International Atlantic Salmon Research Board

SAG(14)8

Report on Progress in analysing samples from the SALSEA Programme

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At the Eleventh Meeting of the Scientific Advisory Group of the International Atlantic Salmon Research Board the following was reported (excerpt from CNL(13)9 - Report of the Twelfth Meeting of the International Atlantic Salmon Research Board):

"5.4 With regard to the SALSEA samples, the Board was advised of on-going initiatives to analyse these and recognised that for the remaining samples, it would be important to first clarify what samples are available, how their analysis could benefit management and how much the analyses would cost. The SAG Chairman indicated that he would be willing to collate the request for information and report back to the Scientific Advisory Group."

This report addresses this request from the Board.

The SALSEA Programme offered a unique opportunity to increase understanding of how Atlantic salmon use the ocean: where they go; how they use ocean currents and the ocean's food resources; and what factors influence migration and distribution at sea. SALSEA drew together intellectual and scientific resources in a concerted cooperative effort to identify the factors influencing mortality of salmon at sea and the applications to counteract them. Considerable advances have been made as a result of the SALSEA Programme in understanding the distribution and migration of salmon at sea (particularly of post-smolts), how salmon use the oceans, and the implications of this new knowledge for management. A large number and wide variety of biological samples were collected from a large number of Atlantic salmon captured during marine surveys in the North Atlantic and land based surveys in Greenland. The Sub-Group on the Future Direction of Research on Marine Survival of Salmon (SGFR(12)10) provided an overview of the samples and data remaining to be analysed from the three main marine components of the SALSEA Programme (SALSEA Merge, SALSEA North America and SALSEA West Greenland). These summaries provide an overview of the survey efforts, summary of the samples collected and the status of the samples as of December 2012. Information from these summaries for the SALSEA Merge effort are provided in Annex 1 and information for the SALSEA North America and SALSEA Greenland efforts are provided in Annex 2.

Since the drafting of that report, addition progress has been made to process the remaining samples from the three main marine components of the SALSEA Programme. Timothy Sheehan (NOAA Fisheries Service, USA) and Dr Niall Ó Maoiléidigh (Marine Institute, Ireland) reviewed the inventory of samples and have provided an updated summary of the remaining unprocessed samples (Table 1).

It should be noted that a large number and wide variety of samples were collected from many of the salmon captured during the marine survey. This was done to maximize the information collected from each individual fish captured/collected. In many instances there was not a clearly defined objective for each sample type collected or more-specifically, an identified Principle Investigator assigned to each sample type or dedicated funding to process the samples. The approach was simply to collect as much from each fish as possible. In addition, the numbers presented in Table 1 should be considered as estimates. Further investigation would be needed to verify the precise numbers of samples available by sample type.

Given that the overwhelming majority of the SALSEA collected samples and data have been processed, reported on or are currently being analysed, the SALSEA program should be considered a significant success. Our knowledge of the marine phase of Atlantic salmon has been vastly improved as a result and ongoing efforts in addition to the processing of these remaining samples may further our understanding.

Table 1. Summary table of the remaining unprocessed samples from the three main marine components of the SALSEA Programme (SALSEA Merge, SALSEA North America and SALSEA West Greenland). The estimated number of samples available by the three main marine SALSEA components, the initial purpose of the sample and the estimated processing cost (USD) per sample for each sample are provided. In cases where the "Approximate processing cost/sample" is listed as 'na', the actually processing cost would be dependent on what type of analysis/processing is pursued.

Sample type	Sample purpose	SALSEA-Merge	SALSEA North America	SALSEA Greenland	Estimated processing cost/sample (USD)
Carcass (frozen)	to be determined		100		na
Disease (frozen)	miscellaneous disease survey		95	1192	na
Misc viscera tissue (frozen and/or EToH)	to be determined	968			na
muscle/steak (frozen)	condition/lipid analysis	946	97	1192	$30-250
Parasites - intestines (formalin)	miscellaneous parasite survey		97	1187	$35-75
Parasites - misc. tissues (formalin)	miscellaneous parasite survey		97	1142	$35-75
Stable Isotopes - misc. tissues (frozen)	stable isotope analysis	968			$16

Annex 1

Current status of samples taken for SALSEA Merge and additional samples and work to be completed from the SALSEA Merge post-smolt programme.

Fish samples

Details of external biological characteristics of all captured fish (approximately 1,700 post-smolts and 53 adults) have been recorded and entered in a SALSEA Merge database. Details include whether the fish were wild or hatchery origin, their length, weight, scale loss, presence of cataracts, presence of external parasites, presence of external tags or finclips. Sex information was noted for 1,300 plus samples. Summaries based on this material were presented in the SALSEA Merge report. There is more scope for further publication on the detail of this information.

In addition, all fish were sampled for genetic stock identification. The origin of these samples (either to river or area of origin) have been reported in the SALSEA Merge final report and in subsequent papers. Further work is being considered to refine assignments using SNPS and it is likely that further publications will arise from the original SALSEA Merge samples. Samples are held at various SALSEA partner institutions.

Scales were removed from all fish and the results of the post-smolt analyses have been presented in the SALSEA Merge report and in subsequent publications. There is scope here for further publications relating post-smolt growth and marine survival/conditions. This is the focus of the MI/IMR/Loughs Agency (Ireland PhD programme – Ecology of salmon at Sea).

In addition, over 23,000 scales of Atlantic salmon from seven rivers, located in six countries have now been analysed with the new scale reading technique. Most scales are from 1970 to the present, with some limited information for one stock extending back to earlier periods. The number of circuli laid down in the marine zone of the scales in specific periods as well as the distance between the circuli were measured, and this information was summarised in the final SALSEA Merge report. Since then a MI Ireland, IMR Norway and Loughs Agency, Ireland/N.Ireland study has been initiated which will increase the number of sample rivers from which archive scale material is available and the results generated in SALSEA Merge will be extended and reinterpreted at a larger scale.

Gonads were preserved and retained for further analyses from approximately 270 post-smolts. These tissues have not been analysed as yet and would provide more insights into the developmental rate of post-smolts at different stages of the migration. Samples are stored with the agencies who collected the samples.

The presence of internal parasites was noted and in most cases enumerated for samples dissected on-board the vessels or in labs. Whole fish were retained and preserved in formalin from approximately 10% of samples taken in the Irish trawl surveys and these have been processed. A small number of samples remain frozen for processing and will be included within the MI Ireland, IMR Norway and Loughs Agency, Ireland/N.Ireland study.

Tissues samples from approximately 1,000 fish were retained for stable isotope analyses and a similar number of fish was sampled for lipid content analyses. These tissues have not been

analysed. Gills and viscera were retained either frozen or preserved in alcohol from approximately 1,200 samples. Samples taken in the Irish trawl surveys have been included in a PhD programme initiated by MI Ireland, IMR Norway and Loughs Agency, Ireland/N.Ireland as an immediate follow up to the SALSEA Merge programme.

Stomach contents were made available for approximately 750 post-smolts, while 1,400 stomachs from other pelagic species (herring and mackerel) were also available. Preliminary analyses were presented in the final SALSEA Merge report and were also presented verbally at the SALSEA symposium in La Rochelle. Data and samples are with IMR in Norway. Remaining samples from Irish trawl surveys have been included in a PhD project initiated by the MI Ireland, IMR Norway and Loughs Agency, Ireland/N.Ireland.

Oceanographic information

206 plankton tows were carried out using both horizontal tows and vertical tows. 26 specific krill trawls were also taken. These samples have not been analysed extensively to date but are with the IMR in Norway.

173 stations were sampled using Constant Temperature and Depth sensors (CTD). Information from these sensors was included within the migration model which was presented in the final SALSEA Merge report and as a subsequent publication. The model is capable of providing putative migration routes for salmon by varying oceanic parameters and is, therefore, useful for more exploratory analyses than have been carried out to date. The model is available from IMR, Norway.

Chlorophyll samples were retained from 120 stations and 97 samples were retained for nutrients at sea. These samples require analysis

A range of oceanographic parameters was recorded from on-board ship monitors including salinity, temperature, depth etc. Most of the data have been included within the oceanographic model. However, there is scope for more in depth analyses of oceanic factors affecting the migrations of salmon post smolts.

For additional information regarding the status or results from any of the SALSEA Merge samples or data, please feel free to contact Dr Niall Ó Maoiléidigh, Marine Institute, Ireland (omaoile@marine.ie).

A table detailing the samples taken during each survey is available from the NASCO Secretariat.

Annex 2

Current inventory and status of samples taken for SALSEA North America and SALSEA Greenland

SALSEA North America

SALSEA North America consisted of research survey cruises conducted in the Labrador Sea during the summer/autumn of 2008 and 2009 in support of the SALSEA research program. A total of 47 stations were surveyed in 2008 with a surface trawl and 21 stations were surveyed in 2009 (14 surface trawls and 7 surface gillnet sets). A total of 107 salmon were captured and biological data and samples are available from 85 fish.

Data collected include fish origin, biological characteristics, sex, scale loss, information on external parasites, presence of external tags or finclips and a variety of biological samples to support further investigations into the health of salmon captured. Sheehan *et al*. 2012 provided a comprehensive summary of the surveys and catch results including oceanographic conditions and bycatch at each station sampled. However, there is scope for further investigation on the samples and data collected as many samples remain unprocessed.

Biological characteristics data are available for all fish sampled. Data are available on conductivity, temperature and depth profiles collected at select stations surveyed and bycatch data at each station surveyed. A small number of sea lice samples were preserved and are being processed to support various genetics studies.

All fish were of North American origin, however finer than continent of origin determinations were not conducted. Scales were collected for ageing although more detailed analysis of growth via image analysis processing has not been conducted to date.

Ovary samples were collected and have been processed although detailed analysis has not been conducted. Various tissue samples were collected and have been preserved in a frozen state for disease screening, although these samples have not been processed yet. Stomach samples were collected and results have been presented (Sheehan *et al*. 2012). A gross summary of the macroparasite intestinal samples have also been presented although further more detailed analyses could be conducted on those samples.

Various tissue samples were collected for stable isotope based investigations and these samples are currently being processed. In addition, dorsal muscle samples for lipid analysis, otolith samples and frozen whole carcasses are also available to support various research interests.

For additional information regarding the status or results from any of the SALSEA North America samples or data, please feel free to contact the Program Coordinator, Timothy Sheehan, NOAA Fisheries Service (Tim.Sheehan@noaa.gov).

A table detailing the samples is available from the Program Coordinator or the NASCO Secretariat.

SALSEA Greenland

SALSEA Greenland was developed to conduct broader and more detailed sampling of fish harvested from the waters off West Greenland in support of the SALSEA research program. Fresh whole fish were purchased directly from individual fishers and detailed sampling resulted in a large number of samples being collected from each fish. The samples and data are in various stages of processing. Some results have been reported in peer reviewed publications (Dixon *et al*. 2012), some preliminary results have been reported in various ICES WGNAS reports (ICES, 2010; ICES, 2011; ICES, 2012) whereas many of the samples have yet to be processed, analyzed and reported.

Data collected includes fish origin, biological characteristics, sex, information on external parasites, presence of external tags or finclips are available. All fish have been assigned to be either North American or European origin, however finer than continent of origin determinations have not been conducted yet. Scales were collected for ageing although more detailed analysis of growth via image analysis processing is ongoing.

Ovary samples were collected (2009 only) and have been processed although detailed analysis has not been conducted. Various tissue samples were collected and have been preserved in a frozen state for disease screening. Stomach samples were collected and are currently being processed and preliminary results have been reported by ICES (2010). Macroparasite intestinal samples were collected although there is scope for further investigation on the samples.

Various tissue samples were collected for stable isotope based investigations and these samples are currently being processed. In addition, dorsal muscle samples for lipid analysis, otolith samples and frozen whole carcasses are available to support various research investigations.

For additional information regarding the status or results from any of the SALSEA Greenland samples or data, please feel free to contact the Program Coordinator, Timothy Sheehan, NOAA Fisheries Service (Tim.Sheehan@noaa.gov).

A table detailing the samples is available from the Program Coordinator or the NASCO Secretariat.

References:

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