SAG(09)9

Report of the Meeting of the Scientific Advisory Group of the International Atlantic Salmon Research Board
Rica Seilet Hotel, Molde, Norway
Sunday, 31 May, 2009

1. Opening of the meeting

1.1 The Chairman, Dr Lars Petter Hansen (Norway), opened the meeting and welcomed participants to Molde. He referred to the significant progress that had been made in implementing the SALSEA Programme since the Group's last meeting.

1.2 A list of participants is contained in Annex 1.

2. Adoption of the agenda

2.1 The SAG adopted its agenda, SAG(09)8 (Annex 2).

3. Review of the updated inventory of research

3.1 An overview of the updated inventory of research relating to salmon mortality in the sea, SAG(09)2, was presented. For 2009, 47 ongoing projects had been included in the inventory with an annual expenditure of approximately £6 million. Six new projects had been included since the last update. The SAG welcomed the inclusion of information for the sampling programme at St Pierre and Miquelon although it was noted that the summary of progress related to 2007 and the project had not been costed. The SAG recommends that the Board Members be given an opportunity to further review the information in the inventory and to provide any necessary amendments to the Secretariat by 1 July. Thereafter, the inventory should be made available on the Board's website.

4. Report of the Inventory Review Group

4.1 Last year, on a recommendation from the SAG, the Board had agreed to establish a Sub-Group of the SAG, to review the inventory to identify areas where there may be merit in encouraging improved coordination of research and to highlight gaps in the research programme where new work might significantly benefit the SALSEA Programme and which might be considered for funding by the Board.

4.2 The Chairman of the Sub-Group, Mr Ted Potter (EU) presented the Sub-Group's report, SAG(09)10 (Annex 3). The Group had conducted its review using the 2009 inventory update, SAG(09)2, which had meant it had limited time in which to carry out its work. As the Sub-Group's TORs related specifically to the SALSEA Programme it had used the SALSEA plan, SAL(04)5, to organize the review. For each task in this plan, the Sub-Group had assessed the extent to which the projects listed in the inventory appeared to address research needs and in addition it had

identified areas where there may be opportunities to further improve collaboration and coordination. In this regard, the Sub-Group had highlighted some workshops and study groups which might be considered for support by the Board to allow the participation of expert scientists who might not otherwise be involved.

4.3 The Sub-Group had also made some suggestions for improvements to the presentation of the inventory that would facilitate future reviews. Currently, the inventory is made available to the ICES Working Group on North Atlantic Salmon (WGNAS) to assist it in identifying relevant data deficiencies, monitoring needs and research requirements. The SAG discussed whether there might be merit in an annual review of the inventory by a Sub-Group. In this regard, it was noted that the review had been productive and had not involved a great deal of effort. The SAG agreed that it would be useful to conduct a further review of the inventory in 2011 when the marine survey component of the SALSEA Programme would be completed to identify any additional research that may be needed. The SALSEA plan should also be reviewed at this time to assist the Board in developing its future research priorities. While it was recognised that there may not be a further SALSEA marine survey programme, which was always planned to be a three year programme, there may be research projects which the Board could support based on the information generated through SALSEA. The Sub-Group's recommendations are referred to in section 5 below.

5. Review of Applications for Potential Funding by the Board

5.1 At its last meeting, the Board had agreed to an approach recommended by the SAG for seeking and prioritising research proposals that might be funded by the Board or for which the Board may support the proposer in seeking funds from other sources. Under this approach the Secretary would invite proposals for research to be submitted for evaluation by the SAG using the guidance developed previously by the Board ICR(03)14.

5.2 The Chairman introduced document SAG(09)3 (Annex 4). Since last year, a total of five proposals had been received as follows:

SAG(08)7: Food availability of Atlantic salmon post-smolt during their marine phase.

SAG(08)8: A study of the relationship between ocean climate and inter-annual variation in adult summer migration distribution patterns of Atlantic salmon in Irish coastal waters over three decades.

SAG(09)4: Application to NASCO's International Atlantic Salmon research Board (IASRB) to support research on salmon post-smolts in the Irminger Sea, Southwest of Iceland.

SAG(08)5: Changes in trophic levels of Atlantic salmon through the marine phase of their life-cycle.

SAG(08)6: Inferring temperature history of Atlantic salmon at sea based on oxygen isotope rations in otoliths.

5.3 Three of these proposals (SAG(08)5, SAG(08)6 and SAG(09)4) sought funds from the Board while SAG(08)7 and SAG(08)8 had been submitted with a view to endorsement by the Board with a view to seeking funds from other organizations. The total cost of the proposals received was £447,500 considerably in excess of the Board's current resources (around £25,000). The SAG reviewed these proposals. Two of the proposals were brought forward from last year (SAG(08)05 and SAG(08)06) and one of these (SAG(08)05) had received partial funding approval from the IASRB of CAN$39,000 last year. An update on progress with proposal SAG(08)05 (SAG(09)7) was provided. The sampling scheduled for 2008 which had been identified in the proposed study had not occurred at the sampling intensities identified in the original proposal. Since the laboratory analysis for the samples which had been collected in 2008 had been deferred to 2009, the project proponents had not requested any payments to date from the Board for this project. A revised proposal (SAG(09)7) was submitted and reviewed by the SAG. A revised proposal for SAG(08)6 was also provided to SAG based on the realized sampling effort in 2008.

5.4 The SAG also reviewed proposals for funding to support workshops or study groups on analysis of historical tagging data and on variations in biological characteristics of Atlantic salmon that may be associated with variations in marine survival. These proposals for support arose from the review of the inventory of research (see section 4) and related to workshops and study groups which had been supported or initiated in previous years. The SAG also discussed the possible need for a workshop on scale analysis.

5.5 The proposals were reviewed relative to a number of criteria including relevance to IASRB priorities, in the context of addressing broad ecological questions for salmon, the extent of collaborations, value-added, and potential to be successful. The comments relative to each of the evaluation criteria for the proposals are summarized in table format in SAG(09)11 (Annex 5). The SAG evaluated how relevant the proposals are to the SALSEA objectives and whether the proposals should be supported by IASRB. The SAG also prioritised the proposals for support of external experts to workshops or study groups. Four of the six proposals were recommended by SAG for support by IASRB. The request for support of the sampling program in the Irminger Sea, SAG(09)4 was considered to be within the priorities of the IASRB but there was insufficient information on how the funds would be used and it could not be adequately reviewed by SAG. The proposal to study the relationship between ocean climate and adult salmon summer migration, SAG(08)8 was considered to be an important research area but outside the present priorities of IASRB.

5.6 In summary, the SAG's assessments of whether or not the Board should support the various proposals is as follows:

SAG(08)5	Support by IASRB
SAG(08)6	Support by IASRB
SAG(08)7	Support by IASRB
SAG(08)8	Important project proposal but is outside current IASRB priorities
SAG(09)4	SAG supports plan to sample in Irminger Sea but insufficient details of how funds will be used.

5.7 In addition, the SAG recommends that the Board support the expert participation in the follow-up workshop on historical tagging information (WKLUSTRE - one GIS expert, up to £2,000) as a priority and secondly, the follow-up meeting of the biological characteristics Study Group (SGBICEPS – two experts, up to £4,000). With regard to the proposal for a workshop on scale microchemistry standardization the SAG wishes to seek additional information on the proposal.

5.8 The SAG recognised that the guidance developed previously by the Board on calls for proposals, ICR(03)14, had been developed several years ago and did not reflect the fact that the Board did not need full project applications for those projects not seeking funds from the Board. The SAG, therefore, recommends that the IASRB Chairman and the Assistant Secretary develop a revised guidance document for consideration by the SAG.

6. Progress with Implementing the SALSEA Programme

(a) Analysis of historical tagging data

6.1 At its 2007 meeting the SAG had received a report of an ICES Workshop on the Development and Use of Historical Salmon Tagging Information from Oceanic Areas which had been held in St John's, Newfoundland in February 2007. The Board had supported this workshop by funding the participation of a GIS expert and this had been extremely useful in facilitating the group's work. A follow-up Workshop on Salmon Historical Information - New Investigations from Old Tagging Data was held in Halifax, Canada in September 2008. The Board had funded the participation of both a GIS expert and a hydrographer. The Workshop had updated information from historical oceanic tagging and recovery programmes conducted by a number of countries in the format agreed and tested several hypotheses relating to oceanic migration and distribution.

6.2 As an example of the findings, analyses in the NW Atlantic indicated that tag recoveries were not uniformly distributed at Greenland with Canadian and USA salmon more commonly captured in northern locations whereas European origin fish tended to be caught further south. For both North American and European salmon the distributions before and after 1989 were found to differ. In both cases, salmon were found further south at Greenland in the later period then in the former. This may be related to temperature, as the more recent period has been cooler, but may also reflect changes in fishing practices or periods. The distribution of Canadian and USA tag recaptures at West Greenland was also found to differ, with Canadian salmon more commonly recaptured in northern areas than USA fish. A comparison of European salmon (Norway, UK (Scotland), Ireland and UK (England and Wales)) yielded similar results, with Scottish and Norwegian salmon recovered more in northern areas whereas salmon from Ireland and UK (England and Wales) were more likely to be recaptured in southwest Greenland.

6.3 ICES intends to hold a further Workshop in London, UK, in September 2009 to complete compilation of available data and analyses of the resulting distributions of salmon at sea, and the SAG recommends further support to allow expert participation (see section 5 above).

(b) Report of the ICES Study Group on biological characteristics of salmon

6.4 At its last meeting the Board had agreed to fund participation of two scientists in the proposed ICES Study Group on the Identification of Biological Characteristics for Use as Predictors of Salmon Abundance (SGBICEPS). A sum of up to £5,000 was agreed. A preliminary report on the meeting of the Study Group which had been held in Lowestoft, UK in March 2009 was presented by Mr Ted Potter. The Study Group had the following ToRs:

a) identify data sources and compile time-series of data on marine mortality of salmon, salmon abundance, biological characteristics of salmon and related environmental information;

b) consider hypotheses relating marine mortality and/or abundance trends for Atlantic salmon stocks with changes in biological characteristics of all life stages and environmental changes;
conduct preliminary analyses to explore the available datasets and test the hypotheses.

6.5 The Study Group had devoted considerable effort to collating datasets and while problems remain in pulling the data together in a common format the preliminary work suggests this could be a valuable exercise. The Group had completed a preliminary review of the available information on the life-history strategies of salmon and changes in the biological characteristics of the fish (including freshwater and marine stages) in relation to key environmental variables. ICES had recognized the progress made by SGBICEPS and recommended that further coordinated efforts are made to collate data from stocks throughout the geographic range of Atlantic salmon and to continue with the analysis of datasets and the development of hypotheses. The SAG has recommended to the Board that it again consider funding the participation of invited scientists at a subsequent meeting of the Group (see section 5 above).

(c) Progress on stable isotope analysis of West Greenland samples

6.6 The Board had agreed at its last meeting to fund the first year of a three year study to continue work supported by the Board in 2007/2008 to examine any changes in trophic levels of Atlantic salmon through the marine phase of their life cycle. A sum of CAN$39,000 (approximately £22,000) had been agreed. Mr Gerald Chaput reported, SAG(09)7, that in 2008 30 smolts were sampled from each of the fifteen index rivers in eastern Canada and tissue samples had been taken and stored for analysis. However, only 15 post-smolt salmon had been obtained from the marine survey in 2008. Tissue samples had been taken from these fish and potential prey items collected during the survey had been stored. The extended sampling had not been conducted at West Greenland in 2008. The analyses of tissue samples had been deferred into 2009 and the funds agreed by the Board to support the project had not therefore been requested. The revised costing for analysis of 2008 and 2009 samples is CAN$52,600, an increase of CAN$13,600 and the SAG recommends that the Board fund the additional sum requested.

(d) Report on the SALSEA-Merge project

6.7 The Chairman of the Board, Dr Ken Whelan, presented a summary of activities since the launch of the SALSEA-Merge project in April 2008. At a genetics symposium in Paris funded by the TOTAL Foundation, it had been concluded that salmon caught at sea could be assigned to their region or river of origin provided that adequate baseline samples had been collected. Progress had been made subsequently in establishing an international database of baseline genetic data and in standardizing analytical procedures among contributing laboratories. The microsatellite marker suite had been agreed. Meetings had also been held to develop scale reading protocols and successful marine surveys had been conducted by Irish, Faroese and Norwegian vessels resulting in the capture and extensive sampling of around 900 post-smolts and some adult salmon together with oceanographic and other sampling. The Norwegian surveys had been conducted in areas not previously sampled for salmon. In these Northern areas the post-smolts were widely dispersed. Analysis of the samples is underway and there has also been progress with development of migration models. The plans for the 2009 surveys have been agreed. In addition to the new material obtained, SALSEA-Merge will analyse archival material both to determine the origin of the fish and fine-scale growth patterns.

(e) Report on SALSEA North America

6.8 A pelagic ecosystem survey of the northwest Atlantic was conducted in August 2008 using the CCGS *Wilfred Templeman*. During 8 - 21 August, a total of 46 stations were sampled with the pelagic surface trawl. The survey covered an area extending from just south of 49°N to 56°N, 49°W to 55°W. Oceanographic data were collected at 16 stations and plankton samples were collected at 12 stations. Stations sampled were characterized by depths from 100m to over 3,000m, and water temperatures (at about 10m depth) ranging from 7.7° to 14.4°C. Very few (N=15) Atlantic salmon, were captured during the survey and 14 of 15 fish were captured at stations north of 52°N latitude. The highest individual trawl catch of salmon was three fish observed at two stations. The stations with salmon catches were characterized by a wide range of water depths (about 250 m to >3,000m depth) and temperatures (less than 10°C to over 13°C). Salmon were only captured during the daytime. The salmon ranged in size from 23 to 31 cm fork length, and whole weights of 0.14 to 0.34 kg.

6.9 Sea surface temperatures were warm in 2008 relative to previous years and the catches of post-smolts from 2008 occurred in the areas with cooler water temperatures (at or less than 12°C). In subsequent surveys in the same season, the sampling effort should be focused on exploring the northern (north of 52°N) and cooler areas of the northwest Atlantic. Vessel time on a DFO (Canada) research vessel has been scheduled for 7 – 30 September 2009. Sampling is planned along a transect running between 56 to 58°N, extending from 42°W towards Labrador. Sampling with the pelagic surface trawl and with experimental gillnets is planned. Sampling protocols are similar to those used in 2008.

(f) Report on SALSEA West Greenland

6.10 Mr Tim Sheehan reported on the sampling programme in West Greenland in 2008. Seven samplers from five countries (Canada, Ireland, UK-England and Wales, UK-

Scotland and the USA) participated in the 2008 sampling program. In addition, an eighth sampler from the Greenland Institute of Natural Resources in Nuuk, Greenland served as a local coordinator and collected additional samples on an *ad hoc* basis. The samplers were deployed to three different communities representing three different Northwest Atlantic Fisheries Organization (NAFO) Divisions (geographic delineations of the area). Two samplers were stationed in Sisimiut (NAFO Division 1B), three in Nuuk (NAFO Division 1D) and two in Qaqortoq (NAFO Division 1F).

6.11 After permission had been obtained to sample the fish, the sampler would inspect each fish for the presence of external tags and/or fin clips. The sampler would also obtain a length and weight and would collect a scale and tissue sample from as many fish as possible. The baseline sampling is non-invasive. Once the sampling is completed, the individual fish are returned to the fishermen/owner and are either displayed for sale or prepared for storage. In total, approximately 2,000 fish were inspected for the presence of identification tags or fin clips. Of these, 1,800 fish were further sampled for length and weight data and scale and tissue samples were collected. Scale samples will provide information on fish age and tissue samples will provide information on fish continent/region of origin through genetic analysis. No extended sampling had occurred at West Greenland in 2008 but discussions are ongoing in order to ensure that the sampling can proceed in 2009.

(g) Report on sonic telemetry studies

6.12 Information on sonic telemetry studies in eastern Canada is presented on the Atlantic Salmon Federation's website, www.asf.ca.

(h) Coordination of the SALSEA Programme

6.13 Last year the Board had agreed an initial approach to improving coordination of the SALSEA-Merge, SALSEA-North America and SALSEA-West Greenland projects. This approach involved the research coordinators (Jens Christian Holst, Gerald Chaput and Tim Sheehan) exchanging experience and results as soon as possible after each marine survey. In 2009 there had been a SALSEA-Merge meeting of all participating organizations. The SAG believes that there is good coordination in relation to planning and implementing the sampling but that efforts may be needed to ensure coordination in relation to processing of samples. The SAG has developed some recommendations for funding workshops in section 4. Furthermore, the SAG wishes to highlight the importance of disseminating the results of the projects to a wide audience in order to convey the progress being made so as to support future fund-raising initiatives. The importance of regularly updating the Board's website and of increasing awareness of the website were stressed. The contact details of all key personnel involved with SALSEA are given on the website and these should be the first point of contact for those seeking additional information. The SAG notes that the PR Group will be proposing some new initiatives to raise the profile of NASCO's work at a Special Session during the Annual Meeting. The SAG also believes that the 2011 symposium is an excellent opportunity to disseminate the findings arising from the SALSEA programme, particularly the management implications of the research, and to seek political and public support for research on salmon at sea.

(i) 2011 Symposium

6.14 The Board had previously agreed to co-convene with ICES and the North Pacific Anadromous Fish Commission (NPAFC) an international symposium on mortality of salmon at sea in Spring 2011. In the interim, it had been agreed that there would be benefits from a continuing exchange between scientists working on these issues in the North Pacific and North Atlantic Oceans. To this end, representatives of NPAFC had been invited to participate in a Special Session on salmon at sea held during NASCO's Twenty-Fourth Annual Meeting in June 2007 and the Assistant Secretary had participated in the NPAFC BASIS Symposium in November 2008 to report on the SALSEA Programme.

6.15 Last year the Board had appointed the Secretary of NASCO (Dr Malcolm Windsor, Co-Convenor), the Assistant Secretary (Dr Peter Hutchinson), the Chairman of the SAG (Dr Lars Petter Hansen), the SALSEA-Merge Scientific Coordinator (Dr Jens Christian Holst) and Mr David Reddin (Canada) as its Steering Committee for the symposium. The Assistant Secretary reported that the symposium had been discussed at NPAFC's Research Planning and Coordination Meeting held in April 2009 and following this meeting the Executive Secretary of NPAFC had advised NASCO that NPAFC would not be able to Co-Convene the symposium because of funding issues related to participation of NPAFC scientists in a meeting in Europe and because it was felt that there would be little new information from research in the Pacific to report in 2011 following the 2008 BASIS Symposium. The SAG noted this decision and agreed that continuing cooperation between NASCO and NPAFC in future would be desirable. However, given the large amount of information being generated under the SALSEA programme and the commitment to hold a 'Salmon Summit' in the SALSEA-Merge contract with the European Commission, the SAG recommends that the Board proceed with the symposium and that keynote speakers be invited to provide overviews of research on salmon mortality at sea in the Pacific. The SAG believes that this arrangement will allow greater time for presentation of the enormous amount of information that has been generated by SALSEA while providing for an overview of the situation in the Pacific. The SAG also recommended that ICES be invited to nominate a Steering Committee member and that planning for the symposium commence.

(j) Other activities

6.16 The SAG was advised of an ICES/PICES Symposium entitled 'Climate Change Effects on Fish and Fisheries: Forecasting Impacts, Assessing Ecosystem Responses, and Evaluating Management Strategies'. There is no session on salmon in the symposium and so a group of salmon experts from ICES and PICES is requesting one of the five workshop time-slots that are available for the day before the symposium. This workshop would focus on expectations for Pacific and Atlantic salmon using the most up-to-date climate scenarios. The SAG considers that this workshop might provide a useful opportunity to obtain information that would assist the Steering Group in organizing the 'Salmon Summit'.

(k) Recommendations to the Board

6.17 The SAG's recommendations to the Board are presented separately under the relevant agenda items above.

7. Other business

7.1 There was no other business.

8. Report of the meeting

8.1 The SAG agreed a report of its meeting.

9. Date and place of next meeting

9.1 The SAG decided to agree the date and place of its next meeting by correspondence.

Annex 1

List of Participants

Canada

Mr Gerald Chaput
Mr Dave Reddin

European Union

Mr Alan Gray
Dr Niall O'Maoileidgh
Mr Ted Potter
Dr Ken Whelan

Iceland

Mr Gudni Gudbergsson

USA

Mr Tim Sheehan

Chairman of the SAG

Dr Lars Petter Hansen

Secretariat

Dr Peter Hutchinson

Annex 2

SAG(09)8

Agenda

1. Opening of the meeting
2. Adoption of the agenda
3. Review of the updated inventory of research
4. Report of the Inventory Review Group
5. Review of Applications for Potential Funding by the Board
6. Progress with Implementing the SALSEA Programme
   - (a) Analysis of historical tagging data
   - (b) Report of the ICES Study Group on biological characteristics of salmon
   - (c) Progress on stable isotope analysis of West Greenland samples
   - (d) Report on the SALSEA-Merge project
   - (e) Report on SALSEA North America
   - (f) Reports on SALSEA West Greenland
   - (g) Reports on sonic telemetry studies
   - (h) Coordination of the SALSEA Programme
   - (i) 2011 Symposium
   - (j) Other activities
   - (k) Recommendations to the Board
7. Other business
8. Report of the meeting
9. Date and place of next meeting

Annex 3

SAG(09)10

Report of the SAG Research Inventory Review Group

1. Introduction

1.1 Background to the SALSEA Plan

Records of the numbers of salmon returning to monitored rivers indicate that, despite drastic reductions in directed fisheries, there has been at least a threefold reduction in marine survival rates since the early 1970s. The reductions in the numbers returning has been accompanied by a marked decline in the proportion of older sea age fish, so much so that 3SW fish are relatively rare in many systems and 4 & 5SW fish vanishingly so. Such a change in an age distribution is a classic symptom of a sustained increase in mortality rate, a conclusion which is supported by the current relative scarcity of repeat spawners in the returning populations.

Other factors which might have contributed to the proportional reduction in the representation of older fish include, higher rates of mortality on non-maturing fish than on maturing ones, a sustained increase in maturation rates and a reduction in the representation of late-maturing populations among the returning stocks. Although all three of these explanations are credible, they do not alter the main conclusion that Atlantic salmon, especially those in the southern part of the species' range, are currently suffering from a raised level of marine mortality which is sustained across all sea age classes.

The IASRB therefore developed the SALSEA Plan (SAL(04)05) to outline the research requirements to address this problem. This included studies of factors affecting juvenile salmon in freshwater and smolts emigrating through coastal waters which may affect their subsequent survival during the marine phase as well as factors directing impacting the fish while they are in the open ocean. While research is required in all these areas, the IASRB has specifically sought to support practical studies of the distribution and migration of salmon in the sea (including studoies of by-catch in pelagic fisheries), and studies of biological processes (e.g. environmental, food, predation, growth, parasites and diseases) relating to the marine phase of the life-cycle for potential.

1.2 Terms of Reference

The International Atlantic Salmon Research Board's (IASRB) inventory of research relating to salmon mortality in the sea was established in 2002 and has been updated annually since then. It is an essential tool in the development of research priorities for potential funding and in better coordinating existing research efforts.

At its annual meeting in 2008, the Scientific Advisory Group (SAG) of the IASRB welcomed the valuable information presented in the inventory but agreed that consideration should be given to how this information could be better utilised. The

IASRB therefore agreed to a proposal from the SAG to establish a Sub-Group comprising at least one representative from each Party, chaired by Ted Potter (EU) and with the following terms of reference:

- to review the inventory to identify areas where there may be merit in encouraging improved coordination of research and
- to highlight gaps in the research programme where new work might significantly benefit the SALSEA Programme and which might be considered for funding by the Board.

The Sub-Group was to work by correspondence and report back to the SAG in 2009.

1.2 Summary of Research Inventory – SAG(09)02

The inventory of research is maintained by the NASCO secretariat. This involves seeking updates from NASCO Parties at the beginning of each year to include new projects that have been funded or approved, to record changes to existing projects and provide progress reports, and to note projects that have been completed. The NASCO secretariat also provide an annual summary of the projects in the form of four tables:

Table 1: Approximate annual expenditure on research in relation to salmon mortality at sea by topic area and Party;

Table 2: Inventory of research relating to salmon mortality in the sea – allocation of projects by topic area;

Table 3: Expenditure on ongoing projects in the inventory of research of relevance to the SALSEA programme; (NB This table contains no financial data and so the heading could be clarified by omitting 'Expenditure on').

Table 4: Summary of ongoing and completed research projects relating to salmon mortality in the sea. (a.) Ongoing projects (b) Completed projects

This report draws heavily on these very helpful tables as a basis for highlighting gaps and opportunities for collaboration and co-ordination.

1.3 Method of working

It was agreed that the Sub-Group would conduct their review on the 2009 update to the research inventory, which was made available to the Sub-Group towards the end of April. As the objectives of the review relate specifically to the SALSEA programme, the Sub-Group used the structure of the SALSEA Plan (SAL(04)05) to organise the review. Each member of the Sub-Group was asked to consider the work being undertaken in relation to a particular Workpackage Task in the Plan and assesses the extent to which the current research projects listed in the inventory appear to address the identified research needs (or new research requirements). In parallel with this, the work being undertaken under each Task was reviewed to identify areas where there may be opportunities to further improve collaboration and co-ordination. The conclusions from these reviews are reported below for each of the

Workpackage Tasks in the Plan with information relating to both terms of reference being combined; the final section summarises the recommendations.

The review was complicated by the fact that the projects listed in the inventory are renumbered each year, with completed projects having no numbers. In addition, less information is provided for the completed projects. It is suggested that the structure of the inventory should be reviewed to make it easier to access information on ongoing and completed projects.

Conclusion:

a. The structure of the IASRB research inventory should be reviewed to make it easier to access information on ongoing and completed projects relating to salmon mortality in the sea.

2. Work Package 1: Supporting Technologies

2.1 Workpackage 1 - Task 1: *Genetic tagging to determine stock origin* – (TP)

2.1.1 Task Objectives:

The overall objective of this task is to map regional genetic structure of Atlantic salmon and establish a standardised genetic baseline database for regional or river-specific populations.

The specific objectives are:

i. Review existing knowledge of genetic structure within the distribution area of Atlantic salmon, and establish an overall picture of population structure;
ii. Compile an inventory of available samples, both recent and historical, that could be used in a larger-scale mapping of genetic structure;
iii. Establish a cooperative programme between the principal genetic laboratories in Europe and North America to screen the major salmon stocks. This will be accomplished by selecting a suitable array of genetic markers, based upon the level of variation observed in previous studies and calibrating the scoring between participating laboratories;
iv. Based on the results from the above studies select an experimental set of populations to be sampled;
v. Review the results and determine whether sufficient precision is achieved for the purposes outlined in the core SALSEA tasks. Expand and include more areas and populations in the baseline as required;
vi. Establish a standardised database of genetic structure of baseline populations;
vii. Carry out comparative studies using conventional tags of known origin to provide support for genetic identification;
viii. Establish a "Biobank" of samples collected, and also of DNA extracts that can be made available for other purposes at later stages.

2.1.2 Assessment:

There are nine current projects (D1, E2, E11, E16, E19, E20, I4, N3, F1) and four completed projects in the inventory involving the use of genetics techniques, although not all are directly related to genetic stock identification (GSI) which is the central

theme of this Task. The main areas being addressed are the development of genetic baselines of Atlantic salmon stock, the application of genetic stock identification in management and the use of genetic techniques in population studies. We are also aware of additional programmes to develop and apply genetic baselines (e.g. in USA), and to coordinate these studies (e.g. the SALMAN programme), which do not appear to be included in the inventory.

Genetic stock identification (GSI) is an integral part of the SALSEA Programme because it was selected in preference to tagging as the primary method to be used to identify the region of origin of fish sampled in marine surveys. In addition, increasing numbers of countries are developing more detailed genetic baselines for their stocks to aid in stock conservation and fishery management activities. To support this work extensive efforts have therefore been made in recent years to establish a network of groups working on salmon genetics, to agree upon sampling and analytical protocols, and to select a standard set of micro-satellite markers.

Baseline genetic datasets that have already been established for a number of countries including USA, Ireland and Canada, and this work is being extended as part of the SALSEA-MERGE project (E1) and in national programmes in Iceland (I4), UK(England and Wales) (E2) and Norway (N3). GSI is also being used to identify the continent of origin of salmon caught at West Greenland (D1), and thereby in the development of catch advice by ICES, and for samples collected in St Piere et Miquelon (F1).

Other genetic studies are being undertaken on the heritable effects of fishing (E11), the exchange of stocks between rivers (E16), the susceptibility of stocks to G.salaris (E19), and to identify genomic regions that affect ecologically and economically important phenotypic traits (E20).

***Conclusion**:*

a. It appears that there are good mechanisms in place (including through SALSEA-MERGE) to co-ordinate genetic studies in Europe, including ensuring all groups use the same satellite markers and comparable sampling and analytical techniques. However, there was felt to be some lack of co-ordinations between current genetics work on Atlantic salmon in Europe and North America, although the European groups were understood to have good contacts with geneticists working on Pacific salmon.
b. Some concern was expressed about the need to clearly distinguish between the delivery of practical results employing established techniques (e.g. microsatelitte markers) from the efforts to develop new techniques (e.g. SNPs).

2.2 Workpackage 1 - Task 2: *Sampling equipment evolution to increase the sampling efficiency for salmon at sea* (TS)

2.2.1 Task Objective:

The overall objective of this task is to initiate research efforts to develop smolt trawl design to minimize size selection. No detailed objectives are specified within the SALSEA Plan.

2.2.2 Assessment:

According to the Inventory, there are no ongoing efforts being directed towards this task. However, as the inventory is an "Inventory of Research Relating to Salmon Mortality in the Sea", it is possible that some relevant research activities (e.g. possible in Norway) have not been reported because they directly involved with investigating salmon mortality at sea. In addition, significant efforts have been made to standardize the survey methods used between the current marine survey programmes.

There is one completed project (European Union – United Kingdom (Scotland) - Testing and development of Institute of Marine Research (IMR), Bergen, Norway, salmon trawl gear), which successfully trialed the use of an open trawl digital observer/analyzer.

The inventory list three projects being undertaken in Canada (C1), Europe (E! - SALSEA-MERGE), USA (U5) which are undertaking marine surveys using similar gear, and these are assumed to impart a size selective bias in their catches. The objective of this Task was to find ways to reduce the size selection, but work in the area has not occurred to the extent envisioned in the SALSEA Plan (SAL(04)05). Any new or ongoing efforts will likely not benefit the SALSEA Programme as we are entering the 2nd and final year of the marine surveys.

Conclusions:

a. Efforts should be made to determine the extent of the possible selective bias in the current marine sampling programmes (e.g. of different sized smolts emigrating from different areas and at different times) in order that this can be taken into account in the analysis of the results.
b. There remains a need for further developmental work on methods to sample post-smolts and adult salmon in the open ocean that are less selective than the methods currently in use. Such work should be included in any future programme to extend marine survey and sampling programmes for salmon.

2.3 Workpackage 1 - Task 3: *Signals from scales* (SP)

2.3.1 Task Objectives:

The overall objective of this task is to establish standardised scale analysis techniques and identify marine growth histories and anomalies indicating common mortality factors on spatial and temporal scales.

The specific objectives are:

i. Ensure that results from scale analysis equipment in selected European and North American laboratories is comparable;
ii. Carry out scale analysis training for all participating laboratories by North American experts while ensuring that agreed-upon standardised scale examination procedures are being followed;
iii. Carry out scale analyses on selected scale sets with a view to establishing a comparable database between laboratories;

iv. Coordinate the examination of scale material available from several research agencies (or from different stocks and stock components) to identify spatial and temporal anomalies in the time series of scale growth during the marine

2.3.2 Assessment:

There are two main strands to this work area, relating to the analysis of scale growth patterns and scale microchemistry. Three ongoing projects listed in the inventory (E7, E10, C5) are specifically related to this Workpackage Task. These projects focus on the analysis of scales from existing and new collections in Scotland, England and Wales and Canada together with scales taken from salmon sampled in the ocean. In addition, at least four of the completed studies undertaken in Canada, USA, England and Norway addressed similar topics. These analytical techniques will also be applied to scale samples collected from salmon caught during the marine surveys (E1, C1, I5 and U5).

There is a considerable collection of historic scale material available from most salmon-producing countries, and the results coming out of the studies suggests that analysis of scale microchemistry is likely to provide very important insights into the factors affecting salmon in the sea. The first requirement in analysing these scale collections and comparing results between countries is to ensure the use of standardised scale analysis procedures between laboratories. It is understood that, significant efforts have been made to standardize the methods used within SALSEA-Merge (E1), particularly in relation to the analysis of growth patterns, but there remains a need for further co-ordination between the European and North American programmes.

The Review Group was aware that concerns have also been expressed about the need to establish standardized protocols for analysising scale microchemistry to ensure that results between laboratories and countries are comparable. Prof Clive Trueman (Southampton University, UK), who is managing project E7, is hoping to arrange such a workshop to bring together scientists using these techniques.

Conclusions:

a. It is important to ensure that the results obtained from the scale analyses being undertaken by different research groups are comparable and can be brought together in the ultimate synthesis of results. SAG should investigate this requirement further to determine whether there is a need for a workshop and whether this should be supported by the IASRB.
b. If a workshop on scale analysis is establish it could also discuss the feasibility of establishing a common scale database for all countries with historic scale data that may be used in scale growth and microchemistry analyses.
c. At their meeting in 2008, the ICES Study Group on Salmon Age Reading, which had previously included only Baltic salmon biologists, recommended that they should extend their remit to bring in Atlantic salmon biologists for a meeting in 2010. It was suggested that any future meeting of SGSAD should be coordinated with current activities with the SALSEA Plan.

3.1 Workpackage 2 - Task 1: *Investigate the influence of biological characteristics of Atlantic salmon smolts on their marine mortality* (TP)

3.1.1 Task objectives:

The overall aim of this task is to identify differences in the marine survival of smolts with different characteristics, and determine the extent to which such factors could account for widespread changes in salmon stock abundance.

The specific research objectives are to:

i. Identify the key biological variables among smolts that may affect marine survival and evidence of widespread changes in these characteristics in stocks;
ii. Determine the impact of smolt characteristics on migratory behaviour;
iii. Determine the impact of smolt characteristics on marine survival and return of spawning adults;
iv. Model the impact of smolt characteristics at the population level;
v. Determine management options.

3.1.2 Assessment:

The inventory lists 13 ongoing studies (C3, E5, E8, E9, E13, E15, E18, E21, I1, N2, R1, U4) that are collecting data directly relevant to this Task, and many of these are long-term monitoring programmes. In addition a number of completed projects have provided relevant information.

There is growing evidence from these and other studies that the growth and survival of salmon in the sea may be related to various biological characteristics of smolts. Studies in this area are therefore particularly important because these are also factors which are likely to be more amenable to management intervention.

Data from many of the above programmes provide important inputs to the work of the ICES North Atlantic Salmon Working Group and the development of advice for NASCO. In addition, in response to a specific question from NASCO, ICES has established the Study Group on the Identification Of Biological Characteristics For Use As Predictors Of Salmon Abundance [SGBICEPS] which met in 2009 to: identify data sources and compile time series of data on marine mortality of salmon, salmon abundance, biological characteristics of salmon and related environmental information; consider hypotheses relating marine mortality and/or abundance trends for Atlantic salmon stocks with changes in biological characteristics of all life stages and environmental changes; and conduct preliminary analyses to explore the available datasets and test the hypotheses. IASRB provided some financial support for the first meeting of this Study Group, which enabled two scientists working outside national laboratories to participate.

The first meeting of this Study Group highlighted the value of combining the analysis of data from a number of different monitoring programmes around the North Atlantic, but also highlighted the severe difficulties in obtaining comparable data from these programmes. This Study Group is likely to have at least two more meetings.

This is a complex and difficult area of research. It is costly to run extensive monitoring programmes and data must generally be collected over a substantial time period (e.g. more than 10 years) to provide useful results. Furthermore, co-ordination of such programmes is problematic because the various on-going programmes use a range of different techniques and collect a range of different information. However, the drivers to maintain the same approaches with the time-series tends to be stronger that the driver to use comparable approaches with other groups undertaking similar studies.

Conclusions:

a. The ICES SGBICEPS could provide a suitable forum for co-ordinating work on the influence of biological characteristics of Atlantic salmon smolts on their marine mortality; consideration should therefore given to including this in the terms of the reference for future meetings;
b. IASRB should be asked to consider providing funding for the participation of two experts from outside national laboratories in the future meetings of SGBICEPS.

3.2 Workpackage 2 - Task 2 - *The impacts of physical factors in fresh water on marine mortality of Atlantic salmon* (LPH)

3.2.1 Task objectives:

The overall aim of this task is to assess the effects of physical variables on marine survival. The goal is to identify common or differing trends in freshwater physical conditions that are common throughout the geographic range, or within a geographic region, and that may modify factors such as smolt quality or migratory behaviour and reduce the ability of smolts to physiologically adapt to the marine environment.

The specific objectives are to:

i. Determine the impact of physical variables at the time of smolt emigration on survival to the open ocean (i.e. to adapt to sea water conditions and thrive and grow in marine conditions and return to natal fresh water to breed) (Sub-task 1);
ii. Determine the impact of key physical variables, such as temperature, flow, turbidity, on the run-timing of wild salmon smolts and consequent survival to the open ocean (Sub-task 2);
iii. Determine the impact of physical variables on behaviour of smolts during the transition between the freshwater and marine environments and on the abilities of smolts to survive the transition from fresh to sea water (Sub-task 3);
iv. Determine impacts of coastal transition waters on survival of returning adults into the river (Sub-task 4);
v. Model the impact of freshwater physical variables on Atlantic salmon at the population level (Sub-task 5);
vi. Determine management options for mitigating impacts (Sub-task 6).

3.2.2 Assessment:

Physical conditions experienced by Atlantic salmon smolts within fresh water may be critical to their subsequent survival in the sea. For instance, water flow and water temperature, both of which may be mediated by climate change, can modify growth, inhibit or delay smolt emigration, reduce sea water adaptation and marine survival,

and influence maturation. Marine survival may also be affected by the transitional conditions, such as temperature, between fresh and saline waters.

The inventory lists two projects (E3 and E4) that specifically address the objectives of this Task. In addition, some of the projects in the inventory covering biological factors of smolts on marine mortality (WP 2:1) may include effects of physical variable as well, and there may also be overlap with WP 2:2, 2:3 and perhaps 2:4.

There is obviously a large amount of information available on how physical factors in freshwater affect the life history and behaviour of salmon, and consequently marine performance such as migration, growth and mortality. Interaction between several of these factors may result in synergistic effects which in turn may increase marine mortality.

There has been no major general and complete analysis of such information. The first step should be screening of literature and development of a network of scientists who are already funded and working in this area, to promote complementary studies, avoid duplication and gain from cooperative planning and analysis of existing data. A preliminary descriptive model of factors in freshwater that affects behaviour, life history and survival and the interaction between them should be developed. The next step would be to run the model(s) by utilizing available quantitative information. When focusing on marine survival this is not an easy task, but a first result of this may be to identify the major gaps in the knowledge and their relative importance.

The network should arrange workshops to synthesize the results, the first could prepare an inventory of completed and ongoing research (literature survey) and to develop the descriptive model. Later, workshops would then be held in order to synthesise results and coordinate ongoing and future work and/or develop an integrated research programme that would address various subtasks.

Realistically the main costs should be covered by the parties, but the fund could support the participation of external scientists with special skills.

Conclusions:

a. Efforts should be made to establish a network of scientists working on topics related to the effects of physical factors in fresh water on marine mortality of Atlantic salmon in order to promote complementary studies, avoid duplication and gain from cooperative planning and analysis of existing data. The ICES Study Group, SGBICEPS could provide a means for establishing such a network (see 3.2.1 Conclusion (a).)
b. A preliminary descriptive model of factors in freshwater that affects behaviour, life history and survival and the interaction between them should be developed and run utilizing available quantitative information. This should provide a mechanism to identify major gaps in knowledge and to assess their relative importance.

3.3 Workpackage 2 - Task 3: *Preparing to migrate – investigate the influence of freshwater contaminants on the marine survival of Atlantic salmon* (NOM)

3.3.1 Task objectives:

The aim of this programme is to assess the effects of freshwater contaminants that are common throughout the geographic range of Atlantic salmon, on marine survival and their potential role in the widespread decline of stocks.

Specific objectives:

i. Identify freshwater contaminants that are common throughout the geographic range of Atlantic salmon and that might be expected to modify migratory behaviour and/or reduce the ability of the smolts to physiologically adapt to the marine environment (Sub-task 1);
ii. Determine the effect of environmental levels of the target contaminants on the parrsmolt transformation and the ability of smolts to survive in marine conditions (Sub-task 2);
iii. Determine the impact of the target contaminants on run-timing of wild salmon smolts and the migratory behaviour of smolts during the transition between the freshwater and marine environments;
iv. Determine the impact of target contaminants on marine survival and return of spawning adults (Sub-task 5);
v. Model the impact of freshwater contaminants at the population level;
vi. Provide management options for resolving impacts identified in these studies.

3.3.2 Assessment:

The inventory lists only one current project (E3) and two completed projects (one of which was undertaken by the same team as E3) specifically aimed at understanding the role of freshwater contaminants in the early stages of salmon migration. However, the Review Group was aware of other ongoing studies, including in USA and Norway, which are not included in the inventory. The limited work in this area is unfortunate because these study have clearly indicated that exposure of smolts to some contaminants (including some widely used pesticides) can significantly reduce the survival of smolts on transition to salt water and these are areas which are clearly amenable to management intervention.

Sub-task 1: ***Identifying freshwater contaminants***
This is mainly a desk study and could be progressed relatively easily. There is probably some work ongoing in UK (England and Wales) and US.

Sub-task 2: ***Effects of contaminants on parr-smolt transformation***
This is mainly lab based – more difficult to progress – most work being undertaken in UK (England and Wales) and US.

Sub-task 3: ***Effects of contaminants on migratory behaviour and distribution***
Sub-task 4: ***Effects of contaminants on smolt behaviour and distribution***
Sub-task 5: ***Effects of contaminants on adult return rates***
All the above sub-tasks could be linked to any of the river monitoring or sampling programmes which handle smolts or other juvenile stages and which could provide

sample material for telemetry or exposure to specific contaminants before release particularly if fish are being micro-tagged. The main focus is for groups of fish to be marked (e.g. PIT tagged) and exposed to environmental levels of contaminants for periods during the parr-smolt transformation. Therefore access to juveniles/smolts for PIT tagging, tracking of juveniles and survival is the common theme etc and links could be developed from some of the ongoing monitoring programmes. A large number of the projects listed in the inventory therefore have potential to provide suitable material to these sub-tasks (e.g. C4, E3, E4, E13, E8, E15, E17, E18, E21, I1, N2, N4, N6, R1, U1, U2, U3, U5)

Sub-task 6: Modelling impacts at a population level
This is mainly a desk study which would depend on some output from the laboratory experimental, field experimental and telemetry work above. This probably can't be progress too far yet.

Conclusions:
There is potential for a number of on-going programmes to contribute to the studies of the effects of freshwater contaminants on the marine survival of salmon, and those working in these areas should be encouraged to make best use of these opportunities.

3.4 Workpackage 2 - *Task 4: The part played by key predators (DS)*

3.4.1 Task objectives

The overall aim is to determine the contribution of predation by key predators to the marine mortality of salmon.

The specific objectives are to:
i. Determine the proportion of out-going smolts and returning adults that are removed by predation, to identify the predator(s) involved, and to determine the time, location, and circumstances of this predation;
ii. Compare current patterns and intensities of predation with the situation prior to the salmon decline.

3.4.2 Assessment:

The inventory lists one ongoing project (U6) related to reducing cormorant predation on emigrating smolts and one completed project on the effects of seals on adult salmon returning through estuaries.

The observed increases in marine mortality of salmon almost certainly mean that a greater proportion of the fish going to sea are being consumed by predators, but it is unclear whether this is a direct effect (e.g. the result of an increase in the number of predators) or a secondary effect (e.g. reduced fitness of the fish or other factors making them more vulnerable to predation). As a result of over-exploitation in human consumption fisheries, the numbers of large predatory fishes in the north Atlantic capable of catching salmon is at an all time low. However, there has been no such reduction in the numbers of surface-feeding and diving bird populations, nor in those of large marine mammals like dolphins and Atlantic grey seals, indeed, grey seal numbers are currently at record levels sustained, perhaps, by dead and dying fish

discarded from fishing vessels. There is therefore remains a need to assess whether increased predator numbers in specific regions of the ocean or at specific times could account for observed reductions in marine survival of salmon. If this is demonstrated, direct investigation of predation on salmon could be focused on estimating losses to marine mammals and birds in areas where the problem appears greatest.

Because small fishes are easier to catch than large ones, studies of predation cannot be isolated from studies of growth and of the abundance of the prey species that sustain it. In the latter instance it is important to know how much reductions in the abundance of important prey species such as sandeels and capelin are driven by fishing mortality and how much by changes in marine climate.

Conclusions:

a. There is a need to assess whether increased predator numbers in specific regions of the ocean or at specific times could account for observed reductions in marine survival of salmon.
b. There are a range of options for extending current studies on the evaluation of levels of predation on salmon stocks in areas where potential problems are identified:
   - Extend the study the occurrence of salmon DNA in seal scats to a wider range of haul out sites (Marine Scotland FW Laboratory and SMRU).
   - Extend the application of P.I.T detection technology currently being used to study sea trout predation by seals to salmon (Marine Scotland FW Laboratory and SMRU).
   - Intensify observations on cetacean predation on salmon (SMRU).
   - Initiate study of the occurrence of salmon tags and salmon DNA at *coastal* bird colonies.
   - Review the current status of industrial fisheries in the north Atlantic.
   - Extend the study of salmon migration pathways to the central and northern North Sea.

3.5 Work Package 2 - *Task 5: The impacts of aquaculture on mortality of salmon* (TP)

3.5.1 Task objectives

The objective of this Task as stated in the SALSEA Programme was for NASCO and ICES to hold a symposium in 2005 on 'Interactions between aquaculture and wild stocks of Atlantic salmon and other diadromous fish species: Science and Management, Challenges and Solutions'.

The objectives of the symposium were:

i. To summarise available knowledge on the interactions between aquaculture and wild stocks of Atlantic salmon and other diadromous species;
ii. to identify gaps in current understanding of interactions and develop recommendations on future research priorities;
iii. to review progress in managing interactions of aquaculture, the challenges that remain and possible solutions;

iv. to make recommendations for additional measures, including cooperative ventures between the various stakeholders, to ensure that aquaculture practices are sustainable and consistent with the Precautionary Approach.

3.5.2 Assessment:

The Symposium specified in the objectives was held and the proceedings written up and published. Since that time the SALSEA Plan has not been updated and it is not clear what the priorities are for future work in this area, relating to the potential effects of aquaculture on marine mortality of salmon.

The inventory lists three ongoing projects (E11, N1 and N5) and four completed projects on the effects of sea lice on wild salmon, the treatment of sea lice in cages and the prophylactic treatment of wild smolts. In this context there is worrying evidence that some strains of sea lice may be gaining resistance to the current treatments in some areas. There have also been two studies involving the release of tagged farm fish to determine their patterns of dispersal and one on the effects of contaminants emanating from freshwater aquaculture facilities on the survival of smolts after they enter the sea.

We understand that the Salmon Farming Liaison Group will be reviewing research requirements relating to the potential impacts of aquaculture, and that the development of Focus Area Reports in this area will allow a more detailed evaluation of current research activities.

Conclusion:

a. The SALSEA Plan needs to be reviewed and updated to spell out the need for any future work on the impact of aquaculture on the marine mortality of salmon.

4. Work Package 3 – Investigating the Distribution and Migration of Salmon at Sea

4.1 Work Package 3 - Task 1: Distribution and migration mechanisms - (JAJ)

4.1.1 Task objectives:

The overall aim of this task is to develop theoretical migration models from existing studies to facilitate surveys and provision of advice for contemporary migration and distribution theory testing.

The specific objectives are:

i. To assemble all available scientific data, both near-shore and open ocean, on post-smolt distribution, migration, growth and feeding at sea;
ii. Review current investigations using oceanographic data so as to refine/develop predictive tools for assessing marine thermal habitat preferences and possible oceanic migration paths;
iii. Test the hypothesis that distribution and stock composition are stable over time by examining time series of oceanic and home-water tag recoveries and from scale sampling programmes;
iv. Review the existing information on differences in the behaviour and survival of hatchery and reared salmon at sea.

4.1.2 Assessment:

The first step in WP3.1 is to ensure that the best use is made of all existing survey, tracking and tagging results, available biological and oceanographic data, along with existing knowledge of salmon migrations, in order to develop hypotheses about salmon distribution and behaviour which can be tested, to improve the resolution of the proposed marine sampling tasks WP3.3.

There are no ongoing projects in the inventory that are solely related to this topic, but the development of migration models has also been addressed by two completed projects and is included within SALSEA-Merge (E1). Some work has also been done on salmon post-smolt migration in relation to sea-surface temperatures in the North Sea/Norwegian Sea by Norwegian scientists and west of Scotland/Norwegian Sea by Scottish scientists.

The analysis of historic tagging salmon data has also been addressed by a series of ICES Workshops.

Conclusion:

a. Further studies relating to the production and distribution of important marine organisms to physical parameters such as sea surface temperature, currents, wind speed, wave action, salinity, etc. are needed to facilitate and enhance a comprehensive study of the distribution and migration mechanisms for salmon in the sea.

4.2 Work Package 3 - Task 2 – A common approach –(TS)

4.2.1 Task objectives:

The overall aim of this task is to refine the plans for a large-scale marine survey programme and standardization of trawl survey techniques between the participating partners

The specific objective is:
To develop Standard Operating Procedures and plan the large-scale marine survey programme.

4.2.2 Assessment:

According to the Inventory, there are no ongoing efforts being directed towards this task. However, it is possible that some studies relevant to this task have not been reported because they are not considered to be directly related to investigating salmon mortality at sea. There have been various meetings to develop the details of the SALSEA research program and specifically plan the large-scale marine survey programmes and ensure that the same methods are used.

There are five projects (C1, E1, U5, D1, F1) listed in the inventory that will be undertaking marine surveys for salmon (both trawl and land based). There have been numerous coordination efforts within and between these projects to develop

standardized operating procedures with standardized data collection requirements. Project leaders have informally met at various meetings (including the 2008 NASCO Annual Meeting) and communicated via email to develop standardized protocols. However, no overarching Trawl Standardization Working Group has been developed for the entire SALSEA Program (SALSEA-Merge, SALSEA North America and SALSEA Greenland).

***Conclusion*:**

a. Work on the further development of trawl survey techniques has not occurred to the extent envisioned in the SALSEA Plan. Any new or ongoing efforts will likely not benefit the current programmme of marine surveys as we are entering the 2nd and final year of that programme.

4.3 Work Package 3 - *Task 3: Salmon at sea - (GG)*

4.3.1 Task objectives:

The overall aim of this task is to carry out a comprehensive marine survey to collect samples and information required to compare migration patterns, distribution and possible factors affecting survival of reared and wild salmon post-smolts at sea

The specific task objectives are to:

i. Determine the ocean migration patterns of salmon from fresh water to return to home waters;
ii. Provide adequate samples to describe the major migration routes and distribution of Atlantic salmon at sea;
iii. Provide samples for regional stock identification using the genetic baseline studies;
iv. Collect information on sea surface temperature, salinity, current speed, direction and other oceanographic and hydrographic information;
v. Collect information on the predators and prey of salmon;
vi. Determine the distribution of salmon in relation to:
    - Sea temperature and currents;
    - Presence of prey;
    - Presence of predators;
    - Presence of competitors;
    - Ocean up-welling and productivity;
vi. Collect and analyse oceanic data (physical, chemical, biological) compared to the relative abundance of salmon (adults and post-smolts) captured in targeted trawl or sampling surveys;
vii. Collect information (scales, growth information, sex ratios, etc.) for studies on the energetics of oceanic migration;
viii. Integrate the SALSEA programme with major marine studies being undertaken by bodies such as ICES, NOAA and Fisheries and Oceans, Canada.

4.3.2 Assessment:

The inventory list 17 ongoing projects related to this Task, four marine surveys (C1, E1, I5, U5), nine acoustic tagging surveys (C2, C4, C6, E17, N4, N6, U1, U2, U3), two studies employing data storage tags (I2, I3) and one looking at trends in

biological characteristics of returning salmon (E12). This part of the SALSEA Plan has been identified as being of prime important to the IASRB and is therefore central to their current research and funding efforts.

This WP is highly likely to give new and valuable information on presence/absence of post-smolts in the areas to be covered. Additional information on ocean conditions, presence of prey, presence of predators, ocean up-welling, as well as physical, chemical and biological information will be compared to relative abundance of salmon. The results can be compared to already available marine studies undertaken by ICES, NOAA and others.

Biological samples like genetic mapping and origin of fish, growth rate, scale pattern, isotopes, etc will also provide new information on salmon in the sea. In threes areas there is a need to ensure that the results obtained by different groups are comparable, and it would be desirable to develop co-ordinated programmes to provide good coverage of the North Atlantic.

Information on environmental factors from fish that have survived the marine phase can be looked at as a "gap" in the already listed SALSEA projects. Although post-smolts are caught in the sea it will not be clear if they are those that will survive or the actual importance of those areas. WE will not know whether the surviving fish are coming from the "hotspot" areas covered by research ships cruises.

Information sampled by data storage tags (DST), like temperature, depth, salinity, location (GPS) etc. could to some extent fill this gap by giving additional information on at least some environmental factors sampled by DST recorders carried by the surviving fish. Areas known to have high sea survival of Atlantic salmon should be prioritized or other areas known to be important or of special value for the salmon distribution and/or existence. This could also be used in areas that are not covered by the SALSEA sampling program.

The use of DST should be encouraged for use on:

- Hatchery smolts. DST tags for tagging hatchery smolts are already available and in use. Although it is not known to what extent they reflect the lifecycle of wild salmon.
- Wild smolts. DST tags for wild smolts are under development. For example wild smolts from River Ellidaar, S-W Iceland will be tagged internally with dummy DST tags with PIT inside in spring 2009.
- Kelts. At least few types of DST suitable for tagging kelts are available and in use. In some areas they are giving valuable information on the ocean habitat preferred by kelts. This part of the salmon population is of high importance in many areas and needs more attention.
- Fish farm escapees – fish released intentionally. Large adult salmon from fish farms could be tagged with "pop-up" DST tags already in use for tagging Tuna. These tags could give information on the environment in areas used by both the fish recovered as well as from fish that do not survive. This will also have the potential for comparison of the fish that dies and fish that survive.

The advantages of using DST are:

- They do not require expensive marine vessels for collection of samples and measurements of environmental factors.
- They collect information from individuals closing the marine phase of the lifecycle.

Disadvantages are:

- The tagged fish needs to be recovered as well as the tags.
- Expensive, while the development costs are paid.
- High number of tags not recovered (depends on survival rate).
- Limited number of parameter recorded as well as limited number of records.

Conclusions:

a. The use of tagging technologies, particularly archival tags, should be encouraged as a cost effect method to complement and enhance the results from marine surveys.
b. Efforts should be made to co-ordinate studies of the condition and lipid content of 1SW & 2SW salmon returning to netting stations in northern and eastern Scotland (Marine Scotland FW Laboratory and Scottish Oceanographic Institute, St. Andrews) with related work elsewhere to provide comparable results from different parts of the North Atlantic.

4.4 Workpackage 3 - Task 4: Distribution and migration –(TP)

4.4.1 Task objectives

The overall aim of this task is to analyse and collate data from the marine surveys, report on the distribution of salmon at sea, report on the biological and physical oceanographic factors which influence migration and distribution of Atlantic salmon and report on natural and man-made mortality factors which may significantly affect survival of salmon at sea

The specific task objectives relating to different sets of results are:

Genetic assessment of stock composition:

- Evaluate the stock composition of the samples at differing geographic scales and assess deviations from expected proportions.

Man-made effects

- Evaluate ICES SGBYSAL report in relation to new data collected during trawl surveys;
- Evaluate the effects of directed fishing mortality;
- Assess the level of ocean contaminants in areas where post-smolts are located.

Predators

- Provide an assessment of predation from historical data and records;
- Compare the distribution of salmon and their predators.

Productivity

- Assess the effect of varying ocean productivity on survival of salmon;
- Combine existing time series of survival and growth of salmon with productivity studies, plankton surveys, weather satellite surveys, etc.

Food availability

- Examine whether the survival of salmon is dependent on the distribution and relative abundance of prey types (fish, crustaceans, squid);
- Investigate the distribution and abundance of prey types in relation to salmon survival.

Growth effects

- Investigate the relationship between survival and growth rate with new data and samples from the research surveys (Work Package 2).

Water temperature

- Investigate the relationship between survival and water temperature from existing long time-series and new data on SST, fixed stations and transects, DST data from the research surveys (Work Package 2).

Competition

- Examine the relationship between survival and competition with other pelagic fish species (herring, mackerel, blue whiting, lumpfish) taking into consideration: competition for food, competition for space, schooling effects.

Combined synergistic effects

- Consider overall natural mortality as a result of combined synergistic effects.

4.4.2 Assessment

The objectives in this Task are obviously picked up in many of the research projects in the inventory, particularly those such as SALSEA-Merge (E1) which involve large integrated programmes. There would be value in developing models which begin to bring some of these information streams together with the aim of exploring more fully the data coming out of these programmes and identifying more clearly the most important gaps in our understanding of the factors that may be having the greatest impact on marine survival.

Conclusion:

There is a need to initiate the development of an integrated model covering the whole pre-smolt and smolt phase with main focus on survival.

5. Summary of comments and conclusions:

This section summarizes the comments and conclusions from the review (numbers in parenthesis indicate the sections in which the conclusions appear in the report):

5.1 Overall conclusions:

a. There is a need for increased co-ordination between groups undertaking work related to the SALSEA Plan, particularly between North America and Europe (see further details below).

b. There is a need to ensure that groups not currently involved in the large SALSEA coordinated programmes can gain sufficient information on those programmes to avoid duplication of effort and generate compatible results.

c. A further review of the research inventory and update to the SALSEA plan should be undertaken after the completion of the current marine survey programmes in 2011.

5.2 Conclusions relating to the research inventory and SALSEA Plan:

a. The structure of the IASRB research inventory should be reviewed to make it easier to access information on ongoing and completed projects relating to salmon mortality in the sea. (1a)

b. The SALSEA Plan needs to be reviewed and updated to spell out the need for any future work on the impact of aquaculture on the marine mortality of salmon. (3.5.2)

5.3 Conclusions relating to improved co-ordination and communication:

a. It appears that there are good mechanisms in place (including through SALSEA-MERGE) to co-ordinate genetic studies in Europe, including ensuring all groups use the same satellite markers and comparable sampling and analytical techniques. However, there was felt to be some lack of co-ordinations between current genetics work on Atlantic salmon in Europe and North America, although the European groups were understood to have good contacts with geneticists working on Pacific salmon. (2.1.2.a)

b. It is important to ensure that the results obtained from the scale analyses being undertaken by different research groups are comparable and can be brought together in the ultimate synthesis of results. SAG should investigate this requirement further to determine whether there is a need for a workshop and whether this should be supported by the IASRB. (2.3.2 a)

c. If a workshop on scale analysis is established (2.3.2.a) it could also discuss the feasibility of establishing a common scale database for all countries with historic scale data that may be used in scale growth and microchemistry analyses. (2.3.2 b)

d. At their meeting in 2008, the ICES Study Group on Salmon Age Reading, which had previously included only Baltic salmon biologists, recommended that they should extend their remit to bring in Atlantic salmon biologists for a meeting in 2010. It was suggested that any future meeting of SGSAD should be coordinated with current activities with the SALSEA Plan. (2.3.2 c)

e. The ICES SGBICEPS could provide a suitable forum for co-ordinating work on the influence of biological characteristics of Atlantic salmon smolts on their marine mortality; consideration should therefore given to including this in the terms of the reference for future meetings; (3.1.2 a)

f. IASRB should be asked to consider providing funding for the participation of two experts from outside national laboratories in the future meetings of SGBICEPS. (3.1.2 b)

g. Efforts should be made to establish a network of scientists working on topics related to the effects of physical factors in fresh water on marine mortality of Atlantic salmon in order to promote complementary studies, avoid duplication and gain from cooperative planning and analysis of existing data. The ICES Study Group, SGBICEPS could provide a means for establishing such a network (see 3.2.1 Conclusion (a).) (3.2.2.a)

h. Efforts should be made to co-ordinate studies of the condition and lipid content of 1SW & 2SW salmon returning to netting stations in northern and eastern Scotland (Marine

Scotland FW Laboratory and Scottish Oceanographic Institute, St. Andrews) with related work elsewhere to provide comparable results from different parts of the North Atlantic. (4.3.2 b)

5.4 Conclusions relating to additional research:

a. Efforts should be made to determine the extent of the possible selective bias in the current marine sampling programmes (e.g. of different sized smolts emigrating from different areas and at different times) in order that this can be taken into account in the analysis of the results. (2.2.1 a)

b. There remains a need for further developmental work on methods to sample post-smolts and adult salmon in the open ocean that are less selective than the methods currently in use. Such work should be included in any future programme to extend marine survey and sampling programmes for salmon. (2.2.1 b)

c. .A preliminary descriptive model of factors in freshwater that affects behaviour, life history and survival and the interaction between them should be developed and run utilizing available quantitative information. This should provide a mechanism to identify major gaps in knowledge and to assess their relative importance. (3.2.2 b)

d. There is potential for a number of on-going programmes to contribute to the studies of the effects of freshwater contaminants on the marine survival of salmon, and those working in these areas should be encouraged to make best use of these opportunities. (3.3.2)

e. There is a need to assess whether increased predator numbers in specific regions of the ocean or at specific times could account for observed reductions in marine survival of salmon. (3.4.2 a)

f. There are a range of options for extending current studies on the evaluation of levels of predation on salmon stocks in areas where potential problems are identified (3.4.2 b):
   - Extend the study the occurrence of salmon DNA in seal scats to a wider range of haul out sites (Marine Scotland FW Laboratory and SMRU).
   - Extend the application of P.I.T detection technology currently being used to study sea trout predation by seals to salmon (Marine Scotland FW Laboratory and SMRU).
   - Intensify observations on cetacean predation on salmon (SMRU).
   - Initiate study of the occurrence of salmon tags and salmon DNA at *coastal* bird colonies.
   - Review the current status of industrial fisheries in the north Atlantic.
   - Extend the study of salmon migration pathways to the central and northern North Sea.

g. Further studies relating to the production and distribution of important marine organisms to physical parameters such as sea surface temperature, currents, wind speed, wave action, salinity, etc. are needed to facilitate and enhance a comprehensive study of the distribution and migration mechanisms for salmon in the sea. (4.1.2)

h. The use of tagging technologies, particularly archival tags, should be encouraged as a cost effect method to complement and enhance the results from marine surveys. (4.3.2 a)

i. There is a need to initiate the development of an integrated model covering the whole pre-smolt and smolt phase with main focus on survival. (4.2.2)

5.5 Other conclusions:

a. Some concern was expressed about the need to clearly distinguish between the delivery of practical results employing established genetic techniques (e.g. microsatelitte markers) from the efforts to develop new techniques (e.g. SNPs). (2.1.2 b)

b. Work on the further development of trawl survey techniques has not occurred to the extent envisioned in the SALSEA Plan. Any new or ongoing efforts will likely not benefit the current programmme of marine surveys as we are entering the 2nd and final year of that programme. (4.2.2)

Members of the Review Group

Gerald Chaput	Canada
Gudni Gudbergsson	Iceland
Lars Hansen	Norway
Jan Arge Jacobsen	Denmark (in respect of Faroes and Greenland)
Niall O'Maoileidigh	European Union
Ted Potter (Chair)	European Union
Sergei Prusov	Russian Federation
Elena Samoylova	Russian Federation
Tim Sheehan	USA
Dick Shelton	AST
Fred Whoriskey	ASF
Peter Hutchinson	NASCO Secretariat

Annex 4

SAG(09)3

Research proposals submitted to the International Atlantic Salmon Research Board

1. At the International Atlantic Salmon Research Board's (IASRB) last meeting in Gijón, Spain, it was agreed that the Parties should be invited to submit to the Secretariat, by 1 September 2008, proposals for research that might be funded by the Board or for which the Board may support the proposer in seeking funds from other sources. The SAG was asked to evaluate and prioritise these proposals using the guidance developed previously by the IASRB (Annex 1).

2. Two new proposals were received by the Secretariat before 1 September 2008. These were as follows:

   SAG(08)7: Food availability of Atlantic salmon post-smolt during their marine phase.

   SAG(08)8: A study of the relationship between ocean climate and inter-annual variation in adult summer migration distribution patterns of Atlantic salmon in Irish coastal waters over three decades.

3. Furthermore, at its Annual Meeting the Board had received a proposal, SAG(08)6, that it did not fund and a second proposal for a three year study the first year of which the Board agreed to fund (£20,000), SAG(08)5. These proposals are as follows:

   SAG(08)5: Changes in trophic levels of Atlantic salmon through the marine phase of their life-cycle.

   SAG(08)6: Inferring temperature history of Atlantic salmon at sea based on oxygen isotope rations in otoliths.

4. These projects, which are contained in Annex 2 were sent to members of the SAG by its Chairman, Dr Lars Hansen, on 16 October 2008 seeking feedback on the priority to be afforded to them. It was stressed, however, that the Board had limited available funds but that it may be able to support applications to other funding sources. The Chairman received very limited feedback from SAG members and he noted that this may have been related to the fact that some SAG members were involved in some of the projects. For this reason the Chairman had referred to the possible benefits of an independent evaluation of the projects in future. He, therefore, wrote again to SAG members on 17 February suggesting that the projects be reviewed further by the SAG at its meeting in Molde, Norway on 31 May 2008.

5. Since this last communication from the Chairman, a further proposal (Annex 3) has been received by the Secretariat. This research proposal is as follows:

SAG(09)4: Application to NASCO's International Atlantic Salmon research Board (IASRB) to support research on salmon post-smolts in the Irminger Sea, Southwest of Iceland.

5. The SAG will be asked to evaluate these five projects and develop its recommendations to the Board on the priorities for support by the Board.

Secretary
Edinburgh
5 May 2009

ICR(03)14

CALL FOR PROPOSALS FOR RESEARCH

The North Atlantic Salmon Conservation Organisation's (NASCO's) International Cooperative Salmon Research Board (ICSRB), hereinafter referred to as "the Board", invites calls for proposals for **"Research into the migration, distribution and survival of North Atlantic salmon at sea**" focusing primarily on:

- *practical studies of the distribution and migration of salmon in the sea (including studies of by-catch in pelagic fisheries)*

- *studies of biological processes (e.g. environment, food, predation, growth, parasites and diseases) relating to the marine phase of the life-cycle.*

Within these broad areas the Board has identified the following sub-headings which are of particular interest:

Tagging
Large-scale marking or tagging (external, coded wire tags (CWT), PIT tags) - release and recovery programmes;
Tagging of adults, kelts, post-smolts or smolts with Data Storage Tags (DSTs);
Sonic tagging and active tracking of salmon movements;
Developments in electronic tag and data acquisition systems and technology.

By-catch
By-catch of salmon in near-surface pelagic trawling in the Norwegian Sea and elsewhere;
Identification of practical measures to reduce by-catch of post-smolts in these fisheries;
Development of sampling gears;
Inter-calibration of survey methods;
Practical methods to reduce by-catch.

Other
Oceanographic influences on migration and distribution and life-history of salmon;
Impacts of diseases, predators and parasites on salmon populations at sea;
Synergistic effects of predation/competition/food availability/freshwater influences on subsequent marine survival.

The Board will give priority to major multi-disciplinary and collaborative (multi-country) projects but will also consider smaller projects and proposals relevant to the topics above for:

Knowledge inventory studies;
Symposia and workshops;
Fellowships and studentships.

Funding may be provided in full or on a partial or matching basis.

An application form is available from the NASCO website or on request from the NASCO Secretariat.

The deadline for receipt of completed applications is: XX/XX/XX

The application form could include the following, as an example:

1. Project title

Give the application a brief title which describes the work to be done.

2. Applicant – Institution/company responsible for the project

As a general rule, an institution or company should be the formal applicant, with legal responsibility for ensuring that the conditions attached to an allocation of funds are met.

3. Project Leader

This should be the name of the technical expert responsible for the project.

4. Project summary

Provide a brief summary of the project description, with an emphasis on describing the objectives of the project, the most important R & D challenges and the potential for application of the project results. The project summary will be made publicly available via the Board's inventory. For this reason, the text should be capable of being understood by non-experts, and should not exceed 200 words.

5. Principal goal and sub-goals

Describe the results that are expected to be obtained in the course of the project period. Formulate individual demonstrable sub-goals which lead to the principal objective.

6. Milestones – timetable

Indicate milestones for the principal activities that fulfil the main objectives and sub-goals of the project (e.g. data-acquisition, field-work, main activities in study plan and final report). Check off these milestones by date (or possibly include a calendar or time grid). Use keywords – maximum of 45 characters. A more detailed timetable may be provided in the project description.

7. Cost plan

The cost plan for the project should be summarized and preferably broken down into sub-costs (e.g. capital costs, contracts or services, consumables, travel and subsistence).

Personnel costs and indirect costs

Personnel costs and indirect costs cover salary, social security and indirect costs such as rent, secretarial help, telecommunications and computing costs, etc.

The "Project total" should show the same amount each year as the total in section 8: "Finance plan".

The Board should consider fixed rates for fellowships and certain types of positions. Companies or institutions may also calculate personnel costs and indirect costs on the basis of their own employees' hours of work on the project and their hourly rates. Consider only work done by their own R & D personnel, i.e. the project manager and research and technical personnel.

8. Finance plan

The finance plan should show how the costs shown in the cost plan are to be financed and the amount sought from the Board.

Own funding

This refers to the applicant's institution's input of own resources such as cash, personnel, infrastructure/goods/equipment into the project.

Other public-sector funding

This refers to public-sector grants such as direct support from ministries, the grants from the State Fund for Regional and Industrial Development, regional support schemes, funds from agricultural or fisheries agreements, local authority industrial development funds, etc.

Other private funding

This includes financial support from cooperating companies, trade organizations, private funds, etc. State-owned companies that operate as commercial concerns are also regarded as sources of private funding in this respect.

9. Active partners

Enter national and international partners who will participate actively in the project. Provide names of persons, universities, institutes, companies, programmes, bodies, etc. Confirmation provided by such partners of their participation in the project should be enclosed with the application. Enter the name of the doctoral fellowship or student supervisor if he or she is not the project manager.

10. Project publication plan

The Board considers that dissemination of information about the projects it supports is very important. Provide brief details of goals, target groups and type of information to be provided.

11. List of enclosures

List all documents enclosed with the application as backup and possibly confirmation of the skills and background of the proposers.

12. Signatures

The Board requires the signatures of the project manager and of a representative of the institution or company responsible for the project and may want to further develop the requirements regarding project manager and institution. If possible, candidates for fellowships or research positions should sign when their names have been confirmed.

Project description

The project description should provide more details of individual points in the application form and offer a basis for academic evaluation of the project proposal. The project description must not exceed 10 pages (including the list of references). (Recommended norm: A4 page format, 12pt Times New Roman font, single line spacing and 2cm margins). A distinction should be made between background material and planned activities. For the application to be considered, the project description must provide information on the following topics, where relevant.

***Familiarity**:* The applicant must document good familiarity with the field of research concerned, both nationally and internationally.

***Problem**:* The problem must be clearly formulated and satisfactorily limited in scope. It must be demonstrated that the project involves an expansion of existing knowledge, and/or that this knowledge provides a basis for further research in the field.

***Method**:* It must be demonstrated that the methods and theories to be used are appropriate for the solution of the problem involved, or that there are good prospects of developing the necessary methods and theory. Analytical methods, including any statistical methods needed to evaluate the significance of the results, should also be described.

***Objectives**:* Concrete, testable main objectives that provide a description of the expected results of the project must be formulated, as well as a set of sub-goals that will lead to the principal objectives.

***Ethics**:* The project description must describe how ethical considerations are taken into account, where appropriate.

***Implications for the environment**:* An assessment must be provided of whether the results of the project will have significant effects (whether positive or negative) on the physical environment. If such is the case, the project description must describe whether there is a need for research related to the environmental consequences, and whether the project has defined objectives or sub-goals that aim to shed light on the environmental implications.

Research Fishing: If the proposal includes research fishing, details should be provided of the purpose of the research fishing; the dates of research fishing; the area in which research fishing will take place; the name, registration, call sign and a description of any participating vessel; the type and amount of gear to be used and the estimated total weight and number of salmon to be retained.

Timetable*:* A more detailed timetable than that shown in item 6 may be drawn up. At least one milestone must be identified.

Information*:* Describe plans for information dissemination and user contact, including purpose, target groups and form of information dissemination, and, if appropriate, usefulness and application potential.

Resources*:* Information should be provided (directly as well as indirectly via the project manager/group of researchers) regarding the resources available to the project.

Professional position: Describe the position of the project with respect to the institution's or company's range of activities, and any co-operation or co-operative agreements with other projects or institutions.

Information regarding professional competence

Project managers should submit their CV with a list of relevant publications for the last 5 years (maximum of four pages).

Specifically named persons for whom fellowships or positions are being sought must document their competence by submitting a CV and a list of publications of a maximum of 4 pages (the applicant should prioritise the information provided if necessary), as well as copies of relevant references and certificates. In applications for doctoral fellowships that are to be dealt with a brief presentation of the supervisor's or project manager's research supervision experience during the previous five years should be provided, stating the number of candidates who have completed their doctoral or master's degree. Similar supervisor information is required for all applications for studentships. Candidates for post-doctoral fellowships who have not completed their doctorate must provide a list of the articles that will be included in their doctoral dissertations.

Project managers who lack qualifications as senior lecturer/associate professor must document their competence in the same way as the persons for whom studentships are being sought.

Costs and financing
The process of evaluating project applications requires information regarding costs and financing, including the company's or institution's own contribution of resources.

Experts

The Board may wish to be able to consult referees proposed by applicants in addition to their own appointed experts when handling applications.

Please list the names, titles and addresses of three persons with a thorough knowledge of the applicant's field of research, who may be consulted as referees.

SAG(08)5

Proposal submitted to the International Atlantic Salmon Research Board relative to furthering the knowledge on marine ecology of Atlantic salmon. June 2008

By

Gérald Chaput, Tim Sheehan, and Brian Dempson
SALSEA North America

Changes In Trophic Levels Of Atlantic Salmon Through The Marine Phase Of Their Life Cycle

The following proposal for funding for 2008 is to analyze tissue samples from Atlantic salmon collected at index rivers in eastern Canada, as post-smolts in the northwest Atlantic, and as non-maturing 1SW salmon at West Greenland.

Costs associated with sample collection are covered by existing and new initiatives independent of this proposal.

Context

While the issue of Atlantic salmon survival is complicated by their complex life cycle requirements, there are various hypotheses regarding survival and production that may pertain to variations in Atlantic salmon abundance. One hypothesis stresses the implications of trophic structure and anthropogenic disturbances of trophic structure that have led to shortened food chains at sea. Hence, the need for investigations of variability in the trophic ecology of salmon. Trophic level can be evaluated by an examination of stomach contents over time, or through stable isotope analysis (SIA). While stomach contents provide a snapshot of recent dietary resource use, stable isotope analyses yield time integrated measures of energy assimilation since analyses are performed on body tissues built from diet assimilated over time. Consequently, SIA has been increasingly used in ecological studies as a reliable means of inferring trophic status and the impacts of anthropogenic disturbance on trophic relationships.

Atlantic salmon are considered opportunistic feeders during their freshwater and marine life-history phases. While in freshwater, juvenile salmon feed on aquatic invertebrates particularly various stages of insect groups. Differences in feeding strategies may occur between systems where parr rear extensively in lacustrine (lake) habitats versus other locations where fluvial (stream) rearing is common. During the marine phase, salmon often target prey in the upper end of the size spectrum with a preference for fish over crustaceans should both be available, but the point in the life cycle when this change happens and the relative importance of these components is poorly understood. Thus, owing to the opportunistic nature of salmon feeding habitats, the species lends itself well to studies

associated with aquatic environmental conditions and food web interactions. This is particularly relevant given the variability in freshwater habitats and differences in smolt size throughout Atlantic Canada, and the potential variation in ocean climate conditions that salmon encounter when first migrating to sea over a geographic range that extends from southern Nova Scotia and New Brunswick to Labrador and into the Ungava region of Quebec.

Variability in the trophic ecology of Atlantic will be examined from analyses of stable isotope signatures of carbon and nitrogen ($\delta^{13}C$ and $\delta^{15}N$). Nitrogen stable isotope analysis provides a quantitative means to determine trophic level since nitrogen signatures from organism tissue are consistently 3 to 5‰ more enriched than dietary sources. In contrast, carbon stable isotopes are conserved up the food chain owing to the slight 0.0 to 1.0‰ enrichment occurring between prey and consumer. Because ^{13}C is conserved during trophic transfer, but varies at the base of the food web, consumer tissue stable isotope signatures will also reflect dietary source information. Various tissues have been used in the analysis of isotopic signatures, including muscle, liver, scales, and fins. Scales tend to provide a longer term perspective of trophic information while analyses of muscle and liver tissue reflect more recent energy assimilation.

We propose to sample salmon at various points in its life cycle and characterize variations and changes in trophic state from the smolt to adult life-stage. This will be accomplished by sampling smolts and adult survivors back to the river from a broad geographic range in eastern North America. Smolt information will provide information on river-specific variability in freshwater feeding strategies. Intermediate marine life-history stages will be investigated from samples obtained at West Greenland as non-maturing one-sea-winter salmon, coupled with the proposed marine research survey intended to target the early post-smolt phase.

Study design

Variability in the trophic ecology of Atlantic will be examined from analyses of stable isotope signatures of carbon and nitrogen ($\delta^{13}C$ and $\delta^{15}N$) with comparisons among populations at the freshwater-smolt stage, as well as between life-history stages from post-smolts caught at sea, non-maturing 1SW salmon feeding at West Greenland, and with adults that return to respective rivers in the following year.

We propose to analyze isotope signatures from muscle, liver, scales and adipose fin tissue. In situations where lethal sampling of salmon is not an option (e.g., catch-and-release angling fisheries, populations at low abundance), scales and adipose fins provide non-lethal alternatives. As noted earlier, this approach will yield information on ontogenetic differences in isotope signatures across life-history stages (smolt, post-smolt, adult) across a broad geographic area.

Samples from West Greenland and from the proposed research cruise will be obtained on an opportunistic basis with a target of approximately 150 specimens from each but with potentially more samples from the marine research cruise should they be available; this, however, would increase the estimated costs of analysis. The potential river sampling locations and the respective tissues identified for stable isotope analyses are identified in Table 1.

To complement salmon trophic information, isotope analyses will also be carried out on a subset of other species that may be captured in the pelagic trawl, or obtained from stomach contents of salmon at sea. These data will provide insight into key dietary items of the food web structure within which salmon operate. Thus, five replicate samples of each of the key prey types within the size range consumed would be desirable.

Table 1. *Location, life stage and tissues to be sampled from Atlantic salmon to examine trophic ecology.*

							Returning adults			
			From Smolts				1SW salmon		2SW salmon	
SFA/Zone	River	Tributary	Muscle	Liver	Fin	Scales	Fin	Scales	Fin	Scales
23	Nashwaak		X	X	X	X	X	X	X	X
21	LaHave		X	X	X	X	X	X	X	X
18	Margaree		X	X	X	X	X	X	X	X
16	Miramichi	Southwest	X	X	X	X	X	X	X	X
		Northwest	X	X	X	X	X	X	X	X
15	Restigouche	Kedgwick	X	X	X	X	X	X	X	X
		Upsalquitch	X	X	X	X	X	X		
Q2	St-Jean		X	X	X	X	X	X	X	X
Q7	De la Trinite		X	X	X	X	X	X	X	X
11	Conne		X	X	X	X	X	X		
9	Rocky		X	X	X	X	X	X		
4	Campbellton		X	X	X	X	X	X		
4	Exploits		X	X	X	X	X	X		
14A	Western Arm		X	X	X	X	X	X		
2	Sand Hill		X	X	X	X	X	X	X	X
			Post-smolt and West Greenland							
Post-smolt			X	X	X	X				
West Greenland			X	X	X	X				

Samples will be collected over three years with the objective of tracking changes in trophic ecology of salmon through the marine phase (Table 2). In addition, annual variation in trophic state among 1SW maturing, 1SW non-maturing and 2SW salmon will be examined by sampling these stages even if some of the data on smolts or early post-smolt stages are not available. The samples from West Greenland will also provide inter-continental comparisons of trophic ecology for that life stage.

Table 2. *Schedule of samples to be collected by life stage.*

	2008					2009					2010				
	May	June	July	August	September	May	June	July	August	September	May	June	July	August	September
Smolt	X	X				X	X								
Post-smolt				X					X						
Marine prey (post-smolt)				X					X						
1SW salmon							X	X				X	X		
1SW non-maturing (WG)				X	X				X	X				X	X
Marine prey (WG)				X	X				X	X				X	X
2SW salmon							X	X				X	X		

Estimated cost of analysis over the next three years (2008 to 2010)

As the number of life stages sampled varies with the year, the cost of analysis also varies. Stable isotope analysis for C and N costs $10 per tissue sample. For 2008, the proposed cost of analysis is $39,000 (Cdn).

Life stage	Number of locations	Tissues	Number of samples per tissue	Total
Smolt	15 index rivers	Muscle, liver, scales, adipose	30	$18,000
Post-smolt	Labrador Sea	Muscle, liver, scales, adipose	150	$6,000
Marine prey	Labrador Sea, Two locations	20 prey item types	5	$2,000
1SW non-maturing (WG)	West Greenland	Muscle, liver, scales, adipose	150	$6,000
Marine prey	West Greenland	20 prey item types	5	$2,000
Labour for laboratory preparations				$5,000
Funding for analysis for 2008				**$39,000**

Smolt	15 index rivers	Muscle, liver, scales, adipose	30	$18,000
Post-smolt	Labrador Sea	Muscle, liver, scales, adipose	150	$6,000
Marine prey	Labrador Sea, Two locations	20 prey item types	5	$2,000
1SW salmon	15 index rivers	Scales, adipose	30	$9,000
1SW non-maturing (WG)	West Greenland	Muscle, liver, scales, adipose	150	$6,000
Marine prey	West Greenland	20 prey item types	5	$2,000
2SW salmon	9 index rivers	Scales, adipose	30	$5,400
Labour for laboratory preparations				$7,500
Funding for analysis for 2009				**$55,900**

1SW salmon	15 index rivers	Scales, adipose	30	$9,000
1SW non-maturing (WG)	West Greenland	Muscle, liver, scales, adipose	150	$6,000
Marine prey	West Greenland	20 prey item types	5	$2,000
2SW salmon	9 index rivers	Scales, adipose	30	$5,400
Labour for laboratory preparations				$4,000
Funding for analysis for 2010				**$26,400**

Timelines for the tissue collections and analysis

For 2008

The tissue collections from smolts from the index rivers began in May 2008 and will be completed by the end of June 2008. The post-smolt survey for the Labrador Sea is anticipated for August 2008 with tissue collection occurring on the vessel. The West Greenland samples would be collected in August and September and be available for analysis by the end of October 2008.

All the laboratory analyses would be conducted between September 2008 to February 2009 with preliminary analyses and interpretation available for the ICES Working Group meeting in April 2009 and the NASCO meeting of June 2009.

Timelines for other years would follow a similar schedule.

Coordination, data analysis and interpretation

Tissue collection from the index rivers and for post-smolts is being coordinated by Gerald Chaput (DFO Gulf Region).
Tissue collection and prey items from West Greenland are coordinated by Dr. Tim Sheehan (NMFS, NOAA, US).
Isotope analyses will be coordinated by Dr. Michael Power and conducted at the Environmental Isotope Laboratory, University of Waterloo (Canada).
Data analysis and interpretation will be lead by Brian Dempson (DFO NL, Canada) and Dr. Michael Power (U. of Waterloo, Canada).

SAG(08)6

Proposal submitted to the International Atlantic Salmon Research Board relative to furthering the knowledge on marine ecology of Atlantic salmon.

June 2008

By

Gérald Chaput, Tim Sheehan, and Brian Dempson
SALSEA North America

Inferring temperature history of Atlantic salmon at sea based on oxygen isotope ratios in otoliths

In addition to tissue samples to evaluate the trophic ecology of salmon, we propose to analyze oxygen isotopes that are deposited in otoliths. Because oxygen isotopes are deposited in equilibrium with the environmental waters in which the fish live, they can provide a temperature history experienced by the fish. Measurement of thermal habitat use relies on temperature dependent fractionation of δ^{18} oxygen isotopes during the formation of otoliths and established otolith δ^{18} oxygen–temperature relationships for conversion between the two. Ideally, insight into the thermal habitat use of salmon across various life-history stages from analyses of oxygen isotopes will be coupled with ecological information on smolt size and age and corresponding food web data as inferred from carbon and nitrogen signatures. Collectively, these analyses may shed additional insight into respective productivity differences among stocks throughout much of the natural distribution of salmon in the North West Atlantic Ocean ranging from Nova Scotia, New Brunswick, Quebec, Newfoundland and possibly southern Labrador.

This proposal complements the stable isotope research and uses the same material sources as for the stable isotope project. As such, the costing of this proposal is for analysis purposes only. A water sample is to be collected at every location where fish are collected.

SFA/Zone	River	Tributary	Smolts	1SW	2SW	Water sample
23	Nashwaak		X			X
21	LaHave		X			X
18	Margaree		X			X
16	Miramichi	Southwest	X	X	X	X
		Northwest	X	X	X	X
15	Restigouche	Kedgwick	X	X		X
		Upsalquitch	X	X		X
Q2	St-Jean		X	X		X
Q7	De la Trinite		X	X		X
11	Conne		X	X		X
9	Rocky		X	X		X
4	Campbellton		X	X		X
4	Exploits		X	X		X
14A	Western Arm		X	X		X
2	Sand Hill		X	X		X
			Post-smolt and West Greenland			
Post-smolt			X			X
West Greenland			X			X

Table 2. *Schedule of samples to be collected by life stage.*

	2008					2009					2010				
	May	June	July	August	September	May	June	July	August	September	May	June	July	August	September
Smolt	X	X				X	X								
Post-smolt				X					X						
1SW salmon							X	X				X	X		
1SW non-maturing (WG)				X	X				X	X				X	X
2SW salmon							X	X				X	X		
Water sample	X	X		X	X	X	X	X	X	X				X	X

Estimated cost of analysis over the next three years (2008 to 2010)

As the number of life stages sampled varies with the year, the cost of analysis also varies. Otolith analysis of oxygen isotopes costs $20 (Cdn) per sample. For 2008, the proposed cost of analysis is $17,900 (Cdn).

Life stage	**Number of locations**	**Tissues**	**Number of samples per tissue**	**Total**
Smolt	15 index rivers	Otoliths	30	$9,000
Post-smolt	Labrador Sea	Otoliths	150	$3,000
1SW non-maturing (WG)	West Greenland	Otoliths	150	$3,000
Water samples	20 locations (15 rivers + 3 Labrador Sea + 2 WG)	Water	1	$400
Labour for laboratory preparations				$2,500
Funding for analysis for 2008				**$17,900**

Smolt	15 index rivers	Otoliths	30	$9,000
Post-smolt	Labrador Sea	Otoliths	150	$3,000
1SW salmon	12 index rivers	Otoliths	30	$7,200
1SW non-maturing (WG)	West Greenland	Otoliths	150	$3,000
2SW maturing	Miramichi River (2 sites)	Otoliths	30	$1,200
Water samples	20 locations (15 rivers + 3 Labrador Sea + 2 WG)	Water	1	$400
Labour for laboratory preparations				$5,000
Funding for analysis for 2009				**$28,800**

1SW salmon	15 index rivers	Otoliths	30	$9,000
1SW non-maturing (WG)	West Greenland	Otoliths	150	$3,000
2SW salmon	Miramichi River (2 sites)	Otoliths	30	$1,200
Water samples	2 locations (WG)	Water		$40
Labour for laboratory preparations				$2,000
Funding for analysis for 2010				**$15,240**

Timelines for the tissue collections and analysis

For 2008
The otolith collections from smolts from the index rivers began in May 2008 and will be completed by the end of June 2008. The post-smolt survey for the Labrador Sea is anticipated for August 2008 with tissue collection occurring on the vessel. The West Greenland samples would be collected in August and September and be available for analysis by the end of October 2008. The otoliths will be extracted from the same fish sampled for tissues for C and N stable isotopes.

All the laboratory analyses would be conducted between September 2008 to February 2009 with preliminary analyses and interpretation available for the ICES Working Group meeting in April 2009 and the NASCO meeting of June 2009.

Timelines for other years would follow a similar schedule.

Coordination, data analysis and interpretation

Tissue and otolith collections from the index rivers and for post-smolts is being coordinated by Gerald Chaput (DFO Gulf Region).
Otolith collections from West Greenland are coordinated by Dr. Tim Sheehan (NMFS, NOAA, US).
Isotope analyses will be coordinated by Dr. Michael Power and conducted at the Environmental Isotope Laboratory, University of Waterloo (Canada).
Data analysis and interpretation will be lead by Brian Dempson (DFO NL, Canada) and Dr. Michael Power (U. of Waterloo, Canada).

SAG(08)7

Proposal submitted to the International Atlantic Salmon Research Board on the food availability of Atlantic salmon post-smolts during their marine phase.

August 2008

By

Webjørn Melle, Marianne Holm
Institute of Marine Research
Norway

Jan Arge Jacobsen
Faroese Fisheries Laboratory
The Faroe Islands

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SALSEA-Merge

FOOD AVAILABILITY OF ATLANTIC SALMON POST-SMOLT DURING THEIR MARINE PHASE

The following proposal for funding for 2009 to 2011 will be an integral part of SALSEA-Merge to analyse zooplankton, chlorophyll and nutrient samples collected during 6 international SALSEA-Merge cruises to the salmon post-smolt habitats of the Northeast Atlantic.

Costs associated with sample collection are covered by SALSEA-Merge, but the analyses and reporting of plankton and other key environmental samples lack funding.

Background

Below is the ABSTRAC of the SALSEA-Merge proposal to the EU quoted:
"Over the past two decades, an increasing proportion of North Atlantic salmon are dying at sea during their oceanic feeding migration. The specific reasons for the decline in this important species are as yet unknown, however, climate change is likely to be an important factor. In some rivers in the southern part of the species range, wild salmon now face extinction. This is in spite of unprecedented management measures to halt this decline. Arguably the greatest challenge in salmon conservation is to gain insight into the spatial and ecological use of the marine environment by different regional and river stocks, which are known to show variation in marine growth, condition, and survival. Salmon populations may migrate to different marine zones, whose environmental conditions may vary. To date it has been impossible to sample and identify the origin of sufficient numbers of wild salmon at sea to enable this vital question to be addressed. SALSEA-Merge will provide the basis for

advancing our understanding of oceanic-scale, ecological and ecosystem processes. Such knowledge is fundamental to the future sustainable management of this key marine species. Through a partnership of 9 European nations the programme will deliver innovation in the areas of: genetic stock identification techniques, new genetic marker development, fine scale estimates of growth on a weekly and monthly basis, the use of novel high seas pelagic trawling technology and individual stock linked estimates of food and feeding patterns. In addition, the use of the three-dimensional Regional Ocean Modelling System, merging hydrography, oceanographic, genetic and ecological data, will deliver novel stock specific migration and distribution models. This widely supported project, provides the basis for a comprehensive investigation into the problems facing salmon at sea. It will also act as an important model for understanding the factors affecting survival of many other important marine species."

In the SALSEA-Merge proposal it was stated that studying the food availability is an integral and important part of the research undertaken by SALSEA-Merge. Food availability, modulated by competition with other pelagic fish species, is important to post-smolt survival, through growth and predation processes. Further, food availability may influence distribution by active swimming of the post-smolts during the search for higher prey densities. Prey species abundances will also serve as major descriptors of post-smolt habitats throughout the SALSEA-Merge sampling areas.

During the process of adjusting the SALSEA-Merge application budget to the available funding it was decided to include sampling of potential food organisms during the cruises, while the analyses of these samples were excluded from the budgets because of the time and personnel consuming nature of such analyses.

Sampling design (by SALSEA-Merge)

The main prey of post-smolts at sea are macrozoooplankton organisms and juvenile fish. Prey abundance and distribution during SALSEA-Merge cruises are observed by macroplankton trawls, traditional plankton nets and multi-frequency acoustics. The macroplankton trawl is equipped with a multiple opening and closing codend to facilitate vertically resolved sampling. The traditional plankton net used during the first three cruises was a WP-2 net. This will probably be adjusted during the next year's cruises to facilitate better near surface sampling and also vertically resolved sampling. Probably, a MOCNESS sampler will be used. Table 1 summarises the anticipated number of samples from the six planned SALSEA-Merge surveys of the Northeast Atlantic and the costs involved in sample analyses.

Table 1. *Available zooplankton samples from six SALSEA-Merge cruises (Fig. 1) during 2008 (cruises 1, 2 and 3) and 2009 (cruises 4, 5, 6) and costs of analyses. Norwegian trawl samples are worked up at sea and need no extra funding. Hours of analysis per sample are 4.*

					Costs of sample analyses				
			Number of samples		Hours		Costs Euros		Total costs
Cruises	**Gear**	**Nation**	**2008**	**2009**	**2009**	**2010**	**2009**	**2010**	**Euros**
1 and 4	Macroplankton trawl	Ireland	0	0	0	0	0	0	
	Plankton net		10	30	40	120	3520	11040	
2 and 5	Macroplankton trawl	Faroe Islands	2	10	8	40	366.4	1832	
	Plankton net		13	30	52	120	2381.6	5496	
3 and 6	Macroplankton trawl	Norway	22	60	0	0	0	0	
	Plankton net		31	160	124	640	10912	58880	
Total			**78**	**290**	**224**	**920**	**17180**	**77248**	**94428**

Analyses and scientific interpretation

Norwegian samples of the macroplankton trawl are sorted, organisms identified, body length measured and weighed at sea. Plankton net samples are stored on formalin and analysed subsequently in the lab. In the present proposal we apply for funding of the analyses of macroplankton trawl samples not analysed at sea and net samples. Further we apply for funding of a Post Doc position over 18 months for analysis of multi-frequency acoustic data, the scientific interpretation of plankton data and for the participation in analyses and publication of results under SALSEA-Merge. See Work packages 4 and 5 of SALSEA-Merge proposal below. The Post Doc period will start 1. July 2010 to facilitate sufficient overlap with the work in SALSEA-Merge WPs 4 and 5:

Work package 4 S&T Objective: Biological Analysis of Samples

- analyse and rank available food items
- analysis of archival scale material
- analysis of scale samples collected in Work package 2
- establish digital scale library
- determine fine scale growth rates
- undertake dietary analysis and assessment of condition

Work package 5 S&T Objective: Merge and analyse genetic, biological and oceanographic data

- map spatial distribution of specific regional stocks or populations
- integrate distribution and migration of salmon with biological and oceanographic data
- develop models to integrate stock specific distribution and migration patterns, with patterns of growth, dietary differences and oceanographic conditions

The total costs of analyses of plankton samples and scientific interpretation, including Post Doc salary over 18 months, are given in Table 2.

Table 2. Total costs of plankton samples analyses and Post Doc salary.

Cost categories	**2009**	**2010**	**2011**	**All years**
Sample analyses	17180	77248	0	94428
Post Doc salery	0	52500	105000	157500
Consumables and travels for Post Doc		3750	3750	7500
Total	**17180**	**133498**	**108750**	**259428**

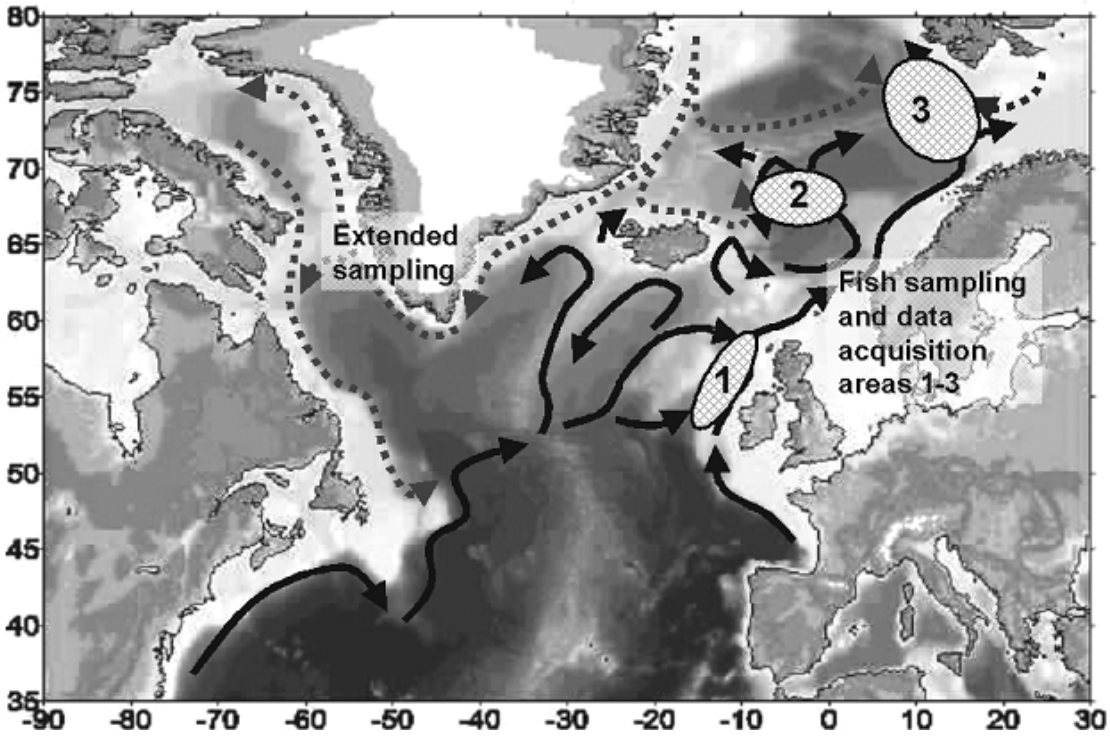

Figure 1. Proposed sampling areas during SALSEA-Merge

Timelines for the samples analysis
Samples will be collected at sea during 6 international cruises during the summers 2008 and 2009 (see above). Samples will be available for analyses after the cruise in the autumn 2008 and 2009. Sample analyses can be completed early 2009 and 2010 for samples collected in 2008 and 2009, respectively. Results of speciation and enumeration of potential food organisms will be disseminated to SALSEA-Merge (WPs 4 and 5) and for inclusion in SALSEA-Merge database immediately after completion of analyses.

Coordination, data analysis and interpretation
The sample transfer between laboratories, analyses and dissemination of results will be coordinated by Dr. Webjørn Melle (IMR, Norway). Scientific interpretation will be an integral part of SALSEA-Merge with additional help by the Post Doc.

List of Partners
Dr. Webjørn Melle, Institute of Marine Research, Norway
Dr. Marianne Holm, Institute of Marine Research, Norway
Dr. Jan Arge Jacobsen, Faroese Fisheries Laboratory, The Faroe Islands
Dr. Dr. Niall O'Maoileidigh, Marine Institute, Newport, Ireland

SAG(08)8

Proposal submitted to the International Atlantic Salmon Research Board relative to furthering the knowledge on marine ecology of Atlantic salmon.

August 2008

By

Phil McGinnity, Niall Ó Maoileidigh, Jamie Coughlan, Eleanor Jennings and Tom Cross.

A STUDY OF THE RELATIONSHIP BETWEEN OCEAN CLIMATE AND INTER-ANNUAL VARIATION IN ADULT SUMMER MIGRATION DISTRIBUTION PATTERNS OF ATLANTIC SALMON IN IRISH COASTAL WATERS OVER THREE DECADES.

Objectives

1. To determine, using genetic stock identification, the region and river of origin of fish captured and sampled in the Irish commercial drift net fisheries since 1980.
2. To determine the relationship between regional stock complex and individual population distribution (including survivorship, growth, timing) and key descriptors of the marine environment such as sea surface temperatures, NAO, Gulf Stream Index.
3. To predict regional population response to future marine climate scenario projections

Background

New data emerging from a genetic analysis of the Irish coastal drift net fisheries in 2005 and 2006 (National Atlantic Salmon Genetic Stock identification Programme) suggests occurrence of salmon populations from wide range of Irish and other southern European stock complex salmon populations. These data also suggest that salmon from many rivers aggregate off the west coast of Ireland before continuing their migration northwards and southwards from the area where they amass (Figure 1). Furthermore, and significantly from the perspective of understanding salmon response during their ocean migration to climate variability, the distribution or centre of this aggregation is variable among years. We hypothesise that the west coast of Ireland is an important migration route for most contributing populations that constitute the ICES defined southern population complex. The proximity of the continental shelf to Irelands coast (at it narrowest for Europe is off Irelands North West) and its significant influence on thermal and current regimes, in addition to the substantial influence of the Gulf Stream, provide strong geographical support for the hypothesis of a migratory 'funnelling point' or 'way mark' for returning adult salmon. We further hypothesise that the variation in salmon migration patterns revealed by the recent genetic analyses and consequent impact on the fishes ocean ecology is a response to both cyclical (Gulf Stream index, NAO) and stochastic (directional climate change) changes in the marine environment between and among years. It is possible that an understanding of these

oceanic processes will provide important new insights into those factors controlling marine survival in Atlantic salmon.

This proposal would seek to exploit the very significant Trans-European Genetic Stock Identification baseline being developed under the EU sponsored SALSEA-Merge Project. In addition we would seek to deploy the suite of new state of the art genetic markers also being advanced in the SALSEA-Merge Project. The proposed project would also endeavour to utilise a unique, long term, high resolution, biological archive representing of salmon scale collected systematically from the Irish drift net fisheries over three decades. There are approximately 15,000 scales in the collection. Accompanying the biological archive are data on capture location, time of capture and size at capture. It is proposed to supplement these data with information on fish age and growth rates acquired using latest methodological developments in scale imaging. Elemental isotope analysis of scales would be used to garner further biological information on the history of individual fish. Finally, both hind-casting and forecasting of oceanic climate environments would be undertaken to model fish distribution response.

This proposal is complimentary to the work being undertaken under SALSEA-Merge. Moreover the temporal component represents a significant additional element to SALSEA-Merge which aims primarily to ascertain salmon stock represents distribution at a single moment in time. The data derived from consistent (28 years) and directed sampling of a large number of fish will provide an opportunity for a significant advance in our knowledge.

We are cognisant that an opportunity exists to replicate the approach and methodology outlined above for the Greenland fishery. The Greenland fishery also represents and important long term biological archive that should represent the inter-annual temporal distribution of Atlantic salmon populations from North America and Europe and is representative of salmon at a different stage in their life cycle, specifically their winter feeding grounds. Studies of the distribution of salmon off Irelands west coat and off Greenland would be complimentary. It should be possible at some future date to integrate these studies, with the current SALSEA-Merge project to provide a broad trans-oceanic perspective of the distribution of Atlantic salmon.

Materials & Methods

The project will comprise of three work packages. As the project will be based on archive material and does not depend on collection of new seasonally dependent biological material the start date for the project is flexible. A start date of January 2009 is assumed. The data generated from the three work packages below will be combined to provide an analysis of the historical distribution of individual river and region Atlantic salmon populations in Irish waters over three decades. Also, based on future marine and freshwater climate projections an attempt will be made to predict the distribution and migration patterns of adult Atlantic salmon on their summer spawning migrations.

Genetic analysis of archive scale collection

A representative sample of 5,000 scales will be selected from the archive scale collection. These will be assigned genetically to river and region of origin using mixed stock analysis and individual assignment methods.

Work Package Leader – Dr. Philip McGinnity, University College Cork.
Duration - January 2009 to December 2009
PDF – 6 months
Technician – 12 months
Estimated cost of work package including direct and indirect costs - €100,000

Acquisition of life history data from scales
Each set of individual scales is accompanied by information on the date of capture, location of capture, size of capture. In this work package information from the fisheries and age and growth information acquired using state of the art scale imaging will be combined to construct a detailed life history and migration distribution map for individual fish within each population as they move through the commercial fisheries.

Work package leader – Dr. Niall Ó Maoileidigh, Marine Institute, Newport, Co Mayo
Duration - July 2009 to December 2009
Technician – 6 months
Estimated cost of work package including direct and indirect costs - €25,000

Synthesis of freshwater and marine climate data
Both freshwater and marine environmental information will be synthesised in this work package. Long term data from 1980-2006 on size and timing of freshwater discharges (processed at national, regional and individual river levels) from the island of Ireland into the ocean, including information on temperatures will be collated. Data on the important indices of the marine environment which are likely to have an important bearing on adult fish migration will also be investigated, e.g. regionally specific sea surface temperatures, NAO, Gulf stream strength index. The leader for this work package has worked extensively with the Rossby Climate Research Institute in Sweden and the Hadley Climate Centre in the UK on providing climate projection information. This work package will seek to acquire freshwater and marine environment projections that could be used to predict future distribution patterns and trends of adult salmon in Irish coastal waters.

Work package leader – Dr. Eleanor Jennings, Dundalk Institute of Technology, Dundalk, Co. Louth.
Duration - July 2009 to December 2009
Technician – 6 months
Estimated cost of work package including direct and indirect costs - €25,000

Total Estimated Cost of Project - €150,000

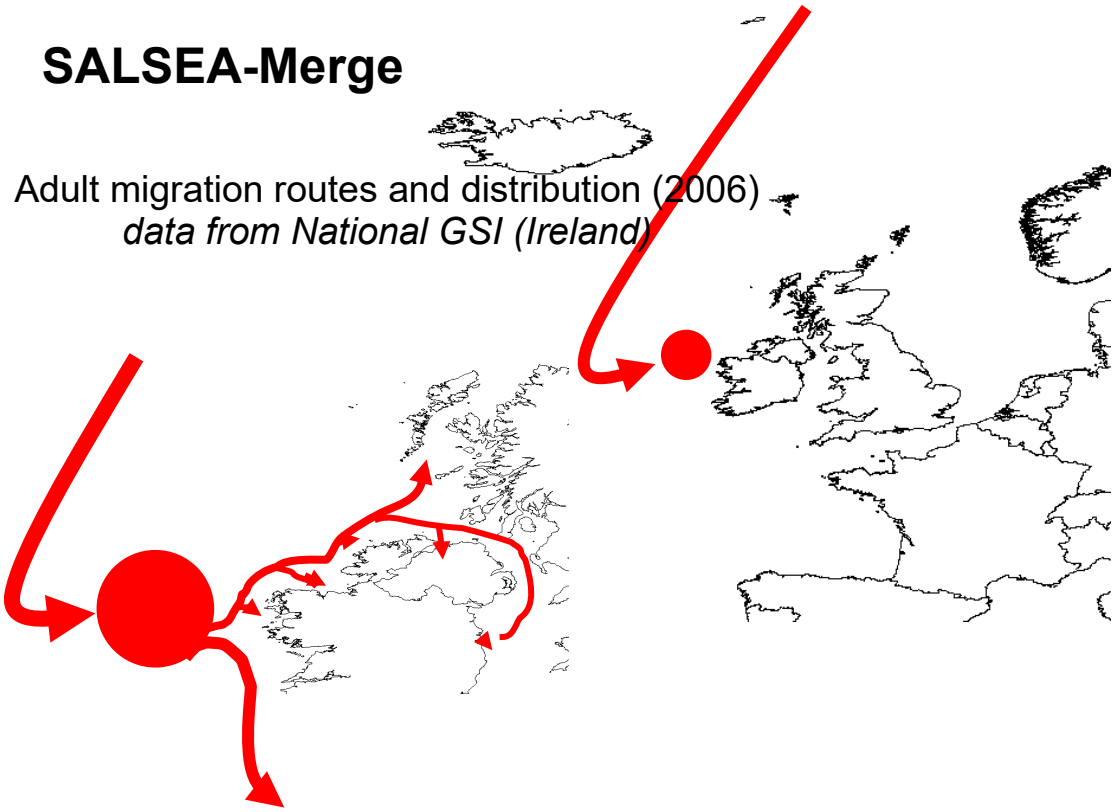
SALSEA-Merge
Adult migration routes and distribution (2006)
data from National GSI (Ireland)

Figure 1

SAG(09)4

Application to NASCO's International Atlantic Salmon Research Board (IASRB) to support research on salmon post-smolts in the Irminger sea southwest of Iceland

Sigurður Már Einarsson
Sigurður Guðjónsson

The research ship Arni Fridriksson

Institute of Freshwater Fisheries
Freshwater Fisheries • Freshwater Biology • Research • Consulting

Introduction

For the last two decades Atlantic salmon in the North Atlantic has seriously declined in abundance. This decline in catches has been attributed to increased mortality during the oceanic part of their life cycle. The decline is generally more pronounced with multi-sea-winter fish, but severe decline has also been observed in many one-sea-winter stocks. This trend is especially evident in some southern rivers, on both sides of the Atlantic where wild salmon face extinction. Arguably the greatest challenge in salmon conservation is to increase knowledge on spatial and ecological use of the marine habitat by different regions and river stocks, which are known to show variation in marine growth, condition and survival. Different stocks may be predisposed to use different marine areas where environmental condition may vary and differently affect growth, condition and survival. Until recently it has been impossible to sample and identify the origin of sufficient numbers of wild salmon caught at sea to enable this vital question to be addressed.

The year 2008 marked the initiation of the SALSEA-Merge project, on the marine ecology of Atlantic salmon, through a partnership of ten European nations. The project is funded under the EU 7th framework. The overall objective of SALSEA-Merge is, by merging ecological and genetic research, to advance understanding of stock specific migration and distribution patterns and overall ecology of the marine life of Atlantic salmon and gain insights in increases in marine mortality of the species.

In SALSEA-Merge an important part of the project is to acquire samples of post-smolts and associated critical oceanographic information in key marine areas of the North Atlantic. In 2008 three cruises were taken to areas in the Northern Atlantic (Figure 1) that were considered to be on the migratory route for post-smolts from Europeean salmon stocks (Jacobsen et.al 2008, Holm et.al 2008, Maoiléidigh et.al 2008).

Initial proposal of SALSEA-Merge sampling of post-smolts included sampling of the Irminger Sea southwest of Iceland, but due to insufficient funding, the area was not included in the project. The Irminger area is on the junction of warm Gulf stream and the cold Greenland current and the area is rich in nutricients (Greene et.al. 2003). Toledano (2006) found relationships between the runs of Icelandic salmon from the west coast of Iceland and SST at certain times and location as well as to abundance of certain groups of zooplankton in the Irminger Sea southwest of Iceland. Recently several salmon, tagged with DST tags were recaptured in a small river in west Iceland, with continuous hourly temperature records and depth regime recorded from the smolt stage until entry in freshwater as 1 SW fish

(Guðjónsson et.al 2008). During the winter months the fish stayed in the surface layers of the sea in temperatures around 8°C. Comparison with SST from satellites indicates a strong possibility that the Irminger gear is the main habitat for Icelandic salmon at least from the south and west Iceland (Guðjónsson et.al. 2008). Furthermore the area may also been utilized by North American stocks and some European stocks.

The Marine Institute of Iceland is planning 2 cruises to the Irminger area in the summer of 2009, in cooperation with Germany and Russia due to research effort on redfish. This cruise creates a unique opportunity to include sampling of salmon post-smolts to the cruise program. However the cruise must be extended by some days to be able to include sampling of salmon. Funding of the project is still unclear, but applications have been sent to the Ministry of Fisheries and Agriculture in Iceland.

Research proposal

The main objective of the proposal is to acquire samples from salmon post-smolts and other oceanographic information in the Irminger area. The cruise will start late in June and will last almost through July 2009. The largest research vessel of Marine Research Institute, Arni Fridriksson will be used. Personnel from Institute of Freshwater Fisheries will be on board throughout the cruise. Another shorter cruise is planned in the autumn if sufficient funding will be obtained. Furthermore, sampling of salmon is possible in some cruises in the east and south of Iceland during the summer and autumn. The SALSEA methodology created for previous cruises for the sampling will be followed in the project and same type of sampling gear will be used.

Research cost

The prospects of getting some additional funding from the Icelandic government are reasonable good. However, further funding is needed. Therefore, we ask the *NASCO's International Atlantic Salmon Research Board (IASRB) t*o support this research work by ***25.000 €. (Euros)*** to be able to complete all the work in the cruise that is need.

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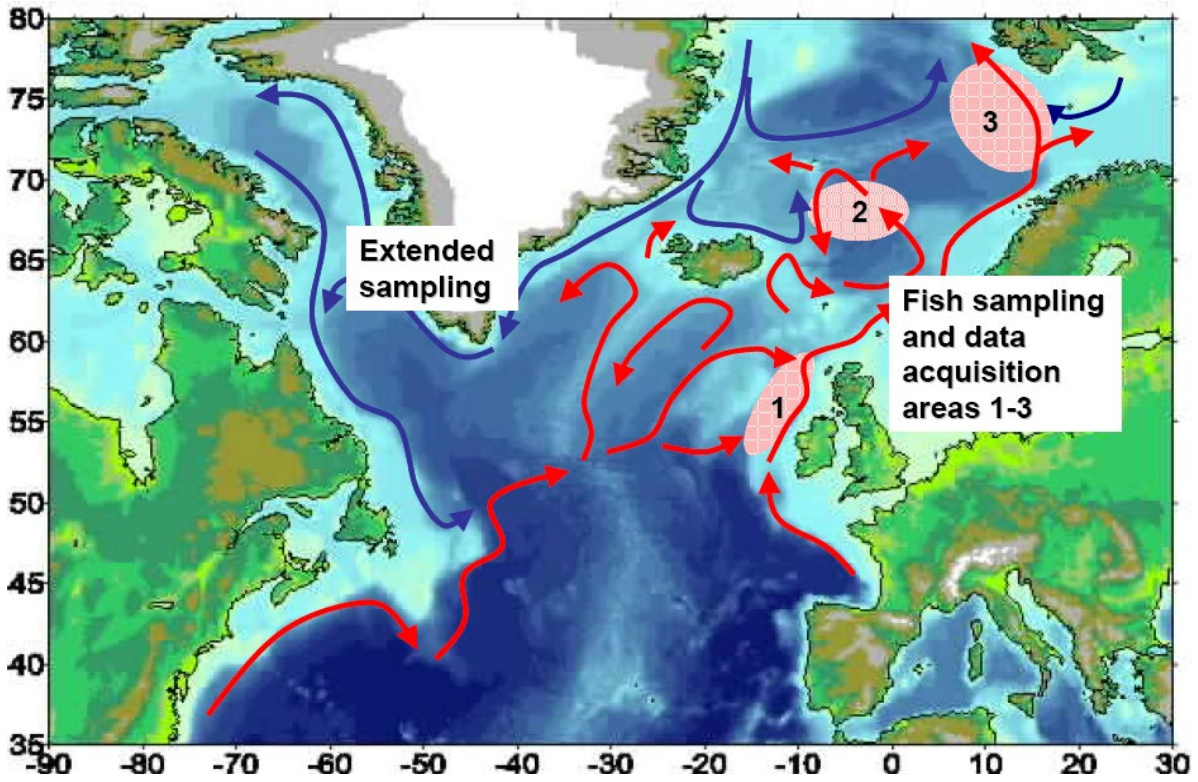

Figure 1.Location of key marine areas for sampling of post smolts, in the North Atlantic in 2008 and 2009 (Jacobsen et. al 2008).

Annex 5

SAG(09)11
Summary of review of research proposals submitted to IASRB

	SAG(08)05 ***Changes in trophic levels of Atlantic salmon through the marine phase of their life cycle***	***SAG(08)06*** ***Inferring temperature history of Atlantic salmon at sea based on oxygen isotope ratios in otoliths***	***SAG(08)07*** ***Food availability of Atlantic salmon post-smolt during their marine phase***	***SAG(08)08*** ***A study of the relationship between ocean climate and inter-annual variation in adult summer migration distribution patterns of Atlantic salmon in Irish coastal waters over three decades***	***SAG(09)4*** ***Post-smolt survey in the Irminger Sea***	***Workshops to improve collaborations (support external people)***
Relevance to IASRB priorities	Relevant to IASRB priorities - enhancement of existing projects	Relevant to IASRB priorities - enhancement of existing projects	Relevant to IASRB priorities - enhancement of existing projects	Peripherally relevant to IASRB priorities in that it addresses distribution of 1SW maturing fish (rather than post-smolt) at a very specific location.	Relevant to IASRB priorities (Irminger Sea sampling)	Workshops by priority – 1) GIS support for WKLUSTRE 2) support for SGBICEPS 3) proposal for microchemistry standardization (scales and other tissues?) – is there an issue that needs to be resolved?
Addresses broad question of salmon ecology at sea	Expected to provide information on ecology of salmon at sea, comparison of maturing and non-maturing stages, and status of survivors.	Expected to provide information on ecology of salmon at sea, comparison of maturing and non-maturing stages, and status of survivors.	Expected to provide information on ecology of salmon at sea Value of acoustic data is in the multi-dimension coverage not possible with physical sampling	Would provide information on mixing of river stocks at sea on the return migration near the coast. Greatest value relates to the temporal variation in stock distribution and its	Adds information of salmon distribution at sea in area which has not been well studied.	1) Analysis of historical tagging data using new technologies is providing new information on salmon distribution at sea 2) Study group is

			gear.	association with climatic factors.		analyzing characteristics of salmon throughout North Atlantic
Potential to be successful	Stable isotope technology is well described in literature. The only risk to the project is the extent of collections of post-smolts at sea. Update on progress shows few samples obtained in 2008 and no samples from West Greenland in 2008. - may require a review of standardization of methods among labs	Oxygen isotope technology to define temperature is well described in literature. The only risk to the project is the extent of collections of post-smolts at sea. Update on progress shows few samples obtained in 2008 and no samples from West Greenland in 2008. - may require a review of standardization of methods among labs	Sample collection is not an issue. Plankton sampling coverage is not extensive given the size of the area sampled and temporal coverage provided but acoustic sampling would provide more complete coverage as sounding is continuous. Is it possible to ground-truth acoustic data? Are there initiatives elsewhere that would allow interpretation of acoustic data? Not clear how much work is involved in analyzing acoustic data or which expertise would be called to guide the analysis.	Indicated in proposal that genetic identification of river-specific stocks is well advanced.	NA	Constructive results from previous workshops and study group participation of outside experts.
Details on costing	Costing is adequately described	Costing is adequately described	Costing is adequately described.	Costing is not adequately described	Costing is not adequately described - funding for science person to go to sea and to pay for extra days	Costing is approximate pending venue and number of experts

					at sea	
Cost of project	40,000 pounds ($79,000 Cdn)	22,500 pounds ($43,140 Cdn)	226,000 pounds (259,428 Euros)	131,000 pounds (150,000 Euros)	22,000 pounds (25,000 Euros)	1) GIS support for tagging workshop: 2,000 pounds 2) Study group on biological characteristics 4,000 pounds
Funding requested from IASRB (amount and % of)	20,000 pounds (50% of total) (approved in 2008)	22,500 pounds (100% of total)	226,000 pounds (100 % of total)	131,000 pounds (100 % of total)	22,000 pounds (XX% of total)	1) GIS support for tagging workshop: 2,000 pounds 2) Study group on biological characteristics 4,000 pounds
Number of years (single or multi-year)	Two (revised from three)	Two (revised from three)	Three	One	One ?	1) Third year of three(?) 2) One (?)
Extent of collaboration	Involves people from several national labs and one university.	Involves people from several national labs and one university.	Involves people from several national labs, no university.	Involves people from a national labs and several universities.	Survey involves several countries (Iceland, Germany, Russia)	Extensive
Contributions of partners	Large amount of inkind and resources associated with collection of samples. A large amount of contributions not specifically included in proposal (marine vessels, WG sampling, freshwater monitoring).	Large amount of inkind and resources associated with collection of samples but these are covered in sampling associated with projet SAG(08)05. A large amount of contribution not specifically included in proposal.	Large amount of inkind and resources associated with collection of samples and real expenses from SALSEA-Merge. A large amount of contributions not specifically included in proposal.	Archived samples represent a large inkind contribution. A large amount of contributions not specifically included in proposal resulting from work in SALSEA-Merge and elsewhere.	Vessel time provided from participating countries	National participants on internal funds
Suggestions for improving work	Would benefit from coordination / complementary analysis of trophic state of NEAC fish from smolt,	Would benefit from complementary analysis of NEAC fish from smolt, post-smolt sampling, as samples	Provide details on other biological oceanographic data that could be used to more completely	Could initially consider selecting scales / years to be processed based on observed important	Need details on use of funds	None

	post-smolt sampling, as samples from West Greenland include NAC and NEAC origin salmon.	from West Greenland include NAC and NEAC origin salmon. Temperature environment used by post-smolts differs between NAC and NEAC?	describe the environment in this area. Provide detail on sampling of stomach contents of other species.	differences in environmental conditions (for ex. pick specific years of contrasting NOA indices or drought versus deluge freshwater conditions) and test these for explanatory power.		
Funding potential from IASRB	Partial funding for this proposal already approved by IASRB. Additional funding level exceeds the current funding available from IASRB. Revised costing based on samples collected in 2008 and potential for collections in 2009 and 2010 provided.	Funding request exceeds the current funding available from IASRB. Requires a revised costing based on samples collected in 2008 and potential for collections in 2009 and 2010 (provided).	Funding request exceeds the current funding available from IASRB.	Funding request exceeds the current funding available from IASRB.	Funding request exceeds the current funding available from IASRB.	Funding request is within the scope of current funding by IASRB.
Recommendation	Support by IASRB	Support by IASRB	Support by IASRB	Important project proposal but is outside current IASRB priorities	SAG supports plan to sample in Irminger Sea but insufficient details of how funds will be used.	Support by IASRB