2,035	2,087	2,309	3,797	1,525	1,871

The CWT harvest estimate for Maine-salmon in 1991 was 1,707 fish.

Carlin harvest estimate of Maine-origin salmon

Year	1987	1988	1989	1990	1991
Harvest	5,571	3,882	2,857	2,037	1.707

The proportional harvest method provides estimates of harvest significantly higher than the CWT method in recent years (Figure 3.1.3.1). As escapees from North American aquaculture facilities could increase the estimate provided by the proportional method, ACFM recommends further investigation of the possible explanation of the discrepancy between the two methods.

3.2 Description of Homewater Fisheries

Tagging experiments have demonstrated that almost all countries listed in the national catch tables (Table 1.1.1) contribute salmon to the West Greenland fishery. However, stocks from these countries contribute to the fishery to differing extents, both because the proportion of MSW salmon in the stocks varies and because of differences in their migratory behaviour at sea.

For European salmon stocks, the relative contributions have not been estimated precisely, although MSW stocks from the UK, Ireland, and France are thought to contribute to the fishery at a higher rate than Scandinavian stocks. Additional information on fisheries in the north-east Atlantic is contained in Section 2.

For North American salmon stocks, most of the salmon that contribute to the West Greenland fishery are produced in rivers of eastern Canada, with the balance originating from a few rivers in the northeastern US. Additional information on the fisheries in the north-west Atlantic is provided in Section 4.

3.3 Stock Abundance and Exploitation at West Greenland

Stock abundance and exploitation at West Greenland was estimated using the results of tagging experiments and the run reconstruction model for the North American stock complex. The continental run reconstruction model provides a range of feasible exploitation rates and fractions of the population present in Canada and Greenland. In turn, these exploitation rates provide an estimate of the total population abundance at West Greenland prior to the fishery. Of course, the population at West Greenland consists of both North American and European stocks. It should be remembered that the pre-fishery abundance estimator reconstructs the population by summing 2SW returns, and catches from fisheries on non-maturing 1SW salmon in Canada and Greenland, and 2SW salmon in Canada. This value represents the extant population and does not account for the fractions of the population present in a given fishery (i.e. availability).

3.3.1 Continental run reconstruction model

Exploitation rates at West Greenland have been variable, showing marked dips in 1983-84 and 1989 and peaks in 1981-82, 1987 and 1991, but overall, the time series is without trend (Figure 3.3.1.1). The estimates of the exploitation rate at West Greenland are sensitive to the value of FU (Fraction of population not available to either the West Greenland or Canadian fishery) used; if a higher value of FU is chosen, then a smaller proportion of the stock will be estimated to be available to the West Greenland fishery and the estimate of exploitation rate will be increased.

The estimated abundance of stocks of all origins at West Greenland has declined fairly steadily from about 1 - 1.5 million at the start of the period to only 200,000-400,000 at the end (Figure 3.3.1.2). The abundance of European and North American stocks has changed very much in line with each other, although European stocks were more abundant at the beginning of the period but less abundant at the end (Figure 3.3.1.3).

3.3.2 Exploitation of Maine (USA) stocks

The extant exploitation rates for 1SW Maine origin salmon in 1991 ranged between 61 and 78% and were the highest in the time series. The extant exploitation rate for 2SW fish was estimated to be over 90% for all combinations of parameters; it was also one of the highest recorded since 1967. The fishery area exploitation rates for US stocks in 1991 in both Canada and Greenland were among the highest estimated for any year since 1967.

The exploitation rates for the Maine stock at West Greenland and in Canada are plotted with the results of the constraints model in Figure 3.3.2.1. For the constraints model the mid-point between the minimum and maximum estimates is used. For the estimates on the Maine stock the results for P=0.1 are used, as this is the closest to the values of P (fraction of extant population available to fishery in Canada) derived from the Constraints model. There is close similarity between the estimates by the two independent methods, particularly since 1982. The results suggest that exploitation rates derived for Maine stocks do not deviate markedly from the overall magnitude and temporal pattern of exploitation rates for the aggregate North American stock complex.

3.3.3 Numerical contributions of salmon stocks to the fishery and exploitation of individual stocks

A maximum likelihood approach to estimate the relative contribution of northern and southern components of the North American stock complex to West Greenland was applied using river age data. The results suggest that the proportion of northern stocks at Greenland has declined greatly since 1974 (Figure 3.3.3.1). Analysis of the overall catches (Figure 3.3.3.2) of the stock complexes suggests that both groups have declined in abundance.

3.3.4 Relative importance to stocks of regulatory measures in the fishery and homewaters

Since the early 1970s both Canada and Greenland have imposed a variety of management measures designed to reduce fishing mortality on stocks. Greenland excluded foreign vessels in 1976 and reduced its quota in 1984 from 1,190 t to 870 t. In 1984, Canada introduced a series of reductions in fishing effort including license buy-out programs, season and regional closures, and quota restrictions. These efforts culminated in 1992 with a moratorium on commercial fisheries in insular Newfoundland, a licence buy-back programme, and the imposition of quotas on recreational fisheries. In spite of these changes, population abundance of the MSW component of the stock has continued to decline.

Estimates of pre-fishery abundance, and numerous other indicators of stock status reveal that the restrictive management measures in Canada and, to a lesser extent, Greenland have coincided with a period of increasing marine mortality.

In order to assess what would have happened without such regulations, ACFM considered the following three scenarios to project the effects of regulations on returning 2SW salmon:

1. What if the quota at West Greenland had remained at 1,190 t?

2. What if Canada had not restricted fishing effort in the Newfoundland-Labrador commercial fishery?

3. What would be the combined effects of 1) and 2)?

Scenario 1. *Effects of 1,190 t Greenland Quota*

Projected effects of a 1,190 t Greenland quota are shown in Figure 3.3.4.1. As the quota was limiting on catches only in 1985-1988, the projected consequences suggest that about 50,000 North American salmon were saved per year between 1985-1988. Similar numbers of European origin salmon would also have been saved, but their subsequent fate cannot be evaluated.

Scenario 2. *Effects of effort reductions of the Newfoundland-Labrador Commercial Fishery in Canada*

Results of this scenario (Figure 3.3.4.2) show that the effort reductions have saved about 50,000 salmon destined to have been 2SW returns per year since 1985 and almost 60,000 salmon in 1992. Conversely, without effort restrictions, actual 2SW returns would have been reduced by 50,000 salmon per year.

Scenario 3. Cumulative Effect of Quotas and Effort Reduction

The penalty for a high quota and high effort (Figure 3.3.4.3) suggests that an additional 70,000 2SW salmon (an increase of about 20,000) salmon would have been harvested in 1985-1988. The effects of both scenarios are not additive.

Overall, the scenarios suggest that substantial savings of 2SW returns to home river areas of North America have occurred as a result of regulatory measures in the Newfoundland-Labrador commercial fishery. Additional benefits to spawning populations would also have resulted from the prohibition on retention of large salmon in most Canadian angling fisheries, season and daily bag limit reductions for angling in Quebec, Labrador and Maine, closures of the Gaspé, New Brunswick, Nova Scotia and Prince Edward Island commercial fisheries and reduction in the commercial fisheries of Quebec. The benefits of the reduced quota are intermittent and related to the availability of salmon at Greenland. Substantial reductions in harvest occurred in Greenland between 1972-1976 as a result of quota regulations; this time period, however, cannot be assessed using this methodology. In years when the stocks are low, a fixed quota will result in increased exploitation.

3.3.5 Relationship between the abundance of grilse and multi-sea-winter salmon in the returns to homewaters and its effect on the management of the fishery

ACFM was unsure of the intent of this question; thus, three different responses were considered. One response dealt with the utility of estimates of the population size of grilse returns to homewaters in predicting or forecasting the population size of 2SW salmon returning the following year. The second response considered the effects of changing the grilse:multi-sea-winter salmon ratio in the spawning population on production of MSW salmon. The third response considers how fisheries in homewaters can be manipulated to account for differences in relative abundances of grilse and multi-sea-winter salmon.

Application of grilse returns to forecast 2SW salmon returns

Forecasts of 2SW salmon returns based on 1SW returns have been used with varying success throughout North America and Europe. Simple linear regression techniques have been tested for the rivers Tay and North Esk, in Scotland; used with greater success in the LaHave and the Liscomb rivers, Nova Scotia; and on various rivers in Iceland. A multiple linear regression has been adopted on the Saint John River, New Brunswick to forecast MSW returns from data on numbers and size of grilse returns. Nonparametric approaches for forecasting MSW salmon from 1SW returns are being used for the Miramichi River.

Effects of changing the grilse:multi-sea-winter salmon ratio in the spawning population on production of MSW salmon.

Sea-age at maturity is believed to be influenced by both genetics and environmental effects. There is evidence that the progeny of grilse produce proportionately more salmon that mature as grilse than progeny from 2SW salmon. It has also been demonstrated both in nature and in husbandry settings that temperature and climate can influence maturation. Selective fishing has an influence on the age of maturity of spawners which may have long-term genetic effects. ACFM was not aware of any studies that demonstrated that the increase in the number of grilse spawners in a river has resulted in a genetic shift to earlier maturation, or grilsification of the stock. However, concern was expressed that this may occur.

Manipulation of fisheries to account for differential abundance

The abundance of grilse versus multi-sea-winter salmon in a stock may be variable. Fishery managers may consider options to adjust the harvest pressure on a particular sea-age category needing additional protection. Where these two sea-age categories are mixed in a fishery, options may include a change in gear or prohibited retention. When the grilse and MSW stocks are not mixed, fisheries can be regulated by opening and closing seasons of the fisheries to reduce exploitation on a specific sea-age. Examples of these possibilities were noted in Canada's management actions since 1984 to reduce exploitation on MSW salmon stocks.

3.4 Advice on Catch Levels at West Greenland

In previous years, ACFM was asked to propose and evaluate methods to estimate possible catch levels based upon maintaining adequate spawning biomass. The aim of advice would be to limit catch to a level that would facilitate achieving overall spawning escapement equivalent to the sum of spawning targets in individual North American and European rivers (when the latter have been defined). To achieve the desired level of exploitation for a given level of predicted abundance either a TAC could be fixed or some form of effort limitation introduced.

Although advances have been made in our understanding of the population dynamics of Atlantic salmon and the exploitation occurring in the fisheries, the concerns about the implications of application of TACs to mixed stock fisheries are still relevant. In principle, reductions in catches in mixed stock fisheries provided via an annually adjusted TAC would reduce mortality on the population as a whole. However, benefits that might accrue to particular stocks would be difficult to demonstrate, in the same way that detriments to individual stocks are difficult to identify.

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

The advice for any given year is dependent on obtaining a reliable predictor of the abundance of non-maturing 1SW abundance for North American stocks prior to the start of the fishery in Greenland. Prediction of this pre-fishery abundance of 1SW salmon destined to return as 2SW salmon is difficult. Such predictions have wide confidence intervals and it would be prudent to use the lower range of predicted abundance levels for management decisions.

3.4.1 Estimating the pre-fishery abundance of non-maturing 1SW salmon at the time of the fishery

The 1993 pre-fishery abundance of non-maturing 1SW salmon of North American origin (the abundance relevant to 1SW fisheries in Canada and Greenland in 1993 and the 2SW salmon fishery in Canada in 1994) was forecasted using two main methods.

The first method involved the use of a univariate time series model. The second method was a regression model in which the independent variable was an estimate of overwintering habitat in the Labrador Sea. Overwintering habitat was defined as a weighted sum of areal sea surface temperatures multiplied by average catch rates at each temperature (Figure 3.4.1.1). The relationship between abundance and catch rate weighted habitat in March was found to be significant (Figure 3.4.1.2).

Forecasts of the pre-fishery abundance for the 1993 fishery year were computed as point estimates (based on the mid-point of historical ranges) and as statistical distributions or stochastic processes utilizing information on the distribution of historical pre-fishery abundances. In addition, a provisional estimate of the 1992 pre-fishery abundance (N1*) was also developed thus allowing forecasts to be made for a single year instead of two years ahead (Figure 3.4.1.3).

Estimates of 1993 pre-fishery abundances are summarized in Table 3.4.1.1 and presented graphically in Figure 3.4.1.4. Regression forecasts are slightly higher than forecasts based on the univariate time series model. The inclusion of the N1* estimate has the effect of lowering both univariate and regression forecasts; this reflects both the low Greenland catch and the low habitat value for 1992. The use of stochastic forecast procedures also had the effect of lowering forecast values compared to estimates based on pre-fishery midpoints. This is due to skewed yearly distributions of pre-fishery abundance. The stochastic regression forecast utilizing N1* is the most robust forecast since it is the technique based on our best biological understanding of the recruitment process and includes information about the statistical error structure of the datasets involved.

ACFM noted the annual fluctuations in the estimates of abundance of salmon at West Greenland (Figure 3.3.1.2) and examined the year to year changes in these values relative to the overall mean.

	Low (i+1)	High (i+1)
Low (i)	9	1
High (i)	2	5

year in parentheses

This analysis indicated that most years when abundance was estimated to be low (i.e. below the 17 year mean) were followed by years when abundance was again low and most years when abundance was high were followed by years when abundance was again high. In 1990 and 1991, the values were the lowest in the time series of pre-fisheries abundance. Thus, some sort of qualitative assessment of the likely level of pre-fishery abundance of 1SW fish at Greenland for a current year could be obtained from knowledge of the preceding year's abundance estimate.

3.4.2 Development of a model to set catch quotas in relation to stock abundance

A worked example of a model to set catch quotas in relation to stock abundance with assessment of the probability of achieving adequate spawning biomass is described. To achieve the spawning management goal, a pool of fish must be set aside prior to fishery allocation in order to meet spawning targets and allowing for natural mortality in the intervening months between the fishery and spawning migration. ACFM identified 193,306 fish as the spawning target for the North American stock complex. Thus, 219,132 pre-fishery abundance fish must be reserved (196,306/exp*(-.01*11)) to ensure achievement of the target.

Given an agreed estimate of the total pre-fishery abundance of non-maturing North American stocks, this abundance minus the spawning reserve is the pool of fish available for harvest in all relevant fisheries (Table 3.4.2.1). The pre-fishery population is viewed as an extant population in this context, thus, availability is unknown and not predicted. The portion of the population in excess of the spawning reserve is divided between harvest in North America and Greenland. From the number of pre-fishery abundance fish designated for harvest in Greenland (NA1SW), the number of European origin pre-fishery abundance fish that contribute to the quota (E1SW) is estimated:

E1SW = (NA1SW/PropNA)-NA1SW

Where:

PropNA = the proportion of the total number of 1SW fish at West Greenland which is of North American origin.

The quota is then computed by:

Quota = (NA1SW*WT1SWNA+E1SW*WT1SWE)*ACF

Where:

E1SW = the Greenland allocation of pre-fishery European 1SW salmon

WT1SWNA = mean weight of North American 1SW salmon at Greenland

WT1SWE = mean weight of European 1SW salmon at Greenland

and

ACF = age correction factor to account for multi-sea-winter salmon in the catch, based on total weight of the catch divided by the weight of 1SW salmon

The data necessary to perform the quota calculations are based on the following forecasts:

Parameter	Value
PropNA	0.540
WT1SWNA	2.525
WT1SWE	2.660
ACF	1.121

The fishery allocation to North America can be harvested in 1SW fisheries in 1993 and/or in 2SW fisheries in 1994. It must be remembered that natural mortality will reduce the numbers of fish to be harvested in 2SW fisheries from the number allocated from the pre-fishery abundance.

This procedure can be expressed graphically. Allocation of extant pre-fishery abundance salmon can be determined in respect to the advice on pre-fishery abundance forecasts by selecting a forecast value of pre-fishery abundance (Figure 3.4.2.1). Translating vertically from this estimate level and observing where the line intersects the allocation curve pairs for various allocation schemes, the allocation can be read on the Y-axis.

Using the above formulation, Greenland allocation levels were computed for each forecast over a range of pre-fishery abundance values (Table 3.4.2.2) and quota options ranging from 42 to 209 tonnes. This catch advice is predicated on allocation of the predicted abundance of salmon and provides no guidance on salmon availability or fishing patterns. Yet quotas of these magnitudes will be expected to have consequences on fishing mortality. To illustrate, the exploitation at West Greenland was computed for a range of catch level using the results of the run reconstruction model to predict mean availability (availability at West Greenland = 1-(mean P)-FU=0.6). These computations suggest it would be impossible to catch more than 740 t due to availability and that catch between 300 and 400 t would result in exploitation rates of approximately 45%, or levels similar to those observed in recent years of the fishery (based on results of run reconstruction model). Catch in the range of options consistent with the catch advice described above would result in exploitation rates below 30% (Figure 3.4.2.2).

3.4.3 Assessment of risk of not achieving management objective of adequate spawning biomass

In North America, relationships between the amount of spawning and subsequent recruits have been identified in some Atlantic salmon populations with recruitment reaching a maximum at an intermediate level of spawning. Consequently, for salmon, fisheries management practices can maximize recruitment by ensuring that an optimum number of salmon are allowed to spawn. The further the spawning escapement is below the target egg deposition (or biological level to maintain optimal production), and the longer this situation occurs, even at rates only slightly below that level, the greater the possibility exists of incurring the following risks, some of which may cause irreversible damage to the stock:

1. Accentuation of annual fluctuations in run size and reduction in the long term capability of the stock to sustain exploitation;

2. Increased susceptibility to extinction from genetic, demographic, or environmental catastrophes and consequent decreases in productivity;

3. Permanent change in demographic characteristics of the spawning population; and

4. Possible replacement in the ecosystem by other competing fish species of potentially less social and economic value.

The probability that the true stock abundance is greater or lower than the value selected (Figure 3.4.2.1) provides a measure of the probability of reaching escapement targets assuming fishery allocations are exactly taken. The probability levels associated with certain reference points can be classified into broad categories termed "risk neutral", "risk averse", and "risk prone". The mean estimate of the forecast represents a reference point at which there is a 50% chance that the true abundance is lower than required to achieve the spawning target. This level is termed the "risk neutral" forecast. Likewise, the forecast value at the 25th percentile, or the value with a 25% chance that the abundance is lower, is the "risk averse" forecast. The forecast value at the 75th percentile, or the value with a 75% chance that the abundance is lower, is the "risk prone" forecast.

If a risk averse approach to protecting returns to homewaters were to be adopted for 1993, no catches of potential 2SW salmon could be permitted in either Greenland or Canada. Even if the "risk neutral" scenario were to be adopted, the catch allowances would be small and would result in either very low allowable catches in Greenland or Canada or no allocation to one or other of the countries and a small permitted catch in the other. Adoption of a risk prone approach, i.e., assume the 75th percentile of the forecast of 363,000 fish, would probably mean that the numbers of 2SW salmon returning to North American homewaters in the year following the fishery would be insufficient to meet target spawning requirements (Table 3.4.2.1).

ACFM will employ a risk neutral approach in the formulation of its management advice. However, the current status of the stocks should be considered in management decisions.

It must also be noted that basing catch advice on estimated stock abundance of Canadian non-maturing 1SW fish may carry with it additional risks of over-exploiting particular stocks or stock complexes that are more vulnerable than the average, for example because they have lower productivity. This will have the effect of increasing the risks for certain stocks at all levels of catch, while decreasing the risks for others. The long term catch advice for the mixed stock fisheries should be based upon the stock complexes that are most vulnerable.

3.5 By-catch and mortality of salmon in non-directed fisheries

The only other fisheries likely to catch salmon in West Greenland are those where gill nets are set for arctic charr. However, these nets are set in the fjords at a time of year when salmon are either not present or in very low abundance. It is thought that by-catches of salmon are of negligible proportions.

3.6 Effects of the NASCO Tag Return Incentive Scheme

A direct estimator of reporting rate in the West Greenland fishery, based on comparison of Carlin and coded-wire tag recoveries in West Greenland for the period 1987 to 1991, was evaluated.

Reporting rates in Greenland appear to have increased appreciably in 1989 to levels 2 to 3 times higher than evident in 1987 and 1988. The low numbers of Carlin-tagged 2SW salmon returning to Maine rivers and the low numbers recovered in Greenland result in high variability in the reporting rate estimate (Figure 3.6.1).

These data suggest that the NASCO lottery scheme increased the Carlin tag reporting rates in the West Greenland fishery. The resulting estimate had wide confidence intervals; thus, the rate could not be shown to be statistically significant.

4. INFORMATION OF INTEREST TO THE NORTH AMERICAN COMMISSION

4.1 Description of the Fisheries in Canada

The following were new management measures for commercial fisheries in 1992:

1) A 5-year moratorium was implemented for the commercial fishery in insular Newfoundland. Fishing was permitted in Labrador Salmon Fishing Areas (SFA) 1, 2 and 14B. Quotas in SFAs 2 and 14B were reduced from those of 1991 by 20 t in SFA 2 and 2 t in SFA 14B. SFA 1 had an allowance of 80 t, the same as 1990 and 1991; an allowance is an estimate of expected catch and not a limitation on allowable harvest. Monitoring of the quotas was conducted by Fisheries Officers who were in contact with buyers and fishermen on a weekly or daily basis.

   A voluntary commercial salmon license buy-back program was also implemented for fishermen in SFAs 2-14. Fishermen were allowed to apply for the buy-back until 31 December 1992.

2) In Quebec, commercial fishing quotas were reduced in area Q 7 by 52% (from 1809 to 875 fish) from 1991, commensurate with a reduction in the number of licences under a buy-back program. In Q 8 and Q 9, the quotas were reduced by 26% and 9%, respectively.

The following were new management measures for recreational fisheries in 1992:

1) The seasonal bag limit for the recreational fishery of Newfoundland-Labrador, Nova Scotia, and New Brunswick was reduced from 10 to 8 fish (SFAs 1-16, and 18-23). In Prince Edward Island (SFA 17), the seasonal and daily limits were reduced from 10 and 2 to 7 and 1, respectively. Most rivers of the inner Bay of Fundy (SFA 22 and parts of SFA 23) were not opened to recreational fishing for conservation reasons. As in previous years, large salmon could be

retained as part of seasonal and daily limits only in Labrador (SFAs 1, 2, and 14B) and in Quebec.

2) Quotas for each SFA were introduced for the first time to the recreational fisheries of Newfoundland and Labrador. All rivers of each SFA were closed to retention of salmon after the quota in each SFA was reached. Some rivers of SFAs 11, 13 and 14 were managed by individual river quotas.

3) There were minor changes in angling seasons relative to previous years.

The total catch of Atlantic salmon in Canada was 470 t in 1992. Catch was distributed between recreational (42%), native (7%), and commercial (51%) fisheries. Commercial catch and quotas by SFA are shown in the text table below:

1992

SFA	Catch (t)	Quota (t)
1	20	80[1]
2	132	180
13-14	17	13
Q7-9	73	NA[2]
Q11	0	15

[1]Allowance
[2]Not applicable

Catches in the Newfoundland commercial fishery are given in the text table below:

Newfoundland commercial fishery

Year	1987	1988	1989	1990	1991	1992
Catch (t)	1,485	972	867	618	454	168[1]

[1]Preliminary

4.1.1 Composition and origin of the catch, 1992

Only salmon of Canadian and USA origin were caught in Canada during 1992. Recaptures of tagged 1SW salmon of USA and Canadian origin occurred in the Newfoundland and Labrador fisheries.

4.1.2 Historical data on tag returns and harvest estimates

ACFM updated the time series of Carlin tag returns and harvest estimates of Maine-origin 1SW salmon in Newfoundland and Labrador. The total harvest of 1,425 Maine-origin salmon in the 1991 fishery was distributed primarily in SFAs 3 and 4.

Carlin harvest, Maine-origin salmon

Year	1986	1987	1988	1989	1990	1991
Harvest	552	580	393	1,722	780	1,425

Comparative harvest estimates based on CWT and Carlin tag recoveries were calculated for the communities, Statistical Sections and SFAs covered by port sampling. The ratio of harvest estimation methods (Carlin/CWT) was consistently less than 1.0 for the Statistical Sections and SFAs where harvests occurred. Previous comparisons of Carlin and coded wire tag harvest estimates generally indicated coded wire tag estimates were greater than Carlin estimates. This reversal would be consistent with the effect of Carlin tag reporting rates that are higher than the levels assumed in the Carlin harvest model.

4.2 Description of Fisheries in United States of America

The average exploitation rate (6.8%) on combined age classes in the Penobscot River for 1992 was lower than for 1991 (11.5%). The reasons for the change in 1992 were attributed to the new management measure enacted (reduction of season limit from 5 to 1) and a conscious effort by Penobscot River anglers to reduce the harvest of salmon caught early in the season. The estimated number of salmon caught and released in Maine rivers exceeded the number caught and killed by a margin of 2:1.

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

The catch of salmon for the islands of St. Pierre and Miquelon in 1992 was 1.3 t (Table 1.1.1). The most recent information on fishing effort is for 1989 when there were 13 professional and 37 recreational fishermen fishing for salmon. Tag returns from previous years indicate that salmon of Canadian and USA-origin have been caught in the fisheries of St. Pierre and Miquelon.

4.4 Evaluate the Effects of Quota Management Measures and Closures Taken in 1991 and 1992 in Newfoundland-Labrador Commercial Fisheries

4.4.1 Effects on Canadian stocks and fisheries

1991 Quota management measures

The quantities of large and small salmon affected by the early closure of the fisheries in 1991, owing to quota management measures, were evaluated by applying the closure date in each SFA in 1991 to the temporal distribution of the landings in each SFA and year, for 1984-1989. With respect to small salmon, the estimated mean tonnage of salmon not caught was 21 t (about 12,600 fish) while for large salmon it was 9 t (2,500 fish).

The estimated average numbers of small (12,600) and large (2,500) salmon not caught in 1991 are about 70% less than the estimated numbers not caught in 1990. The quota had the greatest effect in reducing numbers of small salmon caught in SFAs 10, 11 and 13, while the largest reduction in number of large salmon caught occurred in SFA 11.

1992 Commercial salmon fishery moratorium

The only data available to evaluate the effects of the closure of the commercial fisheries were recreational catch statistics and the counts of salmon on several river systems.

The total recreational catch of small salmon (23,127) retained up to the date quotas were reached in each of the SFAs 3-14A in 1992 increased by 113% over 1991. There was considerable variation in changes in catches from 1992 to 1991 and 1984-1989 among SFAs which may be related to variation in: 1) commercial exploitation rates among stocks; 2) abundance of salmon among SFAs; and 3) exploitation rates in the recreational fisheries among rivers and years. The recreational quotas in 1992 had the effect of eliminating angling catches in the latter part of the season and dramatically reducing angling effort during the hook-and-release component of the fishery.

In southern Labrador (SFAs 2 and 14B), where large salmon could be retained, the early closure appeared to have resulted in the higher exploitation of large salmon over small fish due to the early entry of large salmon to the rivers.

In comparison to the 1984-1989 means, the numbers of small salmon counted in 1992 increased along the northeast and east coasts (SFAs 4-5), generally decreased along the south coast (SFAs 9 and 11) with Northeast River (SFA 10) the exception, and again increased in west coast Newfoundland (SFA 14A) (Figure 4.4.1.1). Except for Northeast Brook, Trepassey, counts of large salmon increased over 1991. In comparison to the 1984-1989 mean, increases occurred for all rivers except Biscay Bay River and Northeast Brook, Trepassey, and Conne River. These rivers are located along the south coast of insular Newfoundland.

If the 1992 moratorium had been in effect during 1984-1989 the estimated weight of salmon not caught per year would have been 403 t of small salmon (227,000 fish) and 314 t of large salmon (78,500 fish).

4.4.2 Effects on USA stocks

ACFM evaluated the effects of the 1991 quota regime on USA stocks harvested in the Newfoundland-Labrador fishery by determining the percentage of Maine-origin salmon that would not have been caught in previous fisheries had the closing dates observed in 1991 been in force. The small numbers of salmon harvested and the variability in the percentage of harvest foregone makes it difficult to evaluate the closure. The mean percentage of 1SW Maine-origin salmon which would not have been caught in SFAs affected by the quota during the period 1984-1989, if the 1991 closure date were in force, is 16%.

The effects of the 1992 moratorium can be estimated directly. In SFAs 1-14a, affected by the moratorium, nearly 100% (i.e. some by-catch in other gears will still occur) of the harvest would be expected to be foregone. The average harvest in these SFAs during the period 1984-1989 was 763 salmon out of an average total harvest of 1,144 fish per year. Thus, within this base period, 67% of the harvest of Maine-origin salmon would have been foregone. A similar percentage of harvests foregone would be expected for Merrimack- and Connecticut-origin salmon.

4.5 By-catch and mortality of salmon in non-directed fisheries

ACFM concluded that adult salmon appear to be caught in low frequencies in non-directed fisheries. The tonnage appears to be negligible relative to the unreported catch in salmon gear. Data were not available to estimate actual tonnage losses in by-catch fisheries. In the North American Commission area, landing of salmon by-catch is not permitted. Thus estimates of by-catch loss are partially addressed in the estimates of unreported catches, when these arise from illegal landings in non-salmon gear.

4.6 Effects of the NASCO Tag Return Incentive Scheme

Angler reporting rate in the Gulf Region, Canada

Tag recovery rates for adult salmon in the Miramichi (1971-75, 1985-91) and on the Margaree (1987-92) rivers were examined. Though slight increases in recovery rate were observed, none of the increases were statistically significant.

Reporting rates for Maine tags

Tag recoveries in distant fisheries were considered in relation to estimated counts of tag returns to Maine rivers. The results of the analysis suggest that the magnitude of the reporting rate change for tags recovered in Canada was less than the inherent variability in the historical relationship between fishery and homewaters recoveries.

Table 1.1.1 Nominal catch of SALMON by country (in tonnes round fresh weight), 1960-1992 (1992 provisional figures).

Year	Canada (5)	Den.	Faroes	Finland	France	East Grld.	West Grld.	Iceland	Ireland (1, 3)	Norway (4)	Russia	St. P & M.	Sweden (WC)	UK E&W	UK Scotland	UK N.I.(1,2)	USA	Others (6)	Total
1960	1636	-	-	-	-	-	60	100	743	1659	1100	-	40	283	1443	139	1	-	7204
1961	1583	-	-	-	-	-	127	127	707	1533	790	-	27	232	1185	132	1	-	6444
1962	1719	-	-	-	-	-	244	125	1459	1935	710	-	45	318	1738	356	1	-	8650
1963	1861	-	-	-	-	-	466	145	1458	1786	480	-	23	325	1725	306	1	-	8576
1964	2069	-	-	-	-	-	1539	135	1617	2147	590	-	36	307	1907	377	1	-	10725
1965	2116	-	-	-	-	-	861	133	1457	2000	590	-	40	320	1593	281	1	-	9392
1966	2369	-	-	-	-	-	1370	106	1238	1791	570	-	36	387	1595	287	1	-	9750
1967	2863	-	-	-	-	-	1601	146	1463	1980	883	-	25	420	2117	449	1	-	11948
1968	2111	-	5	-	-	-	1127	162	1413	1514	827	-	20	282	1578	312	1	403	9755
1969	2202	-	7	-	-	-	2210	133	1730	1383	360	-	22	377	1955	267	1	893	11540
1970	2323	-	12	-	-	-	2146	195	1787	1171	448	-	20	527	1392	297	1	922	11241
1971	1992	-	-	-	-	-	2689	204	1639	1207	417	-	18	426	1421	234	1	471	10719
1972	1759	-	9	32	34	-	2113	250	1804	1568	462	-	18	442	1727	210	1	486	10915
1973	2434	-	28	50	12	-	2341	256	1930	1726	772	-	23	450	2006	182	2.7	533	12746
1974	2539	-	20	76	13	-	1917	225	2128	1633	709	-	32	383	1708	184	0.9	373	11941
1975	2485	-	28	76	25	-	2030	266	2216	1537	811	-	26	447	1621	164	1.7	475	12209
1976	2506	-	40	66	9	<1	1175	225	1561	1530	772	2.5	20	208	1019	113	0.8	289	9536
1977	2545	-	40	59	19	6	1420	230	1372	1488	497	-	10	345	1160	110	2.4	192	9495
1978	1545	-	37	37	20	8	984	291	1230	1050	476	-	10	349	1323	148	4.1	138	7650
1979	1287	-	119	26	10	<1	1395	225	1097	1831	455	-	12	261	1076	99	2.5	193	8089
1980	2680	-	536	34	30	<1	1194	249	947	1830	664	-	17	360	1134	122	5.5	277	10080
1981	2437	-	1025	44	20	<1	1264	163	685	1656	463	-	26	493	1233	101	6	313	9929
1982	1798	-	865	54	20	<1	1077	147	993	1348	354	-	25	286	1092	132	6.4	437	8634
1983	1424	-	678	57	16	<1	310	198	1656	1550	507	3	28	429	1221	187	1.3	466	8731
1984	1112	-	628	44	25	<1	297	159	829	1623	593	3	40	345	1013	78	2.2	101	6892
1985	1133	-	566	49	22	7	864	217	1595	1561	659	3	45	361	913	98	2.1	-	8095
1986	1559	-	530	38	28	19	960	310	1730	1598	608	2.5	54	430	1271	109	1.9	-	9248
1987	1784	-	576	49	27	<1	966	222	1239	1385	564	2	47	302	922	56	1.2	-	8142
1988	1311	-	243	34	32	4	893	396	1874	1076	419	2	40	395	882	114	0.9	-	7716
1989	1139	-	364	52	14	<1	337	278	1079	905	359	2	29	296	895	142	1.7	-	5893
1990	911	13	315	59	15	<1	274	426	586	930	315	2	33	338	624	94	2.4	-	4937
1991	711	3.3	95	69	13	4	472	505	404	876	215	1	38	200	462	55	0.8	-	4124
1992	470	10	23	78	20	5	237	590	630	850	161	1.3	49	195	525	151	0.7		3996
5YM	1171	-	319	53	20	2	588	365	1036	1034	374	2	37	306	757	92	1	-	6162
10YM	1288	-	486	51	21	4	645	286	1199	1285	459	2	38	338	930	107	2	-	7241

5YM - 1987-1991 Mean

10YM - 1982-1991 Mean

1. Catch on River Foyle allocated 50% Ireland and 50% N. Ireland.
2. Not including angling catch (mainly 1SW).
3. Includes only those catches sold through dealers
4. Before 1966, sea trout and sea charr included (5% of total).
5. Includes estimates of some local sales, and, prior to 1984, by-catch.
6. Includes catches in Norwegian Sea by vessels from Denmark, Sewden, Germany, Norway and Finland

Table 2.2.2.1 Origin of catches of salmon in homewater fisheries based on tag recoveries.

++ = Principal component of catch
\+ = Consistant recoveries
\- = Rare tag recovery

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

Table 3.4.1.1. Summary of forecasting methods to estimate 1993 pre-fishery abundance.

Analytical Approach	Parameter	Deterministic Model	Stochastic Model
Univariate Time Series 2-year ahead forecasts based on 1974-91 estimates of pre-fishery abundance	Input Data	Mid-range of N1	200 simulated realizations
	Mean Forecast	258000	250000
	Std. Err. of Estimate	131200	137000
	Acronym	UF	SUF
Univariate Time Series 1-year ahead forecasts based on 1974-91 pre-fishery abundance and imputed value for 1992	Input Data	Mid-range of N1 plus N1*	200 simulated realizations
	Mean Forecast	238000	235000
	Std. Err. of Estimate	126400	132000
	Acronym	UFN1*	SUFN1*
Regression of pre-fishery abundance estimates (1974-91) vs marine habitat indices. Estimate for 1993 based on March 1993 habitat index.	Input Data	Mid-range of N1vs habitat	200 simulated realizations
	Mean Forecast	275000	275000
	Std. Err. of Estimate	146500	155000
	Acronym	RF	SRF
Regression of pre-fishery abundance estimates (1974-91) and imputed value for 1992 vs marine habitat indices. Estimate for 1993 based on March 1993 habitat index.	Input Data	Mid-range of N1vs habitat plus N1*	200 simulated realizations
	Mean Forecast	257000	258000
	Std. Err. of Estimate	143700	152000
	Acronym	RFN1*	SRFN1*

Table 3.4.2.1. Pre-fishery abundance levels from univariate and regression forecasts at probabilty levels between 25 and 75%.

Cumulative Density Function %	Forecast							
	UF	UFN1*	SUF	SUFN1*	RF	RFN1*	SRF	SRFN1*
25	153000	138000	157000	145000	170000	154000	168000	153000
30	176000	160000	174000	165000	193000	177000	192000	176000
35	198000	181000	197000	184000	215000	198000	214000	198000
40	218000	200000	215000	201000	235000	218000	235000	218000
45	238000	219000	233000	218000	255000	238000	255000	238000
50	258000	238000	250000	235000	275000	257000	275000	258000
55	277000	256000	268000	251000	294000	276000	295000	277000
60	297000	275000	285000	268000	314000	295000	316000	297000
65	318000	294000	303000	286000	335000	315000	337000	318000
70	339000	315000	323000	304000	356000	336000	359000	339000
75	363000	337000	344000	324000	380000	359000	383000	363000

Table 3.4.2.2. Quota (in tonnes) options at West Greenland based on univariate and regression forecasts of fishery abundance. Greenland proportion refers to fraction of harvestable surplus allocated to the Greenland fishery. Probabity level assocated with pre-fishery abundance levels derived from probabilty density function.

Greenland Proportion	Probability Level	Forecast UF	UFN1*	SUF	SUFN1*	RF	RFN1*	SRF	SRFN1*
1	25	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0	0
	40	0	0	0	0	85	0	85	0
	45	101	0	74	0	193	101	193	101
	50	**209**	**101**	**166**	**85**	**300**	**203**	**300**	**209**
	55	311	198	262	171	402	305	407	311
	60	418	300	354	262	510	407	520	418
	65	531	402	450	359	622	515	633	531
	70	644	515	558	456	735	628	751	644
	75	773	633	671	563	864	751	880	773
0.8	25	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0	0
	40	0	0	0	0	68	0	68	0
	45	81	0	60	0	154	81	154	81
	50	**167**	**81**	**133**	**68**	**240**	**163**	**240**	**167**
	55	249	158	210	137	322	244	326	249
	60	335	240	283	210	408	326	416	335
	65	425	322	360	287	498	412	506	425
	70	515	412	446	365	588	502	601	515
	75	618	506	536	451	691	601	704	618
0.6	25	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0	0
	40	0	0	0	0	51	0	51	0
	45	61	0	45	0	116	61	116	61
	50	**125**	**61**	**99**	**51**	**180**	**122**	**180**	**125**
	55	186	119	157	103	241	183	244	186
	60	251	180	212	157	306	244	312	251
	65	319	241	270	215	373	309	380	319
	70	386	309	335	273	441	377	451	386
	75	464	380	402	338	518	451	528	464
0.5	25	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0	0
	40	0	0	0	0	43	0	43	0
	45	51	0	37	0	96	51	96	51
	50	**104**	**51**	**83**	**43**	**150**	**102**	**150**	**104**
	55	155	99	131	86	201	153	204	155
	60	209	150	177	131	255	204	260	209
	65	265	201	225	180	311	257	317	265
	70	322	257	279	228	368	314	376	322
	75	386	317	335	282	432	376	440	386
0.4	25	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0	0
	40	0	0	0	0	34	0	34	0
	45	41	0	30	0	77	41	77	41
	50	**83**	**41**	**66**	**34**	**120**	**81**	**120**	**83**
	55	124	79	105	68	161	122	163	124
	60	167	120	142	105	204	163	208	167
	65	212	161	180	144	249	206	253	212
	70	258	206	223	182	294	251	300	258
	75	309	253	268	225	346	300	352	309
0.2	25	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0	0
	40	0	0	0	0	17	0	17	0
	45	20	0	15	0	39	20	39	20
	50	**42**	**20**	**33**	**17**	**60**	**41**	**60**	**42**
	55	62	40	52	34	80	61	81	62
	60	84	60	71	52	102	81	104	84
	65	106	80	90	72	124	103	127	106
	70	129	103	112	91	147	126	150	129
	75	155	127	134	113	173	150	176	155

Figure 1.3.1.1. Percent survival of wild 1SW Atlantic salmon to freshwaters for monitored European rivers.

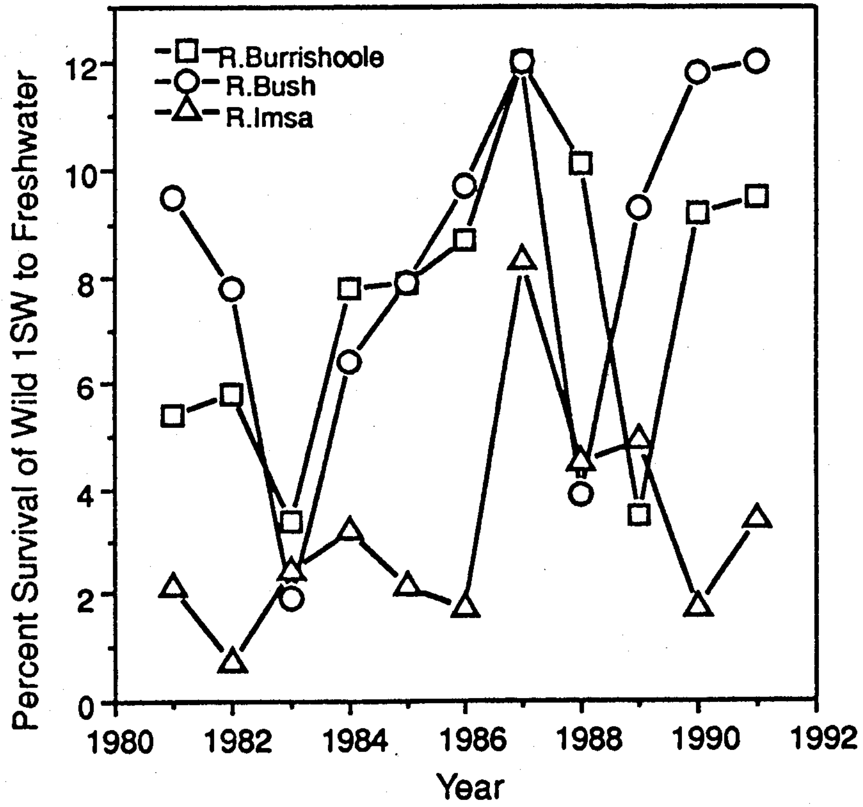


Figure 1.3.1.2. Percent survival of hatchery origin 1SW Atlantic salmon to homewater areas for monitored European rivers.

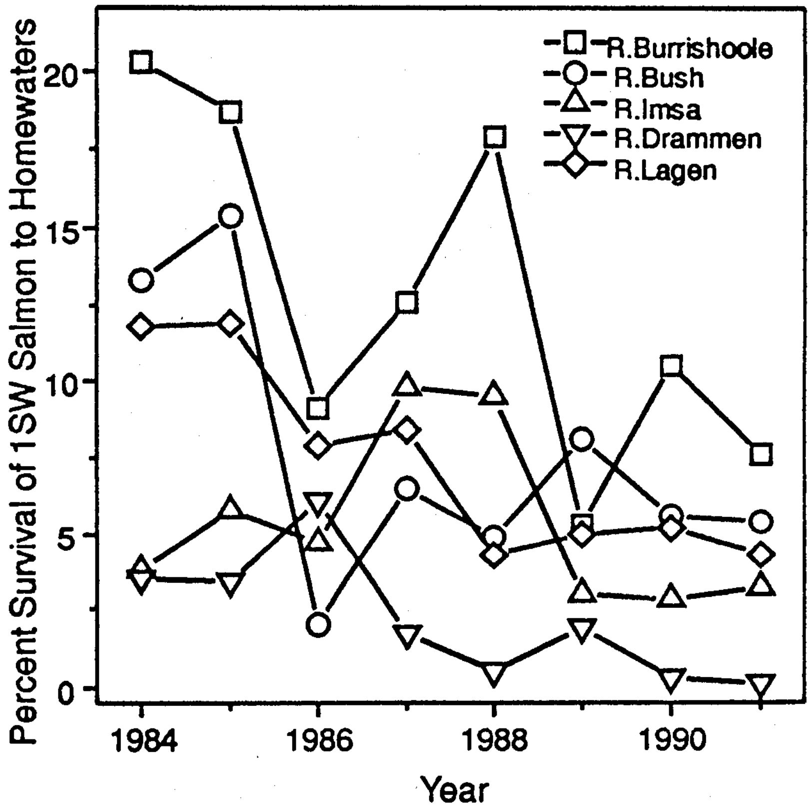


Figure 1.3.2.1. Recreational harvest of wild 2SW Atlantic salmon from Maine, USA (limited to the Dennys, E. Machias, Machias, Narraguagus,and Sheepscot rivers).

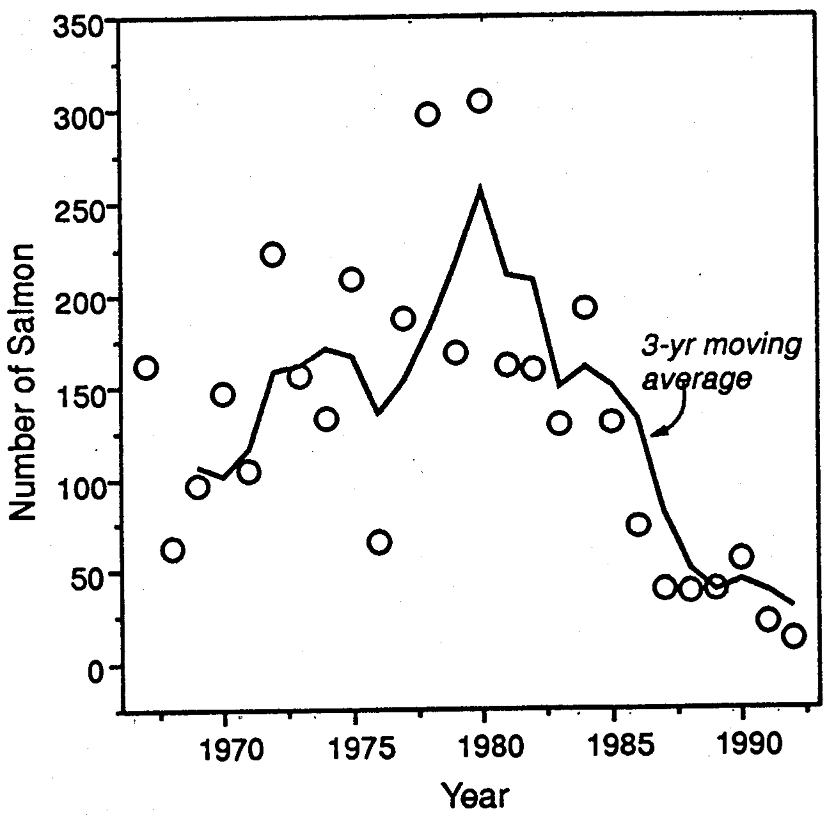


Figure 1.3.2.2. Estimated pre-fishery abundance of 1SW non-maturing salmon of North American origin.

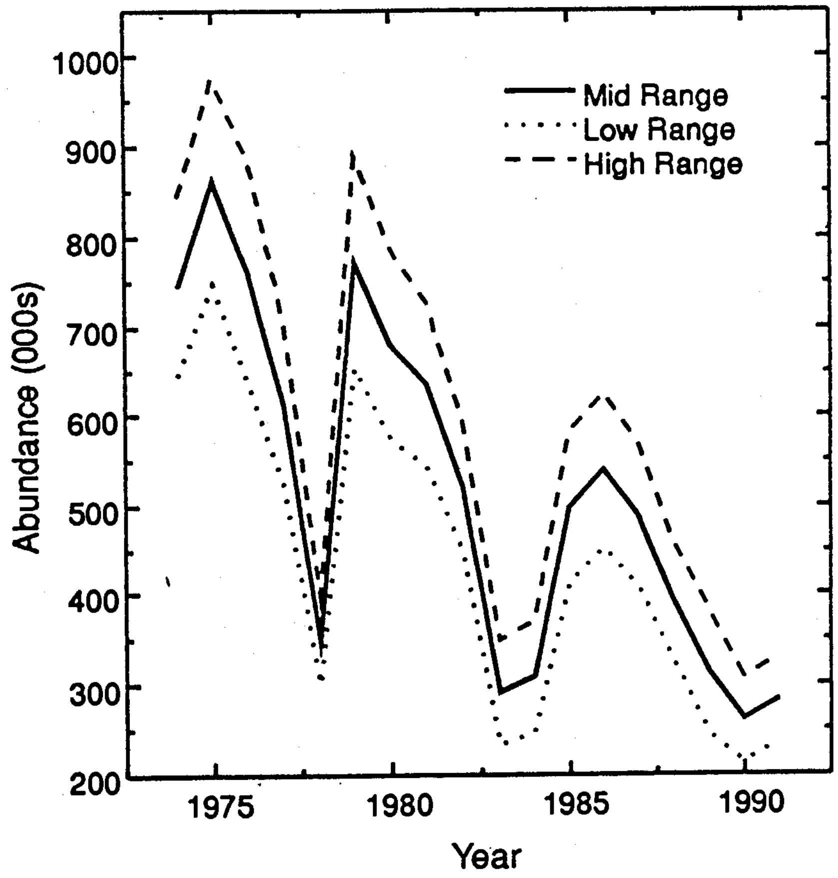


Figure 1.3.2.3. Percent change in 1992 egg deposition from 1987-1991 for specific rivers in Salmon Fishing Areas of Canada.

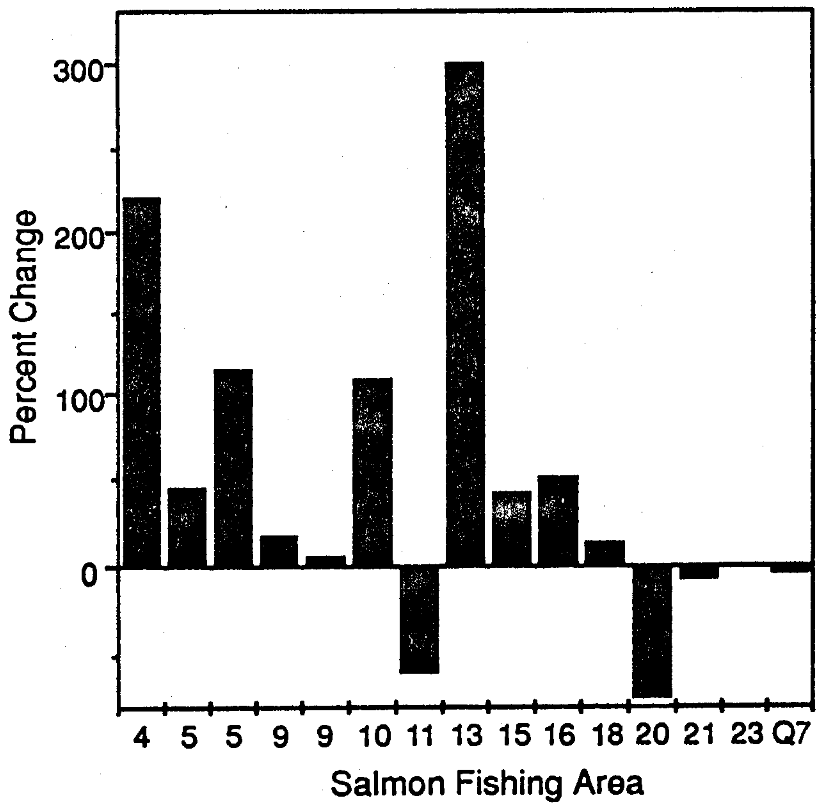


Figure 1.3.2.4. Estimated 2SW spawners in North America, 1974-92.

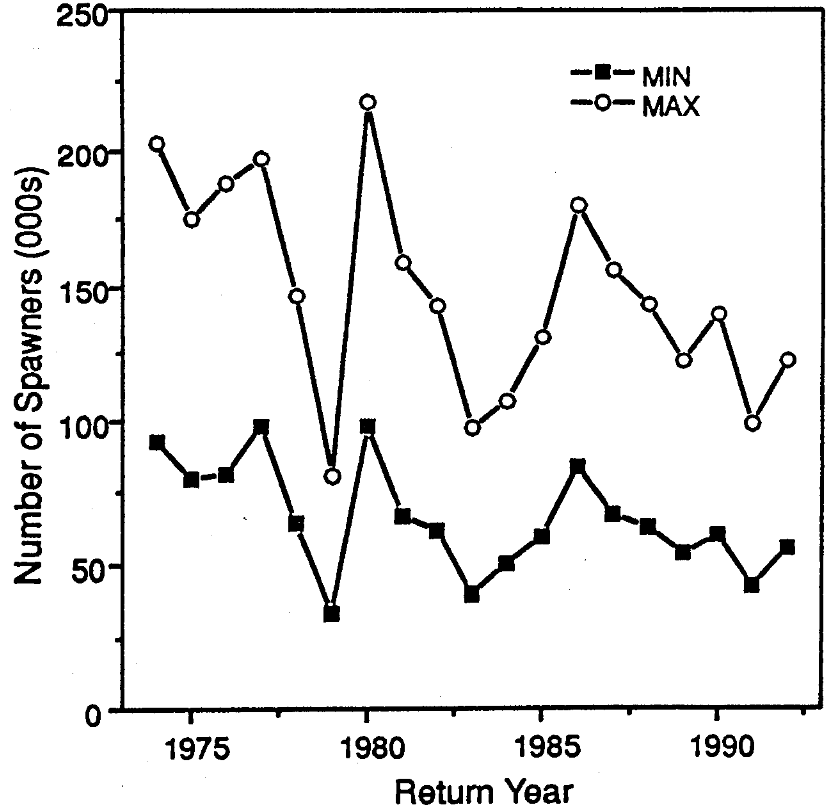


Figure 1.3.2.5. Indices of smolt survival for Western North Atlantic salmon. Top: Wild smolts Canada, Middle: Hatchery smolts Canada, Bottom: Penobscot River hatchery smolts. Data smoothed by three year means.

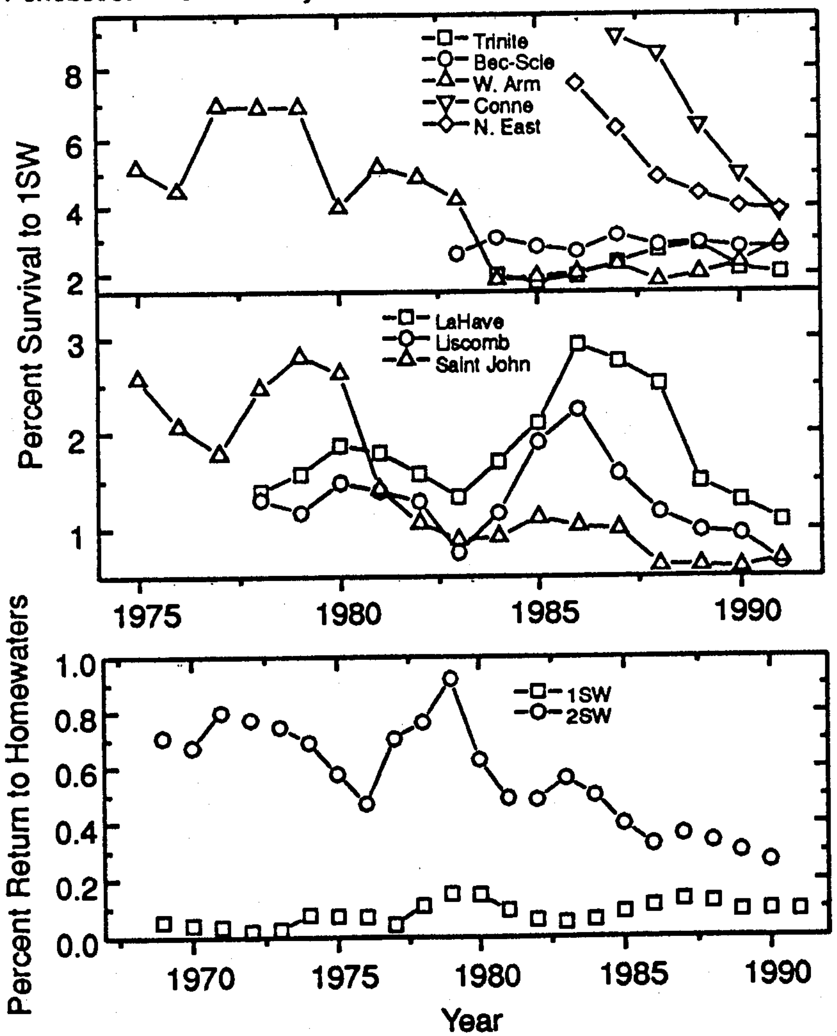


Figure 1.3.4.1. Return rates for several North American stocks (A), standardized return rates for same group of stocks (B).

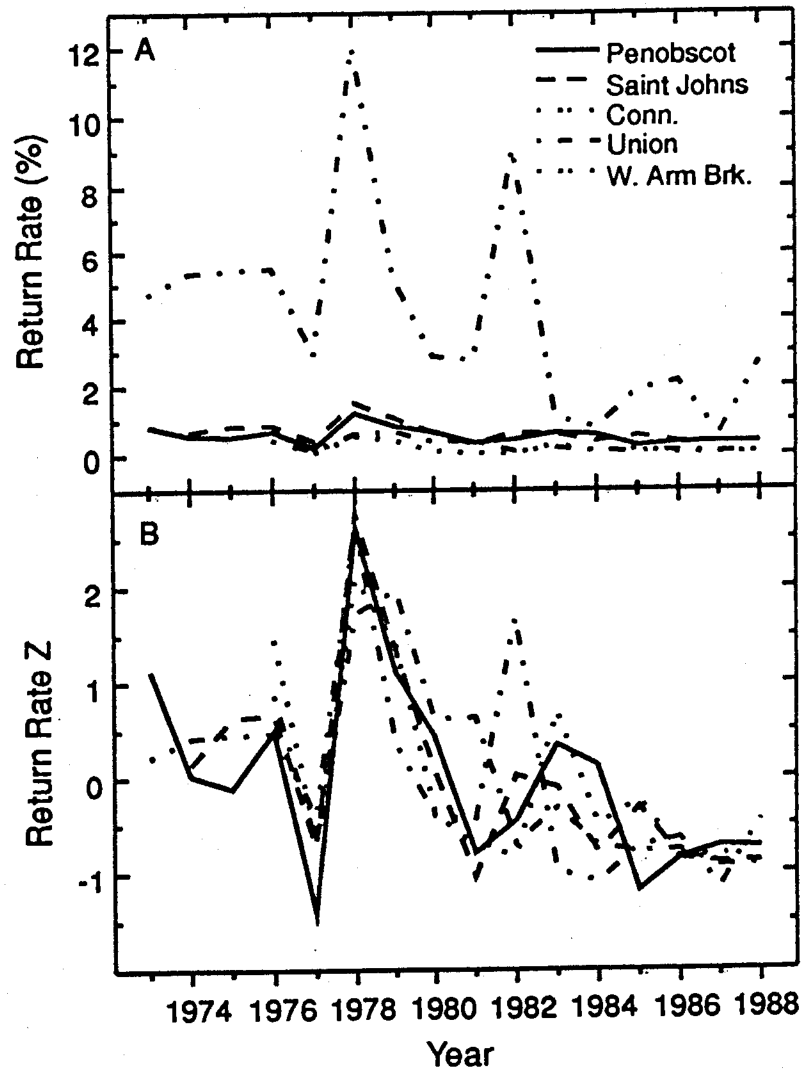


Figure 1.3.4.2. Annual mean weight of Atlantic salmon caught at West Greenland, 1969-1992.

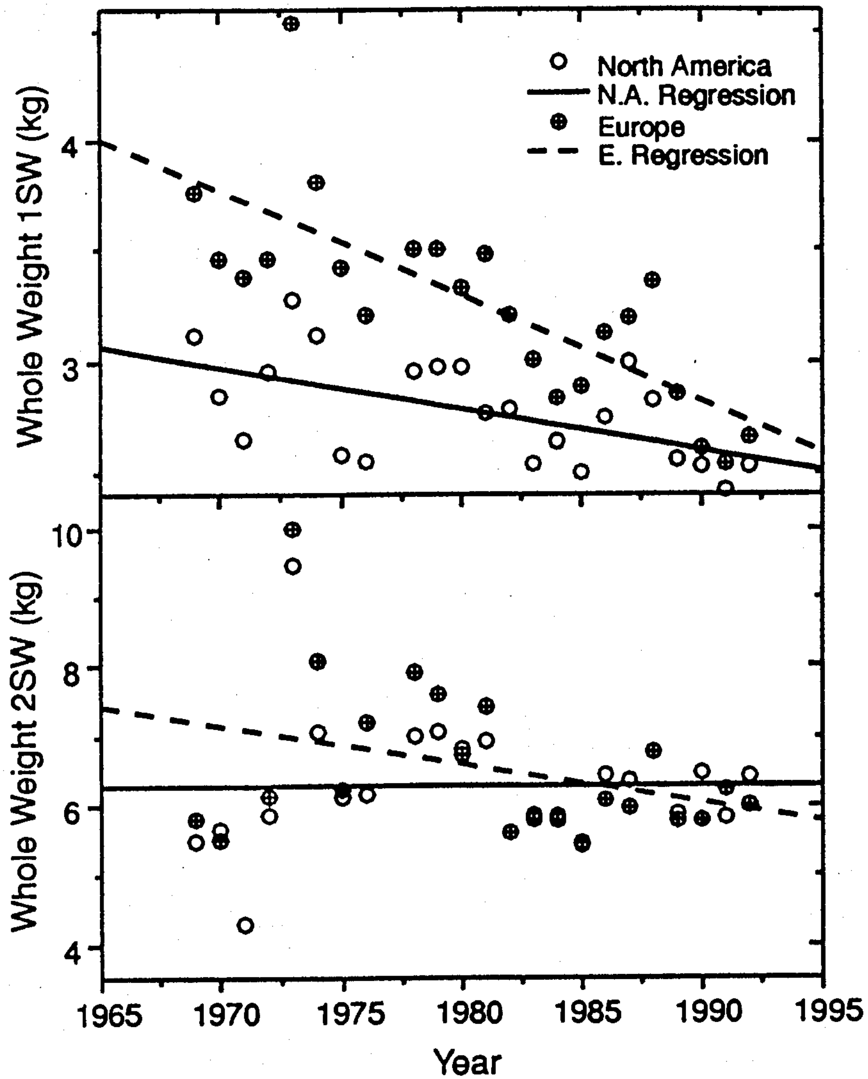


Figure 1.3.4.3. Relationship between estimated stock abundance and mean length of 1SW European origin salmon at West Greenland.

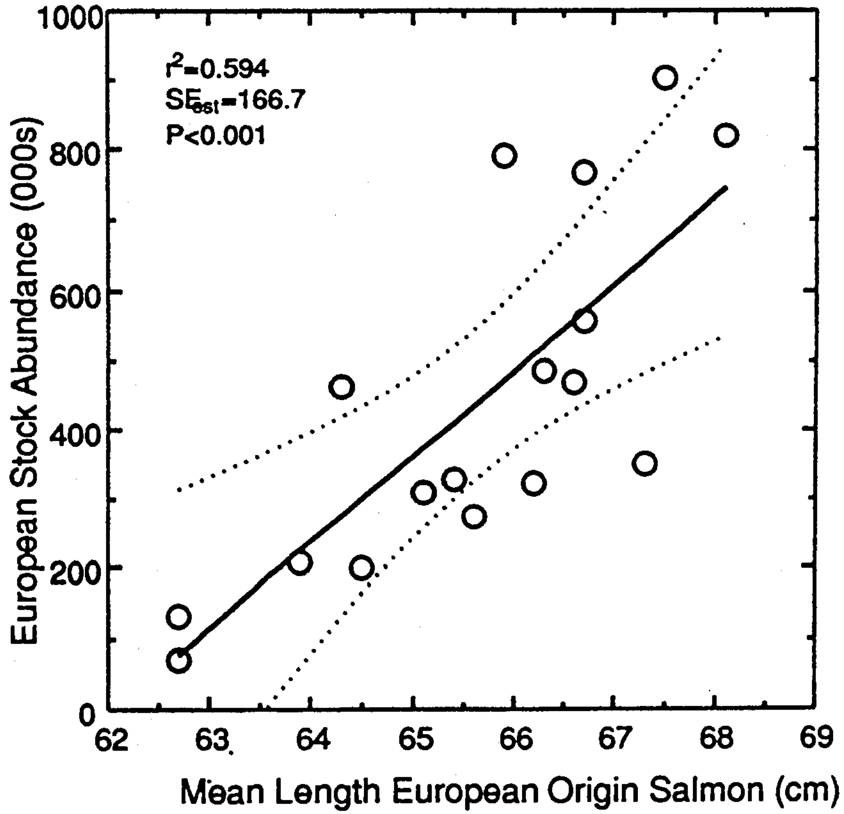


Figure 1.3.4.4. Relationship between estimated stock abundance and mean length of 1SW N. American origin salmon at Greenland.

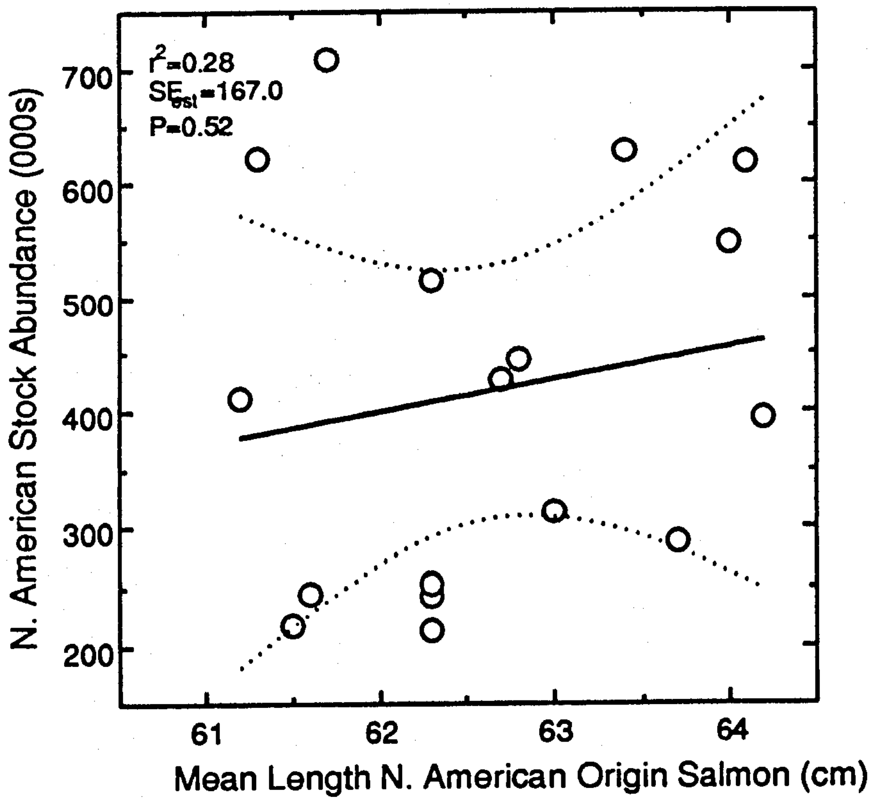


Figure 1.3.4.5. Estimate of catch of North American stock complex (A), standardized catch estimate, first principal component of winter habitat indices, and January index (B).

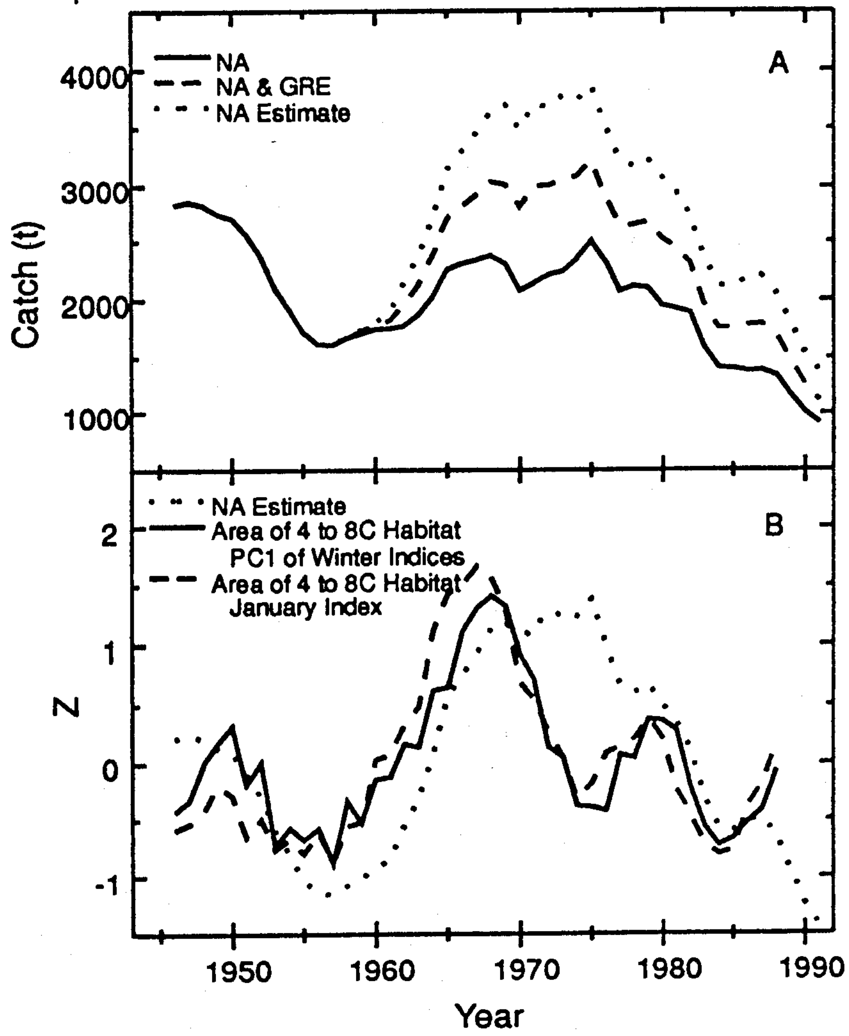


Figure 1.3.4.6. Estimate of catch of European stock complex (A), standardized catch estimates and first principal component of spring habitat indices (B).

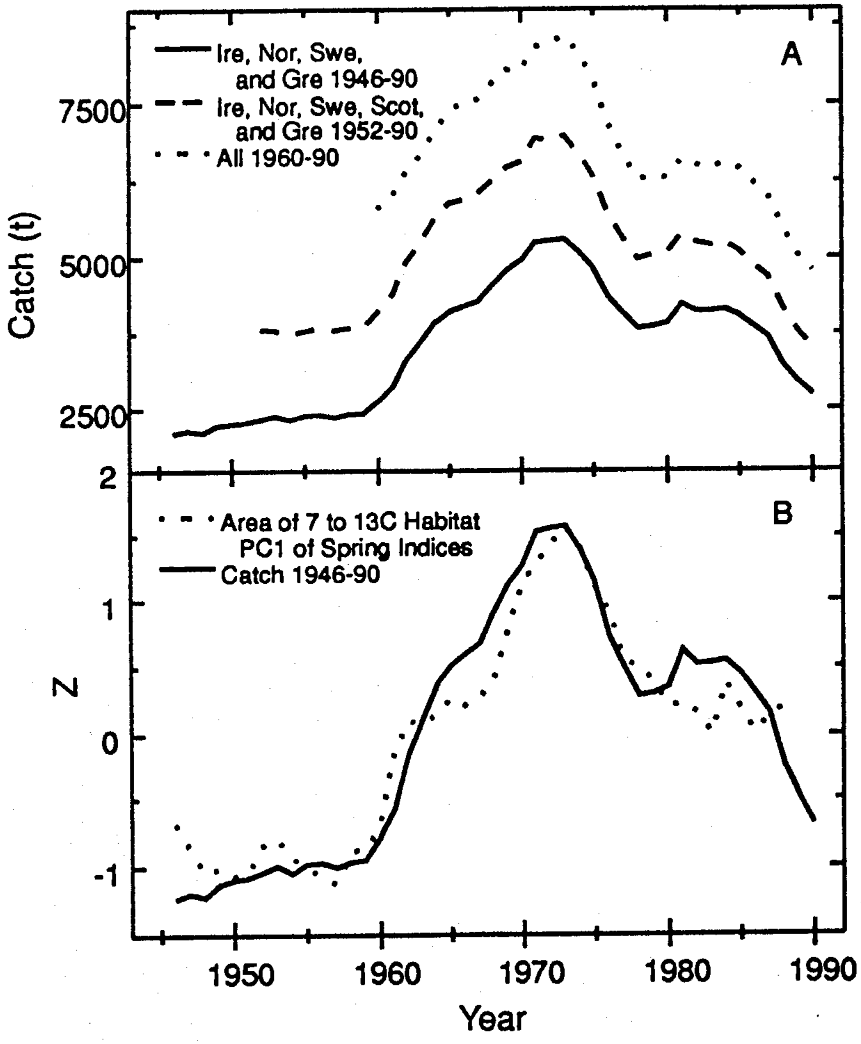


Figure 3.1.3.1. Comparison of harvest estimates of Maine origin salmon at West Greenland, 1987-92.

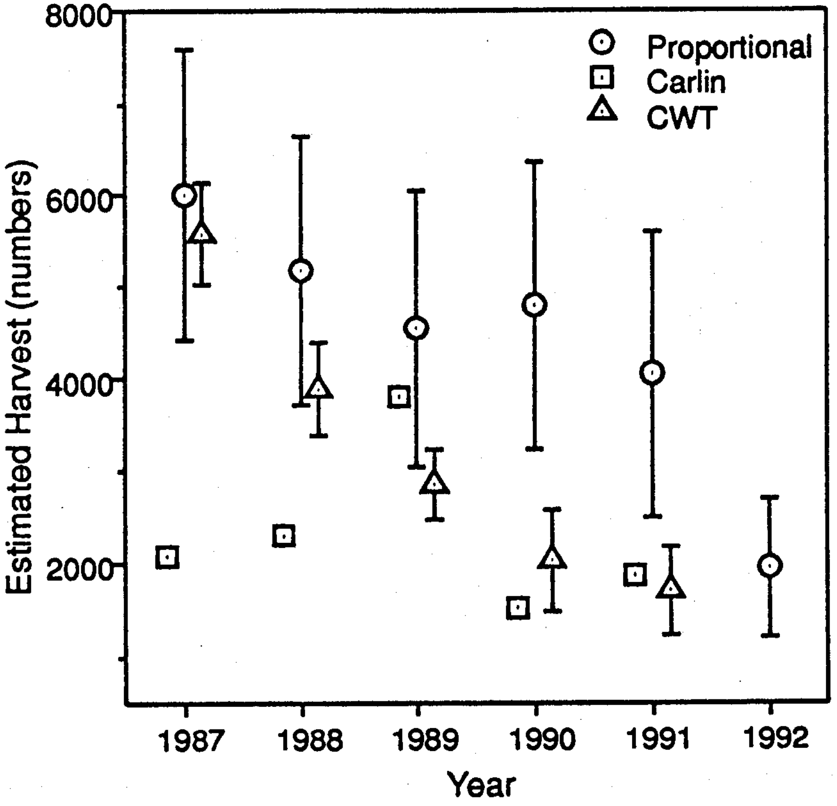


Figure 3.3.1.1. Minimum and maximum estimates of exploitation rates on non-maturing 1SW North American salmon at West Greenland, 1974-91.

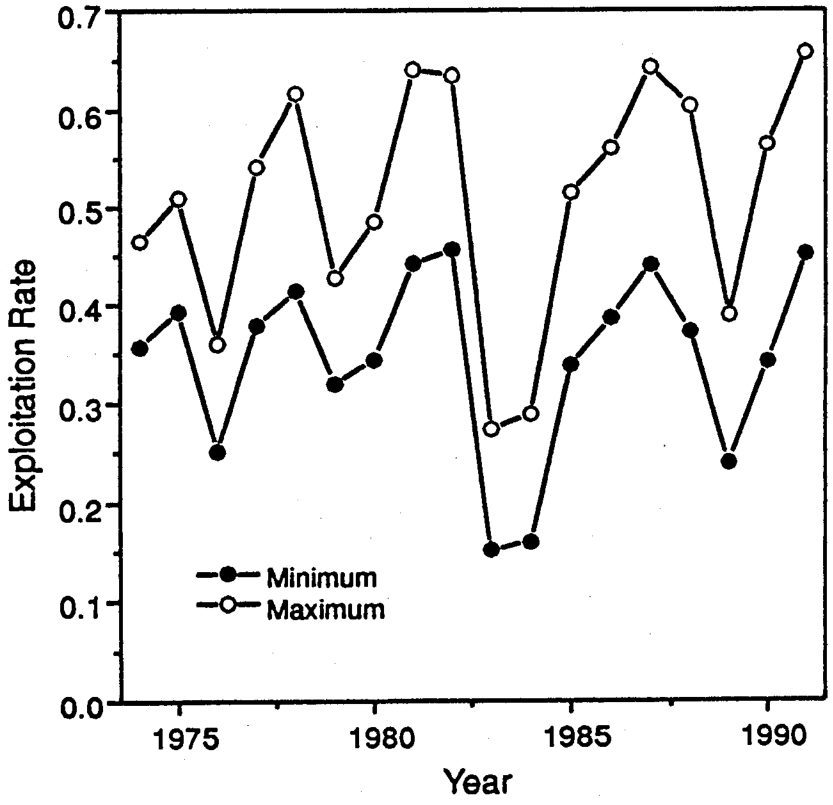


Figure 3.3.1.2. Minimum and maximum estimates of total stock abundance of Atlantic salmon at West Greenland, 1974-91.

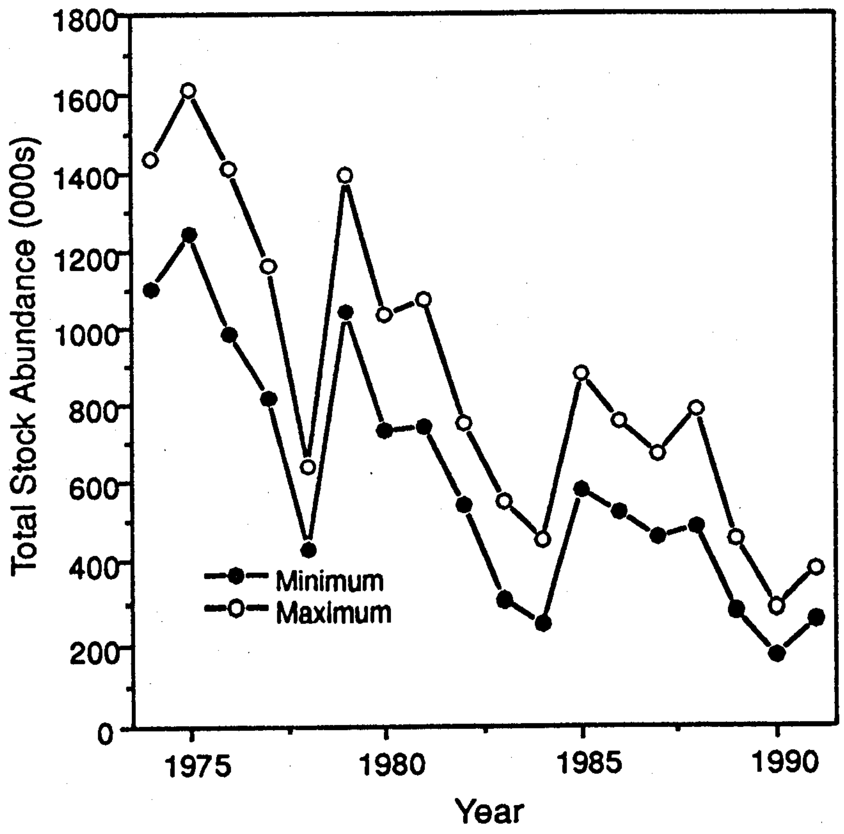


Figure 3.3.1.3. Minimum and maximum estimates of stock abundance of North American and European Atlantic salmon at West Greenland, 1974-91.

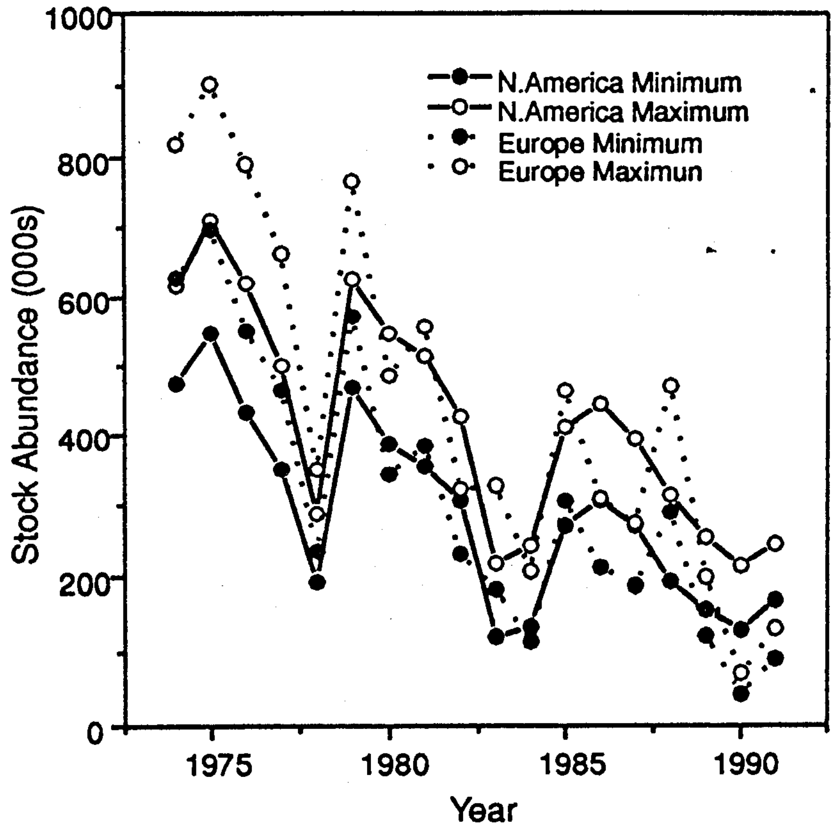


Figure 3.3.2.1. Comparison of exploitation rates in Canada and Greenland as determined by tagging experiments with Maine stocks (P=0.1) and by the continental run-reconstruction model.

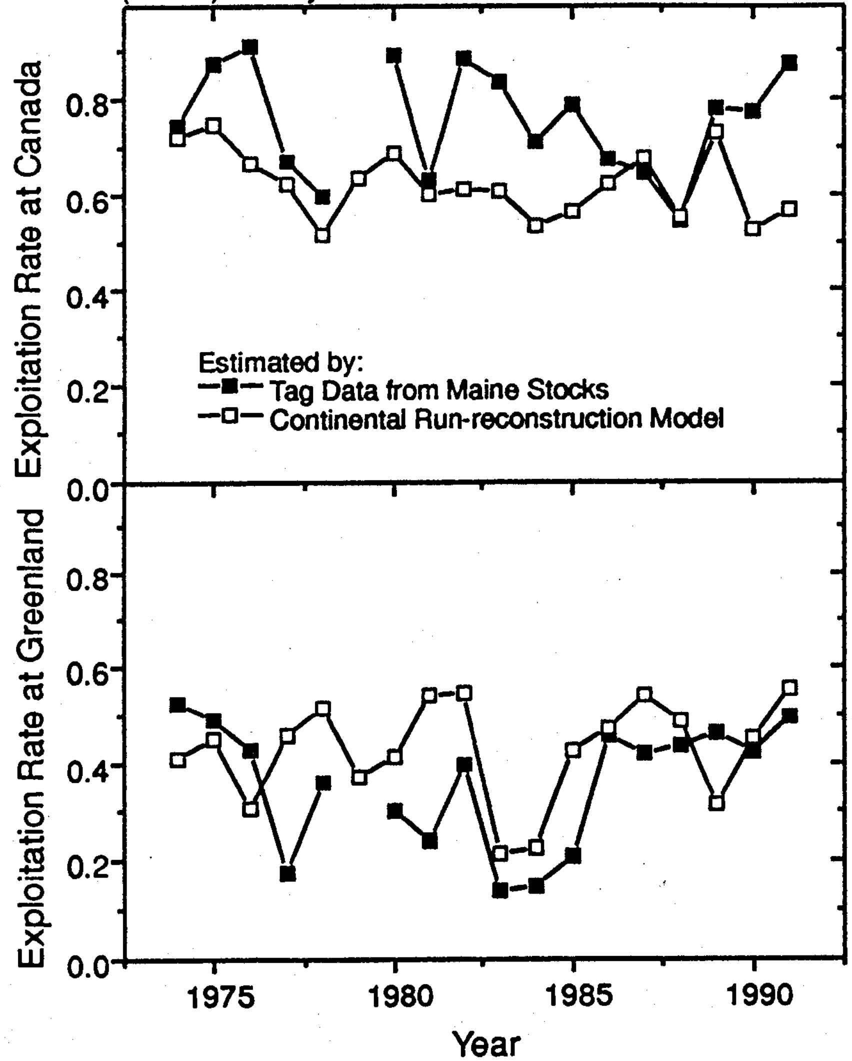


Figure 3.3.3.1. Proportional contribution of the northern North American stock complex to the West Greenland fishery, 1974-92.

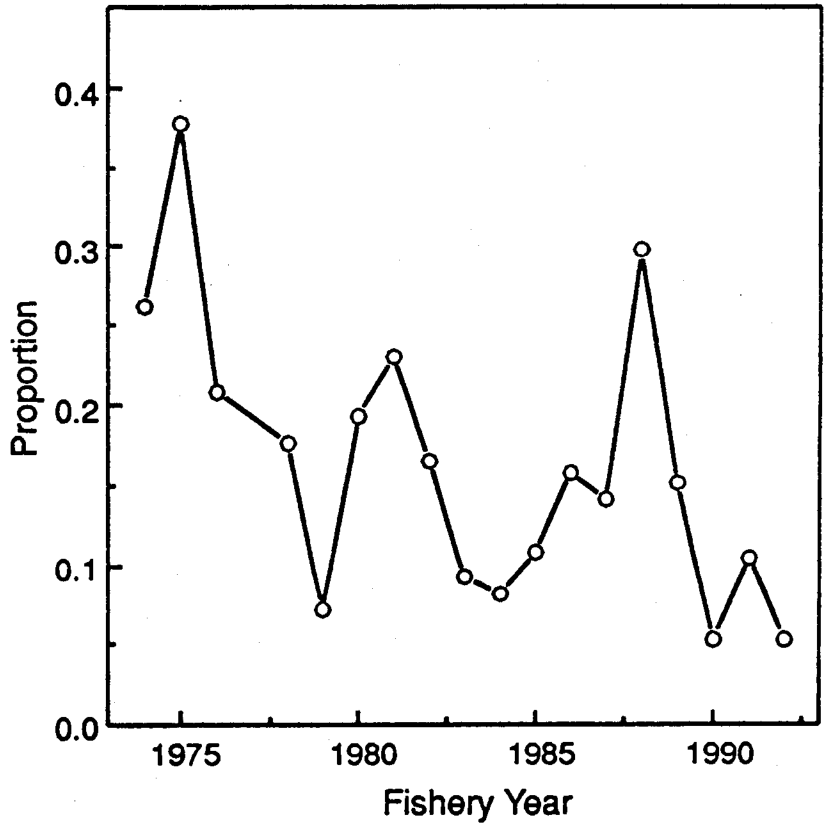


Figure 3.3.3.2. Estimated catches of northern and southern North American stock complexes at West Greenland, 1974-92.

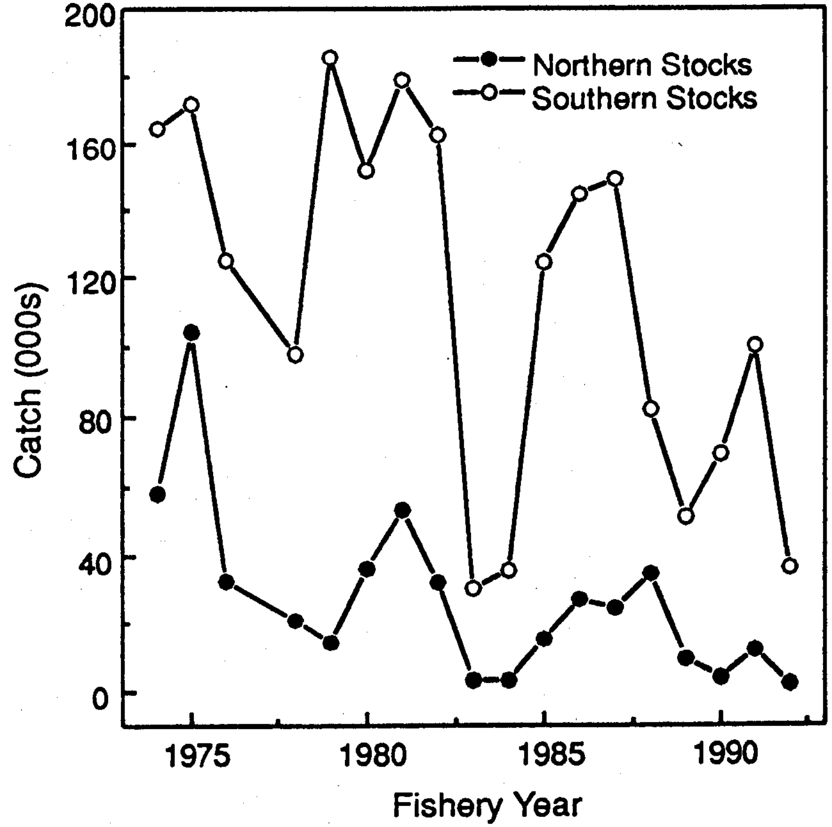


Figure 3.3.4.1. Comparison of observed returns of 2SW salmon to North America and projected returns assuming that the Greenland quota had not been reduced from 1190t.

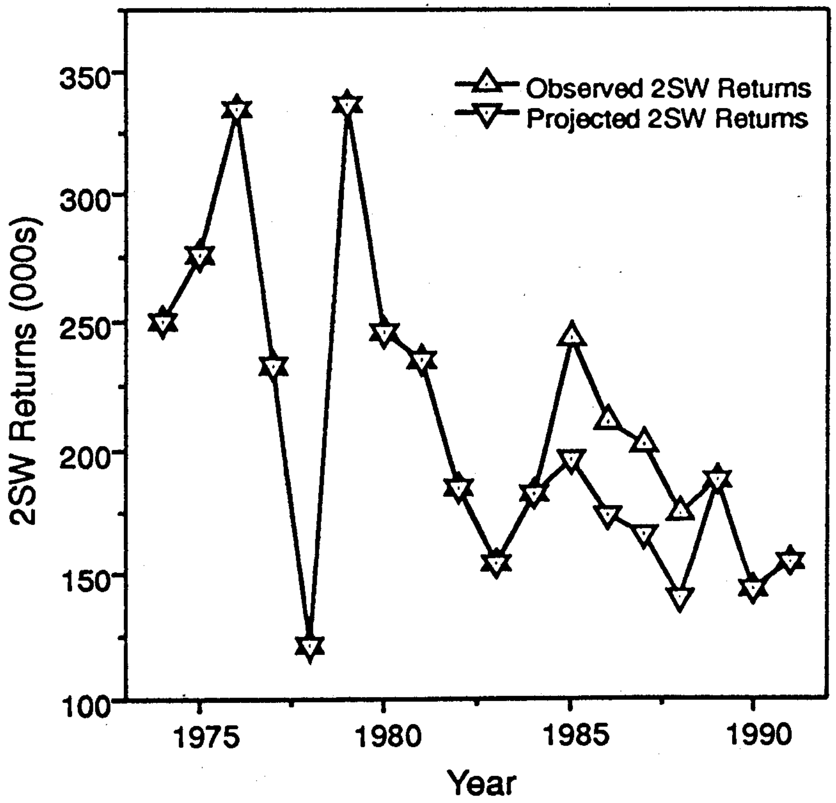


Figure 3.3.4.2. Comparison of observed returns of 2SW salmon to North America and projected returns assuming that Canada had not reduced fishing mortality from the average exploitation rate of 0.44 in 1974-77 in the Newfoundland-Labrador fishery.

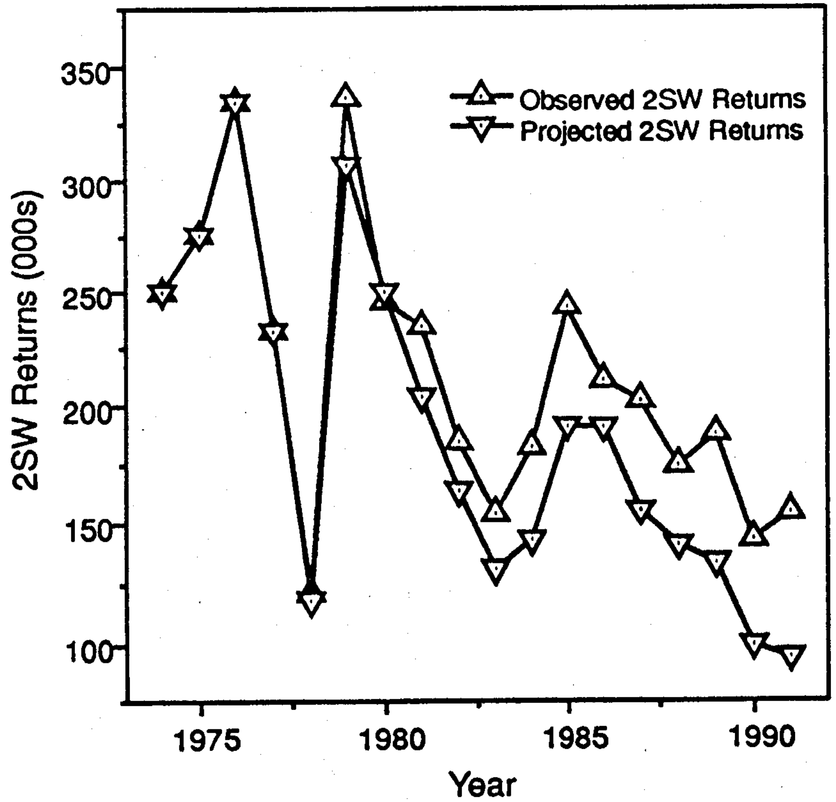


Figure 3.3.4.3. Comparison of observed returns of 2SW salmon to North America and projected returns based on the combined effects of 1) no reduction of the Greenland quota from 1190t and 2) no reduction in exploitation in Nfld.-Lab. from 1974-77 average of 0.44.

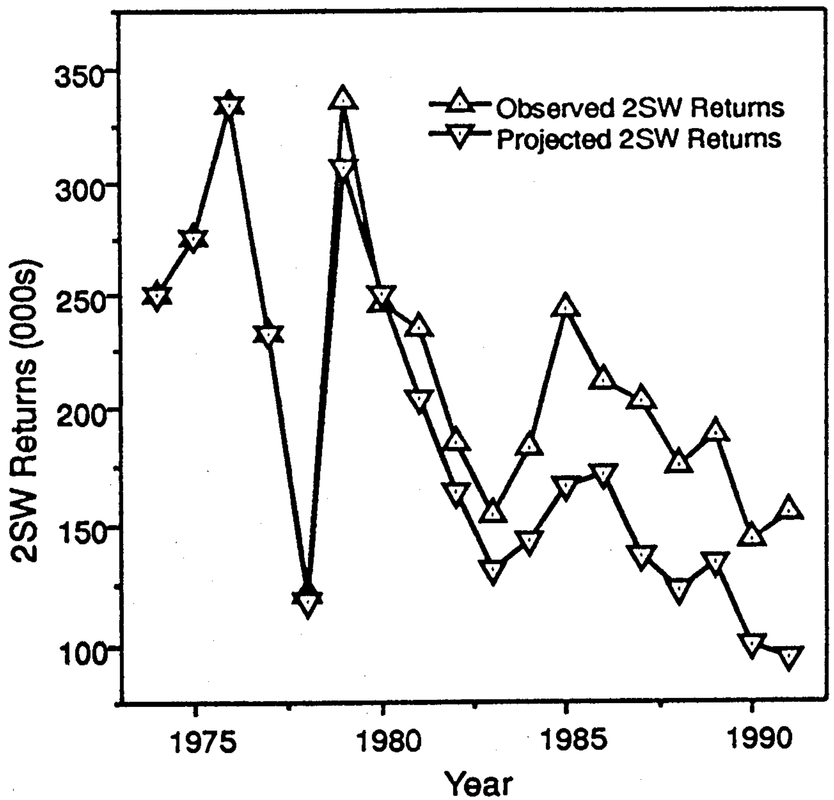


Figure 3.4.1.1. March index of overwintering habitat in the Labrador Sea from 1970-93.

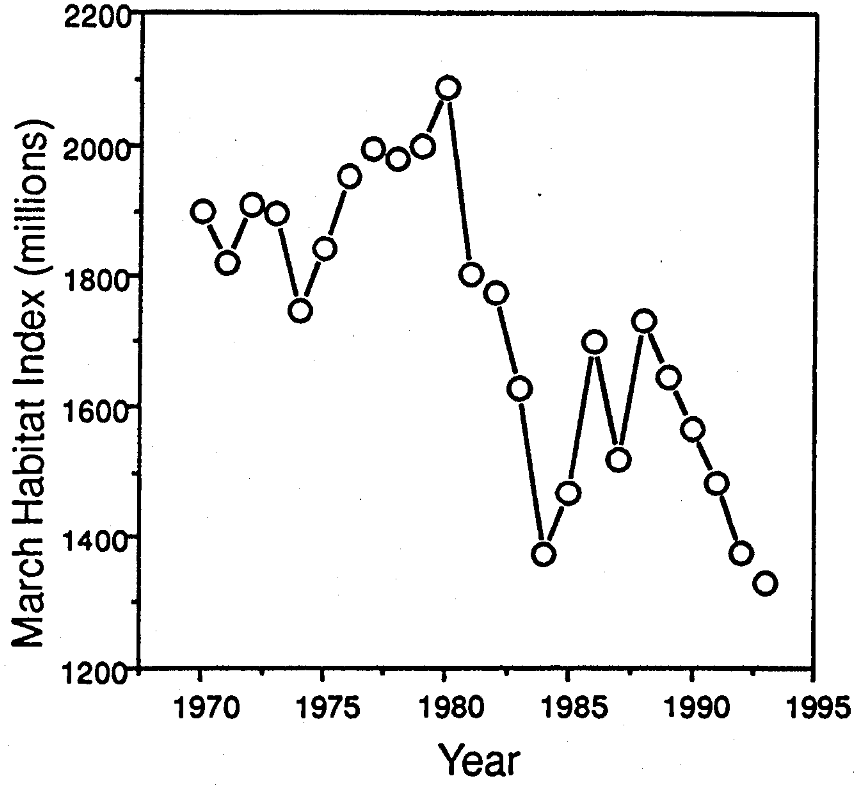


Figure 3.4.1.2. Pre-fishery abundance and predicted values based on habitat area in March (A). Relationship of pre-fishery abundance on weighted habitat area in March (B).

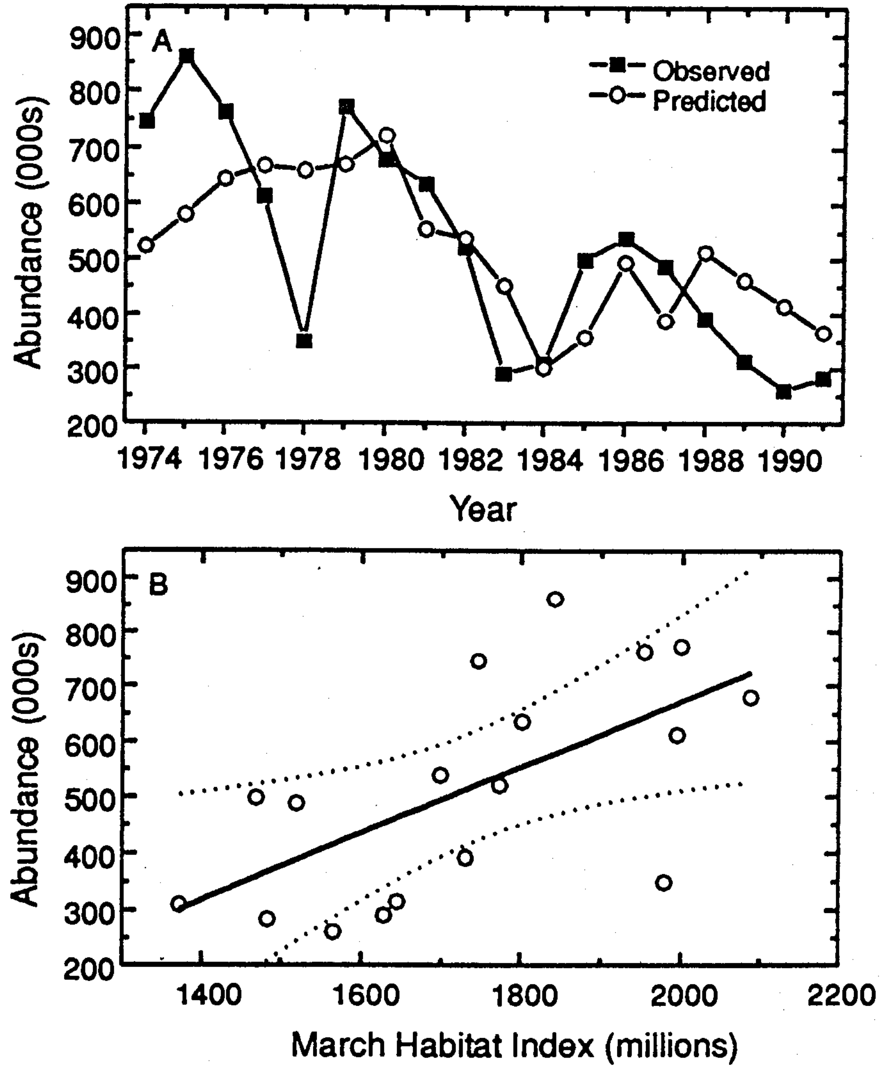


Figure 3.4.1.3. Estimates of pre-fishery abundance of non-maturing North American stock complex.

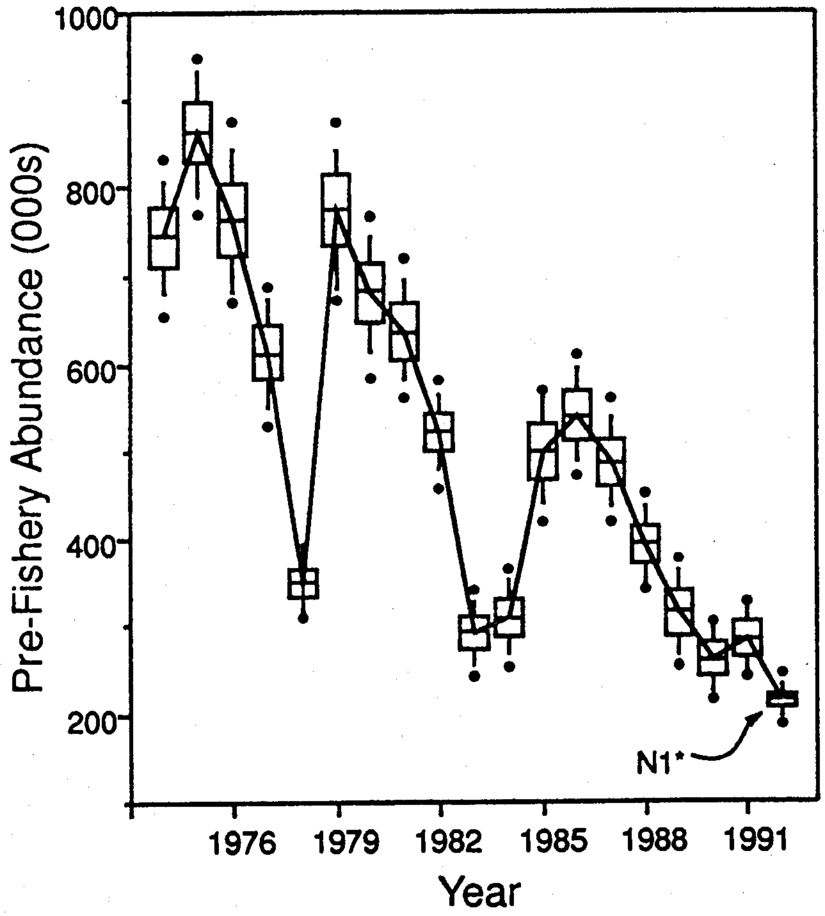


Figure 3.4.1.4. Univariate and regression forecasts of pre-fishery abundance in 1993. Dot centers indicate interquartile range of estimate, cross center indicates interquatile range of point estimates for stochastic forecasts only.

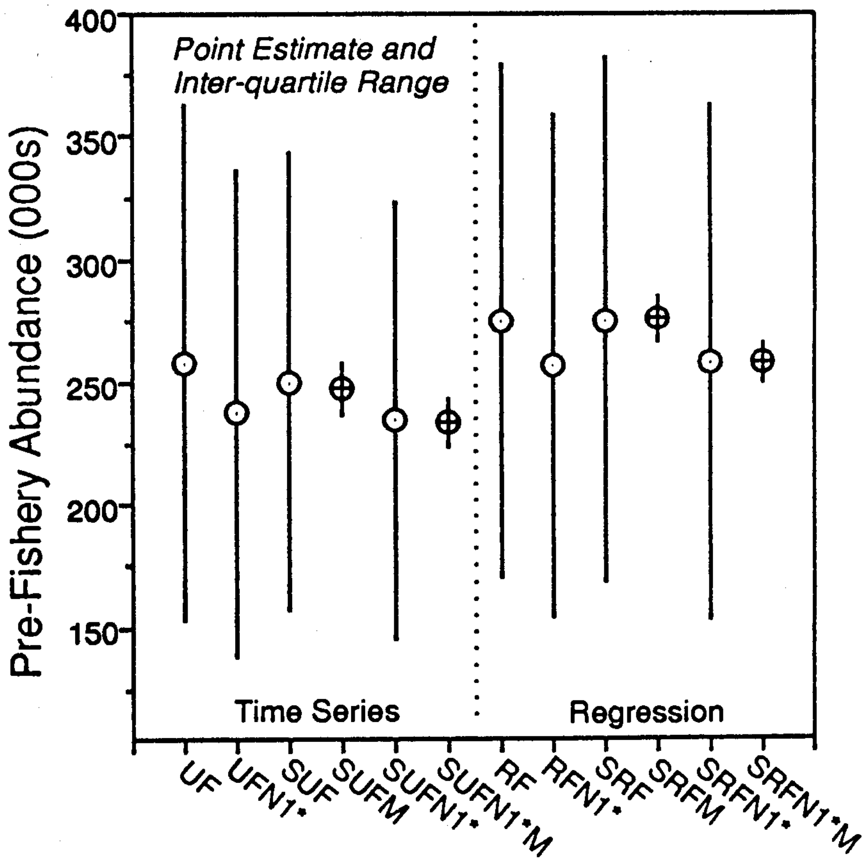


Figure 3.4.2 A probability density function of pre-fishery abundance on non-maturing stocks.

Panel C illustrates the amount of uncertainty associated with the estimate of pre-fishery abundance (PFA) in 1993. The Y-axis gives the probability (chance) that PFA is greater than any of the possible PFA values given on the X-axis. For example, there is a 75% chance that the true PFA is greater than 153,000 but only a 25% chance that the true PFA is greater than 363,000. The uncertainty in PFA implies that there will also be uncertainty in achieving the target spawning escapement level. For reference, the vertical line passing through each of the panels, gives the number of PFA fish (219,132) needed to ensure achievement of the target spawning escapement (196,306). However, the "risk" to the stock in terms of long-term productivity (or other factors) associated with not achieving this escapement is not illustrated by this figure.

In Panels A and B

The pre-fishery abundance level selected can be allocated with respect to the porportional allocation at West Greenland and North America.

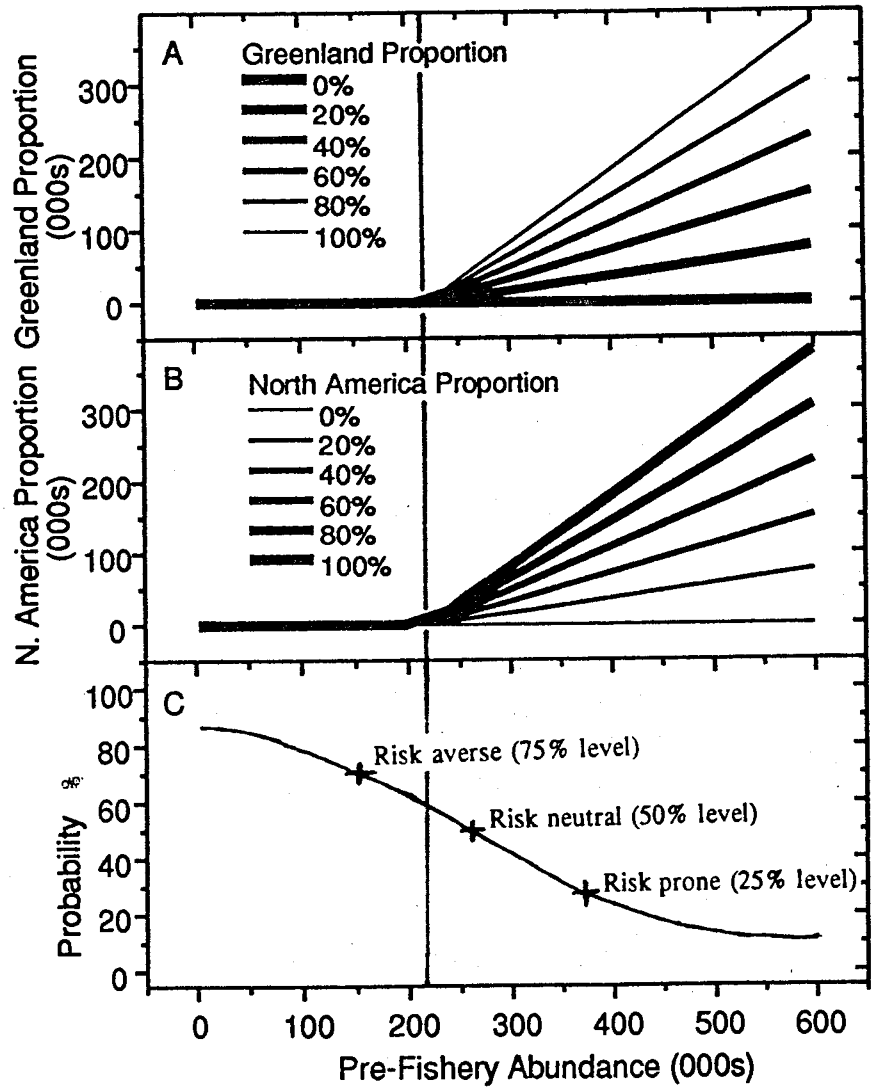


Figure 3.4.2.2. Predicted exploitation versus Greenland catch levels based on an assumed pre-fishery abundance level of 258,000.

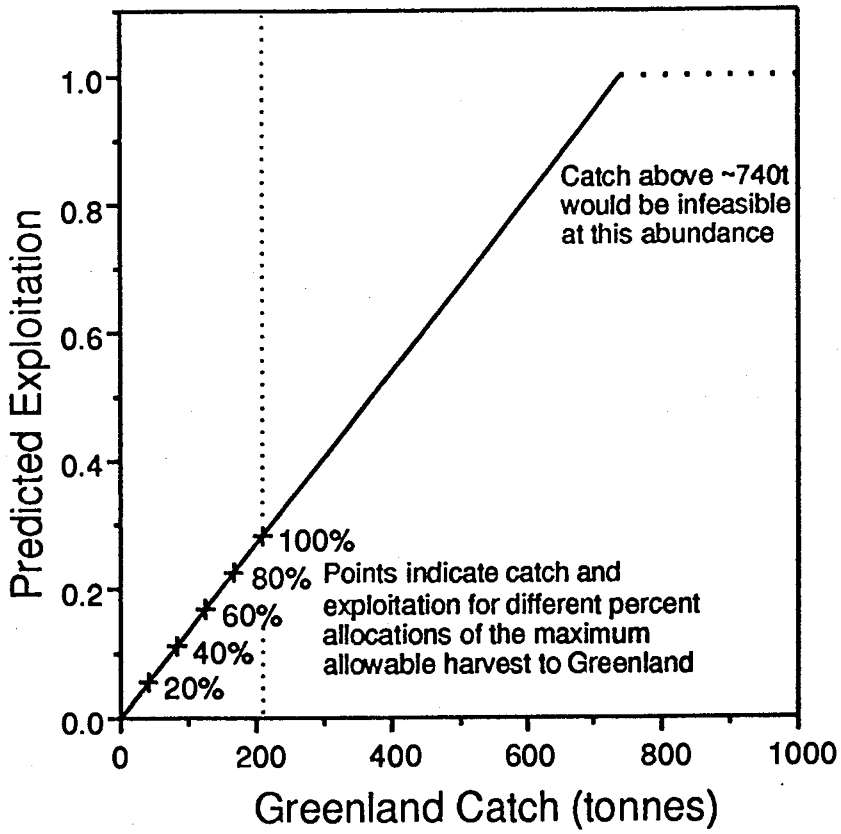


Figure 3.6.1. Reporting rate estimates at West Greenland based on comparison of Carlin and CWT recoveries.

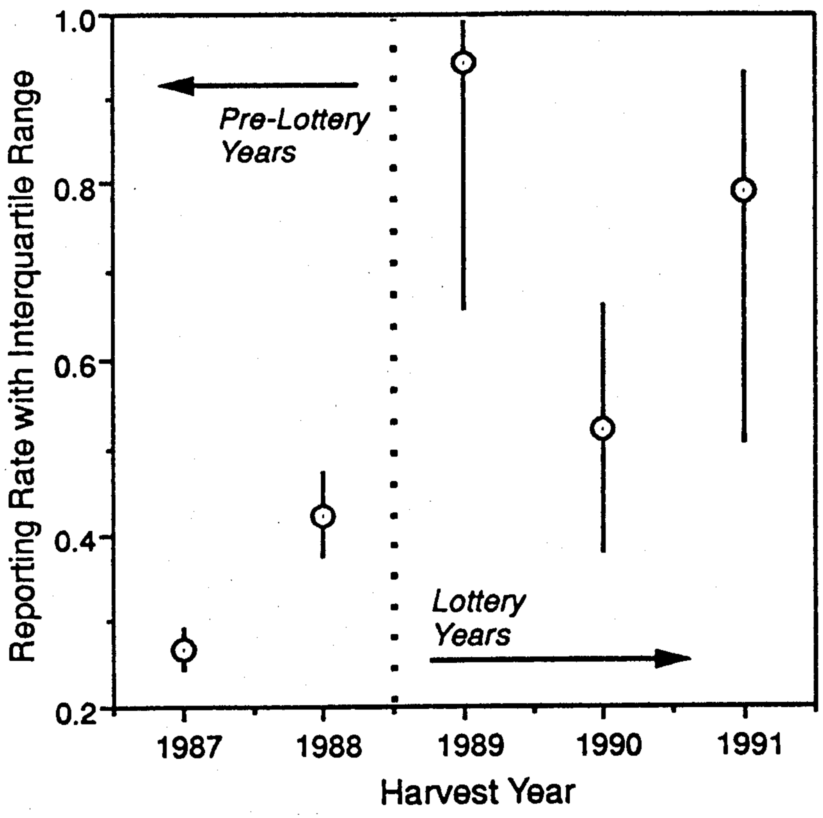
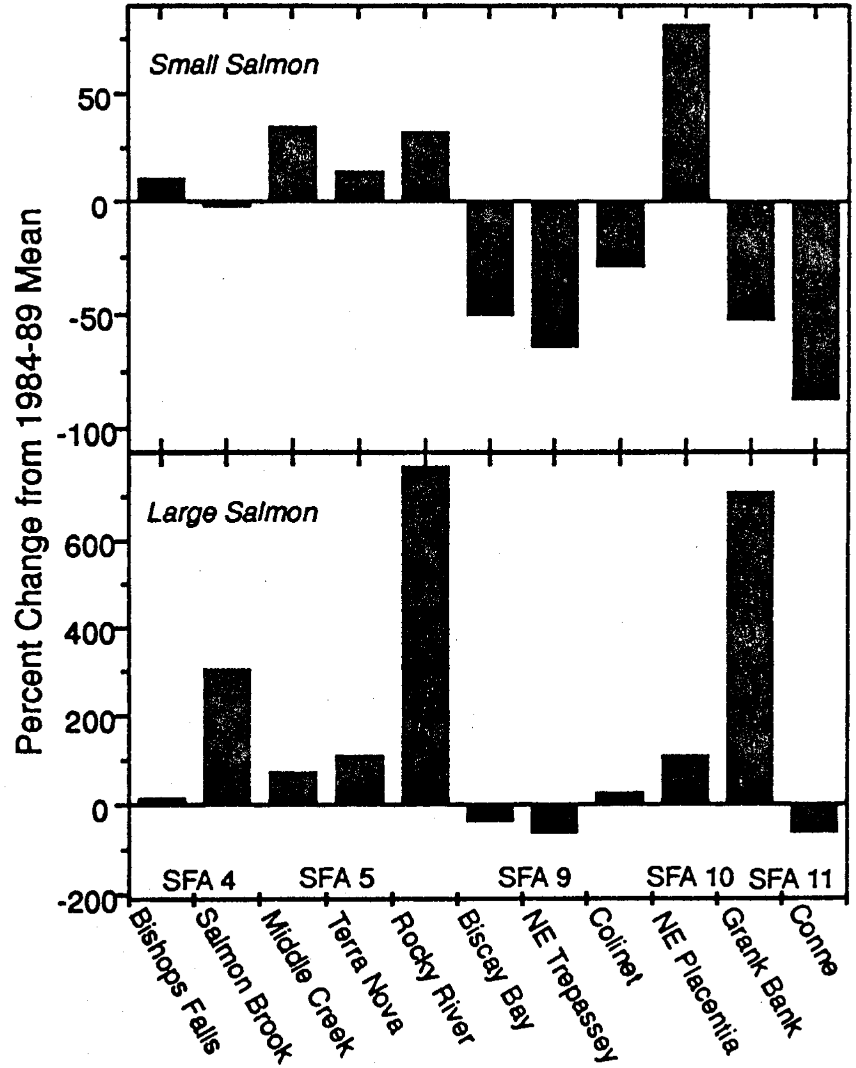


Figure 4.4.1.1. Counts of small and large salmon from fishways and counting fences in insular Newfoundland indicating 1992 returns as a percentage of 1984-89 mean.



ANNEX 8

COUNCIL

CNL(93)50

DECISION OF THE COUNCIL TO REQUEST SCIENTIFIC ADVICE FROM ICES

CNL(93)50

DECISION OF THE COUNCIL TO REQUEST SCIENTIFIC ADVICE FROM ICES

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

   a) describe the events of the 1993 fisheries with respect to catches (including unreported catches), gear, effort, composition and origin of the catch and rates of exploitation;
   b) describe the status of the stocks occurring in the Commission area, and where possible evaluate escapement against targets;
   c) specify data deficiencies and research needs.

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

   a) quota management and closures implemented after 1991 in the Canadian commercial salmon fisheries;
   b) the suspension of commercial fishing activity at Faroes.

3. With respect to the fishery in the West Greenland Commission area:

   a) continue the development of the model used in providing advice on catch quotas in relation to stock abundance;
   b) estimate the pre-fishery abundance of non-maturing 1SW salmon at the time of the fishery;
   c) provide catch options with an assessment of risks relative to the management objective of achieving various levels of target spawning escapement;
   d) describe which stocks make the greatest numerical contributions of salmon to the fishery;
   e) evaluate the relationship between spawning escapement and subsequent pre-fishery abundance.

4. Evaluate the abundance of fish farm escapees and sea-ranched fish in fisheries and rivers and the genetic, disease and parasite, ecological and environmental impacts of these fish on the wild stocks and any impacts from current hatchery practices.

5. Evaluate grilsification mechanisms and assess the impact that grilsification may have on stock abundance and future spawning requirements.

6. Evaluate evidence for recruitment overfishing occurring on Atlantic salmon populations.

7. Evaluate the prospects of developing predictive models of annual migration and distribution of Atlantic salmon stock complexes.

8. Evaluate the results of the research programme at the Faroes.

9. With respect to Atlantic salmon in the NASCO area, provide a compilation of microtag, finclip and external tag releases by ICES Member Countries in 1993.

ANNEX 9

COUNCIL

CNL(93)15

CATCH STATISTICS RETURNS BY THE PARTIES

CNL(93)15

CATCH STATISTICS RETURNS BY THE PARTIES

1. The Official Catch Statistics for 1992, as submitted by the Parties, are tabulated overleaf (Table 1). The figures for 1992 are provisional. These catch statistics, rounded to the nearest tonne, will be used to calculate the contributions to NASCO for 1994 unless the Secretary is advised otherwise.

2. Under Article 12 of the Convention, the Secretary shall compile and disseminate statistics and reports concerning salmon stocks subject to the Convention. Table 2 presents catch statistics for the period 1960-1992 by Party to the NASCO Convention.

3. Tables 1 and 2 are set out in the format for the presentation of catch statistics which was agreed by the Council at its Fifth Annual Meeting. A further, more detailed, record of catch statistics during the period 1960-1992 is provided, for information only, in paper CNL(93)16.

Secretary
Edinburgh
12 May 1993

TABLE 1: OFFICIAL CATCH STATISTICS

	PROVISIONAL 1992 CATCH (TONNES)	PROVISIONAL 1992 CATCH ACCORDING TO SEA AGE						CONFIRMED 1991 CATCH (TONNES)
		1SW		MSW		TOTAL		
		NO	WT	NO	WT	NO	WT	
CANADA	470	-	179	-	291	-	470	711
DENMARK (in respect of Faroe Islands and Greenland)	260	-	-					532.7
FAROE ISLANDS *(1)	23	16	-	8,448	-	8,464	-	95
GREENLAND	237	-	-	-	-	-	-	437.7
EUROPEAN ECONOMIC COMMUNITY	1460.9	-	-	-	-	-	-	1,139.3
FINLAND	78	-	-	-	-	-	-	69
ICELAND	590	149,700	-	34,600	-	184,300	-	505
NORWAY	850	150,580	301	94,624	549	245,204	850	877
RUSSIAN FEDERATION	161	34,015	77	12,877	84	46,892	161	215
SWEDEN	49	9,850	23	4,656	26	14,506	49	38
UNITED STATES OF AMERICA	0.7	54	0.1	139	0.6	193	0.7	0.8

*(1) Breakdown of the Faroese catch according to sea-age is for the 1991/92 season catch of 31 tonnes. The Faroese fishery was subject to a compensation agreement in 1991 and 1992.

TABLE 2: CATCHES OF ATLANTIC SALMON BY THE PARTIES TO THE NASCO CONVENTION

	CANADA	DENMARK*	EEC	FINLAND	ICELAND	NORWAY	RUSSIAN FEDERATION	SWEDEN	USA
1960	1636	60	2683		100	1576	1100	40	1
1961	1583	127	2331		127	1456	790	27	1
1962	1719	244	3946		125	1838	710	45	1
1963	1861	466	3889		145	1697	480	23	1
1964	2069	1539	4283		135	2040	590	36	1
1965	2116	861	3726		133	1900	590	40	1
1966	2369	1338	3582		106	1823	570	36	1
1967	2863	1600	4524		146	2058	883	25	1
1968	2111	1167	3660		162	1752	827	150	1
1969	2202	2350	4428		133	2083	360	76	1
1970	2323	2354	4099		195	1861	448	52	1
1971	1992	2511	3804		204	1847	417	35	1
1972	1759	2146	4221	32	250	1976	462	38	1
1973	2434	2402	4580	50	256	2126	772	73	3
1974	2539	1945	4416	76	225	1973	709	57	1
1975	2485	2086	4473	76	266	1754	811	56	2
1976	2506	1479	2910	66	225	1530	772	45	1
1977	2545	1652	3006	59	230	1488	497	10	2
1978	1545	1159	3070	37	291	1050	476	10	4
1979	1287	1694	2543	26	225	1831	455	12	3
1980	2680	2052	2593	34	249	1830	664	17	6
1981	2437	2602	2532	44	163	1656	463	26	6
1982	1798	2609	2523	83	147	1348	354	25	6
1983	1424	1433	3509	78	198	1550	507	28	1
1984	1112	997	2290	73	159	1623	593	40	2
1985	1133	1430	2989	49	217	1561	659	45	2
1986	1559	1490	3524	38	330	1597	608	53	2
1987	1784	1539	2593	49	250	1385	559	47	1
1988	1311	1136	2833	34	412	1076	419	40	1
1989	1139	701	2450	52	277	905	359	29	2
1990	912	542	1645	59	426	930	316	33	2
1991	711	533	1139	69	505	877	215	38	1
1992	470	260	1461	78	590	850	161	49	1

NOTES: *In respect of the Faroe Islands and Greenland

1. The EEC catch consists of the sum of the catches of the present members of the Community for which data are available.
2. The catch for Denmark in respect of the Faroe Islands and Greenland includes the catch for Greenland when it was a member of the European Community and the catches up to 1983 by Denmark.
3. Figures from 1986 on are the official catch returns to NASCO. Figures to 1986 are based on data contained in the ICES Working Group Reports.
4. The Faroese fishery was subject to a compensation agreement in 1991 and 1992.

ANNEX 10

COUNCIL

CNL(93)51

MINIMUM STANDARD FOR CATCH STATISTICS

CNL(93)51

MINIMUM STANDARD FOR CATCH STATISTICS

1. At its Seventh Annual Meeting the Council agreed that the establishment of a minimum standard for catch statistics was desirable. Last year the Council considered a draft minimum standard which had been prepared to assist in consultations with the Parties. There was support for this draft minimum standard and it was agreed that, following the incorporation of a section on fishing effort, the Secretary should proceed with consultations with the Parties.

2. In accordance with this decision a revised draft minimum standard was circulated to the Parties on 4 February requesting that any difficulties in meeting the standard be submitted to the Secretary by 1 April with a view to adopting the minimum standard at the Tenth Annual Meeting.

3. Responses from the Parties have indicated that no major problems are anticipated in meeting this minimum standard. Comments made by the Parties have been incorporated into the revised document attached (Appendix 1). There is growing interest in the practice of catch-and-release in recreational salmon fisheries and the question of how to deal with this in the statistics has been raised. It is proposed that fish which are caught and immediately released to the water should not be included.

4. The Council is asked to consider the revised version and to adopt it as a minimum standard for salmon catch statistics in NASCO member countries.

Secretary
Edinburgh
7 May 1993

Appendix 1

MINIMUM STANDARD FOR CATCH STATISTICS ADOPTED BY THE COUNCIL AT ITS TENTH ANNUAL MEETING 7-11 JUNE 1993, EDINBURGH, UK

THE ATLANTIC SALMON CATCH STATISTICS OF THE PARTIES TO THE NASCO CONVENTION SHOULD:

- include catches from all components of the salmon fisheries where these catches are retained
- include returns to ranching units
- include both the number and weight of salmon
- weight should be whole round weight or be converted to whole round weight equivalent using appropriate conversion factors where fish are landed gutted or gutted and glazed
- be differentiated into sea-age class or alternatively into grilse and multi-sea-winter salmon
- differentiate, wherever possible, between wild fish and fish which have escaped from fish farms
- include salmon caught in non-salmon gear where retention of fish caught in this way is legal
- information on fishing effort should, wherever possible, be obtained for all components of the salmon fisheries.

NOTE: The Parties to the NASCO Convention also wish to:

~ encourage studies to assess non-catch fishing mortality in both salmon directed and non-directed gears in particular unreported catches

~ encourage measures to reduce the level of non-catch fishing mortality in particular unreported catches

ANNEX 11

COUNCIL

CNL(93)18

SUMMARY OF MICROTAG, FINCLIP AND EXTERNAL TAG RELEASES IN 1992

CNL(93)18

SUMMARY OF MICROTAG, FINCLIP AND EXTERNAL TAG RELEASES IN 1992

1. The Annual summary of the information on tagging programmes conducted by the Parties in 1992 is attached as Table 1. In excess of 4.5 million fish were either tagged or marked prior to release during 1992, of which 41% were microtagged, 52% were finclipped (principally adipose clips), 7% were tagged with external tags (principally Carlin tags) and less than 1% were branded or dyemarked. Approximately 2 million fish bore auxiliary marks, principally adipose clips used in conjunction with microtagging. Thus a total of almost 4.2 million adipose clipped fish were released in 1992 of which approximately 1.8 million carried microtags. Out of the total of 4.5 million marked fish released, approximately 98% were of hatchery origin.

2. Table 2 presents a comparison of the tagging programmes in 1991 and 1992. The 1992 figure of 4.5 million released marked fish is 21% higher than the number released the previous year. There was a 5% increase in the release of microtagged fish and a 6% increase in the number of fish that were externally tagged. The increase overall, however, was due to a 43% increase in the number of fish that were finclipped. There was a small increase in the number of wild fish tagged in 1992 compared to 1991.

Secretary
Edinburgh
13 May 1993

TABLE 1

SUMMARY OF 1992 TAG RELEASES BY PARTY

PARTY	ORIGIN	MARKING METHOD				
		MICROTAGS	EXTERNAL TAGS	BRANDS, DYEMARKS ETC.	FINCLIPS	AUXILIARY TAGS, FINCLIPS, MARKS ETC.
CANADA	Hatchery	24,265	56,932	-	1,621,735	65,103
	Wild	26,214	10,023	-	3,730	26,334
	Mixed*	-	2,334	-	-	35
	TOTAL	50,479	69,289	-	1,625,465	91,472
EEC	Hatchery	747,706	11,603	13,061	191,419	816,080
	Wild	33,045	5,605	-	330	34,519
	TOTAL	780,751	17,208	13,061	191,749	850,599
FINLAND	Hatchery	-	-	-	-	-
	Wild	-	91	-	-	91
	TOTAL	-	91	-	-	91
ICELAND	Hatchery	347,771	1,493	-	-	347,771
	Wild	5,182	-	-	-	5,182
	TOTAL	352,953	1,493	-	-	352,953
NORWAY	Hatchery	34,700	161,708	-	171,400	81,500
	Wild	-	5,913	-	-	-
	TOTAL	34,700	167,621	-	171,400	81,500
RUSSIAN FEDERATION	Hatchery	-	2,600	-	265,900	2,600
	Wild	-	-	-	-	-
	TOTAL	-	2,600	-	265,900	2,600
SWEDEN	Hatchery	-	5,720	-	28,280	-
	Wild	-	249	-	-	-
	TOTAL	-	5,969	-	28,280	-
USA	Hatchery	622,428	50,023	-	50,342	622,428
	Wild	1,193	47	-	-	1,193
	Mixed*	-	52	-	-	-
	TOTAL	623,621	50,122	-	50,342	623,621
TOTAL	**Hatchery**	**1,776,870**	**290,079**	**13,061**	**2,329,076**	**1,935,482**
	Wild	**65,634**	**21,928**	**-**	**4,060**	**67,319**
	Mixed	**-**	**2,386**	**-**	**-**	**35**
	TOTAL	**1,842,504**	**314,393**	**13,061**	**2,333,136**	**2,002,836**

* Either not differentiated into hatchery or wild fish or origin unknown.

TABLE 2

COMPARISON OF 1991 AND 1992 TAGGING PROGRAMMES

	1991	1992	% CHANGE
MICROTAGS			
Hatchery	1,693,225	1,776,870	+4.9
Wild	66,648	65,634	-1.5
TOTAL	1,759,873	1,842,504	+4.7
EXTERNAL TAGS			
Hatchery	266,995	290,079	+8.6
Wild	20,681	21,928	+6.0
Mixed	9,779	2,386	-75.6
TOTAL	297,455	314,393	+5.7
BRANDS, DYEMARKS			
Hatchery	29,331	13,061	-55.5
Wild	1,380	-	-
TOTAL	30,711	13,061	-57.5
FINCLIPS			
Hatchery	1,626,711	2,329,076	+43.2
Wild	2,744	4,060	+47.9
TOTAL	1,629,455	2,333,136	+43.2
TOTAL			
HATCHERY	**3,616,262**	**4,409,086**	**+21.9**
WILD	**91,453**	**91,622**	**+0.2**
MIXED	**9,779**	**2,386**	**-75.6**
TOTAL	**3,717,494**	**4,503,094**	**+21.1**

COUNCIL

CNL(93)19

NASCO TAG RETURN INCENTIVE SCHEME

CNL(93)19

NASCO TAG RETURN INCENTIVE SCHEME

1. The NASCO Tag Return Incentive Scheme was established on a trial basis covering tags returned in the four years 1989-1992. At its Ninth Annual Meeting the Council accepted an offer from the US to fund the Scheme for an additional year covering tags returned in 1993. In accordance with the Rules of the Scheme the participating Parties were requested to provide by 1 May a list of names and addresses of persons returning eligible external tags during the year 1 January - 31 December 1992. The country of recapture of the tags was also requested in order that each tag could be allocated to its appropriate Commission area.

2. In 1993 a total of 1812 eligible tags were returned and entered into the draw for the Grand Prize. This is an increase over 1992 of 2.7%. 913, 48 and 851 eligible tags were entered into the draws in the North American Commission, West Greenland Commission and the North-East Commission respectively. The draw will be made by the auditors to NASCO and in accordance with the Rules of the Scheme. The winner of the $2,500 prize will be announced by the President at the Tenth Annual Meeting of the Council. The winners of the prizes in each Commission area will be announced by the Chairmen of the respective Commissions.

3. The prizes awarded this year for tags returned during 1992 are the last in the initial four year trial period. However, the Scheme will be funded by the US for an additional year covering tags returned during 1993. Assessments by ICES suggest that the Scheme has increased the reporting rate of Carlin tags in the West Greenland fishery and concern was expressed about potential trends in reporting rates if it was to stop. In the North-East Atlantic Commission area no quantitative analysis of the effects of the Scheme was conducted. There was evidence of a positive effect in Finland. In Scotland it is thought that reporting rates are close to 100% in the major fisheries taking tagged fish. In the North American Commission no statistically significant changes were observed. However, in some cases only large increases in reporting rates, of about 50%, would be statistically significant.

4. The awards have generally received good coverage in the media. In St Johns, Newfoundland where the Grand Prize was presented in 1992, good coverage in the press and on local and national radio was obtained. There was also good coverage for the Commission prizes. Over the last three years prizes have been awarded in all participating countries and in most countries publicity for the Scheme has resulted. It would seem safe to assume that awareness of the Scheme and of the potential benefits of returning tags has considerably increased since 1990 when the first awards were announced. The public relations aspects of the Scheme have been very positive. We have seen that it brings right to the river bank or to the fisherman's net an awareness of the need to return tags so as to improve our knowledge of the salmon.

5. On balance it would seem that the Scheme offers an inexpensive method both to encourage tag returns and to give favourable publicity to the work of the Organization. If the Council wishes the Scheme to continue the Secretary might explore various

options, including sponsorship, for continuing the Scheme. The decision can be made in 1994 as the Scheme has assured funding until then.

Secretary
Edinburgh
14 May 1993

ANNEX 13

COUNCIL

CNL(93)20

DATABASE OF SALMON RIVERS FLOWING INTO THE NASCO CONVENTION AREA

CNL(93)20

DATABASE OF SALMON RIVERS FLOWING INTO THE NASCO CONVENTION AREA

1. At its Sixth Annual Meeting the Council decided to establish a database of all salmon rivers flowing into the Convention area with an indication of their status. A format for provision of the information was agreed in 1990 (Appendix 1) and the information was requested from the Parties on 13 March 1991.

2. Last year it was reported that a limited amount of information had been received and that work on establishing the database had commenced. To date returns have been received from four Parties and this information has been incorporated into the database. While all four Parties responding to date have provided the basic information requested (river name, location, category and information on the cause of loss of or threats to, the salmon stocks) additional information on the size of rivers (expressed as either catchment area or mean annual flow) has been provided in some cases.

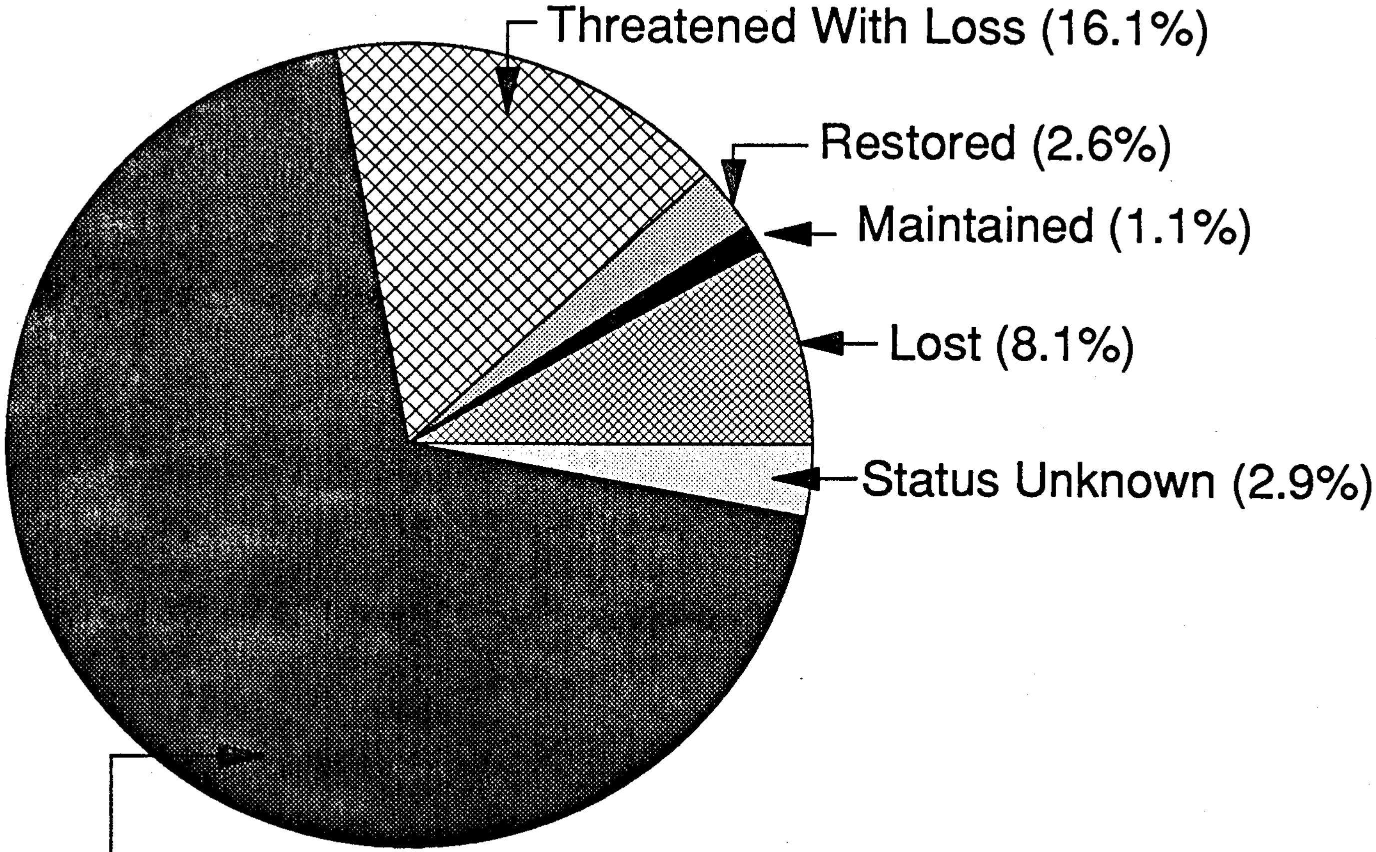
3. In total, information for 921 rivers has now been included in the database and the percentage of rivers in each category is illustrated in Figure 1. It can be seen that for this limited sample about 69% of the rivers have been categorised as being "not threatened with loss". However, a total of 8.1% of the rivers have lost their natural stock of salmon and a further 16.1% are considered to be threatened with loss. For these rivers the most commonly identified threats were deterioration of water quality (including acidification); water regulation and abstraction; diseases and parasites; introductions and transfers (including escapes from fish farms); high marine mortality and over exploitation (including illegal fishing). It should, however, be stressed that the information presented here is based on data for four Parties and may not therefore be representative of the picture in the North Atlantic as a whole.

4. At the Ninth Annual Meeting the President encouraged the Parties to provide the relevant information to the Secretary as soon as possible so that work on this important initiative may commence. Once information has been received from all Parties a comprehensive audit of all salmon rivers flowing into the North Atlantic will be prepared. Over a period of time this will help to record the progress made, in accordance with the Convention, in conservation, restoration and enhancement of salmon stocks.

Secretary
Edinburgh
13 April 1993

NASCO Rivers Database

Figure 1: Proportion of Rivers in Each Category



Sample size = 921

Appendix 1

NASCO SALMON RIVERS DATABASE
FORMAT FOR SUBMISSION OF INFORMATION

CLASSIFICATION OF RIVERS

A river is named as the main stem of the system of rivers and tributaries at the point, within the NASCO Convention area, where it reaches the sea. A tributary is defined as any river or stream which does not flow directly into the sea but flows into a river as defined above.

CATEGORY 1: LOST
Rivers in which there is no natural or maintained stock of salmon but which are known to have contained salmon in the past.

CATEGORY 2: MAINTAINED
Rivers in which there is no natural stock of salmon, which are known to have contained salmon in the past, but in which a salmon stock is now only maintained through human intervention.

CATEGORY 3: RESTORED
Rivers in which the natural stock of salmon is known to have been lost in the past but in which there is now a self-sustaining stock of salmon as a result of restoration efforts or natural recolonization.

CATEGORY 4: THREATENED WITH LOSS
Rivers in which there is a threat to the natural stock of salmon which would lead to loss of the stock unless the factor(s) causing the threat is(are) removed.

CATEGORY 5: NOT THREATENED WITH LOSS
Rivers in which the natural salmon stocks are not considered to be threatened with loss (as defined in Category 4).

INFORMATION REQUIRED

A form for the return of information is attached. For each river details of the river name, its category and locational information (latitude and longitude bearings) for the point at which it enters the sea are requested. In addition a section for other information has been included. It would be useful if the following information, in particular, could be provided if available:

Category 1: Information on the cause and approximate date of the loss.
Category 2: Information on the cause and approximate date of the loss prior to the stock being maintained.
Category 3: Information on the cause and approximate date of the loss prior to restoration.
Category 4: Information on the nature of the threat(s) to the salmon stock.
Category 5: Details of any major losses known to have occurred within these rivers, e.g. major tributaries lost to salmon production.

In the case of Categories 4 and 5 it would be useful if those stocks which are considered to be of particular conservation value could be identified.

In the case of border and cross-border rivers each Party should provide information.

SALMON RIVERS DATABASE - RETURN FORM

PARTY:		COUNTRY/REGION/STATE:		
Category	River Name	Location Latitude	 Longitude	Other Information

ANNEX 14

COUNCIL

CNL(93)23

ECONOMIC VALUE OF ATLANTIC SALMON

CNL(93)23

ECONOMIC VALUE OF ATLANTIC SALMON

1. Previous reviews of the economic value of the Atlantic salmon have concluded that it is a very valuable resource and that in addition to those facets of the value which have been economically assessed people are willing to pay to conserve and restore the salmon for future generations even if they do not themselves intend to use it. Furthermore, the existence of communities which depend on salmon fishing can hardly be given monetary value. It was agreed that the Council should be kept informed of economic assessments and since last year the results of two further studies have been published.

2. Boyle et al (1992) conducted an economic evaluation of Atlantic salmon fishing on the Penobscot river. They found that in 1989 the resident anglers spent an average $116 (£78) and non-resident anglers spent on average $292 (£195) in association with salmon fishing on the Penobscot river. The combined economic impact to Maine's economy during 1989 was $234,506 (£156,300), although only the expenditure by non-residents could be considered as new money in Maine's economy. The authors estimated the overall annual economic benefit to be $335,468 (£223,650). The authors also evaluated two scenarios of potential management policy: suspension of salmon fishing for 5 years to allow the number of spawners to reach 6000 fish annually; and increased stocking rather than natural spawning to increase the number of adults returning to 6000 fish annually. The results indicated that anglers were likely to oppose policies limiting salmon fishing and that anglers tended to be more concerned with being able to fish than with the pure concept of restoring Atlantic salmon to its natural habitat. The authors considered that policies to limit harvest rather than effort would be more acceptable to anglers.

3. A recent review entitled "Biological Diversity in Norway" includes an economic assessment of biological diversity including information concerning the Atlantic salmon (Anon, 1992). It is stated that the value of a resource has traditionally been measured as the gross value of the quantity of biomass that can be harvested. For salmon, trout and sea char this gross value was NOK 36 million (£3.3 million). However, it was concluded that this is a poor measure of the value and other methods of calculating the economic value are discussed. A cost benefit analysis of liming the river Audna is described in which the net present value for conserving Atlantic salmon was estimated to be NOK 97 million (£8.8 million) (based on a 20 year time horizon and 7% discount rate). The authors concluded that there are good economic grounds for such restoration work.

4. These latest studies together with the information presented to the Council in 1991 and 1992 have been summarised in Table 1. As previously reported, a number of different techniques have been used in these economic assessments and comparisons between and even within countries are therefore difficult. The lack of a standard technique is in some cases due to differences in ownership of the fisheries. Nonetheless it is clear that the Atlantic salmon is highly prized and highly valued both by users and non-users of the resource. This value can be assessed as Society's willingness to pay. However, many of the studies listed have assessed only the expenditure by salmon

anglers, ie the actual payment associated with the use of the resource, and as willingness to pay must at least be equal to actual expenditure these estimates may greatly underestimate the true value. Furthermore, there are many facets to the salmon's value comprising user values (both consumptive uses such as angling and non-consumptive uses such as non-fishing tourists) and non-user values (the value associated with having the option to use the resource in the future (option value); the value associated with knowing the species exists (existence value) and the value associated with being able to pass the resource on to future generations (bequest motivation or conservation value)). Most assessments of economic value have been restricted to user values. However, where non-user values have been assessed it is clear that these are high (25-30% of the user values) and studies which fail to take these values into account may therefore seriously underestimate the true value of the resource. Given the various assessments undertaken and their limitations it is only possible to speculate as to the true economic value of the resource in the North Atlantic by scaling up from the results of national studies. On this basis it was speculated last year that the fisheries alone may be worth about £2 billion.

5. In short, economic studies continue to demonstrate the high value of the wild salmon resource not only to the users but to the population at large. In the sphere of fisheries the Atlantic salmon is probably unique in that large numbers of people in all the North Atlantic countries derive pleasure from the existence of the wild stocks and feel that they symbolise that all is well with the world. It may be that in future difficult choices may have to be made about the relations between wild and farmed salmon and it might be useful to look at the value of the wild stocks in comparison to the farmed production.

Secretary
Edinburgh
29 April 1993

TABLE 1 - SUMMARY OF ECONOMIC ASSESSMENTS OF ATLANTIC SALMON

COUNTRY	YEAR	ECONOMIC VALUE	DESCRIPTION OF ASSESSMENT	AUTHORITY
CANADA	1985	£19 million ($28 million)	Expenditure on recreational salmon fishing in Canada	Tuomi (1987)
	1985	£22 million ($33 million)	Investment in major durables and property in conjunction with salmon fishing	Tuomi (1987)
	1985	£23/Fish ($34/fish)	Public cost of salmon supply in Canada	Tuomi (1987)
GREENLAND	1980	30-35% annual income of fishermen	Contribution of commercial salmon fishing to fisheries income	Kreiberg (1980)
UNITED KINGDOM	1978	£84,000 ($126000)	Expenditure by salmon anglers fishing River Usk, Wales	Mawle & Randerson (1983)
	1981-1982	£22-£46 million ($33-$69 million)	Expenditure by salmon anglers fishing in Scotland	Anon (1982)
	1984	£2.4 million ($3.6 million)	Net economic value of recreational salmon fishing on River Lune, England	Radford(1984)
	1984	£28.7 million ($43 million)	Net economic value of recreational salmon fishing on River Wye, Wales	Radford (1984)
	1984	£4.9 million ($7.3 million)	Net economic value of recreational salmon fishing on River Mawddach, Wales	Radford (1984)
	1984	£15.9 million ($24 million)	Net economic value of salmon recreational fishing on River Tamar, Wales	Radford (1984)
	1984	£30 million ($45 million)	Net economic value of recreational salmon fishing in Wales	Radford & Hatcher (1990)
	1988	£340 million ($510 million)	Total net economic value of salmon fisheries in Great Britain	Radford et al (1991)
	1988	£327 million ($490 million)	Total net economic value of salmon sport fisheries in Great Britain	Radford et al (1991)
	1988-1989	£50.4 million ($75 million)	Expenditure by salmon anglers fishing in Scotland	Anon (1989)
	1988-1989	£1.8 million ($2.7 million)	Revenue of salmon netting industry in Scotland	Anon (1989)
	1989	£21-£27 million ($31.5-$40.5 million)	Value of salmon fishing to Scottish economy	Stansfeld (1989)
IRELAND	1982	£11.5 million ($17.2 million)	Economic value of Irish salmon industry	Whelan and Whelan (1982)
	1982	£8.72 million ($13.1 million)	Economic value of Irish salmon industry	Whelan and Whelan (1982)
	1986	£12.6 million ($18.9 million)	Total expenditure by game anglers fishing in Ireland	Whelan and Marsh (1988)
	1986	£16 million ($24 million)	Total expenditure by Irish game anglers	Whelan and Marsh (1988)
ICELAND	1990	£6.5 million ($9.7 million)	Total expenditure on salmon angling permits	Gudbransson (1990)
NORWAY	1990	£3.3 million ($4.9 million)	Value of Norwegian harvest of salmon, trout and sea char	Anon (1992)
	1991	£96,000 ($144,000)	Value of recreational salmon fishery on River Gaula	Rolfsen (1991)
	1991	£5-£17.5 million ($7.5-26.2 million)	Total net benefits of liming project to restore River Audna	Navrud (1991b)
	1991	£1.5 million ($2.2 million)	Value of recreational salmon fishing on River Gaula	Navrud (1991a)
	1991	£61,000-£88,000 ($91500-$132000)	Value of recreational salmon fishing on River Vikesdalselva	Navrud (1991a)
	1991	£62,000-£81,000 ($93000-$121500)	Value of recreational salmon fishing on River Stordalselva	Navrud (1991a)
	1991	£57,000 ($85500)	Value of recreational salmon fishing on River Audna	Navrud (1991a)
USA	1986	£1.7-2.9 billion ($2.6-4.3 billion)	Projected total benefit of New England restoration programme	Edwards (1989)
	1987	>£67 million (>$100 million)	Willingness to pay of New England population to restore rivers	Kay et al (1987)
	1989	£223,600 ($335,468)	Annual benefits of fishing on Penobscot River	Boyle et al (1992)

REFERENCES

Anon (1982): A Study of the Economic Value of Sporting Salmon Fishing in three areas of Scotland. Report to the Department of Agriculture and Fisheries for Scotland by the Tourism and Recreational Research Unit. University of Edinburgh.

Anon (1989): Economic impact of salmon fishing and netting in Scotland. Summary Report by Mackay Consultants to the Scottish Tourist Board and the Highlands and Islands Development Board.

Anon (1992): Biological Diversity in Norway. A Country Study. Directorate for Nature Management. Report DN 1992 5b.107pp.

Boyle, K J, Teisl, M F and Reiling, S D (1992). Qualitative and Economic Evaluation of Atlantic Salmon Fishing on the Penobscot River. Staff Paper ARE 436 Department of Agricultural and Resource Economics. University of Maine, Orono, Maine. 44pp.

Edwards, S.F. (1989): An Economic Review of North Atlantic Salmon Restoration: US Fair Share Working Papers. Northeast Fisheries Centre Reference Document 89-01. NOAA National Marine Fisheries Service, Woods Hole, MA02543. 24pp.

Gudbransson, B S (1990): Economic aspects of salmon sportfishing in Iceland. Unpublished BSc Thesis University of Iceland, Reykjavik 68pp.

Kay, D.L.; Brown, T.L. and Allee, D.J. (1987): The Economic Benefits of the Restoration of Atlantic Salmon to New England Rivers.

Kreiberg, H (1980): Report of the Greenland Expedition, 1980. International Atlantic Salmon Foundation Special Publication Series No.9 December 1980.

Mawle, G W and Randerson, P F (1983): Economic aspects of recreational fishing in South Wales. Proceedings of the Third British Freshwater Fisheries Conference. University of Liverpool. 1983.

Navrud, S (1991a): The Economic value of recreational fishing for Atlantic salmon - the Norwegian experience. Paper presented at the International Workshop on Licensed Recreational Fishing in Watercourses of the Kola Peninsula, Murmansk, USSR. April 22-26, 1991.

Navrud, S (1991b): Cost Benefit Analysis of Liming in the River Audna - a Broader Analysis. Report to the Directorate for Nature Management by the Norwegian Agricultural University.

Radford, A F (1984): The Economics and Value of Recreational Salmon Fisheries in England and Wales: An Analysis of the Rivers Wye, Mawddach, Tamar and Lune. Marine Resources Research Unit Portsmouth Polytechnic.

Radford, A F and Hatcher, A C (1990): An Economic Evaluation of the Recreational Salmon Fisheries in Great Britain: Principles of Economic Evaluation and Discussion of Results for Wales. Paper presented at the Institute of Fisheries Management Annual Conference: "Fisheries in the Year 2000". University of London 10-14 September 1990. Institute of Fisheries Management.

Radford, A F, Hatcher, A C and Whitmarsh, D J (1991): An Economic Evaluation of Salmon Fisheries in Great Britain. Report prepared for the Ministry of Agriculture, Fisheries and Food. Centre for Marine Resource Economics, Portsmouth Polytechnic.

Rolfsen, J (1991): Recreational Value of Salmon and Sea-trout fishing on TOFA's zones in the river Gaula in the season of 1990. Research Thesis from the Norwegian Agricultural University.

Stansfeld, J R W (1989): Is a Rod-Caught Salmon more valuable to the Scottish Economy than one caught by Net? The Salmon Net XXI. August 1989.

Tuomi, A L W (1987): Canada's Atlantic Salmon Recreational Fisheries and their Future: An Economic Overview. Atlantic Salmon Federation, St Andrews, Canada.

Whelan, B J and Marsh, G (1988): An Economic Evaluation of Irish Angling. Report compiled for the Central Fisheries Board by the Economic and Social Research Institute. Dublin.

Whelan, B J and Whelan, K F (1986): The economics of salmon fishing in the Republic of Ireland: Present and Potential. Proceedings of the 17th Annual Study Course of the Institute of Fisheries Management. University of Ulster, Coleraine 9-11 September 1986. Institute of Fisheries Management.

ANNEX 15

COUNCIL

CNL(93)24

RETURNS UNDER ARTICLES 14 AND 15 OF THE CONVENTION

CNL(93)24

RETURNS UNDER ARTICLES 14 AND 15 OF THE CONVENTION

The form for the return of information relevant to the period 1 January - 31 December 1992 was circulated on 5 February 1993 for completion by the Parties. All Parties were requested to complete and return the form even if there had been no changes since the last notification. Where changes have been notified under Article 15, the Laws, Regulations and Programmes concerned have been lodged with the Secretariat and this information will be incorporated into the Laws, Regulations and Programmes database. Copies of the detailed submissions are available from the Secretariat. A summary of the new actions taken under Articles 14 and 15 of the Convention is attached. At the time of preparation of this paper, information has not been received from all of the EEC's member states which have salmon interests.

Secretary
Edinburgh
12 May 1993

ARTICLE 14

1. ACTIONS TAKEN TO MAKE EFFECTIVE THE PROVISIONS OF THE CONVENTION *(Article 14, paragraph 1)*

1.1 The prohibition of fishing for salmon beyond 12* nautical miles from the baselines from which the breadth of the territorial sea is measured. ***(Article 2, paragraph 2)***

* 40 nautical miles at West Greenland
* Area of fisheries jurisdiction of the Faroe Islands

NO NEW ACTIONS

1.2 Inviting the attention of States not party to the Convention to any matter relating to the activities of the vessels of that State which appears to affect adversely the salmon stocks subject to the Convention. ***(Article 2, paragraph 3)***

Canada

Diplomatic notes have been sent to Panama and Poland to urge them to sign the Protocol on fishing on the high seas.

Norway

The Coastguard has continued the inspection of the high seas area, and participated in the work now proceeding on establishing closer cooperation between coastguards from the different member countries. Norway has encouraged Poland and Panama to comply with the Protocol concerning the fishing of salmon in the high seas.

USA

Department of State cable traffic regarding fishing activities in international waters by non-contracting Parties. The US has also invited signatories to the protocol established at the Ninth Annual Meeting of NASCO.

1.3 Measures to minimise the by-catches of salmon originating in the rivers of the other member. ***(Article 7, paragraph 2)*** **[North American Commission members only]**

Canada

A five-year moratorium on commercial salmon fishing off insular Newfoundland was put into effect. The commercial quotas in southern Labrador were reduced from 215t to 193t.

1.4 Alteration in fishing patterns in a manner which results in the initiation of fishing or increase in catches of salmon originating in the rivers of another Party, except with the consent of the latter. *(Article 7, paragraph 3)* [North American Commission members only]

NO NEW ACTIONS

2. <u>ACTIONS TAKEN TO IMPLEMENT REGULATORY MEASURES UNDER ARTICLE 13</u> *(Article 14, paragraph 1)*

NO NEW ACTIONS

ARTICLE 15

3. LAWS, REGULATIONS AND PROGRAMMES ADOPTED OR REPEALED SINCE THE LAST NOTIFICATION *(Article 15, paragraph 5(a))*

Canada

A five-year moratorium on commercial salmon fishing off insular Newfoundland was put into effect. Under a commercial licence retirement program, 96% of the 2,572 commercial salmon fishermen in insular Newfoundland voluntarily retired their licences. About 60% of the 434 commercial salmon fishermen in southern Newfoundland also retired their licences. Quotas in southern Labrador were reduced from 215t to 193t. For the New Brunswick commercial fishery that has been closed since 1985, 38 of the 50 remaining commercial salmon fishermen retired their licences. Area quotas for anglers were also introduced for Newfoundland and Labrador. Areas were closed to the retention of salmon once these low quota levels were reached. (Further details of these initiatives were submitted in the form of press releases).

Denmark (in respect of the Faroe Islands and Greenland)

Home Rule Order No. 26 of 19 July 1991 on Licensing of Salmon Fishing in Greenland applied to the 1992 fishery.

EEC

In England and Wales a number of new regulations were introduced in 1992. These included Net Limitation Orders for certain rivers in the North-West and South-West Regions of the National Rivers Authority and a North-East Coast Limitation of Net Licences Order in the Northumbrian and Yorkshire regions. A number of regulations are under consideration for 1993 including further Net Limitation Orders, byelaws prohibiting certain methods of fishing and a byelaw in the Welsh Region to reduce the impact of fishing particularly on spring salmon.

In Scotland, Orders/Regulations were introduced which prohibit the use of prawns/shrimps as bait in the Girvan and Ugie districts all year round and in the Tay district after 1 September each year, and which reduce the rod fishing season by 6 days in the Findhorn district. A regulation defining the lawful methods of netting salmon in Scotland and an Order which brings Section 21 of the Salmon Act 1986 into force, were also introduced.

In Northern Ireland, a byelaw was introduced which altered the close season in the river Bush so that angling is permitted from 1 March-20 October instead of 1 March-30 September. Byelaws increasing the Licence duties payable from 1 January 1993 for fishing with rod and line, handline and commercial engines have been introduced together with a byelaw increasing the fee for a licence to buy and sell salmon. In the Foyle area regulations have been introduced which fix the annual close seasons as 1 August -14 June in the year following.

In Ireland a number of byelaws were made varying by up to 10 days, in 1992 only, the open season for salmon fishing by draft nets and/or rod and line in a number of individual rivers and districts. A bye-law was also made in 1992 which extended the boundaries of existing sanctuary areas in the Western Fisheries Region whereby drift netting for salmon is prohibited. It created a number of additional sanctuary areas in that region and prohibited drift netting for salmon within 200m of the coast for boats over 26 feet, and 100m of the coast for boats under 26 feet.

Norway

A new salmon law was adopted on May 15, 1992. The law, and the most important regulations introduced, will be translated and sent to the Secretary.

More than 500 watersheds with Atlantic salmon have been categorised according to the present state of their salmon stock, in order to differentiate in fishing seasons and other regulatory measures, giving priority to those rivers that need special attention.

Sweden

In coastal areas:

1) Nets having a diagonal mesh size between 70 and 95mm may not be used in areas having a water depth less than 3m. This regulation enters into force after a transitional period ending December 31, 1993.

2) A new minimum size of 40cm has been introduced for sea trout. This provision entered into force 1 September 1992.

USA

The State of Maine has expanded statewide its one salmon/angler/year to include border rivers between the US and Canada. The Pleasant River (Maine) will continue to be catch and release only. Maine's Atlantic Sea Run Salmon Commission may now accept salmon stock that are offered at no charge from commercial aquaculture hatcheries for release into state rivers subject to rules developed by the Atlantic Sea Run Salmon Commission. These rules must as a minimum (1) ensure no negative impact on existing gene pools results from release of aquaculture reared salmon; (2) prohibit introduction of exotic species from the release of aquaculture reared salmon; (3) establish stock disease testing and monitoring procedures; and (4) establish maximum stocking levels in state rivers. The Atlantic Sea Run Salmon Commission is not required to accept salmon stock if maximum stocking levels are maintained.

4. OTHER NEW COMMITMENTS RELATING TO THE CONSERVATION, RESTORATION, ENHANCEMENT AND RATIONAL MANAGEMENT OF SALMON STOCKS SUBJECT TO THE CONVENTION *(Article 15, paragraph 5(b))*

Canada

A commercial licence retirement program has been announced for the 62 commercial salmon fishermen on the Quebec Lower- and Mid-North Shore. Retirements for Nova Scotia and northern Labrador are also likely to be announced. Under an Aboriginal Fisheries Strategy, agreements have been and are being made with Native bands to further involve them in the conservation and protection of the resource. This includes conversion of gillnets to trap nets and the training of Native fishery guardians. Major cooperation agreements have been made with various Atlantic Provinces to promote recreational fisheries development and commercial licence retirement. These agreements include significant funding for conservation-, restoration- and enforcement-related initiatives. Information on scientific programs related to enhancement, assessment, habitat, etc. are reported annually in the ICES ANACAT Administrative Report.

5. OTHER FACTORS WHICH MAY SIGNIFICANTLY AFFECT THE ABUNDANCE OF SALMON STOCKS SUBJECT TO THE CONVENTION *(Article 15, paragraph 5(c))*

Norway

The sea-lice has long been a problem in salmon cage culture. In 1992 salmon managers and researchers focused on the possible impacts on wild populations of anadromous salmonids (salmon, sea-trout and sea-char). High infestation levels on both smolts and adults of all three species were observed in the proximity of infested salmon cage units. There is evidence that even moderate levels of infestation may cause mortality of fish at the smolt stage. In addition, the sea-lice functions as a vector and reservoir hide-out for other diseases such as Infectious Salmon Anaemia (ISA) and Furunculosis. Several fish pathogenic bacteria and viruses may be secondary invaders. By the end of 1992, 74 watercourses were affected by *Aeromonas salmonicida* sub-species *salmonicida* (furunculosis bacteria).

In 1992 the parasite *Gyrodactylus salaris* was registered in a rainbow trout farming facility situated in the lake Enare drainage system in Finland. Norway approached the Finnish authorities on this matter and informed them of the hazardous effects this parasite has had on Norwegian salmon stocks, and asked Finland to take the necessary steps to safeguard the salmon stocks in the northern areas.

ANNEX 16

COUNCIL

CNL(93)25

PROGRESS REPORT ON THE NASCO PROTOCOL

CNL(93)25

PROGRESS REPORT ON THE NASCO PROTOCOL

1. At its Ninth Annual Meeting in Washington DC, the Council voted unanimously to adopt a Resolution on the Adoption of a Protocol for States not Party to the Convention for the Conservation of Salmon in the North Atlantic Ocean. Following discussions with the European Community, which is the Depositary for the Protocol, the title of the Protocol was modified to read "Protocol Open for Signature by States not Parties to the Convention for the Conservation of Salmon in the North Atlantic Ocean". In accordance with Article 5(3) of the Protocol an authentic version of the Protocol was forwarded to Brussels for deposit with the General Secretariat of the Council of the European Communities.

2. In early December I transmitted copies of the Protocol to the governments of the Republic of Panama and the Republic of Poland through meetings at their Embassies in London. Copies of the Protocol and the Diplomatic Note which accompanied it were sent to all Heads of Delegations and copied to all delegates. Following my meetings at the Panamanian and Polish Embassies the Parties were advised that it would be appropriate to make their representations to Poland and Panama in accordance with the Resolutions adopted by the Council in Washington DC.

3. The problem of vessels which have been reflagged in order to avoid the provisions of international organizations is not restricted to the salmon. At the FAO Committee on Fisheries meeting held in Rome during 15-19 March 1993 the draft text of an "Agreement on the Flagging of Vessels Fishing on the High Seas to Promote Compliance with Internationally Agreed Conservation and Management Measures" was considered. This agreement, if adopted, would seem to be a helpful initiative, complementing the NASCO Protocol. However, no agreement was reached in Rome. For the reasons detailed in my memo to the Parties (CNL27.115) of 10 March 1993 it would seem wise that the Parties should continue to press Poland and Panama to sign the NASCO Protocol.

4. Canada and the US have advised that they have made their representations to Panama and Poland. In response to these representations Panama and Poland had requested documentary evidence concerning the activities of their vessels and the information available to NASCO was provided to Canada and the US. On 27 May 1993 the European Community made a demarche to representatives of the Government of Poland in Brussels with most NASCO Parties in attendance.

5. It seems likely that the process of adoption of the Protocol by Poland and Panama may be a slow process. If and when they have done so the flags of other States could be used. This reinforces the need for vigilance and the closer cooperation between Coastguard Authorities in NASCO countries so as to deal with any such developments.

Secretary
Edinburgh
3 June 1993

COUNCIL

CNL(93)39

PROTOCOL
RESPONSE FROM THE GOVERNMENT OF POLAND

The attached note to the Secretary of NASCO has been received (on 3 June) from the Embassy of the Republic of Poland in London.

DPT.I. 44-9-90

The Embassy of the Republic of Poland presents its compliments to the Secretary of the North Atlantic Salmon Conservation Organization and with reference to his Note No. CNL27.075 of 1 December, 1992, has the honour to communicate the following:

The competent Polish authorities have conducted an inquiry concerning the alleged fishing activities for salmon north of the Faroe Islands by vessels registered in Poland. It has been established that such activities had indeed taken place in the first half of 1990, nonetheless they have ceased after this matter had been brought to the attention of the Polish Government by States-Parties to the Convention for the Conservation of Salmon in the North Atlantic Ocean. Apart from this, competent Polish authorities have not received any concrete evidence confirming the presence of Polish vessels fishing for salmon in that area since 1990.

The Embassy should also like to stress the fact that the landing of salmon in Polish ports by vessels registered abroad has ceased.

The Embassy further has the honour to inform him that the Polish Sejm is in the process of reviewing the draft Maritime Fisheries Act, the provisions of which would authorize the Minister of Transport and Maritime Economy to prohibit fishing on the high seas, as well as the landing and sale of certain species of fish.

This being the case, the Polish Government is of the view that it would not be feasible for it to review the question of signing the Protocol open for signature by States not parties to the Salmon Convention until there is clarity regarding the draft Maritime Fisheries Act.

The Embassy of the Republic of Poland avails itself of this opportunity to renew to the Secretary of the North Atlantic Salmon Conservation Organization the assurances of its highest consideration.

London, 28 May 1993

ANNEX 18

COUNCIL

CNL(93)26

PROGRESS REPORT ON ACTIONS TAKEN IN ACCORDANCE WITH THE RESOLUTION ON FISHING FOR SALMON ON THE HIGH SEAS

CNL(93)26

PROGRESS REPORT ON ACTIONS TAKEN IN ACCORDANCE WITH THE RESOLUTION ON FISHING FOR SALMON ON THE HIGH SEAS

1. At its Ninth Annual Meeting the Council unanimously adopted a Resolution on Fishing for Salmon on the High Seas. This Resolution requested the Secretary to obtain and compile information on sightings of vessels; draw the attention of non-contracting Parties concerned to the activities of their vessels; obtain and compile information on landings and transhipments; obtain and compile scientific and technical data on the fishery; and establish regular contacts with other international organizations with an interest in the area, in particular NEAFC, with a view to sharing information. It also included a request for ICES to undertake research into and analyses of data relating to the bycatch of salmon.

2. The actions taken in accordance with the Resolution are detailed below.

Obtain and Compile Information on Sightings

3. Information on the activities of vessels in international waters has been obtained principally from Norwegian and Icelandic coastguard airborne surveillance flights. The following surveillance flights were undertaken between April 1992 and April 1993:

Icelandic Coastguard		Norwegian Coastguard	
2 April 1992	15 March 1993	10 April 1992	3 April 1993
4 September 1992	21 April 1993	24 April 1992	17 April 1993
15 September 1992		6 May 1992	13 May 1993
2 November 1992		8 May 1992	19 May 1993
		24 May 1992	
		5 June 1992	
		22 June 1992	
		7 July 1992	

It is clear from the above details that there are considerable periods when no surveillance flights occurred over the area of international waters. It is known that at least one vessel has in the past operated during October-December without detection. It is also clear that only a very small part of the area is covered. A report on options to improve the surveillance is presented separately in CNL(93)27.

4. Since last year's report (CNL(92)20), consultations with the Norwegian and Icelandic coastguards have confirmed a further sighting of the vessel "Brodal", which was located at a position of 70°30'N and 04°02'E on 19 May 1993. The information on sightings from airborne surveys which has been received by the Secretary to date is as follows:-

Icelandic Coastguard				Norwegian Coastguard			
Date	**Vessel Name**	**Location**		**Date**	**Vessel Name**	**Location**	
17/01/90	Brodal	67°04'N	05°41'W	28/01/90	Uncle Sam	66°27'N	00°48'W
	Seagull	66°40'N	04°22'W	22/02/90*	Name unknown	66°51'N	01°09'W
26/01/90	Minna	66°22'N	04°15'W		Name unknown	66°55'N	00°24'W
	Seagull	67°41'N	04°22'W		Name unknown	67°05'N	00°20'W
21/02/90	Brodal	66°49'N	01°15'W		Name unknown	66°56'N	03°02'W
	Seagull	66°55'N	00°36'W		Name unknown	67°43'N	00°34'W
02/03/90	Brodal	66°58'N	02°33'W		Name unknown	67°41'N	00°30'W
	Annette Bri	66°58'N	02°33'W		Name unknown	67°50'N	00°40'W
				10/03/90	Brodal	66°45'N	03°17'W
				24/02/91	Name unknown	68°33'N	01°08'E
				06/05/92	Brodal	72°00'N	06°00'E
				06/06/92	Netanya	72°00'N	06°00'E
				08/05/92	Brodal	72°17'N	06°25'E
				08/05/92	Netanya	71°57'N	05°28'E
				19/05/93	Brodal	70°30'N	04°02'E

* Photographs taken of Annette Bri, Seagull, Minna, Brodal.

5. In addition the following information has been received from ports:

Date	Vessel Name	Port
18/1/90	Minna	Torshavn
2/2/90	Minna	Torshavn
28/1/91	Brodal	Bodø
4/3/91	Brodal	Bodø
5/12/91	Brodal	Bodø
5/3/92	Brodal	Bodø

The vessel Brodal was also boarded by Scottish Fisheries Protection Agency officers in December 1989.

Drawing the Attention of Non-Contracting Parties to the Activities of Their Vessels

6. In accordance with the Resolution of the Council on the Adoption of a Protocol for States Not Party to the Convention for the Conservation of Salmon in the North Atlantic Ocean, I transmitted copies of the Protocol to the governments of Poland and Panama through their respective London missions. At this time I provided them with the information concerning the activities of the vessels which had been registered in their countries. Furthermore, following the demarches by the US and Canada, the Panamanian authorities had requested information on the activities of its vessels and the documentary evidence available to the Secretary was provided to these Parties for transmission to Panama.

Obtain and Compile Information on Landings and Transhipments

7. No information has been provided by the Parties concerning landings and transhipments. However, it is understood that there is evidence to suggest that the

vessel "Brodal" landed a catch of 36 tonnes in the Polish port of Kohlberg for transhipment to Switzerland. Further information on landings will be developed.

Obtain and Compile Scientific and Technical Data on the Fishery

8. To date six vessels are known to have been involved in fishing for salmon in international waters. Their details are given below:

Name of Vessel	Registration Number	Country of Registration	Call Sign	Size of Vessel Weight (GRT)	Length (m)
BRODAL	--	PANAMA	OVUH	133	29
MINNA	WLA69	POLAND	OZTH	84.5	
SEAGULL	--	POLAND	OVID	299	46
ANNETTE BRI	WLA12	POLAND	OUHZ	--	
UNCLE SAM	--	PANAMA	OYXP	--	
NETANYA	SG76	SWEDEN	--	--	--

* A number of vessels do not display a registration number.

In addition, there are unconfirmed reports that two other vessels, "Bermuda" and "Marie Viking", have also been involved. The vessel "Bermuda" was registered in Panama but it is believed that this vessel may have reflagged to Poland in March 1991. Its call sign is OWRG and its Polish registration number is understood to be LEB72.

9. Estimates of the catch in international waters by reflagged vessels have been made by ICES over the last three years and the time series of information is as follows:

Year	Estimated catch (tonnes)
1989/90	180-350
1990/91	25-100
1991/92	25-100

10. Information on catches by individual vessels has been obtained as a result of vessels calling at ports and following the boarding of the vessel "Brodal" by Scottish Fisheries Protection Agency officials. When the vessel "Minna" called at Torshavn harbour in February 1990 it had 5 tonnes of salmon on board but the Faroese authorities were advised that the intention was to catch 25 tonnes before returning to Poland. When the vessel "Brodal" was boarded it had 30 tonnes of salmon on board. The catch by the vessel "Netanya" is believed to have been 150kg. Information from the former Northern Norwegian Sea fishery indicates that salmon fishing can be conducted as far north as 75°N and that catch levels at latitudes of 69-72°N can be high. On the basis of known catches by the vessels "Brodal" and "Minna", and assuming that between 2000-3000 hooks can be set a day, historical catch rates would indicate that the vessels would have to fish in the area of international waters for between 30-100 days. It is clear then that the vessels must be in this area for considerable lengths of time.

Establish Contacts with Other International Organizations with Interests in the Area

9. A report on the activities of other international organizations in relation to fishing by non-contracting Parties (CNL27.030) was presented to the Special Meeting on Fishing for Salmon in International Waters held during 14-15 January 1992. The report presented information on actions taken by the Northwest Atlantic Fisheries Organization (NAFO); the North-East Atlantic Fisheries Commission (NEAFC) and the International Commission for the Conservation of Atlantic Tunas (ICCAT). All of these organizations have become aware of the activities of vessels registered to non-contracting Parties within their areas of competence and it is clear that this problem is not restricted to the North-East Atlantic or to salmon.

10. The area of international waters north of the Faroe Islands where fishing for salmon has occurred is also an area of concern to NEAFC although to date no actions have been taken to address the problem. In accordance with the Resolution I contacted the Secretary of NEAFC. He indicated that NEAFC had not addressed the issue but since they had not agreed quotas for stocks in international waters it would not be likely to be a serious problem if a non-Party fished there. In any case, such a non-Party could join NEAFC whereas in NASCO, only those States which exercise fisheries jurisdiction in the North Atlantic Ocean or states of origin for salmon stocks subject to the Convention may join. I agreed with the Secretary of NEAFC, however, that we would develop closer links on sharing information on this subject.

Secretary
Edinburgh
2 June 1993

ANNEX 19

COUNCIL

CNL(93)27

REPORT OF THE INTERNATIONAL MEETING ON SURVEILLANCE OF FISHING FOR SALMON IN INTERNATIONAL WATERS

CNL(93)27

REPORT OF THE INTERNATIONAL MEETING ON SURVEILLANCE OF FISHING FOR SALMON IN INTERNATIONAL WATERS

One of the actions recommended by the 1992 London meeting was that there should be increased cooperation on surveillance. In the light of this the Secretary invited, through Heads of Delegation, representatives of coastguard authorities to a meeting in Edinburgh in March 1993. The meeting made a number of useful recommendations on a salmon fishing surveillance project, on longer-term cooperation, on sources of information from the military and from ports, on publicity and on future communication of information, which are detailed on pages 6 and 7 of the attached report. The Council is asked to consider what action it wishes to take in the light of these recommendations.

Secretary
Edinburgh
14 April 1993

CNL(93)27

REPORT OF THE INTERNATIONAL MEETING ON SURVEILLANCE OF FISHING FOR SALMON IN INTERNATIONAL WATERS

1. INTRODUCTION

1.1 The Chairman, Dr Malcolm Windsor, opened the meeting and welcomed the delegates to Edinburgh. He said that NASCO Council was concerned that fishing for salmon in international waters could, if allowed to continue, undermine the conservation work of the Organization and its members. For this reason NASCO was grateful for the valuable support of the coastguard organizations in each country. The purpose of the meeting was to examine the methods of surveillance and the scope for improvements, where appropriate, through increased international cooperation.

1.2 A list of participants is given in Appendix 1. The agenda for the meeting is contained in Appendix 2.

2. EXISTING SOURCES OF INFORMATION

2.1 A brief review of the sources of information available to NASCO was presented. All of the reported sightings of fishing activity have been by airborne surveillance flights by the Norwegian and Icelandic coastguards but, in addition, valuable information has been obtained from surveillance operations at sea and from ports.

(a) Airborne surveillance flights

2.2 Icelandic airborne patrols are by Fokker F-27-200 aircraft based in Reykjavik. The patrols of the eastern boundary of the Icelandic EEZ take the aircraft into the south-western corner of the area of international waters but diversions further east may be made if vessels are detected by radar. A new 360° radar unit which is more efficient at detecting small vessels, particularly at wind speeds of 25-30 knots when sea clutter is a problem, has been installed. The radar has a range of about 40 miles. Patrols take place approximately three times a month throughout the year. The plane can fly for approximately 12 hours without refuelling and patrols to the southern portion of the area of international waters last about 7 hours. A patrol of the area in mid-March 1993 had revealed no salmon fishing vessels.

2.3 The Norwegian coastguard carries out airborne surveillance using an Orion P3 aircraft which can remain in the air for 16 hours without refuelling. Surveillance of the area of international waters takes place twice a month in connection with patrols of the Jan Mayen fisheries zone. During these flights efforts are made to increase the coverage of the international zone by zig-zagging across the area but the cover is not comprehensive.

2.4 Danish airforce G3 planes are involved in surveillance within the Faroese EEZ but most of the fishing activity in the Faroese zone is to the south of the islands so the patrols are concentrated in this area. The Faroese salmon fishery which was

conducted to the north of the islands is presently subject to a compensation agreement and commercial fishing does not occur. Scottish Office aircraft frequently patrol north of the Shetland Islands but not necessarily to the limit of the EEZ or into international waters. No sightings of the reflagged vessels have been obtained from the patrols in these areas. The possibility of obtaining surveillance information in the future from Russian fishery patrols was discussed.

2.5 The sightings of vessels obtained from airborne patrols were between 66°N and 72°N and between 06°W and 06°E and covered the period 17/01/90-08/05/92. Prior to 1992 all the sightings had been in the southern portion of the international zone between 66-69°N. In 1992 the sightings were, however, considerably further north. Information from the former fishery in the Northern Norwegian Sea indicated that salmon fishing was conducted as far north as 75°N and east to 20°E although the fishery shifted west to between 200-360 nautical miles from the Norwegian baseline after 1975. Catch rates (per 1,000 hooks set) can be relatively high at latitudes of 69-72°N indicating that fishing by reflagged vessels could be conducted over very large geographical areas which would be likely to vary from year to year depending on oceanographic conditions. The meeting agreed that a more detailed examination of the distribution and timing of the former Northern Norwegian Sea fishery could provide useful information on the likely areas of activity by reflagged vessels.

2.6 It is possible to make estimates of the time these vessels may have spent fishing in international waters on the basis of catch, the number of hooks set per day (2,000-3,000) and historical catch rates (per 1,000 hooks). Assuming an average weight of fish of 3kg the vessels would have to fish for between 30-100 days. It is known that the vessel "Brodal" fished in the area between 17 October and 9 December 1989 (54 days) without detection. Furthermore, the meeting agreed that the sighting information might not give a clear indication of the scale of the problem since undetected fishing could take place in other parts of the zone. It was agreed that it would be helpful if a concerted effort was made to conduct a thorough survey of the area specifically in relation to salmon fishing.

(b) Surveillance at sea

2.7 The Scottish Fisheries Protection Agency boarded the "Brodal" near the Shetland Islands. No ship-borne surveillance information has been obtained from the Icelandic, Norwegian or Faroese coastguards. Patrol vessels do not usually operate in international waters, although the Norwegian vessels patrol the Jan Mayen zone twice a year, and no salmon fishing vessels had been intercepted in transit through the economic zones of these countries. This lack of information may be related to the fact that the patrol vessels concentrate on the areas of the main fisheries within the economic zones rather than the possible routes to and from international waters. While only one vessel had been inspected at sea, much valuable information on the catch levels and number of fishing trips was obtained from its skipper. This information formed the basis of the estimates made by ICES scientists of the level of catch in the fishery. In addition, details of the nationality of the crew and the port at which the salmon were to be landed were obtained.

2.8 The meeting discussed the legality of inspection of these vessels. Fishing for salmon in international waters by non-NASCO Parties is not illegal, and inspection of such

ANNEX 19

COUNCIL

CNL(93)27

REPORT OF THE INTERNATIONAL MEETING ON SURVEILLANCE OF FISHING FOR SALMON IN INTERNATIONAL WATERS

CNL(93)27

REPORT OF THE INTERNATIONAL MEETING ON SURVEILLANCE OF FISHING FOR SALMON IN INTERNATIONAL WATERS

One of the actions recommended by the 1992 London meeting was that there should be increased cooperation on surveillance. In the light of this the Secretary invited, through Heads of Delegation, representatives of coastguard authorities to a meeting in Edinburgh in March 1993. The meeting made a number of useful recommendations on a salmon fishing surveillance project, on longer-term cooperation, on sources of information from the military and from ports, on publicity and on future communication of information, which are detailed on pages 6 and 7 of the attached report. The Council is asked to consider what action it wishes to take in the light of these recommendations.

Secretary
Edinburgh
14 April 1993

ANNEX 19

COUNCIL

CNL(93)27

REPORT OF THE INTERNATIONAL MEETING ON SURVEILLANCE OF FISHING FOR SALMON IN INTERNATIONAL WATERS

CNL(93)27

REPORT OF THE INTERNATIONAL MEETING ON SURVEILLANCE OF FISHING FOR SALMON IN INTERNATIONAL WATERS

One of the actions recommended by the 1992 London meeting was that there should be increased cooperation on surveillance. In the light of this the Secretary invited, through Heads of Delegation, representatives of coastguard authorities to a meeting in Edinburgh in March 1993. The meeting made a number of useful recommendations on a salmon fishing surveillance project, on longer-term cooperation, on sources of information from the military and from ports, on publicity and on future communication of information, which are detailed on pages 6 and 7 of the attached report. The Council is asked to consider what action it wishes to take in the light of these recommendations.

Secretary
Edinburgh
14 April 1993

CNL(93)27

REPORT OF THE INTERNATIONAL MEETING ON SURVEILLANCE OF FISHING FOR SALMON IN INTERNATIONAL WATERS

1. INTRODUCTION

1.1 The Chairman, Dr Malcolm Windsor, opened the meeting and welcomed the delegates to Edinburgh. He said that NASCO Council was concerned that fishing for salmon in international waters could, if allowed to continue, undermine the conservation work of the Organization and its members. For this reason NASCO was grateful for the valuable support of the coastguard organizations in each country. The purpose of the meeting was to examine the methods of surveillance and the scope for improvements, where appropriate, through increased international cooperation.

1.2 A list of participants is given in Appendix 1. The agenda for the meeting is contained in Appendix 2.

2. EXISTING SOURCES OF INFORMATION

2.1 A brief review of the sources of information available to NASCO was presented. All of the reported sightings of fishing activity have been by airborne surveillance flights by the Norwegian and Icelandic coastguards but, in addition, valuable information has been obtained from surveillance operations at sea and from ports.

(a) Airborne surveillance flights

2.2 Icelandic airborne patrols are by Fokker F-27-200 aircraft based in Reykjavik. The patrols of the eastern boundary of the Icelandic EEZ take the aircraft into the south-western corner of the area of international waters but diversions further east may be made if vessels are detected by radar. A new 360° radar unit which is more efficient at detecting small vessels, particularly at wind speeds of 25-30 knots when sea clutter is a problem, has been installed. The radar has a range of about 40 miles. Patrols take place approximately three times a month throughout the year. The plane can fly for approximately 12 hours without refuelling and patrols to the southern portion of the area of international waters last about 7 hours. A patrol of the area in mid-March 1993 had revealed no salmon fishing vessels.

2.3 The Norwegian coastguard carries out airborne surveillance using an Orion P3 aircraft which can remain in the air for 16 hours without refuelling. Surveillance of the area of international waters takes place twice a month in connection with patrols of the Jan Mayen fisheries zone. During these flights efforts are made to increase the coverage of the international zone by zig-zagging across the area but the cover is not comprehensive.

2.4 Danish airforce G3 planes are involved in surveillance within the Faroese EEZ but most of the fishing activity in the Faroese zone is to the south of the islands so the patrols are concentrated in this area. The Faroese salmon fishery which was

CNL(93)27

REPORT OF THE INTERNATIONAL MEETING ON SURVEILLANCE OF FISHING FOR SALMON IN INTERNATIONAL WATERS

1. INTRODUCTION

1.1 The Chairman, Dr Malcolm Windsor, opened the meeting and welcomed the delegates to Edinburgh. He said that NASCO Council was concerned that fishing for salmon in international waters could, if allowed to continue, undermine the conservation work of the Organization and its members. For this reason NASCO was grateful for the valuable support of the coastguard organizations in each country. The purpose of the meeting was to examine the methods of surveillance and the scope for improvements, where appropriate, through increased international cooperation.

1.2 A list of participants is given in Appendix 1. The agenda for the meeting is contained in Appendix 2.

2. EXISTING SOURCES OF INFORMATION

2.1 A brief review of the sources of information available to NASCO was presented. All of the reported sightings of fishing activity have been by airborne surveillance flights by the Norwegian and Icelandic coastguards but, in addition, valuable information has been obtained from surveillance operations at sea and from ports.

(a) Airborne surveillance flights

2.2 Icelandic airborne patrols are by Fokker F-27-200 aircraft based in Reykjavik. The patrols of the eastern boundary of the Icelandic EEZ take the aircraft into the south-western corner of the area of international waters but diversions further east may be made if vessels are detected by radar. A new 360° radar unit which is more efficient at detecting small vessels, particularly at wind speeds of 25-30 knots when sea clutter is a problem, has been installed. The radar has a range of about 40 miles. Patrols take place approximately three times a month throughout the year. The plane can fly for approximately 12 hours without refuelling and patrols to the southern portion of the area of international waters last about 7 hours. A patrol of the area in mid-March 1993 had revealed no salmon fishing vessels.

2.3 The Norwegian coastguard carries out airborne surveillance using an Orion P3 aircraft which can remain in the air for 16 hours without refuelling. Surveillance of the area of international waters takes place twice a month in connection with patrols of the Jan Mayen fisheries zone. During these flights efforts are made to increase the coverage of the international zone by zig-zagging across the area but the cover is not comprehensive.

2.4 Danish airforce G3 planes are involved in surveillance within the Faroese EEZ but most of the fishing activity in the Faroese zone is to the south of the islands so the patrols are concentrated in this area. The Faroese salmon fishery which was

conducted to the north of the islands is presently subject to a compensation agreement and commercial fishing does not occur. Scottish Office aircraft frequently patrol north of the Shetland Islands but not necessarily to the limit of the EEZ or into international waters. No sightings of the reflagged vessels have been obtained from the patrols in these areas. The possibility of obtaining surveillance information in the future from Russian fishery patrols was discussed.

2.5 The sightings of vessels obtained from airborne patrols were between 66°N and 72°N and between 06°W and 06°E and covered the period 17/01/90-08/05/92. Prior to 1992 all the sightings had been in the southern portion of the international zone between 66-69°N. In 1992 the sightings were, however, considerably further north. Information from the former fishery in the Northern Norwegian Sea indicated that salmon fishing was conducted as far north as 75°N and east to 20°E although the fishery shifted west to between 200-360 nautical miles from the Norwegian baseline after 1975. Catch rates (per 1,000 hooks set) can be relatively high at latitudes of 69-72°N indicating that fishing by reflagged vessels could be conducted over very large geographical areas which would be likely to vary from year to year depending on oceanographic conditions. The meeting agreed that a more detailed examination of the distribution and timing of the former Northern Norwegian Sea fishery could provide useful information on the likely areas of activity by reflagged vessels.

2.6 It is possible to make estimates of the time these vessels may have spent fishing in international waters on the basis of catch, the number of hooks set per day (2,000-3,000) and historical catch rates (per 1,000 hooks). Assuming an average weight of fish of 3kg the vessels would have to fish for between 30-100 days. It is known that the vessel "Brodal" fished in the area between 17 October and 9 December 1989 (54 days) without detection. Furthermore, the meeting agreed that the sighting information might not give a clear indication of the scale of the problem since undetected fishing could take place in other parts of the zone. It was agreed that it would be helpful if a concerted effort was made to conduct a thorough survey of the area specifically in relation to salmon fishing.

(b) Surveillance at sea

2.7 The Scottish Fisheries Protection Agency boarded the "Brodal" near the Shetland Islands. No ship-borne surveillance information has been obtained from the Icelandic, Norwegian or Faroese coastguards. Patrol vessels do not usually operate in international waters, although the Norwegian vessels patrol the Jan Mayen zone twice a year, and no salmon fishing vessels had been intercepted in transit through the economic zones of these countries. This lack of information may be related to the fact that the patrol vessels concentrate on the areas of the main fisheries within the economic zones rather than the possible routes to and from international waters. While only one vessel had been inspected at sea, much valuable information on the catch levels and number of fishing trips was obtained from its skipper. This information formed the basis of the estimates made by ICES scientists of the level of catch in the fishery. In addition, details of the nationality of the crew and the port at which the salmon were to be landed were obtained.

2.8 The meeting discussed the legality of inspection of these vessels. Fishing for salmon in international waters by non-NASCO Parties is not illegal, and inspection of such vessels in the international zone would not be appropriate. However, it was generally agreed that inspection within economic zones would be possible, particularly if the vessel had fishing gear visible on deck and certainly if the vessels entered port. In the event that evidence of salmon fishing was obtained, it would be up to the Flag State to take action on the basis of the information provided by the surveillance authorities. In this regard the NASCO Protocol would provide the basis for national legislation to be introduced in countries not party to the NASCO Convention.

(c) Information from ports

2.9 Valuable information including details of catches has also been provided to NASCO by the Faroese authorities following inspection of the vessel "Minna" in Torshavn harbour. The vessel "Brodal" is known to have called at the Norwegian port of Bodø on several occasions in 1991 and 1992. Foreign vessels are normally required to display their flag when in port but small vessels, particularly fishing vessels, seldom do. It is possible that vessels skippered, as in these cases, by Danish nationals would not attract attention, particularly in smaller ports. The possibility of a review of harbour records on the basis of the vessels' names and call signs was discussed.

2.10 Limited information on the ports where the salmon had been landed had also been obtained. Salmon are known to have been landed at the Polish port of Kohlberg and subsequently transhipped to Switzerland. The Polish authorities were aware of these landings but as yet had given no binding assurance that the trade in salmon could be stopped. Wild salmon attract a premium price in some markets and although the price of salmon has fallen, following the advent of salmon farming, there is evidence that a small sector of the market is prepared to pay high prices for wild or ranched salmon.

2.11 NASCO had also received information by telephone from an anonymous source advising that two vessels previously observed fishing in international waters had left port to fish for salmon. This information had subsequently been passed on to the coastguards in Norway and Iceland.

(d) Other sources of information

2.12 During the late 1980's NASCO received reports from the Faroese authorities that foreign voices had been heard on VHF radio. The question of monitoring radio traffic in order to identify vessels which may be fishing for salmon was raised at the Special Meeting held in London during 14-15 January 1992.

3. ADDITIONAL POTENTIAL SOURCES OF INFORMATION

(a) Satellite systems

3.1 The utility of earth observation satellites was discussed. A number of such satellites provide remote sensing information including the European ERS1, Japanese JERS1, American Lansat and French Spot satellites. The Lansat and Spot satellites operate in the visible range and would therefore be unable to detect vessels through cloud or at night (a particular problem for detection of vessels at northern latitudes fishing during the winter months). The ERS1 and JERS1 satellites utilise synthetic aperture radar but very fine resolution would be required to enable vessels 30m long or less vessels in the international zone would not be appropriate. However, it was generally agreed that inspection within economic zones would be possible, particularly if the vessel had fishing gear visible on deck and certainly if the vessels entered port. In the event that evidence of salmon fishing was obtained, it would be up to the Flag State to take action on the basis of the information provided by the surveillance authorities. In this regard the NASCO Protocol would provide the basis for national legislation to be introduced in countries not party to the NASCO Convention.

(c) Information from ports

2.9 Valuable information including details of catches has also been provided to NASCO by the Faroese authorities following inspection of the vessel "Minna" in Torshavn harbour. The vessel "Brodal" is known to have called at the Norwegian port of Bodø on several occasions in 1991 and 1992. Foreign vessels are normally required to display their flag when in port but small vessels, particularly fishing vessels, seldom do. It is possible that vessels skippered, as in these cases, by Danish nationals would not attract attention, particularly in smaller ports. The possibility of a review of harbour records on the basis of the vessels' names and call signs was discussed.

2.10 Limited information on the ports where the salmon had been landed had also been obtained. Salmon are known to have been landed at the Polish port of Kohlberg and subsequently transhipped to Switzerland. The Polish authorities were aware of these landings but as yet had given no binding assurance that the trade in salmon could be stopped. Wild salmon attract a premium price in some markets and although the price of salmon has fallen, following the advent of salmon farming, there is evidence that a small sector of the market is prepared to pay high prices for wild or ranched salmon.

2.11 NASCO had also received information by telephone from an anonymous source advising that two vessels previously observed fishing in international waters had left port to fish for salmon. This information had subsequently been passed on to the coastguards in Norway and Iceland.

(d) Other sources of information

2.12 During the late 1980's NASCO received reports from the Faroese authorities that foreign voices had been heard on VHF radio. The question of monitoring radio traffic in order to identify vessels which may be fishing for salmon was raised at the Special Meeting held in London during 14-15 January 1992.

3. ADDITIONAL POTENTIAL SOURCES OF INFORMATION

(a) Satellite systems

3.1 The utility of earth observation satellites was discussed. A number of such satellites provide remote sensing information including the European ERS1, Japanese JERS1, American Lansat and French Spot satellites. The Lansat and Spot satellites operate in the visible range and would therefore be unable to detect vessels through cloud or at night (a particular problem for detection of vessels at northern latitudes fishing during the winter months). The ERS1 and JERS1 satellites utilise synthetic aperture radar but very fine resolution would be required to enable vessels 30m long or less to be detected. Furthermore, the resolution is adversely affected by the surface roughness of the sea. Other factors which limit the utility of satellite systems are the frequency with which the satellite passes over the area of interest and accessibility of the data. Delays in obtaining the information may be greater for high resolution data. Consultations with the Atlantic Centre for Remote Sensing of the Oceans in Nova Scotia, Canada, suggested that while there are research programmes under way to investigate the detection of ships by satellite, for the time being airborne surveillance was probably the most appropriate technique.

3.2 There is growing interest in a number of countries in installing transponders to vessels which could then be located using satellites. However, such systems are expensive and can easily be deactivated. Furthermore, reflagged vessels wishing to avoid detection would be unlikely to have such equipment installed. It was concluded that, for the present, satellite systems were unlikely to be able to contribute to the surveillance of the area.

(b) Military reconnaissance

3.3 The possibility of obtaining surveillance information from military sources was discussed given the former military significance of the area and the changes resulting from the end of the Cold War. Military satellites would be able to provide detailed surveillance information but it was thought unlikely that such information would be readily available. However, it was thought possible that NATO AWACS planes which could cover the whole of the area of international waters from 30,000 feet and could detect the radar of fishing vessels, could be a potentially useful source of information. The information from these planes is data-linked to Keflavik airbase and after screening might be made available. This information could provide a useful overview of the area from which airborne patrols could target certain areas, and the Norwegian coastguard agreed to explore the possibility of obtaining such information.

(c) Monitoring of radio traffic

3.4 Although some useful information had been obtained by chance in the past, the trend to replace VHF radio by satellite telephones means that organised surveillance of radio traffic in the future would be time-consuming and of limited value. However, some useful information might continue to be obtained on a sporadic basis.

(d) Other potential sources of information

3.5 While no other new potential sources of information were identified, the need to increase public awareness of the problem of fishing for salmon in international waters was discussed. Even an apparently unimportant fact could lead to useful information by alerting the relevant authorities. The need to obtain as much information as possible on the location, timing and extent of the fishery was stressed.

4. RECOMMENDATIONS ON POSSIBLE AREAS OF INTERNATIONAL COOPERATION

4.1 The meeting concluded that there was room for strengthening the surveillance, information dissemination and cooperation in the North-East Atlantic. The group made the following recommendations.

Salmon Fishery Surveillance Project

4.2 The scale of the problem could be assessed by a cooperative salmon fishery surveillance project. This would involve international surveillance of certain areas of the Northern Norwegian Sea over an agreed time period or periods by all appropriate means at the disposal of the Parties. The areas and times for coverage would be proposed by NASCO, taking account of catch records in the former Northern Norwegian Sea salmon fishery and information obtained by NASCO concerning the activities of reflagged vessels. The Parties that participate would decide exactly how many resources they could devote to that project and would advise NASCO, who would then communicate this to the other Parties, so that duplication of effort might be avoided.

Longer-term Surveillance

4.3 The group recognised that such a project, whilst potentially valuable, could not be sustained for more than a brief period. The existing surveillance was not comprehensive and many of the sightings had been obtained by chance. It was agreed that a specific effort could be made to improve the extent of the salmon-related surveillance. In this regard the results of the project described in paragraph 4.2 and the data which may be obtained from the AWACS surveillance described in paragraph 4.4 would also influence the shape of longer-term surveillance. It was also agreed that the cooperation on routine surveillance needed to be improved so that it is more closely coordinated and duplication of effort is avoided.

Military Sources of Information

4.4 The radar technology routinely in use in the area aboard NATO AWACS aircraft was thought to be extremely advanced and could cover very large areas. It was agreed that, although the military may, for security reasons, wish to screen the data, there may well be general information which they would be willing to provide. The Norwegian coastguard, which is linked to the military, indicated that they would explore the possibilities of obtaining information from AWACS flights.

Information from Port Authorities

4.5 It was agreed that, because fishing vessels do not generally fly flags, the fact that a vessel was registered in, say, Panama may not be immediately obvious when it came into port. The importance of good information from ports was stressed. The delegates from Iceland and Norway agreed to see if their port records were held in such a way as to allow searching for certain vessel names or call signs so that a pattern might be picked up. There should also be an effort to inform port authorities, even in very small ports, of the possibility that vessels calling at these ports may have been involved in fishing for salmon. NASCO would provide a draft basis for advising authorities of the problem.

General Publicity

4.5 Information about the vessels fishing for salmon in international waters depended often on an awareness at local levels of the nature of the problem. In order to improve this awareness it was agreed that local publicity would be useful. Local journalists were often looking for subjects of interest to coastal communities and it was agreed that it might be useful if NASCO prepared an information sheet or draft article which might be used for such publicity.

Communication of Information

4.7 It was agreed that there was a need to improve the flow of information on the problem whether it be obtained from airborne sightings, surveillance at sea or at ports or from radio traffic or other sources. Even trivial information had in the past been useful. It was agreed that NASCO could best serve as the centre for exchange of information and should set up some guidance and procedures on this function. Such procedures could be simple and straightforward.

Future Technological Advances

4.8 The technologies of surveillance were subject to rapid change and it was agreed that advances in satellite technology might have a significant impact on the surveillance problem. These advances should be kept under close review.

Future Meetings

4.9 It was agreed that it would be useful to hold meetings from time to time to continue to improve international cooperation on surveillance in the area and to review technological developments. Such meetings would not need to be regular but on an ad hoc basis, perhaps in 1994 after the cooperative project, and then approximately every two years.

Appendix 1

LIST OF PARTICIPANTS

Commodore Tor Nikolaisen	Inspector, Norwegian Coastguard, HQ Defence Command Norway, Oslo Mil/Huseby, N-0016 Oslo 1, Norway
Commander Halvar Pettersen	Norwegian Coastguard, Kystvaktskvadron Nord, P O Box 295, N-8401 Sortland, Norway
Captain Helgi Hallvardsson	Icelandic Coastguard, P O Box 7120, IS 127 Reykjavik, Iceland
Mr Arni Isaksson	Institute of Freshwater Fisheries, Vagnhofdi 7, 112 Reykjavik, Iceland
Mr Martin Kruse	Faroese Inspection and Rescue Service, Torshavn FR 100, Faroe Islands
Mr Andrew MacLeod	Scottish Fisheries Protection Agency, Pentland House, 47 Robb's Loan, Edinburgh EH14 1TW, UK
Mr Robert Williamson	Scottish Office Agriculture and Fisheries Department, Pentland House, 47 Robb's Loan, Edinburgh EH14 1TW, UK
Dr Malcolm Windsor (Chairman)	Secretary, NASCO, 11 Rutland Square, Edinburgh EH1 2AS, UK
Dr Peter Hutchinson	Assistant Secretary, NASCO, 11 Rutland Square, Edinburgh EH1 2AS, UK

INTERNATIONAL MEETING ON

SURVEILLANCE OF FISHING FOR SALMON IN INTERNATIONAL WATERS

NASCO HEADQUARTERS
11 RUTLAND SQUARE, EDINBURGH, UK

Wednesday 24 March 1993

AGENDA

1. Introduction

2. Existing Sources of Information:

    (a) Airborne surveillance flights
    (b) Surveillance at sea
    (c) Information from ports
    (d) Other sources of information

3. Additional Potential Sources of Information:

    (a) Satellite systems
    (b) Military reconnaissance
    (c) Monitoring radio traffic
    (d) Other potential sources of information

4. Possible Areas for International Cooperation on Surveillance

COUNCIL

CNL(93)29

IMPACTS OF SALMON AQUACULTURE

CNL(93)29

IMPACTS OF SALMON AQUACULTURE

1. When the NASCO "Guidelines to Minimise the Impacts of Aquaculture on Wild Stocks" were tabled in 1990 we knew much less about the impacts than we do now. The attached paper summarises our present knowledge and the new information gives rise to real concern. Farmed fish now occur on the marine feeding grounds, in fisheries and on the spawning grounds of wild salmon. In some rivers up to 90% of the fish are of farmed origin and we now know that inter-breeding between farmed and wild fish occurs. What we do not know is whether this interbreeding will result in the loss of local adaptations in the wild stocks, ie will the progeny of such interbreeding be less fit for survival than the purely wild stocks. A review of the literature would suggest that the potential impacts could be very serious and that measures to minimise the negative impacts are needed urgently.

2. This major introduction of salmon to the North Atlantic is being made without any understanding of its significance. At worst it could lead to a collapse of the stocks. At best it could have no adverse effect at all. We do not know which of these scenarios will prevail. (However, there are already press reports that anglers are being driven away from fisheries by the occurrence of farmed fish). In such circumstances, if we are to uphold the requirement of the NASCO Convention to conserve the wild stocks, it would seem highly appropriate to adopt a precautionary approach.

3. Such an approach would be in accordance with the UN Convention on Biological Diversity which commits signatories to the conservation and sustainable use of biological diversity. Furthermore, the Declaration of the International Conference on Responsible Fishing, Cancun, Mexico, 1992, encompassed the use of aquaculture practices which are not harmful to ecosystems, resources or their quality.

4. It is clear that there is a lack of scientific information on the genetic impact of reared Atlantic salmon on the wild stocks, although such information exists for other closely related species. Research is presently being undertaken but the results will not be available for some years. The question of the genetic impacts has been considered by the ICES Study Group on Genetic Risks to Atlantic Salmon Stocks but this group has been suspended until the experimentation needed is further advanced. However, the Study Group has stressed the need for managers to act on the basis of the current body of information that exists since if the research finds serious impacts the damage will already be done.

5. While the NASCO Guidelines are still relevant the new information suggests that, if we are to conserve the wild stocks and their characteristics, stronger measures will have to be contemplated as a matter of some priority. This is a complex issue which will need consultations both with wild salmon interests and with the salmon farming industry. The Council may wish to establish a Working Group to consider the evidence and to advise on the options for internationally acceptable action to

protect the wild stocks while allowing the farming of salmon to continue to progress.

The Working Group should be asked to report back to the Council at its next meeting.

Secretary
Edinburgh
13 May 1993

CNL(93)29

IMPACTS OF SALMON AQUACULTURE

CONTENTS

CNL(93)29

IMPACTS OF SALMON AQUACULTURE

1. BACKGROUND

1.1 Since 1988 the Council of NASCO has considered the possible threats to the wild salmon stocks from salmon aquaculture. Special Sessions on this topic were held in both 1989 and 1990 and resulted in the publication, in 1991, of the "Guidelines to Minimise the Threats to Wild Salmon Stocks from Salmon Aquaculture" which have been widely circulated and generally well received.

1.2 Since the Council adopted the Guidelines considerable new information concerning the occurrence and behaviour of salmon which have escaped from salmon farms, and on the interactions with the wild stocks, has been obtained. Furthermore, there is also increased understanding of possible management measures to minimise impacts. This review summarises the present information.

2. STATUS OF AQUACULTURE PRODUCTION

2.1 The recent large scale expansion of salmon aquaculture in the North Atlantic is due to the rapid development of the salmon farming industry. This industry did not exist prior to 1970 and expanded to a maximum production of almost 237,000 tonnes in 1991. In 1992 the production was slightly lower, although it was still approximately 50 times the declared catch of wild salmon, but it is anticipated that production will again expand as demand rises. The majority (>90%) of the production is in the North-East Atlantic Commission area and production by country in 1992 is shown in Table 1.

Country	Production (Tonnes)
Norway	140,000
Scotland	36,101
Faroe Islands	17,000
Canada	10,380
Ireland	9,231
USA	5,850
Iceland	2,100
Northern Ireland	200

Table 1: Production of farmed salmon in 1992 by country (Source: Anon, 1993).

2.2 By far the largest producer of farmed salmon is Norway accounting for 63% of the total production in 1992. It has been estimated that approximately 30 million salmon were harvested from cages in Norway in 1989, compared to an estimated spawning stock of 100,000 fish in Norwegian rivers (Gausen and Moen, 1991). Similarly, in Iceland the number of reared smolts produced in 1989 (10 million) greatly exceeds the natural production of 600,000 smolts (Gudjonsson, 1991).

3. OCCURRENCE OF FARMED SALMON IN THE WILD

3.1 Farmed fish may occur in the wild as a result of escape from aquaculture units or because they are released. Escape of farmed fish is inevitable and losses occur from most sites each year (Webb et al, 1991). These losses may result from handling errors, faulty gear, weather damage, predator damage, other forms of damage (eg vandalism, collisions etc) or accidents during transit. Evidence from freshwater cage culture units in a lake indicates that harvests of escaped farmed fish in the surrounding lake were 2.5-5% of the total production (Phillips et al, 1985). In addition to routine losses through handling errors etc there have been some very significant episodic losses due to severe storms eg 184,000 growing salmon (Webb et al, 1991); 700,000 (Gausen and Moen, 1991); 1,423,000 1 sea-winter salmon (Gausen personal communication). In Norway the majority of large scale escapes are believed to result from damage following the loss of cage moorings during storms (Gausen and Moen, 1991). However, other large scale accidental losses have also been reported, eg Mills (1989) reports the loss of 100,000 smolts when a transport ship ran aground on the Orkneys. It has been estimated that 2 million fish escape from salmon farms in Norway each year (Bergan et al, 1991). These large accidental losses add to the constant small scale loss of fish (Gudjonsson, 1991). In addition to accidental releases, surplus farm stock (principally potential S2 smolts) are removed during grading and either released into neighbouring watercourses, sold to fishery managers, given away or killed (Maitland, 1987; Mills, 1987).

3.2 There is now considerable evidence that substantial numbers of farmed Atlantic salmon which have gained access to the wild occur in the marine feeding grounds, in fisheries in both marine and fresh waters and on the spawning grounds. With an increase in aquaculture production the number of reared fish in the wild has increased (Gudjonsson, 1991). Sampling in the Faroese zone has shown that 25-48% of the salmon caught were farmed fish (Jacobsen et al, 1992). In Norway, farmed salmon were found in 70% of the rivers sampled in 1988 where they comprised 15% of the total samples in southern Norway but only 1% of the samples in northern Norway, reflecting the distribution of farm production (Gausen and Moen, 1991). The highest observed frequency of farmed fish in these samples was 77% in the river Os near Bergen but recent studies in Norway indicate that up to 90% of the fish in some rivers may be of farmed origin. In four Icelandic rivers the proportion of reared (cage reared and ranched) fish in 1989 ranged from approximately 12-47%. In the river Polla, Scotland, 54% of the angling catch during the season following a large escape in a nearby sea-loch was estimated to be of farmed origin (Webb et al, 1991). Studies in the River Lochy, Scotland have demonstrated great inter-annual variability in the occurrence of farmed fish with escaped fish accounting for 18% and 61% of the rod catches in 1988 and 1990 respectively although no farmed fish were recorded in 1989 (Scottish Office Freshwater Fisheries Laboratory, Pitlochry, Annual Review 1990-1991). Similarly in the Burrishoole River, Ireland the occurrence of farmed fish in the river was variable between years with large numbers of farmed fish present following an escape from a local fish farm, but a marked reduction the following year (Whelan, personal communication).

4. BEHAVIOUR OF FARMED SALMON IN THE WILD

4.1 Hansen, Doving and Jonsson (1987) demonstrated that immature farmed fish released into the wild migrated to North Atlantic feeding areas whereas mature fish entered rivers at random when they were ready to spawn. Experiments with hatchery reared smolts and sea-water acclimated post-smolts demonstrated that fish released in winter strayed more and entered rivers farther from the release point than fish released during the rest of the year (Hansen and Jonsson, 1991a). However, survival of fish escaping at the smolt stage in the spring is much higher than for post-smolts escaping during the fall and summer although survival improves as the fish become larger (Hansen and Bakke, 1989). Jonsson et al (1991) found that the marine survival of wild fish was almost twice as high as for hatchery fish and that the straying rate of the wild fish was less than for hatchery fish. Webb et al (in press,a) found that only 0.5% of the 184,000 fish which had escaped from nearby sea cages returned to the river Polla. Furthermore, there was no evidence of substantial returns from this escape to two neighbouring rivers, suggesting that the fish were subject to high mortality at sea after escape. In Norway, most salmon are thought to escape during the winter when the weather conditions are adverse (Hansen and Jonsson, 1991a). Despite survival to adult stage being low for fish escaping at this time large numbers of fish are known to survive to return to homewaters.

4.2 There is evidence that farmed salmon enter freshwater later in the year than the wild salmon (Gausen and Moen, 1991; Gudjonsson, 1991; Jonsson et al, 1991) and that farmed females spawn later than wild females. Farmed females have been observed to cut redds on spawning grounds previously used by wild females (Webb et al, 1991). Studies have shown that farmed salmon can ascend small waterfalls and steep riffles (Gudjonsson, 1991), although some waterfalls passable to wild salmon appeared to be an obstacle to farmed salmon in some rivers (Gausen and Moen, 1991). Webb et al (1991) found that farmed salmon tended to spawn in the lower reaches of the river Polla, with farmed males being more widely distributed at spawning time than farmed females. However, a subsequent study, based on the distribution of fry bearing the pigment canthaxanthin, provided results which suggest that the situation in the Polla may not be general because of the presence of a hatchery near its tidal limit which may have influenced the distribution of the farmed fish (Webb et al; in press,a).

4.3 Recent studies have demonstrated that farmed fish spawn successfully. Lura and Seagrov (1991) demonstrated successful spawning of farmed female salmon in two out of three rivers studied. The method used (identification of optical isomers of astaxanthin in the ova in redds) could not show whether spawning had occurred between farmed males and wild females, although the authors believed that this was likely. Such matings were, however, observed by Webb et al (1991) in the river Polla, Scotland, where farmed fish of both sexes were observed to spawn freely with wild fish. Webb et al (in press, b) conducted a survey of salmon fry at the time of emergence in 16 rivers in western and northern Scotland and used the presence of canthaxanthin to identify the progeny of farmed female fish. Eleven of these rivers were selected at random along that part of the west and north coasts of the mainland associated with cage rearing while three other rivers were chosen as outliers. Fry containing canthaxanthin were detected in samples from 14 of the rivers examined. 4.6% of the fry examined contained canthaxanthin with the proportion ranging from 0-17.8%. The highest frequencies of fry bearing canthaxanthin were detected in rivers located in the area most intensively used for aquaculture. The method of detection used will only identify the progeny of matings involving female farmed salmon which have escaped from sea cages since the pigment is not fed to farmed fish until transfer to seawater. Furthermore, not all farmed fish are fed canthaxanthin in their diet. The results of this study indicate that spawning between wild and farmed salmon is now occurring in Scottish rivers over wide geographic areas.

5. GENETIC INTERACTIONS

5.1 The widespread distribution and marked homing ability of the Atlantic salmon are attributes favouring the development of distinct stocks ie genetically distinct populations (Wilkins, 1985). Circumstantial evidence for distinct stocks (Saunders and Bailey, 1980; Ryman, 1983) has been confirmed by electrophoretic studies of variable proteins (Cross and Healy, 1983; Stahl, 1983; Verspoor, 1986; Crozier and Moffett, 1989). Furthermore, genetic differences within river systems have also been demonstrated (Stahl, 1983; Verspoor et al, 1991) and it is now generally believed that each river which supports Atlantic salmon may be inhabited by one or more genetically distinct forms (NAC, 1991).

5.2 The question arises as to whether genetic differences between populations are of adaptive significance to the population or are adaptively neutral having arisen through random forces. Variation at protein loci is usually assumed to be adaptively neutral, but recent studies have linked variation in performance to variation at one protein locus (Jordan and Youngson, 1991). Furthermore, a number of studies have demonstrated that performance characters have a genetic basis. Riddell et al (1981) compared juvenile salmon from two tributaries of the Miramichi River and demonstrated that the juveniles from a tributary characterised by higher flows had more streamlined bodies and longer fins than fish from slower flowing tributaries. They were able to demonstrate that this inter-population variation in body morphology had a genetic basis. Winter et al (1980) demonstrated that different genotypes exhibited differential resistance to infections such as Bacterial Kidney Disease and Kanis et al (1976) showed that mortality in salmon, particularly for the egg and alevin stages, was heritable. There is also some evidence that the homing ability of salmon may be under genetic control. Bams (1976) demonstrated that while imprinting alone brought back some of an introduced donor stock of pink salmon, *Oncorhynchus gorbuscha*, addition of locally adapted paternal genes improved the returns. Hansen and Jonsson (1991b) provided evidence of a genetic component in the seasonal pattern of return of Atlantic salmon. They believed that differences in time of return to freshwater might be a result of different selective factors operating in the stocks tested such that the salmon return to the rivers at times when flow regimes are favourable to upstream migration.

5.3 During the selection of stock for the developing salmon farming industry, the diversity present in the wild stocks presented farmers with the opportunity to select for attributes favourable to culture such as late maturation eg Norwegian river Alta stock (Naevdal, 1981). Farmed fish may differ genetically from the wild fish for a number of reasons. Firstly, the source material may be different eg Irish farmers use lines developed from Norwegian and Scottish salmon (Cross and Challanain, 1991). Secondly, there may be founder effects because of inadequate sampling of the source population. Thirdly, differences may arise because of genetic drift, that is changes resulting by chance in the hatchery broodstock. Fourthly, differences might arise because fish farmers try to modify the genetic constitution of their broodstock by selective breeding for particular traits (Youngson et al, 1991). In Norway individual and family selection has been practised in dedicated breeding units and there have been significant genetic gains in growth rate, reduced frequency of sexual maturation and tameness of the fish (Gjedrum, 1985), while in Scotland, only the less powerful mass selection technique has been employed and major improvements in target traits are considered unlikely (Youngson, 1991). A number of studies have demonstrated significant reduction in genetic variability in farmed salmon (Ryman and Stahl, 1980; Cross and King, 1983; Verspoor, 1988) but no evidence of this was found in Scottish farmed fish (Youngson, 1991). However, even if there are no genetic changes resulting from hatchery rearing, escapes from salmon farms may differ from the wild fish because they are not of local origin.

5.4 A great deal of concern about the possible adverse genetic effects of fish farm fish on the wild stocks has been expressed in recent years (Maitland, 1987; Cross and Challanain, 1991; Hindar et al, 1991; Skaala et al, 1991) but in the case of the Atlantic salmon this concern is not based on empirical evidence of change to the wild stocks (Youngson, 1991). However, a number of studies have been conducted in which the effects of the introduction of cultured stocks on wild stocks have been monitored. Reisenbichler and McIntyre (1977) compared the survival of offspring from matings of hatchery x hatchery, hatchery x wild and wild x wild summer steelhead, *Oncorhynchus gairdneri*. Wild fish were found to have the highest survival rates in the study streams and the authors concluded that if hatchery fish interbred with wild fish there may be a reduction in smolt output. Similarly, Chilcote et al (1986) compared the reproductive success of naturally spawning summer run hatchery and wild steelhead, *Oncorhynchus gairdneri*. They found that the success of hatchery fish in producing smolt offspring was only 28% of that for wild fish but that hatchery fish outnumbered the wild fish. The authors concluded that under such conditions the genetic integrity of the wild populations may be threatened. Altukhov (1981) described the results of the transfer between 1964-1977 of 350 million fertilised chum salmon (*Oncorhynchus keta*) eggs from the Kalininka river to the Naiba river on Sakhalin Island. By 1969-1970 there had been a genetic shift in the later running Naiba stock and by 1985 the population of this river, which had previously supported a run of about 650,000 salmon, was virtually extinct. Thorpe (1987) stressed the importance of this example for managers of Atlantic salmon stocks which are known to exhibit more genetic variability than Pacific salmon stocks. Skaala et al (1991) studied the reproductive success of a genetically marked strain of brown trout (*Salmo trutta*) and its genetic effect on wild populations in Norway. In the autumn of 1989 genetically marked reared spawners were introduced into two spawning localities of wild trout. The reproductive success of introduced trout was estimated to be approximately 25% compared to that of wild trout. Estimates of survival rates of 0+ trout revealed that survival is almost twice as high in wild trout than in hybrids of wild and reared trout. The authors concluded that when frequent inputs of hatchery fish occur the genetic characteristics of the wild stocks will be altered and the biological consequences of such gene flow are unknown.

5.5 During the NASCO/ICES meeting on Genetic Threats to Wild Stocks from Salmon Aquaculture, a number of views on the impacts were expressed ranging from no impact (or even benefits) to serious impacts. The only evidence, however, suggested that adverse impacts were possible (NASCO, 1989). Hinder et al (1991) reviewed the literature concerning the genetic effects of cultured fish on natural fish populations. They concluded that a wide range of outcomes have been observed ranging from no detectable effect to complete introgression or displacement. Where genetic effects on performance traits have been documented they always appear to be negative in comparison with the unaffected native populations and the authors cautioned against a complacent attitude. They warned that without a necessary reservoir of genetic variation the species becomes vulnerable to environmental changes and to epizootics from which it might not recover with consequences both for those concerned with the wild stocks and the aquaculture industry. Theoretical studies suggest that failure to minimise or to eliminate the co-occurrence of cultured and native salmon will significantly increase the threat of extinction to native populations (Hutchings, 1991). Cross and Challanain (1991) found that in Ireland one line derived from Norwegian and Scottish stocks dominated the salmon farming industry and they concluded that if escaped fish from this line were to enter Irish rivers and interbreed with wild fish in large numbers the present stock structure would be eliminated. Recent international meetings which have considered the genetic impact of farmed Atlantic salmon on the wild stocks have highlighted the lack of empirical evidence of genetic impacts (NASCO, 1989; NASCO, 1990) and the need for experiments involving the deliberate release of genetically distinguishable cultured fish. These experiments are now being undertaken on the Burrishoole River, Ireland and the River Loth, Scotland with EC funding. However the results from these studies will not be available for several years and the need for a precautionary approach until such information is available has been stressed. This approach was recommended by the ICES Study Group on Genetic Risks to Atlantic Salmon Stocks which stressed the need for management decisions designed to reduce impacts to be based on the information which exists now. They also recommended the widescale use of sterile salmon in the aquaculture industry to reduce the genetic risks (Anon, 1991). This Study Group has been temporarily suspended, presumably to allow time for the necessary experimentation to yield results. Furthermore, recent success in the production of transgenic fish, that is fish bearing introduced genes from other species, has given rise to heightened concern since the performance and ecological impacts of such fish is unknown (Kapuscinski and Hallerman, 1990). For example, genes coding for growth hormone and antifreeze protein would be advantageous to salmon farming in reducing the production cycle and allowing culture in northern waters. The release of certain transgenic fish could destabilize aquatic ecosystems since transmission of the inserted genes has been observed (Kapuscinski and Hallerman, 1991).

5.6 The key to protecting the genetic integrity of the wild stocks lies in ensuring that farmed salmon are contained or if they escape they are unable to reproduce with the wild fish. Donaldson (1991) reviewed the literature concerning reproductive containment and concluded that it is generally accepted that total containment is only feasible in land based facilities utilising appropriate security systems, screening of outflows, treatment of effluents etc. However, the present production of the salmon aquaculture industry is dominated by cage culture and escapes from such facilities are regarded as inevitable. In this situation biological containment through sterilization of farmed fish may be appropriate and may offer benefits to the farmer by eliminating the problems associated with maturation.

5.7 Fish may be rendered sterile in a number of ways including surgical removal of the gonads, induction of gonadal auto-immunity, chemosterilization, irradiation, treatment with androgen, induction of triploidy, production of sterile hybrids and production of sterile transgenics. For use in aquaculture the sterilisation technique adopted should render the fish both functionally and hormonally sterile (Johnstone, 1992) so as to avoid development of undesirable secondary sexual characteristics. Donaldson (1992) concluded that only two sterilization techniques are currently available - androgen treatment and production of all female triploids. However, while androgen treatment is not yet available for use on a production basis with Atlantic salmon (Donaldson, 1991) all female triploids have been utilised on commercial farms where triploid yields (the product of triploid rate and survival expressed as a percentage) of >90% have been achieved using hydrostatic pressure shock of eggs (Aberdeen University Research and Industrial Services Ltd (AURIS)). However, the salmon farming industry seems reluctant to use sterile fish possibly because of fears that the use of hormones, albeit one generation away from the harvested fish, will affect the marketability of the product. Furthermore, triploid salmon grow less rapidly because they lack the steroid hormones which stimulate growth in maturing fish and, because they have larger blood cells (triploids have an extra set of chromosomes), there is some concern that they may be less tolerant of reduced oxygen concentrations which may occur because of environmental degradation or at times of crowding (Johnstone, 1992). However, taste panel assessments found that flesh quality and smoking characteristics of triploid fish were identical to those of non-maturing diploid fish (AURIS) and they offer the farmer the flexibility to decide when to harvest the fish and reduce the need to grade out maturing fish. From the point of view of protecting the wild stocks from genetic impacts there is evidence that sterilised fish remain in the marine environment and do not enter rivers (Donaldson, 1991) although little is known about the behaviour of such fish in coastal waters.

5.8 There is some evidence that aquaculture free zones are effective in reducing the occurrence of farmed fish in salmon rivers. Gausen and Moen (1991) found that high proportions of farmed fish (>20%) were never found in rivers at a distance greater than 20km from the nearest cage culture unit. However, since straying of escaped fish may increase at certain times of the year, aquaculture free zones alone are not sufficient for complete protection (Bergan et al, 1991).

6. DISEASE AND PARASITE INTERACTIONS

6.1 Although disease epizootics in wild salmonids are uncommon (Secombes, 1991) they can be a serious threat in intensive culture due to behavioural stress or sub-optimal environmental conditions (Saunders, 1991). Losses due to diseases are by far the most serious problem facing the industry in Norway and the two diseases, vibriosis and cold water vibriosis, alone are estimated to have caused losses of more than $100 million (£67 million) during 1984-1988 (Tilseth et al, 1991). The development of the salmon aquaculture industry has led to an associated increase in the number and severity of diseases of farmed fish (Smith, 1985). For example, Hitra disease was first identified in 1979 and has caused severe losses in Norway (Anon, 1987) and during the 1980's a new disease, Infectious Salmon Anaemia (ISA), caused heavy mortalities at some Norwegian farms. It is understandable, then, that concern has been expressed about the possible transfer of diseases and parasites from farmed fish to the wild. Such transfers of disease may occur through the shedding of infectious agents into the water, through contact of wild fish and farmed fish on each side of the cage, through escaped farmed fish mixing with wild fish and being used as broodstock or through contact with contaminated gear etc (Hastein and Lindstad, 1991). The potential negative interactions are not, however, one sided since wild fish may be an important reservoir creating problems of disease eradication at culture sites (Anderson, 1987). However, while diseases may be treated successfully in the hatchery environment it is not usually possible to treat fish in the wild.

6.2 While concern has been expressed about transmission of diseases from aquaculture sites to the wild there is little evidence of significant adverse effects, although demonstrating transmission of diseases from farmed to wild stocks is difficult (Anderson, 1987). Where disease does occur in a wild stock on a river with culture facilities it is difficult to ascertain if the infections are indigenous or have resulted from the culture operations (Saunders, 1991). There are, however, a number of examples in the literature of transmission of disease from culture units to the wild. Egidius (1987) described the import of furunculosis, *Aeromonas salmonicida*, to Norway with Scottish salmon smolts and this disease has subsequently been reported in the wild. Both cultured and wild salmon are at risk from this disease (Saunders, 1991). For example, Munro (1990) described modelling studies on the release of *Aeromonas salmonicida* from sea cages in a hypothetical sea loch which indicated that wild fish entering the loch would probably encounter viable bacteria released from the farm and would, therefore, be at risk of infection. Munro et al (1976) reported the spread of Infectious Pancreatic Necrosis (IPN) from farmed stock to wild fish although the prevalence of the virus in the wild was low and the infection appeared to be "inactivated" within a short distance of the farm. Since 1989 there has been a rapid spread of IPN at sea water sites in Scotland (Munro and Smail, 1992) and it has been detected in fish in two Scottish West Coast rivers (McVicar et al, 1992).

6.3 In recent years concern has been expressed about the possible effects of sea-lice, *Lepeophtheirus salmonis* and *Caligus elongatus*, on wild salmonids since the populations of this parasite may have increased due to salmon farming (Wootten et al, 1992) and because the parasite can be a vector of diseases such as furunculosis and infectious salmon anaemia (see CNL(93)24). In Norway the level of lice infestation on wild salmon in the area where fish farming is concentrated has been found to be ten times as high as in Oslofjord where there is no farming (Directorate for Nature Management, personal communication) and there is great concern that even moderate levels of infestation may cause smolt mortality (see CNL(93)24). In Ireland, studies in relation to the collapse of sea trout stocks in the mid-western region showed that both sea trout smolts and kelts returned prematurely to freshwater and that many of these fish were severely infested with juvenile sea lice (*L. salmonis*) which had caused severe skin and flesh damage (Tully and Whelan, 1992). Furthermore, dead and dying post smolts were observed in estuaries where the level of infestation was highest and in some of the locations sampled the infestation was of epizootic proportions with significant host pathology. Highest infestation levels on sea trout occurred where farmed production was highest but no cause and effect relationship was established in 1991 between sea-lice present on farmed salmon and infestation on sea trout (Anon, 1992a). In Norway and Ireland efforts are now being made to coordinate the treatment of sea-lice. Farmers are being encouraged to treat fish with dichlorvos or hydrogen peroxide in spring before water temperatures increase so as to avoid stress to the farmed fish and to remove the lice at a time when the rate of reproduction is low. It is important that treatment also takes place before the wild smolts leave the rivers since information from Ireland suggests that the smolt stage is particularly vulnerable to damage by the parasite (Whelan, personal communication). Following the initial treatment, prophylactic treatments are needed to keep lice numbers down. In Norway considerable effort is being invested in publicising the need for coordinated treatment.

6.4 Cage rearing can cause eutrophication and this has been linked to increased parasite loads in some fish populations and pathogenic fungal infections are more common in eutrophic waters (Phillips et al, 1985).

6.5 The NASCO Guidelines make a number of recommendations concerning husbandry techniques. In recent years there have been trends within the industry to use reduced stocking densities and fallowing of sites, which appear to have had beneficial results (Anon, 1992b).

6.6 Hastein and Linstad (1991) reviewed the possible disease interactions between wild and farmed fish and concluded that by acting "unconsciously" man was possibly the greatest factor in creating damage to the natural populations. Interest in introductions and transfers for aquaculture has increased in recent years (NAC, 1991) and the possible impacts of such stock movements are described in document CNL(93)31. The extreme dangers of such movements are highlighted by the spread of *Gyrodactylus* in Norway which is described in CNL(93)33.

7. IMPACTS ON THE AQUATIC ENVIRONMENT

7.1 Concern about the rapid expansion of the salmon farming industry and its effects on the aquatic environment has been expressed by a number of conservation organizations and this concern is shared by the industry who fear that the harmful feedback could adversely affect the economical viability of the farm (Gowen and Bradbury, 1987). A review of the literature on the impacts of salmon aquaculture on the environment was presented at the Seventh Annual Meeting (CNL(90)27) and this information has been summarised and updated below. Impacts on the aquatic environment may result from the addition of waste products and chemicals, or other factors.

7.2 It has been calculated that for each tonne of feed 88kg of carbon and 15.4 kg of nitrogen will enter the environment as waste feed, together with 105.6kg of carbon in the faeces and 6.2kg and 40kg of nitrogen in faeces and excreta respectively.

Waste products in solid form (faeces and waste feed together with scales, mucus and other detritus) will tend to settle while excreted material will be in the soluble form (Anon, 1989a). The nutrient loads from fish farming must, however, be seen in perspective and in Finland it has been estimated that fish farm nutrients account for under 4% (phosphorus) and under 2% (nitrogen) of the total nutrient load from human activities (Makinen, 1989). In the case of salmon aquaculture most of the production occurs in marine waters and even a substantial smolt rearing unit producing 300,000 smolts annually will only have a production of about 15 tonnes per annum. There is very limited information on the effects of salmon production in freshwater although the impacts of wastes from trout production have been documented (Mills, 1987). Phillips et al (1985) reviewed the impacts of salmonid cage culture on inland fisheries but no adverse impacts on the fish communities were reported. However, there were changes in water and sediment chemistry with consequences for microbial and benthic communities. Phosphorous is generally the limiting nutrient in freshwaters. Alabaster (1982) undertook a questionnaire survey of freshwater fish farm effluents in fifteen European countries and found that downstream fisheries were not generally adversely affected unless the total flow of recipient waters was less than 5 litre/second for each tonne of annual production of fish. A similar survey of fish farms utilising freshwaters in the UK found that mortalities among the native fish populations had occurred in a few cases but in general there was little deterioration in fisheries (Solbe, 1982).

7.3 A number of studies in the marine environment have investigated the impacts of solid wastes from salmon cage culture on the sediments below (Braaten et al, 1983; Brown et al, 1987; Gowen and McCluskey, 1988; Rosenthal and Rangeley, 1989). Where water exchange is poor, organic material may build up beneath cages resulting in increased oxygen consumption in near bottom waters and the release of methane and hydrogen sulphide gases which could have repercussions for the health of the fish (Gowen and McCluskey, 1988). Braaten et al (1983) concluded that careful attention should be given to site selection and to all routine operations in order to minimise such pollution. However, where effects on the sediment have been observed these have tended to be localised (Brown et al, 1987) and a problem for the fish farmer rather than the indigenous flora and fauna (Anon, 1989a). Furthermore, "souring" is only likely to be a problem at sites where water depth and movement are inadequate (Gowen and McCluskey, 1988). However, there is a need for caution because formation of anoxic sediments could provide conditions suitable for the accumulation of dinoflagellate cysts and their release into the water column could result in blooms (Rosenthal et al, 1987).

7.4 With regard to the soluble fraction of the wastes the most significant characteristics as they affect water quality are suspended solids, nitrogen and phosphorous compounds, vitamins and trace elements. Nitrogen is generally the limiting nutrient in marine waters (Anon, 1989a). Gowen and McCluskey (1988) found no evidence that a fish farm had increased nitrogen or phosphorous levels of the sea-loch in which it was located although there was a localised increase in ammonium around the site. However, direct ammonium toxicity to either farmed or wild fish populations is considered unlikely (Anon, 1989a). In general, widespread eutrophication as a result of mariculture is unlikely (Gowen and Bradbury, 1987) although there is a need for caution since a salmon farm has been implicated in the formation of a localised phytoplankton bloom and such phenomena could have serious consequences for the wild fish (Anon, 1989a). Furthermore, some vitamins in diets used in aquaculture are required for the growth of toxic microflagellates although there is no evidence that the occurrence of toxic phytoplankton blooms in Scotland and Norway are related to fish farming activity (Gowen and Bradbury, 1987). Recently concern has been expressed about the bleeding of salmon prior to marketing and care is required in the disposal of such wastes (Anon, 1989b).

7.5 A wide variety of chemicals including vaccines, therapeutants, disinfectants and anaesthetics are used in aquaculture which represent a potential threat to the indigenous biota if misused (Rosenthal et al, 1987) and more information is needed on the effect of such chemicals after discharge (Maitland, 1985). One of the most common chemical treatments in salmon mariculture is an immersion treatment with the pesticides trichlorvon or dichlorvos which are used to remove salmon lice. Concern has been expressed about this treatment (Ross and Horsmann, 1988) and Fraser et al (1989) suggested that the use of dichlorvos by salmon farmers may be a possible cause of cataracts in wild salmon on the West Coast of Scotland. However, Dobson and Schuurman (1990) concluded that there appeared to be no logic behind this hypothesis and many other more plausible explanations exist to account for cataract formation. A number of alternative treatments of lice are being investigated by the industry including the use of cleaner wrasse (Bjordal, 1988); vaccination (Anon, 1990); pyrethrum (ground chrysanthemums) and even strings of onions. Wrasse, in particular, appear to be successful in keeping lice numbers down when used at ratios of 1:50-1:100 salmon although as these fish are caught in the wild they have caused some disease problems for the farmers (Secombes, 1991). Concern has also been expressed about the use of antibiotics (in Norway aquaculture accounts for 40-60% of the total antibiotics used) and antifoulants by the salmon farming industry.

7.6 There is also a need to ascertain whether the migratory behaviour of salmon is adversely affected by farming (Phillips et al, 1985) since no information is available on the effects of pheromones released by cultured fish on wild salmon (Anon, 1989b). Furthermore, there is a need for further research into the effects of predator-prey relationships. Species such as juvenile saithe, *Pollachius virens*, are known to utilise waste food from salmon farming and the relationship between these stocks and the prey species of salmon smolts requires further study. It is also important to ascertain if wild smolts are attracted to, and enter, cages since they may be preyed upon by farmed stocks (Anon, 1989c).

7.7 The NASCO Guidelines made a number of recommendations concerning site selection and husbandry techniques. The ICES Working Group on Environmental Impacts of Mariculture concluded that the impacts on the marine environment from aquaculture have not been as great as anticipated and the problems that exist would yield to improved practices, notably improved site selection and advances in husbandry (Anon, 1992b).

8. ECONOMIC INTERACTIONS

8.1 In the last ten years or so the international trade in salmon has developed considerably with increased supplies allowing the development of new markets (Shaw and Muir, 1987). The advent of a large supply of high quality, fresh farmed salmon available throughout the year has had a marked effect on the traditional salmon markets, particularly the market in frozen salmon, which had been supply driven (Stansfeld, 1985). Tuomi (1987) speculated that the traditional commercial fishery in Canada would end because of the advent of salmon farming. In Scotland, price reductions have resulted in many marginal netting stations closing or working shorter seasons resulting in a change in the pattern of exploitation favourable to the development of ranching (Stansfeld, 1985) particularly given the large numbers of smolts being produced and the present financial difficulties facing the industry. Hansen, Lund and Hindar (1987) expressed concern that an increased output of reared fish might lead to higher fishing effort in mixed stock fisheries resulting in over-exploitation of wild salmon stocks. This is exactly what has happened to the Baltic salmon.

8.2 The combination of low stock abundance and reduced fishing effort have resulted in a reduction in the supply of wild salmon on the markets which are now dominated by farmed fish. Although a premium price is paid for farmed salmon in Canada (Anderson, 1987) some consumers demand wild salmon and are prepared to pay to obtain it. There is some evidence that the reflagged vessels operating in international waters have been supplying these markets (see document CNL(93)27).

8.3 There have also been reports in the press that the occurrence of farmed fish in rivers is driving salmon anglers away from fisheries in some areas. One article stated that the fighting qualities of the farmed fish were much poorer than the wild fish and that the flesh quality of the farmed fish was inferior to the wild. Given the considerable economic value of recreational salmon fisheries this impact, if substantiated, would clearly be a matter of concern for those responsible for the management of the fisheries.

9. SUMMARY

9.1 In recent years there has been a rapid increase in aquaculture through the rapid growth of salmon farming. This is a valuable industry which produces a high quality product and has created employment in rural areas. The very rapid growth of the industry has meant that our knowledge of the likely impacts on the wild stocks has lagged behind. Our understanding of the interactions between wild and farmed fish has, however, increased considerably in recent years, through research in a number of NASCO countries, and now gives rise to real concerns.

9.2 Salmon which have escaped from culture units occur in large numbers in both the marine and freshwater environment and in fisheries and are known to inter-breed with wild salmon. Although there is no empirical evidence of the impacts of such interbreeding for Atlantic salmon, information for closely-related species strongly suggests that negative impacts are likely. There is also concern about the impacts of diseases and parasites on the wild stocks and other interactions. Clearly more research is needed and some important experimentation is now being undertaken with EC funding. However, managers have been urged by a number of international fora to act on the basis of current information in order to safeguard the wild stocks.

REFERENCES

Alabaster, J S (1982): Survey of fish-farm effluents in some EIFAC countries. Report of the EIFAC Workshop on fish-farm effluents. EIFAC Technical Paper 41: 5-20.

Altukhov, Yu P (1981): The stock concept from the viewpoint of population genetics. Canadian Journal of Fisheries and Aquatic Sciences 38:123-128.

Anderson, J M (1987): Effects of aquaculture on salmon management. Future of Atlantic Salmon Management Symposium, Portland, Maine, October 27-29 1987.

Anon (1987): New vaccine joins fight against Hitra disease. Fish Farming International 14 (8):24.

Anon (1989a): Fish farming and the safeguard of the Natural Marine Environment of Scotland. Nature Conservancy Council January 1989 136pp.

Anon (1989b): A solution to the bleeding problem. Aquaculture Ireland.

Anon (1989c): Report of the Working Group on Environmental Impacts of Mariculture. ICES CM 1989/F:11.

Anon (1990): Industry defends necessary use of lice chemical. Fish Farming International 17(1).

Anon (1991): Report of the Study Group on Genetic Risks to Atlantic Salmon Stocks. ICES Document CM 1991/M:3

Anon (1992a): Report of the Sea Trout Working Group 1992. Department of the Marine, Ireland. 109pp.

Anon (1992b): Report of the Working Group on Environmental Impacts of Mariculture. ICES CM 1992/F14.

Anon (1993): Report of the ICES North Atlantic Salmon Working Group. NASCO Council document CNL(93)12.

Bams, R A (1976): Survival and propensity for homing as affected by presence or absence of locally adapted parental genes in two transplanted populations of pink salmon (*Oncorhynchus gorbuscha*). Journal of the Fisheries Research Board of Canada 33: 2716-2725.

Bergan, P I; Gausen, D and Hansen, L P (1991): Attempts to reduce the impact of reared Atlantic salmon on wild in Norway. Aquaculture 98: 319-324.

Bjordal, A (1988): Cleaning symbiosis between wrasses (Labridae) and lice infested salmon (*Salmo salar*) in mariculture. ICES CM1988/F:17.

Braaten, B; Aure, J; Ervik, A and Boge, E (1983): Pollution problems in Norwegian Fish Farming. ICES, CM 1983/F:26.

Brown, J R; Gowen, R J and McCluskey, D S (1987): The effect of salmon farming on the benthos of a Scottish sea loch. Journal of Experimental Marine Biology and Ecology 109: 39-51.

Chilcote, M W; Leider, S A and Loch, J J (1986): Differential reproductive success of hatchery and wild summer-run steelhead under natural conditions. Transactions of the American Fisheries Society 115: 726-735.

Cross, T F and Healy, J A (1983): The use of biochemical genetics to distinguish populations of Atlantic salmon, *Salmo salar*. Irish Fisheries Investigations Series A:23: 61-66.

Cross, T F and King, J (1983): Genetic effects of hatchery rearing in Atlantic salmon. Aquaculture 33: 33-40.

Cross, T F and Challanain, D N (1991): Genetic characterisation of Atlantic salmon (*Salmo salar*) lines farmed in Ireland. Aquaculture 98: 209-216.

Crozier, W W and Moffett, J J (1989): Amount and distribution of biochemical-genetic variation among wild populations and a hatchery stock of Atlantic salmon, *Salmo salar* L, from north-east Ireland. Journal of Fish Biology 35: 665-677.

Dobson, D P and Shuurman, H J (1990): Possible causes of cataract in Atlantic salmon (*Salmo salar*). Experimental Eye Research 50: 439-442.

Donaldson, E; Devlin, R H; Solar, I I and Piferrer, F (1991): The reproductive containment of genetically altered salmonids. Paper presented to NATO Advanced Studies Institute Meeting on Genetic Conservation of Salmonid Fishes. Moscow, Idaho and Pullman Washington. June 24-July 5 1991.

Egidius, E (1987): Import of Furunculosis to Norway with Atlantic salmon smolts from Scotland. ICES CM 1987/F:8

Fraser, P; Duncan, G and Tomlinson, J (1989): Effects of a cholinesterase inhibitor on Salmonid lens: A possible cause for the increase incidence of cataract in salmon, *Salmo salar* L. Experimental Eye Research 49: 293-298.

Gausen, D and Moen, V (1991): Large scale escapes of farmed salmon into Norwegian rivers threaten natural populations. Canadian Journal of Fisheries and Aquatic Sciences 48: 426-428.

Gjedrum, T (1985): Selective breeding in fish farming and sea-ranching. Proceeding of the Salmon Farming Conference, Reykjavik, Iceland 19-20 September, 1985. Institute of Freshwater Fisheries 128pp.

Gowen, R J and Bradbury, N B (1987): The ecological impact of salmon farming in coastal waters: a review. Oceanography and Marine Biology Annual Review 25: 563-575.

Gowen, R J and McCluskey, D S (1988): Investigations into benthic enrichment, hypernutrification and eutrophication associated with mariculture in Scottish coastal waters. Report to Highlands and Islands Development Board, Crown Estate Commissioners, Countryside Commission for Scotland, Nature Conservancy Council and Scottish Salmon Growers Association.

Gudjonsson, S (1991): Occurrence of reared salmon in natural salmon rivers in Iceland. Aquaculture 98: 133-142

Hansen, L P; Doving, K B and Jonsson B (1987): Migration of farmed adult Atlantic salmon with and without olfactory sense, released in the Norwegian coast. Journal of Fish Biology 30: 713-721

Hansen, L; Lund, R A and Hindar, K (1987): Possible interaction between wild and reared Atlantic salmon in Norway. ICES Anadromous and Catadromous fish Committee CM 1987/M:14.

Hansen, L P and Bakke, T A (1989): Flukes, genetics and escapees. Atlantic Salmon Journal Autumn 1989: 26-29.

Hansen, L P and Jonsson, B (1991a): The effect of timing of Atlantic salmon smolt and post-smolt release on the distribution of adult return. Aquaculture 98: 61-67.

Hansen, L P and Jonsson, B (1991b): Evidence of a genetic component in the seasonal return pattern of Atlantic salmon, *Salmo salar* L. Journal of Fish Biology 38: 251-258.

Hastein, T and Lindstad, T (1991): Diseases in wild and cultured salmon: possible interaction. Aquaculture 98: 277-288.

Hindar, K; Ryman, V and Utter, F (1991): Genetic effects of cultured fish on natural fish populations. Canadian Journal of Fisheries and Aquatic Sciences 48: 945-957.

Hutchings, J A (1991): The threat of extinction to native populations experiencing spawning intrusions by cultured Atlantic salmon. Aquaculture 98: 119-132.

Jacobsen, J A; Hansen, L P and Lund, R A (1992): Occurrence of farmed salmon in the Norwegian Sea. ICES CM 1992/M:31. 8pp

Johnstone, R (1992): Production and Performance of Triploid Atlantic Salmon in Scotland. Scottish Aquaculture Research Report 2 1992 10pp.

Jonsson, B; Jonsson, N and Hansen, L P (1991): Differences in life-history and migratory behaviour between wild and hatchery-reared Atlantic salmon in nature. Aquaculture 98: 69-78.

Jordan, W C and Youngson, A F (1991): Genetic protein variation and natural selection in Atlantic salmon (*Salmo salar* L) parr. Journal of Fish Biology 39 (A): 185-192.

Kanis, E; Refstie, T and Gjedrum, T (1976): A genetic analysis of egg, alevin and fry mortality in salmon (*Salmo salar*), sea trout (*Salmo trutta*) and rainbow trout (*Salmo gairdneri*). Aquaculture 8: 259-268

Kapuscinski, A R and Hallerman, E M (1990): Transgenic fishes. Fisheries 15(4):2-5.

Lura, H and Seagrov, H (1991): Documentation of successful spawning of escaped farmed female Atlantic salmon, *Salmo salar*, in Norwegian Rivers.

Maitland, P S (1985): The potential impact of fish culture on wild stocks of Atlantic salmon in Scotland. In: The Status of the Atlantic Salmon in Scotland. ITE Symposium No. 15. Banchory Research Station 13-14 February 1985. Edited by D Jenkins and W M Shearer.

Maitland, P S (1987): Genetic impact of farmed Atlantic salmon on wild populations. Nature Conservancy Council ODG 87/1.

Makinen, T (1989): Fish culture and environmental impacts in Finland. ICES CM 1989/F:10.

McVicar, A H; Sharp, L A; Walker, A F and Pike, A Q (1992): Parasites and diseases of wild sea trout in Scotland in relation to fish population decline. Paper presented at the Conference on Pathological Conditions of Wild Salmonids. SOAFD Marine Laboratory, Aberdeen, Scotland, 6-8 May 1992.

Mills, D H (1987): Consideration of scientific problems associated with possible cage-rearing of salmon smolts in Scottish lochs and hydro-electric reservoirs. ICES CM 1987/M:5

Mills, D H (1989): Ecology and Management of Atlantic salmon. Chapman and Hall. 351pp.

Munro, A L S; Liversidge, J and Elson K G R (1976): The distribution and prevalence of Infectious Pancreatic Necrosis Virus in wild fish in Loch Awe. Proceedings of the Royal Society of Edinburgh (B) 75.

Munro, A L S (1990): Release of *Aeromonas salmonicida* from sea cages and possible risks to wild Atlantic Salmon. Paper presented to symposium "Interactions between cultured and wild salmon", Norway 22-26 April 1990.

Munro, A L S and Smail, D A (1992): IPN virus in farmed Atlantic salmon in Scotland. ICES CM 1992/F:11.

NAC (1991): Protocols for the Introduction and Transfer of Salmonids. North American Commission document NAC(92)24. 115pp.

Naevdal, G (1981): Fish rearing in Norway with special reference to genetic problems. In: Fish Gene Pools (Ed: N Ryman) Ecological Bulletin (Stockholm) 34:85-93

NASCO (1989): Report of the Dublin Meeting on Genetic Threats to Wild Stocks from Salmon Aquaculture. Council document CNL(89)19.

NASCO (1990): Report on the Norwegian Meeting on Impacts of Aquaculture on Wild Stocks. Council document CNL(90)28.

Phillips, M J; Beveridge, MC; and Ross, L G (1985): The environmental impact of salmonid cage culture on inland fisheries: present status and future trends. Journal of Fish Biology 27 (Supplement A): 123-137.

Reisenbichler, R R and McIntyre J D (1977): Genetic differences in growth and survival of juvenile hatchery and wild steelhead trout, *Salmo gairdneri*. Journal of the Fisheries Research Board of Canada 34: 123-128.

Riddell, B E; Leggett, W C and Saunders R L (1981): Evidence of adaptive polygenic variation between two populations of Atlantic salmon (*Salmo salar*) native to tributaries of the S W Miramichi River, N.B. Canadian Journal of Fisheries and Aquatic Sciences 38: 321-333.

Rosenthal, H; Weston D; Gowen R and Black, E (1988): Report of the ad hoc Study Group on "Environmental Impact of Mariculture". ICES CM 1987/F:2.

Rosenthal, H and Rangeley, R W (1989): The effect of a salmon cage culture on the benthic community in a largely enclosed bay (Dark harbour, Grand Manon Island, New Brunswick, Canada). ICES CM1989/F:23.

Ross, A and Horsmann, P V (1988): The use of Nuvan 500EC in the salmon farming industry. Marine Conservation Society, Ross-on-Wye.

Ryman, N and Stahl, G (1980): Genetic changes in hatchery stocks of brown trout (*Salmo trutta*). Canadian Journal of Fisheries and Aquatic Sciences 37: 82-87.

Ryman, N (1983): Patterns of distribution of biochemical genetic variation in salmonids: differences between species. Aquaculture 33: 1-21.

Saunders, R L and Bailey J K (1980): The role of genetics in Atlantic salmon management. Proceeding International Atlantic Salmon Symposium (Ed: Went, A J) Edinburgh.

Saunders, R L (1991): Potential interactions between cultured and wild Atlantic salmon. Aquaculture 98:51-60.

Secombes, C J (1991): Current and future developments in salmonid disease control. In: Interactions between Fisheries and the Environment. Proceedings of the Institute of Fisheries Management. 22nd Annual Study Course. University of Aberdeen 10-12 September 1991.

Shaw, J A and Muir J F (1987): Salmon: Economics and Marketing Croom Helm. 270pp.

Skaala, O; Jorstad, K E and Borgstrom, R (1991): Genetic impact on two wild brown trout (*Salmo trutta* L) populations after release of reared non-native spawners. Paper presented at the International Symposium on Biological Interactions of Enhanced and Wild Populations. Department of Fisheries and Oceans of Canada. Nanaimo 17-20 June 1991.

Smith, P D (1985): Fish vaccination: practicalities and economics. Proceedings of the Salmon Farming Conference, Reykjavik, Iceland 19-20 September 1985. Institute of Freshwater Fisheries 128pp.

Solbe, J F de L G (1982): Fish-farm effluents; A United Kingdom survey. Report of the EIFAC Workshop on fish-farm effluents. EIFAC Technical Paper 4: 29-55.

Stahl, G (1983): Differences in the amount and distribution of genetic variation between natural populations and hatchery stocks of Atlantic salmon. Aquaculture 33: 23-32.

Stansfeld, J R W (1985): The effect of the competition of farmed salmon in the market place on the present state of commercial salmon fisheries. In: The Status of the Atlantic Salmon in Scotland, February 1985. Edited by D Jenkins and W M Shearer. ITE Symposium No. 15 Banchory 13-14.

Taylor, E B (1991): A review of local adaptation in salmonidae, with particular reference to Pacific and Atlantic salmon. Aquaculture 98: 185-207.

Thorpe, J E (1987): Salmon enhancement: Stock discreteness and choice of material for stocking. In Atlantic salmon: Planning for the future proceedings of the Third International Atlantic Salmon Symposium, Biarritz, France, 21-23 October 1986. (Ed. Mills, D H and Piggins, D) Croom Helm.

Tilseth, S; Hansen, T and Møller, D (1991): Historical development of salmon culture. Aquaculture 98: 1-9.

Tully, O and Whelan, K F (1992): The impact of sea lice (*Lepeophtheirus salmonis*) infestation of sea trout (*Salmo trutta* L) along the West Coast of Ireland, 1989-1991. Paper presented at the Conference on Pathological Conditions of Wild Salmonids. SOAFD Marine Laboratory, Aberdeen, Scotland, 6-8 May 1992.

Tuomi, A L W (1987): Canada's Atlantic Salmon recreational fisheries and their future: An economic overview. Atlantic Salmon Federation Special publication series 14, St. Andrews. New Brunswick.

Verspoor, E (1986): Spatial correlations of transferrin allele frequencies in Atlantic salmon (*Salmo salar*) populations from North America. Canadian Journal of Fisheries and Aquatic Sciences 43: 1074-1078.

Verspoor, E (1988): Reduced genetic variability in first generation populations of Atlantic salmon (*Salmo salar*). Canadian Journal of Fisheries and Aquatic Sciences 45: 1686-1690.

Verspoor, E; Fraser, N H C and Youngson, A F (1991): Protein polymorphism in Atlantic salmon within a Scottish river: evidence for selection and estimates of gene flow between tributaries. Aquaculture 98: 217-230.

Webb, J H; Hay, D W; Cunningham, P D and Youngson, A F (1991): The spawning behaviour of escaped farmed and wild adult Atlantic salmon (*Salmo salar* L) in a northern Scottish river. Aquaculture 98: 97-110.

Webb, J H; McLaren, I S; Donaghy, N J and Youngson, A F (In press,a): The spawning of farmed Atlantic salmon (*Salmo salar* L) in the River Polla, Scotland in the second year after their escape. Aquaculture and Fisheries Management.

Webb, J H; Youngson, A F; Thompson, C E; Hay, D W; Donaghy, M J and McLaren, I S (In press, b): The spawning of escaped farmed salmon (*Salmo salar* L) in western and northern Scottish rivers: egg deposition by females. Aquaculture and Fisheries Management.

Wilkins, N P (1985): Salmon stocks: A genetic perspective. Atlantic Salmon Trust, Moulin, Pitlochry.

Winter, G W; Schreck, C B and McIntyre, J D (1980): Resistance of different stocks and transferrin genotypes of coho salmon, *Oncorhynchus kisutch*, and steelhead trout, *Salmo gairdneri*:, to bacterial kidney disease and vibriosis. Fisheries Bulletin 77: 795-802.

Wootten, R; Sommerville, C and Bron, J (1992): Sea lice and wild salmonids: including interaction between wild and farmed fish. Paper presented at the Conference on Pathological Conditions of Wild Salmonids. SOAFD Marine Laboratory, Aberdeen, Scotland, 6-8 May 1992.

Youngson, A F; Martin, S A M; Jordan W C and Verspoor, E (1991): Genetic protein variation in Atlantic salmon in Scotland: comparison of wild and farmed fish. Aquaculture 98: 231-242.

Youngson, A F (1991): Escapes of reared salmon, *Salmo salar* L, and future genetic management of wild salmon populations in Scotland. In: Interactions between Fisheries and the Environment. Proceedings of the Institute of Fisheries Management. 22nd Annual Study Course. University of Aberdeen 10-12 September 1991.

COUNCIL

CNL(93)52

IMPACTS OF AQUACULTURE

CNL(93)52

IMPACTS OF AQUACULTURE

1. An ad hoc Committee set up by the Council met to discuss the proposed approach to this subject. The Committee believes that the information contained in document CNL(93)29 gives rise to concern about adverse impacts of salmon aquaculture on the wild stocks and indicates the need for further scientific advice and consideration of specific practical measures aimed at removing these impacts.

2. The ad hoc Committee proposes that the matter should be addressed by twin approaches which should proceed concurrently:

   (a) that the scientific questions addressed by NASCO to ICES should include a question on the impact of salmon aquaculture on wild stocks and that this question might specifically refer to genetic, disease and parasite, ecological and environmental impacts and to any impacts from current hatchery practices.

   (b) that a NASCO Working Group be set up with the following mandate:

   - in the light of the information in paper CNL(93)29 (Impacts of Salmon Aquaculture); and

   - taking note of the questions addressed to ICES on this subject;

   (i) to consider, in active cooperation with appropriate interests, how salmon aquaculture (including salmon cage rearing and sea ranching), can be conducted in a way that is designed to remove adverse impacts on the wild stocks;

   (ii) to report their findings to the NASCO Secretariat no later than 15 April 1994 so that full consideration to the matter can be given at the 1994 Annual Meeting.

   To facilitate the proceedings of the NASCO Working Group, the Secretariat will assemble the relevant background information, and each Party may prepare a position paper, in advance of the first meeting of the Group.

ANNEX 22

COUNCIL

CNL(93)30

INFLUENCE OF THE MARINE ENVIRONMENT ON SALMON

CNL(93)30

INFLUENCE OF THE MARINE ENVIRONMENT ON SALMON

1. In June last year, immediately following NASCO's Ninth Annual Meeting, the Fourth International Atlantic Salmon Symposium was held in New Brunswick, St Andrews. The symposium, co-sponsored by the Atlantic Salmon Trust, the Atlantic Salmon Federation and the Department of Fisheries and Oceans, had as its themes Salmon at Sea and New Enhancement Strategies.

2. The marine phase of the salmon's life-cycle is characterised by high mortality with the combined effects of natural mortality and of marine fisheries generally reducing the number of fish returning to the river to less than 10% of the number of smolts emigrating. For the majority of countries in the North Atlantic there has been a trend towards reduced marine survival in the late 1980's and early 1990's. However, there is a general lack of knowledge of this phase of the salmon's life-cycle. Indeed, it was stated in one of the presentations that our knowledge of salmon at sea is dominated not by what we know but by what we do not know. The Symposium therefore provided a timely opportunity to review what is known and to consider research needs and priorities.

3. Some of the major findings might be summarised as follows:

   (a) there are common patterns to the annual variations in return rates in geographically separated stocks both in Europe and in North America.

   (b) there are common patterns to sea-age at return in geographically separated stocks.

   (c) such evidence suggests that marine conditions are playing an important role in survival and in the sea-age composition of returns.

   (d) the abundance of salmon at sea seems to be closely related to sea temperature, most are found in sea temperatures between 4°C-10°C.

   (e) for North American stocks survival seems to be determined during the first winter at sea and may be related to the available area of suitable winter habitat ie habitat with the required sea temperature.

   (f) the trend has been for a decline in suitable over-winter habitat over a twenty one year period from 1970-1991.

   (g) for European stocks survival seems to be determined by the availability of spring habitat.

   (h) available habitat is determined by atmospheric and oceanographic conditions.

(i) in the North-East Atlantic no correlations between variability in sea age composition or total catch and changes between major climatic events could be demonstrated. However, the decline in the proportion of multi-sea-winter fish occurred at the same time as a decline in the production of plankton was found.

4. A number of the papers presented referred to the need for further research into the marine phase of the salmon's life-cycle and this was reflected in the recommendations of the symposium for research to be undertaken "to understand the cause of marine mortalities other than fishing and to monitor its occurrence. Such studies would involve assessments of forage fish along with their distributions with salmon populations to determine availability". A Workshop was subsequently held to review methods of studying the biology of salmon at sea. Following this Workshop the attached letter was received from the Atlantic Salmon Trust and Atlantic Salmon Federation which requests that NASCO encourages cooperation in research into the marine aspects of the salmon's life-cycle.

5. At its Seventh Annual Meeting the West Greenland Commission discussed a proposal to conduct ship borne research to investigate the relative distribution of salmon throughout the North Atlantic. The need for careful planning of such research was stressed and concerns were expressed by some Parties about the cost of such research and the usefulness of such surveys. Tagging experiments funded by Norway and the Faroe Islands were conducted in the Faroese zone last winter when approximately 3000 salmon were tagged. It is understood that the first tag returns in homewaters from these fish have been received. Clearly, from the information presented at the St Andrews Symposium the marine phase is one of great importance for salmon production and while our understanding of the mechanisms influencing salmon at sea is increasing the scientists believe that further research is needed.

6. The Council is asked to consider the request from the Atlantic Salmon Trust and Atlantic Salmon Federation concerning international cooperation on research programmes and what action might be taken.

Secretary
Edinburgh
14 May 1993

THE ATLANTIC SALMON TRUST

Company Registered in England. Reg. No. 904293 Registered Charity No. 252742

Moulin, Pitlochry, Perthshire PH16 5JQ Telephone: (0796) 473439 Facsimile: (0796) 473554

The Secretary
North Atlantic Salmon
Conservation Organisation
11 Rutland Square
Edinburgh EH1 2AS

21 December 1992

Dear Malcolm

The growing concern in recent years about the reduction in marine survival of wild salmon in the North Atlantic led to one of the recommendations from the Fourth International Atlantic Salmon Symposium, held in St Andrews, New Brunswick, in June this year. This was that research should be conducted "to understand the cause of marine mortality other than fishing and to monitor its occurrence. Such studies would involve assessments of forage fish along with their distributions with salmon populations to determine availability".

Following the Symposium, it was agreed that a multinational workshop sponsored jointly by the Atlantic Salmon Trust and the Atlantic Salmon Federation should be held on methods of gaining information on the movement, abundance, behaviour and mortality of salmon in the sea, and this took place in Edinburgh on 9th/10th December. The meeting identified the current lack of knowledge on salmon at sea, and it was concluded that there could be considerable value in research projects at various stages of the marine life cycle, including observation of the departure of smolts from estuaries and of post-smolts and adult salmon while feeding in the sea and on their return migration. The workshop identified a number of relevant techniques, including the use of research vessel cruises to undertake research fishing, tagging, and the operation of sector scanning sonar to detect and track fish fitted with transponder/sensor tags. The significance of interpreting and exploiting knowledge of environmental conditions in real-time, on a spatial scale not obtainable from shipboard observation, was seen to argue the requirement for information from earth observation satellites. The need for international cooperation in this field was strongly stressed.

We have noted from the 1992 Report of the Council that NASCO's request to ICES for scientific advice included:

- evaluate causes of the apparent reduced survival of salmon in recent years

and - specify data deficiencies and research needs."

I am writing on behalf of the Chairman of the Atlantic Salmon Trust and the President of the Atlantic Salmon Federation to say that the Trust and the Federation strongly support the need for such evaluation and the need for the development of specifications for appropriate research projects of the type considered at the workshop. We look forward to examination of the subject by the ICES Working Group on North Atlantic Salmon. We also support the need for international cooperation in such research, and the exchange of such information, through the Council of NASCO, between the Parties. In this regard, proposed research cruises in the 1993/1994 season by Norwegian and Canadian vessels were described at the workshop, with offers of participation by scientists from other countries. The Trust and the Federation hope that NASCO could encourage further cooperation in this field.

Best wishes,

Derek.

D H MILLS

Chairman, Honorary Scientific Advisory Panel
Atlantic Salmon Trust

ANNEX 23

COUNCIL

CNL(93)31

IMPACTS OF INTRODUCTIONS AND TRANSFERS

CNL(93)31

IMPACTS OF INTRODUCTIONS AND TRANSFERS

1. For centuries man has undertaken introductions, that is, releases of species into an environment outside their present range (ICES, 1988), in order to "improve" the native fauna (Nilsson, 1985). Such introductions were especially common in the nineteenth century when there was much human migration (McDowell, 1968). For example, in 1860 a group entitled "The Society for the Acclimatisation of Animals, Birds, Fishes, Insects and Vegetables within the United Kingdom" was formed with the objectives of introducing exotic species, whether useful or ornamental, to the UK and spreading the indigenous species of the UK to other countries (Lever, 1977). Similarly, in North America introductions and transfers of aquatic species have been undertaken since the late 1800's (NAC, 1987). These introductions were intended to enhance the production of species favoured by humans but many of them had unexpected negative consequences (Li and Moyle, 1981). In addition to intentional introductions some aquatic species have been introduced inadvertently through human activities. For example, the introduction of aquatic species in ship's ballast water or as a result of engineering works, e.g. following the opening of the Welland and Suez canals. There is now increasing interest in introductions and transfers of salmonids for aquaculture, restoration of historic populations and/or improvement of recreational fisheries (NAC, 1992).

2. Nilsson (1985) considered that the introduction of an exotic species could have any of the following consequences:

   i) it is rejected because there is no "vacant niche", or because of predation, native diseases or abiotic factors;
   ii) it hybridises with very closely related stocks formerly adapted to the ecosystem;
   iii) it eliminates a native species that is either an "ecological homologue", or an available prey, or because of diseases and parasites carried by the exotic species;
   iv) it finds a "vacant niche".

   It is, however, impossible to predict with certainty the results of a particular introduction since the behaviour of an animal, although well known in its native habitat, may well be considerably different in the new habitat (ICES, 1988). Once introduced into marine, estuarine or freshwaters an animal can rarely, if ever, be subsequently eradicated (NAC, 1987). Harache (1988) reviewed the introductions of Pacific salmon to Atlantic waters. While ecological consequences appear to have been limited he warned of the threat of the spread of disease. He concluded that much remained to be achieved given the likely increase in movements of live animals associated with sea farming. In North America concern has recently been expressed about the use of rainbow trout in sea-cages along the eastern seaboard since the species has the potential to pose a very severe ecological threat to Atlantic salmon management (NAC, 1987).

3. Transfers of salmonids, that is intentional or accidental transport and releases of salmonids within their present range (ICES, 1988), have also greatly increased recently through escape of fish from salmon farms (see document CNL(93)29). It is generally accepted that each salmon river possesses one or more genetically distinct forms adapted to conditions in that river and that maintenance of this genetic variation is of paramount importance (NAC, 1992). In addition to genetic concerns, stock movements can also result in the inadvertent transfer of disease and parasite agents. The potential dangers of stock movements have been highlighted by the introduction of the monogenean fluke *Gyrodactylus salaris* to Norway which is estimated to have resulted in losses of between 250-500 tonnes to the fisheries. A report on the *Gyrodactylus* situation is presented separately in document CNL(93)33.

4. In recent years the need for caution in introductions and transfers has been recognised by a number of international organisations. For example in 1973 ICES adopted a "Code of Practice to Reduce the Risks of Adverse Effects Arising from Introductions of Non-indigenous Marine Species". This Code was revised in 1979 and subsequently formed the basis of a Code of Practice endorsed by the European Inland Fisheries Advisory Commission (EIFAC). The International Union for the Conservation of Nature and Natural Resources (IUCN) has agreed a position statement in order to reduce the damaging impact of introductions. More recently, the Declaration of Cancun, adopted by the International Conference on Responsible Fishing held in Mexico, May 1992, requested FAO to prepare a draft Code of Conduct for Responsible Fishing. The FAO has recognised the risk of serious adverse interactions between introduced and resident fish populations and the Code of Conduct will include guidelines concerning introductions and transfers.

5. The question of the impact of introductions and transfers on Atlantic salmon has been under review in the North American Commission since its First Annual Meeting when a Scientific Working Group on Introductions of New Salmonids on the Atlantic Seaboard was established. This Working Group, subsequently renamed the NAC Scientific Working Group on Introductions and Transfers, has established an inventory of introductions and transfers of all salmonids into the Great Lakes and the Atlantic coast of North America and each year reports to the Commission on introductions undertaken during the previous year and those planned during the current year. In this way all known proposed stock movements can be reviewed by the Commission prior to being undertaken. Furthermore, recognising the potential for adverse effects on the wild salmon stocks from movements the North American Commission has adopted Protocols for the Introduction and Transfer of Salmonids. These protocols introduced a zoning concept based on the degree of degradation or manipulation of the wild Atlantic salmon stocks. The objectives of the protocols are:

   (a) to minimise the risk of introduction and spread of infectious disease agents;
   (b) to prevent the reduction in genetic variance and prevent the introduction of non-adaptive genes to wild populations;
   (c) to minimise the intra- and inter-specific impacts of introductions and transfers on Atlantic salmon stocks.

6. In the light of the risks involved in introductions and transfers the Organization may wish to build on the initiatives of the North American Commission. There may be a case for following this up in the North-East Atlantic Commission, particularly with regard to the establishment of an inventory of introductions and transfers of salmon. In this way, the Commission could be informed of proposed introductions before they take place, and the Council would then be aware of planned introductions throughout the Convention area. This paper has therefore also been put before the North-East Atlantic Commission for their consideration.

Secretary
Edinburgh
28 April 1993

REFERENCES:

Harache, Y (1988): Pacific Salmon in Atlantic waters. ICES CM 1988/Mini Symposium on "Case histories of the effect of introductions and transfers on Marine Ecosystems". Paper No. 6.

ICES (1988): Codes of Practice and Manual for Procedures for Consideration of Introductions and Transfers of Marine and Freshwater Organisms. Editor G E Turner. Cooperative Research Report No. 159 44pp.

Lever, C (1977): The Naturalised Animals of the British Isles. Paladin 600pp.

Li, H W and Moyle, P B (1981): Ecological Analysis of Species Introductions into Aquatic Systems. Transactions of the American Fisheries Society 110: 772-782.

McDowell, R M (1968): Interactions of the Native and Alien Faunas of New Zealand and the Problem of Fish Introductions. Translations of the American Fisheries Society 97(1): 1-11

NAC (1987): Report of the Activities of the Bilateral Scientific Working Group of the North American Commission on Salmonid Introductions and Transfers. NASCO document NAC (87)20 (Annex 13) 72pp.

NAC (1992): Protocols for the Introduction and Transfer of Salmonids. NASCO document NAC(92)24 119pp.

Nilsson, N A (1985): The Niche Concept and the Introduction of Exotics. Institute of Freshwater Research. 62: 128-135.

Shinn, A P; Sommerville, C and Gibson, D I (1992): The discrimination of *Gyrodactylus salaris* species and their distribution in British Salmonids. Paper presented at the Conference on "Pathological Conditions of Wild Salmonids. SOAFD Marine Laboratory 6-8 May 1992.

ANNEX 24

COUNCIL

CNL(93)32

LONG-TERM TRENDS IN SALMON ABUNDANCE

CNL(93)32

LONG-TERM TRENDS IN SALMON ABUNDANCE

1. The total declared catch of salmon in the North Atlantic in 1992 was 3924 tonnes which is the lowest recorded in the period 1960-1992. Catches have now declined for six years in succession despite the inclusion of increasing catches of fish farm escapees and ranched fish (Anon, 1993a). The decline in catches is to some extent a reflection of recently introduced management measures which have had the specific aim of reducing catches. In that sense it is expected and, indeed, desirable. However, there is evidence that the decline in catches is greater than would be expected as a result of these measures (Anon, 1993). Interpretation of catch statistics is difficult because of the lack of effort data (Shearer, 1988; Anon, 1993), changes in the availability of fish to the fisheries (Shearer, 1988), introduction of regulations and the problem of unreported catches. Despite these limitations catch data are considered indicative of trends in stock abundance (Friedland, 1993) and have inherent value if used in the right context (Bielak and Power, 1988).

2. Given the present period of low abundance through much of the North Atlantic there is an increasing interest in assessing the present stock status in an historical perspective (Bielak and Power, 1988). A number of studies have examined long term catch statistics. For example, Huntsman (1937) examined the periodic scarcity of salmon in the Maritime Provinces utilising data for the period 1870-1935 and Taylor (1985) presented statistics on salmon landings in Newfoundland and Labrador from 1720. In the North-East Atlantic, George (1982) presented evidence of cycles of abundance of Scottish salmon during the period 1790-1976 and Mills (1987) presented information that showed that periods of scarcity and abundance exhibited a broadly similar pattern in a number of North Atlantic countries. Synchrony in catches in the Baltic has also been demonstrated. In his Open Lecture to the 80th Statutory Meeting of ICES Dr Kenneth Mann presented evidence of synchronous changes in widely separated stocks of fish including three species of Pacific salmon. He concluded that while the mechanisms are poorly understood it seems almost certain that global patterns of atmosphere/ocean interactions are in some way responsible for the large changes from year to year and over longer time periods (Anon 1993b).

3. Those not familiar with the cycles of abundance and scarcity in natural resources can draw wrong conclusions from short term changes. Salmon catches have been of interest to man for many years and in some cases historical records go back over 100 years. The availability of such records, which are usually linked to a particular river, is probably unique to the salmon. Clearly care is needed in interpretation of catch statistics but given the apparent present scarcity of the Atlantic salmon there may be merit in reviewing all the historical information from around the North Atlantic in order to try to put the present low catches into some historical perspective. Such a review could draw on the existing literature but it may also be possible to examine new data sets and a report would be made to the Council at its Eleventh Annual Meeting.

Secretary
Edinburgh
13 May 1993

REFERENCES:

Anon (1993a): Report of the ICES North Atlantic Salmon Working Group. NASCO document CNL(93)12.

Anon (1993b): Report of the 80th Statutory Meeting. ICES Annual Report. January 1993. 280pp.

Bielak, A T and Power, G (1988): Catch Records - Facts or Myths. In: Atlantic Salmon: Planning for the Future (Edited by D Mills and D Piggins). Croom Helm. 587pp.

Friedland, K D (1993): History of Salmon Fisheries and Management in the North Atlantic. Paper presented to the ICES/NASCO/IBSFC Dialogue Meeting. Edinburgh 7-8 June 1993.

Huntsman (1937): Periodic Scarcity in Atlantic Salmon. Transactions of the Royal Society of Canada V:17-27.

Mills, D M (1987): Atlantic Salmon Management. In: Development in Fisheries Research in Scotland. Edited by R Bailey and B Parrish. Fishing News Books. Farnham.

Shearer, W M (1988): Relating Catch Records to Stocks. In: Atlantic Salmon: Planning for the Future (Edited by D Mills and D Piggins). Croom Helm. 587pp.

Taylor, V R (1985): The early Atlantic salmon fishery in Newfoundland and Labrador. Canadian Special Publication in Fisheries and Aquatic Sciences 76: 71pp.

COUNCIL

CNL(93)33

THE SPREAD OF GYRODACTYLUS

CNL(93)33

THE SPREAD OF GYRODACTYLUS

SUMMARY

1. The introduction of the parasite *Gyrodactylus salaris* to Norway, and its subsequent dispersal through stocking from an infected hatchery, demonstrate the risks associated with stock movements. It has been estimated that losses to the fishery of 250-500 tonnes have been caused as a result of the mortality of juvenile salmon caused by the parasite. The natural stocks of 37 river systems have been infected and have suffered large reductions in their populations such that most are considered to be threatened with loss. In order to eliminate the parasite and prevent its spread to other rivers the Norwegian authorities have commenced a large scale programme which includes treatment of the infected rivers with rotenone. To date, this has been successful in thirteen rivers and five populations have been re-established using gene banks or local stocks.

2. Despite the measures taken by the Norwegian authorities there has been some spread of Gyrodactylus within Norway. The parasite has also recently been found in Northern Finland and the White Sea area of Russia, where some large and very important salmon rivers are located. It is not known whether these findings, as is the case in Norway, are a result of spreading from the Baltic. Furthermore, although *G. salaris* is not present in the UK, laboratory studies have demonstrated that the salmon stocks are vulnerable. It is therefore vitally important that all efforts are made to prevent the further spread of the parasite throughout the North Atlantic. Protocols to control introductions and transfers have already been agreed in the North American Commission of NASCO and the development of such Protocols might be considered in the North-East Atlantic Commission. A summary of possible actions is contained in document CNL(93)32.

Secretary
Edinburgh

27 April 1993

CNL(93)33

THE SPREAD OF GYRODACTYLUS

1. The genus *Gyrodactylus* is a group of viviparous, monogenean flukes, that is parasitic flatworms, which give birth to live offspring and which spend their entire life-cycle on one host. They occur on the skin, and occasionally on the eyes and gills, of the fish they parasitise and are usually about 0.5mm in length (Roberts and Shepherd, 1974). They can reproduce rapidly and an adult can often be seen to contain a juvenile, which in turn contains another juvenile.

2. *Gyrodactylus salaris* was first described from salmon parr at a fish farm on the River Indalsälven in northern Sweden. As with other species of *Gyrodactylus* it is well known to fish farmers and can be successfully controlled by chemical treatment (Malmberg, 1988). However, in July 1975 the species was found in Norway following a period of high mortality at the Sundalsøra hatchery on the river Driva, western Norway and the following month it was found in the river Lakselva in northern Norway (Johnsen and Jensen, 1991). The wild salmon parr population of this river suffered catastrophic mortality to the extent that within two years the population had almost completely disappeared (Johnsen and Jensen, 1986). At this time the mortality was thought to be related to environmental change in the river but following the discovery of the parasite in three other rivers it was hypothesised that the parasite had been introduced to Norway and subsequently dispersed by stocking from infected hatcheries (Dolmer, 1987). Spreading between neighbouring rivers is thought to occur through brackish waters (Johnsen and Jensen, 1986).

3. In Norway in 1980 a *Gyrodactylus* Committee, comprising representatives of the Directorate for Nature Management, the veterinary authorities, the fish farming industry and the University of Oslo was established and a programme of research into the problem at hatcheries and in natural waters (the *Gyrodactylus* project) was initiated (Johnsen and Jensen, 1991). By December 1980 twenty rivers were known to be infected and had suffered the characteristic high mortality of salmon parr within 2 years (Heggberget and Johnsen, 1982). By the end of the project in 1982 *G. salaris* had been identified in 26 of 212 rivers and 6 of 25 hatcheries investigated (Malmberg, 1988). The pattern of distribution indicated a clear connection between the distribution of *G. salaris* and known deliveries of stock from infected hatcheries (Johnsen and Jensen, 1986). Other species of *Gyrodactylus (G. truttae and G. arcuatus)* were also found in some rivers but these did not appear to cause mortality of salmon parr. Following a request from the veterinary authorities in 1980 to stop deliveries of fish for stocking, *G. salaris* was declared a notifiable disease in 1983. However, the number of infected rivers has continued to increase so that by 1991 34 rivers and 35 hatcheries were known to be infected (Johnsen and Jensen, 1991). To date 37 rivers are known to have been infected.

4. Johnsen and Jensen (1986) estimated that in 1984 the losses to the salmon fishery due to *G. salaris* were between 250-500 tonnes. While epizootics of the parasite in the hatchery environment have been reported, large scale mortalities in the wild appear to be unique to Norway. Bakke (1991) examined the variability in

salmonids to laboratory infections of the parasite. Four Norwegian salmon stocks and one Baltic salmon stock (river Neva) were tested together with a number of other salmonid and non-salmonid species. *G. salaris* was found to reproduce on all the salmonid species but not on the non-salmonids. However, there were marked differences in the resistance to attack of the salmonids. Brown trout and the Baltic stock were able to eliminate the infections. Conversely, all of the Norwegian stocks tested were found to be highly susceptible to the parasite. The proportion of salmon making a response was low, the response was weak and it only occurred after the parasite burden became relatively high. Norwegian salmon did, however, demonstrate host resistance to other species, e.g. *G. derjavini* from trout. The authors suggested that selective breeding or "artificial" introgression may in time accelerate the accumulation of genes for resistance against attack. In this regard, one salmon population in western Norway does appear to be more resistant to the parasite.

5. The Norwegian authorities' primary goal is to prevent further spread of the parasite and its elimination from as many rivers as possible. Although the parasite causes very high mortality among the wild stock of salmon, it can survive on other fish species in the watercourse and on escaped farmed salmon when they enter the river. In order to ensure that the parasite is eliminated so that the salmon population can be rebuilt and in order to prevent spread to other neighbouring rivers the fish populations of the river Vikja were exterminated using rotenone and the treatment of this small river appears to have been effective (Johnsen and Jensen, 1991). To date, thirteen rivers have been treated in this way and populations of salmon have been re-established in five rivers using gene banks or local stocks. Treatment of large river systems in this way would, however, be almost impossible. A possible solution in such cases is to safeguard the stocks and the fishing by means of stock-enhancement.

6. Efforts to overcome the *Gyrodactylus* problem in Norway to ensure that a similar problem is not repeated elsewhere require knowledge of the origin and manner in which the parasite is spread (Malmberg, 1988). While it was initially believed that the problem was related to deterioration of the aquatic environment, Malmberg (1988) concluded that fish transports with *G. salaris* infected small salmon (parr-smolt) helped the parasite to pass the former geographical barrier, the Scandinavian mountains, and thereby reach a new area with rivers draining into the Atlantic Ocean, and a form of salmon genetically distinct from the Baltic salmon. A few rivers may have been infected via a locally arranged import of salmon or rainbow trout, or via a local hatchery, but most infected rivers seem to have been infected via stocking of parr from a central hatchery.

7. More recently, it is believed that *G. salaris* has been introduced into Northern Finland. It appears, in this case, that the parasite was introduced into the area with movements of rainbow trout for cage culture. The parasite has also been located from rivers draining into the White Sea in Russia. A recent study has shown that *G. salaris* is not present in the UK (Shinn et al, 1992). However, laboratory exposure of two Scottish stock (rivers Shin and Conon) has demonstrated that these salmon are as susceptible to the parasite as a Norwegian stock. It is vitally important therefore that all efforts are made to prevent the further spread of the

parasite throughout the North-East Atlantic area. The question of impacts of introductions and transfers is addressed separately in document CNL(93)32.

REFERENCES:

Bakke, T A (1991): A review of the inter- and intra-specific variability in salmonid hosts to laboratory infections with *Gyrodactylus salaris*. Malmberg. Aquaculture 98: 303-310.

Dolmer, D (1987): *Gyrodactylus salaris* (monogenea) in Norway: Infestations and Management. Proceedings of Symposium on Parasites and Diseases in Natural Water and Aquaculture in Nordic countries. Stockholm 2-4 December 1986 (Edited by Stenmark, A and Malmberg, G).

Heggberget, T G and Johnsen, B O (1982): Infestations by *Gyrodactylus* of Atlantic salmon, *Salmo salar* L, in Norwegian rivers. J Fish Biol 21: 15-26.

Johnsen, B O and Jensen, A J (1986): Infestations of Atlantic salmon, *Salmo salar* by *Gyrodactylus salaris* in Norwegian rivers. J Fish Biol 29: 233-241

Johnsen, B O and Jensen, A J (1991): The *Gyrodactylus* story in Norway. Aquaculture 98: 289-302.

MacKenzie, K (1992): Susceptibility of native Scottish stocks of Atlantic salmon, *Salmo salar* L, to *Gyrodactylus salaris* Malmberg. Paper presented to Conference on Pathological Conditions of Wild Salmonids. SOAFD Marine Laboratory 6-8 May 1992.

Malmberg, G (1988): Salmonid transports, culturing and *Gyrodactylus* infections in Scandinavia. Parasites of Freshwater Fishes of N W Europe: 88-104.

Roberts, R J and Shepherd, C J (1974): Handbook of trout and salmon diseases. Fishing News (Books) Ltd 168pp.

Shinn, A P; Sommerville, C and Gibson, D I (1992): The discrimination of *Gyrodactylus* species and their distribution in British salmonids. Paper presented to Conference on Pathological Conditions of Wild Salmonids. SOAFD Marine Laboratory 6-8 May 1992.

ANNEX 26

CNL(93)48

PRESS RELEASE

During the inter-governmental meetings of the Council and regional Commissions of the North Atlantic Salmon Conservation Organization (NASCO), which were held in Edinburgh during 7-11 June, agreement was reached for a regulatory measure for the Faroe Islands fishery for 1994. The agreement establishes a quota of 550 tonnes with reductions in the number of licences issued and in the fishing season.

NASCO also agreed on the need for further diplomatic efforts in order to eliminate fishing for salmon in international waters by vessels which have been reflagged in countries which are not party to the NASCO Convention. Methods of improving cooperation on the surveillance of the area of international waters were also agreed.

Serious concerns were raised about the possible impacts of salmon aquaculture on the wild stocks. In some North Atlantic rivers salmon which have escaped from fish farms comprise up to 90% of spawning populations and there is real concern about the genetic threats to the wild fish together with disease, parasite and other ecological impacts. The Council decided to establish a Working Group to review the options for avoiding adverse impacts on the wild stocks while maintaining a viable aquaculture industry. The North-East Atlantic Commission also agreed to establish a Working Group to examine the question of introductions and transfers. This issue had previously been addressed by the North American Commission and Protocols designed to safeguard the wild stocks had been published.

The Organization held a Special Session, co-sponsored by the International Council for the Exploration of the Sea (ICES) and the International Baltic Sea Fishery Commission (IBSFC), entitled "Atlantic Salmon - A Dialogue". This meeting allowed a frank exchange of views between the scientists, managers and the users of the resource. A keynote address was given by the broadcaster Mr Magnus Magnusson, Chairman of Scottish Natural Heritage, who called for adherence to the principles of environmental sustainability, integrated resource management and partnership.

The Council also adopted a minimum standard for catch statistics so as to improve their comparability throughout the North Atlantic.

NASCO operates a Tag Return Incentive Scheme to encourage the return of scientific tags applied to salmon. Prizes ranging from $100 to $2500 are offered annually. The President of the Organization, Mr Børre Pettersen (Norway), announced that the winner of the Grand Prize was P L Williams of Wrexham.

The next annual Meeting of the Organization will be held in Oslo, Norway during 6-10 June 1994.

ANNEX 27

LIST OF COUNCIL PAPERS

Paper No.	Title
CNL(93)1	Provisional Agenda
CNL(93)2	Draft Agenda
CNL(93)3	Explanatory Memorandum on the Draft Agenda
CNL(93)4	Proposed Schedule of Meetings
CNL(93)5	Secretary's Report
CNL(93)6	Audited Accounts for 1992
CNL(93)7	Contributions by the Parties
CNL(93)8	Outline of 1994 Draft Budget and 1995 Forecast Budget
CNL(93)9	Report of the Finance and Administration Committee
CNL(93)10	Report on the Activities of the Organization in 1991-1992 (for publication)
CNL(93)11	Report on the Activities of the North Atlantic Salmon Conservation Organization in 1992 (not for publication)
CNL(93)12	Report of the ICES North Atlantic Salmon Working Group
CNL(93)13	Report of the ICES Advisory Committee on Fishery Management
CNL(93)14	Report of the Standing Scientific Committee
CNL(93)15	Catch Statistic Returns by the Parties
CNL(93)16	Historical Catch Record 1960-1992
CNL(93)17	Minimum Standard for Catch Statistics
CNL(93)18	Summary of Microtag, Finclip and External Tag Releases in 1992
CNL(93)19	NASCO Tag Return Incentive Scheme
CNL(93)20	Database of Salmon Rivers Flowing into the NASCO Convention Area
CNL(93)21	Review of Salmon Related Literature

CNL(93)22	Report on Laws, Regulations and Programmes
CNL(93)23	Economic Value of Atlantic Salmon
CNL(93)24	Returns under Articles 14 and 15 of the Convention
CNL(93)25	Progress Report on the NASCO Protocol
CNL(93)26	Progress Report on Actions Taken in Accordance with the Resolution on Fishing for Salmon on the High Seas
CNL(93)27	Report of the International Meeting on Surveillance of Fishing for Salmon in International Waters
CNL(93)28	Other Actions in Relation to Fishing for Salmon in International Waters
CNL(93)29	Impacts of Salmon Aquaculture
CNL(93)30	Influence of the Marine Environment on Salmon
CNL(93)31	Impacts of Introductions and Transfers
CNL(93)32	Long-Term Trends in Salmon Abundance
CNL(93)33	The Spread of Gyrodactylus
CNL(93)34	Dates and Places of 1994 and 1995 Meetings
CNL(93)35	UN Resolution on Large-Scale Pelagic Driftnet Fishing
CNL(93)36	Draft Report of the Tenth Annual Meeting
CNL(93)37	NASCO Tag Return Incentive Scheme - 1993 Grand Prize
CNL(93)38	Report of the ICES/NASCO/IBSFC Dialogue Meeting, "Atlantic Salmon: A Dialogue"
CNL(93)39	Protocol - Response from the Government of Poland
CNL(93)40	Further Reports on Fishing for Salmon in International Waters
CNL(93)41	Figures used by the Chairman of ACFM in his Presentation to the Council
CNL(93)42	Report on the Activities of the North Atlantic Salmon Conservation Organization in 1991/1992 (for publication)
CNL(93)43	Draft Impacts of Aquaculture
CNL(93)44	Draft Impacts of Aquaculture

CNL(93)45	Draft Press Release
CNL(93)46	Agenda
CNL(93)47	Outline of 1994 Budget and 1995 Forecast Budget and Schedule of Contributions
CNL(93)48	Press Release
CNL(93)49	Report of the Tenth Annual Meeting of the Council
CNL(93)50	Decision of the Council to Request Scientific Advice from ICES
CNL(93)51	Minimum Standard for Catch Statistics
CNL(93)52	Impacts of Aquaculture

NOTE: This list contains all papers submitted to the Council prior and at the meeting. Some, but not all, of these papers are included in this report as annexes.