Seventh Framework Programme

Theme 6 'Environment (including Climate Change)'
Call One

Proposal Full Title: Advancing understanding of Atlantic Salmon at Sea: Merging Genetics and Ecology to Resolve Stock-specific Migration and Distribution patterns

Proposal acronym: SALSEA-Merge

Type of funding scheme: Collaborative Project (small or medium-scale focused research project)

Work programme topics addressed: SUB-ACTIVITY 6.2.2. MANAGEMENT OF MARINE ENVIRONMENTS; *Area 6.2.2.1 Marine resources;* ENV.2007.2.2.1.2. Ecology of important marine species.

Name of coordinating person: Dr. Jens Christian Holst

Start Date: 01.04.2008

Actual date of the preparation of the DoW: 30.06.2008
Date of revision of the DoW : 01.10.2009

Project no.: 212529

List of participants:

Particpant No.	Participant organisation Name (*non contracting partners)	Country
1 (Coordinator)	Institute of Marine Research (IMR)	Norway
2	Marine Institute (MI)	Ireland
3	Fisheries Research Services (FRS)	UK
4	Norwegian Institute for Nature Research (NINA)	Norway
5	University of Exeter (UE)	UK
6	National University of Ireland, Cork (NUIC)	Ireland
7	Queen's University Belfast (QUB)	UK
8	University of Wales, Swansea (UWS)	UK
9	Danish Institute for Fisheries Research (DIFRES)	Denmark
10	Institute of Freshwater Fisheries (IFL)	Iceland
11	University of Turku (UT)	Finland
12	University of Oviedo (UO)	Spain
13	Geneindex (GENI)	France
14	Finnish Game and Fisheries Research Institute (FGFRI)	Finland
15	*Faroese Fisheries Laboratory (FFL)	Faroes
16	*Atlantic Salmon Trust (AST)	UK
17	*North Atlantic Salmon Conservation Organisation (NASCO)	UK
18	*Total Foundation (TOTAL)	France
19	*Conservatoire du Saumon Sauvage (CSS)	France
20	*Loughs Agency	UK

* Non-contracting partner

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Part A

A1 Budget breakdown and project summary.

A.1 Overall budget breakdown for the project.

Project Number: 212529 | **Proposal Acronym: SALSEA-Merge**

		Estimated eligible costs (whole duration of the project)						
Participant number in this project	**Participant short name**	**RTD/Innovation (A)**	**Demonstration (B)**	**Management (C)**	**Other (D)**	**Total A+B+C+D**	**Total receipts**	**Requested EC contribution**
1	IMR	1 533 377,00		215 607,00		1 748 984,00		1 174 515,00
2	MI	833 192,00				833 192,00		512 394,00
3	FRS	438 411,00				438 411,00		328 808,00
4	NINA	552 138,00				552 138,00		414 103,50
5	UNEXE	172 089,60				172 089,60		129 067,20
6	UCC	339 478,40				339 478,40		254 608,80
7	QUB	164 523,20				164 523,20		123 392,40
8	SU	156 370,00				156 370,00		117 277,00
9	DTU-AQUA	66 353,00				66 353,00		49 765,00
10	IFL	181 945,00				181 945,00		136 458,75
11	U.TORKU	148 436,80				148 436,80		111 327,60
12	UOVE	47 532,80				47 532,80		35 627,75
13	GENIN	47 534,00				47 534,00		23 767,00
14	FGFRI	118 200,00				118 200,00		88 650,00
15	FFL	227 600,00				227 600,00		
16	AST	210 000,00				210 000,00		
17	IASRB	15 000,00				15 000,00		
18	TOTAL	100 000,00				100 000,00		
19	CNSS	32 000,00				32 000,00		
20	LOUGHS AGENCY	20 000,00				20 000,00		
TOTAL		**5 404 180,80**	**0,00**	**215 607,00**	**0,00**	**5 619 787,80**	**0,00**	**3 499 762,00**

A2 Project summary.

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 salmons 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.

A.3 List of Beneficiaries

Beneficiary Number	Beneficiary name	Beneficiary short name	Country	Date enter project	Date exit project
1	Havforskningsinstituttet	IMR	Norway	1	36
2	Marine Institute	MI	Ireland	1	32
3	Fisheries Research Services	FRS	United Kingdom	1	32
4	Stiftelsen Norsk Instiutt for Naturforskning	NINA	Norway	1	32
5	University of Exeter	UNEXE	United Kingdom	1	23
6	National University of Ireland	UCC	Ireland	1	32
7	Queen's Uversity Belfast	QUB	United Kingdom	1	29
8	University of Wales	SU	United Kingdom	1	23
9	Danmarks Tekniske Universitet	DTU-AQUA	Denmark	1	23
10	Institute of Freshwater Fisheries	IFL	Iceland	1	32
11	Turun Yliopisto	U.TORKU	Finland	1	23
12	Universidad de Oviedo	UOVE	Spain	1	23
13	Genindexe	GENIN	France	1	23
14	Riista Ja Kalatalouden Tutkimuslaitos	FGFRI	Finland	1	32
15	The Faroes Fisheries Laboratory	FFL	Faroe Islands	1	32
16	Atlantic Salmon Trust	AST	United Kingdom	1	36
17	International Atlantic Salmon Reserach Board	IASRB	United Kingdom	1	36
18	Total Fondation D'entreprise pour la Biodiversite et la Mer	TOTAL	France		
19	Conservatoire National du Soumon Sauvage	CNSS	France		
20	Loughs Agency	LOUGHS AGENCY	United Kingdom		

PART B

B1 Scientific and/or technical quality, relevant to topics addressed by call

B1.1. Concept and objectives

B1.1.1 Concept

Wild Atlantic salmon numbers declined dramatically in the latter half of the 20th century (ICES 2006). Over the past thirty years considerable public and private investment and effort has been invested in research to understand the life cycle of the salmon, its interaction with its environment, and the threats that it faces. The result of the research has been a much clearer understanding of the salmon's life in rivers and inshore waters. This knowledge has led to action to clean up the environment, to remove obstructions, to improve habitat and reduce threats from exploitation. However, salmon numbers have continued to decrease. One of the main reasons is that far fewer salmon are returning from the ocean. An increasing proportion of salmon are dying at sea and the reasons are as yet unknown. In some southern rivers, on both sides of the North Atlantic, wild salmon now face extinction. There are many theories as to why salmon are dying at sea but as yet no sound research base on which rational action can be taken. The evidence points to there having been changes in the ocean phase (Figure 1.1.1, Hutchinson et al 2002). Evidence includes decreasing trends in overall production of salmon, suggesting that many stocks have been affected by the same factor(s) e.g. decreasing trends in marine survival (smolt to adult) despite fishery closures, declining adult returns in some areas despite there being no decrease in smolt production

In response to concerns about the reduction in survival of Atlantic salmon at sea, the North Atlantic Salmon Conservation Organization (NASCO)[1], which includes The European Union as a party, established an International Atlantic Salmon Research Board (IASRB) in 2001. The objective of this Board is to promote collaboration and cooperation on research into the causes of marine mortality of Atlantic salmon and the opportunities to counteract this mortality.

The first task the Board undertook was to develop an inventory of existing research so as to facilitate improved coordination, to identify research gaps and to develop research priorities. This inventory indicates that parties signed up to NASCO already conduct significant programmes of freshwater and near-shore research on a local or regional basis. While key post-smolt feeding areas have been identified, novel sampling gear has been developed and successful capture trials carried out, the high seas feeding grounds of the salmon have remained relatively unexplored. This is due to difficulties in trans-national co-ordination, the availability of suitable tracking technologies, which would identify the stocks of wild salmon and the substantial costs involved in high seas research. The IASRB agreed that the initial research priorities should be to improve understanding of the migration and distribution of salmon at sea in relation to feeding opportunities and predation. It concluded that only by better understanding where the salmon are at sea, and how they get there, will it be possible to identify the factors that affect survival. This is only possible by putting in place a major, cooperative, trans-national, multi-disciplinary high seas research programme. Having agreed the research priority of this research area, the IASRB set out a framework for an international programme of cooperative research on salmon at sea. This framework is called 'Salmon at Sea' or *SALSEA* and was developed by scientists from all of the NASCO's Parties (www.salmonatsea.com). At NASCO's Annual Meeting in 2005, the NASCO parties unanimously endorsed the *SALSEA*

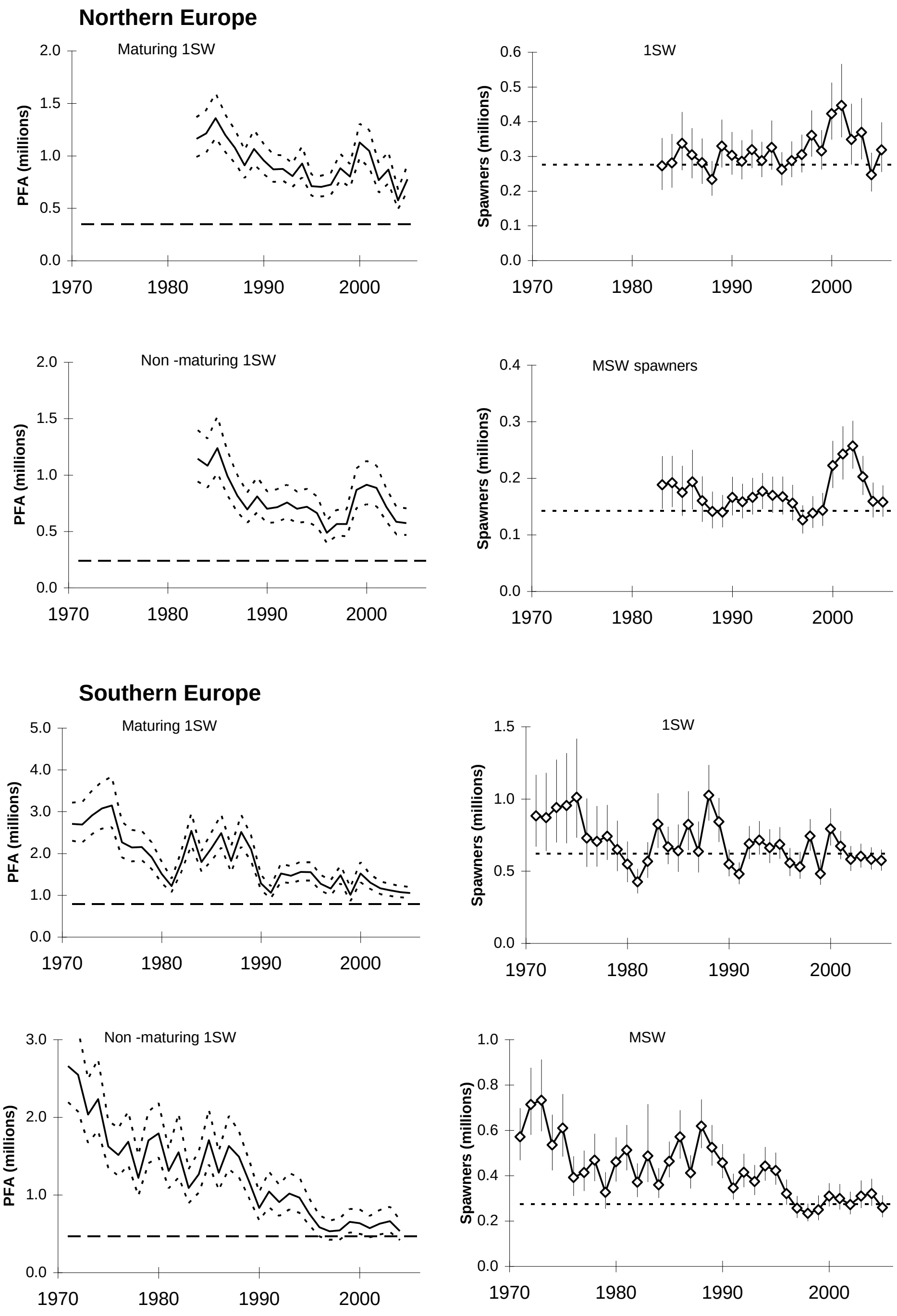

Figure B1.1.1 Estimated recruitment (pre-fisheries abundance) and spawning escapement for one sea winter (1SW) and Multi-Sea-Winter (MSW) Atlantic salmon in Northern and Southern Europe

framework and at the 2006 Annual Meeting agreed that a comprehensive marine investigation was required spanning the period 2008 to 2010.

SALSEA offers for the first time a unique and comprehensive scientific framework for advancing 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 – this is likely to be specific to regional and local stock groups. The *SALSEA* framework identifies the need for a comprehensive mix of freshwater, estuarine, coastal and offshore research to investigate factors that may affect the marine mortality of Atlantic salmon. Research in fresh water and the near-shore zone is ongoing, funded by national agencies and partners, although there is a need to enhance coordination of this research and stimulate additional investment in this work. In contrast, initial work in the open ocean has to date, by its very nature, proved extremely difficult to co-ordinate and fund. To do so required a trans-national agreement on research aims and objectives by all NASCO parties, which has now been achieved through the IASRB and unanimous agreement on the SALSEA framework. Key elements of this research programme require support from national governments, NGO groups, private sector interests and the EU Framework programme if it is to prove successful.

The technology now exists for the first time to capture significant numbers of wild Atlantic salmon at sea and having established the appropriate genetic baseline to identify individuals to a regional or stock specific level. Marine survival of Atlantic salmon affects salmon stocks throughout Western Europe and the SALSEA-Merge project intends to address them. The EU SALSEA Merge Project is complementary to national government and private global research efforts (e.g. supported by the TOTAL Foundation, Atlantic Salmon Trust and coordinated by the IASRB). Fund raising by the Board is ongoing both in Europe and in North America and they are hopeful that additional research support will be made available in the near future.

Arguably the biggest challenge in Atlantic salmon conservation science 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 (Todd et al. 2007). This is likely to be due to differences among stocks in their feeding distribution as a consequence of different migration behaviour, which suggests that this is a heritable trait. Thus different stocks may be predisposed to use different marine areas or zones whose environmental conditions will potentially vary independently, differentially affecting growth, condition and survival. To date it has been impossible to identify the origin of sufficient numbers of wild salmon to enable this question to be addressed. In the course of surveys carried out since the early 1970's information is available for almost 7,000 reared and wild salmon tagged as smolts in home rivers and recovered at Greenland and in the Norwegian Sea/Faroese. In addition over 800 adult salmon have been recovered from tagging experiments at Greenland and in the Norwegian Sea/Faroese (ICES 2006). This provides very important information on where and when to direct research at sea to ensure sampling adequacy and representation (ICES 2007).

There are many factors known to affect salmon at sea (Figure 1.1.2). These include for example: the carry over effects from freshwater, such as obstructions, habitat degradation water contamination, the effects of sub-lethal contaminants the effects of

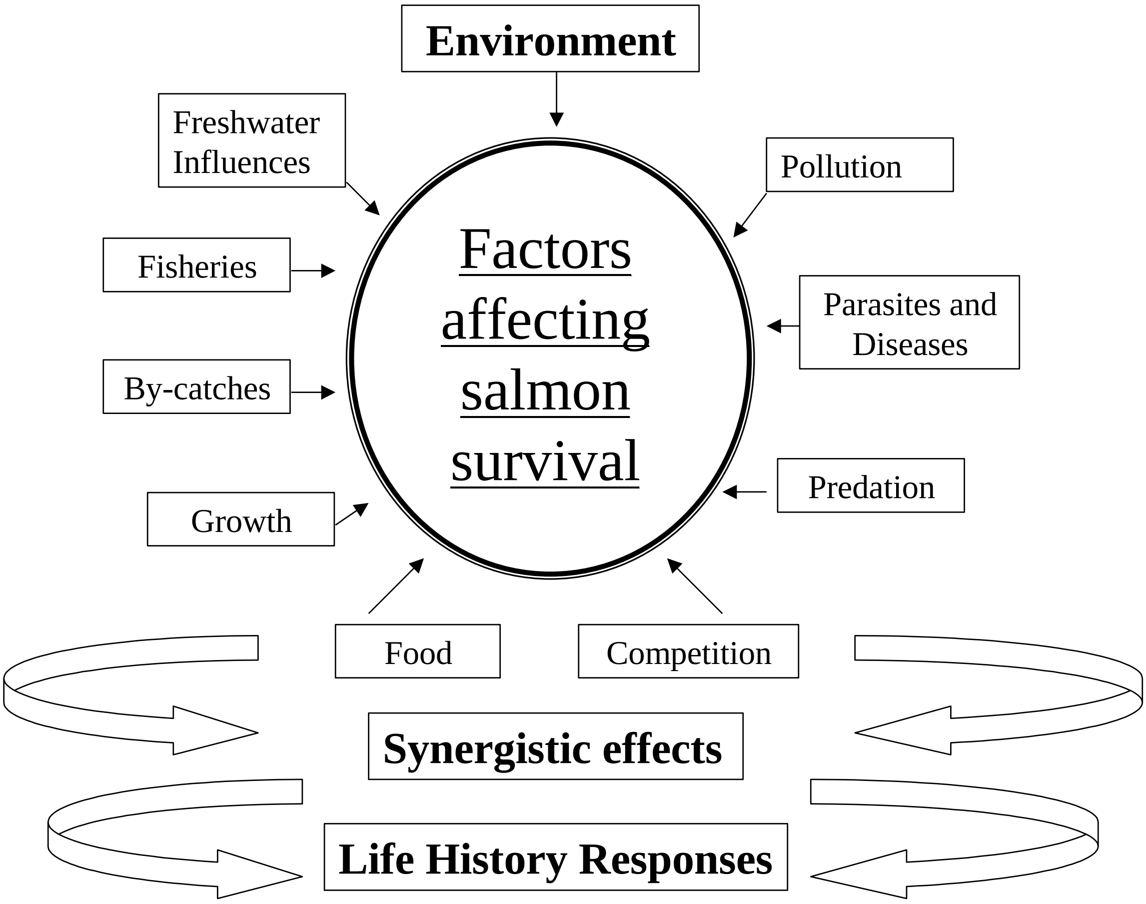

Figure B1.1.2 Factors individually and synergistically affecting marine survival of Atlantic salmon and which lead to life history responses which in many instances can be measured.

aquaculture, and predation. Some of these are being addressed by habitat protection and restoration programmes. Also, potential post-smolt by-catch in pelagic fisheries in the Norwegian Sea has been investigated by the Study Group on By-Catch of Salmon in Pelagic Trawl Fisheries (SGBYSAL, ICES 2004).

The main response to the decline in salmon stocks has been through fisheries management measures and in all salmon producing countries determined efforts have been made to limit exploitation. Most directed commercial fisheries have, in recent times, been significantly reduced or closed - e.g. distant waters fisheries and many home-water mixed stock fisheries. However, the main outstanding problem confounding the expectation of increased returns following these management measures has been the continuing decline in marine survival. Knowledge of the marine ecology of European Atlantic salmon is extremely limited. Thus obtaining information on the biological issues, such as those listed below, is critically needed to determine why stocks have been declining and whether management action can be taken to mitigate the problem. These all relate to when, where, why and how salmon are dying at sea.

One of the key issues in increasing our understanding of the marine ecology of the species is understanding the differences which may occur between different regional stock groups and river/tributary populations. This requires the ability to identify the origin of fish captured in the marine environment, which can be most cost effectively and comprehensively achieved using DNA profiling. DNA profiling is a proven technology in the management of Pacific salmon (Beacham et al., 2006), but has not as yet been applied on a widespread basis to North Atlantic salmon stocks. Individual European countries (Ireland, Norway and Iceland) have, over the past three years, collectively committed some €1.5m in successfully refining these techniques to answer specific management questions. The EU funded Atlantic Salmon Arc Project (€1.6m) has made a significant contribution in the establishment of a comprehensive river specific genetic baseline in the southern European range of the species and SALSEA-Merge has as one of its objectives the completion of this baseline and the delivery of a comprehensive genetic salmon map of European salmon stocks. Based on this comprehensive database DNA profiling techniques will be used to accurately identify from samples of salmon taken at sea, the region or river/tributary of origin of individual fish captured at sea. In order to capitalise on existing collections of tissues and scale samples from previous studies, these will also be genetically typed to region/river of origin for comparative temporal and spatial studies. Historical material from wild salmon collected during previous marine studies will also be assigned to their specific area of origin.

Finally, to obtain regional stock group and river/tributary population specific ecological information, the project will integrate information on the origin of fish obtained from sampling (tagging and genetics) with environmental and other biological information collected during the course of the research cruises. The results of these analyses will then be applied to existing theoretical distribution models to determine distribution and migration patterns of different genetic stock groups. In turn this will provide the basis for the development of new models linking growth performance, environmental conditions, and the distribution of food organisms.

The Atlantic salmon has been managed as principally a fish of fresh water, whereas in reality it is primarily a fast moving pelagic marine predator. The potentially terminal problems the species now faces are in the ocean and co-ordinated international research must rise to the challenge and address these most fundamental of questions. Knowledge of the marine life of the salmon is rudimentary and insight into migration and distribution is fundamental to identifying factors affecting ocean mortality. SALSEA-Merge, a unique partnership of State bodies, universities, NGOs and the private sector, addresses the key element of the SALSEA framework, which is fundamental to the delivery of, and underpins, the other components of the wider SALSEA programme.

B1.1.2 Objectives

SALSEA-Merge, a targeted collaborative research project on the marine ecology of the Atlantic salmon, will contribute to the 'Theme 6 (Environment)' objective '*the sustainable management of the environment and its resources through advancing our knowledge on the interactions between the climate, biosphere, ecosystems and human activities'* of EU Framework 7. The project will address *Area 6.2.2.1 Marine resources,* one of the four main activities identified in this theme, and would be contained within SUB-ACTIVITY 6.2.2. MANAGEMENT OF MARINE ENVIRONMENTS and, specifically, ENV.2007.2.2.1.2. Ecology of important marine species.

B1.1.2.1 Overall Objective

The overall objective of SALSEA-Merge is, by merging genetic and ecological investigations, to advance understanding of stock specific migration and distribution patterns and overall ecology of the marine life of Atlantic salmon and gain an insight into the factors, resulting in recent significant increases in marine mortality.

The information gained will be essential for the identification of areas critical to the species life cycle and needed for the designation of marine protected areas, the regulation of large pelagic fisheries to avoid mortality from by-catches, the regulation of fisheries for key prey species such as sandeel, herring and blue whiting the targeted regulation of inshore commercial salmon fisheries, and to maximise natural sustainable freshwater production.

Recent evidence shows strong regional and local structuring of Atlantic salmon stocks in Europe and North America which indicates that it will be possible to develop a stock identification methodology for Atlantic salmon, as has been done successfully for Pacific salmonids (Beacham et al., 2006). With recent developments in molecular marker identification and screening technology, it is now possible to develop accurate diagnostic and cost effective methods for identifying the origin or proportional contributions of individual stocks from congregations of salmon, sampled at sea.

B1.1.2.2 Detailed scientific and technical objectives

The scientific and technical objectives of SALSEA-Merge focus on elucidating, at a regional and population specific level, the distribution and migration patterns during the marine phase of the salmon's life cycle. The results, which will be obtained, represent essential understanding for the effective formulation of mitigation policies to guide the rational future management of individual salmon populations. This is critical with regard to the potential impacts of a rapidly changing marine environment, particularly with regards to climate change.

Work package1 S&T Objectives: Development of Genetic Identification Methodology

- integration of existing and new genetic data from across the European range of the species into an optimal database to support the identification of the region or river/tributary of origin of fish captured in the North Atlantic
- a practical electronic database, that integrates and extends existing microsatellite and mtDNA data to provide required baseline information
- a suite of molecular markers which can identify salmon to region or river of origin
- optimisation and validation of the database and the assignment methodology

Work package 2 S&T Objective: Marine Data Acquisition

- catalogue and assemble archival tissues for genetic typing
- catalogue and assemble archival scale material for age and growth determinations
- acquire associated historical oceanographic information
- each salmon captured will be sacrificed and a full range of biological samples will be taken
- collect stomachs from post-smolts for dietary analysis
- synchronous plankton trawls will be taken to collect information on available food items (the material to be preserved for analysis in a future IASRB funded programme)
- acquire, for Work package 3 and 4, contemporary samples of post smolts, and associated critical oceanographic information, in three key marine areas between May and August, 2008 and 2009

Work package 3 S&T Objective: Genetic identification of stock origin of samples

- determine the region or river of origin of the fish samples captured or acquired

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
- oceanographic conditions and relate these to patterns of growth and dietary differences

Work package 6 S&T Objective: Dissemination of Project Outputs

- disseminate the results of SALSEA-Merge, to the wider scientific community, EU and national governments, the general public and all relevant stakeholders
- the IASRB (NASCO) will, through their existing SALSEA website (www.salmonatsea.com), host and report on all activities resulting from SALSEA-Merge
- contribute to and participate in a planned NASCO/NPAFC/ICES/PICES International Salmon Summit to take place in autumn 2010
- produce a final detailed technical report of the scientific findings emanating from SALSAEA-Merge and contribute to scientific peer reviewed journals as appropriate

Work package 7 S&T Objective: Project Management

- to establish a management structure
- hold minuted meetings that provide high-level scientific project co-ordination, relevant organisational and financial securities and project management support
- secure the timely completion of project deliverables and reports
- Maintain regular contact with the European Commission

B1.2. State of the Art and Progress beyond the State-of-The-Art

General

The unique international partnership, envisaged in SALSEA-Merge, will result in an unprecedented exploration and investigation of individual wild salmon stocks at sea. SALSEA-Merge will deliver innovation and deliverables beyond the state of the art in the areas of: genetic stock identification, the production of a high resolution genetic baseline of the species throughout its European range, new marker development (SNPs and microsatellite markers), estimates of growth patterns and growth pattern analyses, the use of novel pelagic trawling technology and transfer of this technology and know-how, individual stock linked estimates of food and feeding patterns, delivery of original stock specific migration and distribution models merging hydrography, oceanographic, genetic and ecological data. The benefits of 10 European nations working together and with colleagues from Russia and North America, in a collaborative programme include:

- More efficient sharing of facilities and pooling expertise
- Ability to co-ordinate surveys in time and space
- Make best use of existing information and expertise
- Sum is greater than parts

B1.2.1 State-of-the-art WP 1 - Development of Genetic Identification Methodology

Methods for identifying the region or river/tributary origin of fish using DNA profiling have advanced significantly in the last five years and are now widely applied to salmonid stocks in the Pacific Northwest. These programmes demonstrate the power of these methods, for a number of salmonid and other freshwater and marine species. The basic elements needed to develop DNA methods for Atlantic salmon in the North Atlantic exist. Available DNA markers e.g. microsatellites can already resolve fine scale resolution of genetic structure and with existing statistical techniques and appropriate base line information can assign individuals to population of origin within regions both using mixed stock analysis (MSA) and individual assignment (IA) approaches (e.g. the Baltic - Koljonen *et al.* 2007). This strongly supports the view that a DNA based approach to the identification of the origin of marine samples of Atlantic salmon could be exploited to significantly advance our understanding of migration and distribution patterns.

A number of classes of DNA markers show strong evidence for potential to provide the resolution needed for regional assignment. Existing work shows point mutations in mtDNA with highly restricted regional distributions that could be informative for some regional groups (e.g. Verspoor *et al*., 2002, 2006; Makhrov *et al.* 2005). However, further work is needed to identify a suite of markers to comprehensively cover the European range of the salmon and confirm their diagnostic potential. Existing work also shows regionally restricted distributions of microsatellite alleles and varying levels of regional differentiations among existing microsatellite loci of which ~1700 have been identified in Atlantic salmon. Again, those best suited for regional discrimination remains to be established.

There is considerable potential for identifying single nucleotide polymorphisms (SNPs) for the loci of protein coding genes, (McMeel *et al.*, 2001) with the capacity to contribute regional assignment (Rengmark *et al.*, 2006); in salmon *MEP-2*,* which shows a strong regional differentiation across Europe, would be a particularly valuable locus for which to develop a DNA typing method. However, screening of randomly identified nuclear SNPs, could also identify further markers with strong regional differentiation. A recent pilot study carried out by University College Cork, Ireland and *Biotrove* in the US has shown the diagnostic potential of SNP's in Atlantic salmon research (Coughlan *et al*. 2007).

Beyond state-of-the-art

Taking advantage of recent significant advances in genetic stock identification techniques, a robust genetic baseline of salmon stocks in the major European salmon rivers will be established.

A new suite of regional specific / river origin markers will be developed to resolve fine scale population structure and provide the basis for Individual Assignment and Mixed Stock Analysis. These will include both mitochondrial and single nucleotide polymorphisms (SNP's).

This is an advance over conventional tagging in that genetic assessment ensures that all wild fish sampled can be related back to their region or river of origin, there is less reliance on hatchery tagged fish as surrogates of wild populations and it reduces the need for large scale tagging and recovery programmes.

These techniques will provide new information on the genetic population and the biodiversity resource of European freshwater salmon stocks (i.e. a genetic atlas) and have the approach has the potential to be used in other freshwater species, particularly those which are threatened or endangered.

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State-of-the-art WP 2 - Marine Data Acquisition

Trawling with large research ships for post smolts in the open ocean is a relatively new and highly innovative approach developed in the late 1990s by scientists working out of the Institute of Marine Research Bergen. Until the early tests of this live capture trawl system, the capture of salmon at sea was incidental. The live-capture trawl (Holst and MacDonald 2000) was tested and refined between 1998 – 2000, and has proven very effective for sampling surface dwelling fish up to around 50 cm in length. It is currently used for post-smolt salmon surveys in several countries in Europe and North America. Experience to date with this gear, has generated confidence that absence of salmon in the trawl, indicates absence of juvenile salmon in the sample area.

However, relatively few post-smolts have been captured to date, as there have been relatively few high seas salmon surveys. Thus the known distribution pattern is patchy both in time and space, and is doubtless greatly influenced by the pattern and frequency of Norwegian pelagic cruises. Sampling of oceanographic vertical (CTD profilers) and horizontal profiles (thermosalinographs), and meteorological data is standard procedure on research cruises. Also, advanced echo sounders (Simrad, multi-frequency acoustics) for quantitative assessment of plankton layers and fish aggregations along the survey transects, and the interactive analytical tool, is in standard use on many research ships.

Beyond state-of-the-art

The use of large vessels (60m – 70m) in a coordinated trans-European multidisciplinary sampling programme will provide a synoptic picture of spatial and temporal post-smolt distribution in three important post smolt feeding areas. These include blue water sites, postulated to be important feeding areas for northern salmon stocks but never before sampled or investigated.

The survey will be carried out using new and improved post-smolt trawls (i.e. with an opened-ended video linked trawl). Crews from other participating nations will be trained in the use of this new technology.

Also a new macro-zooplankton trawl (Melle et al. 2006) will be deployed, which will facilitate sampling at varying depths. Application of this technology will facilitate horizontal and vertical mapping of the major prey species of post-smolts. Again, crews from other participating nations will be trained in the use of the new technology.

A considerable amount of acoustic data will be collected and provided from each cruise for future studies and projects which will take advantage of new developments in multi-frequency acoustics for processing multi-frequency acoustic data (e.g. newly designed interactive analytical tool, the LSS (Korneliussen *et al.* 2006). This will lead to greatly improved spatial resolution of prey, competitors and predators.

For the first time, information from echo sounders and profilers will provide high-definition oceanographic information on the marine ecosystems, where stocks of post smolts are found.

State-of-the-art WP 3 Genetic Identification of Stock Origin of Samples
At present it is possible to assign individuals to both continent of origin (macro scale) (Gilbey *et al.* 2005) and at catchment scale (micro-scales -e.g studies in Moy and Foyle catchments in Ireland, Loch Feochan rivers in Scotland, the Varzuga river in Russia, Teno river in Finland) with a high degree of confidence. Currently, however, baseline information is inadequate for assignment at the regional or river/tributary level on a trans-European scale (meso-scale). Studies of genetic protein variation (Verspoor *et al.* 2005) show meso-scale assignment will be possible. They show a strong division of European salmon stocks into genetically distinct regional geographic groups and DNA variation associated with this protein variation should be able to be resolved to provide practical cost-effective regional assignment. An ongoing (2006 /2007) genetic study in Ireland to determine the river of origin of Irish Atlantic salmon from mixed stock marine fisheries has shown strong river specific and regional assignment.

Beyond state-of-the-art
To date it has not been possible to formulate population specific maps showing the marine and freshwater distribution of European Atlantic salmon populations. This work package will compile a detailed GIS database showing the geographic distribution of all major European salmon stocks and the specific marine location of stocks recovered at sea.

Application of this tool will result in a greater understanding of Atlantic salmon ecology and will form the basis for the development of similar tools, to be applied to other important marine species.

State-of-the-art WP 4 Biological Analysis of Samples

Growth
Scales are used to determine the age at which salmon leave their river of origin (smolt age), and also to estimate the time it spent at sea. The difference in spacing between the circuli (growth rings) indicate growth rate. Wider spacings develop during summer growth, while more densely set circuli develop during the winter. Smolt age of Atlantic salmon from northern rivers is generally higher than in rivers farther to the south. Salmon from the west, mid and north Norway, as well as Icelandic and Russian salmon usually stay 3-5 years in fresh water before they smolt, while those originating from south Norway and southwest Sweden are two or more years. Smolts from UK, Ireland, France, Spain and Portugal are usually one or two years of age. Thus, smolt age determined from scales of post smolt and adult Atlantic salmon caught at sea may contribute significantly in revealing the origin of the fish, for example the age structure of the salmon post smolts from the trawl captures in the Norwegian Sea strongly suggests that most of these fish are of southern origin (Holm et al. 2004).

Traditionally salmon scales were only used to estimate age and growth rate. Recent developments in digital analysis have resulted in substantial advances in the area. With this novel equipment, developed in North American laboratories, the number of circulii established each year and the spacing between the circuli are recorded. These data will assist greatly in analysing growth patterns of salmon caught at sea, as well as in analysing archival material. The rate of growth can be accurately estimated, and growth checks and other growth anomalies can be temporally assigned. Hence, growth rate can now be estimated over short periods of time – weeks in summer periods, months in winter period (Peyronnet 2006). This technique has been used for identification of the continent of origin in the commercial West Greenland salmon fishery and also to assess marine growth patterns from Irish salmon (Reddin & Friedland 1999, Peyronnet 2006).

Diet

During their oceanic phase, European post-smolts early in the first summer are largely associated with slope currents. However, as they grow larger they move away from these currents and their feeding area is more widely dispersed in the Norwegian Sea (Shelton *et al.* 1997, Holm *et al.* 2003). The Atlantic current seems to explain major distributional characteristics. Juvenile prey fish and amphipods, the other main food item of post-smolts, have different distribution patterns in the Norwegian Sea (Skjoldal 2004). Juvenile herring originate from the Norwegian shelf and have a more easterly distribution, while amphipods are more evenly distributed in the Norwegian Sea, depending on the species (Melle et al. 2004).

Previous studies of post-smolt diet have shown post-smolts to be primarily piscivores but crustaceans, mainly amphipods, may dominate when prey fish are scarce (Haugland *et al.* 2006). In the Norwegian Sea, post-smolts mainly feed on juvenile herring *Clupea harengus*, and the forage ratio is strongly correlated with herring recruit numbers (Haugland et al. 2006). It has also been noted that the production of Atlantic salmon stocks was at its highest during the period when the Norwegian herring spring spawning stock was very low, following its collapse in the late 1960s. Amphipods and juvenile fish are macro-planktonic and micro-nektonic organisms, known to have a typically epipelagic distribution. In fact, most prey of post-smolts occupies the top of the water column. Except for Atlantic mackerel *Scomber scomber*, which are known to be facultative piscivores, other pelagic fishes of the Norwegian Sea feed at greater depths. Herring feed primarily on *Calanus* spp., while blue whiting feed meso-pelagically; on copepods during their first year and later on krill. Salmon, are however known to dive at times to substantial depths (>300 m), but the reasons for these forays are unknown (M. Holm, unpublished)

Recently, there have been indications of shifts in protein and lipid deposition of postsmolts at the beginning and in the end of their first season at sea (May – October). Rapid growth and protein deposition, rather than deposition of lipids appear to predominate at the start of their migration while the reverse occurs towards the end of the summer period. It would appear that in the autumn somatic growth is reduced and energy deposition is prioritised, perhaps to meet the challenges of the winter season (Haugland unpublished). A greater understanding of food preferences and the food sources available to young salmon, as well as competition from other species, is therefore vital to understanding the migration patterns and survival of individual different cohorts.

Beyond state-of-the-art

Taking advantage of new digital technology, several leading European laboratories will establish inter-calibration protocols to standardize and improve the accuracy of scale reading and imaging techniques.

This collaboration will provide fine scale temporal estimates of growth rate and pattern (weeks in summer periods, months in winter periods) and identify growth anomalies, relating these to associated oceanographic conditions.

New information will be available on the different growth patterns, occurring between stocks from different parts of Europe, and these may be traced to particular oceanic areas or particular times of the year.

The information from historical material is expected to deliver unique insights into changes over time in the species' use of this ecosystem, and in the probable link between marine growth and survival between areas, with contrasting history of abundance and survival.

Growth data from scales collected at sea, in addition to growth data derived from historical scale samples, will be held in a common database, and a common European digital scale image library will be established.

As mentioned above, information from archival material will deliver unique insights into temporal changes in the species' use of the ecosystem, and to links between marine growth and survival in different areas of the North Atlantic.

The food preference data obtained will be used to develop predictive models of ocean migration and distribution. The feeding preferences of key associated species will also be described and incorporated into this model.

State-of-the-art - WP 5 Merge and analyse genetic, biological and oceanographic data

The migration patterns of post-smolt salmon still remain largely unknown. In order to understand ocean migration behaviour of salmon and make predictions of their survival, it is necessary to obtain a more complete picture of how Atlantic salmon are dispersed in the sea in time and space.

Atlantic post-smolts migrate to the feeding areas in the ocean during late spring and summer (e.g. Thorpe, 1988; Mills, 1989). After the post-smolts enter the ocean, their migration pattern is little known, due to the relatively small number of fish captured relative to the potential migration area. It has been hypothesised that the major post–smolt mortality occurs in the first weeks or months after the smolts have left freshwater. The distribution, mortality and growth of salmon in the ocean are related to sea surface temperature (e.g. Reddin and Shearer, 1987; Friedland *et al.*, 1993) although other factors are known to be important. It has been suggested that the direction and strength of the surface current influences the transport of post-smolts to the feeding areas in the Norwegian Sea. A number of post-smolts have been caught in oceanic areas from the North Sea to the Norwegian Sea during pelagic trawl surveys in the Norwegian Sea in July and August (Holst *et al.* 1993; Shelton *et al.* 1997; Holm *et al.* 2000), and north of Scotland in May and June (Shelton *et al.* 1997). Based on the distribution of captures north of Scotland, the fish appear to move northwards with the shelf edge current (Shelton *et al.* 1997). Entering the Norwegian Sea, post smolts are found in the current running north parallel with the western edge of the Vøring Plateau (Holm *et al.*, 2003).

In February 2006, ICES, at the request of NASCO and financially supported by the IASRB, ran a week long workshop on the development and use of historical salmon tagging information from oceanic areas (ICES, 2007). This workshop examined in detail returns from 40,000 adults and smolts from both North America and Europe and in line with its terms of reference: collated published information on oceanic tag recoveries of salmon; evaluated the data available, compiled an inventory of available databases, developed a spatial framework for analysis of tag recovery data and examined how the material could be used to develop and test hypotheses on oceanic migration. The resulting GIS, incorporating all of the tagging returns available to the group, provides a firm foundation for the construction of a more complete and comprehensive distribution and migration model under the proposed SALSEA-Merge research programme. For example, the relative distribution of European versus North American salmon caught at

West Greenland is now available by country or region of origin, by year, season (month), and life-history stage.

Beyond state-of-the-art

Emerging from the assimilation of the key elements described above it will now be possible, using for example the three-dimensional Regional Ocean Modelling System (ROMS) developed in Norway, to construct an integrated ecological, and oceanographic model of post–smolt migration and distribution (Aadlandsvik *et al* 2004, Budgell (2005), Haidvogel *et al.*, 2000, Budgell 2005, Skogen *et al.*, 2007, Svendsen *et al.*, 2007), which will be linked with observed genetically determined population distribution and origins.

Technology transfer through collaboration with modellers from North America, who have advanced expertise in migration models/mechanisms of the Atlantic salmon, will ensure the model is constructed using the best available expertise. Using available archival and current data, the accuracy of the model can be tested and measured.

Through the integration of the genetic analysis of archival scale material and growth studies, it will be possible to examine alterations in biological characteristics over time and relate these to changes in the climate over recent decades

This model will allow the testing of specific hypotheses relating to the survival of salmon at sea.

The establishment of distribution and migration patterns for specific regional stocks will create an important set of information that can be used to refine the sampling strategy of future surveys and can also be used in the assessment of the response to climate change.

B1.3 S/T methodology and associated work plan

The overall strategy of the work plan

The scientific programme set out will advance understanding of the marine ecology of European Atlantic salmon stocks using a leading edge dual approach. The programme of work will exploit advances in molecular genetics and integrate these with novel approaches to fish capture and growth analysis, by close organisational networking, to develop a unified and trans-European understanding of this important biological issue.

It is critical that the Project commences in April 2008 to allow planning of ocean sampling programmes and their timely execution starting in early May 2008. The project is based on sequential sampling of two year classes of salmon smolts as they migrate from south to north across the North East Atlantic – see map of the three survey areas below. The migration of Atlantic salmon smolts begins in early May from the southernmost rivers, while in the northern most catchments migration can be as late as June or early July. The project is scheduled to commence with two surveys along the Irish and Scottish coasts commencing on May 10th from Killybegs in North West Ireland using both the RV Celtic Voyager and the RV Celtic Explorer. Booking ships and organising the appropriate crew has been planned well in advance (work has been ongoing since autumn 2007) and is logistically very complex.

The SALSEA-MERGE Project Consortium has acquired essential additional matching funding, including 50% funding for the ship costs and full cost support for the Faroese cruise. The matching finance is from national resources for the planned Ireland surveys in 2008 and 2009 and, if the SALSEA-MERGE Project start up is delayed and cruises require to be postponed, there is no guarantee that the matching funding will be available.

On the basis of the successful participation to date in the FP7 programme the project has leveraged substantial funding from both the private sector (€400k) and from the Canadian Government (€600k). The latter Canadian funding is only guaranteed for 2008 and again to delay or curtail the SALSEA Merge programme for this year would be to miss out on a unique research opportunity.

It is also important to ensure that the research sampling programmes at sea, both in the East and West Atlantic would take place synchronously. This would ensure that analysis of the growth and survival / mortality data would be directly comparable and that the integrated analysis of the biological, climatological and oceanographic data would span the same years, in selected areas of the North Atlantic.

To take advantage of these sampling programmes, expertise in fish genetics and Atlantic salmon ecology from leading European laboratories will be linked with the marine logistic resources of leading marine research institutes across northern Europe. This linkage represents the optimal and most cost-effective approach for delivering the required programme of work. The programme will provide the basis for advancing our understanding of oceanic-scale, ecological and ecosystem processes needed for implementing, in the future, sustainable management of this key marine species. The basis will be put in place through a set of seven interconnected work packages, integrated as set out in Figure 1.3.1. Two of these focus on genetics, two on ecology, one on merging of genetic and ecological data, one on communicating project outputs and, finally, one on overall project management.

WP1 concerns the first genetic component of the project. It involves the development of a molecular genetic tool for the accurate assignment of Atlantic salmon captured at sea to the regional or river stock group from which they derive, either on a proportional or individual basis, and is applicable to both new and archival tissues. Three basic, but interconnected issues must be addressed. The first issue concerns identification of an appropriate set of molecular markers for stock discrimination and optimisation of the screening protocols for both contemporary and historical material. The second issue concerns the development of a sufficiently comprehensive set of baseline data for salmon rivers in the North East Atlantic to allow accurate assignment of captured fish. The third issue relates to the validation of the assignment accuracy of the tool. To address these issues, 4 tasks, subdivided into 13 sub-tasks, have been specified.

WP2 will provide the samples on which the stock specific ecological analysis will be based. It involves assembly of samples for genetic typing and biological analysis, and collection or collation of associated spatial and oceanographic data. The samples assembled will be obtained from two sources. The first, which will provide material for a broad overview and supplement contemporary samples, will be taken from the extensive collection of archived material from historical marine cruises and sampling exercises in the North Atlantic undertaken over the last 40 years, and encompasses both frozen and ethanol preserved tissues, as well as scales. This source contains up to 40,000+ samples, including scale material and tissue from the West Greenland fishery since the late 1960s, from which the most informative will be selected for analysis. The second source of samples will be from the contemporary cruises, carried out as part of the proposed SALSEA-Merge programme, targeted at known marine feeding and migration areas. Three cruises will be carried out. For both sources of material, basic oceanographic data, including sea-surface temperature and position of capture, will be assembled.

WP3 will, in years two and three of the project, take the methodology developed in WP1 and apply it to the samples assembled and collected under WP2. The resulting genetic typing will be used to carry out both mixed stock analysis and individual

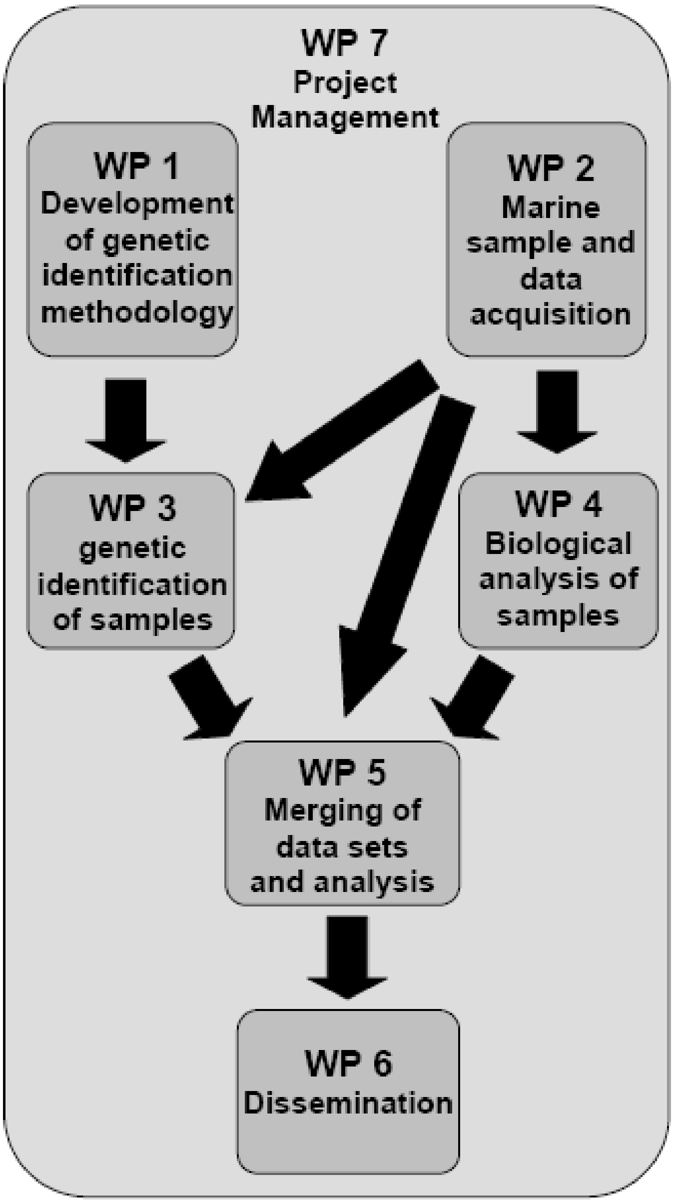

Figure B1.3.1 Pert diagram showing the interdependencies between the different work packages

assignment of salmon from two sources of marine material. This WP will, for the first time, provide information on the region or river/tributary of origin of wild salmon captured at sea, thus make possible an unprecedented level of sophistication of the ecological analysis which will be undertaken in WP5. The work package involves 2 tasks, each composed of 2 subtasks.

WP4 will, in years two and three of the project, undertake the biological analysis of the contemporary samples collected during the cruises in the targeted marine areas as part of WP2. It encompasses the determination of growth performance using information from scale analysis, data on body condition, and on stomach contents of captured fish. This determination will involve the development of new imaging facilities in key research institutes and the training of researchers. An important part of this major data acquisition task will be ensuring consistency in image interpretation across laboratories and establishing a digital scale image library. In addition biological samples for disease and parasite screening will be collected during the cruises and made available to pathologists for analysis. This component of the work programme has 3 tasks broken down into 6 subtasks.

WP5 concerns the merging of the biological, oceanographic and genetic data sets, to develop an integrated spatially informative ecological perspective on the marine ecology of the species on a regional and river-specific stock basis. The integration will make use of the latest geographic information system (GIS) approaches and provide a detailed and broad insight into the spatial use by European Atlantic salmon of the North Atlantic marine ecosystem. The information from historical material is expected to deliver unique insights into changes over time in the species' use of this ecosystem. It will also provide important baseline information to describe the nature and extent of expected responses of the species to future climate change. These databases will also extend existing marine data bases, relating to the ecology of the Atlantic marine environment. WP5 is composed of 2 tasks with three subtasks in total.

WP6 addresses the need in the project to communicate new developments and insights produced in work packages 1-5, both to project partners and to stakeholders, the broader science community, and the public at large. The communication framework put in place will involve a number of major initiatives - a project website linked to the IASRB site www.salmonatsea.com , peer-reviewed publications, internal workshops, a public symposium, and two map-based atlases. The symposium will be integrated within the broader joint NASCO/NPAFC/ICES/PICES International Salmon Summit set for autumn 2010. The Salmon Summit will include a detailed comparative overview of research on salmon at sea in both the Pacific and the Atlantic oceans and follows the first symposium on causes of marine mortality in the Pacific and Atlantic oceans and the Baltic sea held in Vancouver in 2002 (Hutchinson et al 2002). The Subject to IPR conditions, databases of raw information will be made available to the science community through ICES, subject to agreement, either directly or through a meta-database with associated links to sites where primary data are lodged. Public access to non-technical summaries of the information produced will be achieved through the project website and the production, in pdf format, of a popular, non-technical atlas specifically targeted at stakeholders, fisheries managers, fishermen, NGOs, schools, and the public-at-large. 3 tasks and 6 subtasks are identified in this work package. Initially the scientific data will be available on a restricted basis to members of the SALSEA Merge consortium but subsequently the data will be posted on a range of public websites. In addition data will be made available to other interested scientists on request.

WP7 addresses the overall management of the project. Given the complex nature of the scientific programmes involved in SALSEA-Merge and its use of large-scale infrastructure, which will be subject to national issues relating to governance and use of tax payer's money, in the countries involved, the management of the project will be shared between the projects administrative coordinator and the projects scientific co-ordinator. The projects administrative coordinator will have overall responsibility for the project and will retain specific responsibility for the finance and administrative components of SALSEA-Merge. The projects scientific coordinator will take overall responsibility for the technical aspects of the programme. A senior scientist will have direct responsibility for each of the genetics and the ecology components of the various work packages. These four individuals will form the Project Steering Group (PSG). It should be noted that the scientific coordinator post will be fully funded by the Atlantic Salmon Trust as part of their continuing support for the larger SALSEA programme and the individual recruited at the commencement of the project. Both genetics and ecology components will have their own steering groups. With three work packages explicitly devoted to either integration or co-ordination, the project structure proposed ensures the focus of effort and resources on those activities required to achieve a strong over-arching management structure. This is critical to successful delivery of project results and outputs, and of reliably achieving this objective, and is commensurate with the overall complexity of the task.

At the same time, the partitioning of the scientific work into the well defined and largely discrete packages. These tasks will, to a significant degree, be carried out independently, and only require monitoring of progress to ensure they are in line with overall project needs. This gives the proposed management structure robustness and ensures that work is not unnecessarily hampered by complicated and difficult to manage cross-package dependencies and interactions. Additionally, each work packages contains a co-ordination task to ensure that the different subtasks are appropriately integrated and that WP outputs are delivered on time and of the required quality. Furthermore, considerable effort has gone into clearly defining the deliverables for each sub- task within the work packages (Table 1.3.d). This will aid communication between project management and the participants and will be central to monitoring the projects progress.

This hierarchical management structure will lead to a highly productive interaction among partners collaborating on each work package, while minimizing the time required for co-ordination and the complications arising from managing a large number of geographically dispersed partners. Simultaneously, the overlapping nature of the management structure and steering group composition, combined with strategic timing of steering group meetings, ensures general awareness across the project consortium of progress and issues. In this way problems and progress can be appropriately addressed and rapidly exploited to maximize the quality and level of realised project outputs.

Sub Task	Description	Budget K€	Personnel person months
WP 1	**Development of genetic identification methodology**		
1.1.1	Critical Assessment of background information	40307	4.75
1.2.1	Develop DB structure	40375	5
1.2.2	Calibration of overlapping microsatellite data sets	117164	13.75
1.2.3	Enter existing data	43572	4.75
1.2.4	Extend genotype analysis of existing baseline material to conform with standardized marker set	264533	29
1.2.5	Carryout genotype analysis to spatially extend existing genetic baseline	413340	41.25
1.2.6	Assess temporal stability	141262	16
1.3.1	Assemble standard set of samples for marker development	34786	4
1.3.2	Assess existing microsatellite loci for regional differentiation	150276	14
1.3.3	Identify regional mtDNA SNPs for regional differentiation	161982	18.5
1.3.4	Identify and develop nDNA SNPS	124943	12.5
1.4.1	Assembly of blind test samples from baseline river and non-baseline rivers	34786	4
1.4.2	Optimisation and Validation of MSA and IA methodology	71858	7.5
WP 2	**Marine data acquisition**		
2.1.1	Prioritize and assemble archival biological material for genetic analysis	28551	2.5
2.1.2	Prioritize and assemble archival materials for scale studies	38286	3
2.1.3	Assembly of historical tagging and fish distribution	71906	9
2.2.1	Coded wire tagging and release of salmon smolts	109715	5
2.3.1	Co-ordination workshops and training	56600	4
2.3.2	Assessment of Cruise effectiveness	7935	0.5
2.4	**Expedition A**	632486	
2.4.1	Expedition A trawl for samples		5.75
2.4.2	Expedition A collect oceanographic data		3
2.4.3	Expedition A macro-plankton sampling for food availability		3
2.4.4	Expedition A acoustic for macroplankton, fish and predators		0.5
2.4.5	Expedition A Biological sampling		3
2.5	**Expedition B**		
2.5.1	Expedition B trawl for samples		
2.5.2	Expedition B collect oceanographic data		
2.5.3	Expedition B macro-plankton sampling for food availability and acoustics		
2.5.4	Expedition B acoustic for macroplankton, fish and predators		
2.5.5	Expedition B Biological sampling		
2.6	**Expedition C**	791475	
2.6.1	Expedition C trawl for samples		5.5
2.6.2	Expedition C collect oceanographic data		4.5
2.6.3	Expedition C macro-plankton sampling for food availability		5.5
2.6.4	Expedition C acoustic for macroplankton, fish and predators		4
2.6.5	Expedition C Biological sampling		4.5
WP3	**Genetic identification of stock origin of samples**		
3.1.1	Genetic typing of archival samples	205519	23.75
3.1.2	MSA and IA analysis to identify stock origin of archival samples	39119	4.25
3.2.1	Genetic typing of contemporary samples	225103	19
3.2.2	MSA and IA analysis to identify stock origin of contemporary samples	20407	2.5
WP 4	**Biological Analysis of Samples**		
4.1.1	Training	39050	2.25
4.2.1	Reading of archival scale material from WP2	487114	38.2
4.2.2	Reading of scale samples collected in expeditions		5
4.2.3	Establish digital scale library		4.5
4.2.4	Determination of growth indices from scale readings		4.5
4.3.1	Analysis of material from stomachs	182750	20
WP 5	**Merge and analyse genetic, biological and oceanographic data**		
5.1.1	Map spatial distribution of specific regional stocks or populations	53646	4.25
5.1.2	Analysis of associations of distribution patterns with biological and oceanographic data	42658	2.5
5.2.1	Development of new spatial models and observed biological and oceanographic associations to refine existing ecological models	128826	10
WP 6	**Dissemination of Project Outputs**		
6.1.1	Creation of website		1
6.1.2	Maintenance and updating of website		3
6.2.1	Hold symposium		
6.2.2	Assemble, review and edit proceedings papers		
6.3.1	Design and production		
WP7	**Project management**		
7.1	Annual consortium meetings (*includes a General Assembly Meeting)	15000	2
7.2	Steering group meetings	15000	4
7.3	Task monitoring and co-ordination	150000	14
7.4	Progress reports		4
7.5	Mid-term review and Final reports		2

Table B1.3a: Work package list

WP No.	Work package Title	Type of Activity	Lead Participant No.	Person months	Start Month	End Month
1	Development of genetic identification methodology	RTD	3	175	1	24
2	Marine data acquisition	RTD	1	81.25	1	21
3	Genetic identification of stock origin of samples	RTD	2	49.5	18	29
4	Biological analysis of samples	RTD	2	74.95	3	28
5	Merge and analyse genetic, biological and oceanographic data	RTD	1	18	11	33
6	Dissemination of project outputs	RTD	1	4	1	36
7	Project management	MGT	1	48	1	36
	TOTAL			450.7		

Table B1.3b Deliverables list

Del.No.	Deliverable Name	WP No.	Nature	Dissemination	Delivery Date
D 1.1	Report on integration strategy and data base structure	1			3
D 1.2	Report on new regional markers	1			20
D 1.3	Web-based Trans-European genotype database for Atlantic salmon GSI	1			24
D 2.1	Cruise reports for 2008	2			5
D 2.2	Cruise reports for 2009	2			17
D 2.3	Tissues from marine samples for genetic and biological analysis	2			5,17
D 2.4	Electronic data bases of biological information on marine samples	2			5, 17
D 3.1	Report on genetic assignment of archive samples to river/region of origin	3			30
D 3.2	Report on genetic assignment of marine survey samples to river/region of origin	3			30
D 4.1	Electronic database of digital scale images and growth data	4			23
D 4.2	Electronic data base of results of growth indices	4			28
D 4.3	Final report on fish diet and stomach analyses	4			28
D 5.1	GIS project on the statistical distribution of specific stocks, or stock groups	5			33
D 5.2	Report on analyses of the relationships between distribution of post smolts with physical and biological variables	5			33
D 5.3	Report describing a conceptual migration and ecological model	5			33
D 6.1	Operational Web site	6			2
D 6.2	On line availability of reports and other project news	6			1-36
D 6.3	Participation and presentation of papers at International symposium	6			33
D 6.4	Completed stock distribution Atlas (pdf file)	6			36
D 7.1	Interim progress and financial reports, and independent reviewer's report	7			18
D 7.2	Final project and financial reports	7			36

Table B1.3c: Work package description

WP 1: Development of genetic identification methodology

Work package no.	**1**	**Start date or starting event**			**Month 1**	
Work package title	**Development of genetic identification methodology**					
Activity type	RTD					
Participant number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Person-months per Participant	21.75	3.25	25.75	6.25	18.75	18	19.75
Participant number	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Person-months per Participant	19.75	8	6	18.75	4.5	4.5	0
Participant number	**15**	**16**	**17**				
Person-months per Participant	0	0	0				

Objectives

To develop, in year one for objective 3, an optimum, practical, accurate and cost-effective genetic solution for determining the region or river of origin of European Atlantic salmon captured at sea, both from historical and contemporary biological material, building on existing EU, national and international genetic data bases and resources. The specific needs addressed by this work package are:

- Integration of existing and new genetic data into an optimal database to support the identification of the region and river/tributary of origin of fish captured in the North Atlantic
- a practical electronic database, that integrates and extends existing microsatellite and mtDNA data to provide required baseline information
- a suite of molecular markers which can identify salmon to region of origin
- optimisation and validation of the database and the assignment methodology

Description of work

Task 1.1 Critical Assessment of background genetic information

Sub-task 1.1.1 *Evaluate existing Atlantic salmon genetic data bases to define integration strategy*

An up-dated catalogue of existing data bases containing genetic information on microsatellite and mitochondrial DNA locus variation will be assembled, with a view to the requirements for their integration into a single, unified trans-European data base for genetic identification of the origin of European salmon captured in marine waters. Primary consideration will be given to identifying the degree of commonality of the markers sets in different data bases held in different regions and laboratories, differences in sampling approaches underlying the data bases (e.g. spatial intensity, sample size, etc), need for further baseline information to get optimal regional coverage, fill geographic gaps, etc. This will be achieved by assembling a meta-data base through correspondence with known active or past research groups. This meta-data base will then be used as the basis for convening a workshop to define a practical, optimal integration strategy which will form the basis for task 2.1. A catalogue of biological material available for the development of baseline information, including the analysis of temporal stability of stock differentiation. Locus and baseline GAPS will be identified.

Participants: Lead – 3,8; other 1,2, 5-13

Task 1.2 Integrate existing microsatellite and mtDNA data base

Sub-task 1.2.1 *Develop DB structure*

The database strategy will be translated into an electronic database format implemented using standard database software, to be identified in the strategy developed in subtask 1.1.1. Entry of data into the base, and data access and review, will be web-enabled to allow remote, rapid and universal access by consortium members. A consortium agreement will be developed and agreed with consortium partners to ensure IPR but maximize availability of individual existing data sets to other researchers and to the science community generally.

Participants: Lead – 1; other

Sub-task 1.2.2 *Calibration of overlapping microsatellite data sets*
Existing methodologies will be used to standardize and calibrate existing microsatellite and mtDNA databases, to make it possible to align them so that they can be combined for pan-European analyses. This will be achieved by the exchange of standard sets of samples and overlapping of sample analyses and the development of a standard variant nomenclature. The nominated participants will travel between laboratories to assess the specific integration challenges and define appropriate solutions. This will include the development of computer macros to translate existing nomenclatures into the agreed standard nomenclature and data storage formats. The calibration report will set out how databases will be linked.

Participants: Lead - 5,6; other 1
Sub-task 1.2.3 *Enter existing data*
Participants, whom own most of the existing information on microsatellite and mtDNA variation in European Atlantic salmon stocks, will input this information, once calibrated and standardized (see Subtask 1.2.2) into the web-based electronic database constructed as part of subtask 1.2.1

Participants: Lead – other 1; 3-13

Sub-task 1.2.4 *Extend genotype analysis of existing baseline material to conform with standardized marker set*
Existing regional European microsatellite and mtDNA databases are only partially overlapping with regard to the genetic loci screened. Consortium laboratories will undertake further genetic analysis to extend existing data sets to include the full set of agreed markers, and as identified in Subtask 1.1.1, using their archival DNA or tissues. This data will then be entered into the Trans-European genotype database.

Participants: Lead – 2; other 3-12

Sub-task 1.2.5 *Carryout genotype analysis to spatially extend existing genetic baseline*
Existing regional microsatellite and mtDNA databases only partially cover the European range of the species and there are significant spatial gaps, which need to be filled to provide the required geographical coverage for accurate assignment. Consortium laboratories will undertake further genetic analysis to spatial extend existing data sets for the full set of agreed markers, and as identified in Subtask 1.1.1, using newly collected or archival DNA or tissues. Much of the material will be obtained from routine management electrofishing and trapping surveys. This data will then be entered into the Trans-European genotype database.

Participants: Lead – 2; other 1, 3-7, 10,11,13

NB: When European database for the agreed standard set of genetic markers is completed with information from the subtasks 1.2.2 to 1.2.4, it will be lodged in electronic form via ICES as part of WP5, with access according to an agreed IPR protocol agreed among consortium members.

Sub-task 1.2.6 *Assess temporal stability*

An assessment of a number of river populations will be undertaken in order to determine their genetic stability and thus provide an indication of the integrity of the newly established baseline in the long-term and to make recommendations on required sampling frequencies.

Participants: Lead – 9; other 1,3-13

Task 1.3 Identify optimal suite of genetic markers for regional assignment

Sub-task 1.3.1 *Assemble standard set of samples for marker development*
A representative subset of river/regional samples spanning the European range of the salmon will be assembled in order to provide material for identifying region specific genetic markers. This will be achieved by defining a number of agreed selection criteria, which are developed out of consideration of existing information on regional variation and European geography. Three replicate sample sets, one for each lead group in sub-tasks 1.3.2, 1.3.3., 1.3.4 will be created from a fish specifically collected for this purpose. The sets will be made by sub-sampling aliquots of tissue from ethanol preserved whole fish, with the remainder of the carcasses deposited for future use in a institution specialising in maintaining reference collections such as the British Museum. This collection will then be available as reference baseline DNA for future genetic studies. An agreed protocol of future access to this material will be agreed with the institution where the sample collection is deposited.

Participants: Lead – 2; other 1-13

Sub-task 1.3.2 *Assess existing microsatellite loci for regional differentiation*
A subset of 400 of the over 1700 microsatellite loci identified in Atlantic to date will be selected based on an assessment of their suitability for population genetics work. Based on screening of the reference collection assembled in Subtask 1.3.1, a suite of 8-12 multiplexable microsatellite loci which give high resolution regional assignment potential will be chosen and optimal conditions for genotyping established.

Participants: Lead – 1; other 4,11

Sub-task 1.3.3 *Identify regional mtDNA SNPs for regional differentiation*
mtDNA from the *D-loop*, *ND1*, *Cytb* and other gene regions will be sequenced to identify single nucleotide polymorphism (SNPs). Based on screening of the reference collection assembled in Subtask 1.3.1, a suite of SNPs which provide useful regional assignment capability will be chosen and optimal conditions for typing established.

Participants: Lead – 3; other 8

Sub-task 1.3.4 *Identify and develop nDNA SNPS*
Known nDNA sequences identified in electronic databases such as GENBANK and cGRASP will be reviewed and the most promising selected for screening for SNPs. Based on screening of the reference collection assembled in Subtask 1.3.1, a suite of 100 SNPs which provide useful regional assignment capability will be chosen and optimal conditions for typing established.

Participants: Lead – 6; other 2,7

Task 1.4 Optimisation and Validation of MSA and IA methodology

Sub-task 1.4.1 *Assembly of blind test samples from baseline river and non-baseline rivers*
Two sets of samples of 200 fish will be assembled, one will be used as a known test sample for optimization and the other will be used as a blind test sample for validation. The samples will be assembled by a consortium member independent of the partners involved in the optimization and validation, and supplied to the appropriate partners for genetic typing (see sub tasks 1.3.2, 1.3.3 and 1.3.4. The emerging data will be used in sub task 1.4.2. Also provided will be data for weighting of samples in baseline by productivity potential and catch, data simulations, assess effect of temporal variation.

Participants: Lead – 2; other 1, 3-13

Sub-task 1.4.2 *Optimisation and Validation of MSA and IA methodology*
The samples provided under subtask 1.4.1 will be genetically typed for the standard set of microsatellite and mtDNA loci, as well as for the newly developed regional markers from subtasks 1.3.2, 1.3.3, and 1.3.4. The data will then be used with baseline data from Task 1.2 and 1.3 to run simulations and optimisations using standard available genetic assignment software e.g. STRUCTURE, BAYES, SPAM. Findings will be reported to and discussed by all partners at a WP1 workshop. The output to be used in WP3 Task 3.1. The most parsimonious set of markers giving optimal MSA and IA will be identified and used for defining the MSA/IA baseline selection of loci and the set of loci to be used for screening marine samples in WP3.

Participants: Lead – 3; 1, 6, 7

Deliverables from WP1
D 1.1 - Report on integration strategy and data base structure (month 3)
D 1.2 - Report on new regional markers (month 20)
D 1.3 – Web-based Trans-European genotype database for Atlantic salmon GSI (month 24)

WP 2 : Marine data acquisition

Work package no.	2	Start date or starting event			Month 1	
Work package title	**Marine data acquisition**					
Activity type	RTD					
Participant number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Person-months per Participant	33	17.25	1	8	0	0	0
Participant number	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Person-months per Participant	0	0	3.5	0	0	0	0.5
Participant number	**15**	**16**	**17**				
Person-months per Participant	18	0	0				

Objectives

Catches of post-smolts and older aged fish will provide information on distribution and relative abundance of salmon as well as providing samples for genetic assignment (WP3) and integrated ecological analyses (WP 4). The locations of capture will be related to geographic (latitude, longitude) and oceanographic (fronts, temperature, salinity) characteristics. These data will provide information on preferences and/or selection of the physical characteristics by size / age groups. Catches and relative abundance of other species will provide information on the distribution of salmon within this larger pelagic ecosystem. Contemporary samples of post smolts, and associated critical oceanographic information, in three key marine areas between May and August, 2008 and 2009, from which high resolution estimates of marine growth, body condition, key prey species in diet, and stock origin can be determined, in addition to assembling available archival material and data. The various research needs are:

- assembling of archival tissues and scales for combined genetic typing and biological analysis
- development of marine sampling strategy and protocols
- conduct cruises to collect samples of salmon, stomach contents, macro-plankton and oceanographic information from 3 key marine areas in the Northeast Atlantic
- increase the number of tagged fish available for recapture

Description of work

Task 2.1 Assemble archival material

Sub-task 2.1.1 *Prioritise and assemble archival biological tissue material for genetic analysis*
A wide range and amount of biological material is available for analyses including body tissues and scales collected from previous marine post-smolt surveys and adult salmon/juveniles from in home-waters waters. These samples are held by the partner research institutions. The material must be catalogued initially to allow samples to be identified for genetic purposes, prioritised and the potentially most informative material will then be selected and stock identification carried out in WP3.

Participants: Lead – 1; other 3

Sub-task 2.1.2 *Prioritise and assemble archival biological tissue material for scale analysis*
A wide range and amount of biological material is available for analyses including scales collected from previous marine post-smolt surveys and returns of adult salmon to home-waters. These samples are by the partner research institutions. The material must be catalogued initially to allow samples to be identified and prioritised. The potentially most informative material will then be selected and assembled for growth and age characteristics by geographic region.

Participants: Lead – 4; other 1,2,10,14,15

Sub-task 2.1.3 *Assembly of archival tagging and fish distribution information*
A considerable amount of information from conventional tagging studies (CWT, floy, carlin etc) and resides in participant laboratories. A recent ICES Workshop reviewed this information and concluded that there were sufficient data to establish initial models on migration and distribution patterns in the ocean. Within this sub-task, archival

tagging information will be assembled into an appropriate database for use in designing the cruises in WP 2 and contributing to model development in WP 5.

Participants: Lead – 4

Task 2.2 Strategic coded wire tag release to support stock ID and modelling

<u>Sub-task 2.2.1</u> <u>*Coded wire tagging and release of salmon smolts*</u>
Approximately 800,000 coded wire tagged salmon are released annually from Ireland, Iceland, UK, France and Germany. The main objective is to make use of extensive tagging and hatchery facilities operated by individual countries while increasing the potential in areas where there is poor coverage i.e. Norway. This sub-task will allow a further 100,000 salmon smolts to be released thus increasing the potential for recovery of tagged fish in the marine sampling phase and thereby allowing dynamic models of migration, distribution, growth and survival to be developed. Information from tag recoveries at sea will help determine migration paths of post smolt in the first months in the ocean and will allow estimation of the importance of marine climate in distribution, migration and mortality Specific objectives are to:

- maximise the use of tagged salmon from tagging programmes to increase probabilities of recapture at sea in WP2
- refine and improve current state of the art knowledge of distribution and migrations of Atlantic salmon originating from several countries in WP5.

Participants: Lead – 4, other- 2

Task 2.3 Preparation and planning of marine sampling

<u>Sub–task 2.3.1</u> <u>Co-*ordination workshops and training*</u>
In advance of the sampling period in 2008, a planning meeting will be held where standard operating procedures (SOPs) for sampling fish, plankton, oceanographic and meteorological data will be agreed. The correct operation of both the salmon and the plankton trawls will require training of crews lacking experience in their use. An IMR (participant 1) Master Fisherman will attend to provide hands-on instructions on some of the experimental trawl and other equipment.

Participants: Lead – 1; 2, 15

<u>Sub-task 2.3.2</u> <u>Assessment of *Cruise effectiveness*</u>
Following the first years sampling, a follow up co-ordination meeting will be held in autumn 2008. This will be a debriefing and evaluation of the first sampling expedition to allow maximum feedback from the experiences of the first expedition, and to adjust the protocols if necessary for year 2 cruises.

Participants: Lead – 1; 2, 15

Task 2.4 Expedition A - West of Ireland – Northwest Scotland (Area 1 Figure 1.3.1)

<u>Sub-task 2.4.1</u> <u>*Experimental trawling for post-smolts*</u>
Norwegian research vessels undertaking mackerel surveys have captured post-smolts as bye-catch in this area. Directed salmon surveys have been conducted by Scottish researchers in the northern part of Area 1 and these were also successful in capturing post-smolts. Although the assumed migration route along the North Atlantic Current shelf edge is based on a few tag recaptures, this current in this area is likely to be the main carrier for post-smolts from Ireland, SW England and from remaining salmon rivers in Northwest Iberian peninsula and southwest France. Post-smolt catches from area 1 will represent a mixture of several stocks/populations. The salmon trawl (7 m deep and 40 m wide) will be used according to standard procedures in 0.5 * 1 h surface trawl tows to collect fish samples at determined cruise transects. The position (latitude and longitude) of the captures is routinely recorded in the electronic logs as well as towing speed and direction and other relevant data such as wind speed/direction and sea depth.

Participants: Lead – 2; Other 1, 15

<u>Sub-task 2.4.2</u> <u>C*ollect oceanographic data*</u>

Hydrographic data will be collected from vertical CTD-profiles (salinity, temperature, density and fluorescence) taken at each trawl station from 0 to 200m. Continuous thermosalinograph surface sampling (5 m depth) of temperature, salinity and fluorescence along the ships transects will be undertaken. Other relevant information, such as meteorological observations from the ship, satellite data (e.g. SST) etc. will also be collected. Acoustic Doppler Current Profiler (ADCP) measurements will be collected at the trawl stations.

Participants: Lead – 2; Other 15

Sub-task 2.4.3 *macro-plankton sampling for food availability*

The macro-plankton trawl will be towed at each trawl station according to protocols determined in sub-task 2.3.1, This fine-meshed trawl is equipped with a multiple cod-end to facilitate depth resolution of samples taken. Additionally, horizontal distribution of meso-zooplankton will be sampled with a traditional WP2 net hauled vertically from about 50 m (to be decided in sub-task 2.1.1) to the surface. Samples will
be fixed in formalin and made available for laboratory analysis

Participants: Lead – 2; Other 15

Sub-task 2.4.4 *Acoustic sampling for macro-plankton, associated fish species and predators*
Macro-zooplankton and juvenile fish (because of their swim bladders) can be identified in acoustic surveys. Continuous acoustic monitoring of fish and plankton will be undertaken using multi-frequency acoustic systems (e.g. Simrad). An assessment of acoustic data will be carried out on board for preliminary information on distributions and abundance of plankton per unit area/volume as well as co-occurring fish and potential predators. Further in-depth analyses can be carried out on the stored information in the macro-plankton database in future projects.

Participants: Lead – 2

Sub-task 2.4.5 *Biological sampling*
Each salmon captured will be sacrificed and a full range of biological samples will be taken:
length, weight, condition factor, sex, origin (wild or farmed), fin clips, presence of tags, cwt, sea lice levels, fin or opercular punches, scale sample, stomach preserved for analysis of contents.

Participants: Lead – 2

Task 2.5 Expedition 2 – Mid Norwegian Sea - North of Faroes – East of Iceland (Area 2 Figure 1.3.1)

Sub-task 2.5.1 *Experimental trawling for post-smolts*
This area has been the most intensively surveyed to date for salmon. Based on previous tag recaptures a mixing area for southern and mid European post-smolts as well as Norwegian post-smolts is likely to occur in this area. During this expedition from late June to July, the capture of a large number of post-smolts can be anticipated. The expedition to this area provides the best opportunity to obtain fish from a variety of stocks for the proposed analyses in WP3 and WP4. This expedition is will commence approximately one month after survey 1. The salmon trawl (7 m deep and 40 m wide) will be used according to standard procedures in 0.5 * 1 h surface trawl tows to collect fish samples at determined cruise transects. The position (latitude and longitude) of the captures is routinely recorded in the electronic logs as well as towing speed and direction and other relevant data such as wind speed/direction and sea depth.

Participants: Lead – 15

Sub-task 2.5.2 *Collect oceanographic data*
Hydrographic data will be collected from vertical CTD-profiles (salinity, temperature, density and fluorescence) taken at each trawl station from 0 to 200m. Continuous thermosalinograph surface sampling (5 m depth) of temperature, salinity and fluorescence along the ships transects will be undertaken. Other relevant information, such as meteorological observations from the ship, satellite data (e.g. SST) etc. will also be collected. Acoustic Doppler Current Profiler (ADCP) measurements will be collected at the trawl stations.

Participants: Lead – 15

Sub-task 2.5.3 *macro-plankton sampling for food availability*
The macro-plankton trawl will be towed at each trawl station according to protocols determined in sub-task 2.3.1,

This fine-meshed trawl is equipped with a multiple cod-end to facilitate depth resolution of samples taken. Additionally, horizontal distribution of meso-zooplankton will be sampled with a traditional WP2 net hauled vertically from about 50 m (to be decided in sub-task 2.1.1) to the surface. Samples will
be fixed in formalin and made available for laboratory analysis

Participants: Lead – 15

Sub-task 2.5.4 *Acoustic sampling for macro-plankton, associated fish species and predators*
Macro-zooplankton and juvenile fish (because of their swim bladders) can be identified in acoustic surveys. Continuous acoustic monitoring of fish and plankton will be undertaken using multi-frequency acoustic systems (e.g. Simrad). An assessment of acoustic data will be carried out on board for preliminary information on distributions and abundance of plankton per unit area/volume as well as co-occurring fish and potential predators. Further in-depth analyses can be carried out on the stored information in the macro-plankton database in future projects.

Participants: Lead – 15

Sub-task 2.5.5 *Biological sampling*
Each salmon captured will be sacrificed and a full range of biological samples will be taken:
length, weight, condition factor, sex, origin (wild or farmed), fin clips, presence of tags, cwt, sea lice levels, fin or opercular punches, scale sample, stomach preserved for analysis of contents.

Participants: Lead – 15

Task 2.6 Expedition 3 – North Norwegian – western Barents – east Greenland Sea (Area 3 Figure 1.3.1)

Sub-task 2.6.1 *Experimental trawling for post-smolts*
This area has not been consistently sampled for post-smolts, but sporadic bye-catches of post-smolts, in conjunction with IMR and Russian scientific surveys of pelagic fish stocks in these areas, indicate that young salmon are present. Sampling will be carried out using one research vessel for 16 days in late July- August over two years (2008 and 2009) along the 15°E longitude between Norwegian shelf edge at 69°N to West Spitzbergen at 79°N, plus additional transects to east and west. The salmon trawl (7 m deep and 40 m wide) will be used according to standard procedures in 0.5 * 1 h surface trawl tows to collect fish samples at determined cruise transects. The position (latitude and longitude) of the captures is routinely recorded in the electronic logs as well as towing speed and direction and other relevant data such as wind speed/direction and sea depth.

Participants: Lead – 1

Sub-task 2.6.2 *collect oceanographic data*
Hydrographic data will be collected from vertical CTD-profiles (salinity, temperature, density and fluorescence) taken at each trawl station from 0 to 200m. Continuous thermosalinograph surface sampling (5 m depth) of temperature, salinity and fluorescence along the ships transects will be undertaken. Other relevant information, such as meteorological observations from the ship, satellite data (e.g. SST) etc. will also be collected. Acoustic Doppler Current Profiler (ADCP) measurements will be collected at the trawl stations.

Participants: Lead – 1

Sub-task 2.6.3 *macro-plankton sampling for food availability*
The macro-plankton trawl will be towed at each trawl station according to protocols determined in sub-task 2.3.1, This fine-meshed trawl is equipped with a multiple cod-end to facilitate depth resolution of samples taken. Additionally, horizontal distribution of meso-zooplankton will be sampled with a traditional WP2 net hauled vertically from about 50 m (to be decided in sub-task 2.1.1) to the surface. A set of plankton samples from the macro-plankton trawl will be worked up on board (Expedition C only) while other samples will be fixed in formalin and made available for laboratory analysis.

Participants: Lead – 1

Sub-task 2.6.4 *Acoustic sampling for macro-plankton, associated fish species and predators*
Macro-zooplankton and juvenile fish (because of their swim bladders) can be identified in acoustic surveys. Continuous acoustic monitoring of fish and plankton will be undertaken using multi-frequency acoustic systems (e.g. Simrad). An assessment of acoustic data will be carried out on board for preliminary information on distributions and abundance of plankton per unit area/volume as well as co-occurring fish and potential predators. Further in-depth analyses can be carried out on the stored information in the macro-plankton database in future projects.

Participants: Lead – 1

Sub-task 2.6.5 *Biological sampling*

Each salmon captured will be sacrificed and a full range of biological samples will be taken: length, weight, condition factor, sex, origin (wild or farmed), fin clips, presence of tags, cwt, sea lice levels, fin or opercular punches, scale sample, stomach preserved for analysis of contents.

Participants: Lead – 1

Deliverables from WP2

D 2.1 - Cruise reports for 2008 (Month 5)
D 2.2 - Cruise reports for 2009 (Month 17)
D 2.3 - Tissues from marine samples for genetic and biological analysis (Month 5 and Month 17)
D 2.4 - Electronic data bases of biological information on marine samples (Month 5 and Month 17)

WP 3: Genetic identification of stock origin of samples

Work package no.	**3**	**Start date or starting event**			**Month 19**	
Work package title	**Genetic identification of stock origin of samples**						
Activity type	RTD						
Participant number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Person-months per Participant	14	4	16.5	2	0	11	2
Participant number	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Person-months per Participant	0	0	0	0	0	0	0
Participant number	**15**	**16**	**17**				
Person-months per Participant	0	0	0				

Objectives

To identify, in years two and three using the methodology developed (WP1), the region or river stock origin of salmon in the samples obtained (WP2) for use in WP5. The specific research need addressed by this work package is the determination of the region and/or river of origin of the fish samples captured or acquired.

Description of work

Task 3.1 Archival samples

Subtask 3.1.1 *Genetic typing*
The archival material assembled under task 2.1.2 will be genetically typed for the standard set of microsatellite and mtDNA loci, as well as for the newly developed regional markers from subtasks 1.3.2, 1.3.3 and 1.3.4.

Participants: Lead – 2; other 1, 3,4, 6

Subtask 3.1.2 *MSA and IA analysis to identify stock origin*
The data derived from subtask 1.4.1 will then be used with the optimised assignment protocol from Task 1.4.2 to determine if fish are European and to genetically assign European fish to their region and river/tributary of origin; genetic and phenotypic data on freshwater growth and age of smolting will be integrated into the assignment algorithm; output will be used in Task 4.1

Participants: Lead – 3; other 1,2,7

Task 3.2 Contemporary samples

Subtask 3.2.1 *Genetic typing*
The contemporary material assembled under Task 2.1.1 will be genetically typed (maximum for the standard set of microsatellite and mtDNA loci, as well as for the newly developed regional markers from subtasks 1.3.2, 1.3.3 and 1.3.4.

Participants: Lead – 1; other 2, 3, 6

Subtask 3.2.2 *MSA and IA analysis to identify stock origin*
The data derived from subtask 1.4.1 will then be used with the optimised assignment protocol from Task 1.4.2 to determine if fish are European and to genetically assign European fish to their region and river/tributary of origin; genetic and phenotypic data on freshwater growth and age of smelting will be integrated into the assignment algorithm output will be used in Task 4.1

Participants: Lead – 3; other 1,2,7

Deliverables from WP3
D 3.1 – Report on genetic assignment of archive samples to river/region of origin (Month 30)
D 3.2 - Report on genetic assignment of marine survey samples to river/region of origin (Month 30)

WP 4 : Biological Analysis of Samples

Work package no.	**4**	**Start date or starting event**				**Month 3**
Work package title	**Biological Analysis of Samples**					
Activity type	RTD					
Participant number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Person-months per Participant	20	11.7	0	15.75	0	0	0
Participant number	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Person-months per Participant	0	0	13.5	0	0	0	13.5
Participant number	**15**	**16**	**17**				
Person-months per Participant	0.5	0	0				

Objectives

The key objective of this work package is to characterise for growth, body condition, and key prey species and diet the salmon collected from the three key marine areas in 2008 and 2009 in work package 2. The research need addressed by this work package is the determination of the biological status of the fish captured, specifically;

- to train researchers in the new scale reading techniques,
- to develop historical material of growth from selected salmon stocks,
- to examine and estimate growth indices, body condition factor, and key prey species in diet of salmon collected from key marine areas in 2008 and 2009 (WP2),
- to examine feeding and food availability for post-smolts

Description of work

Task 4.1 Implementation of New Digital Scale Reading Methodology

Sub-task 4.1.1 *Training*

Scale imaging and reading will be carried out at four geographical centres, in Ireland, Norway, Finland and Iceland. A workshop will be held to train researchers from the four centres in the new scale reading techniques and in the use of the new imaging equipment purchased for the project. These new techniques, developed in the US, will be transferred to the project by inviting appropriate expertise for teaching. An important aspect of the workshop will be to ensure standardised scale (inter-calibration) reading procedures are implemented at the laboratories.

Participants: Lead – 4; Other 2, 10, 14

Task 4.2 Obtaining biological information from salmon scales

Subtask 4.2.1 *Reading of scale material from WP2*

Scale reading and digital analyses will be carried out in four geographical centres, in Ireland, Norway, Finland and Iceland, on up to 15,000 historical scale samples from approximately 15 salmon stocks.

Participants: Lead – 4; Other 2, 10, 14

Subtask 4.2.2 *Reading of scale samples collected in expeditions*

Contemporary scales collected in during the marine sampling will be digitally processed and information made available for WP 4 and 5.

Participants: Lead – 4; Other 2, 10, 14

Sub-task 4.2.3 *Establish digital scale library*

Growth data from scales collected at sea during the cruises (WP2), as well as data from historical scale samples from selected salmon stocks in several countries will be stored in a common database, establishing a digital scale image library. An important part of this major data acquisition task will be ensuring consistency in image interpretation between laboratories.

Participants: Lead – 4; Other 2, 10, 14

<u>Sub-task 4.2.4</u> *<u>Determination of growth indices from scale readings</u>*
Estimation of growth indices, using the electronic database with data from sub-task 4.2.1 and subtask 4.2.2.

Participants: Lead – 14; Other 4; 2, 10

Task 4.3 Feeding and food availability

<u>Subtask 4.3.1</u> *<u>Stomach analysis</u>*
Stomachs from approximately 900 salmon post smolts and 600 fish of other species co-occurring in the trawls will be analysed. Partner 1 will act as clearing house for stomachs from expedition 1 and 3. Stomachs from expedition 2 will be analysed by the Faroese fisheries laboratory. In the laboratory, total stomach weights and number and weights of key taxonomic groups will be recorded and entered into the project database. The post smolt feeding data and distribution will be analysed in relation to macro-plankton prey availability recorded during acoustic analysis on board (WP 2), size, condition, age and growth (i.e. to what extent the present feeding status is representative for historical growth). The degree of ecologic niche overlap will be inferred from analyses of the stomachs of co-occurring species. The material will be made available for further ecological analyses in WP 5.

Participants: Lead – 1; 15

Deliverables from WP4

D 4.1 - Electronic database of digital scale images and growth data (Month 23)
D 4.2 - Electronic data base of results of growth indices (Month 28)
D 4.3 - Final report on fish diet and stomach analyses (Month 28)

WP 5: Merge and analyse genetic, biological and oceanographic data

Work package no.	**5**	**Start date or starting event**				**Month 22**	
Work package title	**Merge and analyse genetic, biological and oceanographic data**						
Activity type	RTD						
Participant number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Person-months per Participant	8.5	1	1.25	2.25	0	1	0
Participant number	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Person-months per Participant	0	0	1.5	0	0	0	1.25
Participant number	**15**	**16**	**17**				
Person-months per Participant	1.25	0	0				

Objectives

To merge current data from the ocean model (ROMS) with results from WP 2, 3, 4 to develop a conceptual stock specific migration and ecological model for Atlantic salmon in their first year at sea. The specific research needs addressed by this work package are:

- the integration and analysis of specific stock distribution, biological and oceanographic information
- the use of new information for the advancement of models of marine ecology

Description of work

Task 5.1 Combined analysis of data

Sub-task 5.1.1 *Map spatial distribution of specific stocks or populations*
This sub-task will be to develop a GIS project based on geographical reference information collected during the marine surveys. The GIS will be interrogated to provide geo-referenced information on stock distributions, feeding areas (distribution of preferential prey items), oceanographic conditions (currents, temperature, fronts etc.) related to observed migration routes. The unique post smolt data set generated from WP2, WP3 and WP4 will be used to develop spatial, temporal distribution maps of specific stocks or groups of stocks. Such distribution charts can be utilized to visualise the movement of the young salmon and will be used for development of a migration and ecological model in Task 5.2.

Participants: Lead – 1; Others 2, 3,4,6,10,14,15

Sub-task 5.1.2 *Analysis of the distribution patterns associated with biological and oceanographic data*
An analysis of the relationships between the biological and hydrographic data from the surveys together with other available oceanographic data sets (e.g. gridded SST fields) will be carried out in order to determine the extent of the associations between posts smolt behaviour and physical and biological parameters. The expected results from these analyses will support the development of the migration and ecological model in task 5.2.

Participants: Lead –1; Other 2, 3,4,6,10,14,15

Task 5.2 Development of a conceptual migration and ecological model for young salmon at sea

Subtask 5.2.1 *Integration of post-smolt data with oceanographic fields from the ROMS model*
The advance in ecological models of salmon has been hampered by the lack of knowledge on behavioural processes that determine migration and distribution of salmon. To address this, a conceptual migration and ecological model will be developed by using oceanographic fields (such as ocean currents) from the ROMS ocean model, together with the post-smolt distribution data acquired in previous WPs. Several different biological and oceanographic associations/hypothesis on swimming behaviour identified in the previous sub-tasks (5.1.1 and 5.1.2), will be tested using a particle tracking model, which will be based on the velocity fields identified from the ocean model. The swimming behaviour, speed and direction, of the post smolts can be used as variables in the model. The results emanating from Task 5.1.1 will be used to refine the migration model. A workshop will be held to evaluate the efficacy of the model and the veracity of the different hypotheses on the behaviour of post smolts

produced. The results of this work package will generate new biological and oceanographic relationships that will improve our understanding of the key factors that determine the survival of post-smolts at sea e.g. response of salmon to oceanic climate change. These models will also be used to refine sampling strategies for future surveys. **Participants:** Lead – 1; Others 2, 3,4,10,14,15
Deliverables from WP5 **D 5.1** - GIS project on the statistical distribution of specific stocks, or stock groups (Month 33) **D 5.2** - Report on analyses of the relationships between distribution of post smolts with physical and biological variables (Month 33) **D 5.3** – Report describing a conceptual migration and ecological model (Month 33).

WP 6: Dissemination of Project Outputs

Work package no.	**6**	**Start date or starting event**				**Month 1**	
Work package title	**Dissemination of Project Outputs**						
Activity type	RTD						
Participant number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Person-months per Participant	0	0	0	0	0	0	0
Participant number	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Person-months per Participant	0	0	0	0	0	0	0
Participant number	**15**	**16**	**17**				
Person-months per Participant	0	1	3				

Objectives

To disseminate information and results obtained both internally and externally to the wider scientific community, the public and, in particular, relevant stakeholders including national governments, the EU and NGO's. This communication requirement will be addressed by:

- hosting a project website
- participating in an international scientific symposium and publishing symposium proceedings
- producing a non-technical atlas of the marine ecology of the Atlantic salmon

Description of work

Task 6.1 Creation and maintenance of a web site

The NASCO SALSEA web site will host SALSEA-Merge to facilitate internal project access to information by partners (restricted access) and give public access to the project results and reports as they emerge (unrestricted access).

Subtask 6.1.1 Creation of web pages
Appropriate web pages will be designed and constructed within the NASCO supported SALSEA website.

Participants: Lead – 1;

Subtask 6.1.2 Maintenance and updating of website
The project coordinator will regularly update and lodge reports, databases and appropriate material in conjunction with the NASCO web master will maintain this site.

Participants: Lead – 1, Other 16,17

Task 6.2 Symposium

A Symposium is to be arranged jointly by NASCO/ICES/PICES in 2010 to correspond with the end of the SALSEA-Merge project. This Symposium will bring together key scientists with the broader scientific community as well as representatives from NASCO, the EU, national government agencies, and other stakeholders including NGOs. The focus of the symposium will be to cover, and sum up information on: 1) the genetic assignment methods developed, 2) historical data sets and cruises carried out, 3) insights gained into stock specific distribution and migration patterns 4) revised models of Atlantic salmon marine ecology developed, 5) implications for species management and conservation, and 6) emerging research challenges. The symposium, building on feedback and discussions, will aid in the maximal exploitation of the information gathered during the project and provide a formal, peer-reviewed record of the scientific results.

Subtask 6.2.1 *Participation in symposium*
The symposium will allow an excellent avenue for dissemination of the results of SALSEA-Merge to the appropriate

scientific and management community

Participants: Lead – 17; Other - all partners

__**Subtask 6.2.2** *Assemble, review and edit proceedings papers*__
Participants will produce manuscripts for submission for peer review publications in the ICES Journal of Marine Science.

Participants: Lead – 17; Other - all partners

Task 6.3 Produce atlas

Effective assimilation and exploitation of the results of the project will be critically dependent on summarising and setting out in a simple, user friendly format the basic findings of the project. To achieve this, an atlas of the marine ecology of the species, focusing on the spatial distribution of the species, its constituent regional and river stock groups, will provide a minimally technical and easily digested graphical summary of the science outputs to ensure they reach the broadest possible audience.

__**Subtask 6.3.1** *Agree and assemble content*__

Participants: Lead – 16; Other- all partners

__**Subtask 6.3.2** *Design and production*__

Participants: Lead – 16; Other- all partners

Deliverables from WP6
D 6.1 - Operational Web site (Month 2)
D 6.2 - On line availability of reports and other project news (Month 1-36)
D 6.3 - Participation and presentation of papers at International symposium (Month 33)
D 6.4 - Completed stock distribution Atlas (pdf file) (Month 36)

WP 7: Project Management

Work package no.	7	Start date or starting event				Month 0	
Work package title	**Project Management**						
Activity type	MGT						
Participant number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Person-months per Participant	12	0	0	0	0	0	0
Participant number	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Person-months per Participant	0	0	0	0	0	0	0
Participant number	**15**	**16**	**17**				
Person-months per Participant	0	36	0				

Objectives

The aim of this work package is to provide high-level scientific project co-ordination, relevant organisational and financial securities, and project management support so as to secure the timely completion of project deliverables and reports. This work package also encompasses contact with the European Commission as required to meet project management needs.

Description of work

Task 7.1

The Institute of Marine Research, Norway, will serve as the coordinating body for the collaborative research project. The project coordinator will regularly contact the European Commission scientific officer, in most cases in the form of formal written reports, to inform him/her about the progress of the project:

Sub-Task 7.1.1 This work package will comprise the following activities:

- contract negotiations and completion
- consortium agreement, including provisions on the use of unpublished or proprietary information
- project summary for publication by the EU
- establishment of detailed provisions on cost documentation and reimbursement, and establishing the confidentiality provisions (model participant agreement)
- scheduling and organisation of project steering meetings, including preparation of minutes
- co-ordination of the activities in WP1-WP6 and contingency for troubleshooting support
- promotion of equal gender participation in project activities
- conducting of financial transactions and project-specific book-keeping
- preparation of annual/final financial report and collection of audit certificates from consortium members
- preparation of annual progress reports and final report
- liaison meetings with relevant EU institutions (DG Fish and others)

Deliverables from WP7

D 7.1 – Interim progress and financial reports, and independent reviewers report (Month 18)
D 7.2 - Final project and financial reports (Month 36)

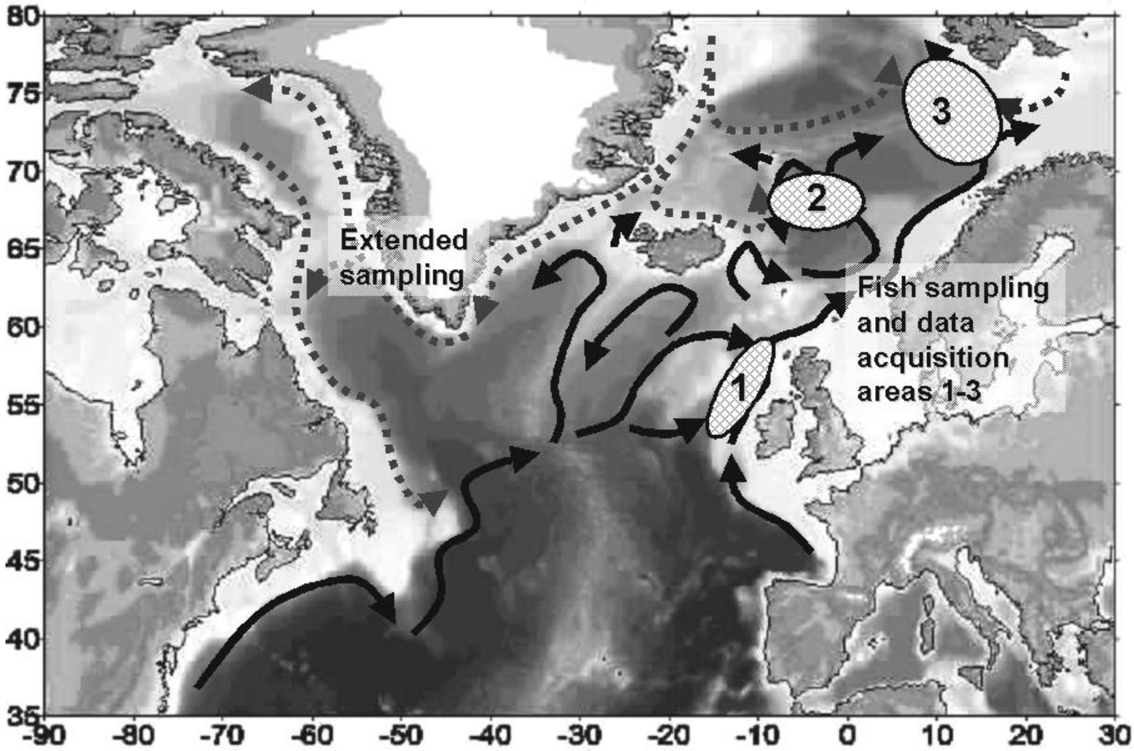

Figure B1.3.1 Proposed areas for marine sampling

Table B1.3d: Summary of staff effort

Participant No. /Short name	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total Person Months
1. IMR	21.75	33	14	20	8.5	0	12	109.25
2. MI	3.25	17.25	4	11.7	1	0	0	37.2
3. FRS	25.75	1	16.5	0	1.25	0	0	44.5
4. NINA	6.25	8	2	15.75	2.25	0	0	34.25
5. EXE	18.75	0	0	0	0	0	0	18.75
6. NUIC	18	0	11	0	1	0	0	30
7. QUB	19.75	0	2	0	0	0	0	21.75
8. US	19.75	0	0	0	0	0	0	19.75
9. DIFRES	8	0	0	0	0	0	0	8
10. IFL	6	3.5	0	13.5	1.5	0	0	24.5
11. UT	18.75	0	0	0	0	0	0	18.75
12. UO	4.5	0	0	0	0	0	0	4.5
13. GENI	4.5	0	0	0	0	0	0	4.5
14. FGFRI	0	0.5	0	13.5	1.25	0	0	15.25
15. FFL	0	18	0	0.5	1.25	0	0	19.75
16. AST	0	0	0	0	0	1	36	37
17. IASRB	0	0	0	0	0	3	0	3
	175	**81.25**	**49.5**	**74.95**	**18**	**4**	**48**	**450.7**

Table B1.3e: List of milestones

Milestone No	Milestone name	WPs involved	Expected date	Means of verification
1	Historical samples assembled	WP2	4	Data base and samples
2	2008 cruises	WP3	8	Report and samples
3	Optimal marker set produced	WP1	20	Report and markers
4	2009 cruises	WP2	19	Report and samples
5	Growth assessment method	WP4	20	Data base and indices
6	Growth analysis	WP4	24	Data base
7	Genetic baseline	WP1	23	Data base
8	Genetic tool validated	WP1	24	Report and methodology
9	Origin of samples identified	WP3	26	Data base
10	Integrated analysis completed	WP5	33	Maps and statistics
11	Symposium	WP6	33	Proceedings
12	Atlas produced	WP6	33	pdf File
13	Project completed	WP7	36	Final Report

B.2. Implementation

B.2.1 Management structure and procedures

B.2.1.1 Activity structure

Activities to be carried out under SALSEA-MERGE are partitioned into seven work packages - five scientific, one for dissemination, and one for coordination. The scientific work packages define discrete components of the overall science programme. These are:

- WP1: the development of the genetic tool for identifying the region/river of origin of marine samples of Atlantic salmon
- WP2: the collection and assembly of marine samples for analysis along with associated ecological data (WP2),
- WP3: application of the genetic tool to t identify the region/river of origin of marine samples of salmon,
- WP4: the biological analysis of marine samples
- WP5: the integration of genetic, biological and oceanographic information to generate ecological insights

Complementing these, WP6 addresses the important function of disseminating project outputs, including information collected and assembled in WP1-4, and the scientific outputs, which describe the ecological insights gained from the merging of the genetic and biological data in WP5. A separate work package, WP7, addresses the critical need for overall coordination and management of the project. The functional relationship of the packages is set out in Figures 1.3.1 and 1.3.2 and Figure 2.1.1

Work packages 5-7, focus on integration or co-ordination, and provide a strong over-arching management framework for the project, which will ensure that effort and resources are optimally focused on the timely delivery and dissemination of quality outputs. The major emphasis of work packages on integration and co-ordination is commensurate with the overall biological and organisational complexity of the project, and is critical to its successful completion. Also critical is the partitioning, within the overall management structure, of the scientific work into the five well, defined and largely operationally discrete packages, of which WP5, addresses its overall integration.

Overall project planning and monitoring of work package progress will be carried out by the Project Steering Committee (PSC), supported by two Co-ordination Groups (CGs). The PSC, led by the projects administrative co-ordinator, will meet to oversee work package activities and ensure the timely meeting of milestones and production of deliverables, and to address problems which cannot be dealt with at CG level and require a general project response. The PSC will also directly manage WPs 6 and 7. The PSC will be composed of the projects administrative co-ordinator, the projects scientific co-ordinator plus the co-chairs of the two CGs. The Chairman of the International Atlantic Salmon Research Board will also attend meetings of the PSC and will act as a liaison with other research elements of the overall SALSEA Programme and the IASRB. Work package leaders, and sub-task leaders may be co-opted to the PSC as required.

The effective communication among, and co-ordination of, the management network will be achieved by the overlapping membership of the PSC and CGs. The proposed structure will operate in a strategic framework and annual cycle of meetings of the different levels of management (Figure 2.1.1). Two meetings of the PSC are planned for each of the three years of the project. The CGs will meet and adopt a similar schedule and will where possible co-ordinate these meetings with PSC. The structure, combined with the strategic plan of the meetings, will ensure effective coordination and monitoring of all project elements while still, to a large degree, ensuring that work tasks can be carried out independently and efficiently.

This management structure facilitates maximum productive interaction among partners collaborating on work packages, minimizes coordination time and complications arising from a complex interaction of a large number of geographically dispersed partners. It will ensure that time is most efficiently and productively expended on meeting project milestones and producing deliverables of the highest quality. The overlapping membership and hierarchical structure also makes the management structure robust and will avoid being unnecessarily hampered by complicated and difficult to manage cross-package dependencies and interactions. At the same time, the overlapping structure and steering group composition, and strategic timing of steering group meetings will ensure there is good awareness across the project consortium of progress and issues. As such problems and progress can be addressed in a timely way to maximize the quality and level of realised project outputs.

Management structure
The projects administrative coordinator, an overall co-ordinator the of the SALSEA-Merge project (Dr Jens Christian Holst, IMR), through the PSC, will be responsible for the internal organization and supervision of the development of the project, including the management of activities, communications, and finances in accordance with the project's objectives. On behalf of the project's consortium, the coordinator will also be in charge of communicating with the EU's Commission Services.

The project's scientific coordinator, who will be funded and recruited separately to this application, will take overall responsibility for the technical aspects of the programme and will liaise directly with the Chairman of the International Atlantic Salmon Research Board to ensure harmonization of the SALSEA Merge initiative with the other components of the SALSEA Programme .

The leader of the genetics co-ordination group (GCG) will be Philip McGinnity (MI) the ecology co-ordination group (ECG) being led by Marianne Holm (IMR).

The project's 7 work packages will be assigned work package leaders as follows:
• WP1 – Eric Verspoor, FRS
• WP2 – Marianne Holm, IMR
• WP3 – Philip McGinnity, MI
• WP4 – Arne Johan Jensen, NINA
• WP5 – Kjell Arne Mork, IMR
• WP6 – Jens Christian Holst, IMR
• WP7 – Jens Christian Holst, IMR

The inter-relationship between these management groups is outlined in Figure 2.1.1.

Work package leaders will be responsible for ensuring that expectations and opportunities for research and collaboration are transparently communicated and well understood among all the teams contributing to their work packages, that responsibilities are clearly assigned and kept, that milestones and deliverables are achieved as required, that research plans and budgets are closely adhered to and adjusted as necessary, that problems and questions arising within or between teams are swiftly resolved, that task-based efforts within their work packages are orchestrated and synchronized within and across work packages, and that a synthetic perspective on the eventual integration of individual contributions prevails throughout the entire project.

As can be seen in an internationally distinguished expert in fisheries research will lead the institutional profiles each of the project's teams. These team leaders are responsible for carrying out, directly and through delegation to other members of their team, the tasks assigned to their teams by SALSEA-Merge research plan. This involves maintaining high scientific standards for all work in their teams, acting as a responsive liaison between their teams and the responsible work package leader, participating in annual coordination meetings, utilizing the budgets allocated to their teams in a manner that best contributes to SALSEA-Merge objectives in accordance with agreed levels of effort and funding, ensuring timely contributions by their teams towards the established milestones and deliverables, orchestrating work shared between teams with the involved other team leaders, fulfilling the reporting obligations of teams, and resolving any obstacles potentially encountered within their teams or through their interaction with other teams.

Individual participants in the SALSEA-Merge project will contribute to the tasks assigned to their teams and will take part in training and co-ordination meetings and task-related meetings as advised by their team leaders. The overall control and decision-making body of the SASEA-Merge project will be the responsibility of the PSC. In addition to on-going technical liaison through the scientific co-ordinator the PSC will, as required, assess the overall project in terms of progress, results, and plans. These assessments will be based on discussions between CG members, which will provide an opportunity for the systematic evaluation of each team's progress with regard to the assumed responsibilities. Mutual feedback on the functioning of the consortium will be exchanged, and, if applicable, solutions for identified difficulties will be discussed. Following these discussions, the steering committee may provide team leaders with a brief summary, containing action items if applicable. Upon an evident need, these discussions may be repeated at shorter intervals. As a result of the project-wide evaluations, the PSC may propose adjustments to the project's structure and budget. The steering committee will always consult team leaders before taking decisions that have critical implications for their teams. Similarly, team leaders will always consult the PSC when local decisions have implications for the consortium at large.

Communication provisions

Successful communication between all teams involved in the SALSEA-Merge project will be ensured through a suite of mutually complementary means:

• Email announcements by work package and team leaders and email-based discussions between participating team members will provide the generic day-to-day communication platform within the SALSEA-Merge project.

• A dedicated Web site will serve as the project's 'public face', providing salient information about the project's activities, in addition to general information about fisheries-induced evolution. In addition, the Web site's password-protected internal part will provide a flexible clearing house for the swift and smooth exchange of information emerging across the entire SALSEA-Merge network.

The preparation of reports will be a means of structured communication between all teams and SALSEA-Merge steering committee. The interim and final evaluation discussions described above will be strongly based on this input.

Annual meetings of the Project Steering Committee will bring together ecology and genetic area leaders to communicate achieved results and to plan next steps. One will be held at month 3, one at month 18 and one at month 30. To a large extent, task-related discussions and planning will take place during these meetings, and the provision of support and advice, in cases in which a partner is facing scientific, technical, or practical difficulties, will be an important function of these meetings. In addition the meeting at month 18 will include a whole consortium meeting. This will be to inform all members of progress and of the remaining challenges associated with the Project completion.
The Commission's Scientific Officer will be invited to all Consortium/General Assembly meetings in order to gain an overview of the projects progress. These would include the start-up meeting, the mid term meeting and the end of project meeting. Where necessary, the Scientific Officer would also be invited to the Steering Committee meetings. In

addition the Commission's Scientific Officer will be provided with access to the password protected internal project homepage.

To the degree necessary for the effective execution of tasks, visits of individuals will be arranged between teams. Such visits will provide important points of personal contact between participants collaborating between teams and will thus foster the orchestration of shared responsibilities, as well as the preparation of joint publications.

On occasion, it will be important to bring together, in the form of small task workshops, all teams involved in the work on a shared task. To prevent the project's organization from becoming too heavy, such workshops will, however, be the exception rather than the rule, as individual visits and the annual consortium meetings are likely to suffice for ensuring the successful orchestration of research efforts.

Several tasks will lead to the collaborative preparation of joint scientific publications among the members of different teams. The investment of efforts into this particular type of deliverable will be encouraged, since the peer-review process associated with publications in leading scientific journals will provide a welcome extra source of input and quality control for the project's research.

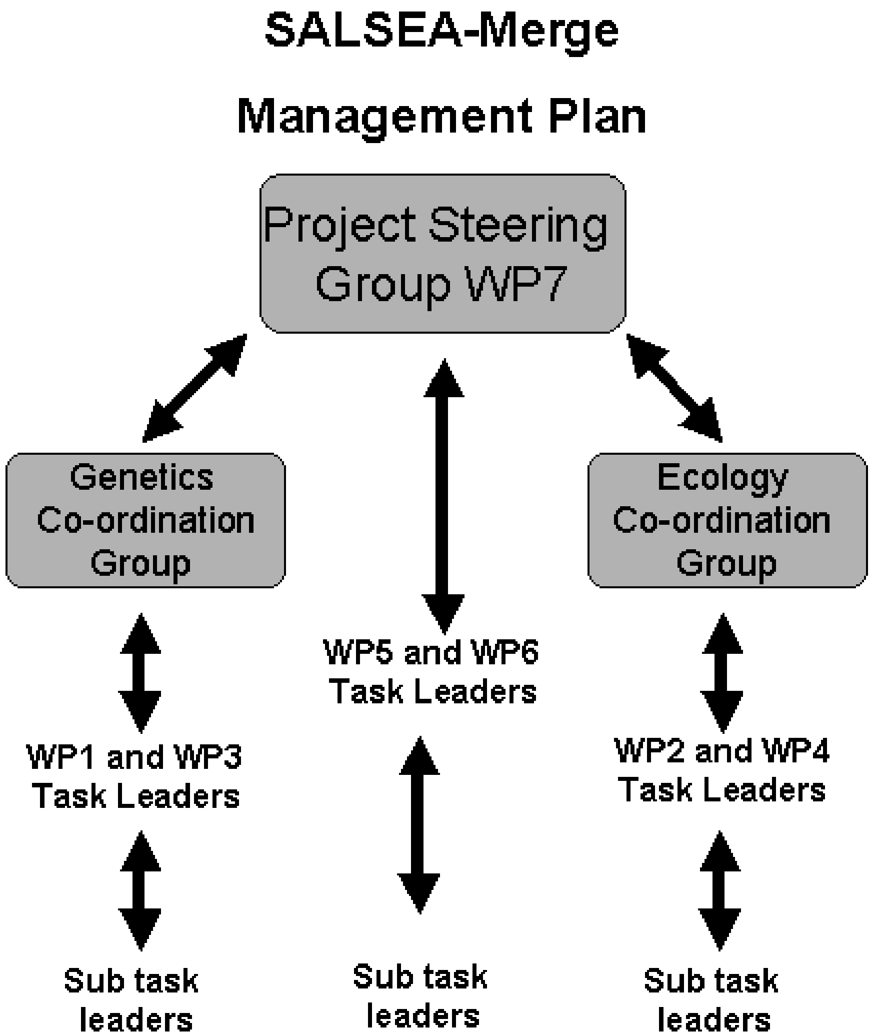

Figure B.2.1.1 Overall Management Network

Individual participants

Partner 1- Institute of Marine Research (IMR), Bergen, Norway

Main tasks: Project management; Marine data acquisition; Biological analysis of samples; Genetic baseline construction; Genetic stock identification; Migration distribution analysis

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Institute profile

The Institute of Marine Research (IMR), Bergen, is the principal research and advisory body for fisheries, marine resources, environment and aquaculture in Norway. IMR located in Bergen, SW-Norway has excellent facilities for both experimental and survey studies and is one of the largest and most comprehensive Marine Research Institutes in Europe. The IMR possess some of the most advanced marine research ships and laboratories in the world. Its facilities, which extend from the southern to the northern part of the country, include a chain of research and field stations, laboratories and 10 research vessels, ROVs and AUVs. In total, the Institute employs 650 persons and has an annual budget of 80 million Euro (www.imr.no). IMR has first-class expertise and experience in performing studies in the ecology and genetics of a range of marine organisms. The Institute has had long years of experience with coordinating and administering large-scale research projects both at national and international levels. The most recent is the MAR-ECO project (http://www.mar-eco.no/), where scientists from 16 nations around the northern Atlantic Ocean (including the USA and Canada) are participating in research of the waters around the mid-Atlantic Ridge from Iceland to the Azores.

Group profile

The current IMR research group consists of an interdisciplinary specialist team from several different IMR Research Divisions. It covers the marine ecology of the organisms the salmon are feeding on (macroplankton and fish) or competing with (various pelagic species), the salmon themselves as well as physical oceanography and hydrographical modeling, genetics and project administration. The team will associate with the extensive IMR expertise in acoustic monitoring of plankton and fish communities. The team has very large experience in carrying out marine expeditions.

Key personnel

Ms Marianne Holm is a senior scientist in the Pelagic Fish Research Group at IMR. She has wide research experience ranging from salmon ocean ranching experiments to salmon marine ecology. She has specialised on salmon behaviour, migration and marine distribution. She has 30 years of experience of marine expeditions, including planning of cruises and coordination of several ships at sea. Her recent publications (refereed journals, chapters in books and a large number of reports) concentrate on the distribution and ecology of salmon at sea. She has been member of several committees including the Scientific Steering Committee of the Wild Salmon Programme of the Research Council of Norway 2002 – 2007. She has been a member of ICES North Atlantic Salmon Working Group (NASWG) since 1982

Dr. Kjell Arne Mork, is senior Scientist in the IMR Oceanography Group and an affiliate of the Bjerknes Centre of Climate Research in Bergen, (a Norwegian Centre of Excellence). His research focus is on the variability and the dynamical processes (climate included) responsible for the hydrography and the circulation features of the Norwegian Sea. He has participated in several interdisciplinary projects analysing hydrographical and biological data for modelling purposes, a.o. studies of salmon at sea. He has been leading hydrographical data collection at expeditions. He is leading the IMR environmental monitoring project for the Norwegian Sea (hydrography, nutrients, phyto- and zooplankton). He participates in several national and international committees such as the International Polar Year, the ICES ”Working Group on Oceanic Hydrography” and “Planning Group on Northeast Atlantic Pelagic Ecosystem Surveys” (PGNAPES).

Dr. Vidar Wennevik is a senior scientist in the Population Genetics and Ecology research group at IMR. His research interests include population genetics of fish species, interactions between farmed and wild salmon, and the application of genetic methods and statistical tools in the management of fish populations. He is a member of the ICES North Atlantic Salmon Working Group (NASWG).

Dr. Webjørn Melle is a senior scientist and head of the Plankton Research Group at IMR. His main research interests include zooplankton ecology and population dynamics in relation to environmental conditions and climate variability in particular. Other research interests have been the effect of zooplankton dynamics on fish growth and migration in oceanic habitats, and the suitability of plankton as feed resource for reared fish.

Dr. Øystein Skaala is a senior scientist in the Population Genetics and Ecology research group at the IMR. His work has included population genetic studies on salmonids, and interactions between wild and farmed salmon, and he has published extensively within these fields.

Recent relevant publications

Haugland, M., Holst, J. C., Holm, M., and Hansen, L. P. 2006. Feeding of Atlantic salmon (Salmo salar L.) post-smolts in the Northeast Atlantic. ICES Journal of Marine Science, 63: 1488-1500.

Holm, M., Holst, J.C., And Hansen, L.P. 2000. Spatial and temporal distribution of post-smolts of Atlantic salmon (Salmo salar L.) in the Norwegian Sea and adjacent areas. - ICES J. Mar. Sci., 57:955 – 964.

Olsen, E. M., W. Melle, S. Kaartvedt, J.C. Holst and K.A. Mork, 2007. Spatially structured interactions between a migratory pelagic predator, the Norwegian spring-spawning herring Clupea harengus L., and its zooplankton prey. Journal of Fish Biology, Volume 70, Number 3, pp. 799-815(17).

Mork, K.A. and J. Blindheim, 2000: Variations in the Atlantic inflow to the Nordic Seas, 1955-1996. Deep-Sea Res. I 47: 1035-1057.

Skaala, Ø., Wennevik, V., and Glover, K.A. 2006. Evidence of temporal genetic change in wild Atlantic salmon, Salmo salar L., populations affected by farm escapees: Interactions between Aquaculture and Wild Stocks of Atlantic Salmon and other Diadromous Fish Species: Science and Management, Challenges and Solutions. ICES Journal of Marine Science 63: 1224-1233.

Partner 2 - Marine Institute (MI), Furnace, Newport, Ireland

Main tasks: Project management; Marine data acquisition; Biological analysis of samples; Development of genetic markers; Genetic baseline construction; Genetic stock identification; Migration distribution analysis

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Institute profile

The Marine Institute is Ireland's national agency with the following general functions: to undertake, to co-ordinate, to promote and to assist in marine research and development and to provide such services related to marine research and development, that in the opinion of the Institute will promote economic development and create employment and protect the environment." The Marine Institute, established under statute in 1992 has grown rapidly in the intervening period. In 2006, the Institute has a staff of 147 people, located in 11 facilities around Ireland.

Group profile

The Aquaculture and Catchment Management Service Group is responsible for delivering scientific services in relation to salmon, aquaculture, sea trout, eels and some aspects of experimental inshore fisheries. Experimental work has been ongoing in Newport since 1955 to investigate all aspects of salmonid biology both in artificially reared and wild populations. Since that time it has attained a high international reputation for elucidating salmonid life history strategies, environmental and ecological field studies in addition to the development of ocean ranching and husbandry methodologies. Staff expertise complements successes in these fields.

Key personnel

Dr. Ken Whelan worked for the Central Fisheries Board from 1980 to 1989, where he acted as principal advisor to the Board on the management of salmon and sea trout stocks. He was appointed. Director of the Salmon Research Agency in 1989 and served in that capacity until his appointment, in July of 1999, as an Executive Director of the Marine Institute. In this capacity he acts as advisor to the Minister and Department of Communications, Marine and Natural Resources on all matters relating to salmon stocks. He also advises the Department on a broad range of policy areas, relating to fin fish aquaculture, freshwater fisheries, freshwater environment, and fish habitat. He is currently President of the North Atlantic Salmon Conservation Organisation (NASCO). He has been published widely in these fields.

Dr. Niall O'Maoileidigh is currently a Section Manager in the Aquaculture and Catchment Management service group of the Marine Institute. He is Chairman of the Standing Scientific Committee of the National Salmon Commission of Ireland, Chairman of ICES's Diadromous Fish Committee, and was formerly Chairman of the ICES North Atlantic Salmon Working Group (NASWG). He is also a scientific advisor to the Foyle Fisheries Commission. Dr. Maoileidigh's research interests include fish stock assessment, salmon life history modeling, and the study of salmon at sea. He has been published widely in these fields

Dr. Philip McGinnity joined the Marine Institute (formerly the Salmon Research Agency of Ireland) as a biologist in 1990. His research activities, for which he has been published extensively, include development of salmonid fishery management strategies, population genetics of salmon, salmon population and production dynamics, aquatic habitat inventory methodologies and Geographical Information Systems. He has successfully undertaken a large number of EU funded projects (AIR 1-CT92-0719; LIFE 93/UK/A32/UK3167; LIFE98/ENV/UK/000607; Climate and Environment – PL970936; [Q5RS-2001-01185], [QLK5-CT1999-01546], and nationally ([IR.95.MR.023]; [IR.97.MR.015]; [MRM A119]; [TRAM 2002]; [2002-W-DS9-M1]; [NDP, 2006 – 002]).

Recent relevant publications

McGinnity, P., Prodohl, P., O Maoileidigh, Hynes, R., Cotter, D., N., Baker, N., O Hea, B. and Ferguson, A. (2004). Differential lifetime success and performance of native and non-native Atlantic salmon examined under communal natural conditions. Journal of Fish Biology, 62 (Supplement A), 1-15.

McGinnity, P., Prodohl, P., Ferguson, A., Hynes, R., O Maoileidigh, N., Baker, N., Cotter, D., O Hea, B., Cooke, D., Rogan, G., Taggart, J. and Cross, T. (2003) Fitness reduction and potential extinction of wild populations of Atlantic salmon, Salmo salar, as a result of interactions with escaped farm salmon. Proc. R. Soc. Lond. B, DOI 10.1098/rspb.2003.2520.

McGinnity, P., Stone, C., Taggart, JB., Cooke, D., Cotter, D., Hynes, R., McCamley, C., Cross, T. and Ferguson, A. (1997) Genetic impact of escaped farmed Atlantic salmon on native populations: use of DNA profiling to assess freshwater performance of wild, farmed and hybrid progeny an a natural river environment. ICES Journal of Marine Science, Vol 54, No. 6.

O'Maoileidigh, N., McGinnity, P., Prevost, E., Potter, E.C.E., Gargan, P., Crozier, W.W., Mills, P. and Roche, W. (2004). Application of Pre-fishery Abundance modelling and Bayesien Hierarchical Stock and Recruitment Analysis to the provision of precautionary catch advice for Irish salmon fisheries. ICES Journal of Marine Science: 61, 1370-1378.

Whelan, K.F. International Atlantic Salmon Management – A Model for Marine Resource Strategy. Went Memorial Lecture 2005, *Royal Dublin Society*, 24pp

Youngson, A.F., Jordan, W.C., Verspoor, E., McGinnity, P., Cross, T. and Ferguson, A. (2002). Management of salmonid fisheries in the British Isles: towards a practical approach based on population genetics. Fisheries Research 62, p 1-17.

Partner 3 – Fisheries Research Services, Freshwater Laboratory, Pitlochry, Scotland, UK

Main tasks: Development of genetic markers; Genetic baseline construction; Genetic stock identification; Migration distribution analysis

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Institute profile
Fisheries Research Services (FRS) is Scotland's national centre for research on fisheries, aquaculture, and the aquatic environment. FRS is an agency of the Scottish Executive (SE), is based at the Marine Laboratory, Aberdeen and the Freshwater Laboratory, Pitlochry, and runs a number of field stations in support of its work. It is part of the Environment and Rural Affairs Department (ERAD) of the Scottish Executive, whose mandate is to support and enhance rural life, rural communities, and the rural economy. The institute provides expert scientific and technical advice on the sustainable management of marine and freshwater fisheries, founded on a programme of research, monitoring, and assessment of the resources in Scotland. This is to ensure, as far as possible, that the policies and regulatory activities of Government are supported by full and up-to-date knowledge. FRS employs approximately 350 persons and has an annual budget of around 35 M€.

Group profile
The FRS Freshwater Programme is based at the Freshwater Fisheries Laboratory (FFL), Faskally, Pitlochry (Perthshire) and at ancillary facilities in Montrose (Angus), Deeside (Aberdeenshire), Almondbank (Perthshire), and Shieldaig (Wester Ross). FFL is responsible for monitoring the status of freshwater (and migratory) fish populations in Scotland. It conducts wild fish population monitoring (going back more than 40 years) and research in support of scientific advice provided to the Scottish Executive to help protect fish and promote the development of sustainable fisheries. Laboratory staff
also contribute to the salmon management activities of the International Council for the Exploration of the Sea (ICES) and to the North Atlantic Salmon Conservation Organization (NASCO). Work on salmon and sea trout continues to form the majority of the research programme because of their high economic value and consequent heavy demand for stock management advice.

Key personnel
Dr. Eric Verspoor is a molecular population geneticist and the principal research scientist leading the Conservation and Restoration group at FRS FFL. His main focus is the application of genetics to fisheries management. He has research interests in fish phylogeography, genetic population structuring, population adaptation, biodiversity conservation, salmonid stock restoration, and the genetic impacts of fishery and management practices. He has been working in the area for over 23 years and published over 90 scientific articles. He has been involved over the years in EU-funded research programmes on salmonid and marine fish in support of CFP and under FAR, FAIR, and FP6. He is currently involved as a principal researcher in the recently launched FP6 GENIMPACT project.

Dr. John Gilbey is a population genetics modeler with the Conservation and Restoration group at FFL. His main fields of research include salmonid genome structure, salmonid population and genetic modeling, impact of cultured conspecifics on wild populations, impact of variations in environ-mental and anthropomorphic pressures on salmonid population demographic and genetic structures, and salmonid genotype/fitness relationships. John Gilbey has been involved in the quantitative trait loci (QTL) mapping of genes involved in growth, development, maturation, and parasite resistance in Atlantic salmon. He published the first partial microsatellite linkage map of the Atlantic salmon genome. He is responsible for the development of an empirically derived, individual based model of salmon population demographics. He is at present developing a genetic component to the demographic model, which will link genotype to fitness, and will allow examination of the influence of changes in management practices, fishery pressures, and environmental stressors on population structure, genetic make-up, and fitness.

Recent relevant publications

King, T.L., Verspoor, E., Spidle A. P., Gross, R., Phillips, R. B., Koljonen, M-L., Sanchez, J.A. & Morrison, C.L. (2007). Biodiversity & Population Structure. Chapter 5, In The Atlantic Salmon: Genetics, Conservation & Management (Verspoor, E., Stradmeyer, L & Nielsen, J.L., eds). Blackwell Publishing, Oxford. 500pp.

Gilbey, J., Verspoor, E., Mo, T.A., Jones, C. & Noble, L. (2006). Identification of genetic markers associated with Gyrodactylus salaris resistance in Atlantic salmon (Salmo salar L.). Journal of Fish Diseases 71: 119-121.

Herbinger, C.M, O'Reilly, P.T. & Verspoor, E. (2006) Unravelling first generation pedigrees in wild endangered salmon populations using molecular genetic markers. Molecular Ecology 15: 2261-2275.

Verspoor, E. (2005) Regional differentiation of North American Atlantic salmon (Salmo salar) at allozyme loci. Journal of Fish Biology 67 (Supplement A): 80-103.

Verspoor, E., Beardmore , J.A., Consuegra, S., Garcia de Leaniz, C. Hindar, K. Jordan, W. C. Koljonen, M-L. Mahkrov, A. A, Paava, T. Sánchez, J.A. Skaala, O. Titov, S. & Cross T.F. (2005) Population Structure in the Atlantic Salmon: Insights From 40 Years of Research into Genetic Protein Variation. Journal of Fish Biology 67 (Supplement A): 3-54.

Partner 4 – Norwegian Institute for Nature Research

Main tasks; Biological analysis of samples; Genetic baseline construction; Genetic stock identification; Migration distribution analysis

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Institute profile

The Norwegian Institute for Nature Research (NINA) is Norway's leading institution for applied ecological research. NINA is responsible for long-term strategic research and commissioned applied research to facilitate the implementation of international conventions, decision-support systems and management tools, as well as to enhance public awareness and promote conflict resolution. NINA's activities encompass resource assessment and monitoring, development of methodologies, environmental impact assessments, community-based resource management, and analysis of natural, anthropogenic and socio-economic aspects of biodiversity and resource management. NINA's staff offers comprehensive and up-to-date scientific expertise, and guarantees top-quality services in commissioned research and consultancy tasks.

Group profile

NINA has a long tradition in ecological research on Atlantic salmon, brown trout and Arctic charr, and has more recently added population genetics and socio-economics of wild salmonids into its research repertoire. Freshwater- and marine ecology of salmonid fishes, their demographic and population genetic structure, and their exploitation by humans are studied in several locations along a wide geographic scale ranging from 58^{o} N to 71^{o} N at the Norwegian coast, as well as on the Svalbard archipelago at 74-80^{o} N. Long-term studies provide time series suitable for the study of climatic effects on salmonids fishes. These data series are also highly relevant for understanding their viability in relation to management (including harvesting and interactions with farmed fish). Moreover, NINA has two research stations located in the southern and northern part of Norway. In these stations, experiments on adaptations in near-natural situations can be carried out in southern and northern environments, respectively.

Key Personnel

Dr. Arne Johan Jensen is a Senior Research Scientist with long experience in studying salmonid ecology, life history traits and effects of climate change on salmonid populations. His research focuses on growth, including modeling of growth, and survival of salmonids in relation to key environmental factors such as water temperature and discharge. He has also wide experience in fish population management. Jensen has published more than 60 scientific papers.

Dr. Lars Peter Hansen is a project manager of many research projects: Life history of Atlantic salmon (freshwater and marine), salmon ranching, salmon culture, interactions between salmon culture and wild salmon, salmon fisheries and assessments of fisheries, and basic and applied research in fish ecology and behaviour. He has an active involvement in several interdisciplinary projects in fish physiology, parasitology and genetics. Hansen has published almost 120 scientific papers.

Dr. Kjetil Hindar is a Senior Research Scientist who specialises in population genetics and population ecology of salmonid fishes. He is particularly interested in how salmonid fishes are structured within and among populations, and on how humans and human-caused environmental perturbations affect this structuring. Hindar has published more than 60 scientific papers, primarily on Atlantic salmon and other salmonid fishes, and is a member of the government-appointed Norwegian Biotechnology Advisory Board.

Recent relevant publications

Friedland, K.D., Hansen, L.P., Dunkley, D.A. & MacLean, J.C. 2000. Linkage between ocean climate, post-smolt growth and survival of Atlantic salmon (Salmo salar L.) in the North Sea area. ICES Journal of Marine Science 57: 419-429.

Hansen, L.P., Holm, M., Holst, J.C. & Jacobsen, J.A. 2003. The ecology of Atlantic salmon post-smolts. In Mills, D. (ed). Salmon on the edge, Blackwell Science, Oxford, pp. 25-39.

Hindar, K., Tufto, J. Sættem, L.M. & Balstad, T. 2004. Conservation of genetic variation in harvested salmon populations. ICES Journal of Marine Science 61: 1389-1397.

Jensen, A.J., Zubchenko, A.V., Heggberget, T.G., Hvidsten, N.A., Johnsen, B.O., Kuzmin, O., Loenko, A.A., Lund, R.A., Martynov, V.G., Næsje, T.F., Sharov, A.F. & Økland, F. 1999. Cessation of the Norwegian drift net fishery: Changes observed in Norwegian and Russian populations of Atlantic salmon. ICES Journal of Marine Science, 56: 84-95.

Jonsson, B., Forseth, T., Jensen, A.J. & Næsje, T.F. 2001. Thermal performance in juvenile Atlantic salmon, Salmo salar L. Functional Ecology, 15: 701-711.

Partner 5 – University of Exeter, School of Biosciences

Main tasks: Genetic baseline construction; Genetic stock identification.

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Institute profile

The University of Exeter was established in 1922 and gained its Charter in 1955. Today it is one of the UK's leading universities with 13,500 students at campuses in Exeter and Cornwall, and research income of more than £30m a year. The University was ranked among the top 20 UK universities in a recent Sunday Times poll of more than 100 institutions. The School of Biosciences (http://www.biosciences.ex.ac.uk/) engages in a wide variety of research, which ranges from fundamental studies of how biological molecules function, to developing an understanding of how organisms interact with one another within the ecosystems they occupy. The complementary expertise of staff within the School facilitates a vibrant research culture. The School is organized into six research groups and takes full advantage of the attributes of its location in the South-West Peninsula as a unique environment in which to undertake environmental, ecological and conservation studies.

Group profile

Dr Jamie Stevens joined the University of Exeter in 1998 to undertake a Wellcome Trust Biodiversity Fellowship. His research group occupies the Molecular Systematics laboratory (http://www.projects.ex.ac.uk/meeg/) and forms part of the Molecular Ecology and Evolution research group. Dr Stevens' group has extensive experience in the use of molecular techniques for evolutionary and population genetics analysis of a range of organisms, including fish, mammals, parasites and pathogens. The group has been a partner in two previous EU-funded programmes (ASAP, ASAP2, within the INTERREG IIIB programme), in which personnel have undertaken genetic characterisation studies of Atlantic salmon; this work is now being prepared for publication. The Molecular Systematics laboratory has a full suite of genetic equipment, including a dedicated automated sequencer.

Key Personnel

Dr. Jamie Stevens is an evolutionary biologist and molecular population geneticist, and is the leader of the Molecular Ecology and Evolution research group. He has been working in the field for over 20 years and has published more than 70 scientific articles since 1989. He has research interests in evolutionary and population genetics questions pertaining to a range of organisms, including fish, mammals, parasites and pathogens. In 2001, in collaboration with a local rivers trust, he began a programme of research into salmonid population genetics in rivers in south-west England with the aim of facilitating informed management practices in the south-west rivers. Subsequently, he has been involved in several EU-funded research programmes, notably the Atlantic Salmon Arc Project (ASAP), an INTERREG IIIB programme in which his group, together with partner laboratories in Ireland and Spain, successfully characterised over 5000 Atlantic salmon; this work is now being prepared for publication.

Relevant recent publications

Stevens, J.R., Griffiths, A.M., Garcia-Vasquez, E., et al. (2006) The Atlantic Salmon Arc Project (ASAP): construction of a spatial database of genetic population profiles for Atlantic salmon (Salmo salar) to facilitate the sustainable management and conservation of this trans-national migratory species Journal of Fish Biology 69: 250-251 Suppl. C.

Griffiths, A., Stevens, J. and Bright, D. (2006) The, population structure of brown trout (Salmo trutta) on Dartmoor National Park (England) and short-term temporal stability of microsatellite markers. Journal of Fish Biology 69: 258-259 Suppl. C.

Griffiths, A., Bright, D. and Stevens, J.R. (in press) Can genetic stock identification (GSI) be usefully be applied to Atlantic salmon (Salmo salar)? A short history of GSI and an evaluation of its potential for success. Journal of Fish Biology (invited review, special edition, guest editors: Verspoor, E. and King, T.).

Partner 6 - National University of Ireland, Cork

Main tasks: Development of genetic markers; Genetic baseline construction; Genetic stock identification; Migration distribution analysis

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Group profile

The Department of Zoology, Ecology & Plant Science's Aquaculture & Fisheries Development Centre(now part of the Environmental Research Institute) was established in 1988 as a centre of excellence within the University to serve the R & D needs of the growing Irish aquaculture industry. In the past, it has played a significant role in this capacity through involvement in numerous national (Marine Institute of Ireland) and EU-funded programmes (FAR, AIR, FAIR, COMETT, LEONARDO, FORCE, SOCRATES and TMR - Marie Curie Fellowships) through a succession of projects including general aquaculture, genetics and immunology. The AFDC has a full suite of genetic laboratories. The genetic research group led by Professor Cross who has extensive experience in molecular genetic analysis of wild fish population structures and of cultured strains, and their interactions.

Key Personnel

Professor Tom Cross is Associate Professor of Zoology and has 33 years of experience in molecular genetics in fisheries and aquaculture. He has received research funding of more than 2.5 M Euro from the European Commission (e.g. co-ordinator of FAR MA-2-480, partner on AIR 1-CT92-0719, FAR MA-3-781, FAIR CT95-0282, FAIR CT96-1520, FAIR CT97-3544, Q5RS-2001-01185, QLRT-2001-01056 and supervisor of HCM and Marie Curie fellows), and also from Irish, UK, US and Canadian sources. He has acted as EC FAR and AIR assessor and served on the advisory committees to formulate the aquaculture genetics components of Frameworks 4, 5 and 6. He has published over 100 scientific papers, mostly in the area of molecular genetics, and has been invited speaker at several International conferences. He is also Irish delegate on the ICES WG on the application of genetics to Fisheries and Mariculture. Professor Cross was the Director of the Aquaculture Development Centre (ADC) until its incorporation into the Environmental Research Institute (ERI).

Recent relevant publications:

Coughlan, J., Stefansson, M., Galvin, P., FitzGerald, R. and Cross, T.F. 2000. Isolation and characterisation of 11 microsatellite loci in Atlantic halibut (Hippoglossus hippoglossus L.) Molecular Ecology, 9, 822-824.

Cross, T. F. 2003. Genetic effects on wild fish and invertebrates of accidentally or deliberately introduced cultured organisms. In Davenport, J., Black, K., Burnell, G., Cross, T., Culloty, S., Ekaratne, S., Furness, B., Mulcahy, M. and Thetmeyer, H. (eds.). Aquaculture: the Ecological Issues. British Ecological Society, 55-64.

McGinnity, P., Prodöhl, P., Ferguson, A., Hynes, R., Ó'Maoiléidigh, N., Baker, N., Cotter, D., O'Hea, B., Cooke, D., Rogan, G., Taggart, J. and Cross, T. 2003. Fitness reduction and potential extinction of wild populations of Atlantic salmon, Salmo salar, as a result of interactions with escaped farm salmon. Proceedings of the Royal Society B, 270,2443-2450.

McGinnity, P., Stone, C., Taggart, J. B., Cooke, D, Cotter, D., Hynes, R., McCamley, C., Cross, T. and Ferguson, A. 1997. Genetic impact of escaped farm Atlantic salmon (Salmo salar L.) on native population: use of DNA profiling to assess freshwater performance of wild, farm and hybrid progeny in a natural environment. ICES Journal of Marine Sciences, 54, 998-1008.

Youngson, A., Jordan, W.C., Verspoor, E., McGinnity, P., Cross, T. and Ferguson, A. 2003. Management of salmonid fisheries in the British Isles: towards a practical approach based on population genetics. Fisheries Research, 62, 193-209.

Partner 7 – A partnership between two independent research groups within Queen's University Belfast (QUB), Belfast, Northern Ireland, UK: 1- Fisheries Genetics and Molecular Ecology Laboratory (FGMEL), and 2- The Fisheries and Aquatic Ecosystems Branch (FAEB)

Main tasks: Development of genetic markers; Genetic baseline construction; Genetic stock identification.

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Institute profile

The School of Biological Sciences has over 36 full-time academic staff divided in three main research groups: Ecology and Evolutionary Biology (EEB), Molecular Biology and The Institute of Agri-Food and Land Use. Research emphasis is on the biosciences from the molecular to the ecosystem. Research, within the School, ranges from human, animal and environmental health, to the sustainable exploitation of living resources and rural development.

Group profile (FGMEL)
The FGMEL is part of the EEB Research Group, which is comprised of 14 full-time academic staff. Members of this research cluster are involved in a wide range of projects in Ecology and Evolutionary Biology. Research includes broad areas of Ecology (Marine, Freshwater and Terrestrial), Behavioural Ecology; Ecophysiology, Animal Behaviour; Molecular Ecology, Conservation (including Conservation Genetics), Aquaculture, Systematics (both Molecular and Morphological). Additional research facilities existing within the EEB group include C-Mar, the Centre for Marine Resources and Mariculture (www.qub.ac.uk/bb/cmar/), and Quercus, a major research centre for biodiversity and conservation biology in Northern Ireland, which include a genomic molecular facility (www.quercus.ac.uk). Within the EEB group, the FGMEL has a strong international reputation in genetic research, which is primarily focused on the areas of biodiversity, population and conservation genetics, and aquaculture of finfish and shellfish. Equipped with a range of 'state of the art' molecular facilities, including automated sequencer/genotyper, the Laboratory is renowned by its personnel expertise in the development, application and analyses of modern molecular methodologies such as microsatellite DNA profiling, AFLP, in addition to RFLP and sequencing analysis of both mtDNA and nuclear genes. These are routinely used in a number of projects orientated towards furthering our understanding of factors affecting levels and distribution of genetic diversity, the population genetic structure, evolutionary patterns, and life history variation of organisms.

Key personnel
Dr. Paulo A. Prodöhl is the head of the FGMEL, which is currently comprised of ten active research personnel including PDRAs and PhD students. He has over 14 years experience on the development, application, and analysis of a wide range molecular methodologies in population genetics. His research interest, summarized in his many publications, is focused in the areas of biodiversity, population and conservation genetics, and aquaculture of finfish and shellfish. Among other activities, Dr. Prodöhl is: Convenor of the Genetic Degree Board of Queen's University Belfast; member of C-Mar (Centre for Marine Resources and Mariculture) Management Committee and Advisory Board; member of the QUERCUS Management Committee; Coordinator of the QUERCUS Genomic Facility; and member of the ICES Working Group on the Application of Genetics in Aquaculture and Fisheries Management (WGAGAFM). Over the past ten years, he has been directly involved in the writing, supervision, and delivery of successful research projects amounting to over £2.6M from a number of national and international sources, including European Commission, NERC, EHS-DOE, Royal Society, Norwegian Research Council, and the HEA (North South Research Program)

Dr Rosaleen Hynes is an Experimental Officer based at the FGMEL. She has over 18 years experience on the development and use of molecular methodologies as applied to population genetics, an area that she has contributed for an extensive number of publications.
Recent relevant publications
Chapman, D. D., Prodöhl, P. A., Gelsleichter, J., Manire, C. and Shivji, M. (2004). Predominance of genetic monogamy by females in a hammerhead shark, Sphyrna tiburo: Implications for shark conservation. Molecular Ecology 13: 1965-1974.
Jørstad, K.E., Prodöhl, P. A., Agnalt, A.-L., Hughes, M., Apostolidis, A., Triantaphyllidis, A., Farestveit, E., Kristiansen, T., Mercer, J. and Svåsand, T. (2004). Sub-Arctic populations of European lobster (Homarus gammarus) in Northern Norway. Environmental Biology of Fishes, 69: 223-231.
McGinnity, P., Prodöhl, P., Ferguson, A., Hynes, Ó Maoiléidigh, R. N., Baker, N., Cotter, D., O'Hea, B., Cooke, D., Rogan, G., Taggart, J. and Cross, T. (2003). Fitness reduction and potential extinction of wild populations of Atlantic salmon Salmo salar as a result of interactions with escaped farm salmon. Proceedings of the Royal Society B, 270: 2443-2450.
Nelson, W. S., Prodöhl, P. A. and Avise, J. C. 1996. Development and application of long-PCR for the assay of full-length animal mitochondrial DNA. Molecular Ecology. 5:807-810.
Prodöhl, P. A., Taggart, J. B. and Ferguson, A. (1994). Single locus inheritance and joint segregation analysis of minisatellite DNA single locus probes in the brown trout (Salmo trutta L). Heredity. 73, 556-566.

Group profile (FAEB)
The Fisheries and Aquatic Ecosystems Branch (FAEB) of the Queen's University of Belfast is based at the Agri-Food and Biosciences Institute in Belfast (www.afbini.gov.uk). FAEB carries out R&D, monitoring and technology transfer in support of sustainable management of fisheries and aquatic resources in Northern Ireland, in support of the policy objectives of a wide range of

government and other customers. FEAB employs around 40 staff and has an annual budget of approximately 5.5MEuro. In addition, FAEB presently hosts approximately 12 contract staff and postgraduate students. Facilities include a state of the art 53m marine research vessel and a molecular biology laboratory. The R. Bush Salmon Station is a field station in Co. Antrim, where long term research into salmon ecology and population dynamics since 1973 has gained international renown. Fundamental work into the stock and recruitment relationships of wild salmon carried out on the R. Bush has played a seminal role in the introduction and development of conservation limits for the management of wild Atlantic salmon resources.

Key Personnel

Dr Walter Crozier is currently head of the Fisheries and Aquatic Ecosystems Branch at the Queen's University of Belfast. He is a member of the Standing Scientific Committee of the Irish National Salmon Commission and a former Chairman of the ICES North Atlantic Salmon Working Group. He is a UK national delegate to ICES, a member of the ICES Council and a member of the EU delegation at the North Atlantic Salmon Conservation Organisation (NASCO). He is also a member of the Management Group of Directors of the UK fishery laboratories and a scientific advisor to the Loughs Agency (Foyle Fisheries Commission). Dr Crozier's research interests include salmon ecology and population dynamics, salmon marine survival and salmonid population genetics and he has published extensively across these fields (over 55 peer reviewed scientific papers). He successfully led the EU Concerted Action SALMODEL (QLK5-CT1999-01546) under the FP5 programme.

Recent relevant publications

Jordan, W.C., Cross, T.F., Crozier, W.W., Ferguson, A., Galvin, P., Hurrell, R.H., McElligott, E.A., McGinnity, P., Martin, S.A.M., Moffett, I.J.J., Price, D.J., Youngson, A.f., and Verspoor, E., (2005). Allozyme variation in Atlantic salmon (Salmo salar L.) from the British Isles: associations with geography and the environment. Journal of Fish Biology, 67, Supplement A: 146-168.

Crozier, W.W., Schon, P.J., Chaput,G., Potter, E.C.E., O'Maoileidigh, N., MacLean, J., (2004). Managing Atlantic salmon in the mixed stock environment: Challenges and considerations. ICES Journal of Marine Science, 61: 1344-1358.

Crozier, W.W. and Kennedy, G.J.A. (2003). Freshwater influences on marine survival of Atlantic salmon: Evidence from the River Bush, Northern Ireland. pp 124-130. In, E.C.E Potter, N. O'Maoileidigh and G.Chaput (Eds.). Marine mortality of Atlantic salmon, Salmo salar L.: Methods and measures. DFO Canada, Science Adv. Secr. Res. Doc. 2003/101.

Crozier, W. W. and Kennedy, G. J. A. (2002). Impact of tagging with coded wire tags on marine survival of wild Atlantic salmon (Salmo salar L.) migrating from the R. Bush, Northern Ireland. Fisheries Research 59: 209-215.

Potter, E.C.E. and Crozier, W.W. (2000). A perspective on the marine survival of Atlantic salmon. In: Mills, D.H. (ed.). Problems Facing Salmon In the Sea. Fishing News Books, pp. 19-36.

Partner 8 – University of Wales Swansea (UWS)

Main tasks: Development of genetic markers; Genetic baseline construction; Genetic stock identification.

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Institute profile

Within the School of the Environment and Society at Swansea University, The Department of Biological Sciences offers a stimulating, multidisciplinary environment for study and research in all main biological areas. Research is organised in four main themes (Pathobiology & Aquaculture, Trophic dynamics, Behavioural, Physiological & Molecular Ecology, and Biomolecular Mass Spectrometry). All academic staff are active scientists, and our aim is to engage in world-class teaching and research, assuring all students that the education they receive is of the very highest quality. In addition, the Institute of Environmental Sustainability (IES) is one of two inter- and multi-disciplinary research institutes within the School, bringing together a diverse team of biologists, geographers and development studies specialists, of international standing, working across a broad range of environmental research issues.

Group profile

The Department of Biological Sciences offers through Aquaculture Wales and the Centre for Sustainable Aquaculture Research (CSAR), outstanding facilities for research in sustainable aquaculture, capitalizing on an international and very active team of international scientists. The Aquaculture group has strong links with European and international institutions, and is presently engaged in several large scale research projects (see http://www.swansea.ac.uk/biosci/Research/PathobiologyAquaculture/) including a DEFRA-funded Darwin Initiative which is developing molecular markers for genetic stock identification of fish escaping from salmon farms (www.biodiversity.cl).

Key Personnel

Dr. C. Garcia de Leaniz Lecturer in Aquaculture. Dr. Garcia de Leaniz is the director of the Aquaculture MSc course at the University of Wales Swansea. He has served for over 14 years as government advisor on the application of aquaculture to the restoration of endangered salmonid populations, and has participated in over 12 national and international research projects, including three European programmes (SALGEN, Q5AM-2000-0020; REDCAFE, Q5CA-2000-31387L, and AIR1-CT-92-0719). He leads a Darwin Initiative which aims to reduce the impact of exotic Aquaculture on Chilean aquatic biodiversity. His current research focuses on the evolutionary ecology of aquatic organisms and the impacts of exotic aquaculture, with funding from DEFRA, FSBI, ESF, the Atlantic Salmon Trust, the Environment Agency, the Middle Dee Group, and the Mammals Trust. He has supervised 8 MSc students and currently supervises 3 PhD theses.

Dr. S. Consuegra Post doctoral Research Officer. Dr. Consuegra's early research work examined the postglacial origin of European Atlantic salmon and the genetic consequences of population bottlenecks and anthropogenic disturbances in small populations. She then worked at the Institute of Zoology (London) and the U. of St. Andrews on the variability and evolution of MHC salmonid genes and the molecular basis and adaptive significance of variation in fish muscle. Dr. Consuegra has been involved in several Salmon Research projects, including SALGEN, SALIMPACT, and SEAFOOD. She is currently employing molecular marker to examine the impact upon native biodiversity of exotic species escaping from fish farms, and is supervising 1 PhD student and 1 MSc student.

Recent relevant publications

García de Leániz, C., et al (2007). A critical review of adaptive genetic variation in Atlantic salmon: implications for conservation. Biological Reviews 82 (2): 172-211.

Consuegra, S. & Garcia de Leániz, C. (2007). Fluctuating sex ratios, but no sex-biased dispersal, in a promiscuous fish. Evolutionary Ecology 21: 229-245.

Consuegra, S.; Megens, H.-J., Schaschl, K. Leon H., Stet, R. J. M. & Jordan, W.C. (2005) Rapid evolution of the MHC Class I locus results in different allelic compositions in recently diverged populations of Atlantic salmon. Molecular Biology and Evolution 22: 1095-1106.

Consuegra, S., Verspoor, E., Knox, D. & García de Leániz, C. (2005). Asymmetric gene flow and the evolutionary maintenance of genetic diversity in small, peripheral Atlantic salmon populations. Conservation Genetics 6: 823-842.

Consuegra, S., García de Leániz, C., Serdio, A. & E. Verspoor. (2005). Selective exploitation of early running fish may induce genetic and phenotypic changes in Atlantic salmon. Journal of Fish Biology 67: 130-146.

Partner 9 – Danish Institute for Fisheries Research, Technical University of Denmark, Silkeborg, Denmark

Main tasks: Genetic baseline construction.

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Institute profile

The Danish Institute for Fisheries Research (DIFRES) has merged with the Technical University of Denmark 1 January 2007. DIFRES employs approximately 285 people and has a total budget of approximately 24 M€. DIFRES conducts research and provides advice concerning the sustainable utilization of living marine and freshwater resources. This includes interactions between the aquatic environment, human activities and fish populations, as well as the assessment of fish population productivity and abundance. DIFRES provides advisory services to the Danish ministry, other public authorities, international organizations, the industry, and other stakeholders such as recreational anglers.

Group profile

The population genetics group of the Danish Institute for Fisheries Research was established in 1994. At present, it includes three scientists, three technicians, and a variable number of MSc and PhD students. The group's research interests focus on questions in the areas of population genetics, evolutionary biology, and conservation biology/fisheries management; with particular emphasis on the identification and maintenance of locally adapted populations. For almost a decade, the group has worked on the population structure of marine, freshwater, and anadromous fishes using state-of-the-art molecular genetic and statistical methods. The group is particularly renowned for their experience in the genetic analysis of historical tissue collections (scales and otoliths) for the retrospective analysis of population structure and of genetically effective population sizes. For that reason, a high number of guest scientists are visiting the lab. The group is involved in a number of EU-funded research projects
(see below). Members of the group are experienced in providing advice for genetically sustainable management of fish populations, both nationally and internationally (e.g., in the ICES Working Group on the Application of Genetics in Fisheries and Mariculture, WGAGFM).

Key personnel

Senior Research Scientist Einar Eg Nielsen has worked, for more than a decade, on the population genetics and management of anadromous (Atlantic salmon, brown trout) and marine fishes (Atlantic cod, turbot, flounder). He has been among the very first scientists to exploit the revolution in molecular biology to study genetic variation among populations of fish in the wild and in aquaculture, including the temporal dimension, exploiting DNA information from historical collections. His current research projects all focus on identifying adaptive genetic variation on spatial and temporal scales in marine fishes using cutting-edge genomic tools. He has published more than 30 scientific papers. He has received several external national and international research grants including: FP5 EU project METACOD (coordinator for genetic work packages), FP6 integrated project SEAFOOD+ (work package leader), the specific targeted research project UNCOVER (task leader), and in two FP6 networks of excellence, Marine Genomics Europe (member of the scientific steering committee) and MARBEF (work package leader). He has served on several national and international advisory committees on genetically sustainable fisheries management. He is the chairman of ICES Working Group on the Application of Genetics in Fisheries and Maricul-ture (WGAGFM), and associate editor of the journal Conservation Genetics. Serves as chairman for the ICES Working Group on the Application of Genetics in Fisheries and Mariculture (WGAGFM).

Recent relevant publications

Koljonen,M-L., King,T.L. and Nielsen,E.E. (2007) Genetic identification of individuals and populations In: The Atlantic Salmon: Genetics, Conservation and Management (Verspoor, E., Nielsen, J. & Stradmeyer, L., eds.). In press.

Nielsen,E.E. Bach, L.A. & Kotlicki, P. (2006) HYBRIDLAB (version 1.0): A program for generating simulated hybrids from population samples. Molecular Ecology Notes 6, 971-973.

Poulsen NA, Nielsen EE, Schierup MH, Loeschcke V & Grønkjær P (2006). Long-term stability and effective population size in North Sea and Baltic Sea cod (Gadus morhua). Molecular Ecology 15: 321-331.

Nielsen, E.E., Hansen, M.M., Schmidt, C., Meldrup, D. & Grønkjær, P. (2001). Population of origin of Atlantic cod. *Nature*, **413**, 272.

Hansen, M.M., Kenchington, E. & Nielsen, E.E. (2001) Assigning individual fish to populations using microsatellite DNA markers: Methods and applications. *Fish and Fisheries*, **2**, 93-112

Partner 10 - Institute of Freshwater Fisheries

Main tasks: Marine data acquisition; Biological analysis of samples; Genetic baseline construction; Genetic stock identification; Migration distribution analysis

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Institute profile

The Institute of Freshwater Fisheries is an independent state organisation, operating under Act 59/2006 on research and management of all freshwater biota, including fish and fisheries. IFF is under the Ministry of Agriculture. IFF is a research and service organisation for the freshwater fisheries and aquaculture sector. IFF's function is to engage in research, provide consultancy and disseminate information to the government and interested parties. IFF's specialised fields include freshwater ecology, fisheries management, fisheries enhancement, aquaculture and environmental research. IFF´s goal is to build knowledge and database on the freshwater biota in Iceland. Furthermore, IFF's goal is to keep all freshwater fisheries over it sustainable level and to increase the value of fisheries through research, development, dissemination of knowledge and consultancy. IFF is operated in four places in Iceland.

Group profile

The group consists of people with extensive experience in freshwater ecology, ecology of salmon at sea and molecular genetic analysis of wild fish population structures and of cultured strains, and their interactions. The group is working closely with the Procaria company owned by Matis ltd. in Iceland for genetic analyses.

Key Personnel

Dr Sigurdur Gudjonsson
Sigurdur Mar Einarsson
Ingi Runar Jonsson
Dr. Sigridur Hjorleifsdottir

Dr. Sigurður Gudjonsson is the director of the institute and has been project manager of many research projects: Life history of Atlantic salmon (freshwater and marine), salmon ranching, salmon culture, interactions between salmon culture and wild salmon, salmon fisheries and assessments of fisheries, basic and applied research in fish ecology and behaviour, population genetics.

Recent relevant publications

Antonsson, Th., Gudbergsson, G. and Gudjonsson, S. 1996. Environmental continuity in fluctuation of fish stocks in the North Atlantic Ocean, with particular reference to Atlantic salmon. North American Journal of Fisheries Management 16: 540-547.

Antonsson, T. and Gudjonsson, S. 2002. Variability in Timing and Characteristics of Atlantic Salmon Smolt in Icelandic Rivers. Transactions of American Fisheries Society, 131: 643-655

Danielsdottir, A. K., Marteinsdottir, G. and Gudjonsson, S. 1997. Genetic structure of wild and reared Atlantic salmon (*Salmo salar*) population in Iceland. ICES Journal of Marine Science. 54: 986-997.

Gudbergsson, G. and S. Gudjonsson 2003. Marine natural mortality of Atlantic salmon (Salmo salar L.) in Iceland. In: Marine mortality of Atlantic salmon, Salmo salar L: methods and measures. (p 110-117) E.C.E. Potter, N.Ó Maoilédigh and G. Chaput (Eds.). CSAS (Canadian Science Advisory Secretariat) Reasearch Document 2003/101.

Gudjonsson, S., Einarsson, S.M., Antonsson, Th. and Gudbergsson, G. 1995. Relation of grilse/salmon ratio to environmental changes in several wild Atlantic salmon stocks in Iceland. Canadian Journal of Fisheries and Aquaculture. 52:1385-1398.

Partner 11 – University of Turku

Main task: Development of genetic markers; Genetic baseline construction.

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Institute profile

The University of Turku is Finland's second largest university and has a strong and internationally distinguished position as a multidisciplinary scientific university. The six faculties and separate institutes, which specialise in a number of different scholarship areas, provide an all-round foundation for high-quality research and training for competent professionals. The area of biosciences is considered by the university as its main strength. In 2006, the University had around 300 research contracts, 52 of which were funded by the European Commission. Funding obtained through these research contracts was 13.5 million euros. The University's Research and Industrial Services Office is a focal support service unit for researchers and the university in pre- and post-award research management of externally funded projects: applying for funding, drafting and completing contracts, financial management, exploitation of research results as well as information delivery, guidance and training.

Group profile

Professor Craig Primmer's group includes 3 post docs, six PhD students and 2 technical staff.. Research of the group focuses on the evolutionary and conservation genetics of non-mammalian vertebrates, in particular salmonid fishes. The group is one of three core research groups in the Finnish Centre of Excellence in Evolutionary Genetics and Physiology (See http://www.coe.fi). The group has strong collaborations in the neighbouring regions of NW Russia and Estonia and has an extensive tissue data bank from these regions. Primmer's group also specialises in utilising recently developed population genetic analysis methods such as 'individual assignment tests' and clustering methodologies for stock identification in salmonid fishes. The laboratory of the group is fully equipped for high throughput fragment analyses and the group has access to the extensive core molecular facilities at BioCity Turku.

Key Personnel

Prof. Craig Primmer is a professor of genetics at the Department of Biology, University of Turku. Research in the group has been internationally highly successful at merging ecological, evolutionary and genetic/genomic research in various non-mammalian vertebrate species, in particular salmonid fishes and has published 60 papers in the past 10 years on these topics (see http://users.utu.fi/primmer). One of the key features of the research group has been an ability to recognize and utilize the advantages of applying molecular approaches developed for use in traditional model organisms, and applying them to non-model species such as salmonid fishes. Primmer has also conducted a number of applied conservation genetic studies for developing management plans for harvested Finnish and Russian salmonids.

Juha-Pekka Vähä is a PhD student on the verge of completing his studies on the conservation genetics of Atlantic salmon in November 2007. During the course of the studies he has build a thorough know-how of the state-of-the-art statistical methods required to collect and analyze genetic data to study demography of wild salmon populations.

Relevant recent publications

Vähä J-PK, Erkinaro J, Niemelä E, and Primmer CR (2007) Life-history and habitat features influence the within-river genetic structure of Atlantic salmon. Molecular Ecology (in press)

Primmer CR, Veselov AJ, Zubchenko A, Poututkin A, Bakhmet I & Koskinen MT (2006) Isolation by distance within a river system: genetic population structuring of Atlantic salmon, Salmo salar, in tributaries of the Varzuga River in northwest Russia. Molecular Ecology 15: 653–666.

Vasemägi A, Nilsson J and Primmer CR (2005) Expressed sequence tag (EST) linked microsatellites as a source of gene associated polymorphisms for detecting signatures of divergent selection in Atlantic salmon (Salmo salar L.). Molecular Biology and Evolution 22: 1067-1076.

Ryynänen HJ & Primmer CR (2006) Single nucleotide polymorphism (SNP) discovery in duplicated genomes: intron-primed exon-crossing (IPEC) as a strategy for avoiding amplification of duplicated loci in Atlantic salmon (Salmo salar) and other salmonid fishes. BMC Genomics 7: 192

Tonteri A, Veselov A, Titov S, Lumme J and Primmer CR (2007) The effect of migratory behavior on genetic diversity and population divergence: a comparison of anadromous and freshwater Atlantic salmon (Salmo salar L.) Journal of Fish Biology (in press)

Partner 12: Departamento de Biologia Funcional, Universidad de Oviedo, (UOVE) Oviedo, Spain.

Main tasks: Genetic baseline construction.

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Institute profile

With 160 faculty members, the Department of Functional Biology at the University of Oviedo contains several very productive research groups, working on different aspects of microbiology, basic and applied genetics, animal physiology and immunology. More than 100 research projects are carried out in the Department currently, many of them international.

Group profile

Eva Garcia-Vazquez is full professor of Genetics at the University of Oviedo. She has coordinated various international projects: the EU RTD MARINEGGS QLK5-01157 (5 Framework Program), two NATO contracts, one Fulbright projects and five Bilateral Integrated Actions with Germany, France and Portugal. She has been principal investigator in other six EU contracts in the 3FP, 4FP and 6FP, and 22 research contracts with different public Administrations and private companies. She is an expert in development and application of genetic markers to the conservation of ichthyologic natural resources. Currently she is Contractor in three EU projects: STREP FISH & CHIPS (6 Framework Program), CA GENIMPACT (6FP), ASAP and ASAP-2 (INTERREG). In these last projects she and her team are involved in the creation of a database of microsatellite genotypes for identification of the natal river and region of Atlantic Arc Atlantic salmon, together with the University of Exeter and the University College Cork. She is associated member of the NoE MARBEF (6FP). She is author or coauthor of more than 100 articles in international scientific journals indexed in SCI, many of them focused on population genetics of Atlantic salmon.

Key Personnel involved in SALSEA

Professor Eva Garcia-Vazquez
Dr. Gonzalo Machado Schiaffino
Mr. Jose Luis Horreo
Ms. Mar Gonzalez Hermosa (Manager)
Mr. Ivan Gonzalez Pola (Technician)

Recent relevant publications

Ayllon, F., Davaine, P., Beall, E., Martinez, J.L., Garcia-Vazquez, E. (2004). Bottlenecks and genetic changes in Atlantic salmon stocks introduced in the Subantarctic Kerguelen Islands. Aquaculture, 237: 103-116.

Ayllon F, Davaine P, Beall E, Garcia-Vazquez E. (2006) Dispersal and rapid evolution in brown trout colonizing virgin Subantarctic ecosystems. Journal of Evolutionary Biology, 19: 1352-1358.

Ayllon F, Martinez JL, Garcia-Vazquez E. (2006). Loss of regional population structure in Atlantic salmon, Salmo salar L., following stocking. ICES Journal of Marine Science, 63: 1269-1273.

Machado-Schiaffino G, Dopico E, Garcia-Vazquez E. (2007). Genetic variation losses in Atlantic salmon stocks created for supportive breeding. Aquaculture 264: 59-65.

Castillo AGF, Beall E, Moran P, Martinez JL, Ayllon F, Garcia-Vazquez E. (2007). Introgression in the genus Salmo via allotriploid hybrids. Molecular Ecology 16:1741-1748

Partner 13 – Genindexe

Main tasks: Genetic baseline construction.

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Institute profile

Genindexe is a small private company established in 2001 providing services for public research institutes (INRA, CNRS, IFREMER, Universities, Federation des Chasseurs) and industries (Fisheries, Food Industries) in the fields of animal genetics and food safety & quality. Genindexe is also a partner in several research projects lead by public institutes (CIPA, SYSAAF, IFREMER, CNP, Federation des Chasseurs, University of Poitiers). Genindexe is accredited ISO/CEI 17025 by the COFRAC for some of its molecular biology activities: sheep scrapie genotyping and bird DNA sexing. Genindexe is also accredited by the French Ministry of Agriculture and Fisheries for sheep scrapie genotyping and cattle parentage testing. Finaly, Genindexe is accredited by the French Ministry of Research for the “Credit Impôt Recherche” meaning that the research performed by Genindexe is recognized by this Ministry. Genindexe is a research partner of several public and private Institutes : SYSAAF, CIPA, Fédération des Chasseurs, IFREMER, Zoos, Fisheries.

Key Personnel

Dr Corinne CHERBONNEL

Chief of Scientific Officers at Genindexe and also Associate Professor at the La Rochelle University Institute of Technology, University.

Dr Sophie BARON

Scientific Officer at Genindexe

Relevant recent publications

Nicolas Taris, Sophie Baron, Timothy F Sharbel, Christopher Sauvage, Pierre Boudry (2005) A combined microsatellite multiplexing and boiling DNA extraction method for high-throughput parentage analyses in the Pacific oyster (Crassostrea gigas) Aquaculture Research 36 (5), 516–518.

Partner 14 Finnish Game and Fisheries Research Institute

Main tasks: Biological analysis of samples; Migration distribution analysis

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Institute profile

The Finnish Game and Fisheries Research Institute (FGFRI) is a governmental research organization and the principal research centre on fisheries research in Finland. The institute has a long tradition in performing interdisciplinary research projects in many fields of fisheries science. FGFRI produces high-quality scientific information for the sustainable use of exploitable resources and helps to maintain their biodiversity. FGFRI’s Fisheries Research Unit assesses major fish and crayfish stocks, studies the impact of fishing and of environmental changes, and develops fisheries management methods and harvesting technology. The Unit has scientific expertise in all major fields of fisheries research and fish biology. A large body of data is available on catches, stocks, distribution, growth, spawning and nursery grounds, migration patterns, selectivity, and discarding of several fish species. Extensive research projects are under way in the areas of stock assessment and fisheries management. There is also considerable experience on the assessment of biological and socio-economic impacts of various management measures. Cooperation with other research institutes and industry has greatly expanded and the partnership funding of research activities is rapidly growing.

Group profile

The group working on Atlantic salmon populations in Finland has covered several fields including e.g. population dynamics, juvenile production, life history variation, genetics and growth patterns both in freshwater and in the ocean. Much of this work has been carried out in international cooperation, especially with Norwegian universities, authorities and research institutes. The group has collected long term data on the salmon stocks since early 1970s including catch information, scale samples and juvenile salmon abundance. Most recently, special emphasis has been put in analyzing long term development in marine growth patterns of Teno river salmon stocks.

Key Personnel

Research Professor, Dr. Jaakko Erkinaro is in charge of the Atlantic salmon research and monitoring in FGFRI. His fields of research have covered both freshwater and marine phases of Atlantic salmon, for which he has been published c. 50 scientific articles, both in Atlantic salmon rivers and in the Baltic Sea area. Recently, Dr. Erkinaro has been involved in several international projects including a cooperative project between Norwegian, Russian and Canadian institute investigating various elements of the marine ecology of Barents Sea salmon populations focusing on long-term variation in abundance, survival and marine growth of salmon and their migration routes at sea.

Dr. Eero Niemelä has started the long-term monitoring programmes of the Finnish Atlantic salmon stocks and has a long, extensive experience in research work and international cooperation. His research interests include various aspects of salmon biology, ranging from population dynamics and juvenile production to long-term patterns in run timing, marine growth and effects of fisheries management. He has been working in the area for over 30 years and published more than 30 scientific articles.

Relevant recent publications

Erkinaro, J., Dempson, J.B., Julkunen, M. & Niemelä, E. 1997. Importance of ontogenetic habitat shifts to juvenile output and life history of Atlantic salmon in a large subarctic river: an approach based on analysis of scale characteristics. Journal of Fish Biology 51: 1174-1185.

Erkinaro, J., Niemelä, E., Saari, A., Shustov, Yu., & Jørgensen, L. 1998. Timing of habitat shift by Atlantic salmon parr from fluvial to lacustrine habitat: analysis of age distribution, growth and scale characteristics. Canadian Journal of Fisheries and Aquatic Sciences 55: 2266-2273.

Niemelä, E., J. Erkinaro, J. B. Dempson, M. Julkunen, A. Zubchenko, S. Prusov, M. A. Svenning, R. Ingvaldsen, M. Holm, and E. Hassinen. 2004. Temporal synchrony and variation in abundance of Atlantic salmon (Salmo salar) in two subarctic Barents Sea rivers: influence of oceanic conditions. Canadian Journal of Fisheries and Aquatic Sciences 61: 2384-2391.

Niemelä, E., J. Erkinaro, M. Julkunen, and E. Hassinen. 2005. Is juvenile salmon abundance related to subsequent and preceeding catches? Perspectives from a long-term monitoring program. ICES Journal of Marine Science 62: 1617-1629.

Niemelä, E., J. Erkinaro, M. Julkunen, E. Hassinen, M. Länsman, and S. Brørs. 2006. Temporal variation in abundance, return rate and life histories of previously spawned Atlantic salmon in a large subarctic river. Journal of Fish Biology 68: 1222-1240.

Partner 15 – The Faroese Fisheries Laboratory

Main tasks: Marine data acquisition; Biological analysis of samples; Development of genetic markers; Genetic baseline construction; Genetic stock identification; Migration distribution analysis

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Institute profile

The Faroese Fisheries Laboratory (FFL) is a governmental institute that conducts research of the marine resources harvested by Faroese fishermen and the environment governing their distribution and production. This includes fish biology, physical and biological oceanography including fluctuations in the stocks, fish behaviour, gear technology, and seabird biology. The FFL provides the Government of the Faroe Islands with scientific advice based on its research on marine resources and their environment. Assessments are made of the most important fish stocks, based on investigations, independent of the industry, carried out by their fully equipped research vessel, *Magnus Heinason*, e.g. 0-group surveys, bottom trawls surveys and acoustic pelagic surveys. The oceanography and the living organisms (plankton) in the waters around the Faroes are also studied; e.g. temperatures, currents, and the conditions for living organisms to grow and reproduce are examined. In particular climatic changes likely to affect the reproductive success of various species of fish in Faroese waters are investigated.

Group profile

Atlantic salmon is part of the pelagic fish stock assemblage, including also herring, blue whiting and mackerel, covered by the pelagic section at the FFL. The institute has been a partner in several research initiatives on salmon in recent years. They have long and valuable experience of carrying out research on salmon at sea in their waters, which are key feeding areas for maturing home water stocks.

Key Personnel

Dr. Jan Arge Jacobsen is currently leading the research on the main pelagic fish species in Faroese waters and the assessment of those species, i.e. blue whiting, herring, mackerel, horse mackerel, and Atlantic salmon. Further he has experience from several joint Nordic projects under the Nordic Council of Ministers, one concerned with tagging of wild salmon at sea north of the Faroes to determine country of origin, with the Norwegian Institute for Nature Research (NINA). He holds a PhD (Dr. scient.) titled "Aspects of the marine ecology of Atlantic salmon (*Salmo salar* L.)" from the University of Bergen, Norway in 2000. Currently he is involved in a joint Nordic project (with Norway and Iceland) on distribution of salmon in relation to environmental parameters and continent of origin in the North Atlantic.

Relevant recent publications

Jacobsen, J.A. and Hansen, L.P. 2004. Internal and External Tags. In Stock Identification Methods (Cadrin, S.X., Friedland, K.D. and Waldman, J.R., eds.), pp. 403-421, Academic Press.

Hansen, L. P., and Jacobsen, J. A. 2003. Origin, migration and growth of wild and escaped farmed Atlantic salmon, *Salmo salar* L., in oceanic areas north of the Faroe Islands. ICES Journal of Marine Science, 60 (1): 110-119.

Hansen, L. P., and Jacobsen, J. A. 2002. Atlantic salmon: the ocean traveller. ICES Marine Science Symposia 215: 371-381.

Jacobsen, J. A., Lund, R. A., Hansen, L. P., and O'Maoileidigh, N. 2001. Seasonal differences in the origin of Atlantic salmon (*Salmo salar* L.) in the Norwegian Sea based on estimates from age structures and tag recaptures. Fisheries Research, 52: 169-177.

Jacobsen, J. A., and Hansen, L. P. 2001. Feeding habits of wild and escaped farmed of Atlantic salmon, *Salmo salar* L., in the Northeast Atlantic. ICES Journal of Marine Science, 58: 916-933.

Partner 16 – Atlantic Salmon Trust

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Partner 17 – North Atlantic Salmon Conservation Organisation

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Partner 18 – TOTAL Fondation d'entreprise pour la Biodiversité et la Mer

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B.2.3 Consortium as a whole

Following the formation of the IASRB in 2002 the planning for SALSEA commenced. Three detailed workshops were help over the period 2003 to 2005 in Dublin and Bergen to agree a detailed science programme. In parallel the IASRB Board agreed a fundraising programme extending over all interest groups to source funding SALSEA. Since this time the four main partners in the consortium, Ireland, Norway, UK and Faeroes have played a lead role in the formulation of the overall programme and the other partners have through their science delegates at NASCO and on the IASRB have been fully involved at all stages in the planning of the marine salmon research programme. In addition to their involvement in preparation for the SALSEA programme the partners work together on a regular basis on science project and have been fortunate to jointly participate in a range of major EU funded salmon related programmes. The individuals work together well, are well versed in the rigours of international consortium based initiatives and on the need for adherence to strict deadlines and deliverables in the context of EU funded programmes. The administration in the state agencies and third level colleges are very familiar with EU governance and procurement procedures and will we believe have no difficulty in fulfilling their obligations in what is a complex and challenging multi disciplinary programme. The consortium also includes six non-contractual partners who are bringing to the programme substantial additional resources, additional scientific and practical marine science skills and also a range of administrative expertise and private sector support which we believe is unique in this type of Framework programme, encompassing as it does the public sector, the private sector and NGO groups.

The mix of skills in the consortium comprises world experts in the areas of salmon ecology, marine ecology, fisheries genetics, biological modelling, GIS expertise, both national and international fisheries management experience, private sector business acumen, NGO drive and commitment and an enviable scientific publications record in the various fields of expertise. We believe we have assembled not alone the best scientists in Europe in their fields but in several cases the best scientists in the world. The group has spent several years honing the objectives of SALSEA-Merge and the components are carefully balanced to achieve a successful merging of ecological, oceanographic and genetic datasets. The consortium is confident that if supported it will succeed in the construction of marine migration and distribution model for Atlantic salmon in the north Atlantic.

One of the main reasons SALSEA-Merge was not completed on a national basis, at an earlier date, is the need for a trans-European support mechanism. Several European states (Norway, UK and Faeroes) previously attempted marine survey programmes and while the expeditions resulted in exciting discoveries and novel technologies the effort could not be sustained. At its earliest meetings the IASRB recognised that the ambitious goals of SALSEA could only be achieved by a co-operative programme and all NASCO parties have committed themselves fully to this endeavour.

The objectives of SALSEA-Merge tackle fundamental issues of EU marine policy and could we believe act as a flagship project in key areas such as halting biodiversity loss and management of marine resources based on an ecosystem approach.

B.2.4 Resources to be committed

Organisation	**€ (m)**
EU FP7 (SALSEA-Merge) - Proposed	3,50
Participants own contribution (SALSEA-Merge) - Proposed	1,70
Private Sector (Total Foundation & Others)	0,20
NGO (Atlantic Salmon Trust)	0,21
Total	5,61

The full SALSEA-Merge research programme will cost a total of €5.6m. Uniquely, this comprises a contribution of €3.5m from FP7 funds, matching contributions from all partners, including the Faroese, authorities, a contribution of €210,000 from the Atlantic Salmon Trust (UK) and a contribution of €200,000 from the TOTAL Foundation (France). The AST contribution will fund a fulltime Scientific Coordinator for the programme. The TOTAL Foundation contribution comprises two components: €150,00 to cover the two planned Faroese cruises in 2008 and 2009 (Expedition B), on the same percentage contribution basis as the FP7 programmes (50% ship costs and 75% of scientific costs) and €50,000 to cover a major preparatory genetics workshop and a series of key meetings for participants with genetic workers in North America. When taken as a percentage of the total project costs, the EU contribution sought represents excellent value for money at some 64% of the full cost of the programme.

The direct cash funding by the private sector and the AST resulted from the active fundraising programme carried out by the IASRB. This activity will continue with a view to ensuring a similar series of cruises in the western Atlantic, funded it is hoped by charitable ocean foundations in the US and Canada and research projects centred on ancillary biological material collected during the 08 and 09 expeditions (e.g. plankton analysis and examination of post-smolt physiology samples). The IASRB is in a position to accept and administer large cash donations towards marine research and has in place a Scientific Advisory Group to assess scientific applications for such funding.

The SALSEA-Merge programme does not include the purchase of any large equipment items, as these are available on board ship from the participating partners. The large research ships participating in the programme are highly sought after, for a wide range of fisheries surveys both national and international and the contribution of this large-scale infrastructure to the programme in addition to laboratory facilities, and support staff, reflects how seriously these nations regard the immediate threat to salmon survival at sea. This concern is shared by the third level sector and by NASCO's NGO's and by a range of interest groups in the private sector, who clearly see the salmon as an index for other marine species, which may yet encounter similar marine survival problems. All of these interest groups are fully committed to focusing on marine survival of salmon as a key research objective and are currently investing in a wide range of ancillary programmes totalling €7.5 m, which are outlined in the IASRB research inventory (www.salmonatsea.com).

B.3. Impacts

B.3.1 Expected impacts listed in the work programme

The wild Atlantic salmon was in the past a fish of major economic importance (Netboy,1968) but in recent times its importance as a commercial species has diminished while its iconic status as an indicator of environmental purity has increased. In line with a decrease in European salmon stock abundance its economic value as a recreational species has increased. In a recent study of salmon fisheries in England and Wales, Scotland, Ireland, Iceland and Spain by Le Quesne and Selby (2007) have estimated the recreational value of the species at €1.2 billion. This figure does not include the considerable 'existence values' of Atlantic Salmon, which some commentators suggest may in itself exceed the recreational and commercial value of the fisheries. The authors have shown that the value of such fisheries angling generates considerable ancillary economic activity, often in remote, economically marginalised areas. There is clear evidence that the recreational value of salmon angling is increasing over time and can be expected to continue appreciating as real incomes increase. The authors have shown that the value of angling generates considerable ancillary economic activity, often in remote, economically marginalised areas. There is clear evidence that the recreational value of salmon angling is increasing over time and can be expected to continue appreciating as real incomes increase. The authors also maintain that the local, regional and national benefits of recreational salmon angling in terms of increased economic activity justify significant expenditure on the protection and enhancement of the resource and its supporting infrastructure. Protection of wild salmon stocks should also be viewed as an important economic investment. In this regard the significant drop in the survival of salmon at sea is of considerable economic as well as major environmental and biological concern.

Only by better understanding the distribution and migration of salmon at sea and the factors influencing them can there be a more rational basis for management and the opportunity to address those factors that are subject to human control. Such understanding may also help to answer the broader environmental issues that are daily becoming more urgent.

Research over the past two decades has conclusively demonstrated that our oceans are changing at an alarming rate. Some are warming, some are cooling. Increasing acidity and toxicity are major concerns. Melting ice is diluting the upper layers of the northern and southern oceans. Worryingly, currents are changing. Traversing all of these troubled zones are the long distance migrants and it is these species that first encounter the full impact of these global changes. The sharks, the tunas and the salmon all traverse these zones in their great annual trans-oceanic journeys.

Of these the salmon experiences the widest variety of environments. Hatching and growing in clean fresh water, the smolt (young salmon) head downriver for estuaries and inshore waters before migrating into the far reaches of the ocean. There fish from rivers thousands of miles apart mingle together until it is time to return to home water, each surviving fish unerringly returning to spawn in the place of its birth.

Until now such a level of understanding has seemed impossible to achieve. Research in the open ocean is extremely expensive and could only be justified if it promised clear and comprehensive information but recent developments in technology have opened up opportunities to change this situation Analysis of DNA can now detect the lineage of a fish in enough detail to identify the river population to which it belongs and in every scale each salmon carries its own natural genetic identity tag. These genetic techniques and the availability of a wide range of archival material will also ensure that the major risk to the project, a series of unsuccessful expeditions, is guarded against. Innovative new trawl-gear that records salmon numbers passing through the net and enables live capture has been tested and we are now in apposition to plan a series of well-targeted ocean surveys and to identify the origin of all the salmon sampled.

The objectives of SALSEA-Merge tackle fundamental issues of EU marine policy and could we believe act as a flagship project in key areas such as halting biodiversity loss and management of marine resources based on an ecosystem approach.

B.3.1.2 Policy impacts

"*A healthy Marine Environment is a sine qua non to realising the full potential of the oceans. For this reason, preservation of this resource base is the key to improving the EU's competitiveness, long-term growth and employment."* EU Green Paper on Maritime Policy

"… The particular need for an all-enhancing maritime policy aimed at developing a thriving maritime economy, in an environmentally sustainable manner. Such a policy should be supported by excellence in marine scientific research, technology and innovation." Strategic Objectives: European Commission 2005-2009*.*

The past two decades have seen major advances in our appreciation of the need to integrate national and international (cross boundary) environmental policies so as to ensure that in the future THE EU economy functions and grows on a sustainable basis. Underpinning national initiatives and national legislation in this area, is a raft of hard-hitting EU environmental legislation, geared towards the protection and conservation of the environment. The implementation of the EU Habitats Directive and the EU Water Framework Directive; and the inclusion of biodiversity objectives in various national and EU policy instruments are a clear signal that the welfare of the global environment is seen as fundamental to economic progress. In launching the recent Millennium Ecosystem Assessment, Kofi Annan stated; "we are spending the earth's natural capital and putting at risk the ability of ecosystems to sustain future generations, we can reverse the decline, but only with substantial changes in policy and practice".

The EU has made significant commitments in this regard, the EU Heads of State agreed in 2001, "to halt the decline of biodiversity by 2010", and to "restore habitats and natural systems". In 2002, they joined some 130 world leaders in agreeing to "significantly reduce the rate of biodiversity loss (globally), by 2010". Opinion polls show that these concerns for nature and biodiversity are strongly supported by EU citizens.

At Community level the policy framework to halt biodiversity loss in the EU is now largely in place, biodiversity objectives are, for example, integrated in the Sustainable Development Strategy (SDS) and the Lisbon Partnership for Growth and Jobs and in a wide range of environmental and sectoral policies. An EC Biodiversity Strategy was adopted in 1998 and related action plans in 2001; most member states have also or are developing such strategies and or action plans.

From a marine perspective two significant issues have been the issuing of the Galway Declaration and the recent publication of the EU Green Paper: *Towards a Future Maritime Policy for the Union: a European Vision for the Oceans and the Seas.* The Galway Declaration, endorsed by the 2004 EurOcean Conference, identified the contribution of marine industries towards achieving the Lisbon Agenda objectives, and the role of marine science and technology in the current FP 7th , which aims to develop world class excellence in marine science and technology. The 2004 EurOcean Conference emphasised that alongside marine and maritime research there is an urgent need to support co-ordinated and sustained collection, archiving of and ready access to, comprehensive marine data sets.

Following on from the Galway Declaration, the publication of the recent EU discussion paper on an EU maritime policy is highly significant. It recognises for the first time, the economic potential of Europe's maritime dimension and states that between 3% and 5% of Europe's Gross Domestic Product is estimated to be generated by marine based industries and services, without including the value of raw materials such as oil, gas or fish. The European maritime regions account for over 40% of GDP.

In its strategic objectives for 2005-2009, the European Commission declared the particular need for an all-embracing maritime policy aimed at developing a thriving maritime economy in an environmentally sustainable manner. Such a policy should be supported by excellence in marine scientific research, technology and innovation. Principles of good governance suggest the need for a European maritime policy that embraces all aspects of the oceans and the seas; this policy should be integrated, inter-sectoral and multidisciplinary, and not a mere collection of vertical sectoral policies. It should look at the oceans and seas based on sound knowledge of how they work and how the sustainability of their environment and ecosystems may be preserved, it should aim to provide answers as to how decision making and the conciliation of competing interests in marine and coastal areas can result in a climate more conducive to investment and to the development of sustainable economic activities. To achieve this it is necessary to increase cooperation and to promote effective coordination, integration of ocean and sea related policies at all levels and to improve the status of the resource upon which all maritime activities are based: the ocean itself. To do this, ecosystem-based management, built on scientific knowledge, is essential. The EU Commission has laid the groundwork for this by putting forward its thematic strategy for the marine environment.

The Commission believes that in pursuing this vision our approach should rest firmly on twin pillars. First it should be anchored within the Lisbon Strategy, stimulating growth and more and better jobs within the Union. Continued investment in knowledge and skills are key factors for maintaining competitiveness and ensuring quality jobs.

The EU's integrated approach to industrial policy emphasises that Europe's future lies in bringing new high quality products and services to the world market for which customers are prepared to pay a premium.

Secondly, we must maintain and improve the status of the resource upon which all maritime activities are based: the ocean itself. To do this, ecosystem-based management, built on scientific knowledge, is essential. The EU Commission has laid the groundwork for this by putting forward its thematic strategy for the marine environment.

In 2002 the EU became a signatory of the Johannesburg Declaration, which commits the EU to the rebuilding of all fish stocks, included within the Common Fisheries Policy, so that they can be fished at maximum sustainable yield but within the constraints of the ecosystem they inhabit. Amongst the management objective are:

- that management advice is based on consideration of the ecosystem as a whole, i.e. that separate components of the ecosystem are not manipulated in order to improve the yield of others;
- that management advice is long-term, taking into account industry requirements and stability of employment;
- that stakeholders and Regional Advisory Councils are fully involved in the decision making process;

- that the socio-economic implications of management decisions are fully taken into account;

In May 2004 the European Platform for Biodiversity Research Strategy (EPBRS) recommended specific priorities for the compilation of an action plan for marine fisheries and aquaculture. They recommended the following:

- Develop the ecosystem-based approach to the management of fisheries and aquaculture supported by appropriate sociological and socio-economic research.
- Improve the understanding of the population structure of commercial species using genetic and traditional approaches to optimise stock management.

"…Promote the sustainable use of the seas and conservation of marine ecosystems, including seabed's, estuarine and coastal areas, paying special attention to sites holding a high biodiversity value." EU Marine Strategy-COM (2002)539

In March 2000, the EU Council of Ministers set the EU goal of becoming "The most competitive and dynamic knowledge based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion." (Lisbon Agenda 2000). Following close on the Lisbon meeting the Gothenburg Council meeting 2001 emphasized the importance of "sustainable development" in the EU's Economic Development Strategy and called for urgent action to secure a "better quality of life" for future generations. More recently (October 2005), the EU Commission launched its strategy for the protection and conservation of the marine environment, the aim of which is to "promote sustainable use of the seas and conserve marine ecosystems". Within this strategy, which will form the basis of a new directive, a new approach to marine monitoring and assessment is envisaged. It will see future ocean governance based on the availability and use of marine science and data. As outlined previously in this paper these aspirations, particularly those relating to economic progress and harmony with the marine environment, underpin the recently published Green Paper: Towards a Future Marine Policy for the Union: A European Vision for the Oceans and Seas.

- Improve understanding of the ecosystem effects on fishing activities and how they can be reduced in particular through fishing gear developments including selectivity.
- Pursue further research into the ecological impacts of aquaculture to facilitate informed and sustainable development and management.
- Investigate new and alternative approaches to ensure the future economic and environmental sustainability of the aquaculture sector.

The goal of SALSEA-Merge is to help develop policies that could help reduce the potential of environmental collapse and to lead to a more sustainable use.

To conclude, SALSEA-Merge and its wider aims has taken into account several EU policy related issues. In summary:

- <u>Scientific Support to Policies - Sustainable Management of Europe's Natural Resources and Sustainable Fisheries and Aquaculture Production -.</u> SALSEA-Merge will provide sound scientific information to tackle the questions posed and include a high level of stakeholder participation. It will address a gap in our knowledge of the impact of climate change on an aspect of renewable marine resources.
- <u>Common Fisheries Policies.</u> The result will help achieve some of the most crucial aims of the CFP i.e. conservation of resources and management of fisheries and will enable the CFP to refine its future policies.
- <u>European Research Area.</u> The programme will ensure a high level of cooperation between European research institutes and for the first time will

ensure a novel partnership of fisheries geneticists, ecologists and modellers in the area of wild Atlantic salmon research. The consortium will contribute to achieving some of the major goals of the European Research Area.

- FP7 Environment (including climate change) Sustainable Management of resources. SALSEA Merge will contribute to our knowledge of the biodiversity of wild fish populations and their marine ecosystems. Such knowledge is fundamental to the achievement of sustainable fisheries, in the longer-term. SALSEA-Merge will significantly improve the salmonid knowledge base; develop advanced models and tools needed for the sustainable management of the resource and assist in the conservation and rational management of the species.
,
- 7th Framework Programme of Research and Technological Development (FP7) SALSEA-Merge will integrate the following cross-cutting issues of FP7: 1) Needs of SMEs and Interest groups, 2) Ethical principles and requirements, 3) Women in science, 4) Socio-economic aspects, 5) Reporting to European Parliament and Council, and 6) Promotion of Innovation.
- Community social objectives. 'SALSEA-Merge' will contribute indirectly to employment in the fisheries sector and provide quantitative results to inform a rational debate among stakeholders and policy makers. It will aid in ensuring that future management decisions are taken on a sound scientific basis.

B.3.2 Dissemination and/or exploitation of project results, and management of intellectual property

The exploitation and dissemination of the results of 'SALSEA-Merge' is embedded in the project from an early stage. A web site will be set up and advertised to science and journals in order to keep those interested in the subject updated. These means are relatively cheap, but they have wide-ranging effects and therefore ensure optimal use of EU funds. The results of the project will subsequently be worked out in information for policy makers. The project will prepare press information about the project and disseminate it to the digital, written, oral and television press.

In this regard the project will benefit from the existing communications strategy in place in both NASCO (www.nasco.int) and the IASRB. Because of the projects strong links with NGO groups and the private sector this will provide additional opportunities to profile and disseminate both scientific information and information on the progress of the various components of SALSEA-Merge to the general public. The participation of national agencies and universities will also ensure an even wider dissemination through links with existing media initiatives such as the "follow the fleet" schools initiative, regularly featured on the Irish Marine Institute website (www.marine.ie). The SALSEA programme has already received a great deal of publicity in the national press in both Europe and north America, including recent detailed features in both The Times (of London) and the Irish Times. Several of those involved in the current proposal have wide experience of both television and radio and discussions are underway with a television production company who are seeking funding to film the three year programme. One specific deliverable relates to the publication (both hard copy and web-based) of a genetic Atlas of European salmon stocks, summarising both the baseline stock data for the major European salmon rivers and the migration and distribution model developed through SALSEA-Merge. This concept has already been piloted and would be of major interest to a range of potential sponsors. Pdf maps are a convenient format to deliver the information to the non-technical stakeholder. In addition the primary data will also be available on request in GIS compatible formats, including *shape files,* to interested parties and their availability will be highlighted on appropriate websites.

Initially the scientific data will be available on a restricted basis to members of the SALSEA Merge consortium, but mature analysed data will eventually be made available to the International Atlantic Salmon Research Board for the expansion of the North Atlantic Rivers Database (www.nasco.int/asd/index.asp), to ICES for the compilation of public databases relating to; stock genetics, scale reading and salmon migration patterns and on public websites such as OBIS, GBIF and Pangaea. In addition data will be made available to other scientists on request.

The above data dissemination and storage strategies are in line with Community Data Policies and are designed to fulfil the conditions of the INSPIRE Directive. The SALSEA Merge Consortium will ensure that plans for data collection and storage are fully in line with Community Data Policy. The Community Institutions and Bodies shall enjoy access rights on a royalty free basis to all data (f*oreground*) generated during the project, for the purpose of developing, implementing and monitoring environmental policies. Such access rights shall be granted by the Consortium on a royalty-free basis. The Consortium will also indicate to the Commission if and when data will not be used and facilitate where appropriate the transfer of ownership of such data to the Community. Such transfer shall be made free of charge and without restrictions on use and dissemination. Once the project is complete the Consortium will inform the Commission of their specific plans regarding the use of the information systems developed as part of the project, as outlined above and their future data management plans.

As previously outlined a major International Salmon Summit will be held by NASCO/NPAFC/ICES/PICES in the autumn of 2010. The Salmon Summit will include a detailed comparative overview of research on salmon at sea in both the Pacific and the Atlantic oceans and will include scientists, politicians and managers. The results of the SALSEA-Merge programme will be central to this initiative and the timing of the symposium will ensure timely delivery of the programmes objectives, as well as providing a unique communications forum. From a management perspective, the fourteen contracting and six non-contracting governmental and academic institutions participating in the SALSEA-Merge project will greatly enhance the transfer of knowledge gathered on the distribution and migration of Atlantic salmon at sea to practical impacts on fisheries science and policy. Many of these institutions provide their national authorities and the fishing industry with information about the status of living marine resources, and represent their countries in national and international fisheries management forums. On the basis of their own stock assessments and of quotas proposed by the International Council for the Exploration of the Sea (ICES), these agencies prepare and distribute scientific advice before and during the annual fisheries negotiations between EU countries and other countries (including Iceland, Norway, and Russia). The scientists involved with SALSEA-Merge are actively participating in this work. More specifically, many of them are involved in the work of various ICES and NASCO / IASRB thematic expert groups: WGNAS (North Atlantic Salmon Working Group); Scientific Advisory Group (IASRB), Working Group on Ecosystem Effects of Fishing Activities (WGECO); Working Group on Application of Genetics in Fisheries and Mariculture (WGAGAFM). These working groups allow the formulation management advice in the ICES Advisory Committee on Fishery Management (ACFM) and the ICES Scientific, Technical and Economic Committee for Fisheries (STECF, Commission Decision No. 93/619/EC).

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for Fisheries (STECF, Commission Decision No. 93/619/EC).

B.4. Ethical Issues

The project contains some ethical issues relating to the capture and sacrifice of wild post-smolts at sea and the by-catch of other marine species. The crews involved in the programmes are professional, well trained and very experienced and will ensure that all salmon are sacrificed quickly with a minimum of stress. In the case of by-catch the fish will be where possible returned alive to the water and where they are dead or judged to be in danger of dying will be treated humanely, in the same manner as commercial by-catch on board scientific or commercial vessels.

ETHICAL ISSUES TABLE

	YES	page
Informed Consent		
• Does the proposal involve children?	No	
• Does the proposal involve patients or persons not able to give consent?	No	
• Does the proposal involve adult healthy volunteers?	No	
Does the proposal involve Human Genetic Material?	No	
Does the proposal involve Human biological samples?	No	
Does the proposal involve Human data collection?	No	
Research on Human embryo/foetus		
• Does the proposal involve Human Embryos?	No	
• Does the proposal involve Human Foetal Tissue / Cells?	No	
• Does the proposal involve Human Embryonic Stem Cells?	No	
Privacy		
Does the proposal involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)	No	
• Does the proposal involve tracking the location or observation of people?	No	
Research on Animals		
• Does the proposal involve research on animals?	Yes	
Are those animals transgenic small laboratory animals?	No	
Are those animals transgenic farm animals?	No	
• Are those animals cloning farm animals?	No	
• Are those animals non-human primates?	No	
Research Involving Developing Countries		
• Use of local resources (genetic, animal, plant etc)	No	
Benefit to local community (capacity building ie access to healthcare, education etc)	No	
Dual Use		
• Research having potential military / terrorist application	No	
I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	Yes	

B.5.Consideration of gender impacts

Traditionally in field ecology and genetics, more men then women were employed and few women were in leading positions. However in recent years this has changed radically and many of the field, ocean going and laboratory crews involved in SALSEA- Merge will be near to 30:70 ratio of females to males. In this project, it is envisaged that at least two team leaders and one member of the project steering group will be female. In recruiting staff for the programme every effort will be made to address any gender imbalances in teams, while ensuring that the very best skills are available to the project.

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