Scientific Advisory Group of the
International Atlantic Salmon Research Board

SAG(10)2

Inventory of Research Relating to Salmon Mortality in the Sea

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Summary

1. The Board's inventory of research relating to salmon mortality in the sea was established in 2002 and has been updated annually since then. It is an essential tool in the development of research priorities for potential funding and in better coordinating existing research efforts. Maintaining the inventory involves updating it as new projects are approved (including those commencing in the current year and for which funding has been confirmed), existing projects are changed, and projects are completed.

2. Having reviewed earlier inventories, the Board agreed that its initial research priority was studies of the distribution and migration of salmon at sea in relation to feeding opportunities and predation. In 2005, the Board adopted a comprehensive and innovative programme of research, the SALSEA Programme, designed to improve understanding of the distribution and migration of salmon at sea. Its three main work packages relate to the development of supporting technologies, early migration through the inshore zone and marine surveys. The Board recognised that studies of the early migration through the inshore zone were largely nationally funded but the Board might play a role in coordinating such research. In 2009, the SAG received a report from its Inventory Review Group, SAG(09)10, established to identify areas where there may be merit in encouraging improved coordination of research and to highlight gaps in the programme. This Group also made some suggestions for changes to the presentation of the inventory. For this year, the inventory has been presented in the format agreed previously by the Board, but some possible changes to this format, in the light of consultations with the Review Group Chairman, are proposed separately in document SAG(10)3.

3. Table 1 provides details of expenditure on research by topic area for each Party. All on-going projects have been costed and as requested by the Board information has been included, for the first time, for the St Pierre and Miquelon salmon fishery sampling programme. In Table 2, on-going projects are listed according to the five research topic areas agreed by the Board on the basis of the main focus of the research, although some projects could have been allocated to a number of these research areas. The total annual expenditure on the 44 on-going projects included in the inventory amounts to approximately £6.1 million.

4. As requested by the Board at its 2006 meeting, those projects that fall within the SALSEA programme have been allocated to the relevant work package in Table 3. In 2007, the Board had agreed that studies involving acoustic tags and DSTs should be listed under work package 3.

5. Table 4 provides summary information on both the on-going (Table 4a) and completed projects (Table 4b) and full details of these projects are contained in Annexes 1 and 2 respectively. The total of 44 ongoing projects represents a reduction of four projects since last year, several of these ongoing projects are in their final

stages. Seven projects have been completed since last year. Following its withdrawal from NASCO, the five Icelandic projects have also been removed. After consulting the EU delegation one project from Finland concerning genetic baseline sampling in Russian rivers has also been removed. Ten new projects have been included in the inventory. The new projects are as follows:

Canada:

- Genomic basis of adaptive divergence and marine survival among Atlantic salmon populations.

European Union:

- Development and application of salmonid life-cycle models;
- The impacts of contaminants and temperature on freshwater fish populations;
- Impacts on juvenile salmonid populations from a changing freshwater environment;
- Development of a general spatial model of within river population structuring in Scottish Atlantic salmon (POPMOD);
- Focusing Atlantic salmon management on Atlantic salmon (FASMOP).

Norway:

- Origin of Atlantic salmon off Svalbard;
- SALMOTRACK - Electronic tracking of northern anadromous salmonids.

Russian Federation:

- Establishing a genetic baseline of northern salmon populations across the Russian – Norwegian border for management purposes.

USA

- SALSEA Greenland

Secretary
Edinburgh
3 May 2010

Table 1: Approximate Annual Expenditure on Research in Relation to Salmon Mortality at Sea by Topic Area and Party

	Canada	Denmark (Faroe Islands and Greenland)	European Union	Norway	Russian Federation	United States of America	France (in respect of St Pierre and Miquelon)	**Totals by Topic Area**
Long-term monitoring	£639,500 1		£1,060,500 8	£134,000 1	£80,000 1	£14,000 1		**£1,928,000 12**
Distribution/ migration in the sea	£392,000 5	£88,200 1	£2,436,500 8	£457,500 3	£141,950 1	£123,250 4	- 1	**£3,639,400 23**
Life history/ biological processes	£18,000 1	-	£104,700 3	-	-	-	-	**£122,700 4**
Development of methods	-	-	-	-	-	-	-	**-**
Specific natural and anthropogenic factors	-	-	£339,600 2	£75,000 2	-	£3,500 1	-	**£418,100 5**
Totals by Party	**£1,049,500 7**	**£88,200 1**	**£3,941,300 21**	**£666,500 6**	**£221,950 2**	**£140,750 6**	**- 1**	**£6,108,200 44**

The figures shown are in pounds sterling. The number of projects is shown below the expenditure figure. The costs have been allocated on the basis of the NASCO Party coordinating the research project. However, in many cases the projects involve collaboration with other Parties or with NGO partners who may have made financial contributions to the projects (some details of these contributions have been provided and are given in Annex 1).

Table 2: Allocation of projects by topic area

Topic Area	Objective/Issue	Comments/examples	Projects	Potential for cooperation among Contracting Parties	Priority for access to 'Fund'
1. Long-term monitoring	a. Time-series of marine survival/growth estimates	Essential on-going tagging/monitoring programmes; require long-term national funding.	C3, E3, E8, E9, E15, E16, E19, E21, N2, R1, U3	Medium	Low
	b. Time series of marine survival in relation to environmental parameters (e.g. SST)	Desk studies on time series.	E10	Medium	Medium
2. Distribution/ migration in the sea	a. Distribution of salmon in the sea	Marine surveys of post-smolt distributions in NEAC and NAC areas; identification of fish caught (e.g. tagging, genetics).	C1, E1, U4	High	High
	b. Migratory behaviour of individual fish	Active smolt tracking; automated data collection by DSTs.	C2, C4, C6, E18, N3, N6, U1, U2	High	High
	c. Origin of catches in directed fisheries	Catch sampling in distant water fisheries; genetic analysis and scale analysis, etc; changes over time.	C7, D1, E2, E11, E13, E14, E17, E20, N5, R2, U6, F1		Low
	d. Migration and bioenergetic models	Desk studies based on data obtained from other studies.		Medium	Medium
	e. By-catches in pelagic fisheries	Can be conducted as part of marine surveys of post-smolt distributions; sample commercial pelagic catches.		High	High
3. Life history/biological processes	a. Freshwater factors	Age, growth, migration timing, etc.	E5, E7	Low	Low
	b. Pre-fishery recruitment marine factors	Environment, food, predation, growth, parasites and diseases, etc.		High	High
	c. Post-fishery recruitment marine factors	Environment, food, predation, maturation processes, growth, etc.	C5, E4, E12	High	High
4. Development of methods	a. Post-smolt survey methods	Development of trawls with cameras, tag detection, etc.		Medium	Medium
	b. Electronic tag technology	Development of smaller/smarter/cheaper tags.		Medium	High
5. Specific natural and anthropogenic factors	a. Fish farms	Increased sea lice infestations.	N1, N4	Low	Low
	b. Predation	Predation by seals, birds, fish, etc. in estuaries/coastal areas.	U5	Low	Low
	c. Obstructions to fish movements	Barrages, etc.		Low	Low
	d. Pollutants	Acidification; freshwater contaminants.	E6	Low	Low

Note: The priorities of low, medium and high assigned to the topic areas in this table are those currently considered appropriate for international cooperation and funding. The Board will keep them under review. They are not intended to reflect overall importance of these topics.

Table 3: Ongoing projects in the inventory of research allocated to SALSEA programme work packages

SALSEA Work Packages	Ongoing Projects
Work Package 1: Supporting Technologies	
Task 1: Genetic tagging to determine stock origin	C7, D1, E2, E11, E13,E14, E17, E20, N5, R2, F1
Task 2: Sampling equipment evolution	-
Task 3: Signals from scales	C5, E4, E10
Work Package 2: Early Migration through the Inshore Zone: fresh waters, estuaries and coastal waters	
Task 1: Investigate the influence of biological characteristics of Atlantic salmon smolts on their marine mortality	C3, E3, E8, E9, E15, E16, E19, E21, N2, R1, U3
Task 3: The impacts of physical factors in fresh water on marine mortality of Atlantic salmon	E5, E7
Task 3: Preparing to migrate – investigate the influence of freshwater contaminants on the marine survival of Atlantic salmon	E6
Task 4: The part played by key predators	U5
Task 5: The impact of aquaculture on mortality of salmon	N1, N4
Work Package 3: Investigating the distribution and migration of salmon at sea	
Task 1: Distribution and migration mechanisms – develop theoretical migration models	-
Task 2: A common approach – refine the plans for a large-scale marine survey	-
Task 3: Salmon at sea – carry out a comprehensive survey - marine surveys	C1, E1, U4,
- - acoustic tagging surveys	C2, C4, C6, E18, N3, N6, U1, U2
- - data storage tags	-
- others	E12, U6
Task 4: Distribution and migration – analyse and collate data	-
Appendix 1: Supporting technologies, further development of which will support the SALSEA programme	
1. Novel trawl sampling technologies	-
2. Data storage tags	-
3. Coded wire tagging	-
4. Sonic tags and sonic detector arrays	-

Table 4: Summary of ongoing and completed research projects relating to salmon mortality in the sea

Table 4(a) ONGOING PROJECTS (see Annex 1 for details)

Project No. and Title	Summary of objectives	Topic Area	Date of research	Area of research/ Collaborating countries	Coordinating Scientist(s)	Annual expenditure (Pounds Sterling – approx.)	Main research methods
CANADA							
C1: Pelagic ecosystem survey of the Northwest Atlantic	Sample the upper pelagic ecosystem during the period corresponding to the early post-smolt phase. Determine distribution and relative abundance of post-smolts at selected locations and times along hypothesised ocean migration route. Obtain data on relative abundance of other species including macroplankton aggregations to provide information on the role of salmon in the pelagic ecosystem. Obtain oceanographic information.	Distribution/ migration in the sea.	2008-2010 Sample analysis only in 2010	North West Atlantic (stations north of 52°N in 2009) *Colloborating countries:* USA	Gerald Chaput ChaputG@dfo-mpo.gc.ca Dave Reddin reddind@dfo-mpo.gc.ca Tim Sheehan Tim.Sheehan@noaa.gov	-	Surface pelagic trawl, oceanographic and plankton samplers.
C2: Miramichi River kelt movements and survival	Document the spring movements and survival of kelts from the Miramichi River as they return to the sea. Use pressure sensitive tags to record the depths used by kelts.	Distribution/ migration in the sea	April 2008 – March 2010	Miramichi River estuary and Gulf of St Lawrence	Dr. F. Whoriskey fwhoriskey@asf.ca	£12,500 (excluding receiver deployment and other costs recovered under other projects)	Acoustic tags and receiver arrays
C3: Marine survival of Canadian Atlantic salmon stocks: long-term monitoring	Long-term monitoring of smolt production and adult return estimates from a number of rivers in Newfoundland region, Maritimes region, Gulf region and Quebec.	Long-term monitoring	April – November, annually	Canadian rivers in Newfoundland region, Maritimes region, Gulf region and Quebec	Contact for information: Gerald Chaput Chaputg@dfo-mpo.gc.ca	£639,500	Smolt and adult traps, fences, trap nets, rotary screw smolt traps.

Project No. and Title	Summary of objectives	Topic Area	Date of research	Area of research/ Collaborating countries	Coordinating Scientist(s)	Annual expenditure (Pounds Sterling – approx.)	Main research methods
C4: Atlantic salmon smolt migration and survival within Canadian rivers, estuaries and during the marine life stage	Provide a time-series of stage specific estimates of mortality rates for smolts and post-smolts at various points of their at-sea migration, including for their transitions through fresh water, the estuary and to various points in the ocean; examine the relation between biological characteristics of the fish and survival rates to attempt to isolate mortality causes; document the migration pathways and speeds of smolts from different rivers.	Distribution/ migration in the sea	2003-2010 (spring/ summer)	Miramichi River and estuary; Restigouche River and Baie des Chaleurs; Cascapedia River and estuary; St-Jean (Côte-Nord) River and estuary; Western Arm Brook; Strait of Belle Isle, Cabot Strait, Labrador; West River, Sheet Harbour. *Colloborating countries: USA*	Dr. F. Whoriskey fwhoriskey@asf.ca	£300,000	Acoustic tags and receivers, smolt wheels, small boats and chartered fishing vessel.
C5: Stable isotope ratios to infer trophic structure and condition of Atlantic salmon during their life at sea.	Improve understanding of marine ecology of salmon through status of trophic state and condition. Questions to be addressed include: - are trophic states of 1SW non-maturing fish similar between NAC and NEAC origin salmon?; - are trophic states of 1SW non-maturing fish different from those of maturing 1SW fish of the same cohort? Can this tell us anything about when these different maturity groups separate in the North Atlantic?; - has there been a trophic state change between West Greenland and return to home rivers as 2SW salmon?	Life history/ biological process	2007-2010	West Greenland and from salmon returning to the index rivers of Eastern Canada. *Collaborating countries:* Greenland	Gerald Chaput Chaputg@dfo-mpo.gc.ca Tim Sheehan Tim.Sheehan@noaa.gov	£18,000 (smolt tissue sample analysis)	Stable isotope analyses.
C6: Identification of essential habitat for repeat spawning Atlantic salmon of Inner Bay of Fundy origin	To identify the freshwater and marine habitats used by post-spawning Atlantic salmon of inner Bay of Fundy (iBoF) origin for reconditioning until their return as repeat spawners, and identify the sites and times of mortality for those that fail to return.	Distribution/ migration at sea	2008-2010	Primarily the Big Salmon River but possibly other inner Bay of Fundy rivers (i.e. Stewiacke) as well as the Saint John River and Bay of Fundy.	Dr. Gilles Lacroix Gilles.Lacroix@dfo-mpo.gc.ca Ross Jones Ross.A.Jones@dfo-mpo.gc.ca	£15,000 In-kind contributions from Fort Folly First Nation.	Acoustic tags and receivers satellite tags.

Project No. and Title	Summary of objectives	Topic Area	Date of research	Area of research/ Collaborating countries	Coordinating Scientist(s)	Annual expenditure (Pounds Sterling – approx.)	Main research methods
C7: Genomic basis of adaptive divergence and marine survival among Atlantic salmon populations	Elucidate the genetic basis of adaptive divergence and marine survival in Atlantic salmon populations from eastern Canada. Contribute to the identification of management units.	Distribution/ migration in the sea	**New Entry** 2010-2013	*Collaborating countries:* Norway, USA,	Louis Bernatchez, Louis.Bernatchez@bio.ulaval.ca Mélanie Dionne, Melanie.Dionne@mrnf.gouv.qc.ca Patrick O'Reilly, OReillyP@mar.dfo-mpo.gc.ca Vincent Bourret, vincent.bourret.1@ulaval.ca	£64,500	Genetic analyses.
DENMARK (FAROE ISLANDS AND GREENLAND)							
D1: West Greenland Salmon Fishery Sampling Programme	Continue time series of data on the continent of origin and biological characteristics of salmon in the fishery. Provide data on mean weight and length and continent of origin for input to models. Collect information on the recovery of internal and external tags. Collect other additional biological samples as required.	Distribution/ migration in the sea	Annually during the fishing season, (August – October)	West Greenland *Collaborating countries:* USA, UK, Ireland, Canada	Helle Siegstad helle@natur.gl	£88,200 in 2009	Catch sampling, scale analysis, genetic analysis, and other biological sampling.
EUROPEAN UNION							
E1: SALSEA-Merge: Advancing understanding of Atlantic salmon at sea: Merging genetics and ecology to resolve stock – specific migration and distribution patterns.	Merge 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.	Distribution/ migration in the sea	April 2008 – March 2011	North-East Atlantic with marine surveys off coast of Ireland and UK, around the Faroes and in the Northern Norwegian Sea and Barents Sea *Collaborating countries:* Denmark, Finland, France, Faroes, Iceland, Ireland, Norway, Spain, UK	Jens Christian Holst jens.christian.holst@imr.no	£1.8 million	Pelagic live capture trawls, pelagic trawls, genetic analysis, oceanographic data analysis
UK – England and Wales							
E2: Genetic sampling to type British salmon stocks	Coordinate and support the establishment of baseline information on the genetic character of breeding populations within and among rivers in Britain.	Distribution/ migration in the sea	April 2008 – March 2010	England, Wales, Northern Ireland and Scotland *Collaborating countries:* Scotland, Northern Ireland	Miran Aprahamian Miran.aprahamian@environment-agency.gov.uk	£60,000	Genetic sampling

Project No. and Title	Summary of objectives	Topic Area	Date of research	Area of research/ Collaborating countries	Coordinating Scientist(s)	Annual expenditure (Pounds Sterling – approx.)	Main research methods
E3: Deriving estimates of marine survival and exploitation for monitored river stocks in England and Wales	Establish 'monitored' rivers where estimates of marine survival can be derived and compared with other North Atlantic stocks.	Long-term monitoring	Ongoing annual monitoring programme	River Dee (North Wales), River Tamar (SW England)	Ian Davidson ian.davidson@ environment-agency.wales.gov.uk Rob Hillman rob.hillman@environment-agency.gov.uk Ian Russell ian.russell@cefas.co.uk	£120,000	Rotary screw traps, microtagging, adult traps and counters.
E4: The marine life of Atlantic salmon : evidence from the microchemistry of scales	The objectives include measuring the stable isotope and trace element compositions from salmon scales in relation to variations in the marine environment and develop a model to predict impacts of changes in the marine environment on return rates of salmon.	Life history /biological processes	2007 – 2010	England and Wales	Clive Trueman trueman@noc.soton.ac.uk	£22,200	Stable isotope and trace element analysis.
E5: Development and application of salmonid life cycle models	The objectives include reviewing available models to assess suitability and to build on existing models or develop new models to *inter alia* compare marine and freshwater factors affecting stocks.	Life history /biological processes	**New Entry** April 2009 – March 2013	England and Wales	Ted Potter: ted.potter @cefas.co.uk	£52,500	Modelling.
E6: The impacts of contaminants and temperature on freshwater fish populations	Undertake further studies of the impacts of contaminants derived from intensive agriculture and aquaculture facilities on wild salmonids and investigate the implications of predicted climate change scenarios on the impacts of different sources of diffuse and point source pollution on wild fish populations.	Specific natural and anthropogenic factors	**New Entry** April 2009 – March 2014	England and Wales	Andy Moore: andy.moore@cefas.co.uk	£159,000	Modelling
E7: Impacts on juvenile salmonid populations from a changing freshwater environment.	Investigate how predicted changes in the freshwater environment might impact on juvenile salmonid populations and how changing conditions during the early life history stages may influence their behaviour and subsequent survival within the marine environment.	Specific natural and anthropogenic factors	**New Entry** April 2009 – March 2014	England and Wales	Bill Riley: bill.riley@cefas.co.uk	£180,600	Various
UK – Northern Ireland							
E8: The marine survival of Atlantic salmon from the River Bush, Northern Ireland	Investigate factors influencing the survival at sea of salmon smolts migrating from the River Bush until their return as adults.	Long-term monitoring	1973 – Ongoing	River Bush, N. Irish/Irish coastal waters and distant-water fisheries *Collaborating countries:* Ireland (tag recovery programme)	Richard Kennedy Richard.kennedy@ afbini.gov.uk	£60,000	Microtagging, traps, run-reconstruction models.

Project No. and Title	Summary of objectives	Topic Area	Date of research	Area of research/ Collaborating countries	Coordinating Scientist(s)	Annual expenditure (Pounds Sterling – approx.)	Main research methods
UK – Scotland							
E9: Post-smolt mortality of Atlantic salmon	Assess post-smolt mortality rates of Atlantic salmon from three Scottish rivers, and the contribution of these salmon to fisheries that exploit them.	Long-term monitoring	Ongoing	North Esk, Western catchment of River Dee, River Conon salmon fishery district	Julian Maclean (N. Esk and Dee) j.c.maclean@ marlab.ac.uk John Armstrong (River Conon) j.armstrong@marlab.ac.uk	Approxim-ately £50,000	Traps, counters, rotary screw traps, electro-fishing, PIT tags and detectors.
E10: Analysis of post-smolt life history by scale reading	Investigate the relationship between growth and mortality, particularly during the marine phase, by analysis of scale growth patterns.	Long-term monitoring	Continuing project under longer-term remit	Samples from around Scotland but North Esk and Girnock Burn in particular *Collaborating countries:* USA and Canada	Julian Maclean j.c.maclean@marlab.ac.uk	Approxim-ately £10,000	Scale analysis.
E11: Fisheries-induced evolution	Determine the incidence and extent of heritable genetic changes in salmon stocks due to fishery programmes.	Distribution/ migration in the sea	2007-2010	Scotland and across European species' distribution, including marine migration routes. *Collaborating countries:* Austria, Norway, France, Denmark, Belgium, UK, Netherlands, Finland, Germany	Ulf Dieckman dieckman@iiasa.ac.at *Scotland* John Gilbey J.Gilbey@marlab.ac.uk *Ireland* Philip McGinnity P.McGinnity@ucc.ie	*Scotland* £52,000 (FRS cost) *Ireland* £3,500 (travel for meeting costs only)	Case studies, genetic analyses and modelling.
E12: Size and condition of returning grilse (1SW) and MSW salmon	Investigate decadal trends in the size and condition of adult salmon returning to Scotland.	Life history/ biological processes	2007 -	Six locations in Scotland, in particular North Esk.	Philip Bacon P.J.Bacon@MarLab.ac.uk	£30,000	Collection of biometric data.
E13: Development of a General Spatial Model of Within River Population Structuring in Scottish Atlantic salmon (POPMOD)	To improve the scientific basis for *inter alia* setting biologically appropriate conservation limits, providing advice on conservation and restoration initiatives, accurately and cost-effectively monitoring the status of salmon stocks. This project will provide baseline information in support of project E1.	Distribution/ migration in the sea	**New Entry** 2008-2011	River systems across Scotland	Dr. Eric Verspoor verspoor@marlab.ac.uk	£267,000	Genetic analysis.

Project No. and Title	Summary of objectives	Topic Area	Date of research	Area of research/ Collaborating countries	Coordinating Scientist(s)	Annual expenditure (Pounds Sterling – approx.)	Main research methods
E14: Focusing Atlantic Salmon Management on Atlantic Salmon (FASMOP)	To establish the number and spatial boundaries of breeding populations of salmon within any Scottish river system; establish the ancestral relationships and functional biological differences between wild salmon stock components across Scottish rivers; improve local management practice and increase the focus of management on local breeding populations. This project will provide baseline information in support of project E1.	Distribution/ migration in the sea	**New Entry** 2009-2011 (possible extension)	River systems across Scotland	Dr. Eric Verspoor verspoor@marlab.ac.uk	£140,000	Genetic analysis.
Ireland							
E15: Marine survival of wild and hatchery reared salmon: National coded wire tagging and tag recovery programme and Burrishoole wild salmon census	Provide information on marine survival and exploitation rates by commercial fisheries; estimate contribution of individual river stocks to catches; examine performance of selected experimental groups; and evaluate potential for salmon ranching.	Long-term monitoring	Code wire tagging since 1980 Burrishoole census since 1960s	Tag recovery from around North Atlantic Salmon census facility Newport *Collaborating countries:* Norway, UK, Faroes, France, Spain, Germany, Denmark	Niall O'Maoileidigh niall.omaoileidigh@ marine.ie Russell Poole russell.poole@marine.ie	£372,000	Micro-tagging and tag recovery programmes. Traps.
France							
E16: The sea survival of Atlantic salmon from the River Scorff, Brittany	Estimation and long-term monitoring of survival at sea in the southern part of the European distribution range of the species.	Long-term monitoring	1994 on	River Scorff (Southern Brittany)	Etienne Prévost eprevost@st-pee.inra.fr	£165,000	Adult and smolt trapping facilities.
E17: Atlantic salmon metapopulation investigation in Normany rivers	Estimate exchanges between rivers flowing into the Mont Saint-Michel Bay and the impact on management of salmon populations.	Distribution/ migration in the sea	2007-2010	Rivers flowing into Mont Saint-Michel Bay, Normandy	Jean-Luc Bagliniere Jean-Luc.Bagliniere@rennes.inra.fr	£50,000	Standard sampling equipment and genetics laboratory equipment traps.
Denmark							
E18: Salmon Rehabilitation Plan: monitoring numbers of spawners, spawning and nursery areas in four Atlantic Salmon rivers	The Danish national salmon rehabilitation plan describes four rivers with natural wild salmon populations. This project monitors the effect of the rehabilitation plan and the development of the populations (the goal is at least 1,000 spawners in each river to fulfil the plan). This study will allow estimates of marine mortality of salmon to be made.	Distribution/ migration in the sea	Started in autumn 2008 (tagging) and fry collection during summer 2009 and so on.	River Skjern Å, River Ribe Å, River Storå and Varde Å. The rivers flowing into the North Sea.	Anders Koed, ak@aqua.dtu.dk Einar Eg Nielsen, én@aqua.dtu.dk	£14,000	Pit and radio tags, lab equipments

Project No. and Title	Summary of objectives	Topic Area	Date of research	Area of research/ Collaborating countries	Coordinating Scientist(s)	Annual expenditure (Pounds Sterling – approx.)	Main research methods
Finland							
E19: Long-term variation in population dynamics, life history characteristics, sea growth and origin (wild/reared) of salmon in the rivers Teno (Tana) and Näätämöjoki (Neidenelva)	Collect long-term data on variation in the stock components, life histories, sea growth and abundance of escaped farmed salmon in the salmon stocks of the rivers Teno and Näätämöjoki. Relate the population dynamics of the juvenile salmon and returning adult salmon in preceding and subsequent generations	Long-term monitoring	Long-term ongoing	Northern Finland and Norway *Collaborating countries:* Norway	Jaakko Erkinaro jaakko.erkinaro@rktl.fi	£275,000	Collection of catch statistics and sampling. Analysis of scale samples (2,000-8,000 annually). Electro-fishing.
E20: Joint use of high-throughput SNP assay infrastructure in Atlantic salmon	The key aims of the project include: I) A concerted effort to identify genomic regions that affect ecologically and economically important phenotypic traits in domesticated and wild Atlantic salmon; II)efficient joint utilization of a state-of-the-art Nordic genomics infrastructure to generate large-scale salmon SNP datasets;	Distribution/ migration in the sea	2009-2010	Norway and Finland	Craig Primmer craig.primmer@utu.fi	£50,000	Genetic analyses.
Sweden							
E21: Long-term variation in population dynamics, life-history and exploitation of salmon stocks in monitored rivers	Estimate long-term variation of survival in different life-stages, life-history characteristics and growth of wild salmon in the River Åtran and its major tributary. Estimate sea survival, growth and exploitation for wild fish in the River Åtran and wild and reared fish in the rivers Lagan and Nissan.	Long-term monitoring	Ongoing	Rivers Åtran, Lagan and Nissan	Lars Karlsson lars.karlsson @fisheriverket.se	£8,500	Adult and smolt traps. Carlin tags.
NORWAY							
N1: Significance of salmon lice for growth and survival of salmon in the sea	Estimate the effects of salmon lice on post-smolt growth and survival, dependent on release site and time and year of release.	Specific natural and anthropogenic factors	2006-2010	Western Norway, River Dale, Matre Aquaculture Station	Ove Skilbrei ove.skilbrei@imr.no	£75,000	Smolt trap, tags, SLICE.
N2: Marine survival, growth and exploitation of salmon from the Rivers Figgjo, Imsa, Drammenselv and Halselv	Estimate marine survival, marine growth and changes in marine exploitation of salmon from four rivers in Norway. Develop predictive models.	Long-term monitoring	Long-term ongoing monitoring project	Rivers Figgjo, Imsa, Drammenselv and Halselv with tag recovery programme in fisheries along Norwegian coast and elsewhere	Lars Petter Hansen l.p.hansen@nina.no Nina Jonsson Nina.jonsson@nina.no Arne Johan Jensen Arne.jensen@nina.no	£134,000	Fish traps, electro-fishing.

Project No. and Title	Summary of objectives	Topic Area	Date of research	Area of research/ Collaborating countries	Coordinating Scientist(s)	Annual expenditure (Pounds Sterling – approx.)	Main research methods
N3: Population-limiting mechanisms for Atlantic salmon during early estuarine and coastal migration (SALPoP)	Map migratory behaviour and quantity where, when and why mortalities occur; correlate data on migration and mortalities with health status and major population-limiting factors; develop improved mitigating actions and management strategies to contribute to sustainability of salmon populations.	Distribution/ migration in the sea	2008 - 2012	Eresfjord in Møre and Romsdal, mid Norway *Collaborating countries:* Sweden, UK, Canada	Bengt Finstad bengt.finstad@nina.no	£200,000 in 2010	Acoustic telemetry, external tags, fish health screening.
N4: The Hardangerfjord salmon lice project	Improve sea lice monitoring and management; evaluate success of sea lice management strategies; quantify the abundance and distribution of salmon lice in the Hardangerfjord area; analyse data sets for possible risk factors associated with varying lice infection pressure.	Specific natural and anthropogenic factors	January 2007 – June 2010	Hardangerfjord on the Norwegian west coast *Collaborating countries:* Canada, UK	Bengt Finstad bengt.finstad@nina.no	-	Lice monitoring, models.
N5: Origin of Atlantic salmon off Svalbard	Identify the origin of Atlantic salmon occuring in gill net fisheries at Isfjorden, Spitsbergen, by life history (age, growth) and genetic analyses.	Distribution/ migration in the sea	**New Entry** 2008 –2011	Isfjorden, Spitsbergen	Arne Johan Jensen arne.jensen@nina.no	£7,500	Scale and genetic analysis.
N6: SALMOTRACK - Electronic tracking of northern anadromous salmonids	Track different life-stages of northern Atlantic salmon and other anadromous species in river, fjord and open ocean.	Distribution/ migration in the sea	**New Entry** 2006-2012	Northern Norway (2007-2012) Mid Norway (2010) Western Norway (2006) *Collaboration Countries:* Denmark, UK, Finland, USA, Japan, Ireland, Canada	Audun H. Rikardsen, audun.rikardsen@uit..no	£250,000	Different telemetry equipment and tags.
RUSSIAN FEDERATION							
R1: Monitoring of the stock status, abundance assessment and provision of advice on the allowable level of harvest of Atlantic salmon	Estimate survival of juveniles and adult return rates; estimate natural and fishing mortality; study population dynamics; assess population sizes and spawning escapement and estimate allowable catch.	Long-term monitoring	Annual monitoring programmes (May to October)	Atlantic salmon rivers of the Kola Peninsula, Archangel Region and Karelian Republic	Sergey Prusov prusov@pinro.ru Gennady Ustuzhinsky gena@sevpinro.ru	£80,000	Barrier fences, nets, electro-fishing, smolt traps, external tagging.
R2: Establishing a genetic baseline of northern salmon populations across the Russian – Norwegian border for management purposes.	Establish a genetic baseline of sufficient resolution for the purposes of partitioning bag net catches between Russian and Norwegian regions.	Distribution/ migration in the sea	**New Entry** 2009-2010	Northern Norway, North West of the Russian Federation *Collaboration Countries:* Norway	Dr. Vidar Wennevik (IMR) vidar.wennevik@imr.no Dr. Sergey Prusov (PINRO) prusov@pinro.ru	£141,950	Genetic analysis.

Project No. and Title	Summary of objectives	Topic Area	Date of research	Area of research/ Collaborating countries	Coordinating Scientist(s)	Annual expenditure (Pounds Sterling – approx.)	Main research methods
USA							
U1: Penobscot hatchery versus wild smolt telemetry	Evaluate migration timing and pathways in the Penobscot Estuary and Bay and estimate survival of migrating smolts and post-smolts.	Distribution/ migration in the sea	2005-2010	Penobscot Estuary Penobscot Bay *Collaboration Countries:* Canada	James Hawkes James.Hawkes@noaa.gov	£66,750 (public funding)	Ultrasonic tags and receivers. Small research boats and leased commercial vessels.
U2: Comprehensive evaluation of marine survival of hatchery-stocked smolts: migration behaviour and success of Dennys River smolts	Evaluate migration speed and behaviour from lower river release sites through estuarine habitat; estimate survival of migrating smolts and identify areas where mortality may be occurring.	Distribution/ migration in the sea	April – June, 2001-2010 (Data analysis and publication 2005-2010)	Dennys River, Cobscook Bay, Gulf of Maine *Collaborating countries:* Canada	James Hawkes James.Hawkes@noaa.gov	£3,500 (public funding)	Ultrasonic tags and receivers. Electro-fishing gear. Small research boats and leased commercial vessels.
U3: Comprehensive evaluation of marine survival of hatchery-stocked smolts: Dennys River smolt stocking assessment	Evaluate smolt-to-adult survival rates based on temporal and spatial patterns of release; determine optimal stocking levels to achieve stock rebuilding objectives.	Long-term monitoring	May – October, 2001-2010	Dennys River, Cobscook Bay, Gulf of Maine *Collaborating countries:* Recovery of marked fish through NASCO West Greenland sampling programme	Greg Mackey greg.mackey@maine.gov	£14,000 (public funding)	Elastomer marks, rotary smolt traps, weir-based smolt and adult traps.
U4: Evaluation of estuary and nearshore marine distributions of Atlantic salmon post-smolts in Penobscot Bay and the Gulf of Maine	Evaluate nearshore distribution and migration pathways of smolts and post-smolts; estimate the relative contribution of stocked hatchery smolts to overall post-smolt populations; evaluate the relative contribution of spatially and temporally distinct smolt releases on post-smolt populations; evaluate the physiological condition of post-smolts in marine environments.	Distribution/ migration in the sea	2001-2010 Data analysis from 2005-2010	Penobscot Bay, Gulf of Maine	Tim Sheehan Tim.Sheehan@noaa.gov	£20,000 (public funding)	Post-smolt trawl, oceanographic instruments, commercial trawlers.
U5: Cormorant harassment in the Narraguagus River/Narraguagus Bay	Reduce predation on migrating salmon smolts by excluding double-crested cormorants from the Lower Narraguagus River and Bay, and assess the efficiency of non-lethal predator exclusion as a means of reducing predation on migrating salmon smolts.	Specific natural and anthropogenic factors	2005-2010 (Data analysis and publication only in 2005-2010)	Lower Narraguagus River, Estuary and Narraguagus Bay, Maine	James Hawkes James.Hawkes@noaa.gov	£3,500 (public funding)	Shotguns with firecracker and screamer shells, laser, small boat, cameras.

Project No. and Title	Summary of objectives	Topic Area	Date of research	Area of research/ Collaborating countries	Coordinating Scientist(s)	Annual expenditure (Pounds Sterling – approx.)	Main research methods
U6: SALSEA Greenland	Advance understanding of the ecology of the Atlantic salmon West Greenland stock complex and to gain an insight into the factors resulting in recent significant increases in marine mortality across the North Atlantic. (The baseline sampling programme at West Greenland is described in project D1)	Distribution/ migration in the sea	**New Entry** Sampling August – October 2009 and 2010, sample processing to 2012.	Sisimiut, Nuuk and Qaqortoq, Greenland	Tim Sheehan Tim.Sheehan@noaa.gov	£33,000	Standard sampling and laboratory equipment.
FRANCE (in respect of St Pierre and Miquelon)							
F1: St Pierre and Miquelon Salmon Fishery Sampling Programme	To improve the understanding of the biological characteristics and origin of salmon harvested in the fishery at St Pierre and Miquelon.	Distribution/ Migration in the sea	Annually during the fishing season (1 May – 31 July). No sampling in 2009	Around the islands of St Pierre and Miquelon	Jean-Claude Mahé, jean.claude.mahe@ifremer.fr Herlé Goraguer herle.goraguer@ifremer.fr	-	Coastal sampling

Note: Germany and the Netherlands had previously indicated that they do not carry out research on the marine phase of salmon. No information was provided by other EU Member States (Portugal and Spain) with salmon interests.

Table 4(b) COMPLETED PROJECTS (see Annex 2 for details)

Party	Project Title and Details of Coordinating Scientist(s)	Summary of Objectives	Year removed from inventory
Canada	Marine migration and survival of post-smolt Atlantic salmon from Bay of Fundy rivers *Coordinating scientist:* Gilles L Lacroix LacroixG@dfo-mpo.gc.ca	Provide knowledge about marine habitat (migration routes and feeding grounds) used by salmon post-smolts from Bay of Fundy rivers. Determine the location, timing and extent of salmon post-smolt mortality at sea. Investigate the causes and mechanisms of marine mortality of salmon post-smolts. Provide information to fuel the recovery programme for inner Bay of Fundy salmon stocks.	2003
Canada	Distribution, health and condition of Atlantic salmon from Bay of Fundy rivers while at sea *Coordinating scientist:* Gilles L Lacroix LacroixG@dfo-mpo.gc.ca	Provide knowledge about marine habitat and health of salmon post-smolts from Bay of Fundy rivers. Investigate the causes and mechanisms of marine mortality of salmon post-smolts. Provide information to fuel the recovery programme for inner Bay of Fundy salmon stocks.	2004
Canada	Marine migration and survival of post-smolt Atlantic salmon from the Saint-Jean River (Gaspé) *Coordinating scientist:* Julian Dodson julian.dodson@bio.ulaval.ca Francois Caron francois.caron2@mrnf.gouv.qc.ca	Provide knowledge of the marine habitat (migration routes and feeding grounds) used by salmon post-smolts from Bay of Gaspé rivers. Determine the location, timing and extent of salmon post-smolt mortality at sea. Investigate the causes and mechanisms of marine mortality of salmon post-smolts.	Not previously included (completed in 2006)
Canada	Marine migration and survival of kelt Atlantic salmon from the Saint-Jean River (Gaspé) *Coordination scientist:* Francois Caron francois.caron2@mrnf.gouv.qc.ca	Provide knowledge of the marine habitat (migration routes and feeding grounds) used by salmon kelts from Bay of Gaspé rivers. Determine the location, timing and extent of kelt mortality at sea. Investigate the causes and mechanisms of marine mortality of salmon kelts.	Not previously included (completed in 2007)
Canada	Tracking experimentally 'escaped' farmed salmon *Coordinating scientist:* Fred Whoriskey asfres@nb.aibn.com	Determine the course tracks and fates of sonically tagged farmed salmon released in winter and spring.	2006
Canada	Atlantic salmon distribution and abundance at sea *Coordinating scientist:* David Reddin reddind@dfo-mpo.gc.ca	Determine salmon distribution and abundance at sea, particularly post-smolts in the Labrador Sea and Northern Grand Banks; collect biological and other data; investigate the relationship between salmon and their prey; investigate the relationship between oceanographic parameters and salmon abundance; tag and release salmon.	2006
Canada	Integrated field and laboratory assessment of the effects of endocrine – disrupting substances on Atlantic salmon smolts. *Coordinating scientist:* Wayne Fairchild Fairchildw@mar.dfo.mpo.gc.ca	Laboratory tests of the effects of endocrine-active substances in municipal, and industrial effluents; field tests of the effects of endocrine-active substances in municipal and industrial effluents; field tests on caged smolts near sites with potential for significant agriculture run-off; ocean field tests of link between exposure of smolts to endocrine - disrupting substances and subsequent lower adult returns.	2008

Party	Project Title and Details of Coordinating Scientist(s)	Summary of Objectives	Year removed from inventory
Canada	Use of stable isotopes to assess long-term changes in marine trophic ecology of Atlantic salmon (*Salmo salar*) *Coordinating scientist:* J Brian Dempson dempsonb@dfo-mpo.gc.ca	Assess trophic and dietary information through analysis of stable isotope signatures of carbon and nitrogen from previously compiled scale samples from various salmon stocks; compare isotopic signatures within and among stocks to various differences in feeding ecology in time and space; examine evidence of environmental influences on trends in isotopic signatures; examine linkings of stable isotope signatures with trends in abundance.	2008
Canada	Effective population size, gene flow and population structure of Atlantic salmon in Newfoundland and Labrador *Coordinating scientist:* Daniel Ruzzante daniel.ruzzante@dal.ca	Document population structure and connectivity (gene flow) among Newfoundland and Southern Labrador rivers. Test for temporal stability of the structure over the past 50 years.	2008
Canada	River and extended estuary acoustic tracking of Atlantic salmon (*Salmo salar*) kelts and bright salmon *Coordinating scientist:* Peter G. Amiro AmiroP@mar.dfo-mpo.gc.ca A Jamie F. Gibson GibsonAJF@mar.dfo-mpo.gc.ca	1) To track and document migratory behaviour of Atlantic salmon kelts as they leave the river for the open ocean and bright salmon at they return to rivers; 2) To identify possible critical habitat sites utilized by kelts and bright salmon during their migration; 3) To examine the mortality rates of kelts and bright salmon during migration.	2009
Canada	Integrated modelling of juvenile Atlantic salmon movement and physical habitat in fluvial and estuarine environments *Coordinating scientist:* Julian Dodson julian.dodson@bio.ulaval.ca	Objectives: 1) to develop an innovative geomatic approach capable of relating the behaviour of smolts during their migration to the characteristics of the physical habitat in rivers and estuaries, 2) to apply this approach to the analysis of the migration of smolts through the estuaries of the St. Jean, Dartmouth and York rivers and down the Baie de Gaspé.	2009
Canada	Estuary acoustic tracking of Atlantic salmon (*Salmo salar*) smolts and kelts – Conne River, Little River, and Bay d'Espoir, Newfoundland *Coordinating scientist:* J. Brian Dempson brian.dempson@dfo-mpo.gc.ca Keith Clarke keith.clarkek@dfo-mpo.gc.ca	1) To tag and track migratory behaviour of Atlantic salmon smolts and kelts as they leave the Conne River, Newfoundland; 2) To determine the movements and migration patterns throughout the Bay d'Espoir fjord; 3) To provide insight into the initial survival and residency of smolts and kelts migrating through the fjord.	2009
Canada	Spatio-temporal distribution of Atlantic salmon stocks and the impact of the West Greenland fishery. *Coordinating scientist:* Louis Bernatchez (Supervisor; Université Laval); Tim King (Co-supervisor; US Geological Survey) louis.bernatchez@bio.ulaval.ca	Provide knowledge about the river origin of the salmon catch in the commercial fishery at West Greenland.	2009

Party	Project Title and Details of Coordinating Scientist(s)	Summary of Objectives	Year removed from inventory
Canada	Genetic population structure of Atlantic salmon in Eastern Canada and its implication for conservation. *Coordinating scientist:* Louis Bernatchez louis.bernatchez@bio.ulaval.ca Mélanie Dionne melanie.dionne@giroq.ulaval.ca	This project aims at elucidating the genetic population structure of Atlantic salmon from a small (river) to a large (Eastern Atlantic coast) spatial scale and at helping in proposing conservation units for the Canadian distribution range. Samples from 51 rivers in Quebec, New-Brunswick and Labrador have been obtained and their characteristics evaluated at 13 microsatellite loci. Further work is ongoing on the variability in major histo-compatability complexe genes and its association with exposure to pathogens. The project began in 2004 and was completed in 2008 as part of the PhD project of Mélanie Dionne (Université Laval, Québec).	2009
European Union	SALMODEL Concerted Action – A co-ordinated approach towards the development of a scientific basis for management of wild Atlantic salmon in the north-east Atlantic *Coordinating scientist:* Walter Crozier walter.crozier@dardni.gov.uk	Improve our ability to set salmon conservation limits (CLs), addressing transportability and dynamic change issues, also taking into account underlying stock structure, and; Examine methods of estimating pre-fishery abundance (PFA) for north-east Atlantic (NEAC) salmon stocks and to determine whether and how PFA estimates can be used to give catch advice.	2003
European Union – Denmark	Estuarine migration of smolts in the Rivers Skjern Å (North Sea) and River Guden Å *Coordinating scientist:* Gorm Rasmussen gr@dfu.min.dk	To assess the effect of restoration of habitat in the River Skjern Å on the smolt runs of salmon and sea trout, in particular with regard to predation by piscivorous birds. To investigate the migration of salmon smolts in the River Guden Å.	Not previously included
European Union – Denmark	Mortality of Atlantic salmon smolts during estuary migration *Coordinating scientist:* Anders Koed ak@difres.dk Kim Aarestrup kaa@difres.dk	Estimate mortality of salmon smolts during migration through estuaries and compare the return ratio of wild, stocked ½- and one-yearlings.	2009
European Union – France	Evolution of biological characteristics in Atlantic salmon from all the Armorican massif rivers (Brittany and Low-Normandy, France) *Coordinating scientist:* Jean-Luc Baglinière Jean-Luc Bagliniere:rennes.inra.fr	Examine relationships between the cumulative effects of climate warming and other anthropogenic stresses and changes in biological features in populations in the Southern part of the European distribution range of the species.	2005
European Union – Ireland	Assessment of the levels of the parasite *Lepeophtheirus salmonis* on Atlantic salmon post-smolts in salmon aquaculture bays along Ireland's western seaboard *Coordinating scientist:* Paddy Gargan paddy.gargan@cfb.ie	Determine whether sea lice from marine salmon farms are a contributory factor in increased marine mortality of salmon post-smolts migrating from bays with salmon aquaculture. Gather information on salmon post-smolt migration patterns.	2003

Party	Project Title and Details of Coordinating Scientist(s)	Summary of Objectives	Year removed from inventory
European Union – Ireland	Oceanic factors influencing marine survival of Irish salmon stocks *Coordinating scientists:* Niall O'Maoileidigh niall.omaoileidigh@marine.ie Kevin Friedland friedlandk@forwild.umass.edu	Provide information on marine survival at various stages of ocean migration.	2006
European Union – Ireland	Sustainable management of interactions between aquaculture and wild salmonid fish (EU SUMBAWS project – Irish component of project only) *Coordinating scientist:* Paddy Gargan paddy.gargan@cfb.ie Niall O'Maoileidigh niall.omaoileidigh@marine.ie	To assess efficacy of prophylactic treatments for salmon smolts migrating through aquaculture bays.	2007
European Union –Ireland	Early distribution and migration of Atlantic salmon smolts off the West of Ireland *Coordinating scientist:* Niall O'Maoileidigh niall.omaoileidigh@marine.ie	Test new pelagic trawl in open waters off Irish coast; train and familiarise staff on the operation and development of the trawl for further surveys in 2008 and 2009; obtain samples of post-smolts for background and genetic analysis; relate run-timing, timing of migration, swimming speed, growth, etc to oceanographic parameters.	2008
European Union –Ireland	Migration of salmon in estuarine and coastal waters *Coordinating scientists:* Russell Poole, russell.poole@marine.ie Deirdre Cotter deirdre.cotter@marine.ie Niall O'Maoileidigh niall.omaoileidigh@marine.ie	Investigate the timing, route of migration and aspects of the biology of migrating ranched salmon smolts in comparison to the native wild smolt migration.	2009
European Union –Ireland	National Development Plan - National Genetic Stock Identification Project *Coordinating scientists:* Tom Cross t.cross@ucc.ie Paddy Gargan paddy.gargan@cfb.ie Philip McGinnity p.mcginnity@ucc.ie	Identify and map discrete spawning areas within tributaries of Irish salmon rivers and collect juveniles for establishment of genetic baseline for mixed sample analysis. Undertake molecular genetic analysis of juvenile salmon tissue and adult scales to determine relative contributions of different baseline river populations within mixed samples.	2009
European Union –Ireland	Interactions between aquaculture and wild salmonid fish *Coordinating scientist:* D Jackson dave.jackson@marine.ie	Assess efficacy of prophylactic treatments for salmon smolts migrating through aquaculture bays.	2010
European Union – United Kingdom (England and Wales)	Salmonid migration and climate change *Coordinating scientist:* Andrew Moore a.moore@cefas.co.uk	Describe and model the environmental factors affecting the migration of salmonids and investigate the effects of climate change on salmonid migration and survival both in fresh water and the sea.	2005

Party	Project Title and Details of Coordinating Scientist(s)	Summary of Objectives	Year removed from inventory
European Union - United Kingdom (England and Wales)	Impacts of agricultural contaminants on wild salmonids *Coordinating scientist:* Andrew Moore a.moore@cefas.co.uk	Identify and describe the effects of environmental levels of agricultural pesticides on salmonid embryo survival, smolt emigration and marine survival and model their potential impacts at the population level. In addition, the role of pheromones in sea trout biology was investigated in order to predict the effects of water quality on sea trout reproduction.	2005
European Union - United Kingdom (England and Wales)	Impact of intensive in-river aquaculture on wild salmonids *Coordinating scientist:* Andrew Moore a.moore@cefas.co.uk	Describe the nature and extent of the impact of aquatic contaminants derived from intensive freshwater aquaculture (effluents, pesticides, antibiotics and hormones) on reproduction and migration of wild salmonids.	2007
European Union - United Kingdom (England and Wales)	Modelling the bioenergetics of Atlantic salmon migration *Coordinating scientist:* Douglas Booker dobo@ceh.ac.uk	Model the energetic requirements of salmon during their marine migrations and predict the effects of environmental and oceanographic changes on smolt growth and survival.	2007
European Union - United Kingdom (England and Wales)	Cardiff Bay Fisheries Monitoring Programme *Coordinating scientist:* Peter Gough peter.gough@environment-agency.wales.gov.uk	Assess the impact of Cardiff Bay barrage on salmon stocks of the rivers Taff and Ely.	2008
European Union - United Kingdom (England and Wales)	Atlantic Salmon Arc Project, ASAP *Coordinating scientist:* Dylan Bright dylan@wrt.org.uk	Define exploitation at sea on a regional basis using genetic tools. Create a long-term database for these studies and create an international management tool to inform decision-making.	2009
European Union - United Kingdom (England and Wales)	Diffuse pollution and freshwater fish populations *Coordinating scientist:* Andrew Moore a.moore@cefas.co.uk	Investigate the role of diffuse aquatic contaminants in regulating populations of freshwater fish with particular reference to salmonid stocks and fisheries.	2010
European Union - United Kingdom (England and Wales)	The influence of the freshwater environment on salmonid populations *Coordinating scientist:* Andrew Moore a.moore@cefas.co.uk	Investigate the impact of environment change on juvenile salmon production and ecology. One aspect of the research directly related to marine survival is the potential role of assessment techniques (trapping, anaesthetisation tagging) in influencing marine survival.	2010
European Union - United Kingdom (England and Wales)	Factors affecting the distribution and behaviour of salmonid populations *Coordinating scientist:* Andrew Moore a.moore@cefas.co.uk	Investigate the habitat requirements of adult salmonids within the estuarine and freshwater environments. One key element of the research is to investigate how changes in prey availability within the marine environment may influence recruitment of stocks between years.	2010

Party	Project Title and Details of Coordinating Scientist(s)	Summary of Objectives	Year removed from inventory
European Union – United Kingdom (Northern Ireland)	Development of conservation limits, pre-fishery abundance and management of the Foyle salmon fishery *Coordinating scientist:* Paddy Boylan p.boylan@loughs-agency.org	To build upon the existing Foyle salmon management system, to develop it into a precautionary catch advice framework that fully takes account of biological data on stock abundance and which fulfils all the main requirements of the Precautionary Approach.	2009
European Union - United Kingdom (Scotland)	Testing and development of Institute of Marine Research (IMR), Bergen, Norway, salmon trawl gear *Coordinating scientist:* Julian MacLean j.c.maclean@marlab.ac.uk Jens Christian Holst jens.christian.holst@imr.no Dick Shelton freda.shelton@btopenworld.com	Test a prototype trawl developed by IMR, Bergen, Norway, which, rather than capturing post-smolts, records, by use of CCTV, their passage as they pass through an open-ended trawl net. A supplementary objective, dependent on the success of the gear trials, was to conduct a post-smolt survey at the shelf edge.	2006
European Union - United Kingdom (Scotland	Protecting salmonid fisheries from seal damage *Coordinating scientist:* John Armstrong (Fishery Research Services) j.armstrong@marlab.ac.uk	Develop and apply new molecular tools for discriminating among species of fish in the diets of seals from their remains in scats. Test the possibility of using molecular tools to quantify the occurrence of diet components. Identify factors influencing the migration routes of salmon in estuaries and relate to the presence of predators. Recommend strategies for the most effective deployment of methods for protecting salmonid stocks in inshore waters.	2009
Norway	Identification of salmon by geochemical signatures; further development and testing of methods *Coordinating scientist:* Peder Fiske peder.fiske@nina.no	The main objectives of this project were to: • test if geochemical signatures are stable from year to year • test if geochemical signatures of salmon scale samples can be used to discriminate among fish from different rivers • develop analytical procedures (otolith core sampling, chemical and statistical analyses) for application of this method in ecological studies on Atlantic salmon.	2003
Norway	Development of models to predict marine survival and return of salmon to Norway *Coordinating scientist:* Lars Petter Hansen l.p.hansen@nina.no	Identify and examine feasibility of applying time series of marine environmental data, ecoplankton productivity, productivity of pelagic fish and salmon life-history information for model development. Develop appropriate models.	2006
Norway	By-catch in pelagic fisheries as a population-regulating factor in wild salmon stocks *Coordinating scientist:* Jens Christian Holst jens.christian.holst@imr.no	Investigate the extent of by-catch and develop management advice to reduce by-catch while maintaining catch rates in the mackerel fishery.	2006
Norway	Sea lice as a population-regulating factor in Norwegian salmon: status, effects of measures taken and future management *Coordinating scientist:* Jens Christian Holst jens.christian.holst@imr.no	Further clarify the effects of sea lice on wild salmon populations and propose measures to reduce sea lice infections in wild salmon and develop alternative measures in critically affected stocks.	2006

Party	Project Title and Details of Coordinating Scientist(s)	Summary of Objectives	Year removed from inventory
Norway	Distribution of salmon in relation to environmental parameters and origin in the North Atlantic – capture, tagging and release of salmon with data storage tags (DSTs) *Coordinating scientist:* Marianne Holm marianne.holm@imr.no	Investigate the temporal and spatial distribution of DST-tagged salmon in the Norwegian Sea and adjacent areas, with emphasis on spatial distribution and temperature preferences; growth in relation to environmental parameters; and diurnal vertical distribution.	2007
Norway	Temporal variation in abundance of the northern-most populations of Atlantic salmon with emphasis on the River Tana *Coordinating scientist* Martin Svenning martin.svenning@nina.no	Examine the influence of ocean climate, predation, marine fisheries and smolt production on the abundance of salmon in the River Tana	2007
Norway	The importance of early marine feeding on the growth and survival of Atlantic salmon post-smolts in Norwegian fjords. *Coordinating scientist:* Bengt Finstad bengt.finstad@nina.no	Analyse spatial variation in early marine post-smolt feeding and growth along a north-south geographical scale; investigate how post-smolt feeding and growth is associated with timing of smolt descent, marine prey availability, parasite infection, fjord migration and abiotic factors.	2008
Norway	Distribution and ecology of post-smolts and salmon at sea. *Coordinating scientist:* Marianne Holm marianne.holm@imr.no	Analyse age, growth and migratory paths in relation to environmental conditions and competitors so as to expand understanding of salmon marine life-history in order to explain observed variations in salmon survival.	2008
Norway	Dispersal of salmon lice in Norwegian fjords *Coordinating scientist:* Karen Boxaspen karinb@imr.no	Estimate and describe to what extent free-living salmon lice larvae disperse from wild and farmed sources within and between areas.	2008
Norway	Experimental tagging programme for investigating the behaviour of escaped farmed salmon: pilot study *Coordinating scientist:* Lars Petter Hansen l.p.hansen@nina.no	Examine the migration of escaped large farmed salmon and test if they are transported with the currents and appear in Norwegian waters.	Not previously included in the inventory but reported in 2008
Norway	Individual assignment of salmon caught in the ocean to region of origin *Coordinating scientists:* Oystein Skaala oystein.skaala@imr.no Vidar Wennevik vidar.wennevik@imr.no	Investigate genetic variation in Norwegian Atlantic salmon populations on different spatial scales. Provide calibrated data from micro-satellite markers for a database. Analyse samples caught in the ocean and assign to country/region of origin.	2010
Norway	Migratory behaviour of smolts and post-smolts of cultured Atlantic salmon *Coordinating scientist:* Ove Skilbrei ove.skilbrei@imr.no	Study the change in migratory behaviour from smolt during the post-smolt stages in cultured Atlantic salmon.	2010
Russian Federation	Assessment of by-catch of post-smolts of Atlantic salmon in pelagic fisheries in the Norwegian Sea. *Coordinating scientist:* Boris Prischepa pboris@pinro.ru Alexander Zubchenko zav@pinro.ru	Assess occurrence of post-smolts in catches by Russian vessels engaged in the pelagic fisheries for mackerel, blue whiting and herring.	2008

Party	Project Title and Details of Coordinating Scientist(s)	Summary of Objectives	Year removed from inventory
United States of America	Forecasts of Atlantic salmon transoceanic migration: climate change scenarios and anadromy in the North Atlantic *Coordinating scientist:* Kevin Friedland friedlandk@forwild.umas.edu	Develop and evaluate marine migration models for Atlantic salmon from North America and Europe; evaluate the potential effects of climate change on migration patterns of Atlantic salmon.	2005
United States of America	Stable isotope composition of Atlantic salmon scales *Coordinating scientist:* Kevin Friedland friedlandk@forwild.umas.edu	Develop a retrospective time series of stable isotope ratios to evaluate feeding patterns over time.	2005
United States of America	Ultrasonic telemetry of smolts and post-smolts in the Narraguagus River and Narraguagus Bay *Coordinating scientist:* James Hawkes James.Hawkes@noaa.gov	Evaluate migration timing and pathways in the lower Narraguagus River and Narraguagus Bay and estimate survival of migrating smolts and post-smolts.	2010

Annex 1

Inventory of Research relating to Salmon Mortality in the Sea – Project Details

1. CANADA

Project No. C1 Status: Ongoing

Party or relevant jurisdiction	Canada
Title of project	**Pelagic ecosystem survey of the Northwest Atlantic**
Objective of research project	A marine pelagic trawl survey was conducted to sample the upper pelagic ecosystem during the period corresponding to the early postsmolt phase of Atlantic salmon (August and September). The survey design addressed hypotheses of post-smolt distribution (mixing of stocks, mixing of maturing and non-maturing components) and oceanographic features. Catches of post-smolts provided information on distribution and relative abundance of salmon at selected locations and times along the hypothesized ocean migration route. Data on relative abundance of other species, including macroplankton aggregations, provided information on the role of salmon within this larger pelagic ecosystem. Oceanographic conditions would be examined relative to smolt catches.
Brief description of research project	A Fisheries and Oceans Canada research vessel was used to the ecosystem components within the upper 20 m of the water column. Surface gillnets were deployed to assess size-selective catchability of the pelagic trawl and to validate trawl catchability. Catches of salmon were examined relative 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 salmon size / age groups. Catches and relative abundance of other species, including macroplankton aggregations, will provide information on the role of salmon within this larger pelagic ecosystem.
Dates during which research will take place	Research surveys were conducted during August 2009 and September 2009.
Area in which research will take place	In 2008, in the northwest Atlantic from just south of 49°N to 56°N, 49°W to 55°W. In 2009 in the northwest Atlantic between 56°N to 58°N, 45°W to 60°W
Estimated number and weight of salmon to be retained	In 2008, 15 post smolts, total weight = 3.5 kg. In 2009, catch of 63 post smolts and 22 non-maturing salmon, total weight = 85 kg.
Resources	
Estimated cost of the research project	For 2008: Total estimated cost excluding any analysis: **£350,000** £230,000. Fisheries and Oceans Canada Research vessel cost excluding science personnel (23 days @ £10,000) Science personnel costs (salary, overtime, operations) £70,000 Fisheries and Oceans Canada £10,000 MRNF Province of Québec (Canada) £40,000 US NOAA For 2009: Total estimated cost excluding any analysis: **£350,000** £230,000. Fisheries and Oceans Canada Research vessel cost excluding science personnel (23 days @ £10,000) Science personnel costs (salary, overtime, operations) £70,000 Fisheries and Oceans Canada

	£10,000 MRNF Province of Québec (Canada) £40,000 US NOAA For 2010 Analysis of samples collected in 2008 and 2009. Costing unknown to date
Number of participating scientists	6 scientists Five from Atlantic DFO regions (Gulf, Maritimes, Newfoundland and Labrador), one from US NOAA
Name and e-mail address of coordinating scientist in charge of project	Gerald Chaput Chaputg@dfo-mpo.gc.ca Dave Reddin Reddind@dfo-mpo.gc.ca Tim Sheehan tsheehan@mercury.wh.whoi.edu
Details of research vessels, e.g. name, registration, call sign and description of vessel	
Type and amount of gear and other equipment to be used	
Details of any collaborating countries	US NOAA

Summary of Progress:

During August 8 to 21, 2008, 46 stations were sampled with the pelagic surface trawl. The survey covered an area extending from just south of 49°N to 56°N, 49°W to 55°W. Very few (N=15) Atlantic salmon postsmolts were captured. Atlantic salmon were captured at 8 of the 46 stations (17%) and the majority (14 of 15 fish) were captured at stations north of 52°N. The stations with salmon catches were characterized by a wide range of water depths (about 250 m to >3,000m depth) and temperatures (less than 10°C to over 13°C). Salmon were only captured during the daytime. The salmon ranged in size from 23 to 31 cm.

For 2009, 21 sets were made in the Labrador Sea between 55 ^{0} N and 58 ^{0} N. Fourteen tows were made with the surface trawl and eight post smolt salmon were caught with the aquarium attached. No postsmolts were caught during tows without the aquarium. Different fishing techniques including adjustments to warp length, vessel speed, length of tow time and time of fishing were tried. Two night tows were done and 5 postsmolts caught. Two tows and one gillnet set were made in the colder water of the Labrador Current with no salmon caught. Seven drift net sets of 42 to 48 nets of varying mesh size (2.5-5 inch) were completed in the Labrador Sea. Eighty four salmon (61 post smolt, 23 adults) were caught with an average time of each set being approximately 16 hours. CTDs and plankton tows were done at stations where salmon were successfully captured.

In spite of the poor weather for fishing surface trawl and gillnets, the SALSEA program objectives of sampling the ecosystem components within the upper 20 m of the water column were achieved. The salmon that were intensively sampled when analysed will define the characteristics, origin, age, health, and diet of the salmon population in the northern Labrador Sea area. Stable isotope analysis will define the salmon's place trophically in the ecosystem. Other accomplishments were showing that salmon could be caught in the surface trawl at night and the high productivity and species diversity of the upper portion of the water column in the Labrador Sea. No salmon were caught in sets on the shelf area influenced by the Labrador Current versus fishing sets in mid-Labrador Sea where salmon were commonly

caught. Species caught during surface trawling included salmon, lumpfish, myctophids, jellyfish, amphipods, barracudina, squid, redfish, Atlantic saury, redfish and Greenland halibut. Most abundant species were lumpfish, myctophids, redfish, salmon and squid.

For 2010, various activities related to tissue processing and data analysis will be ongoing.

Project No. C2 Status: Ongoing

Party or relevant jurisdiction	Canada. Joint project of the Miramichi Salmon Association, Atlantic Salmon Federation, with collaboration from the Department of Fisheries and Oceans
Title of project	**Miramichi River kelt movements and survival**
Objective of research project	Document the spring movements and survival of post-spawning kelts from the Miramichi River system as they return to the sea, and subsequent return as repeat spawners. Use pressure-sensitive tags to record the depths used by the kelts.
Brief description of research project	Sonic telemetry will be used to document the movements and survival of salmon kelts as they move back to the ocean and across the Gulf of St. Lawrence.
Dates during which research will take place	1 April 2009 to March 31 2011.
Area in which research will take place	Miramichi River, estuary, and Gulf of St. Lawrence
Estimated number and weight of salmon to be retained	Up to 25 kelts to be sonically tagged and released in 2009
Resources	
Estimated cost of the research project	£25,000 direct costs for tags, student salary, operating expenses. Receiver deployment and other costs are covered under other projects.
Number of participating scientists	4
Name and e-mail address of coordinating scientist in charge of project	Dr. F. Whoriskey fwhoriskey@asf.ca
Details of research vessels	na
Type and amount of gear and other equipment to be used	Sonic telemetry arrays and charter/coastal vessels as described in Canada ongoing project C2 *Atlantic salmon smolt migration and survival within Canadian rivers, estuaries and during the marine life stage.*
Details of any collaborating countries	

Summary of Progress:

In spring 2008, 50 kelts in total from the two principal branches of the Miramichi River were marked with sonic tags. Twenty of the tags carried pressure and temperature sensors. Kelt movements were followed downstream of the freshwater marking point, and out of Miramichi Bay to the open sea. Three of the kelts returned to the river within three months, maturing apparently as consecutive spawners. Twenty two kelts were detected in the Strait of Belle Isle, en route to feeding grounds off Greenland. Three of these fish were additionally detected shortly after crossing the Strait of Belle Isle in a coastal receiver array maintained by Memorial University in Labrador. Tag lives (620 days minimum) should be sufficient to permit us to detect any of these fish should they survive return as alternate year spawners. Acoustic receivers have been overwintered in the river to detect any fish that may return very early in the season.

In 2009, 50 kelts were again tagged. Similar movements to those observed in the first year were observed. These results are now being analyzed for submission as part of a MSc degree at McGill University, and for submission for publication.

In 2010, 25 kelts are planned to be tagged. For the first time, sonic receivers have been deployed in part of the Cabot Strait (by Dalhousie University's Ocean Tracking Network). These fish will give the first estimate of whether kelts use both the Strait of Belle Isle and the Cabot Strait during their migration.

Project No. C3 Status: Ongoing

Party or relevant jurisdiction	Canada
Title of project	**Marine survival of Canadian Atlantic salmon stocks: long-term monitoring**
Objective of research project	Smolt production and adult return estimates are available for many salmon populations in Canada, from rivers (wild) and from hatcheries. In some cases, these time series extend to 30 years. Spatial and temporal trends in freshwater smolt production and in marine survival are monitored at the following sites: In DFO's Newfoundland Region, five (5) facilities: Campbellton River; Northwest River (Trepassey) and Rocky River; Conne River; Western Arm Brook, and Sand Hill River (Labrador). In DFO's Maritimes Region, smolts and return rates are monitored at four locations: Nashwaak River, Mactaquac dam on Saint John River, LaHave River (wild and hatchery), and St. Mary's River. In DFO's Gulf Region, four (4) facilities: two on the Miramichi River (Northwest and Southwest tributaries), Restigouche River, Margaree River In Quebec, Ministère des Ressources Naturelles et de la Faune (MRNF) has two (2) facilities on Rivière de la Trinité and Rivière St-Jean (Gaspé); in addition, stocked salmon survival is monitored on three (3) rivers: Rivière aux Rochers, Rivière a Mars, and Rivière Malbaie, the latter two in collaboration with CIRSA.
Brief description of research project	*Newfoundland:* Smolt and adult Atlantic salmon abundance is monitored by fish-counting fences or mark-recapture (Conne River smolts). Survival is determined both for smolt to small (< 63 cm) and MSW adult salmon returns. Biological characteristics (e.g. length, weight, condition, age etc.) of both life-stage components are collected along with additional information on run timing and environmental conditions. These data are periodically examined in relation to patterns of annual variation in marine survival of wild smolts. *Maritimes:* Continuation of a 30- and 25-year time series of marine survival for hatchery smolts released to the Saint John (Mactaquac) and LaHave River. Continuation of 6-year data series for wild smolt survival on the Saint John (Nashwaak trib) and LaHave River. *Gulf:* Smolt production and adult return estimates are obtained from the two branches of the Miramichi River. Biological characteristics are described and survival rates assessed relative to size of smolts, age, and sex of returning adults. Programme began in 1998 for the Northwest Miramichi and was extended to include the Southwest Miramichi in 2001. Smolt production is obtained from the Restigouche River and Margaree River. Biological characteristics are described including size of smolts, age, and sex ratios. Programme began in 2001 in Margaree River and 2002 in the Restigouche River. *Quebec:*

	Smolt trap to estimate smolt run by mark-recapture, counting adult return in a fishway (de la Trinité) or direct observation (St-Jean), characteristics of adult returns using recreational catch. For the MRNF projects, stocked smolt returns are determined by scale analysis of all returning adult salmon. This data permits estimation of sea survival of the stocked fish. For the CIRSA project stocked fish returns are determined by scale analysis (smolts) and genetic analysis (fry). Reproductive success is determined by genetic analysis.
Dates during which research will take place	April – November, annually
Area in which research will take place	On Canadian rivers named in 'objectives' section
Estimated number and weight of salmon to be retained	Generally not applicable, although in some studies a few smolts are retained (less than 500 overall) for biological sampling
Resources	
Estimated cost of the research project	Newfoundland (£362,000 sub-total): DFO - £209,000 per year, including overheads NGO Partners - £78,000 per year Maritimes (£27,000 sub-total): DFO - £21,500 per year, incl overheads NGO Partners - £5,500 per year (including Atlantic Salmon Federation for purchase of smolt wheels in Nashwaak River) Gulf (£109,000 sub-total): DFO - £73,000 per year (includes DFO operating costs, capital investment and salaries, incl overheads) Partners: £36,000 spent in 2001/02 by NGO partners (Atlantic Salmon Federation, Northumberland Salmon Protective Association, Miramichi Salmon Association, First Nations) for capital acquisitions, and O&M for assistance. Same level of support anticipated in 2006-2007 Quebec (£141,500 sub-total): MRNF - £41,500 per year, incl overheads Hydro Quebec – £22,200 per year CIRSA - £77,800 per year --- **Canada Total - £639,500 per year**
Number of participating scientists	Newfoundland (5), Maritimes (3), Gulf (3), Quebec (10)
Name and e-mail address of coordinating scientist in charge of project	C. Bourgeois (Rocky River), B. Dempson (Conne River; Northeast Brook, Trepassey), G. Veniott (Western Arm Brook), D. Reddin (Campbellton & Sand Hill rivers), T. Goff, R. Jones, J. Gibson (Maritimes), C. Breau, P. Cameron, G. Chaput (Gulf) For information, contact: G. Chaput, Chaputg@dfo-mpo.gc.ca
Details of research vessels	N/A
Type and amount of gear and other equipment to be used	Smolt and adult traps in fishways and fences, trap nets, rotary screw smolt traps.
Details of any collaborating	

countries	

Summary of Progress

Newfoundland: (Dempson, Reddin, Veinot)
All five monitored rivers were maintained in 2009. Smolt production data and return rates from smolts in 2008 are being compiled.

Maritimes: (J. Gibson)
Simultaneous monitoring of both wild smolt migrations and adult returns was maintained at four locations: the Nashwaak River, the LaHave River, St. Mary's River and the Big Salmon River. Return rates for hatchery smolts are presently being obtained at Mactaquac and on the Big salmon River, although releases of hatchery smolts have been reduced with the increased emphasis on exposure to wild environments. These data together indicate a major downward shift occurring after 1990 that has affected both wild and hatchery salmon. The information collected for these populations provides data for age-structured, life history models, which when combined with information about freshwater productivity, are being used to assess persistence and recovery strategies for this stocks. Values of smolt production in 2009 and return rates from smolts in 2008 are presently being compiled.

Gulf: (G. Chaput)
Smolt production from rivers in the southern Gulf was maintained at four locations, as in previous years. Freshwater production estimates in most rivers indicate that freshwater production rates are not the factor constraining adult salmon abundance in this region. Values for 2009 are presently being compiled.

Quebec: (M. Dionne)
Smolt monitoring continued at the two index rivers in 2009. Smolt production values and return rates from 2008 smolts are presently being compiled.

Project No. C4 Status: Ongoing

Party or relevant jurisdiction	Canada NGO (Atlantic Salmon Federation), DFO (Gulf and Newfoundland Regions) and Province of Québec collaboration
Title of project	**Atlantic salmon smolt migration and survival within Canadian rivers, estuaries and during the marine life stage**
Objective of research project	Provide a time series of stage-specific estimates of mortality rates for smolts and post-smolts at various points of their at-sea migration, including for their transitions through fresh water, the estuary and to various points in the ocean. Examine the relation between biological characteristics of the fish and survival rates to attempt to isolate mortality causes. Document the migration pathways and speeds of smolts from different rivers.
Brief description of research project	Smolts are captured in smolt wheels in fresh water and fitted with acoustic tags. Acoustic receiving arrays are positioned in rivers, at the head of tide, and at the exit of the estuary and in the Strait of Belle Isle. Additional receivers will be placed at points of opportunity. In 2010 the Cabot Strait from Saint Paul's Island to Cape Breton has been fitted with an acoustic line This line is being funded by the Ocean Tracking Network (OTN) based out of Dalhousie University.
Dates during which research will take place	2003 – present (spring/summer)
Area in which research will take place	Miramichi River and estuary; Restigouche River and Baie des Chaleurs; Cascapedia River and estuary; St-Jean (Côte-Nord) River and estuary; Western Arm Brook, Strait of Belle Isle, Cabot Strait, Labrador, West River, Sheet Harbour.
Estimated number and weight of salmon to be retained	309 smolts, tagged and released in 2009. No fish retained.
Resources	
Estimated cost of the research project	Approx. £125,000 for operations, salaries and acoustic tags Approx. £75,000 for receiver arrays Approx. £100,000 for smolt wheels (Partner contribution: 8 wheels and their operation) **Total Approx. £300,000 per annum** Principal Supporting Partners: DFO Miramichi Salmon Association Bowater US NOAA Fisheries
Number of participating scientists	8
Name and e-mail address of coordinating scientist in charge of project	Fred Whoriskey fwhoriskey@asf.ca
Details of research vessels,	Small boats (20 feet in length) Chartered fishing vessel (approx 35 feet) for gear deployment

Type and amount of gear and other equipment to be used	Up to 200 VR 2 acoustic receivers 309 acoustic tags
Details of any collaborating countries	Data sharing underway with US NOAA Fisheries tracking programs.

Summary of Progress

The study now encompasses five rivers spanning a south-to-north latitudinal difference of about 700 km. This provides the opportunity for a test of the hypothesis that early smolt survivals in southern rivers where populations are most depressed are worse than those rivers further north. For the Miramichi and Restigouche Rivers, seven and six years of data respectively have been collected, whereas five or less years of data are available for the other sites. Results for the Miramichi and Restigouche have been consistent among years. In the Miramichi system, smolt survival through freshwater is generally high (about 90%), with about 50% of the tagged smolts surviving to exit the estuary to the sea. In the Restigouche River, mortality in fresh water was higher than in the Miramichi River, and heavy losses occurred in the estuary, resulting in about 30% of the smolts surviving to exit the river and its associated estuary to the sea. Significant fractions of the post-smolts from the Miramichi, Restigouche and Cascapedia Rivers have now been documented using the Strait of Belle Isle to exit the Gulf of St. Lawrence. Margaree River fish also use this pathway.

Project No. C5 Status: Ongoing

Party or relevant jurisdiction	Canada, US
Title of project	**Stable isotope ratios to infer trophic structure and condition of Atlantic salmon during their life at sea**
Objective of research project	Marine ecology of these fish could be advanced through studies of trophic state and condition. The questions to be addressed include: 1. Are trophic states of 1SW non-maturing fish similar between NAC and NEAC origin salmon? 2. Are trophic states of 1SW non-maturing fish different from that of 1SW maturing of the same cohort? Can this tell us anything about when these different maturity groups separate in the North Atlantic? 3. Has there been a trophic state change between West Greenland and when these fish finally return to home rivers as 2SW salmon?
Brief description of research project	A complete cohort of Atlantic salmon will be tracked from the time they leave the rivers to their return to rivers two years later as 2SW salmon. Smolts will be sampled from the broad geographic range of rivers in eastern North America to characterize their stable isotope signatures as they enter the sea. Stable isotope signatures will be characterized from post-smolts from the marine surveys followed by 1SW maturing and non-maturing salmon as they return to rivers or during their feeding migrations at West Greenland. This will be followed by sampling 2SW salmon upon their return to homewaters. The present sampling program at West Greenland includes the purchase of whole fish specifically for disease sampling. Additional tissue sampling of these fish would be conducted including muscle, liver and caudal fin punches. Liver and muscle samples would be analysed for lipid and stable isotope ratios. Caudal punches would be analysed for stable isotope ratios. Caudal punches can be collected without lethal sampling and would therefore be collected from sacrificed fish to permit calibration to the other tissues to allow sampling of survivors of 1SW and 2SW salmon back in home waters.
Dates during which research will take place	Tissue samples from smolts collected in spring 2008. Post-smolts were sampled in the Labrador Sea in August 2008. West Greenland samples will be collected in August and September 2009. 1SW maturing samples will be collected in summer 2009. 2SW salmon samples will be collected in summer 2010.
Area in which research will take place	Sampling will occur at West Greenland and from salmon returning to the index rivers of eastern Canada
Estimated number and weight of salmon to be retained	Sampling program at West Greenland includes the purchase of whole fish specifically for disease sampling. Additional tissue sampling of these fish would be conducted and therefore no additional fish are to be retained. Tissue samples from 1SW and 2SW salmon in the Miramichi will be collected preferentially from First Nations food fisheries. Target sample size for tissue sampling is 50 fish per age group.
Resources	
Estimated cost of the research project	Purchase of fish at West Greenland accounted for in ongoing project D1 (Denmark) Laboratory analysis in winter 2010: Smolt tissue sample analyses: **£18,000**, funded by International Atlantic Salmon Research Board

	Samples to be processed at cost at U. of Waterloo, Canada
Number of participating scientists	Lead scientists: Gerald Chaput. Brian Dempson (DFO Canada) Mike Power U. of Waterloo (Canada) Tim Sheehan (US NOAA)
Name and e-mail address of coordinating scientist in charge of project	Gerald Chaput : chaputg@dfo-mpo.gc.ca Tim Sheehan : Tim.Sheehan@noaa.gov
Details of research vessels	Not applicable
Type and amount of gear and other equipment to be used	Not applicable
Details of any collaborating countries	Denmark (in respect of the Faroe Islands and Greenland)

Summary of Progress

Smolts were collected from 15 index rivers in eastern Canada in May and June 2008 : LaHave, Margaree (Nova Scotia), Nashwaak, Southwest Miramichi, Little Southwest Miramici, Kedgwick, Upsalquitch (New Brunswick), Saint-Jean, de la Trinité (Québec), Conne, Rocky, Campbellton, Exploits, Western Arm Brook (Newfoundland), Sand Hill River (Labrador). Tissues (liver, dorsal muscle, adipose, caudal fin, scales) were collected from 50 fish per river. Tissues have been dried and are awaiting processing at the U. of Waterloo laboratory in winter 2010. Tissues will be analysed for C and N ratios.

Similar tissues from the 15 post-smolts captured in August 2008 have been collected and will be processed as above.

Similar tissues (liver, dorsal muscle, adipose, caudal fin, scales) from the 63 post-smolts and 22 adult salmon captured in September 2009 have been collected.

The extended sampling program at West Greenland collected similar tissues from 450 non-maturing 1SW salmon from West Greenland in 2009.

Scale and adipose fin tissue were collected from up to 30 individual 1SW maturing salmon from 13 rivers in eastern Canada in 2009.

Preliminary results should be available for the Scientific Advisory Group meeting in June 2010.

Project No. C6 Status: Ongoing

Party or relevant jurisdiction	Canada
Title of project	**Identification of Essential Habitat for Repeat Spawning Atlantic Salmon of Inner Bay of Fundy Origin**
Objective of research project	To identify the freshwater and marine habitats used by post-spawning Atlantic salmon of inner Bay of Fundy (iBoF) origin for reconditioning until their return as repeat spawners, and identify the sites and times of mortality for those that fail to return.
Brief description of research project	The project is part of an overall strategy to use telemetry to identify the marine habitat used by iBoF salmon (the most obvious data gap). Satellite tags can be used immediately on large salmon (kelts) to help fill this gap until the Ocean Tracking Network (OTN) establishes monitoring arrays (2009–2011) for acoustic tags that can be used on small salmon (postsmolts).
Dates during which research will take place	September, 2008 – December, 2010
Area in which research will take place	Primarily the Big Salmon River but possibly other inner Bay of Fundy rivers (i.e. Stewiacke) as well as the Saint John River + Bay of Fundy.
Estimated number and weight of salmon to be retained	None
Resources	
Estimated cost of the research project	Expenditures to date and for 2009-2010: **£30,000** Fisheries and Oceans Canada: personnel, satellite tags, operating costs In-kind contributions from Fort Folly First Nation.
Number of participating scientists	2
Name and e-mail address of coordinating scientist in charge of project	Dr. Gilles Lacroix Gilles.Lacroix@dfo-mpo.gc.ca Ross Jones Ross.A.Jones@dfo-mpo.gc.ca
Details of research vessels, e.g. name, registration, call sign and description of vessel	Not applicable
Type and amount of gear and other equipment to be used	Seine nets, angling gear and Rotary Screw trap Acoustic receivers and tags (freshwater component) Satellite tags (marine component)
Details of any collaborating countries	None to date

Summary of Progress

Atlantic salmon kelts from three different regions of the Bay of Fundy were tagged with pop-up satellite archival tags (PSATs) with 4-month pop-off delay as they left the rivers in the fall and spring for reconditioning at sea. Tags from 15 of 20 kelts tagged in 2008-2009 (75%) reported some data. Kelts from one region migrated thousands of kilometers to the northern edge of the Labrador Sea and as far east as the Flemish Cap, whereas those from the other two regions remained in the Bay of Fundy and Gulf of Maine. Detailed migration tracks were obtained from the archived light data (geo-positioning using sunrise and sunset times and day length). Preliminary examination of the water temperature and depth data archived at 2-15 min intervals revealed some interesting and common behaviour. Although kelts encountered a wide temperature range (-1˚C to 20˚C) they tended to exploit areas within a narrow range (5-10˚C). Kelts spent most of their time near the surface (depth <2 m) while migrating but there were nevertheless frequent diel periods of repeated diving to 25-50 m, possibly associated with feeding. There were also occurrences of deep diving in the 100-500 m range (maximum depth 700 m). Mortality during migration was high and the archived parameters revealed that predation was a frequent cause. Changes in diving behaviour and temperature also allowed for identification of a common predator (fish with thermoregulation capabilities) for several cases in the Gulf of Maine.

Project No. C7 **Status:** **New Entry**

Party or relevant jurisdiction	Canada
Title of project	**Genomic basis of adaptive divergence and marine survival among Atlantic salmon populations**
Objective of research project	Elucidate the genetic basis of adaptive divergence and marine survival in Atlantic salmon populations from eastern Canada. Contribute to the identification of management units.
Brief description of research project	This project aim at creating a genetic database across eastern Canada populations by resolving the genetic structure of populations using the same genetic markers across the study area. Moreover, with the use of recent genomic resources developed for Atlantic salmon, it will identify genes under selection and environmental factors responsible for the genetic divergence between populations. Finally, these ressources will help identify the genetic basis of high marine mortality during the first years at sea.
Dates during which research will take place	2010-2013
Area in which research will take place	Eastern Canada: Québec, Maritimes, Newfoundland and Labrador
Estimated number and weight of salmon to be retained	Salmon samples have already been collected through another project
Resources	
Estimated cost of the research project	£193,600. Funded by the Natural Sciences Engineering Research Council of Canada (NSERC), the Ministère des Ressources naturelles et de la Faune (MRNF) and the Réseau Aquaculture Québec (RAQ)
Number of participating scientists	3
Name and e-mail address of coordinating scientist in charge of project	Louis Bernatchez, supervisor, Louis.Bernatchez@bio.ulaval.ca Mélanie Dionne, co-supervisor, Melanie.Dionne@mrnf.gouv.qc.ca Patrick O'Reilly, coordinator, OReillyP@mar.dfo-mpo.gc.ca Vincent Bourret, PhD student, vincent.bourret.1@ulaval.ca
Details of research vessels, e.g. name, registration, call sign and description of vessel	
Type and amount of gear and other equipment to be used	
Details of any collaborating countries	Norway: the centre for integrative genetic (CIGENE) developed some of the genomic ressource that will be used in this project USA: tissue samples from Greenland fisheries
Summary of Progress New entry.	

2. DENMARK (IN RESPECT OF THE FAROE ISLANDS AND GREENLAND)

Faroe Islands

The Faroese Fisheries Laboratory is collaborating in a number of projects detailed in the returns made by other Parties.

Greenland

Project No. D1 Status: Ongoing

Party or relevant jurisdiction	Greenland
Title of project	**West Greenland Salmon Fishery Sampling Programme**
Objective of research project	1. Continue the time series of data (1969-2008) on the continent of origin and biological characteristics of the salmon in the West Greenland Fishery; 2. Provide data on mean weight, length and continent of origin for input to the North American and European run-reconstruction models; 3. Collect information on the recovery of internal and external tags; 4. Collect other additional biological samples as required. In addition to the long-term baseline sampling under the West Greenland Fishery Sampling Programme, samples from fresh whole fish are being collected under the SALSEA-West Greenland project (see project U6)
Brief description of research project	One of the key data inputs to international stock assessments of Atlantic salmon is the origin of Atlantic salmon harvested in mixed stock fisheries. The Parties to the West Greenland Commission of NASCO have, therefore, worked cooperatively over the past three decades to collect biological data on Atlantic salmon harvested at West Greenland. The sampling programme collects biological data, scale and tissue samples, and information on tags and marks from Atlantic salmon caught in the commercial fishery at West Greenland. Under the NASCO 2009 West Greenland Sampling Agreement (WGC(09)5), Parties to the NASCO West Greenland Commission agreed to provide staff to sample catches of Atlantic salmon in the West Greenland fishery during the 2009 fishing season. The sampling programme collects: • Biological characteristics data including lengths and weights of landed fish; • Information on tags, fin clips and other marks; • Scale samples to be used for age and growth analyses; • Tissue samples to be used for genetic analyses; • Other biological data requested by the ICES scientists and NASCO co-operators.
Dates during which research will take place	Annually during the fishing season, usually August – October

Area in which research will take place	Sisimiut, Nuuk and Qaqortoq, Greenland
Estimated number and weight of salmon to be retained	
Resources	
Estimated cost of the research project	Greenland - approximately £9,000 per annum (includes salaries, travel, lodging and equipment) Canada - £7,000 per annum (excludes costs of scale sample and data analyses) EU (United Kingdom) - £24,000 per annum (includes staff costs, travel and subsistence, and equipment) EU (Ireland) - £6,200 per annum USA - £42,000 per annum **£88,200**
Number of participating scientists	1 technician and 1 scientist from Greenland working with scientists from Canada (1), USA(2) , EU-UK (2) and EU-Ireland (1)
Name and e-mail address of coordinating scientist in charge of project	Helle Siegstad helle@natur.gl
Details of research vessels, e.g. name, registration, call sign and description of vessel	None
Type and amount of gear and other equipment to be used	Standard sampling equipment Standard genetics laboratory equipment
Details of any collaborating countries	Collaborative project with investigators from US (T. Sheehan), the United Kingdom (T. Potter and J. MacLean), Ireland (N. Ó Maoiléidigh) and Canada (G. Chaput and D. Reddin). The work is coordinated via NASCO and is reported to ICES (Working Group on North Atlantic Salmon).

Summary of Progress

In 2009, the sampling programme included sampling teams from Greenland, United States, Canada, Scotland, England and Wales, and Ireland. Teams were in place at the start of the fishery on 1 August and continued until 31 October. In total, approximately 1,660 specimens were sampled for presence of tags, fork length, weight, scales, and tissue samples for DNA analysis. Samples were obtained from three landing sites: Sisimiut (NAFO Division 1B), Nuuk (1D), and Qaqortoq (1F). The sampled salmon were measured, scales were removed for ageing, and gutted weight recorded. Approximately 1,660 scale samples were collected and aged by Canadian collaborators and approximately 1,640 tissue samples were removed and preserved for DNA analysis with US collaborators.

3. EUROPEAN UNION

Project No. E1 **Status: Ongoing**

Party or relevant jurisdiction	European Union - (consortium of 20 partners)
Title of project	**SALSEA-Merge - Advancing understanding of Atlantic salmon at sea: Merging genetics and ecology to resolve stock-specific migration and distribution patterns.**
Objective of research project	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.
Brief description of research project	SALSEA-Merge comprises seven work packages including: development of genetic identification methodology; marine data acquisition through a series of marine surveys in the north-east Atlantic; genetic identification of stock origin of samples collected; biological analysis of samples including analysis of scale samples (historic and contemporary), diet analysis and assessment of condition; merging and analysis of genetic, biological and oceanographic data.
Dates during which research will take place	April 2008 – October 2011 (marine surveys in 2008 and 2009)
Area in which research will take place	North- East Atlantic with marine surveys conducted west of Ireland and the UK, around the Faroes, the Norwegian Sea and western Barents Sea. Laboratory analysis of contemporary and historic samples.
Estimated number and weight of salmon to be retained	All salmon sampled during the marine surveys will be retained. Approximately 900 fish each year, predominantly postsmolts.
Resources	
Estimated cost of the research project	Euro 5.5million (£5.5million) over 3 years with Euro 3.5million (£3.5million) funded through the EU Seventh Research Framework Programme (FP7) and Euro 2million (£2million) contributed by the programmes scientific and private sector partners. The Atlantic Salmon Trust is funding the scientific coordinator's post £50,000 (Euro 50,000) per annum and the TOTAL Fondation is contributing Euro 100,000 (£100,000) to the Faroese marine surveys in both 2008 and 2009.
Number of participating scientists	
Name and e-mail address of coordinating scientist in charge of project	Scientific Coordinator - Jens Christian Holst jens.christian.holst@imr.no Project Coordinator – Merethe Flatseth merethef@IMR.no
Details of research vessels, e.g. name, registration, call sign and	*RV* Celtic Explorer, *RV* Celtic Voyager, *RV* Magnus Heinason, *RV* Johan Hjort, *FV* Eros, *FV* Libas

description of vessel	
Type and amount of gear and other equipment to be used	Pelagic trawls, Pelagic Live Capture Trawls (Fish-Lift), CTD, plankton sampling equipment, genetic analysis.
Details of any collaborating countries	The SALSEA-Merge consortium comprises 20 partners as follows:

Participant No.	Organization Name.	Country.
1 (Co-ordinator).	Institute of Marine Research (IMR).	Norway.
2.	Marine Institute (MI).	Ireland.
3.	Fisheries Research Services (FRS) (now Marine Scotland Science).	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.	* NASCO's International Atlantic Salmon Research Board (IASRB).	UK.
18.	*Total Foundation (TOTAL).	France.
19.	*Conservatoire National du Saumon Sauvage (CNSS).	France.
20.	*Loughs Agency.	UK.

* Non-contracting Partners

Summary of Progress:

2008:

SALSEA-Merge as an EU FP-7 project, formally commenced on 1 April 2008, but before that, in February 2008, an international SALSEA-SALMAN II Genetics Symposium and Workshop was arranged by IASRB in Paris with sponsorship from the Total Foundation. The symposium reviewed the state of the art within the field of salmon genetics and the possibilities of developing genetic techniques to support the SALSEA-Merge project. The workshop went into the planning of the project and strategies were developed with regard to the work both on the genetic baseline of European salmon stocks, the construction of a common European genetic salmon database, the optimisation of the standardised set of genetic markers to be used by the labs involved and the first preliminary organising of the seagoing sampling.

In March, the marine data acquisition group met in Copenhagen to plan the marine surveys and sampling strategies in detail. The meeting developed a common plan for the four surveys focusing on intercepting the high concentrations of north-ward migrating post-smolts along the strong currents on the shelf edge The plan developed in Copenhagen was later followed in detail by the vessels.

RV Celtic Voyager carried out the first survey during May 10-15 and sampled the areas west off Ireland and Scotland between 55°N and 57°N. The survey was very successful with 76 post-smolts caught.

The SALSEA-Merge launch meeting was held in Sligo, Ireland, during 14-15 May. The second survey, by *RV* Celtic Explorer, was launched from Killibegs 16 May which also promoted the official launch of the SALSEA-Merge seagoing activities with participation by the Deputy Prime Minister and broad media coverage. The *RV* Celtic Explorer surveyed the shelf edge current west off the British Isles from 56°N to almost 62°N during the period 16–24 May The total catch was 358 post-smolts.

The Faroese survey by *RV* Magnus Heinason was the third survey, and it took place during the period 2-16 July in the areas around 65°N-69°N along and north of the Vøring plateau in the Norwegian Sea. This is an area of high post-smolt abundance because of a very narrow migration corridor. The vessel caught 363 salmon, further underlining the success of the sampling strategy put out in Copenhagen.

The Norwegian *FV* Eros left Longyeartown in Spitzbergen on 26 July and surveyed the northern Norwegian Sea from 77°N south to Tromsø at 70°N on 9 August. In these northern areas the concentrated transport migration phase in the shelf edge current is over and the fish spread out over a vast area. This leads to much lower concentrations which are reflected in the lower catch of 88 post-smolts despite a large trawling effort.

In August, a genetic planning and strategy meeting was held at Stansted, London. The meeting focused in particular on choosing the genetic markers to be used in SALSEA-Merge and on different aspects of the future genetic work. The planning of the database was advanced, as was the work on the common European genetic salmon baseline.

In September, a workshop on scale reading was organised in Trondheim, Norway. The focus of the meeting was training and standardising the measuring and reading technique to be used by the SALSEA-Merge partners.

2009:

The 2009 General Assembly was held in Bergen 5-7 March, combined with internal planning meetings for the Genetics and Sea groups.

The survey activities continued in 2009, with 2 Irish, one Faroese and two Norwegian surveys. The first survey was carried out by the *RV* Celtic Voyager during 9 -12 May on the shelf edge off western Ireland and western Scotland. The survey was severely hampered by bad weather and only 9 post-smolts were caught in 9 hauls.

The second survey by the *RV* Celtic Explorer took place during 23 June - 2 July on the western edge of the Voering plateau at about 67-68ºN, 2ºE. During a hectic four day period 15 trawl hauls were made and in total 465 salmon were caught under very good weather conditions.

The third survey was carried out by the Faroese *RV* Magnus Heinasson in the Norwegian Sea between 66-69 ºN, 1ºW to 4 ºE during the period 1-5 July. This survey also took place under very favourable conditions and in total 342 salmon were caught.

The fourth and fifth surveys were carried out by the Norwegian vessels *FV* Libas and *FV* Eros during the period 15 July - 6 August. Eros made experiments with the 'Continuous video trawl' system (CVT) and did not catch salmon while *FV* Libas caught 87 salmon in total.

2010:

The Steering Group met in London during 13-15 January 2010 focusing on administrative, financial and practical issues that have a bearing upon the management of the SALSEA-Merge project.

Project No. E2 **Status: Ongoing**

Party or relevant jurisdiction	European Union – United Kingdom (England, Wales, Northern Ireland and Scotland)
Title of project	**Genetic sampling to type British salmon stocks**
Objective of research project	Coordinate and support the establishment of baseline information on the genetic character of breeding populations within and among rivers in Britain.
Brief description of research project	The initial aim will be to provide the basis for identifying salmon to specific rivers or regions to assist in a range of stock assessment and management scenarios (e.g. management of mixed stock fisheries). Subsequently it may be possible to answer a range of additional questions relating to the size and structure of breeding populations, levels of exploitation, and the contribution of stocked fish. The study will also provide a tool that may be used in a variety of other scientific investigations. The project will complement the work already undertaken to characterise genetically salmon river stocks in Ireland, and for optimum benefit will build on the sample collection and analysis currently budgeted for under the SALSEA MERGE programme. Sampling of fry and parr will be conducted in the main spawning areas of a range of rivers in Scotland, England and Wales as required to supplement sampling that has already been undertaken or is planned under other contracts (e.g. ASAP and SALSEA MERGE). Genetic analyses will be undertaken using the same techniques and markers (micro-satellites) as in those other studies. The project will be overseen by a Steering Group which will coordinate and support the establishment of the baseline genetic information. In additional, a Technical Working Group will: • Determine how best to achieve the overall objective • Provide technical advice • Coordinate methodologies Participants in the programme will include Environment Agency, AFBNI, Defra/Cefas, Marine Institute, Scottish Government, Association of River Trusts, FRS, AFTS / DSFBS
Dates during which research will take place	1 April 2008 - 31 March 2010
Area in which research will take place	England, Wales, Northern Ireland and Scotland.

Estimated number and weight of salmon to be retained	50 fry and 50 parr per population sampled. No adults will be killed specifically for this project but samples will be taken from fish caught in the rod and net fisheries.
Resources	
Estimated cost of the research project	£120 k (total) £20 k (staff costs includes overheads)
Number of participating scientists	10
Name and e-mail address of coordinating scientist in charge of project	Miran Aprahamian Miran.aprahamian@environment-agency.gov.uk
Details of research vessels, e.g. name, registration, call sign and description of vessel	No RVs involved
Type and amount of gear and other equipment to be used	N/A
Details of any collaborating countries	England and Wales, Scotland

Summary of Progress:

Juvenile salmon samples have been collected from 65 sites on 24 rivers in North East and North West England, and from South West Wales. These have been sent to Exeter University and FRS Pitlochry for analysis. Sampling in summer 2010 will target the few remaining rivers that have so far not been sampled in North Wales and South West England. In addition, samples will be sought from the net fisheries that we regulate.

Project No. E3 Status Ongoing

Party or relevant jurisdiction	European Union – United Kingdom (England and Wales)
Title of project	**Deriving estimates of marine survival for monitored river stocks in England and Wales**
Objective of research project	The objective of this programme is to establish 'monitored' rivers in England and Wales where estimates of marine survival can be derived for comparison with other North Atlantic stocks.
Brief description of research project	For a number of indicator stocks around the North Atlantic there is evidence that the marine survival of salmon is highly variable and is currently well below previous levels. However, until recently, there were no long-term data sets for stocks in England and Wales. The project seeks to collect data in a consistent manner from year to year in order to provide a reliable time series and to allow trends to be identified. In order to provide data for different regions and thus allow for possible spatial differences, two monitored stocks have been established: the River Dee (North Wales) and the River Tamar (SW England). Both these stocks have a reasonable proportion of MSW salmon. Smolt tagging programmes have been carried out at both sites for a number of years using rotary screw traps. This has enabled the trapping and tagging of wild fish on the main stems of these two rivers. Both rivers also have facilities (counters/traps) close to the tidal limit for monitoring returning adult fish and for estimating the return rate of the tagged fish. Models have been developed which provide confidence limits around the return rate estimates; the results are reported annually to the ICES North Atlantic Salmon Working Group. The investigations are run on a collaborative basis by the Environment Agency and the Centre for Environment, Fisheries and Aquaculture Science (Cefas).
Dates during which research will take place	Ongoing annual monitoring programme (subject to annual review).
Area in which research will take place	River Dee (North Wales) River Tamar (SW England)
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	Approximately £120,000 per annum
Number of participating scientists	~10 – involves staff from the Environment Agency's Fisheries Science Teams and regional offices, and personnel from the Cefas Salmon & Freshwater Fisheries Team.
Name and e-mail address of coordinating scientist in charge of project	Ian Davidson (Environment Agency – Dee) ian.davidson@environment-agency.gov.uk Rob Hillman (Environment Agency – Tamar) rob.hillman@environment-agency.gov.uk Ian Russell (Cefas) ian.russell@cefas.co.uk

Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	Rotary screw fish traps, coded wire microtagging equipment, adult fish traps and fish counters.
Details of any collaborating countries	N/A

Summary of Progress

The Environment Agency and Cefas have continued the programmes on the Rivers Dee (North Wales) and Tamar (SW England) to monitor marine survival of these salmon stocks. Smolt trapping with rotary screw traps has continued, with over 3,200 and 7,500 salmon smolts tagged in 2009 on the Dee and Tamar respectively; additional sea trout smolts were also tagged at both sites (with different management objectives). The Environment Agency have continued to operate upstream traps on both rivers throughout the year to monitor the run of adult fish and allow return rates of tagged fish to be estimated. The traps are also used to collect additional biological information, such as the size and age of the returning fish.

Project No. E4 Status: Ongoing

Party or relevant jurisdiction	European Union – United Kingdom (England and Wales)
Title of project	**The marine life of Atlantic salmon: evidence from the microchemistry of scales**
Objective of research project	1. To identify existing Atlantic salmon scale libraries in England and Wales. 2. Refine and improve existing methods to stable isotope ratios and trace elements in salmon scales. 3. Measure the stable isotope composition (C and N) from salmon scales in relation to variations in the marine environment. 4. Measure trace element compositions from salmon scales in relation to variations in the marine environment. 5. Develop a model to predict the impact of changes in the marine environment (e.g. productivity) on return rates of salmon from specific populations. 6. Assess the suitability of stable isotope and trace element analysis to understand the distribution of other keystone fish species (e.g. European eel).
Brief description of research project	The research will focus on scale microchemistry using scales from existing libraries together with scales taken from grilse and MSW salmon sampled in the ocean to develop a model to predict the impact of changes in the marine environment (e.g. productivity) on return rates of salmon from specific populations using scale microchemistry.
Dates during which research will take place	1 April 2007 – 31 March 2010
Area in which research will take place	England and Wales
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	£66,709 over 3 years
Number of participating scientists	3
Name and e-mail address of coordinating scientist in charge of project	Dr Clive Trueman School of Ocean and Earth Sciences, University of Southampton National Oceanography Centre, Southampton European Way Southampton SO14 3ZH trueman@noc.soton.ac.uk
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	N/A
Details of any collaborating countries	N/A

Summary of Progress	

To date, 613 fish have been analysed for stable isotope composition, 289 fish from the North Sea driftnet archive and 324 fish from the River Frome archive. Several interesting observations can be made:

1) $\delta^{13}C$ values and temporal patterns differ between grilse and MSW fish from the Frome and between the Frome data and the North Sea data. This demonstrates that these populations feed in separate areas of the North Atlantic – and thus form discrete, consistent feeding populations.

2) The North Sea archive shows clear systematic variation in carbon isotope composition, reflecting decadal-scale changes in ocean conditions at the location of feeding. Interestingly, carbon isotope signals in the North Sea data correlate with modelled numbers of returning fish, suggesting that fluctuations in ocean conditions at the feeding location influence marine mortality. If this pattern is repeated with additional data, it will have very significant implications for understanding marine survival in salmon. In contrast, the Frome archive shows no such systematic variation, indicating relatively stable conditions in the feeding areas – and thus that factors other than variations in ocean feeding conditions may have greater influence over marine survival for this population.

3) We have developed a method to predict marine location from carbon isotope data. Applying this method to the salmon archive dataset yields maps showing most likely regions for marine feeding areas. The North Sea stock is predicted to feed in the Norwegian sea, with MSW returning fish feeding at more northerly latitudes. By contrast, MSW returning fish from the Frome stock are most likely to feed either south west of Iceland, or in the West Greenland fishery area. This method clearly has potential to identify stocks with common feeding areas, and to explore marine effects on salmon mortality. Our methodology can be applied to any tissue archive, and we are extending the project to consider migration routes and feeding areas for other salmon stocks.

4) There is no evidence for a long term, directional trend in nitrogen isotope values in either the Frome or North Sea archive, and therefore no evidence for long term change in trophic level as an influence on marine survival.

Project No. E5 **Status: New entry**

Party or relevant jurisdiction	European Union – United Kingdom (England and Wales)
Title of project	**Development and application of salmonid life cycle models**
Objective of research project	1. Undertake a review of available salmonid life cycle models to assess their suitability to apply to migratory salmonid populations in England and Wales; 2. Build on existing models and/or develop new models of salmon and sea trout life-histories to permit: – Prioritisation of factors affecting stocks in freshwater – Scaling of impacts on individuals to populations – Comparison of marine and freshwater factors affecting stocks – Comparison of the impacts of factors on stocks with different life-cycle characteristics (e.g. grilse v MSW stocks) – Comparison of anthropogenic and environmental impacts on stocks; Comparison of management regimes for salmon and sea trout.
Brief description of research project	The general objectives of the project are to develop tools to assist with the interpretation of results from a range of experimental studies on salmonids and advise policy on the prioritisation of management decisions relating to the protection, conservation, restoration and enhancement of salmonid populations and related research activities.
Dates during which research will take place	April 2009 – March 2013
Area in which research will take place	England and Wales
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	£210,000 over 4 years ie £52,500 per annum
Number of participating scientists	4
Name and e-mail address of coordinating scientist in charge of project	Ted Potter: ted.potter @cefas.co.uk
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A

Type and amount of gear and other equipment to be used	N/A
Details of any collaborating countries	N/A
Summary of Progress: New entry	

Project No. E6 **Status: New entry**

Party or relevant jurisdiction	European Union – United Kingdom (England and Wales)
Title of project	**The impacts of contaminants and temperature on freshwater fish populations**
Objective of research project	The main objectives of the research are to undertake further studies of the impacts of contaminants derived from intensive agriculture and aquaculture facilities on wild salmonids and investigate the implications of predicted climate change scenarios on the impacts of different sources of diffuse and point source pollution on wild fish populations.
Brief description of research project	The research will further investigate contaminants derived from or associated with freshwater aquaculture facilities and determine their effects on critical salmonid life stages particularly the transition of smolts from the freshwater to marine environments. In addition, the work will investigate the impact of the changes in flows and temperatures that may be expected under different climate change scenarios on the impacts of environmental levels of specific contaminants on biological processes regulating fish populations (e.g. reproduction and survival of diadromous fish between fresh and marine environments). Finally, the results of the work will be used to model the impact of different climate change scenarios on the impacts of specific contaminants on wild salmonid populations.
Dates during which research will take place	April 2009 - March 2014
Area in which research will take place	England and Wales
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	£795,000 over 5 years ie £159,000 per annum
Number of participating scientists	5
Name and e-mail address of coordinating scientist in charge of project	Andy Moore: andy.moore@cefas.co.uk
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	N/A
Details of any collaborating countries	N/A
Summary of Progress: New entry	

Project No. E7 **Status: New entry**

Party or relevant jurisdiction	European Union – United Kingdom (England and Wales)
Title of project	**Impacts on juvenile salmonid populations from a changing freshwater environment.**
Objective of research project	The overall objective of the research programme is to investigate how predicted changes within the freshwater environment might impact upon juvenile salmonid populations and how changing conditions during the early life history stages of the fish may influence their behaviour and subsequent survival within the marine environment. The research will be carried out within the context of the revised climate change scenarios for England and Wales (UKCP09). The overall aim will be to better understand the potential changes to the characteristics of salmonid populations in order to better manage and conserve stocks within a dynamic environment. The research will principally focus on specific factors within the freshwater environment that are considered to directly impact upon particular life-history strategies of juvenile salmonids, regulate production and modify the fitness of emigrating smolts.
Brief description of research project	The research project will examine the following areas of concern to salmonid populations: 1. Determine the ecological drivers within freshwater that affect the propensity for wild juvenile salmon to migrate downstream in the autumn. 2. Determine whether there are changes in the relative number of adult returns derived from autumn and spring migrating juveniles over time, and the geographic significance of the autumn migration. 3. Determine the impact of assessment techniques on wild salmon smolt physiology and subsequent adult return rates. 4. Assess the impact of changes within the freshwater environment on smolt "quality", biological characteristics and survival in the marine environment. 5. Determine the impact of diffuse artificial light pollution on salmonid fry emergence and smolt migratory behaviour.
Dates during which research will take place	April 2009 - March 2014
Area in which research will take place	England and Wales
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	£903,000 over 5 years ie £180,600 per annum
Number of participating scientists	12

Name and e-mail address of coordinating scientist in charge of project	Bill Riley: bill.riley@cefas.co.uk
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	N/A
Details of any collaborating countries	N/A
Summary of Progress: New entry	

Project No. E8 **Status:** **Ongoing**

Party or relevant jurisdiction	European Union – United Kingdom (Northern Ireland)
Title of project	**The marine survival of Atlantic salmon from the River Bush, Northern Ireland**
Objective of research project	Investigate factors influencing the survival at sea of salmon smolts migrating from the River Bush until their return as adult salmon
Brief description of research project	This long-term project centres on enumerating numbers of migrating wild smolts and returning adults to the River Bush, by means of trapping facilities, in order to assess return rates and maturation schedules. A programme of microtagging wild and hatchery-origin smolts provides detailed information on exploitation levels and patterns in coastal and distant-water fisheries. Run-reconstruction modelling provides information on return rates to Irish homewaters, which provides an index of natural survival at sea.
Dates during which research will take place	Started in 1973. Project ongoing 2010.
Area in which research will take place	River Bush, N. Irish/Irish coastal waters and distant-water fisheries.
Estimated number and weight of salmon to be retained	None retained, as tag recovery based on already-captured fish. Tagged adults at River Bush retained alive as broodstock for hatchery programme.
Resources	
Estimated cost of the research project	Total annual cost: £60,000 Breakdown: Staff £49,000 Consumables £8,000 Travel and Subsistence £2,000
Number of participating scientists	2 project scientists and 3 technical staff
Name and e-mail address of coordinating scientist in charge of project	Richard Kennedy Richard.kennedy@afbini.gov.uk
Details of research vessels, e.g. name, registration, call sign and description of vessel	Not applicable
Type and amount of gear and other equipment to be used	Not applicable
Details of any collaborating countries	Ireland (tag recovery programme)

Summary of Progress:

The marine survival project continues to provide annual metrics on marine performance of R. Bush wild and hatchery-origin salmon. These data are made available to ICES. The River Bush programme involves the microtagging of wild and hatchery-origin smolts and provides detailed annual information on exploitation levels and patterns in coastal and distant-water fisheries. Focus has recently been given to the timing of smolt migration, in relation to environmental parameters and subsequent marine survival.

Project No. E9 **Status: Ongoing**

Party or relevant jurisdiction	European Union – United Kingdom (Scotland)
Title of project	**Post-smolt mortality of Atlantic salmon**
Objective of research project	Assess post-smolt mortality rates of Atlantic salmon from the rivers North Esk, Aberdeenshire Dee (two tributaries) and Conon (a river harnessed for hydro-electricity generation) and their contribution to fisheries that exploit them.
Brief description of research project	North Esk: Project started in 1964. Annual smolt production estimates are made using stratified mark-recapture models. Fish are tagged using coded-wire microtags or modified Carlin tags. An alternative method using river flow characteristics is currently being developed. Age distribution and sex ratio data are collected by sampling trap catches of smolts. Analysis of recapture data yields information on post-smolt mortality levels and contribution of North Esk salmon to fisheries. River Dee: Juvenile surveys by electro-fishing and traps have been operated in the Girnock Burn since 1966, and in the Baddoch Burn since 1989. Fish are tagged using coded-wire microtags. Salmon and grilse entering the tributaries to spawn are trapped and age and length distribution data are collected. Stock-recruitment relationships are investigated. Analysis of recapture data yields information on post-smolt mortality levels and contribution of Upper Dee salmon to fisheries. Both tributary populations are driven by early-running salmon (2SW plus a minor proportion of early-running grilse). Return rates have declined markedly in recent years. Smolt production from the streams has altered qualitatively, as a result, with a shift to younger smolt age. Statistical analysis strongly associates return rates of adults to the traps with the size of the annual spring fishery in the main River Dee, suggesting that the monitored sites typify a wider area of production. The Dee fishery, in turn, is strongly correlated with the Scottish fishery as a whole, indicating generalised effects of marine mortality across river catchments. River Conon: Collaborative project with Conon District Salmon Fishery Board and Scottish and Southern Energy started in 1996. Juvenile salmon are captured by electro-fishing and trapping exercises in selected parts of the River Conon catchment. The fish are tagged using a variety of tags including coded-wire microtags (occasionally) and PIT tags (annually). Returning adults are registered automatically as they pass through a Borland lift in Torr Achilty Dam. Occasional surveys and trapping exercises have recorded the proportion of tagged fish in the net-and-coble and rod-and-line fisheries. Work has been undertaken to provide information on the contribution of seals to the marine mortality of Conon salmon
Dates during which research will take place	Ongoing
Area in which research will take place	North Esk, Western catchment of River Dee, River Conon salmon fishery district
Estimated number and weight of salmon to be retained	N/A

Resources	
Estimated cost of the research project	Approximately £50,000 per annum
Number of participating scientists	North Esk - 7 (also employed on other projects) River Dee - 5 (also employed on other projects) River Conon - 6 (includes non-FRS staff, and all are also employed on other projects)
Name and e-mail address of coordinating scientist in charge of project	North Esk and Dee - Julian MacLean j.c.maclean@marlab.ac.uk River Conon - John Armstrong j.armstrong@marlab.ac.uk
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	North Esk - Purpose-built smolt trap and resistivity counter on the lower reaches of the North Esk. One additional resistivity counter and two rotary screw traps deployed to assess trends in sub-catchment populations. Electrofishing gear used for juvenile surveys. River Dee - Purpose-built traps, electro-fishing. River Conon - Electro-fishing gear, traps, PIT tagging equipment and detectors.
Details of any collaborating countries	N/A

Summary of Progress

Results from the surveillance monitoring continue to be provided to the Working Group for consideration in their on-going modelling work.

Project No. E10 Status: Ongoing

Party or relevant jurisdiction	European Union – United Kingdom (Scotland)
Title of project	**Analysis of post-smolt life history by scale reading**
Objective of research project	Investigate the relationship between growth and mortality in Atlantic salmon, particularly during the marine phase, by analysis of scale growth patterns
Brief description of research project	Scale samples of fish of known age (recaptures from smolt tagging operations) and from salmon catches generally are examined to assess growth characteristics. Associations between growth performance and independent measures of mortality are examined with the aim of identifying the periods crucial to survival.
Dates during which research will take place	Continuing project under longer-term remit.
Area in which research will take place	Samples from around Scotland and from the North Esk and Girnock Burn (Aberdeenshire Dee) in particular
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	Approximately £10,000 per annum
Number of participating scientists	3 (also employed on other projects)
Name and e-mail address of coordinating scientist in charge of project	Julian MacLean j.c.maclean@marlab.ac.uk
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	N/A
Details of any collaborating countries	USA and Canada

Summary of Progress

Factors affecting early marine mortality and its possible causes continue to be investigated. Growth patterns across Europe are being examined in collaboration with colleagues from other organisations. Fine scale data relating to growth checks have been collected for further analysis.

Project No. E11 Status: Ongoing

Party or relevant jurisdiction	European Union – United Kingdom (Scotland) and Ireland
Title of project	**Fisheries-induced Evolution**
Objective of research project	The Specific Targeted Research Project on Fisheries-induced Evolution will analyze the prevalence and consequence of fisheries-induced adaptive changes in exploited salmon (and other fish) stocks. This objective will be realized through a carefully selected set of empirical phenotypic case studies, the investigation of salient adaptive genetic variation, and through the development of new quantitative models for understanding trends and evaluating management options. The FinE project will deliver insights and recommendations for addressing the overlooked evolutionary dimension of modern fisheries. The FinE project aims at combining fields of expertise as diverse as population genetics and quantitative genetics, life-history theory, population dynamics, evolutionary theory, and fisheries science. The project will ensure a close integration of both empirical and theoretical lines of development in our understanding of evolutionary processes in exploited populations. The FinE project will thereby provide the scientific basis required for designing policies and implementing management measures that can cope with fisheries-induced adaptive changes.
Brief description of research project	The project's overall objective can be broken down into three main lines of research: 1) Phenotypic case studies will aim at documenting phenotypic trends in life-history traits relevant for the demography and productivity of exploited salmon populations, thus focusing on maturation, reproductive effort, and growth. In order to assess the ubiquity of fisheries-induced adaptive changes, various exploited stocks from European and North American waters will be investigated. The studies will be based on long-term time series of field data, mostly hosted by national organizations responsible for fish stock assessment and advising for fisheries management. The general principle of the analyses will be to disentangle the plastic component of observed phenotypic trends from a potentially underlying evolutionary component, in order to assess the degree of reversibility of the fisheries-induced changes. The use of specifically tailored statistical methods, like probabilistic maturation reaction norms, will be critical in this respect. 2) Genetics analyses will aim to elucidate the genetic basis of fisheries-induced evolutionary changes suggested by phenotypic analysis. The work will be based on a two-pronged approach, thereby developing two complementary lines of research: (i) adaptive genetic changes affecting life-history traits under fisheries-induced selection will be assessed at the DNA level (candidate genes) and in terms of quantitative genetics using historical collections of biological tissues (otoliths) sampled in the field; (ii) artificial fisheries-induced selection experiments on a model species (*Poecilia reticulate*, the guppy) will be set up in order to corroborate molecular and quantitative genetic results in the wild. These studies will rely on the development of innovative molecular and statistical methodologies allowing tackling temporal adaptive genetic changes,

	instead of only investigating the neutral genetic differentiation that customarily was at the focus of previous genetics work. 3) Eco-genetic models will be designed for evaluating alternative hypotheses advanced to explain observed data; for assessing the ecological consequences of fisheries-induced evolution in terms of exploited stock dynamics, viability and recovery, as well as fisheries yield; and for comparing various management scenarios. These analyses will address features and dimensions that are particularly difficult to cover in empirical analyses: multi-trait evolution, sex-specific fisheries-induced evolution, and economic drivers of fishery dynamics. Models will be constructed by carefully integrating relevant genetic, ecological, and environmental details, so as to attain sufficient degrees of realism for predicting the speed of evolutionary changes, while also properly describing population dynamics and fishery dynamics. The following specific topics will be addressed: • Evolutionary determination of maturation reaction norms • Fisheries-induced multi-trait evolution • Evolutionary vulnerability of prototypical life histories • Sex-specific dimensions of fisheries-induced evolution • Fisheries-induced evolution of neutral and selected genetic markers • Fisheries-induced evolution of specific stocks • Implications for stock stability and recovery potential • Economic models of fisheries-induced evolution • Evolutionarily enlightened stock management
Dates during which research will take place	2007-2010
Area in which research will take place	FRS will focus on Scottish and Irish salmon stocks; however, fisheries data will be collected from across Europe, including along marine migration routes.
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	Scotland: FRS cost: £155,000 Ireland: £10,000 (Travel and subsistence for project meetings only)
Number of participating scientists	FRS: 6 Total: 40+
Name and e-mail address of coordinating scientist in charge of project	*EU Project co-ordinator:* Ulf Dieckman dieckman@iiasa.ac.at *Scotland:* *FRS project leader:* John Gilbey J.Gilbey@marlab.ac.uk *Ireland*: Marine Institute project leader: Philip McGinnity P.McGinnity@ucc.ie
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	N/A

Details of any collaborating countries	Austria: International Institute for Applied Systems Analysis (IIASA); Norway: Institute of Marine Research (IMR); France: French Research Institute for the Sustainable Exploitation of the Sea (Ifremer); Denmark: Danish Institute for Fisheries Research (DIFRES); Belgium: Catholic University of Leuven (KUL); UK: University of Wales (UW); UK: Fisheries Research Services (FRS); Norway: University of Tromsø (UT); Netherlands: Netherlands Institute for Fisheries Research (RIVO); Norway: University of Oslo (UO); Spain: Spanish National Research Council (CSIC); Finland: Finnish Game and Fisheries Research Institute (FGFRI); Germany: Johann Heinrich von Thünen-Institut (vTI), Federal Research Institute for Rural Areas, Forestry and Fisheries

Summary of Progress

The first meeting of the FinE project was held near Bergen, Norway in September 2007. A follow-up meeting dedicated to salmon issues was held at Pitlochry, Scotland in March, 2008. This second meeting was devoted to mustering data sets, discussing preliminary analyses and planning the way forward for the main data analyses. Since this meeting data relating to Scottish salmon populations has been collated and analysis is ongoing. A meeting was held at IIASA in June 2008 where the details of the Atlantic salmon eco-genetic models were defined and a plan developed to build and use such models. The second annual project meeting was held at Biarritz in October 2008 where the progress of all tasks was presented and future directions discussed.

Work is underway in fitting specific life history models to Irish and Scottish datasets, and in running simulations using the eco-genetic models. A further technical meeting was held in Newport, Ireland in February 2009. Further collaborative work has been undertaken during 2009 with a view to completing updating of data series and further developments of the models. Further meeting to finalise the analyses and reports will be held in 2010.

Project No. E12 Status: Ongoing

Party or relevant jurisdiction	European Union – United Kingdom (Scotland)
Title of project	**Size and condition of returning grilse (1SW) and MSW salmon**
Objective of research project	Investigate decacal trends in the size (length, weight) and condition (weight/length^3) of adult salmon returning to Scotland.
Brief description of research project	Biometric data spanning a forty year period at the North Esk, and shorter periods for 5 other sites, are being analysed to document fluctuations in the size and condition of age at return to breed. Complicated trends are evident, which differ between 1SW and MSW fish.
Dates during which research will take place	June 2007 – ongoing.
Area in which research will take place	Six locations in Scotland, in particular the North Esk
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	£30,000 per annum
Number of participating scientists	4 (also employed on other projects)
Name and e-mail address of coordinating scientist in charge of project	Philip Bacon P.J.Bacon@MarLab.ac.uk
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	N/A
Details of any collaborating countries	Atlantic Salmon Trust

Summary of Progress

Data from the North Esk show that recent reports by anglers of high proportions of thin grilse (1SW salmon) in their catches were an extreme of a longer term (five year) trend *(see also Smith et al 2007; Todd et al 2008*). However, the situation for MSW fish is dissimilar, and for both sea age classes, the trends since 2000 need interpreting in the light of former, decadal, fluctuations. The work is currently being extended to five other Scottish sites (with less complete data sets) to investigate the generality of the findings. Very weak correlations, probably indicating only indirect effects, are apparent with a variety of marine environmental data. Analysis of long term data is continuing.

Smith, G.W., MacLean, J.C. and Whyte, B.D.M. (2007). The presence of "small grilse" in the 2006 Scottish salmon catches: a historical perspective. ICES Working Group on North Atlantic Salmon. Working Paper No. 30/2007. Copenhagen 11th to 20th April 2007.

Todd, C.D., Hughes, S.L., Marshall, C.T., MacLean, J.C., Lonergan, M.E. and Biuw, E.M. 2008. Detrimental effects of recent ocean surface warming on growth condition of Atlantic salmon. Global Change Biology (2008) 14, 1–13 (pages refer to online version only).

Project No. E13 Status: New entry

Party or relevant jurisdiction	European Union – United Kingdom (Scotland)
Title of project	**Development of a General Spatial Model of Within River Population Structuring in Scottish Atlantic salmon (POPMOD)**
Objective of research project	To improve the scientific basis for - setting biologically appropriate conservation limits for salmon rivers in line with NASCO obligations - effectively regulate the salmon movements under the new Aquaculture and Fisheries Act - providing advice on conservation and restoration initiatives in support of the TWG process and Gs Contingency Planning, and the EU Habitats and Water Framework Directives - accurately and cost-effectively monitoring the status of salmon stocks The anticipated outcomes of the project are: • a general model which can be used to predict population structuring within any Scottish salmon rivers • an optimised, cost-effective methodology which can be used to test model predictions • an evaluation of the potential for using genetic estimates of effective numbers of breeders for monitoring the conservation status of breeding populations **This project will provide baseline information in support of project E1**
Brief description of research project	Building on the information collected as part of previous MS and associated SNH, AST/AFT and DSFB contracts, and linked associated projects (FASMOP, SALSEA MERGE), microsatellite and mtDNA markers will be used to assess the spatial boundaries of Atlantic salmon selected Scottish river systems. The genetic information on the relatedness of salmon in the systems will be analysed and the number and spatial boundaries of salmon populations present within each river explored. The genetic information will be combined with biophysical information on river structure, including salmon habitat distribution, water chemistry, and presence of natural and man-made barriers, to develop a general predictive model. The generality of these associations will be explored and tested using GIS and Bayesian statistical methods. For identified populations, genetic data will be further analysed for each breeding population to determine the effective numbers of breeders contained in each population. The estimates derived will be compared with the spatial extent of the population and estimates of census size based on electrofishing, wetted area, and angling catches.
Dates during which research will take place	1 April 2008 to 31 March 2011
Area in which research will take place	-river systems across Scotland
Estimated number and weight of salmon to be retained	- not applicable

Resources	
Estimated cost of the research project *Details of the full economic costs of each study are requested, including staff costs, equipment and overheads. For collaborative projects, a breakdown of costs between public and private partners is requested.*	Estimated Costs: FEC £800,883 Breakdown Staff Costs: £350,228 T&S: £6,000 Equipment: £32,000 Consummables: £78,000 Overheads: £367,740 100% public (SG) funded
Number of participating scientists	3
Name and e-mail address of coordinating scientist in charge of project	Dr. Eric Verspoor verspoor@marlab.ac.uk
Details of research vessels, e.g. name, registration, call sign and description of vessel	-none used for work
Type and amount of gear and other equipment to be used	- not applicable
Details of any collaborating countries	- none
Summary of Progress: New entry	

Project No. E14 Status: New entry

Party or relevant jurisdiction	European Union – United Kingdom (Scotland)
Title of project	**Focusing Atlantic Salmon Management on Atlantic Salmon (FASMOP)**
Objective of research project	The project seeks to: • Establish the number and spatial boundaries of breeding populations of salmon within any Scottish river system using micro-satellite genetic markers; • Establish the ancestral relationships and functional biological differences between wild salmon stock components across Scottish rivers; • Use information and insights gained to improve local management practice and increase the of focus salmon management on local breeding populations as these are the fundamental biological units underpinning recruitment in river stocks **This project will provide baseline information in support of project E1**
Brief description of research project	The project will provide: • Detailed local population structure insights for rivers within Fisheries Trust and DSFB areas for application in local management decision making through the analysis of molecular microsatellite DNA genetic markers; • Atlantic salmon population structure information for river catchments across Scotland; • Contribute to the development of national and international scale knowledge and understanding of the factors underlying population structuring through the input of information into Marine Scotland Science projects and the SALSEA MERGE project
Dates during which research will take place	1 April 2009 to 31 March 2011, with a possibility of the project extension depending of the nature of the findings and the demand for further work from individual Trusts.
Area in which research will take place	- river systems across Scotland for which local fisheries trusts have responsibility; this encompasses 24 Scottish Trusts covering in the order of 90% of Scottish river systems with salmon.
Estimated number and weight of salmon to be retained	- sampling of tissue for DNA analysis will be collected by individual Trusts for the programme of work and will to a large extent be taken non-destructively from salmon fry and parr collected by Trusts by electrofishing but samples will also be taken from returning adults captured by anglers, including both killed and catch-and-release fish.

Resources	
Estimated cost of the research project *Details of the full economic costs of each study are requested, including staff costs, equipment and overheads. For collaborative projects, a breakdown of costs between public and private partners is requested.*	FEC for two year programme of work is dependent on the precise funding stream but is estimated for the initial 2 year time frame to be ~ £280,000. Staff costs: ~£146,000 Equipment costs: £20,000 Consumables costs: ~ £50,000 Overheads: ~ £50,000 (including both MS and RAFTS) Public (SG) contribution: ~50% Private (Trusts) contribution: ~50%
Number of participating scientists	2 post-doctoral research fellows and one part-time research assistant specifically employed for project work
Name and e-mail address of coordinating scientist in charge of project	Dr. Eric Verspoor verspoor@marlab.ac.uk Dr. Calum Sinclair callum@rafts.org.uk
Details of research vessels, e.g. name, registration, call sign and description of vessel	- no research vessels used for work.
Type and amount of gear and other equipment to be used	- no marine gear to be used
Details of any collaborating countries	- no other collaborating countries
Summary of Progress: New entry	

Project No. E15 **Status:** **Ongoing**

Party or relevant jurisdiction	EU – Ireland
Title of project	**Marine Survival of Wild and hatchery reared salmon** **National coded wire tagging and tag recovery programme and Burrishoole wild salmon census**
Objective of research project	The National Coded Wire Tagging and Tag Recovery Programme was initiated in 1980 to: Provide information on marine survival and exploitation rates by commercial fisheries; Estimate the contribution of individual river stocks to catches; Examine the performance of selected experimental groups; Evaluate the potential of a salmon ranching industry in Ireland. The Burrishoole salmon census began in the 1960's to investigate factors influencing the survival at sea of salmon smolts migrating from the Burrishoole river until their returns as adult salmon
Brief description of research project	Up to 500,000 salmon smolts are tagged with coded wire tags and released from 9 Irish rivers annually. Tag recovery takes place in scanning programmes in Greenland and Faroes (during any experimental fishing) and in experimental trawling for post-smolts in the Norwegian Sea and north of Scotland. Subsequently, tags are recovered from homewater fisheries at over 40 locations in Ireland. Between 40 and 50% of the total declared catch of salmon is examined for tags. With the imposition of the carcass tagging scheme, and the district quotas tag recovery has dropped to about 35% of the total catch. With the closure of the Irish mixed stock salmon fishery, returns are now being generated principally from river catches (commercial and recreational) and broodstock returns. This Burrishoole wild salmon census long-term project centres on enumerating numbers of migrating wild smolts and returning adults to the Burrishoole river, by means of trapping facilities, in order to assess return rates and maturation schedules. Return rates to Irish homewaters, which provides an index of natural survival at sea.
Dates during which research will take place	Coded Wire tagging since 1980 Tagging November to April. Recovery Post-smolts - May to July (Norwegian Sea), September to November (Faroes) Grilse – May to November MSW – January to November Wild salmon census in the Burrishoole are monitored 24/t both upstream and downstream migrating since the 1960's
Area in which research will take place	Tag recovery Post-smolts Norwegian Sea, Wyville Thompson Ridge, North of Scotland, North of Faroes Grilse: West Greenland, Irish estuarine and river fisheries, Irish rivers. MSW: North of Faroes, Irish estuarine and river fisheries, Irish rivers

	Salmon Census Facility, Newport Co. Mayo Ireland
Estimated number and weight of salmon to be retained	Up to 200,000 adults may be examined and cored to retrieve tags. Approximately 40,000 in recent years with mixed stock fisheries and approximately 10,000 in 2007 in the absence of MSF. Up to 40 post-smolts may be recovered in high-seas experimental fisheries of Faroes and Norwegian Sea
Resources	
Estimated cost of the research project	£300,000 per annum nationally funded (does not include sampling in experimental fisheries in high seas, etc.) Staff approx. £200,000 Equipment (including tags) £100,00 Burrishoole salmon census - £72,000 per annum mainly staff costs
Number of participating scientists	National Coded Wire tagging and Tag Recovery programme = 5 Burrishoole salmon census = 6
Name and e-mail address of coordinating scientist in charge of project	Niall O' Maoileidigh niall.omaoileidigh@marine.ie Russell Poole russell.poole@marine.ie
Details of research vessels, e.g. name, registration, call sign and description of vessel	None
Type and amount of gear and other equipment to be used	None
Details of any collaborating countries	Norway, UK, Faroes, France, Spain, Germany, Denmark

Summary of Progress

National Coded Wire Tagging and Tag Recovery Programme – This tagging programme takes place in up to 8 locations nationally, with recovery centres in commercial fisheries, recreational fisheries and hatchery broodstock collections. Up to 500,000 smolts have been tagged and released since 1980 with approximately 250,000 being tagged presently. The data are reported to ICES annually and are incorporated in the Reports of the Working group on North Atlantic Salmon. Returns of tagged adult salmon and the distribution of Irish and international tagged salmon in the drift net fisheries from 1980 to 2006 clearly demonstrated the mixed stock nature of these fisheries and has been a key element in the Irish government's decision to close this fishery on the precautionary principle in 2007. Subsequent genetic stock identification confirmed the highly mixed stock nature of this fishery. In the absence of the landings of salmon at many major ports, the tag recovery programme will concentrate on key areas with remaining single stock fisheries in estuaries, bays and rivers and the information will continue to be used for the management of the individual and district river stocks. Following the closure of the Irish Mixed Stock salmon fishery in 2006, tag returns from commercial fisheries were as anticipated extremely low relative to other years but there was a significant increase in the recovery of tags in riverine brood stock collections in both years as more fish escaped to enter freshwater. In 2009 approximately, 4,000 individual tag recoveries were generated from a release in 2008 of approximately 260,000 smolts. Survival was again low in 2009 for most groups returning to the coast and rivers confirming that conditions at sea for salmon survival are not yet improving.

Burrishoole wild salmon census - Long-term monitoring programme reflecting the decline in marine survival of European salmon stocks. This site is one of only three facilities in NEAC area with total census capabilities (i.e. upstream adult and downstream adult and juvenile trapping and monitoring).

Project No. E16 Status: Ongoing

Party or relevant jurisdiction	European Union - France
Title of project	**The sea survival of Atlantic salmon from the River Scorff, Brittany**
Objective of research project	Estimation and long-term monitoring of survival at sea in the southern part of the European distribution range of the species
Brief description of research project	This project centres on quantifying smolt production and adult returns, by means of trapping and mark-recapture techniques, to enable estimation of sea survival. The Scorff is an index river which provides management-oriented scientific information at the regional (Brittany) and international (ICES) levels. It is the only stock in the Southern European part of the species distribution range (France and Spain) for which both smolts and adults are enumerated at the mouth of the river. In addition, no coastal or estuarine commercial fishery targeting Atlantic salmon is currently operating. Thus, the Scorff provides a unique opportunity for assessing marine survival of salmon in an area for which such information is virtually lacking. The project is operated jointly by the National Institute for Agronomical Research (INRA), and Angling Associations.
Dates during which research will take place	1994 on
Area in which research will take place	The River Scorff (Southern Brittany)
Estimated number and weight of salmon to be retained	No fish are retained, all animals trapped for tagging or mark control are released
Resources	
Estimated cost of the research project	£165,000 per annum
Number of participating scientists	2 scientists + 2 technicians
Name and e-mail address of coordinating scientist in charge of project	Etienne Prévost eprevost@st-pee.inra.fr
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	Adult and smolt trapping facilities specially designed to minimize impacts on wild fish due to handling
Details of any collaborating countries	None

Summary of progress

First estimates of sea survival are indicative of higher marine mortality than for more northern stocks (UK, Scandinavia, Iceland). Combined with information on freshwater survival, they reveal the precarious status of the stock. The stock is still able to maintain itself at a reasonably high level of abundance, but may not stand any additional increase in fishing or marine mortality. Recent years have shown an increase in marine mortality (reduction by half of the smolt to adult survival). In addition there is a constant decline in the size combined with a later date of freshwater entry of the adults returning in the Scorff.

Project No. E17 Status: Ongoing

Party or relevant jurisdiction	European Union - France
Title of project	**Atlantic salmon metapopulation investigation in Normandy rivers**
Objective of research project	Estimate exchanges between rivers flowing into the Mont-Saint-Michel-Bay and impact on the management of salmon populations
Brief description of research project	Straying salmon and river proximity lead to individual exchanges and genes flow between populations and can result in a metapopulation structure. Moreover, stocking of Atlantic salmon populations with non-native and hatchery-reared fish can have important consequences on metapopulations by increasing gene flow. Inversely, the river proximity could increase straying of released fish. A good example for such study is the salmon populations in four neighbouring rivers flowing into from the Mont-Saint-Michel Bay (Couesnon, Sélune, Sée, and Sienne) in Lower Normandy and were stocking has been settled since 1989 using non-native salmon coming from two French hatcheries. We propose to explore 1- the functioning of the metapopulation by investigating salmon and gene flows between the four rivers 2- the genetic impact of stocking 3- the consequences for management, including habitat, stocking, and exploitation. We are coupling three approaches: - Molecular genetics using microsatellite markers - Otoliths microchemistry - Modelling the two types of data with capture-recapture informations
Dates during which research will take place	2007 to 2010
Area in which research will take place	5 rivers flowing into the Mont-Saint-Michel Bay, Normandy, France
Estimated number and weight of salmon to be retained	No adult fish are retained; all fish trapped are released. Genetic analyses are performed mainly from scales of adult salmon caught by angling. 100 juveniles have been caught and killed for removing otoliths and. for microchemistry analysis.
Resources	
Estimated cost of the research project	£150,000 (Euro150,000) i.e. £50,000 per annum
Number of participating scientists	1 PHD, 8 scientists, 2 technicians
Name and e-mail address of coordinating scientist in charge of project	Jean-Luc Baglinière Jean-Luc.Bagliniere@rennes.inra.fr
Details of research vessels, e.g. name, registration, call sign and description of vessel	none
Type and amount of gear and other equipment to be used	Standard sampling equipment Standard genetics laboratory equipment LAICPMS (Laser Ablation Inductively Coupled Plasma-Mass Spectrometer) for microchemistry analysis

	Trapping
Details of any collaborating countries	none

Summary of Progress

Molecular analyses showed very low and not significant differentiation between populations from the Mont-Saint-Michel Bay. Furthermore, the comparison with others wild stocks (Brittany populations (west side) and Upper Normandy (north side)), and with hatchery-reared strains, showed large genetic differences. These results also show relatively high genetic introgression of Normandy populations following stocking.
LAICPMS analysis discriminated juveniles from the four rivers with 85% accuracy and also allowed to discriminate juvenile from hatchery.
Overall, coupling genetic and microchemistry analyses showed high straying rates of wild and released hatchery-reared adults salmon among the rivers of Normandy and successfull reproduction of stocked fish in the wild.
Further investigations are needed to quantify the natural exchange rate between the four populations, and the impact of stocking, by using statistical models and a more complete analysis of otolith microchemistry.

Project No. E18 **Status:** **Ongoing**

Party or relevant jurisdiction	EU - Denmark
Title of project	**Salmon Rehabilitation Plan: monitoring numbers of spawners, spawning and nursery areas in four Atlantic Salmon rivers**
Objective of research project	The Danish national salmon rehabilitation plan describes four rivers with natural wild salmon populations. In earlier years monitoring has estimated numbers of smolts and numbers of spawners in the River Skjern Å but the exact spawning areas are not known. In 2008 monitoring took place in River Skjern Å, in 2009 in River Ribe Å, in 2010 in River Storå and in 2011/12 in River Varde Å. In 2013 again in River Skjern Å and so forth. In this way the effect of the rehabilitation plan and the development of the populations is assessed (the goal is at least 1,000 spawners in each river to fulfil the plan). This study will allow estimates of marine mortality of salmon to be made.
Brief description of research project	Every year about 100 spawners are radio tagged and a number of spawners are PIT tagged and followed by boat and listening stations during the spawning period. Spawning areas are determined and numbers of spawners estimated from tagged and untagged salmon caught by electro fishing and reports from anglers. From identified spawning areas salmon fry are collected and genetically analyzed (20 – 25 micro satellites) to identify numbers of families on the spawning areas. High numbers of fry and families indicate better areas versus few fry and spawners.
Dates during which research will take place	Annually. Started in autumn 2008 (tagging) and fry collection during summer 2009 and so on.
Area in which research will take place	River Skjern Å, River Ribe Å, River Storå and Varde Å. The rivers flow into the North Sea.
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	Annually about £14,000 for running costs (tags and chemicals). The amount is indexed. Annually about 510 scientist hours and 720 technical assistant hours
Number of participating scientists	Two (2)
Name and e-mail address of coordinating scientist in charge of project	Anders Koed, ak@aqua.dtu.dk Einar Eg Nielsen, én@aqua.dtu.dk
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	Pit and radio tags, lab equipments

Details of any collaborating countries	

Summary of progress

The spawning run in Skjern Å river in 2008 was estimated to c. 3,100 of which about 30 % were wild fish and the rest from stocked fish of the Skjern Å strain; and in Ribe Å 2009 c. 726 spawners, most of them from stocked fish of the Ribe Å strain. In 2010 the spawning run will be estimated in the Stor Å river system.

Project No. E19 Status: Ongoing

Party or relevant jurisdiction	European Union - Finland
Title of project	**Long-term variation in population dynamics, life-history characteristics, sea growth and origin (wild/reared) of salmon in the rivers Teno (Tana) and Näätämöjoki (Neidenelva)**
Objective of research project	Collect long-term data on variation in the stock components, life histories, sea growth and abundance of escaped farmed salmon in the salmon stocks of the rivers Teno and Näätämöjoki. Relate the population dynamics of the juvenile salmon and returning adult salmon in preceding and subsequent generations.
Brief description of research project	The wild Atlantic salmon stocks of the Rivers Teno (Tana) and Näätämöjoki (Neidenelva) have been subject to long-term monitoring programme since the 1970s in cooperation between Finnish and Norwegian research institutes and authorities. Catch statistics and samples have been collected in the freshwater salmon fisheries since 1972 covering all user groups, seasons and gear types. Typically, some 2,000-8,000 adult salmon scales have been collected yearly. Long-term electrofishing at permanent sampling sites has been carried out in the Teno since 1979 and in the Näätämöjoki since 1990.
Dates during which research will take place	Long-term ongoing programme
Area in which research will take place	Northern Finland and Norway
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	£275,000 per annum
Number of participating scientists	5
Name and e-mail address of coordinating scientist in charge of project	Jaakko Erkinaro jaakko.erkinaro@rktl.fi
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	N/A
Details of any collaborating countries	Norway

Summary of progress

Long-term monitoring programmes. Analyses have indicated relationships between the yearly stock fluctuation and the environmental conditions, especially the Barents Sea temperatures. In addition, positive correlations between the catch fluctuations and the preceding and subsequent juvenile salmon production have been documented. Special emphasis has been allocated to the monitoring of possible escaped farmed salmon in the river catches of the Rivers Teno and Näätämöjoki.

Project No. E20 Status: Ongoing

Party or relevant jurisdiction	EU - Finland
Title of project	**Joint use of high-throughput SNP assay infrastructure in Atlantic salmon**
Objective of research project	The key aims of the project include: I) A concerted effort to identify genomic regions that affect ecologically and economically important phenotypic traits in domesticated and wild Atlantic salmon; II)efficient joint utilization of a state-of-the-art Nordic genomics infrastructure to generate large-scale salmon SNP datasets;
Brief description of research project	Atlantic salmon is one of the most economically and scientifically important fish species world-wide and especially in the Nordic countries Atlantic salmon can be seen as a "flagship" species because of their vulnerability, attractiveness and broad influence in conservation biology as well as evolutionary, ecological and genomic research. In recent years, the ability to study biological processes from a whole genome perspective have opened unforeseen directions and opportunities but at the same time the resources required for high-throughput genomic projects are becoming prohibitively large for single research groups. Hence, there is an urgent need for collaborative effort for utilizing the latest genomic developments and it provides an ideal ground for joint use of Nordic infrastructures in merging evolutionary, ecological and genomic perspectives.
Dates during which research will take place	2009 -2010
Area in which research will take place	Norway and Finland
Estimated number and weight of salmon to be retained	-
Resources	
Estimated cost of the research project	Staff costs: - Travel: £2,000 Laboratory expenses: £98,000 Overheads: Total 2009-2010: £100,000 i.e. approximately £50,000 per annum
Number of participating scientists	4
Name and e-mail address of coordinating scientist in charge of project	Craig Primmer craig.primmer@utu.fi
Details of research vessels, e.g. name, registration, call sign and description of vessel	-
Type and amount of gear and other equipment to be used	-
Details of any collaborating countries	Department of Biology, University of Turku, Finland Center for Integrative Genomics, Norwegian University of Life Sciences, Aas, Norway

Summary of Progress

Initial testing and optimisation of the SNP chip for use with a range of salmon populations and DNA extraction methods has commenced.

Project No. E21 Status: Ongoing

Party or relevant jurisdiction	European Union – Sweden
Title of project	**Long-term variation in population dynamics, life history and exploitation of salmon stocks in monitored rivers**
Objective of research project	The objective is to estimate long-term variation of survival in different life stages, life history characteristics and growth of wild salmon in the River Ätran with its major tributary Högvadsån. Estimates of sea survival, growth and exploitation are provided from annual Carlin taggings of wild fish in River Ätran and fish from reared stocks in the Rivers Lagan and Nissan.
Brief description of research project	The wild salmon stock in River Ätran has been subject to monitoring since the 1950s with annual recording of the number of ascending fish in the tributary Högvadsån since 1954 and partial smolt trapping since 1959. Present monitoring programmes include electrofishing surveys, smolt trapping, adult counters in the main stem of River Ätran and in Högvadsån, catch sampling and scale reading, Carlin tagging and collection of catch statistics. As the river Ätran is infected by *Gyrodactylus salaris*, there is an annual monitoring of the parasite infection. In addition to the major programme in River Ätran there is a tagging programme for the reared stocks in the rivers Lagan and Nissan. This gives data on sea survival and exploitation of reared stocks.
Dates during which research will take place	Long-term ongoing project (subject to annual review).
Area in which research will take place	Sweden
Estimated number and weight of salmon to be retained	No adult fish are retained. Up to 100 parr/smolt are retained in sampling programmes.
Resources	
Estimated cost of the research project	£8,500 in 2009 dedicated to the project. Other parts of project in larger monitoring programmes or part of compensatory programme after hydro-electric power development.
Number of participating scientists	2-4 (also participating in other projects)
Name and e-mail address of coordinating scientist in charge of project	Lars Karlsson lars.karlsson@fiskeriverket.se
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	Adult and smolt trapping facilities.
Details of any collaborating countries	N/A

Summary of Progress

Although River Ätran was infected by *Gyrodactylus salaris* somewhere around 1990, this river still supports the most substantial salmon angling of any of the wild salmon rivers on the Swedish west coast. An analysis of the effect of the parasite on all wild salmon stocks indicated a negative influence, as the densities of parr were lower in infected rivers. The decrease in densities of older parr was particularly pronounced in River Ätran. Within a Gyrodactylus monitoring programme a significant correlation was found between high infection rates with parasites and low survival of older salmon parr. The partial smolt trapping in River Ätran indicate a quite stable smolt production level in the last 10 years, but it is on a substantially lower level than it was in the 1970s. There are signs of an increase in sea trout production in the last 10 years. This may fit in with negative effects of parasites on salmon that partly compete with sea trout for space. All monitoring programs continue.

River Ätran is one of the European projects in The Interreg lVB North Sea Region Programme and granted 0,7 million euro. In 2010 a hydropower plant will be eliminated in River Ätran. Salmon can pass the plant using a fishway (Denile type) since 1945, but elimination of the plant will further enhance the spawning run and also the smolt migration and of course the migration of eel. Earlier spawning areas (15 000 m2) will also be restored. The estimated cost is Euro 1.8 million. In the Interreg project a new liming project will also be carried out.

4. NORWAY

Project No. N1 Status: Ongoing

Party or relevant jurisdiction	Norway, Institute of Marine Research, P.O. Box 1870 Nordnes, N-5817 Bergen, Norway
Title of project	**Significance of salmon lice for growth and survival of salmon in the sea**
Objective of research project	To estimate the effects of salmon lice on post-smolt growth and survival, dependent on release site, and time and year of release.
Brief description of research project	Cultured smolts have been treated against salmon lice, tagged with microtags and released in the River Dale, western Norway, each year from 2002 to 2009. The effect of the time of "escape" is studied by releasing T-bar anchor tagged smolts and post-smolts from May to August from Matre Research Station in 2005, 2007 and 2008. A comparison of the effect of salmon lice in fjord versus coastal areas is done by releasing smolts in both environments; from Matre and at the nearby coast in 2006 and 2007, and from Dale River and at the coast from 2007 to 2009. Further releases will occur in 2010.
Dates during which research will take place	Fish releases during 2006-2010.
Area in which research will take place	Western Norway; River Dale, Matre Aquaculture Station and nearby coast.
Estimated number and weight of salmon to be retained	Catch of adult tagged fish: 30-300 fish each year.
Resources	
Estimated cost of the research project	Total: £75,000 per annum; overheads: £25,000; salary: £33,000; equipment: £13,000; other costs: £4,000
Number of participating scientists	3
Name and e-mail address of coordinating scientist in charge of project	Ove Skilbrei, ove.skilbrei@imr.no
Details of research vessels, e.g. name, registration, call sign and description of vessel	No vessels
Type and amount of gear and other equipment to be used	Tags; 25,000 microtags,
Details of any collaborating countries	

Summary of Progress

Returns of grilse to the River Dale were sufficient for statistical analysis in 2002 and 2003 and an effect of salmon lice was observed. The marine survival of smolts seems to have been very low in the following years, with no differences between treated and control groups, except for a higher survival and significant benefit for treated smolts released at the coast 2007. Small or no differences in survival with time of release have been observed after the successive releases from May to August 2005 in Matre, but very low survival in following years. New releases of smolts treated against sea lice are planned in 2010.

Project No. N2 Status: Ongoing

Party or relevant jurisdiction	Norway
Title of project	**Marine survival, growth and exploitation of salmon from the Rivers Figgjo, Imsa, Drammenselv and Halselv.**
Objective of research project	1. Estimation of marine survival 2. Estimation of marine growth 3. Estimation of marine exploitation 4. Data input in predictive models 5. Monitoring
Brief description of research project	Maintain time series of smolt taggings (wild and hatchery-reared) and tag returns in index rivers. Use the information to study fluctuations in marine survival and growth as well as describe changes in marine exploitation.
Dates during which research will take place	Long-term ongoing monitoring project
Area in which research will take place	Tagging in rivers Figgjo, Imsa, Drammenselv and Halselv with tag recovery programme in fisheries along Norwegian coast and elsewhere
Estimated number and weight of salmon to be retained	
Resources	
Estimated cost of the research project	Approximately £134,000 per annum
Number of participating scientists	5
Name and e-mail address of coordinating scientist in charge of project	Lars P. Hansen l.p.hansen@nina.no Nina Jonsson nina.jonsson@nina.no Arne Johan Jensen Arne.jensen@nina.no
Details of research vessels, e.g. name, registration, call sign and description of vessel	
Type and amount of gear and other equipment to be used	Fish traps, electric fishing
Details of any collaborating countries	

Summary of Progress

The long-term monitoring of salmon from the four rivers has revealed that marine survival has improved compared with the poor survival in the late 1990s. Survival rates of wild and hatchery-reared salmon are correlated. Survival rates of 1SW fish are correlated with survival rates of 2- and 3SW fish from the same smolt cohort. There is a significant relationship between growth and survival, and slow-growing individuals tend to become sexually mature at a higher sea age than fast-growing individuals. The marine exploitation rates have continued to decrease. In the River Halselv a significant correlation has been found between return rates of first-time migrants of sea trout and sea charr, and return rates of salmon of the same smolt year class.

Project No. N3 Status: Ongoing

Party or relevant jurisdiction	Norway
Title of project	**Population-limiting mechanisms for Atlantic salmon during early estuarine and coastal migration (SalPoP)**
Objective of research project	The main objectives of the project are to: o Map migratory behaviour and quantify where, when and why mortalities of Atlantic salmon post-smolt occur. o Correlate data on migration and mortalities with health status and major population-limiting factors. o Significantly contribute to the future sustainability of Atlantic salmon populations by developing improved mitigating actions and management strategies.
Brief description of research project	The proposed project consists of five integrated workpackages (WPs). The first four WPs are aimed at examining specific population limiting factors, while WP5 is aimed at summarising the results in order to evaluate actions and management strategies for maintenance and re-establishment of wild Atlantic salmon populations. Groups of smolt will be exposed to various contaminants using a common protocol to establish dose response relationships affecting smolt health. Fish health will be assessed on basis of physiological, immunological and morphometric measurements. Movements, behaviour and survival will be studied with both acoustic telemetry methodology for smaller sub-samples and with external tagging methodology for some larger sub-samples. The use of telemetry will provide more detailed and comprehensive knowledge regarding survival and behaviour of the post-smolt than has been possible in earlier large scale external tagging studies.
Dates during which research will take place	January 2008 – January 2012
Area in which research will take place	Eresfjord in Møre and Romsdal, middle Norway
Estimated number and weight of salmon to be retained	Wild and farmed salmonids
Resources	
Estimated cost of the research project	Funding from the Norwegian Research Council, Statkraft Energy AS and The Norwegian Directorate for Nature Management: 2008: £191,200 (NOK 1,950 000) 2009: £209,800 (NOK 2,140 000) 2010: £200,000 (NOK 2,040 000) 2011: £124,500 (NOK 1,270 000)
Number of participating scientists	15

Name and e-mail address of coordinating scientist in charge of project	Bengt Finstad bengt.finstad@nina.no
Details of research vessels, e.g. name, registration, call sign and description of vessel	
Type and amount of gear and other equipment to be used	
Details of any collaborating countries	o Prof. Thrandur Björnsson and Dr. Ingibjörg E. Einarsdottir - Göteborg University (GU) o Dr. Andy Moore – Centre for Environment, Fisheries and Aquaculture Science (CEFAS) o Prof. Robert Scott McKinley - University of British Columbia (UBC)

Summary of Progress

Both the telemetry (acoustic) and laboratory experiments (contaminants) have been performed in the 2009 field season and a progress report to the Norwegian Research Council has been submitted and approved by the Council.

Project No. N4: Status: Ongoing

Party or relevant jurisdiction	Norway
Title of project	**The Hardangerfjord salmon lice project**
Objective of research project	Even though strategies for lice treatment in fish farms have been greatly improved during recent years there still remain episodes of high lice infestation on wild salmonids in the Hardangerfjord system. Therefore, there is a need to extend the time series to cover more combinations of environmental and management factors which influence salmon lice levels on the different salmonid populations. This will enable us to obtain a better understanding of the fjord system by: 1. Improving sea lice monitoring and management on individual farms and the region in general by fjord integrated pest management and synchronized delousing processes. 2. Evaluating the success of sea lice management strategies in the Hardangerfjord through investigation of the infection level on farmed and wild fish. 3. Quantifying the abundance and distribution of salmon lice in the Hardangerfjord area based on the physical oceanographical and meteorological conditions for a given salmon lice production. 4. Analyzing data sets being collected at the Hardangerjord for possible risk factors associated with varying lice infection pressure with the aim of developing a mathematical population model for the Hardangerfjord system. Results obtained in this project can also be used for other fjord systems globally in management schemes aimed at minimising the risk of salmon lice infestation on wild and farmed fish stocks.
Brief description of research project	This three-year research effort will focus on the interactions of salmon lice between farmed and wild salmonids in the Hardangerfjord and will be a continuum of the project which was initiated in 2004 (see: http://www.nina.no and the attachment to the present application; NFRProgressReportHardanger2005). The applied project consists of four closely linked workpackages: 1) Salmon lice abundance on wild and escaped salmonids; 2) Optimised salmon lice monitoring and control strategies in farms; 3) Understanding the physical oceanographical factors on salmon lice abundance and distribution in the Hardangerfjord and 4) Development of a mathematical population model for the Hardangerfjord system. The Hardangerfjord has the largest density of fish farms in Norway. However, even though strategies for lice treatment in fish farms have been greatly improved during the present project, we still experience episodes of high lice infestation on wild salmonids in this fjord. Therefore, there is a great need to extend the time series to cover and understand more of the different combinations of environmental and managemental factors which influence salmon lice levels on the different salmonid populations. By using and combining the long-time results from the project our overall goal is to develop a mathematical population model for the Hardangerfjord system which can be used in management schemes aimed at minimising the risk of salmon lice infestation on wild and farmed fish stocks. Epidemiological models in combination with lice dispersal models is vital to understand the complex relationship between hosts, parasites,

	environment and measures taken in fish farms. Modelling will also give advice to the industry for optimal placement of fish farms within a fjord system. The degree of international collaboration also shows that results obtained in this project can be used for other fjord systems globally in management schemes aimed at minimising the risk of salmon lice infestation on wild and farmed fish stocks.
Dates during which research will take place	January 2007- June 2010
Area in which research will take place	Hardangerfjord at the Norwegian West Coast
Estimated number and weight of salmon to be retained	Wild- and farmed salmonids
Resources	
Estimated cost of the research project	Funding from The Norwegian Fisheries and Aquaculture Research Fund and the Norwegian Research Council: 2007: £143,600 (NOK 1,465 000) 2008: £151,000 (NOK 1,540 000) 2009: £149,000 (NOK 1,520 000)
Number of participating scientists	14
Name and e-mail address of coordinating scientist in charge of project	Bengt Finstad bengt.finstad@nina.no
Details of research vessels, e.g. name, registration, call sign and description of vessel	
Type and amount of gear and other equipment to be used	
Details of any collaborating countries	Prof. Robert Scott McKinley, University of British Columbia (UBC) Dr. Crawford Revie and Prof. George Gettinby, University of Strathclyde

Summary of Progress

All 4 work packages (see above) have been performed in the 2009 field season and a progress report to the Norwegian Research Council has been submitted and approved by the Council. A final report for the project period will be delivered by June 1, 2010.

Project No. N5: **Status:** **New entry**

Party or relevant jurisdiction	Norway, Norwegian Institute for Nature Research, Trondheim, Norway
Title of project	**Origin of Atlantic salmon off Svalbard**
Objective of research project	To identify the origin of Atlantic salmon occuring in gill net fisheries at Isfjorden, Spitsbergen, by life history (age, growth) and genetic analyses.
Brief description of research project	Some individuals of Atlantic salmon are annually caught as by-catch in a gill net fishery outside Lonyearbyen, Svalbard. Scales of about 40 individuals were collected each year in 2008 and 2009. Life history (age, growth) and genetic analyses of these individuals will be conducted in an attempt to identify their conntry/region of origin.
Dates during which research will take place	September 2008 – February 2011
Area in which research will take place	Isfjorden, Spitsbergen
Estimated number and weight of salmon to be retained	80
Resources	
Estimated cost of the research project	£22,500 i.e. £7,500 per annum
Number of participating scientists	4
Name and e-mail address of coordinating scientist in charge of project	Arne Johan Jensen (arne.jensen@nina.no)
Details of research vessels, e.g. name, registration, call sign and description of vessel	
Type and amount of gear and other equipment to be used	Gill nets
Details of any collaborating countries	

Summary of progress

About 40 Atlantic salmon were caught each year in 2008 and 2009. Age and growth analyses from their scales are in progress.

Project No. N6: **Status:** **New entry**

Party or relevant jurisdiction	Norway, Tromsø
Title of project	**SALMOTRACK - Electronic tracking of northern anadromous salmonids**
Objective of research project	To track different life-stages of northern Atlantic salmon and other anadromous species in river, fjord and open ocean.
Brief description of research project	The SALMOTRACK-project is a primary framework that coordinates many activities on electronic tracking of northern anadromous salmonids, with special emphasis on Atlantic salmon. This also includes coordination of available logistics and equipment in order to maximize the synergistic effects and reduce the cost of each sub-project. The project utilizes several types of electronic tracking techniques to map the migrations and behaviour of almost all life stages of salmon, including juveniles, smolts, post-smolts in fjords, open ocean migrations of adults, returning adults in fjords and rivers, kelts (post-spawners) in the river and fjord and escaped farm salmon. In addition, silver eels, anadromous Arctic charr and sea trout have been tracked in fjords, rivers and lakes. Two post-doc positions, three PhD positions and several master and bachelor students are directly involved in the project. The SALMOTRACK-project was initiated in 2006 through support from the Norwegian Research Council, but has since then grown considerably in extent due to additional support from other funds and institutions.
Dates during which research will take place	2006-2012.
Area in which research will take place	Northern Norway (Alta, Neiden, Tana, Skibotn, 2007-2012), Middle Norway (Orkla, 2010), Western Norway (Hardangerfjord, 2006).
Estimated number and weight of salmon to be retained	Electronic tagging of all stages from parr and smolts to adults
Resources	
Estimated cost of the research project	Approximately £1,500,000 for the whole study period (2006-2012) ie £250,000 per annum
Number of participating scientists	About 25 Norway: University of Tromsø (9), Norwegian Institute of Nature Research (5) and the Norwegian Institute of Marine Research (2) Several international participants, see below
Name and e-mail address of coordinating scientist in charge of project	Audun H. Rikardsen, audun.rikardsen@uit..no
Details of research vessels, e.g. name, registration, call sign and description of vessel	22 ft Buster Magnum with 150 HP engine (on trailer) FF Johan Ruud (100 ft trawler)
Type and amount of gear and other equipment to be used	Different telemetry equipment and tags (PIT, acoustic, radio, archival, PSAT's)
Details of any collaborating	Kim Aarestrup (Denmark), David Righton (UK), Paddy Gargan

countries	(Ireland), R. Scott McKinley (Canada), Brian Dempson (Canada), Jaakko Erkinaro (Finland), Ben Letcher (US), Hiro Mitamura (Japan)

Summary of Progress

The project has so far been very successful, and has already obtained new and important information related to migratory behaviour of northern salmonids. In total, more that 1,900 fish (mostly salmon, but also charr, trout, pike and eel) have been tagged with electronic tags (acoustic, archival, radio, satellite pop-up archival tags) from 2006 to 2010. In addition, 4,000 salmon parr have been tagged with PIT-tags.

6. RUSSIAN FEDERATION

Project No. R1 Status: Ongoing

Party or relevant jurisdiction	Russian Federation
Title of project	**Monitoring of the stock status, abundance assessment and provision of advice on the allowable level of harvest of Atlantic salmon.**
Objective of research project	Derive estimates of survival of juveniles and adult return rates, estimates of natural and fishing mortality, study the dynamics of population characteristics, assess population sizes and spawning escapement, estimate allowable catch.
Brief description of research project	Research fishing is conducted. Data is collected on the Atlantic salmon population characteristics (age structure, size distribution, sex composition, fecundity, proportion of various salmon groups in the spawning run). Adults and smolts are marked with tags to assess population size and survival rates. The dynamics of the smolt migration and the spawning run, and the behaviour of adults are studied. The quality of Atlantic salmon spawning habitat and the impact of human activities on the habitat are assessed.
Dates during which research will take place	Annual monitoring programmes (May-October).
Area in which research will take place	Atlantic salmon rivers of the Kola Peninsula, Archangel Region and Karelia Republic.
Estimated number and weight of salmon to be retained	About 1,500 salmon and 5,500 parr and smolts
Resources	
Estimated cost of the research project	Approximately £80,000 for 2010
Number of participating scientists	~ 25 scientists from PINRO
Name of coordinating scientist in charge of project	Sergey Prusov (PINRO) prusov@pinro.ru Gennady Ustuzhinsky (PINRO) gena@sevpinro.ru
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	Barrier fences, nets, electrofishing units, smolt traps, external tags
Details of any collaborating countries	N/A

Summary of Progress

Adult returns in 2009 to home waters were assessed. The level of attainment of spawning requirements was determined, the condition and success of spawning was assessed, and estimates of parr density were derived. The harvestable surplus was determined. Recommendations on TACs and quotas for 2010-2011 salmon fisheries was developed for the Federal Agency for Fisheries of the Russian Federation and for the Regional Committees on Management of Salmon Fisheries.

Project No. R2 **Status: New Entry**

Party or relevant jurisdiction	Russian Federation and Norway
Title of project	**Establishing a genetic baseline of northern salmon populations across the Russian – Norwegian border for management purposes.**
Objective of research project	To establish a genetic baseline of sufficient resolution for the purposes of partitioning bag net catches between Russian and Norwegian regions.
Brief description of research project	In northern Norway, salmon are caught in bag net fisheries along the coast. Tagging studies conducted in the 1960s and 1970s demonstrated that these fisheries were mixed-stock fisheries (Prusov & Zubchenko 2009, Hansen *et al*. in prep.), intercepting salmon returning to a large number of rivers, both in Russia and Norway. Though fishing effort in marine fisheries for salmon has decreased since these studies were conducted, there is still a substantial marine fishery in Norway's two northernmost counties with a catch totalling 44,414 salmon (55% of the total marine fishery) in 2008 (ICES 2009). The proportion of Russian salmon in these catches is unknown, and whether the proportions observed in earlier tagging studies are stable over this time period is also uncertain. The development of a genetic baseline of Norwegian and Russian salmon populations provides an opportunity for applying genetic methods to investigate the present distribution of different salmon populations contributing to the coastal fisheries. The development of the baseline will be conducted in cooperation between PINRO, IMR and NINA. DNA will be extracted from the samples using commercial kits such as Qiagen DNEasy, which gives high quality DNA for long-term storage. The samples will be amplified for the selected multiplexed markers and fragment analysis will be conducted on ABI 3130XL (NINA) and ABI 3730XL (IMR) Genetic Analyzers. DNA will be analyzed for variation in 18-25 microsatellite markers The analyses of bag net sampled fish will be conducted at IMR. The statistical analysis and assignment will be conducted in cooperation between NINA and IMR, with participation from PINRO. The common dataset of Norwegian and Russian rivers will be made available for the purposes of the SALSEA-Merge project. The data will also be used for constructing a national genetic baseline for Norwegian and Russian Atlantic salmon populations.
Dates during which research will take place	2009-2010
Area in which research will take place	Northern Norway, North-West of the Russian Federation
Estimated number and weight of salmon to be retained	N/A

<table>
<tr><td>Resources</td><td></td></tr>
<tr><td>Estimated cost of the research project</td><td>
<table>
<tr><td></td><td>Norway</td><td>Russia</td></tr>
<tr><td>Collection of av samples</td><td>£3,400</td><td>£33,600</td></tr>
<tr><td>Meetings & Travel</td><td>£5,600</td><td>£1,100</td></tr>
<tr><td>Analyses (incl. labour)</td><td>£50,500</td><td>-</td></tr>
<tr><td>Evaluating results</td><td>£13,500</td><td>-</td></tr>
<tr><td>Analysis of bagnet samples</td><td>£25,250</td><td>-</td></tr>
<tr><td>Assignment/Mixed stock analysis and report</td><td>£9,000</td><td>-</td></tr>
<tr><td>Total</td><td>£107,250</td><td>£34,700</td></tr>
<tr><td colspan="3">Total: £141,950</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Number of participating scientists</td><td>Norway – 4, Russian Federation – 3.</td></tr>
<tr><td>Name and e-mail address of coordinating scientist in charge of project</td><td>Dr. Vidar Wennevik (IMR) vidar.wennevik@imr.no
Dr. Sergey Prusov (PINRO) prusov@pinro.ru</td></tr>
<tr><td>Details of research vessels, e.g. name, registration, call sign and description of vessel</td><td>N/A</td></tr>
<tr><td>Type and amount of gear and other equipment to be used</td><td>Electrofishing units – 5 (PINRO, IMR)
Smolt traps – 2 (PINRO)
Genetic Analyzer ABI 3730XL – 1 (IMR)
Genetic Analyzer ABI 3130XL – 1 (NINA)</td></tr>
<tr><td>Details of any collaborating countries</td><td>Norway</td></tr>
<tr><td colspan="2">Summary of Progress:

New entry</td></tr>
</table>

7. UNITED STATES OF AMERICA

Project No. U1 Status: Ongoing

Party or relevant jurisdiction	United States of America
Title of project	**Penobscot hatchery versus wild smolt telemetry**
Objective of research project	1) Evaluate migration timing and pathways in the Penobscot Estuary and Bay 2) Estimate survival of migrating smolts and post-smolts
Brief description of research project	Telemetry data was first collected on hatchery-reared out-migrating Atlantic salmon smolts in the Penobscot River, Maine, in 2005, and this research effort is continuing. Atlantic salmon smolts are surgically implanted with ultrasonic tags. Automated fish identification receivers are deployed throughout the estuary and near-shore marine arrays in Penobscot Bay. The array identifies the migration pathways of smolts as they exit the system between release groups. In 2005, 180 hatchery-reared smolts were tagged and released. In 2006, 25 hatchery and 25 naturally reared smolts were tagged and released. In 2007, no smolts were tagged. In 2008, 80 hatchery-reared smolts, 31 fall parr stocked smolts and 46 naturally reared smolts were tagged and released. In 2009, 122 hatchery reared and 37 fall parr stocked smolts were tagged and released.
Dates during which research will take place	2005-2012
Area in which research will take place	Penobscot Estuary Penobscot Bay
Estimated number and weight of salmon to be retained	It is anticipated that no Atlantic salmon will be retained during this project.
Resources	
Estimated cost of the research project	Approximately £66,750 annually (Public Funding)
Number of participating scientists	~5
Name and e-mail address of coordinating scientist in charge of project	James Hawkes James.Hawkes@noaa.gov
Details of research vessels, e.g. name, registration, call sign and description of vessel	Equipment deployed from small research boats and leased commercial vessels. Vessel use is subject to change annually.
Type and amount of gear and other equipment to be used	Ultrasonic Telemetry Tags (~150-250 annually) Automated Pinger Detection Units (100-150 annually)
Details of any collaborating countries	Automated Pinger Detection arrays deployed by Canadian investigators were capable of detecting and recording tagged fish. Automated Pinger Detection arrays deployed for this study were capable of detecting and recording Canadian tagged fish.

Summary of Progress

Field activities and preliminary analysis are currently ongoing. 159 smolts were tagged in 2009. The 2009 array was put in place and maintained in cooperation with the University of Maine and the U.S. Geological Survey (other species are being tracked with the array – e.g., shortnose sturgeon). Approximately 150 salmon smolts will be tagged in 2010. Detailed analysis and development of peer-reviewed manuscript(s) will be released upon conclusion of field studies.

Project No. U2 Status: Ongoing

Party or relevant jurisdiction	United States of America
Title of project	**Comprehensive evaluation of marine survival of hatchery-stocked smolts: Migration behaviour and success of Dennys River smolts**
Objective of research project	1) evaluate migration speed and behaviour from lower river release sites through estuarine habitat 2) estimate survival of migrating smolts and identify areas where mortality may be occurring
Brief description of research project	An experimental evaluation of river-specific Atlantic salmon smolt stocking in the Dennys River was developed. The program was scheduled to run for a minimum of five years (2001-2006), but ultrasonic telemetry efforts on the Dennys were discontinued in 2005. Ultrasonic telemetry investigations were used to evaluate the migration success, nearshore marine mortality and nearshore migration routes of these stocked smolts. Approximately 50,000 smolts are released annually and, of these, approximately 70-150 fish are released with surgically implanted ultrasonic pingers.
Dates during which research will take place	Data collection April – June, 2001-2005. Data analysis and publication 2005-2010.
Area in which research will take place	Dennys River Cobscook Bay Gulf of Maine
Estimated number and weight of salmon to be retained	It is anticipated that no Atlantic salmon will be retained during this project.
Resources	
Estimated cost of the research project	Approximately £3,500 per annum (public funding)
Number of participating scientists	~3
Name and e-mail address of coordinating scientist in charge of project	James Hawkes James.Hawkes@noaa.gov
Details of research vessels, e.g. name, registration, call sign and description of vessel	Equipment deployed from small research boats and leased commercial vessels. Vessel use is subject to change annually.
Type and amount of gear and other equipment to be used	Ultrasonic Telemetry Tags (70-200 annually) Automated Pinger Detection Units (20-40 annually) Electro-fishing gear for juvenile assessments
Details of any collaborating countries	Automated Pinger Detection arrays deployed by Canadian investigators were capable to detecting and recording tagged fish. Automated Pinger Detection arrays deployed for this study were capable to detecting and recording Canadian tagged fish.

Summary of Progress

Ultrasonic telemetry efforts on the Dennys River were discontinued in 2005. Preliminary results suggest that emigrating smolts pass through the freshwater zone quickly, experiencing low mortality. However, once fish entered the near-shore environment, mortality markedly increased and large variations were observed in the timing of emigration. Low numbers of smolts were detected entering the Gulf of Maine. Detailed analysis and development of peer-reviewed manuscripts are ongoing (2010).

Project No. U3 Status: Ongoing

Party or relevant jurisdiction	United States of America
Title of project	**Comprehensive evaluation of marine survival of hatchery-stocked smolts: Dennys River smolt stocking assessment**
Objective of research project	1) evaluate smolt-to-adult survival rates of Atlantic salmon smolts based on temporal and spatial patterns of release 2) determine optimal stocking levels to achieve stock rebuilding objectives
Brief description of research project	The Maine Atlantic Salmon Technical Advisory Committee (TAC) developed, and fishery managers supported, the experimental evaluation of river-specific Atlantic salmon smolts in the Dennys River for a minimum of five years (2001-2006). Stocking rates were developed based on retrospective analysis of Penobscot River stocking and adult return data during the period from 1973 to 1995. Model results indicated that a range of 32,000 (low) to 56,000 (high) would result in a 75% probability of achieving 2SW Atlantic salmon returns of at least 67 (low) or 117 (high) adults. Approximately 50,000 smolts will be released annually. All stocked fish will receive an elastomer mark and adipose fin clip to allow quantitative evaluation of survival in relation to release location and time. Returning adults will be enumerated and identified at a weir-based adult trap.
Dates during which research will take place	May – October, 2001-2010
Area in which research will take place	Dennys River Cobscook Bay Gulf of Maine
Estimated number and weight of salmon to be retained	It is anticipated that no Atlantic salmon will be retained during this project.
Resources	
Estimated cost of the research project	Approximately £14,000 per annum (public funding)
Number of participating scientists	~3
Name and e-mail address of coordinating scientist in charge of project	Greg Mackey greg.mackey@maine.gov
Details of research vessels, e.g. name, registration, call sign and description of vessel	None
Type and amount of gear and other equipment to be used	Elastomer Marks and Marking Equipment Rotary Screw Smolt Trap Weir-Based Smolt Trap Weir-Based Adult Trap
Details of any collaborating countries	Elastomer marks may be recovered during the NASCO international cooperative sampling programme at West Greenland.

Summary of Progress

Monitoring of hatchery-origin smolts on the Dennys River was performed from 2001 to 2005. Stocking groups of Visual Implant Elastomer marked smolts are released at different times and from different stocking sites. An adult weir trap is used to monitor the contribution of each stocking group. Preliminary results indicate extremely low numbers of returning adults have been documented, indicating very low marine survival levels. Analysis is ongoing.

Project No. U4 **Status: Ongoing**

Party or relevant jurisdiction	United States of America
Title of project	**Evaluation of estuary and nearshore marine distributions of Atlantic salmon post-smolts in Penobscot Bay and the Gulf of Maine**
Objective of research project	1) evaluate nearshore distribution and migration pathways of smolts and post-smolts 2) estimate the relative contribution of stocked hatchery smolts to overall post-smolt populations 3) evaluate the relative contribution of spatially and temporally distinct smolt releases on post-smolt populations 4) evaluate the physiological condition of post-smolts in marine environments
Brief description of research project	Synchronous declines in the survival of Atlantic salmon smolts throughout North America indicate a sharp decline in marine survival. Many investigators hypothesize that this decline occurs early in the marine phase, as Atlantic salmon smolts transition from freshwater to marine environments. A surface pelagic trawl survey was initiated in 2001 in the Penobscot Bay estuary and nearshore waters of the Gulf of Maine to sample hatchery- and naturally reared Atlantic salmon smolts in the marine environment. A Norwegian-designed pelagic net with a modified aquarium cod end is towed through the surface waters enabling live capture and release. Biological data including size, scale samples, genetic samples, physiology samples, and diet composition are collected from a subsample of fish.
Dates during which research will take place	Data collection from May, 2001-2005. Data analysis from 2005 to present (2010).
Area in which research will take place	Penobscot Bay Gulf of Maine
Estimated number and weight of salmon to be retained	Although project objectives and methodology strive to minimize mortality of Atlantic salmon, immediate trawl and or sampling induced mortality is estimated to be approximately 5%.
Resources	
Estimated cost of the research project	Approximately £20,000 per annum (public funding)
Number of participating scientists	2
Name of coordinating scientist in charge of project	Tim Sheehan Tim.Sheehan@noaa.gov
Details of research vessels, e.g. name, registration, call sign and description of vessel	F/V Nobska and F/V Morue 30-m commercial trawler
Type and amount of gear and other equipment to be used	Post-smolt trawl Standard oceanographic instruments
Details of any collaborating countries	No direct collaboration

Summary of Progress

Two manuscripts summarizing the findings of this project are currently under review and being considered for publication.

Project No. U5 Status: Ongoing

Party or relevant jurisdiction	United States of America
Title of project	**Cormorant harassment in the Narraguagus River/Narraguagus Bay**
Objective of research project	To reduce predation on migrating Atlantic salmon smolts by excluding double-crested cormorants from the lower Narraguagus River and Narraguagus Bay, and to assess the efficacy of non-lethal predator exclusion as a means of reducing predation on migrating Atlantic salmon smolts.
Brief description of research project	U.S. Department of Agriculture (USDA) Wildlife Services professionals will use non-lethal methods to exclude cormorants from the lower Narraguagus River and Narraguagus Bay. These professionals will use fire-cracker shells, "screamers", and other non-lethal methods to displace foraging cormorants anywhere they are encountered within the study area. Effort will be focused within areas in which substantial amount of smolt mortality occurs. Observational data on the frequency and occurrence of cormorants in Narraguagus Bay during the smolt migration will also be collected. These data will be useful for comparing smolt movements with the occurrence of cormorants before, during, and after cormorant exclusion. USDA personnel will fill out a data sheet each day they are in the field. Additionally, cormorant abundance will be documented using two automated digital cameras. Telemetry arrays, already in place in the Narraguagus system, will allow us to assess the efficacy of the cormorant harassment by providing mortality data at each telemetry array.
Dates during which research will take place	May-June 2005. This research will expand upon similar work that was done in May-June 2004. Data analysis and publication of findings in 2005-2010.
Area in which research will take place	Lower Narraguagus River, Estuary and Narraguagus Bay, Maine
Estimated number and weight of salmon to be retained	It is anticipated that no Atlantic salmon will be retained during this project.
Resources	
Estimated cost of the research project	£3,500 per annum (public funding)
Number of participating scientists	Approximately five, representing Federal and State resource management agencies
Name and e-mail address of coordinating scientist in charge of project	James Hawkes James.Hawkes@noaa.gov
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	Small boat, digital cameras, shotguns with fire-cracker and screamer shells, laser.

Details of any collaborating countries	None

Summary of Progress

Cormorant harassment activities concluded in 2005 and analysis is being performed to determine what effect was observed as a result. Ultrasonic telemetry data collected during the harassment period is used to determine success of the project. Preliminary results suggest that emigrating smolts pass through the fresh water with a high rate of success. However, once fish enter the estuary, mortality increases, specifically during daylight hours. Detailed analysis and development of peer-reviewed manuscript is ongoing and expect to be completed in 2010.

Project No. U6 **Status: New Entry**

Party or relevant jurisdiction	United States of America
Title of project	**SALSEA Greenland**
Objective of research project	To advance understanding of the ecology of the Atlantic salmon West Greenland stock complex and to gain an insight into the factors resulting in recent significant increases in marine mortality across the North Atlantic.
Brief description of research project	SALSEA Greenland involves purchasing fresh whole Atlantic salmon from individual fishers and performing an Enhanced Sampling Program on these fish in addition to the Baseline Sampling Program referenced in project D1 "West Greenland Salmon Fishery Sampling Programme". The enhanced sampling protocols are similar to the sampling protocols followed for SALSEA North America and SALSEA-Merge and will allow the results from these three marine sampling programs to be combined and analyzed across temporal and spatial scales.
Dates during which research will take place	Sampling is expected to occur during the fishing season, August – October 2009 and 2010, and sample processing and analysis is expected to continue through 2012.
Area in which research will take place	Sisimiut, Nuuk and Qaqortoq, Greenland
Estimated number and weight of salmon to be retained	Maximum of 900 1SW non-maturing (primarily) adults annually
Resources	
Estimated cost of the research project	Many of the sample collection costs are accounted for in project D1. Only costs additional to those are provided here: Approximately $147,000 (USD) or £98,000 (GBP) – all public funding over three years, i.e. £33,000 per annum
Number of participating scientists	2 additional personnel above and beyond those identified in project D1 actively worked on this project in 2009
Name and e-mail address of coordinating scientist in charge of project	Tim Sheehan Tim.Sheehan@noaa.gov
Details of research vessels, e.g. name, registration, call sign and description of vessel	None
Type and amount of gear and other equipment to be used	Standard sampling and laboratory equipment
Details of any collaborating countries	Collaborative project with investigators from US (T. Sheehan), Canada (G. Chaput and D. Reddin) and scientists from SALSEA-Merge. The work is coordinated via NASCO and is reported to ICES (Working Group on North Atlantic Salmon).

Summary of Progress

In 2009, a total of 412 fresh whole fish were purchased directly from individual fishermen in support of SALSEA Greenland. In addition to the Baseline sampling (outlined in project D1), the full suite of Enhanced Sampling samples were also collected from these fish. The Enhanced Samples will be used to evaluate a wide variety of topics such as age and growth, diet, origin, lipid analysis, stable isotope

analysis, parasites, diseases, sea age at maturity as well as genetic relations and SLICER resistance in sea lice. Samples collected in 2009 are either in the auditing or initial processing/analysis phase. The 2009 sampling effort was largely successful and the data collected will provide novel insights into the health and status of the West Greenland Stock complex. These data will be valuable in furthering our understanding of marine phase salmon once they are combined with the data collected under the SALSEA North America and SALSEA-Merge programs.

8. FRANCE (IN RESPECT OF ST PIERRE AND MIQUELON)

Project No. F1 Status: Ongoing

Party or relevant jurisdiction	France (In respect of St Pierre and Miquelon)
Title of project	**St Pierre and Miquelon Salmon Fishery Sampling Programme**
Objective of research projects	To improve the understanding of the biological characteristics and origin of salmon harvested in the fishery at St Pierre and Miquelon.
Brief description of research project	- The Scientific Programme at St Pierre and Miquelon was introduced in 2003 under the direction of the Institut Francais de Recherche pour l'Exploitation de la Mer (IFREMER). The project was developed through cooperation with NASCO and was designed so as to include three components: - A biometric study - A genetic study A disease and parasite study.
Dates during which research will take place	Annually during the fishing season (1 May – 31 July)
Area in which research will take place	Around the islands of St Pierre and Miquelon
Estimated number and weight of salmon to be retained	Sampling of harvest : none in 2009
Resources	
Estimated cost of the research project	-
Number of participating scientists	1
Name and e-mail address of coordinating scientist in charge of project	Herlé Goraguer herle.goraguer@ifremer.fr
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	Samples obtained from the fishery
Details of any collaborating countries	Canada (Newfoundland)

Summary of Progress:

Studies regarding salmon harvest at sea `: the biometric study has been conducted annually since 2003 and includes the weighing and measuring of salmon harvested in the fishery. In addition, water temperature is recorded at the fishing sites. The number of salmon sampled has varied between 310 and 391 in the 2003-2006 period, but comprised only 12 individuals in 2007, and 68 in 2008. In 2004, genetic analyses were conducted in cooperation with the Canadian scientists and authorities, and the results were presented in the 2005 WGNAS Report. To date, it has not been possible to conduct the pathology study.
In 2009, the sampling programme was not conducted. The studies will restart in 2010.

Note: A study was conducted during the 2009 summer in some sections of the Belle Rivière de Langlade, to map potential salmon habitat and to investigate the presence of a salmon population. Young salmons were captured between June and September, showing the existence of a limited population. A number of river sections were identified as potential favourable habitats. The study will be continued during the 2010 summer.

Annex 2

Inventory of Completed Research Projects relating to Salmon Mortality in the Sea

CANADA

Party	Canada
Title	**Marine migration and survival of post-smolt Atlantic salmon from Bay of Fundy rivers**
Coordinating Scientist	Gilles L Lacroix LacroixG@dfo-mpo.gc.ca
Summary of Objectives	Provide knowledge about marine habitat (migration routes and feeding grounds) used by salmon post-smolts from Bay of Fundy rivers. Determine the location, timing and extent of salmon post-smolt mortality at sea. Investigate the causes and mechanisms of marine mortality of salmon post-smolts. Provide information to fuel the recovery programme for inner Bay of Fundy salmon stocks.
Year removed from inventory/completed	2003

Summary of Findings

Atlantic salmon smolts were tagged in the spring of 2002 (n=378) and released from inner and outer Bay of Fundy rivers (241 inner bay, 137 outer bay). Two lines comprising 132 receivers (VR-2, Vemco Ltd.) were deployed for tracking inner and outer bay movements of post-smolt salmon. Data is being analyzed to publish in 2004.

Field components of this post-smolt tracking project were completed in 2002. Results from the 1999, 2001, and 2002 tracking of tagged smolts were combined in an overall analysis which took place during 2003. The results of these analyses will be summarized in a series of manuscripts to be completed during 2004. At this stage, all results are preliminary. Results will be made available as soon as manuscripts have been completed and approved by the Department for submission and distribution.

No resources were allocated to this project in 2003, and no resources will be allocated in 2004. The project represented the first phase of research to define the migration and early marine survival of post-smolts from rivers of the Bay of Fundy, and it has now been completed.

Findings from this project will be made available as soon as the draft manuscripts are completed (in 2004) and they receive approval for submission and release. In the interim the summary of findings submitted last year can be used since no new research was conducted during 2003.

Party	Canada
Title	**Distribution, health and condition of Atlantic salmon from Bay of Fundy rivers while at sea**
Coordinating Scientist	Gilles L Lacroix LacroixG@dfo-mpo.gc.ca
Summary of objectives	Provide knowledge about marine habitat and health of salmon post-smolts from Bay of Fundy rivers. Investigate the causes and mechanisms of marine mortality of salmon post-smolts. Provide information to fuel the recovery programme for inner Bay of Fundy salmon stocks.
Year removed from inventory/completed	2004

Summary of Findings

Atlantic salmon *Salmo salar* post-smolts migrating through the Bay of Fundy and Gulf of Maine were surveyed and sampled in 2001-2003 by trawling in surface waters. Post-smolts were aggregated in several areas while in the Bay of Fundy and then dispersed over a broader area in the Gulf of Maine, and their distribution reflected major surface current patterns. There was considerable spatial and temporal overlap between migrating post-smolts and the herring fishery. Post-smolt origin (e.g., wild vs. hatchery, inner vs. outer Bay of Fundy) did not affect their distribution. The low density of post-smolts indicated that they were too scarce to form large schools that offer protection from pelagic predators. The recapture rate of marked post-smolts was higher for wild than for hatchery fish, but it was nil for wild fish from the salmon farming area. The health and condition of post-smolts was excellent; they had no bacterial or viral pathogens and no salmon sea lice. Environmental conditions and food supply apparently did not limit growth of post-smolts; new circuli on scales and their spacing indicated that growth at sea had started and was accelerating. Post-smolts had shifted to a pelagic foraging behaviour, feeding opportunistically on different prey depending on location; the main food items were amphipods, euphausiids, and fish larvae. Post-smolts of hatchery and wild origin consumed the same prey but the larger hatchery fish did so in much greater quantity than the wild post-smolts, possibly giving them a growth and survival advantage.

A trawling survey for post-smolts was conducted 4-18 June 2003 in Canadian waters of the outer Bay of Fundy and northern Gulf of Maine. Catches (n = 42 post-smolts) were lower than in the previous two years, and only 24% of the post-smolts captured were wild. They were in good health and free of diseases and sea lice. Analyses of growth and feeding habits were completed. The observed distribution confirmed and extended the distribution and origin data obtained in 2002. Results from surveys conducted in 2001, 2002, and 2003 were combined in a manuscript, “Distribution, origin and health of Atlantic salmon post-smolts migrating through the Bay of Fundy and Gulf of Maine”, that has been completed and will be submitted in 2004 pending Departmental approval.

No resources will be allocated to this project in 2004. No marine survey will be conducted in 2004 for several reasons; the availability of ship time in the region is severely constrained because of a recent fire aboard the research vessel CCGS Alfred Needler, and the initial goals of the project have been met. The project is therefore considered as completed.

Publications:

Lacroix, G. L. 2008. Influence of origin on migration and survival of Atlantic salmon (Salmo salar) in the Bay of Fundy, Canada. Canadian Journal of Fisheries and Aquatic Sciences 65: 2063-2079.

Lacroix, G. L and D. Knox. 2005.Distribution of Atlantic salmon (Salmo salar) postsmolts of different origins in the Bay of Fundy and Gulf of Maine and evaluation of factors affecting migration, growth, and survival. Canadian Journal of Fisheries and Aquatic Sciences 62: 1363-1376.

Party	Canada
Title	**Marine migration and survival of post-smolt Atlantic salmon from the Saint-Jean River (Gaspé)**
Coordinating Scientist	Julian Dodson julian.dodson@bio.ulaval.ca François Caron francois.caron2@mrnf.gouv.qc.ca
Summary of Objectives	Provide knowledge of the marine habitat (migration routes and feeding grounds) used by salmon post-smolts from Bay of Gaspé rivers. Determine the location, timing and extent of salmon post-smolt mortality at sea. Investigate the causes and mechanisms of marine mortality of salmon post-smolts.
Year removed from inventory/completed	Not previously included in the inventory. Completed in 2006.

Summary of Findings

Migration patterns of wild Atlantic salmon smolts were studied in a coastal embayment (consisting of a partially enclosed inner bay and an open outer bay) in the Gaspé peninsula of Québec, Canada.

In 2005 and 2006, 24 and 30 smolts respectively were tagged with coded short-term internal ultrasonic transmitters, and their migration throughout the bay was monitored using an array of fixed hydrophones coupled with a characterization of the physical habitat (current and salinity). The migration patterns were complex, with some smolts taking a direct route through the coastal embayment and other smolts repeatedly changing direction over short spatial and temporal scales.

Migration was mainly an active process involving an overall seaward (outward) migration in the face of an inward residual circulation. Smolt swimming direction, as determined from current velocity and smolt ground velocity, was predominantly seaward. Swimming direction was significantly more focussed towards the sea but swimming speed was less during inflowing currents than during outflowing currents. Similarly, swimming direction was significantly more focussed toward the sea but swimming speed was less during the night than during the day. Swimming direction was significantly more focussed towards the sea and swimming speed was greater when there was a positive salinity gradient (salinity increasing towards the sea) than when there was a negative salinity gradient. Exposure to more saline waters resulted in increased migration rates.

These observations are consistent with the hypothesis that smolts exploit an innate compass to maintain a preferred bearing and that the speed and direction of swimming is controlled by salinity, residual circulation and the diurnal cycle.

Party	Canada
Title	**Marine migration and survival of kelt Atlantic salmon from the Saint-Jean River (Gaspé)**
Coordinating Scientist	François Caron francois.caron2@mrnf.gouv.qc.ca
Summary of Objectives	Provide knowledge of the marine habitat (migration routes and feeding grounds) used by salmon kelts from Bay of Gaspé rivers. Determine the location, timing and extent of kelt mortality at sea. Investigate the causes and mechanisms of marine mortality of salmon kelts. Provide information about migration routes used at sea, using code that can be detected by ASF project (see Fred Whoriskey project) at sea.
Year removed from inventory/completed	Not previously included in the inventory. Completed in 2007

Summary of Findings

Migration patterns of wild Atlantic salmon kelts were studied in a coastal embayment (consisting of a partially enclosed inner bay and an open outer bay) in the Gaspé peninsula of Québec, Canada. In 2006, 24 kelts were tagged during last week of April with coded short-term (3 months) internal ultrasonic transmitters, and their migration throughout the bay was monitored using an array of fixed hydrophones coupled with a characterization of the physical habitat (current and salinity). Kelts stayed for some days in the upper part of the estuary, staying mainly in a limited range. Migration was an active process involving an overall seaward (outward) migration in the face of an inward residual circulation. Kelt swimming direction, as determined from current velocity and kelt ground velocity, was seaward. Swimming direction was significantly more focussed towards the sea and swimming speed was rapid when there was a positive salinity gradient (salinity increasing towards the sea).

Party	Canada
Title	**Tracking experimentally "escaped" farmed salmon**
Coordinating Scientist	Fred Whoriskey asfres@nb.aibn.com
Summary of objectives	Determine the course tracks and fates of sonically tagged farmed salmon released in winter and spring
Year removed from inventory/completed	2006

Summary of Findings

Publication:

Whoriskey, FG; P. Brooking, G. Doucette, S. Tinker, and J.W. Carr. 2006. Movements and survival of sonically tagged farmed Atlantic salmon released in Cobscook Bay, Maine, USA. ICES Journal of Marine Science 63: 1218-1223.

Abstract. We sonically tagged and released farmed Atlantic salmon (Salmo salar) from a cage site in Cobscook Bay, Maine, USA. The fish were released in January (n=75) and in April and May (n=198) 2004 to study their movement patterns and survival and to assess the possibility of recapturing them. Inshore and offshore waters in this region are subject to intense tidal currents. Tagged salmon dispersed >1km from the cage site within a few hours of their release. Mortality was high within Cobscook Bay and the surrounding coastal region (56% of the winter (January) releases; 84% of the spring (March) releases), probably the result of seal predation. Most surviving fish exited the coastal zone and entered the Bay of Fundy along the routes of the dominant tidal currents, passing through Canadian waters. No tagged fish were detected during the wild salmon spawning season in autumn 2004 in any of the 43 monitored salmon rivers draining into the Bay of Fundy, or during 2005 either in the Magaguadavic River, the site of the hatchery in which the fish were reared to the smolt stage, or by a limited coastal receiver array.

Party	Canada
Title	**Atlantic salmon distribution and abundance at sea**
Coordinating Scientist	David Reddin ReddinD@dfo-mpo.gc.ca
Summary of objectives	(1) Determine the distribution and abundance of salmon, particularly post-smolts, in the Labrador Sea and northern Grand Banks; (2) collect biological, meristic, morphometric, and biochemical data on salmon; (3) investigate the relationship between salmon and prey by collecting stomach contents; (4) investigate the relationship between sea temperature and other oceanographic parameters and salmon abundance; (5) tag and release salmon in good condition.
Year removed from inventory/completed	2006

Summary of Findings

Trip program was reduced due to the need to survey for scallops in St. Pierre-Miquelon area and due to Search and Rescue missions. The Norwegian surface trawl was successfully fished from the Templeman. In total, there were 9 trawl sets with only one salmon post-smolt capture. Comparative fishing with gillnets resulted in the capture of 60 post-smolts. Other species caught in the trawl included billfish, Atlantic mackerel, lantern fish, jelly fish, squid, and amphipods. Two drift net sets were completed in the Labrador sea. Forty-seven post smolt salmon and 11 adult salmon were caught with an average length of each set being approx. 16 hrs. Disease survey on 35 specimens indicated no pathogens present.

Party	Canada
Title	**Integrated field and laboratory assessment of the effects of endocrine-disrupting substances on Atlantic salmon smolts**
Coordinating Scientist	Wayne Fairchild Fairchildw@dfo-mpo.gc.ca
Summary of Objectives	This project was based on research conducted over three years under ESSRF/TSRI (DFO projects 95052 and 92548) funding which evaluated the effects of nonylphenol and other endocrine-disrupting substances on growth and survival of Atlantic salmon (Salmo salar) during and after smoltification. Concentrations of these compounds occurring presently in the environment have been shown to have endocrine-disruptive effects on fish in rivers and estuaries downstream of municipal sewage treatment works. The current research indicates estrogenic effects on fish at low 4-nonylphenol levels (µg/l-1 range) raises the potential that pesticide formulations containing nonylphenol ethoxylates and leaving residues in water may be capable of affecting fish due to the presence of nonylphenol ethoxylate degradation products (including 4-NP), and not necessarily due to the presence of the pesticide's active ingredient. Smoltification is a time of great stress for salmon, as they are changing physiologically and adapting to a new environment. Endocrine hormones play an integral part in the smoltification process. Additional stress or modification of endocrine function at this crucial life stage may pose problems for growth and survival of smolts as they enter salt water. This project moved the research out of the laboratory and considered population level effects on smolt survival to the adult stage in nature with survival of cohorts exposed to these compounds compared to those of controls.
Year removed from inventory/completed	2008

Summary of Findings

In 2004, smolts were exposed to pesticides (herbicides and nonylphenol) while in fresh water, and subsequent growth and survival was measured in the aquarium at the St. Andrews Biological Station, St. Andrews, NB. In 2003 and 2004, smolts were exposed to nonylphenol and estrogen at the Marine Institute, on the Burrishoole River, County Mayo, Ireland, and were then released to the North Atlantic. Adults were monitored in the returns to the river and in the interceptions in the coastal fisheries. Results from both treatment years (2003 and 2004) indicate variable survival among years and a decrease in sea survival of a cohort exposed to nonylphenol relative to controls. Field operations are complete, data are still being verified and analysed.

Publications:

Jardine, T.D., MacLatchy, D.L., Fairchild, W.L., Chaput, G. and Brown, S.B. 2005. Development of a short-term in-situ caging methodology to assess long-term effects of industrial and municipal discharges on salmon smolts. Ecotoxicology and Environmental Safety, 62:331-340.

Jardine, T.D., MacLatchy, D.L., Fairchild, W.L., Cunjak, R.A. and Brown, S.B. 2004. Rapid carbon turnover during growth of Atlantic salmon (*Salmo salar*) smolts in sea water, and evidence for reduced food consumption by growth-stunts. Hydrobiologia 527:63-75.

Arsenault, J.T., Fairchild W.L., Maclatchy, D.L., Burridge, L., Haya, K. and Brown, S.B. 2004. Effects of water-borne 4-nonylphenol and 17ß-estradiol exposures during parr-smolt transformation on growth and plasma IGF-I of Atlantic salmon (*Salmo salar* L.). Aquatic Toxicology 66:255-265.

Party	Canada
Title	**Use of stable isotopes to assess long-term changes in marine trophic ecology of Atlantic salmon (*Salmo salar*)**
Coordinating Scientist	J. Brian Dempson dempsonb@dfo-mpo.gc.ca
Summary of Objectives	Examine long-term variability in the trophic ecology of Atlantic salmon using analyses of stable isotope signatures of carbon and nitrogen ($\delta^{13}C$; $\delta^{15}N$) derived from archived scale samples. Changes in stable isotope signatures will be evaluated for evidence of Pauly's food web hypothesis and also in relation to variation in marine climate conditions in the north Atlantic over the past several decades. These analyses would contribute to further understanding of observed variability in abundance and survival of various stocks of Atlantic salmon.
Year removed from inventory/completed	2008

Summary of Findings

Publication:

Niloshini Sinnatamby. R., J. B. Dempson, G. Chaput, F. Caron, E. Niemelä, J. Erkinaro, and M. Power. 2009. Spatial and Temporal Variability in the Trophic Ecology of Atlantic Salmon in the North Atlantic Inferred from Analyses of Stable Isotope Signatures. American Fisheries Society Symposium 69:447–463.

In many areas of the North Atlantic, populations of Atlantic salmon Salmo salar are now either in a state of decline or extirpated such that concern over the continued survival of the species has been given more attention in recent years despite large reductions in directed ocean fisheries. Previous investigations have established linkages between ocean climate conditions and variability in abundance or survival. However, one avenue not previously explored considers whether changes in marine food webs owing to ever increasing and unsustainable levels of exploitation on many marine species—the so-called "fishing down marine food webs" hypothesis—could influence survival and abundance of salmon as a result of shifts in trophic position or changes in energy flows. Since Atlantic salmon are opportunistic feeders during the marine life history phase, the species lends itself well to studies associated with marine environmental conditions and food web interactions. Here, we examine long-term variability in the trophic ecology of Atlantic salmon using analyses of stable isotope signatures of carbon and nitrogen (d13C and d15N). Signatures were extracted from the marine growth portion of scales of maiden one-sea-winter fish. Data were obtained from nine Canadian and one north European river (Teno) covering periods extending over three to four decades. Significant differences in d13C and d15N signatures were found to exist among rivers, as well as among years within rivers. Trends over time in either d13C or d15N signatures were evident in only a few situations, thus providing little evidence of substantive changes in the trophic ecology of salmon in the North Atlantic. In addition, isotopic signatures were largely invariant in relation to variations in abundance or to various environmental measures characterizing ocean climate conditions in the North Atlantic.

Party	Canada
Title	**Effective population size, gene flow and population structure of Atlantic salmon in Newfoundland and Labrador**
Coordinating Scientist	Daniel E Ruzzante Daniel.ruzzante@dal.ca
Summary of Objectives	Objective was to estimate effective population sizes and connectivity (gene flow) among Atlantic salmon populations from Newfoundland and Labrador. Examined genetic variability in a suite of 14 microsatellite DNA loci among ca 3000 individuals from some 20 populations from around Newfoundland and from southern Labrador collected over the period of the last 5 decades starting in the 1950s to the present. The availability of extensive temporal samples allows for tests of changes in effective population size related to the declines and subsequent closure of commercial fisheries. Analyses provide information on the relationship between effective population size and gene flow. Also examining the genetic basis for phenotypic and life history differences by means of common garden experiments with salmon from two populations in Newfoundland.
Year removed from inventory/completed	2008
Summary of Findings No summary provided.	

Party	Canada
Title	**River and extended estuary acoustic tracking of Atlantic salmon (*Salmo salar*) kelts and bright salmon**
Coordinating Scientist	Peter G. Amiro AmiroP@mar.dfo-mpo.gc.ca A Jamie F. Gibson GibsonAJF@mar.dfo-mpo.gc.ca
Summary of Objectives	1) To track and document migratory behaviour of Atlantic salmon kelts as they leave the river for the open ocean and bright salmon at they return to rivers; 2) To identify possible critical habitat sites utilized by kelts and bright salmon during their migration; 3) To examine the mortality rates of kelts and bright salmon during migration.
Year removed from inventory/completed	2009

Summary of Findings

Hubley, P.B., P.G. Amiro, A.J.F. Gibson, G.L. Lacroix, and A.M. Redden. 2008. Survival and behaviour of migrating Atlantic salmon (Salmo salar L.) kelts in river, estuarine, and coastal habitat. ICES Journal of Marine Science 65; 1626-1634.

Abstract:
The downstream migration of 30 Atlantic salmon (Salmo salar) kelts tagged with acoustic transmitters was monitored using 26 underwater receivers at eight locations from April to October 2006 in the LaHave River and Estuary. In all, 27 tags were detected as they left the coastal environment by the middle of May, 5 weeks after release, indicating a possible 90% kelt survival to coastal departure. Two missing tags and one dropped tag were assumed to be attributable to natural mortality in the estuary. Migration time from release to the outermost coastal receivers 24 km below the tide limit took an average of 14 d, but varied from 3 to 32 d. Some 40% of the kelts lingered and were active in the lower estuary. Five kelts monitored with depth transmitters migrated mostly at the surface in all habitats, with occasional brief descent to the bottom. A consecutive spawning salmon returned after 79 d outside the outermost array. The low rate of returns is consistent with the historical repeat spawning schedule for this river, and more precisely documents the temporal and spatial habitat use of migrating kelts.

Party	Canada
Title	**Integrated modelling of juvenile Atlantic salmon movement and physical habitat in fluvial and estuarine environments**
Coordinating Scientist	Julian Dodson julian.dodson@bio.ulaval.ca
Summary of Objectives	Objectives: 1) to develop an innovative geomatic approach capable of relating the behaviour of smolts during their migration to the characteristics of the physical habitat in rivers and estuaries, 2) to apply this approach to the analysis of the migration of smolts through the estuaries of the St. Jean, Dartmouth and York rivers and down the Baie de Gaspé.
Year removed from inventory/completed	2009

Summary of Findings

Publication: Hedger, R. D; F. Martin, D. Hatin, F. Caron, F. G. Whoriskey, and J. J. Dodson. 2008. Active migration of wild Atlantic salmon Salmo salar smolt through a coastal embayment. Marine Ecology Progress Series Vol. 355: 235-246.

Abstract: Migration patterns of wild Atlantic salmon Salmo salar smolt were examined in a coastal embayment in the Gaspe peninsula of Quebec, Canada. Twenty-four smolt in 2005 and 30 in 2006 were tagged with coded ultrasonic transmitters, and their migration throughout the bay was monitored using an array of fixed VR2 hydrophone receivers. Migration patterns were complex, with some smolt taking a direct route through the coastal embayment and others repeatedly changing direction over short spatial and temporal scales. Migration was mainly an active process with an overall outward (seaward) migration in the face of an inward residual circulation. Swimming direction was mainly outward during nocturnal inflowing currents but was more dispersed during daytime and nocturnal outflowing currents; swimming speed was greater during daytime than during nighttime. This pattern was consistent with smolt migrating offshore nocturnally and using daytime for prey detection and predator avoidance. Salinity had a strong effect: exposure to more saline waters caused increased swimming speeds. These observations are consistent with the hypothesis that smolt exploit an innate compass to maintain a preferred bearing and that the speed and direction of swimming is controlled by salinity and the diurnal cycle.

Party	Canada
Title	**Estuary acoustic tracking of Atlantic salmon (*Salmo salar*) smolts and kelts – Conne River, Little River, and Bay d'Espoir, Newfoundland**
Coordinating Scientist	J. Brian Dempson brian.dempson@dfo-mpo.gc.ca Keith Clarke keith.clarkek@dfo-mpo.gc.ca
Summary of Objectives	1) To tag and track migratory behaviour of Atlantic salmon smolts and kelts as they leave the Conne River, Newfoundland; 2) To determine the movements and migration patterns throughout the Bay d'Espoir fjord; 3) To provide insight into the initial survival and residency of smolts and kelts migrating through the fjord.
Year removed from inventory/completed	2009

Summary of Findings

For the past three years (2006 – 2008) Atlantic salmon smolts and kelts have been tagged with acoustic transmitters and released during April and May from Conne River, with smolts only being released at Little River in 2007 and 2008. The objectives were to determine movements and migration patterns throughout the Bay d'Espoir fiord, and obtain insight into the initial survival and residency time of both life history stages and compare patterns across years. This past year (2008), an additional 30 smolts and 8 kelt were tagged at Conne River with 20 smolts released from Little River. A total of 28 Vemco VR2 receivers were again positioned at various locations throughout Bay d'Espoir. This year several receivers were located in more distant areas outside of the Bay d'Espoir fiord. Extended areas included Dragon Bay (west of McCallum), Round Harbour (south coast of Long Island) and several positioned along the Connaigre Peninsula past Hermitage that could potentially extend tracking coverage upwards of 65 km from the point of release.

With respect to 2008 results, all Conne River kelt that were tagged and released were subsequently accounted for. Three (3) kelt returned to Conne River after an absence of 57 to 73 days. Several kelt were tracked migrating into the North Bay arm of the Bay d'Espoir fiord. Analysis of data compiled over the past three years indicates that while there some differences in the annual migration route, the differences were not statistically significant. Thus, most kelt (77.4%) migrate out of Bay d'Espoir via Lampidoes Passage.

Regarding Conne River smolts, in 2008 half of the fish tagged and released provided no recovery data. At least one smolt was tracked out to Dragon Bay and several migrate up into the North Bay arm. Similar to the kelt, there were no significant differences in the migration route out of Bay d'Espoir over the past three years with most smolts (54.3%) leaving by way of Lampoides Passage. There was no significant difference in the size of smolt that were successfully tracked versus those for which no data were obtained and thus likely represent mortalities. However, the migration route of Conne River smolt differed significantly from that of out migrating kelt.

Little River smolts differed from the Conne River smolt in that most (78.8%) migrate out through the main channel of the Bay d'Espoir fiord. At least six smolt were tracked out to Dragon Bay and four down along the Connaigre Peninsula (Halfway Point/Western Cove). As observed with Conne River smolt, Little River smolt were also tracked up into the North Bay arm of the fiord. Last year (2007) it was observed that Little River smolt took noticeably longer to migrate to the outer areas of the Bay d'Espoir fiord by comparison with Conne River smolts. In 2008, Conne River smolt were found to have taken about a week longer to reach the outer fiord than the previous year, while Little River smolt timing was similar to 2007.

Collectively, results suggest that the outer areas of the Bay d'Espoir fiord that includes the North Bay arm are important staging areas for smolts and kelts prior to fish undertaking any open sea migrations.

Party	Canada
Title	**Spatio-temporal distribution of Atlantic salmon stocks and the impact of the West Greenland fishery.**
Coordinating Scientist	Louis Bernatchez (Supervisor; Université Laval); Tim King (Co-supervisor; US Geological Survey) louis.bernatchez@bio.ulaval.ca
Summary of Objectives	Provide knowledge about the river origin of the salmon catch in the commercial fishery at West Greenland.
Year removed from inventory/completed	2009

Summary of Findings

Samples were collected from the West Greenland fishery in August and September, 2006 and 2007 and were compared to historical samples. Analyses for genetic characterization were completed. Results show that the Southern Québec, Labrador and New-Brunswick regions contributed significantly more than the other regions of North America to the West Greenland Fishery. Regional contribution to the fishery was correlated with the regional MSW production.

Publication:
Gauthier-Ouellet M, Dionne M, Caron F, King TL, Bernatchez L. 2009. Spatio-temporal dynamics of the Atlantic salmon Greenland fishery inferred from mixed-stock analysis. Canadian Journal of Fisheries and Aquatic Sciences, 66 : 2040-2051.
The manuscript is available at:
http://pubs.nrc-cnrc.gc.ca/rp-ps/inDetail.jsp?jcode=cjfas&lang=eng&vol=66&is=12

Party	Canada
Title	**Genetic population structure of Atlantic salmon in Eastern Canada and its implication for conservation.**
Coordinating Scientist	Louis Bernatchez louis.bernatchez@bio.ulaval.ca Mélanie Dionne melanie.dionne@giroq.ulaval.ca
Summary of Objectives	This project aims at elucidating the genetic population structure of Atlantic salmon from a small (river) to a large (Eastern Atlantic coast) spatial scale and at helping in proposing conservation units for the Canadian distribution range. Samples from 51 rivers in Quebec, New-Brunswick and Labrador have been obtained and their characteristics evaluated at 13 microsatellite loci. Further work is ongoing on the variability in major histo-compatability complexe genes and its association with exposure to pathogens. The project began in 2004 and was completed in 2008 as part of the PhD project of Mélanie Dionne (Université Laval, Québec).
Year removed from inventory/completed	2009

This project aims at elucidating the genetic population structure of Atlantic salmon from a small (river) to a large spatial scale (Eastern Atlantic coast) and proposing conservation units for the Canadian distribution range. Results show that most rivers are genetically differentiated from one another (mean $F_{st} = 0.05$, $p < 0.001$), suggest that in general each river in Eastern Canada represents a distinct population. However, genetic differentiation is also found within certain river systems such as the Moisie, Romaine and Restigouche, suggesting that populations can be identified at the tributary level. At a large spatial scale, seven genetic regions are identified in Eastern Canada. Genetic differentiation is found to be associated with temperature regime conditions, suggesting local adaptation in Atlantic salmon. Results have been published.

Publications :

Dionne, M.; Miller, K. M; Dodson, J. J; Caron, F.; Bernatchez, L.; Sunnucks, P. 2007. Clinal variation in mhc diversity with temperature: evidence for the role of host-pathogen interaction on local adaptation in Atlantic salmon. Evolution Vol. 61(9) : 2154-2164.

Dionne. M., F. Caron, J. J. Dodson, and L. Bernatchez. 2008. Landscape genetics and hierarchical genetic structure in Atlantic salmon: the interaction of gene flow and local adaptation. Molecular Ecology 17: 2382–2396.

Dionne. M., F. Caron, J. J. Dodson, and L. Bernatchez. 2009. Comparative survey of within-river genetic structure in Atlantic salmon; relevance for management and conservation. Conserv. Genet. 10: 869–879.

Dionne M, Miller KM, Dodson JJ, Bernatchez L. 2009. MHC standing genetic variation and pathogen resistance in wild Atlantic salmon. *Philosophical Transactions of the Royal Society of London B,* 364: 1555-1565.

EUROPEAN UNION

Party	European Union
Title	**SALMODEL Concerted Action - A co-ordinated approach towards the development of a scientific basis for management of wild Atlantic salmon in the north-east Atlantic**
Coordinating Scientist	Walter Crozier walter.crozier@dardni.gov.uk
Summary of objectives	- Improve our ability to set salmon conservation limits (CLs); addressing transportability and dynamic change issues, also taking into account underlying stock structure, and; - Examine methods of estimating pre-fishery abundance (PFA) for north-east Atlantic (NEAC) salmon stocks and to determine whether and how PFA estimates can be used to give catch advice.
Year removed from inventory/completed	2003

Summary of Findings

- examined current models used to estimate PFA, including that used by ICES
- assessed sensitivity of the ICES model to data types and variation, and tested assumptions of incorporation of natural mortality "m" into PFA models, this resulting in a change to the default value of "m" used at ICES
- SALMODEL also evaluated the basis of the NEAC stock groupings being used in the catch advice process
- evaluated options for developing a predictive PFA model from the historic time series employing environmental and other data, producing for the first time forecasts of PFA of southern European stocks at West Greenland
- investigated predictive PFA models based on smolt production estimates/indices for the NEAC area
- examined approaches for model validation and examined scales at which the various model types can be applied

Further details are presented in NASCO document CNL(03)9.

Party	European Union - Denmark
Title	**Estuarine migration of smolts in the Rivers Skjern Å (North Sea) and River Guden Å**
Coordinating Scientist	Gorm Rasmussen gr@dfu.min.dk
Summary of objectives	
Year removed from inventory/completed	This project was not previously included in the inventory.

Summary of Findings

In Skjern Å estuary we have demonstrated very high smolt mortalities during two research seasons caused by cormorants (28 and 44%). European rivers and their floodplains are generally severely affected by human activity. As a consequence, both the water and the river habitat quality have been seriously degraded in numerous European rivers during the twentieth century. In Denmark less than 5% of the rivers have been left in a natural physical state. During the 1960s the lower part of River Skjern Å was regulated and adjacent bogs, ponds, marshes and meanders drained. In the beginning of the 1990s the Danish government decided to restore the River Skjern Å and its floodplain and in 2002 the River Skjern Nature Project was implemented. The project consisted of several parts, including returning the straight, regulated river back to its former meanders and introducing better hydraulic interaction between the river and its meadows. Before implementation of the restoration project the causes of mortality of wild salmon *Salmo salar* and trout *Salmo trutta* smolts in River Skjern Å and its estuary Ringkøbing Fjord were investigated in 2000. A follow-up comparable study was performed in the spring of 2002 after the majority of the project was implemented, aimed towards assessing the effect of the restoration project on the salmon and trout smolt runs. This study indicated that the river restoration had an indirect slightly negative effect on the smolt run, mediating bird predation within the river system. As also demonstrated in 2000, bird predation in the estuary had a major adverse effect on the smolt run and jointly the smolt mortality in the river and in the estuary may threaten a self-sustaining salmon population in River Skjern Å.

In the River Guden Å and its estuary the migration of salmon smolts was investigated in 2002 and 2003 by acoustic telemetry.

Party	EU – Denmark
Title	**Mortality of Atlantic salmon smolts during estuary migration**
Coordinating Scientist	Anders Koed (River Skjern Å and River Stor Å) ak@difres.dk Kim Aarestrup (River Guden Å) kaa@difres.dk
Summary of Objective	The main objective of the research is to estimate mortality of salmon smolts during migration through estuaries and to compare the return ratio of wild, stocked ½- and one-yearlings.
Year removed from inventory/completed	2009

Summary of Findings

Year 2004. Salmon and sea trout smolts and mature eel were trapped and numbered in River Guden Å and tagged with acoustic transmitters and followed during their migration through the estuary to the Kattegat. The migration speed of salmon exceeded the speed of sea trout smolts. The project continues in 2005 when the salmon and sea trout smolt project in River Skjern Å and the Ringkøbing estuary commences.

Year 2005. The project continued in 2005 and the results are being analysed. A report and paper will be published in year 2008. A peer reviewed publication on the results is planned in 2010.

Year 2005 and 2006. In River Skjern Å salmon and sea trout smolts were caught in a rotary screw trap in the river and acoustic tagged and followed on their downstream migration in the river and through the estuary, i.e. the Ringkøbing Fjord. The total mortality of salmon smolts in river and estuary was 54 % and was caused by predation from pike and birds (mostly cormorants) in the river and cormorants in the fjord; that means that 46 % of the salmon smolts entered the North Sea. Because of the low wild salmon population in River Skjern Å, each year ½- and one-year-old parr are stocked (F1 offspring from wild salmon). In 2005 about 27,300 smolts migrated out from the river, of which about 30 % were wild smolts from spawning in the river and 70 % were from stocking. It is concluded that because of bird predation, mostly from cormorants, the natural wild salmon in River Skjern Å is threatened. The data also showed that relatively the ½- and one-year-old parr give the same number of smolts, but the reason is uncertain; maybe it has something to do with a longer stay in hatchery of the one-year-old parr and therefore less adaptability in the river after release.

The results was analyzed and published in 2006 (Research on the smolt run of Atlantic salmon from River Skjern Å and mortality during migration through Ringkøbing Fjord, DFU-rapport nr. 160-06, in Danish). A peer reviewed publication on the results is planned in 2010.

Year 2007. In River Stor Å salmon and sea trout smolts were caught in a rotary screw trap in the river and acoustic tagged and followed on their downstream migration in the river and through the estuary, i.e. the Nissum Fjord.(to the North Sea) . The salmon smolt production was about 17,800 smolts. The total mortality of salmon smolts in river and estuary was about 64 % and was caused by predation from pike and birds (mostly cormorants) in the river and cormorants in the fjord; that means that about 36 % of the salmon smolts entered the North Sea. The results was published in 2008 (Smolt run from River Stor Å in 2007 and smolt mortalities during migration through Felsted Kog and Nissum Fjord, DFU-rapport nr. 186-08, in Danish).

Party	European Union – France
Title	**Evolution of biological characteristics in Atlantic salmon from all the Armorican massif rivers (Brittany and Low-Normandy, France)**
Coordinating Scientist	Jean-Luc Baglinière Jean-Luc.Bagliniere@rennes.inra.fr
Summary of objectives	Examine relationships between the cumulative effects of climate warming and other anthropogenic stresses and changes in biological features in populations in the southern part of the European distribution range of the species.
Year removed from inventory/completed	2005
Summary of Findings No report provided.	

Party	European Union - Ireland
Title	**Assessment of the levels of the parasite *Lepeophtheirus salmonis* on Atlantic salmon post-smolts in salmon aquaculture bays along Ireland's western seaboard**
Coordinating Scientist	Paddy Gargan paddy.gargan@cfb.ie
Summary of objectives	Determine whether sea lice from marine salmon farms are a contributory factor in increased marine mortality of salmon post-smolts migrating from bays with salmon aquaculture. Gather information on salmon post-smolt migration patterns.
Year removed from inventory/completed	2003

Summary of findings

This work has now been submitted for publication. Eight experimental releases of tagged, hatchery-reared salmon smolts were released in river systems draining into 3 salmon aquaculture bays over a 3-year period. For each experiment, groups of smolts were fed untreated pellets or were treated prophylactically with pellets including an in-feed sea louse treatment (Slice™; emamectin benzoate) prior to their release. Analysis of tag recaptures showed that Slice-treated smolts experienced increased survivorship over un-treated controls in six of the seven releases when farm net-pens were in production. The present experimental results suggest that sea lice larvae released from over-wintering farmed salmon may influence the survivorship and conservation status of wild salmon in these river systems.

Party	European Union - Ireland
Title	**Oceanic factors influencing marine survival of Irish salmon stocks**
Coordinating Scientist	Niall O' Maoileidigh (Ireland) niall.omaoileidigh@marine.ie Kevin Friedland (US) friedlandk@forwild.umass.edu
Summary of objectives	The programme was initiated in 1999 to: Provide information on marine survival at various stages of ocean migration.
Year removed from inventory/completed	2006

Summary of Findings

Evidence was found that the level of marine recruitment of 1SW salmon is linked to growth during the marine residency, and that decreasing growth over the last 30 years explains the observed decrease in salmon recruitment. Furthermore, the work concludes that changes in climate in the northeast Atlantic have affected the salmon via bottom-up effect, by affecting the abundance, distribution and phenology of key zooplankton species in the northern North Sea and southern Norwegian Sea.

Party	European Union - Ireland
Title	**Sustainable management of interactions between aquaculture and wild salmonid fish (EU SUMBAWS project – Irish component of project only)**
Coordinating Scientist	Paddy Gargan paddy.gargan@cfb.ie Niall O'Maoileidigh niall.omaoileidigh@marine.ie
Summary of objectives	To assess the efficacy of prophylactic treatments for salmon smolts migrating through aquaculture bays
Year removed from inventory/completed	2007
Summary of Findings Preliminary results – prophylactic-treated fish had statistically higher returns compared to non-treated controls.	

Party	European Union - Ireland
Title	**Early distribution and migration of Atlantic salmon smolts off the West of Ireland**
Coordinating Scientist	Niall O'Maoileidigh niall.omaoileidigh@marine.ie
Summary of objectives	Test a new pelagic trawl in open waters off the Irish coast; train and familiarise technical and support staff on the operational development of the trawl for further surveys in 2008 and 2009; obtain samples of post-smolts for biological and genetic analyses; relate run timing, timing of migration, swimming speed, growth, etc to oceanographic parameters.
Year removed from inventory/completed	2008

Summary of findings

A summary of the cruise and the catches of post-smolts was provided to NASCO in document CNL(07)35. Specific results from the genetic stock identification work will be available in April 2008.

Party	European Union – Ireland
Title	**Migration of salmon in estuarine and coastal waters**
Coordinating Scientist	Russell Poole russell.poole@marine.ie Deirdre Cotter deirdre.cotter@marine.ie Niall O'Maoileidigh niall.omaoileidigh@marine.ie
Summary of objectives	Investigate the timing, route of migration and aspects of the biology of migrating ranched salmon smolts in comparison to the native wild smolt migration.
Year removed from inventory/completed	2009

Summary of Progress

It was hoped to repeat and expand this experiment in 2008 but this was not possible. Therefore there is no new summary since the 2006 report.

Party	European Union - Ireland
Title	**National Development Plan - National Genetic Stock Identification Project**
Objectives of research project	To identify and map discrete spawning areas within tributaries of the salmon-bearing rivers in Ireland (approximately 149) and to collect juvenile Atlantic salmon from these rivers at locations close to the principal spawning areas for establishment of genetic baseline for mixed sample analysis. To undertake the molecular genetic analysis (genotyping) of juvenile salmon tissue samples and adult salmon scales using a pre-determined panel of microsatellite markers. To use the genotype data obtained above, using appropriate statistical packages to identify and characterise river populations as a basis for determining the relative contributions of different baseline river populations within mixed samples.
Coordinating scientists	Tom Cross t.cross@ucc.ie Paddy Gargan paddy.gargan@cfb.ie Philip McGinnity, Chairman of Scientific Steering Committee) p.mcginnity@ucc.ie
Year removed from inventory/completed	2009

Summary of Progress

The report of this project The National (Ireland) Atlantic Salmon Genetic Stock Identification Project (ST-05-002 Final report is now available. This report was produced by University College Cork, Central Fisheries Board and the Marine Institute.

Preliminary results for both “offshore” and “inshore” confirmed the results using other tagging methods over the years and showed the highly mixed stock nature of the marine fisheries whether some distance offshore or even within estuaries and bays. These fisheries, despite being restricted to specific geographic districts and fishing season (June and July), will comprise of salmon destined not just for that particular district but also comprise salmon from neighbouring and even distant districts, sometimes in high proportions relative to the proportion of “own district” salmon. Also, the fisheries are indiscriminate in that they will not exclusively target only those stocks which are above Conservation Limits.

In general, the original objectives of the programme were achieved and several important spin-offs in relation to the development of markers and other techniques (Single Nucleotide Polymorphisms SNPS) are now under investigation.

Party or relevant jurisdiction	European Union - Ireland
Title of project	**Interactions between aquaculture and wild salmonid fish**
Objectives of research project	To assess efficacy of prophylactic treatments for salmon smolts migrating through aquaculture bays
Coordinating scientist in charge of project	D. Jackson dave.jackson@marine.ie
Year Removed from inventory/completed	2010

Summary of Progress

Two treated and control fish groups of salmon, differentially micro-tagged (5,000 fish in each group), released from several freshwater river systems' fisheries, between 2002 to 2006 (Burrishoole, Shannon, Lee, Delphi, Screebe). Survivors in experimental groups being recaptured in commercial fisheries and freshwater traps.

Project commenced October 2003 and is now complete with recovery of final release groups in 2008. Preliminary results indicate that in nearly all instances the treated groups showed a higher survivorship than the untreated controls but these were not always significant differences. There it would appear that there was variable levels of resistance between treated and untreated fish. Final analyses are being carried on brood stock returns collected from October 2007 to January 2008. These results are in preparation for scientific publication. Further releases may be made from the Burrishoole research facility on Newport, Ireland.

Party	European Union – United Kingdom (England and Wales)
Title	**Salmonid migration and climate change**
Coordinating Scientist	Andy Moore a.moore@cefas.co.uk
Summary of objectives	Describe and model the environmental factors affecting the migration of salmonids and investigate the effects of climate change on salmonid migration and survival both in fresh water and the sea
Year removed from inventory/completed	2005

Summary of Findings

The key objectives of the research were to describe and model the environmental factors affecting the migration of salmonids and to investigate the effects of climate change on salmonid migration and survival both in fresh water and the sea.

The main findings of the research are as follows:

Migratory behaviour of salmonid smolts and post-smolts

- The migratory behaviour of the sea trout smolts in the River Fowey was similar to populations of both salmon and sea trout in other river systems in England and Wales.
- Smolt emigration in the freshwater section of the river was correlated with increasing water temperature and increasing river flows although no particular threshold was evident for either environmental parameter.
- There was a seasonal difference in the time that tagged smolts spent in the freshwater section of the river before entering the estuary. Fish released later in the season spent less time in the river before emigrating into coastal waters. As a result a significant proportion of the sea trout smolts migrated out of the estuary and into coastal waters during a 10-day period that coincided with a spring tide.
- Migration through the estuary was principally on a spring ebb tide and in the region of the water column with the highest flows. This is energetically the most advantageous strategy for migration and resulted in the fish being moved rapidly out into coastal waters.
- The smolts were pre-adapted in fresh water to the marine environment and as a result there was no requirement to spend long periods acclimating within the estuary during one of the most critical periods in the life-cycle of the sea trout.
- A physiological requirement for smolts to leave fresh water and to enter the marine environment is likely to be the major stimulus initiating the emigration of sea trout smolts in spring.
- In coastal waters salmon and sea trout post-smolts demonstrated active, directed swimming. Migratory behaviour was initiated when the direction of the prevailing tidal currents was suitable to assist the fish in rapid movement away from the estuary mouth and in the case of the salmon in the general direction of the principal feeding grounds in the Norwegian Sea.
- The speed of migrating salmon over the ground was within the range 18-23 cm sec^{-1}, which is similar to the migratory speeds recorded in studies on other salmon populations in UK river systems.
- The physiological transformation of the emigrating fish to full smolt status was necessary for successful migration within the marine environment. Therefore any factors that operate within the freshwater environment to inhibit smoltification (e.g. contaminants or high water temperatures) or delay migration (e.g. estuarine barrages, amenity constructions) will reduce the survival of the post-smolts in the marine environment.

Migratory behaviour of sea trout kelts

- The post-spawning survival of the sea trout was relatively high and over 60% of the tagged kelts emigrated from fresh water and into the coastal zone.

- Seaward migration within fresh water was predominantly nocturnal and generally occurred in conjunction with increasing river discharge and rising water temperature. Post-spawning residency within the freshwater zone was highly variable between individuals, ranging from 4 days to over 2 months.
- Measurements of gill ATPase activity in fish sampled soon after spawning indicated that the fish were not yet physiologically adapted to migrate into saline conditions. However, the subsequent movement through the estuary and into coastal waters was rapid and the fish showed no evidence of a requirement to adapt to the increasing salinities. Physiological adaptation after spawning would therefore appear to be rapid prior to the onset of emigration.
- Migration through the estuary was predominantly nocturnal and occurred during an ebbing tide. This ebb tide form of transport is energetically the most favourable method of movement and migration at night would reduce the level of mortality from visual predators.
- Tagged trout were recorded returning to the river after a period at sea and, in the case of one individual, successfully spawned whilst still retaining the tag in the body cavity.
- The high return rates of tagged sea trout suggests that similar techniques using electronic data storage tags would permit longer-term studies such as the thermal habitat requirements of the sea trout in the marine environment.

Distribution of salmon in the sea

- Attachment methods have been developed to allow data storage tags (DSTs) to be used as part of large-scale studies to determine the distribution of salmon in relation to marine environmental conditions. Existing DSTs can be placed within the body cavities of adult salmon for long-term monitoring of marine environmental conditions although the exteriorisation of the light sensor to permit the geographical position of the fish to be calculated would be necessary.
- A non-invasive technique for monitoring cortisol levels in tagged fish was developed in order to quantify the effect of electronic tag attachment to fish and their subsequent recovery. The technique measures the level of cortisol excreted into the water by individual tagged fish and allows the recovery rate of the fish to be assessed. The technique will be used to quantify the effects of tags on salmon prior to the long-term studies on the distribution and behaviour of salmon in the sea.
- Collaborative links have been developed with international organisations through the NASCO Working Group on International Cooperative Research held in Norway to study the factors regulating populations of salmon in the sea.
- CEFAS contributed to ***SALSEA – A marine research strategy to determine key factors affecting salmon survival at sea*** presented to the EU in 2004 for funding.
- Other opportunities have continued to be investigated for applying DSTs to salmon in the sea and a variety of approaches have been pursued through this project and related work programmes. These have included membership of the Lotek Wireless - Ocean Technology Fund Committee (funded by Lotek Wireless) and participation in the Census of Marine Life - Pacific Ocean Salmon Tracking Program.
- However, the cost of research programmes has been the main factor in preventing large-scale studies on salmon in the sea.

The impact of climate change on salmonids

- A literature review was completed using the available models and scenarios of climate change and organised into a framework with which to predict the impact on the freshwater and marine environments and subsequent effects on populations of salmon and sea trout over the next 20 and 50 years.
- The climatic information on which the study was based was taken principally from the UK Climatic Impacts Programme (UKCIP) Technical Report 1 and from the NOAA-CIRES Climatic Diagnostics Center and the work on the North Atlantic Oscillation (NAO) by CEFAS, Lowestoft.
- In fresh water, the expected increases in winter temperature and precipitation will be greatest in

NW England and in Wales; the highest increase in summer temperatures will occur in SE England where there will be a corresponding reduction in summer and annual rainfall. Warming of rivers should be less than the 1-2°C anticipated for annual mean air temperatures. However, the warming of rivers in winter will probably be more significant for salmonids than increases at other seasons. The frequency of extreme events such as droughts and floods will increase. Increasing abstraction and reduced precipitation will increase the contaminant loading in many rivers and exacerbate their impact on salmonid populations.

- The warming of rivers by 1-2°C will accelerate embryonic and alevin development during the winter, and lead to earlier emergence of fry from the gravels.
- The consequential effects on survival and growth of later stages will depend on a synchronous phenological advancement of food organisms, plant growth and other requirements.
- Survival of eggs and alevins in upland rivers could be reduced should expected higher winter rainfall generate more frequent river spates resulting in wash-out of the embryos.
- Growth rates of salmonid parr will increase significantly as the result of a temperature rise of 1-2°C providing that there is a commensurate increase in their food resources.
- Faster growth could lower the mean age at which parr reach the smolt stage by about 1 year, increasing smolt production for a particular year-class. However, density-dependent regulation would regulate overall smolt production.
- Reduced river flows and lower water temperatures would inhibit or delay the emigration of smolts and their entry into coastal waters. Modification to the timing of the entry of smolts into the marine environment has been shown to affect survival and the return of spawning adults.
- Reduced flows will inhibit and delay the movement of adult spawning salmon into the freshwater environment. Increased temperatures will reduce the amount of suitable thermal habitat for returning salmon. Reproductive success and fecundity may be reduced at higher water temperatures.
- Increases in river flow will facilitate upstream spawning migration and assist the movement around obstacles such as weirs and barrages.
- There are major uncertainties regarding the impact of changes in climate within the marine environment. The various models and predictions indicate either small gradual rises in sea surface temperature, no significant changes, or even slight cooling in those regions occupied by salmon.
- Changes to sea surface temperature and oceanographic features such as currents may modify the distribution and abundance of key prey items of the post-smolts and adult salmon. A mis-match in prey availability during entry into the marine environment may reduce post-smolt survival and growth.
- Changes in sea surface temperatures (SST) will reduce the amount of suitable thermal habitat required for the suitable growth and development of salmon in the sea.
- Changes in oceanographic features such as shelf edge currents may compromise the bio-energetic requirements of the migrating fish and lower survival.

Party	European Union – United Kingdom (England and Wales)
Title	**Impacts of agricultural contaminants on wild salmonids**
Coordinating Scientist	Andy Moore a.moore@cefas.co.uk
Summary of objectives	Identify and describe the effects of environmental levels of agricultural pesticides on salmonid embryo survival, smolt emigration and marine survival and to model their potential impacts at the population level. In addition, the role of pheromones in sea trout biology was investigated in order to predict the effects of water quality on sea trout reproduction.
Year removed from inventory/completed	2005

Summary of Findings

The key objectives of the research were to identify and describe the effects of environmental levels of agricultural pesticides on salmonid embryo survival, smolt emigration and marine survival and to model their potential impacts at the population level. In addition, the role of pheromones in sea trout biology was investigated in order to predict the effects of water quality on sea trout reproduction.

The main findings of the research are as follows:

- Exposure of juvenile salmon during the parr-smolt transformation to environmentally relevant levels of the herbicide atrazine inhibited smoltification and reduced the ability of the fish to adapt to salt water conditions. Smolts exposed in fresh water to atrazine demonstrated low survival when transferred to seawater.

- Exposure of juvenile salmon during the parr-smolt transformation to environmentally relevant levels of the herbicide atrazine inhibited or delayed downstream migratory behaviour during the spring.

- Exposure of juvenile salmon during the parr-smolt transformation to mixtures of environmentally relevant levels of the herbicide atrazine and the endocrine-disrupting chemical 4-nonylphenol inhibited smoltification and reduced the ability of the fish to adapt to salt water conditions. Mixtures of the two contaminants operated synergistically to reduce survival when the fish were transferred to seawater.

- Exposure of juvenile salmon during the parr-smolt transformation to mixtures of environmentally relevant levels of the sheep dip insecticides diazinon and cypermethrin had no significant effect on smoltification or reduced the ability of the fish to adapt to salt water conditions.

- Exposure of juvenile salmon during the parr-smolt transformation to environmentally relevant levels of the brominated flame retardant PBDE inhibited smoltification and reduced the ability of the fish to adapt to salt water conditions. Smolts exposed in fresh water to PBDE demonstrated low survival when transferred to seawater.

- The freshwater environment cannot be considered in isolation from the marine environment. The contaminants that juvenile salmon are exposed to within the freshwater environment can have a direct impact on their subsequent survival within the sea.

- Exposure to environmentally relevant levels of the sheep dip insecticides diazinon and cypermethrin for a brief period during fertilisation inhibits or delays the timing of emergence of fry from the spawning gravel. Exposure to the insecticides also reduces the subsequent survival and development of salmonid fry.

- Exposure of fertilised salmon and sea trout embryos to sediments containing environmentally

relevant levels of the sheep dip insecticides diazinon and cypermethrin reduces survival and inhibits or delays the timing of emergence of fry from the spawning gravel.

- The sea trout has a similar reproductive pheromone system to the Atlantic salmon and is likely to be affected by environmental contaminants in the same way and that has been previously shown for Atlantic salmon. The shared reproductive pheromone system may further explain the occurrence of hybridisation in certain sympatric populations.

- Exposure of mature male trout to mixtures of the pesticides diazinon and cypermethrin inhibited the ability of the fish to detect and respond to the reproductive priming pheromone Prostaglandin $F_{2\alpha}$. As a result there was no significant increase in the levels of milt that are required for successful reproduction.

- The life-cycle model developed in order to predict the potential effects of environmental contaminants on Atlantic salmon at the population level predicted that exposure to contaminants during fertilisation, smoltification and reproduction result in a significant decline in the number of returning adult fish, particularly in exploited stocks.

Party	European Union – United Kingdom (England and Wales)
Title	**Impact of intensive in-river aquaculture on wild salmonids**
Coordinating Scientist	Andrew Moore a.moore@cefas.co.uk
Summary of objectives	The main objective of the research is to describe the nature and extent of the impact of aquatic contaminants derived from intensive freshwater aquaculture (effluents, pesticides, antibiotics and hormones) on reproduction and migration of wild salmonids.
Year removed from inventory/completed	2007

Summary of findings

The study investigated the effects of trout farms (both rainbow trout farms and brown trout) on both reproduction and smoltification in Atlantic salmon. The research involved laboratory-based studies on the impacts of identified contaminants within the fish farm effluents on salmon reproduction, smoltification and the ability of smolts to adapt to sea water. In addition, field-based studies were carried out where both male salmon and salmon smolts were caged upstream and downstream of rainbow and brown trout fish farms to investigate the impact of the effluents on physiology and survival. The majority of the research was undertaken at an intensive rainbow trout farm on the River Test at Romsey and a brown trout farm at Netheravon on the River Avon. Additional studies were undertaken at a mixed rainbow/brown trout farm at Stockbridge on the River Test. The research has indicated that the effluents from fish farms can have significant impacts on Atlantic salmon particularly during sensitive life-history stages such as reproduction and smoltification. In addition, effluents from rainbow trout farms may also have a deleterious effect on the macro-invertebrate populations, which include many of the prey items of juvenile salmonids.

Party	European Union – United Kingdom (England and Wales)
Title	**Modelling the bioenergetics of salmon migration**
Coordinating Scientist	Douglas Booker dobo@ceh.ac.uk
Summary of objectives	The principal objectives of the research are to model the energetic requirements of salmon during their marine migrations and predict the effects of environmental and oceanographic changes on smolt growth and survival.
Year removed from inventory/completed	2007

Summary of findings

The aim of the research was to develop a numerical model for investigating potential changes in the growth and survival of Atlantic salmon during the marine phase arising from changes in smolt condition or oceanic conditions. A numerical model was designed to calculate growth and survival resulting from spatial and temporal patterns of physical oceanographic conditions, specifically ocean currents, sea surface temperature and prey availability. The results of the different modelling scenarios suggest that, during their oceanic phase, salmon may be capable of adapting to future climate change provided that their migration routes are not inherited and guided by cues other than temperature (e.g. celestial or wave patterns). However, the ability to predict the effects of climate change on salmon populations is limited by a lack of knowledge about migration behaviour, which in turn is due to the paucity of observations of salmon movements and growth in the open sea.

Party	European Union – United Kingdom (England and Wales)
Title	**Cardiff Bay Fisheries Monitoring Programme**
Coordinating Scientist	Peter Gough Peter.gough@environment-agency.wales.gov.uk
Summary of objectives	Assess the impact of Cardiff Bay barrage on salmon stocks of the rivers Taff and Ely.
Year removed from inventory/completed	2008
Summary of Findings No summary provided.	

Party	European Union – United Kingdom (England and Wales)
Title	**Atlantic Salmon Arc Project, ASAP**
Coordinating Scientist	Dylan Bright dylan@wrt.org.uk
Summary of objectives	Define exploitation at sea on a regional basis using genetic tools. Create a long-term database for these studies and create an international management tool to inform decision-making.
Year removed from inventory/completed	2009

Summary of Progress

The ASAP project has successfully completed its first phase. A database of salmon population genotypes has been defined for Spain, France the UK and Ireland. The database has been blind tested and shows a very good level of discrimination in assigning salmon from different regions to their correct population of origin and destination. The database has been tested with samples from small inshore net fisheries in the UK and it has been demonstrated that in most cases these fisheries are exploiting multiple populations. The database has been used in collaboration with the Marine Institute to examine the destination and origin salmon represented by an extensive suite samples from Irish Inshore and Offshore fisheries. The findings from this study are in press. Details of each population used in the database and the details of each of the rivers of origin are available online in an interactive, multilingual web based GIS. Data is only partially uploaded to the data base at present.

Party	European Union – United Kingdom (England and Wales)
Title	**Diffuse pollution and freshwater fish populations**
Objective of research project	The main objective of the research is to investigate the role of diffuse aquatic contaminants in regulating populations of freshwater fish with particular reference to salmonid stocks and fisheries.
Coordinating scientist	Andrew Moore a.moore@cefas.co.uk
Year removed from inventory/completed	2010

Summary of Progress

There is now evidence from studies carried out in Europe and North America that contaminants derived principally from intensive agriculture may have significant effects on salmonids at specific periods during the life cycle, often at concentrations frequently found in the environment. In particular, research carried out at the Cefas, Lowestoft Laboratory has indicated that a range of pesticides may compromise Atlantic salmon (*Salmo salar* L.) sense of smell, reproduction, embryo development and the parr-smolt transformation and/or entry into saltwater. This research has highlighted that in terms of the life cycle of the Atlantic salmon, the freshwater and marine environments cannot be considered in isolation and that exposure to poor water quality in freshwater may be a key factor influencing survival of the fish once they migrate into the sea. However, the majority of this research was based on laboratory experiments and there is a requirement to determine whether exposure to environmentally relevant contaminants within river systems in England and Wales are indeed affecting populations in the wild.

Therefore, the present research programme had two principal aims. Firstly, to validate the results from the laboratory based studies carried out under a previous Defra funded research programme SF0228 – *Impacts of agricultural contaminants on wild salmonids*, and determine whether exposure to these contaminants within river systems in England and Wales are affecting populations in the wild. Secondly, recent monitoring of the aquatic environment has highlighted the presence of novel contaminants whose chemical structure and toxic mechanisms are known to target important biological processes in fish and which may significantly compromise and regulate populations. These contaminants include specific pharmaceuticals, antibiotics from intensive agriculture and aquaculture and brominated flame retardants from industry. The present research examined the potential impacts of these contaminants on fish at both the individual and population level in order to support the advice to the Policy Customer on the regulation of contaminants within aquatic ecosystems and the conservation and management of fish populations.

The specific objectives of the research programme were:

1. To determine the impact of novel diffuse contaminants on juvenile salmon with specific reference to development, olfactory imprinting, run-timing and behaviour within the marine environment.
2. To determine the impact of novel diffuse contaminants on adult salmon with specific reference to freshwater entry, homing, and fecundity in female salmonids.
3. Determine the relationship between specific declining salmon stocks, land management changes and occurrence of target contaminants in the aquatic environment.
4. To assess the effects of diffuse contaminants on the biology of salmon within wild populations.
5. To provide recommendations to Policy Division for any required remedial action to reduce the impacts on diffuse contaminants on fish populations.

Laboratory and field based experiments have formed the basis of the research to determine the impact of contaminants on juvenile and adult salmon. The contaminants that were selected for study are known to routinely occur in rivers during the period of the parr-smolt transformation and seaward migration of the smolts and during the spawning season. The concentrations of the contaminants studied also reflect the levels that may occur routinely in the rivers and tributaries and so are therefore

relevant to many salmonid populations. Extensive literature and data based investigations formed the basis for the studies examining the relationship between the decline in salmonid stocks and the occurrence of specific agriculture derived contaminants within river catchments.

The major findings of the research were that contaminants such as the brominated flame retardants, which are known to mimic thyroid hormones, significantly disrupt the parr-smolt transformation process whereby the juvenile salmon undergo a number of physiological and behavioural changes that adapt them to a life in the ocean. Specifically, hexabromocyclododecane reduces the olfactory abilty of the fish to detect odours that are considered important during the imprinting process during which the emigrating fish remember the "smell" of their home river and subsequently use this to home to their natal tributaries as spawning adults. Exposure of salmon smolts to hexabromocyclododecane was also shown to reduce the survival of the fish during the transition from freshwater and into the sea. Exposure of salmon smolts in freshwater to environmental levels of the pesticide atrazine (0.5, 1.0, 2.0 and 5.0 $\mu g\ l^{-1}$) also reduced their ability to detect specific odours during the imprinting period. The results clearly demonstrate that exposure of salmon smolts to environmental levels of a range of diffuse contaminants inhibits olfactory function, which is known to play a pivotal role in the imprinting process and the subsequent homing of adult salmon to their natal river.

Diffuse contaminants were also demonstrated to interfere with female salmonid reproduction and the subsequent survival of the eggs and embryos. Eggs exposed to atrazine during fertilisation had a 66% higher risk of mortality compared to control eggs for every microgram per litre of atrazine in the water. Comet assays also indicated that in those surviving eyed eggs, 30 days after fertilisation, DNA damage was higher in the eggs that had been fertilised in the water containing both 0.5µg/l or 2.0µg/l atrazine. Exposure to polycyclic aromatic hydrocarbons (PAH) produced modifications to the kidney structure of the female fish, as well as lower levels of intestine Na^+K^+ ATPase activity. This may indicate that the female fish are under physiological stress as a result of PAH exposure. There was also a significant difference in the subsequent survival of the eggs after 50 days, which had been fertilised in PAH water compared to the controls. Once again exposure of eggs to contaminants during fertilisation have a poorer survival rate than those fertilised in "clean" water.

It proved difficult to obtain suitable data with which to investigate relationships between pesticide concentrations in the catchments and variations in salmon stocks. However, in the River Avon rod catches of salmon were lower in years when the atrazine levels were high, and similar correlations were shown between the level of another triazine herbicide (simazine) rod catch in this river. Such results may be informative, but must be interpreted with great care.

The incorporation of the laboratory and field-based experimental data into the life cycle model of the salmon demonstrated that low levels of environmental contaminants can have a serious impact on both individuals and populations of salmonids. As more data is gathered, both from laboratory and field-based research programmes the models and the predictions will become more robust.

Party	European Union – United Kingdom (England and Wales)
Title of project	**The influence of the freshwater environment on salmonid populations**
Objective of research project	This is a large research project examining the impact of environmental change on juvenile salmon production and ecology
Coordinating scientist	Andrew Moore a.moore@cefas.co.uk
Year removed from inventory/completed	2010

Summary

In recent years declines in salmon catches and shifts in population structure involving a diminishing of the multi-seawinter fish component have given concern for many salmon populations throughout the NE Atlantic. Although there has been much recent concern regarding the factors influencing and regulating populations of salmon in the sea, it is now accepted that conditions within freshwater also play a pivotal role to a juveniles salmons subsequent survival within the marine environment. However, human pressures on freshwater environments continue to mount and the effects of these are likely to be exacerbated by climate change. There is, therefore, a requirement to understand how the predicted changes in river flow may modify wild populations of juvenile salmonids.

There is increasing evidence that juvenile salmon migrate downstream in the autumn in a wide range of river systems throughout the NE Atlantic. However, the extent and range of movement of these fish and their distribution and habitat requirements during the winter and prior to the spring smolt migration are not known. If such movements are widespread in UK rivers, it could have significant effects on our approaches to stock monitoring and assessment, the evaluation of factors affecting stocks, particularly during the critical transition between freshwater and marine environments and the development of management strategies.

Assessment methodologies such as trapping, anaesthetisation and tagging of wild/ hatchery juvenile salmon could subsequently affect the ability of the fish to adapt and survive in fresh or saline water and there is a need to identify any such effects in order to ensure best possible practice in assessment programmes.

There is also increasing concern regarding the potential impact on ecosystems of increasing levels of artificial light throughout the northern hemisphere. Much of our inland waters are now affected by light pollution, which has the potential to affect salmon at a number of stages throughout their life cycle.

Therefore, the main objectives of the research were to:

Investigate the impact of changes in freshwater river flows expected to result from the predicted climate change scenarios on juvenile salmon production in rivers in England and Wales and determine how these should be managed.
Determine the abundance and distribution of the autumn migrant component of salmonid populations in rivers and estuaries in order to assess their relative contribution to smolt production and determine the effects on current stock assessment and management practices;
Critically assess the techniques routinely used for population assessments in the development of advice to managers on stock assessments, biological reference points and management measures for specific fisheries and propose appropriate improvements.
Review the known information on the impact of diffuse artificial light pollution on freshwater fish populations in order to assess the potential problem and provide recommendations on appropriate research.

Objective 1. Investigate the impact of changes in river flows expected to result from the predicted climate change scenarios on juvenile salmon production in rivers and determine how these should be managed.

The effects of managed severe low summer flow events on habitat use, displacement and survival of wild populations of juvenile salmon, trout and grayling were investigated in a small chalk stream. Significant changes in habitat use and range of movement were identified, many associated with the loss of the stream margins under low flow. However, with no net downstream movement of any species under low flow, displacement was spatially limited. There was an increase in the mortality rate in first year salmon, trout and grayling. This may be related to their small size and increased vulnerability to predation under low flow conditions due to the reduction in depth and loss of the stream margins that are their preferred habitat under normal flow. The findings have implications for the management of chalk streams. In particular, they underline the importance of the stream margins as juvenile salmonid habitat, and suggest that a flow management strategy is required to combat drought conditions.

Conversely, subsequent investigations suggested that low spring flow at the same study site in 2007 had little, or no, impact on the migratory behaviour of wild salmon smolts.

Objective 2. Determine the abundance and distribution of the autumn migrant component of salmon populations in rivers and estuaries in order to assess their relative contribution to smolt production and determine the effects on current stock assessment and management practices.

The autumn juvenile salmon migration on the R. Frome was monitored between 2005-2007, in collaboration with Centre for Ecology and Hydrology (CEH). The results found the size of the autumn migration to be significant. Subsequent investigations have confirmed a contribution by autumn migrating parr to the returning adult stock.

Integrated laboratory and field investigations were carried out to determine whether autumn migrants are physiologically adapted for migration into saline water. The results showed that the juvenile salmon migrating downstream on the R. Frome in autumn, and those fish that were subsequently found in the tidal reaches during the winter, were not sufficiently physiologically adapted to survive entry to seawater. Therefore, this autumn migration of parr represents a habitat shift to the lower freshwater reaches of the river.

If such findings are generic to salmon populations, it would have important implications for fisheries managers, and catchment scale management plans, which should now take account of the tidal reaches as important juvenile salmon habitat. Further, stock-monitoring programmes that do not account for autumn migrations to the lower river, or any inter-annual variation in their abundance, will under-estimate total smolt output, with a consequential under-estimation of marine mortality, and confound the interpretation and comparison of marine mortality and adult return rates.

Objective 3. Critically assess the techniques routinely used for population assessments in the development of advice to managers on stock assessments, biological reference points and management measures for specific fisheries and propose appropriate improvements.

Integrated field and laboratory investigations found that both the migratory behaviour and ability survive in saline water of some salmon smolts is affected following tagging. Previous studies have suggested that natural smolt migration patterns are a predator avoidance tactic and also ensure that the fish enter the marine environment at the optimum time. Therefore, any such disruption may increase the rate of predation on these fish or impact on their fitness to survive at sea.

Differences in adult return rates between wild salmon tagged as smolts and a control population are currently being determined on the River Frome, in collaboration with CEH. At present the number of returns is too small for useful statistical comparison, however this study is ongoing, with more returns expected from the 2007, 2008 and 2009 smolt migrations. Applying the precautionary approach until the results of this large-scale field based investigation are known, we provisionally recommend that fisheries scientists carefully consider the costs/ benefits of the capture, handling and tagging of salmon smolts and ensure that they can account for any potential bias these commonly used marking methodologies may have on their experimental results before commissioning programmes which

involve handling smolts.

Objective 4. Review the known information on the impact of diffuse artificial light pollution on freshwater fish populations in order to assess the potential problem and provide recommendations on appropriate research.

Our extensive literature review revealed large gaps in our knowledge on this subject. Indeed, detailed case studies on the impact to wild freshwater fish were noticeable only by their absence. As a consequence, we strongly recommend that research programmes on this subject be commissioned.

Party	European Union – United Kingdom (England and Wales)
Title of project	**Factors affecting the distribution and behaviour of salmonid populations**
Objective of research project	The main objective of the research is to investigate the habitat requirements of adult salmonids within the estuarine and freshwater environments. However, one key element of the study is to investigate how changes in prey availability within the marine environment may influence recruitment of stocks between years.
Year Removed from inventory/completed	2010
Coordinating scientist	Andrew Moore a.moore@cefas.co.uk

Summary

This programme had three parallel themes addressing the factors that might affect the distribution and behaviour of adult salmon in the sea, estuaries and freshwater.

Although there has been a substantial amount of research on the habitat requirements of juvenile salmonids and the factors controlling the emigration and behaviour of smolts, there has been very little work describing the migration of adult fish within estuaries. In addition, we have very little understanding of the environmental mechanisms controlling the entry, migration and the habitat requirements of adults within estuaries. In many river estuaries returning salmon congregate in holding areas for variable periods waiting for suitable freshwater conditions before continuing their spawning migration. This may make salmon stocks very susceptible to adverse conditions but losses may often go unnoticed. However, there is little information on the physical and water quality characteristics of these areas, their temporal and spatial distribution or the environmental and anthropogenic factors that may affect them. The purpose of the research is to describe the behaviour of adult salmon in estuary systems prior to freshwater entry and of salmon kelts as they return to sea.

One of the potential causes of the decline in salmon stocks may be modification to the freshwater environment that result in changes to the thermal regime, thereby reducing the habitat available to salmon and affecting their survival and reproductive success. Such changes could be due to general climate warming and/or changes in flow regimes due to agricultural and other land-management practices, such as groundwater abstraction. The purpose of the research is to establish whether or not the freshwater thermal environment in rivers in England and Wales impacts on the migratory behaviour, and reproductive success of adult salmonids.

Potential changes in the marine environment such as suitable water temperature and changes in oceanographic circulation patterns may influence the migration routes, growth, run-timing and survival of salmon in the sea and these changes will be influenced further by modifications to the climate. It has also been hypothesised that these changes in marine conditions may regulate salmon populations through modifying the distribution and abundance of key prey items. Therefore, variations in the numbers of returning adults may be directly correlated to previous feeding conditions in the open sea. The purpose of the research is to investigate using this method whether "poor" years in terms of adult recruitment can be related to changes in productivity and the availability and quality of key prey species within the marine environment.

The research was conducted using an integrated approach of field-based telemetry studies and laboratory investigations. Much of the telemetry work was conducted on the River Tyne, north east England. Returning salmon and sea trout were caught in the lower estuary and their subsequent movements monitored using an acoustic telemetry system consisting of individually coded transmitters and an array of submersed receivers. Data was obtained of the patterns of behaviour through the estuary, into freshwater and, for those fish that survived the ordeal of the spawning migration, their emigration back out to sea. Smaller studies were also conducted on other river systems. Data from this aspect of the programme revealed detailed and novel information on many aspects of migratory behaviour, including; swimming depth behaviour of returning salmon and emigrating kelts, impacts of seal predation and previously unreported data on the behaviour of salmon in freshwater holding pools. The findings of this work provide practically useful information that will

aid the protection of adult salmon in estuaries and rivers and open up new areas of research into thermal refuging, predation, energy dynamics, olfactory response and the impacts of estuarine engineering projects (e.g. pile driving and tidal barrages).
The laboratory studies had two objectives. The first, focused on investigating the effect of temperatures within the range experienced by wild salmonids, on gonad investment, egg production and reproductive success in hatchery reared fish. This was achieved by holding adult and juvenile salmonids in climate controlled tank facilities under various thermal conditions at specific stages in their life cycle. The results suggest that water temperatures can influence the level of gonad investment, timing of ovulation and the trade-off between the number and size of eggs produced by migratory salmonids. These findings have implications for population models that do not take account of the variation in egg numbers, reproductive success and subsequent offspring fitness of spawning anadromous salmonids. The second objective was to investigate the relationship between marine prey consumption and recruitment of adult salmon. This was achieved by retrospective measurement of the stable isotopic composition of salmon scales. Scales reflect the isotopic composition of the prey items and therefore changes in the abundance or availability of specific food items may show up as changes in the composition of salmon scales. The results revealed cyclical patterns in the level of carbon isotope that are likely to reflect cyclical variations in the North Atlantic Oscillation (NAO). These patterns explained a large proportion of variation in the numbers of adult salmon returning to regional waters. This implies that there will be greater returns of adult salmon (relative to the number of juveniles entering the ocean) following higher levels of primary production. It also suggests that high winter temperatures leading to smaller phytoplankton blooms, less enriched $\delta^{13}C$ values and therefore less favourable trophic conditions for salmon at sea, may increase mortality perhaps by nutritional stress. Techniques developed within this programme provide a wide range of future research opportunities, including further investigations on the influence of ocean productivity on regulating fish populations

The research has continued to examine salmon scale microchemistry in order to determine the potential role of climate/environmental change in regulating populations within the marine environment.

Party	European Union – United Kingdom (Northern Ireland) and Republic of Ireland (Loughs Agency is a statutory cross-border body).
Title	**Development of conservation limits, pre-fishery abundance and management of the Foyle salmon fishery**
Coordinating Scientist	Dr. Patrick Boylan p.boylan@loughs-agency.org
Summary of objective	To build upon the existing Foyle salmon management system, to develop it into a precautionary catch advice framework that fully takes account of biological data on stock abundance and which fulfils all the main requirements of the Precautionary Approach.
Year removed from inventory/completed	2009
Summary of Progress Conclusions not yet available. To be reported in 2010.	

Party	European Union – United Kingdom (Scotland) in collaboration with Norway and the Atlantic Salmon Trust
Title	**Testing and development of Institute of Marine Research (IMR) Bergen, Norway, salmon trawl gear**
Coordinating Scientist	Julian MacLean (Fishery Research Services) j.c.maclean@marlab.ac.uk Jens Christian Holst (IMR) jens.christian.holst@imr.no Dick Shelton (Atlantic Salmon Trust) freda.shelton@btopenworld.com
Summary of objectives	Test a prototype trawl developed by IMR, Bergen, Norway, which, rather than capturing post-smolts, records, by use of CCTV, their passage as they pass through an open-ended trawl net. A supplementary objective, dependent on the success of the gear trials, was to conduct a post-smolt survey at the shelf edge.
Year removed from inventory/completed	2006

Summary of Findings

The trial of the modified pelagic trawl gear was a success with real-time footage of fish passing through the net being obtained and recorded. In total 178 post-smolts, one wild adult and one farmed adult salmon were observed. In addition, the supplementary aim of undertaking survey trawls on the shelf edge and collecting ancillary hydrographical information was also achieved.

The successful survey along the shelf edge has shown that the trawl gear is a practical tool for investigating post-smolt distribution at sea. This is extremely relevant with respect to the SALSEA proposal. In summary there are three major advantages of the new gear. First, it is much more cost-effective than using normal pelagic trawls with cod ends. The new trawl can be towed for almost unlimited periods and the fish passing through the net can be observed via the camera link, negating the need to shoot and haul the net every hour or so. Thus, a much greater area of sea can be covered, greatly increasing the efficiency of collecting distribution information. Second, the new trawl provides a non-destructive way in which to observe the distribution of post-smolts. This is a major breakthrough given the high sea mortality rates currently impacting upon salmon in the sea. Third, it is now possible to link the distribution of individual, or shoals of, post-smolts, much more closely to the prevailing hydrographical conditions as the precise location of each observation can be recorded. This was not the case previously when normal pelagic trawls were used and the location of capture could only be recorded relative to the entire area of the particular trawl.

While the trial was an undoubted success, there are some areas of development that need to be considered further in order to obtain the maximum benefits from the new trawl system. In particular, the conditions under which the gear was deployed were relatively calm (gale force 3 – 4) and thus the stability of the trawl requires testing under more testing conditions. In addition to a short FRS Internal Report by Julian MacLean, outlining the findings, an article written by Dr Richard Shelton has also been published in the Atlantic Salmon Trust Journal, Winter 2005-06.

Party	European Union – United Kingdom (Scotland)
Title	**Protecting salmonid fisheries from seal damage**
Coordinating Scientist	John Armstrong (Fishery Research Services) j.armstrong@marlab.ac.uk
Summary of objectives	Develop and apply new molecular tools for discriminating among species of fish in the diets of seals from their remains in scats. Test the possibility of using molecular tools to quantify the occurrence of diet components. Identify factors influencing the migration routes of salmon in estuaries and relate to the presence of predators. Recommend strategies for the most effective deployment of methods for protecting salmonid stocks in inshore waters.
Year removed from inventory/completed	2009

Summary of Findings

1. Seal diet.

Occurrence of salmon and sea trout in the diets of seals has usually been estimated by quantifying hard part remains of the fish in seal scats. However, there is concern that this method underestimates consumption due to either seals discarding heads of the fish, which contain the principle diagnostic hard parts, called otoliths, or the otoliths nor surviving digestion. Furthermore, it is not possible to differentiate between salmon and sea trout from the morphologies of their otoliths. The use of DNA remains in scats potentially has some advantages over the conventional techniques because it does not depend on the consumption of and recovery of hard parts. A quantitative PCR (qPCR) assay was therefore developed for detecting and providing a semi-quantitative measure of the occurrence of salmon and sea trout DNA in seal scats. The qPCR assay was shown to be consistent in detecting salmonids in scats, and was found to be more sensitive than conventional analysis of hard-parts. Nevertheless, the results confirmed findings from previous studies indicating that salmon and sea trout are not common prey for seals in Scottish estuaries.

In addition to the molecular work was undertaken in developing a seal- mounted detector that can record each time a seal consumes a sea trout post smolt fitted with as passive integrated transponder (PIT tag). The aim was to try and quantify the consumption of smolts by seals, which has not proved to be possible using other means. Major advances have been made through collaboration with WyreMicro and SMRU to miniaturise the device and test it on captive seals. The Mk III version currently in final stages of testing uses a SMRU mobile phone transmitter to relay information to shore. The expected outcome is the development of a state-of-the-art electronic device that will provide an insight into consumption of sea trout post-smolts by seals that could not be achieved by any other means.

2. Identify factors influencing the in-shore migration routes of salmon.

If the benefits of non-lethal scaring techniques are to be maximised, then they need to be targeted at areas where salmon and sea trout congregate. Acoustic tracking was used to examine the habitat use of salmon and sea trout in coastal areas. Adult salmon tagged in the Cromarty Firth did not follow common migration routes through the firth nor were there areas in which they were shown to congregate. This finding led to the outcome that protection should best be concentrated at river mouths. Similarly, tracking of sea trout in Loch Torridon suggested that best value would be to offer protection to the fish around the river mouths during the period of smolt migration. Sea trout largely remained near their natal river over the first 20-day period after sea entry, during which the population experienced a loss rate of c. 50%. This combination of high loss and localised distribution provides a clear management target time and area.

The tracking programmes also allowed losses of salmon and sea trout to be quantified. Losses of salmon in the Upper Cromarty Firth were roughly ten percent, with half being possibly attributable to

seals and half to net and coble fisheries. No difference in mortality of sea trout was detected between two areas contrasting seal abundance. Neither study provided evidence that seals were the main cause of fish mortality.

3. Recommend strategies for the most effective deployment of methods for protecting salmonid stocks in inshore waters.

The rationale behind this aim was to translate the findings of this project into management advice. Balancing SG's obligations to conserve salmon and seals while maintaining economically sustainable fisheries is a considerable challenge, particularly when both spring-running salmon and common seals on the East Coast are declining.

In the past, seal management has focussed on populations of seals around the coastline, particularly in the estuaries of salmon rivers. However, in view of the decline in numbers of common seals and the need to conserve their stocks, it is becoming increasingly important to control only those seals that are actually causing damage to salmonid stocks. The work undertaken during this project supports a policy of concentrating management efforts at river mouths for the following reasons. First, there is no evidence that all seals present in estuaries consume salmon and sea trout and therefore shooting in estuaries is unlikely to be effective at targeting those seals that are consuming salmonids. Second, there is no evidence of high losses of salmon in estuaries. Third, there is no evidence that there are specific areas in which salmon congregate within estuaries or on the high sea and where they can be protected by localised scaring of seals.

A modelling exercise was undertaken to examine the benefits to the salmon populations of removing seals. This work emphasised that targeting management on small rivers, and on larger rivers during key periods (eg during spring), is likely to have most value. The outcome of such action is a capacity for increasing the efficiency of protection of fish stocks. The aim was further supported through diversion of resources into directly supporting the Moray Firth Management Project and undertaking counts of seals in 2006 and 2008.

NORWAY

Party	Norway
Title	**Identification of salmon by geochemical signatures; further development and testing of methods**
Coordinating Scientist	Peder Fiske peder.fiske@nina.no
Summary of objectives	The main objectives of this project were to: • test if geochemical signatures are stable from year to year • test if geochemical signatures of salmon scale samples can be used to discriminate among fish from different rivers • develop analytical procedures (otolith core sampling, chemical and statistical analyses) for application of this method in ecological studies on Atlantic salmon.
Year removed from inventory/completed	2003

Summary of Findings

Our initial results suggest that salmon parr from different rivers could be differentiated based on the composition of trace elements in their otoliths. However, we could not classify new samples taken at a different time to the correct rivers using the discriminant functions based on the first sample.

This suggests that there are year to year variations in the chemical composition of the otholiths, and that if the method should be used to identify salmon of unknown origin one would need year-specific samples from the possible rivers of origin.

The usefulness of the method to identify salmon from mixed-stock fisheries to the river of origin therefore seems limited.

Party	Norway
Title	**Development of models to predict marine survival and return of salmon to Norway**
Coordinating Scientist	Lars Petter Hansen l.p.hansen@nina.no
Summary of objectives	Identify and examine the feasibility of applying time-series of marine environmental data, ecoplankton productivity, productivity of pelagic fish and salmon life-history information for model development. Develop appropriate models.
Year removed from inventory/completed	2006

Summary of Findings

A large amount of material of information on time series of hydrography, plankton production, biomass and condition of pelagic marine fish species and of salmon growth and survival indices (e.g. catches, estimated marine survival rates) has been analysed. A method to estimate the number of salmon entering the coast before exploitation (pre-fishery-abundance, or PFA) has been developed.

Models were developed to forecast runs and PFA of 2- and 3SW salmon in years i+1 and i+2 based on the run of 1SW fish in year i. This approach is independent of smolt production. Models to forecast 1SW salmon were developed from environmental variables, plankton production and condition factor and biomass of herring. This approach is based on the assumption that the smolt production is the same every year. The precision of the forecasts were variable, lowest in south Norway and highest in north Norway. This has been the first approach to forecast salmon runs to Norway, and there is a significant potential to improve the predictions by further development of models. Important in this aspect is to maintain, improve and standardise the sampling of data so that the quality of appropriate time series would be less variable.

Party	Norway
Title	**By-catch in pelagic fisheries as a population-regulating factor in wild salmon stocks**
Coordinating Scientist	Jens Christian Holst jens.christian.holst@imr.no
Summary of objectives	Concentrated migration paths of post-smolt Atlantic salmon of Norwegian and southern European origin have been described in the North-East Atlantic during the last 10 years. The post-smolts typically migrate northwards in the major slope currents outside the continental shelf in May-June with dispersal over large areas in the Norwegian Sea in July-August. One of the major migration paths described overlaps in time and geography with a pelagic trawl fishery for mackerel harvesting, in total, 50,000 tonnes a year during a short period of the summer. Based on preliminary observations made by the Institute of Marine Research (IMR) research vessels, there is good reason to believe that significant numbers of post-smolt salmon are caught in this fishery. Estimate the extent of such by-catch and, through cooperation with Russian scientists, develop management advice which could reduce by-catch of salmon while, at the same time, maintaining the catch rates in the mackerel fishery.
Year removed from inventory/completed	2006
Summary of Findings No summary provided.	

Party	Norway
Title	**Sea lice as a population-regulating factor in Norwegian salmon: status, effects of measures taken and future management**
Coordinating Scientist	Jens Christian Holst jens.christian.holst@imr.no
Summary of objectives	Sea lice are currently regarded as the major population-regulating factor in many Norwegian salmon and sea trout stocks, with documented mortality ranging up to over 95% in salmon. This project involves broad cooperation between the leading Norwegian institutions on sea lice/wild salmon interaction studies with the object of further clarifying the effects of sea lice on wild salmon populations, suggesting further actions and measures to reduce sea lice infections in wild salmon and developing alternative methods for critically affected stocks.
Year removed from inventory/completed	2006
Summary of Findings No summary provided.	

Party	Norway
Title	**Distribution of salmon in relation to environmental parameters and origin in the North Atlantic - capture, tagging and release of salmon with data storage tags (DSTs)**
Coordinating Scientist	Marianne Holm marianne.holm@imr.no
Summary of objectives	Investigate the temporal and spatial distribution of DST-tagged salmon in the Norwegian Sea and adjacent areas with special emphasis on: - Spatial distribution and temperature preferences - Growth in relation to environmental parameters - Vertical distribution of salmon during day and night (relating to possibility of intercepting fisheries)
Year removed from inventory/completed	2007

Summary of Findings

Within the framework of the Nordic project, 741 large post-smolts (October captures) and 1-2SW salmon had been captured in the North Atlantic by January 2005. Of these, 478 were captured and 293 were tagged with DSTs and released north of the Faroes, 28 captured and 11 tagged and released south-east of Iceland and 225 captured and 109 tagged and released in the Norwegian Sea. By January 2005, 5 of the tagged fish released in the Norwegian Sea had been recaptured. Two were re-captured in the Namsen fjord in mid-Norway after 18 and 74 days respectively and around 500 km of travel (shortest distance). Another salmon was recovered in the Trondheim fjord in June 2004 after 48 days at sea and ~ 480 km of travel. The fourth recapture was made in the Surna river after 122 days and ~ 500 km. The fifth fish was taken in the river Ätran on the Swedish west coast. This fish had travelled around 1,400 km in 127 days. 5 adipose fin-clipped salmon were found, but none of them carried a microtag. Most fish captured in April 2004 in the Norwegian Sea had entered the sea as 1-2 year-old smolts. The scale material from the Faroese catch will be analysed in 2005. Genetic samples and scales have been taken from most of the fish. In 2003 and 2004 all released salmon had an additional external yellow numbered tag (T-bar anchor) attached under the dorsal fin. In September 2004 the recapture of one such tag was reported from Scotland; unfortunately, however, the DST was either removed with the viscera or it had grown out through the body wall and shed, because it was never found. In 2005 one might expect 1-2 recaptures from DST releases north of the Faroes in November 2004 and possibly also from the DST taggings performed in the Norwegian Sea in April 2004. Data have been analysed in 2005 and two publications are in preparation.

Party	Norway
Title	**Temporal variation in abundance of the northern-most populations of Atlantic salmon with emphasis on the River Tana**
Coordinating Scientist	Martin Svenning martin.svenning@nina.no
Summary of objectives	Examine the influence of ocean climate, predation, marine fisheries and smolt production on the abundance of salmon in the River Tana.
Year removed from inventory/completed	2007
Summary of Findings No summary provided.	

Party	Norway
Title of project	**The importance of early marine feeding on the growth and survival of Atlantic salmon post-smolts in Norwegian fjords**
Coordinating scientist	Bengt Finstad bengt.finstad@nina.no
Summary of obejectives	Analyse spatial variation in early marine post-smolt feeding and growth along a north-south geographical scale; investigate how post-smolt feeding and growth is associated with timing of smolt descent, marine prey availability, parasite infection, fjord migration and abiotic factors
Year removed from inventory/completed	2008
Summary of Findings No summary provided.	

Party	Norway
Title	**Distribution and ecology of post-smolts and salmon at sea**
Coordinating Scientist	Marianne Holm marianne.holm@imr.no
Summary of obejectives	Analyse age, growth and migratory paths in relation to environmental conditions and competitors so as to expand understanding of salmon marine life-history in order to explain observed variations in salmon survival.
Year removed from inventory/completed	2008
Summary of Progress No summary provided.	

Party	Norway
Title	**Dispersal of salmon lice in Norwegian fjords**
Coordinating Scientist	Karin Kroon Boxaspen karinb@imr.no
Summary of obejectives	Estimate and describe to what extent free-living salmon lice larvae disperse from wild and farmed sources within and between areas.
Year removed from inventory/completed	2008
Summary of Progress No summary provided.	

Party	Norway, Scotland
Title	**Experimental tagging programme for investigating the behaviour of escaped farmed salmon: pilot study**
Coordinating Scientist	Lars Petter Hansen (l.p.hansen@nina.no
Summary of objectives	The objective was to examine migration of escaped large farmed salmon and to test if they are transported with the currents and appear in Norwegian waters.
Year removed from inventory/completed	Not previously included – reported in 2008

Summary of Findings

Farmed Atlantic salmon reared at Ardmair near Ullapool in Scotland and at Rognaldsvåg outside Florø in Norway were individually tagged with external Lea tags and released from the fish farms in the spring of 2006 (Ardmair: 678 with mean length of 719 mm; Rognaldsvåg: 597 with mean lenth of 721 mm). Most of the salmon were expected to be sexually mature the autumn of 2006.

Five tags from the Scottish release (0.6% of the total number relased) have been reported recaptured, one was found on a beach in Scotland a bit north of the release site. Another tag was found on a beach in Shetland. A tagged salmon from the same batch was recaptured on the in the Göta River on the west coast of Sweden, and another was recaptured at the outlet of the Hardangerfjord in south west Norway. The fifth one was recaptured at the Lofoten area in north Norway.

Of the fish released from the Norwegian fish farm 42 have been recaptured (7 % of the number released). Most of the fish moved relatively quickly into nearby fjords and entered rivers there, only one individual moved a large distance, and was recaptured in the Drammenfjord in south east Norway.

Salmon released from the Norwegian fish farm showed a much higher survival that the fish released at the Scottish farm and their migration pattern was very local. The migration pattern of the salmon released in Scotland can be explained by transport with the currents, and therefore some large salmon escaping from fish farms in this area in the spring may turn up in Norway and west coast of Sweden.

Party	Norway
Title of project	**Individual assignment of salmon caught in the ocean to region of origin**
Objective of research project	Investigate genetic variation in Norwegian Atlantic salmon populations on different spatial scales; national, regional and within-river. Provide calibrated data on microsatellite markers for a database. Conduct genetic analysis of samples of ocean-caught salmon and attempt assignment of these samples to country/region of origin.
Coordinating scientists	Øystein Skaala Oystein.Skaala@imr.no Vidar Wennevik Vidar.Wennevik@imr.no
Year removed from inventory/completed	2010

Summary of Progress

The project was originally intended to be completed by December 2008, but was extended to March 30 2009. During the projects final year, genotyping for 15 microsatellite markers has been completed for 35 Norwegian rivers, as well as for 1800 samples from ocean caught salmon. Further, a selection of samples from 8 different rivers, with differing environmental conditions, have been screened for a large number of EST-microsatellites and indel-markers in cooperation with the University of Turku, Finland. Presently data are being readied for analysis, and inclusion into the pan-European database developed for the EU-project SALSEA-Merge.

Party	Norway, Institute of Marine Research, P.O. Box 1870 Nordnes, N-5817 Bergen, Norway
Title of project	**Migratory behaviour of smolts and post-smolts of cultured Atlantic salmon**
Objective of research project	To study the change in migratory behaviour from smolts during the post-smolt stages in cultured Atlantic salmon.
Coordinating scientist	Ove Skilbrei ove.skilbrei@imr.no
Year removed from inventory/completed	2010

Summary of progress

Results have been submitted for publication. Migratory behaviour was highly developed in 1+ smolts and in post-smolts released 6 weeks later, but was gradually lost during autumn, when many fish resided and were recaptured in the fjord. Data on 0+ smolts not analyzed yet.

RUSSIAN FEDERATION

Party	Russian Federation
Title	**Assessment of by-catch of post-smolts of Atlantic salmon in pelagic fisheries in the Norwegian Sea**
Coordinating Scientist	Boris Prischepa pboris@pinro.ru Alexander Zubchenko zav@pinro.ru salmon@pinro.ru
Summary of objectives	Assess the occurrence of post-smolts in catches by Russian vessels engaged in the pelagic fisheries for mackerel, blue whiting and herring
Year removed from inventory/completed	2008

Summary of Findings

Results from surveys to map the distribution of post-smolts of Atlantic salmon in the Norwegian Sea conducted by IMR (Institute of Marine Research, Bergen, Norway) on a regular basis since 1995 (Holm et al., 2000) enabled WGNAS to conclude that areas of the distribution of post-smolts and mackerel in the Norwegian Sea in June-August overlap (ICES 2000/ACFM:13). Both species migrate in a surface layer: mackerel in the depth interval 0-50 m (ICES 2002/G:03), while post-smolts are found more frequently between 0 and 1 m (ICES 2002/ACFM:14). Targeted surveys conducted by IMR between 13 and 17 June 2001 in the Norwegian Sea in the vicinity of the area, where an intensive commercial fishery of mackerel took place later, showed simultaneous occurrence of mackerel and post-smolts in catches taken by the salmon survey trawl specifically designed for sampling post-smolts in the surface layer (ICES 2002/ACFM:14). Their findings gave rise to speculations that mackerel fishery in the Norwegian Sea in June-August can be viewed as the most precarious in terms of by-catch of post-smolts of Atlantic salmon.

In the light of this, the Russian Federation carried out a programme in 2002-2006 to study the Atlantic salmon post-smolt potential by-catch in the Russian mackerel fishery in the Norwegian Sea.

Scientific observers and fisheries inspectors worked onboard Russian fishing vessels that fished mackerel in the Faeroese fishing zone and international waters of the Norwegian Sea. Usually 2-5 Russian inspectors and 5-7 scientific observers stayed permanently onboard the vessels during the season. They checked licenses, logbooks, gear, catches and collected biological samples. Their tasks included also screening of the mackerel catch for potential by-catch of post-smolts and adult Atlantic salmon. The vessel's crew assisted in the work. The catches were screened immediately after retrieval of the trawl, during discharge of the fish into bins and at a ship factory during grading. All Russian trawlers had a factory and every single catch was graded onboard. The entire Russian commercial catch of mackerel was used for human consumption and most vessels froze and stored their products onboard. Consequently all catches were sorted and packed by species in standard boxes. Some of the vessels also produced canned fish. In all cases the catch was loaded from the trawl onto an accumulation conveyor at the vessel's factory immediately and sorted by the crew, which implied that the fish were handled more or less individually before packing or milling.

Calculation of the ratio of total number of post-smolts per tonne of mackerel in the international zone gave an estimated of 0.0015 post-smolts per metric tonne captured in the commercial fishery in 2002, and 0.0003 in 2003. The ratio of total number of adults per 1 tonne of mackerel in the international zone was 0.0019 in 2002 and 0.0039 in 2003. No adult salmon or post-smolts were recorded in 2004. Like in 2002 and 2003 the results from 2005 and 2006 suggested very low numbers of post-smolts and adult salmon caught in the mackerel fishery in July-August in the Norwegian Sea.

Such a low by-catch could, apparently, be explained by two reasons: first, most post-smolts pass the

international waters before a large-scale fishery of mackerel starts there, second, commercial pelagic trawl practically does not capture post-smolts, migrating very close to the surface, which can be attributed to both specific features of its design and fishing technique for mackerel, these include the overall size, towing speed, ratios of width to height and the mesh sizes used in the construction, particularly in the fore part of the net.

The main design parameter of concern is the mesh sizes used in the front part of the trawl. The mesh sizes range from 0.8 m for the salmon survey trawl up to 50 m for the largest commercial net. With a commercial pelagic trawl mackerel are fished in the 0-5 m layer and down to 50-70 m from the sea surface. Post-smolts inhabit the upper 10 m of the surface, which is only filtered by the section of the net with the largest meshes. It is thought that the smolts simply pass through the large meshes, while mackerel tend to dive in response to a vessel and are visually herded by the netting bars. The presence of significant quantities of post-smolts in the salmon survey trawl, which only covers the top 10 m of the surface and is designed specifically for the capture of post-smolts, supports this.

As regards the post-smolt run timing, it could be suggested, that the majority of post-smolts among those migrating with the western branch of the Norwegian current pass the international waters before a large-scale fishery of mackerel begins, it usually starts in July. In addition, as the map of distribution of post-smolts in the Norwegian Sea shows (ICES 2002/ACFM:14), the main route of post-smolt northward migration is to the east of the area where the fishery is prosecuted.

All said above suggests a conclusion that the pelagic fisheries in the Norwegian Sea and, of mackerel in particular, cannot be considered as a significant source of post-smolt mortality. This is also supported by assessments undertaken by ICES.

USA

Party	United States of America
Title	**Forecasts of Atlantic salmon transoceanic migration: climate change scenarios and anadromy in the North Atlantic**
Coordinating Scientist	Kevin Friedland friedlandk@forwild.umass.edu
Summary of objectives	1) develop and evaluate marine migration models for Atlantic salmon from North American and European stocks 2) evaluate the potential effects of climate change on migration patterns for Atlantic salmon
Year removed from inventory/completed	2005
Summary of findings No summary provided.	

Party	United States
Title	**Stable isotope composition of Atlantic salmon scales**
Coordinating Scientist	Kevin Friedland friedlandk@forwild.umass.edu
Summary of objectives	The objective of this study is to develop a retrospective time series of stable isotope ratios for the DPS in Maine and the mixed stock samples from the continental stock complex to evaluate the feeding patterns of the stocks over time.
Year removed from inventory/completed	2005
Summary of findings No summary provided.	

Party	United States of America
Title of project	**Ultrasonic telemetry of smolts and post-smolts in the Narraguagus River and Narraguagus Bay**
Objective of research project	1) evaluate migration timing and pathways in the lower Narraguagus River and Narraguagus Bay 2) estimate survival of migrating smolts and post-smolts
Coordinating scientist	James Hawkes James.Hawkes@noaa.gov
Year removed from inventory/completed	2010

Summary of Progress

Kocik, J. F., J. P. Hawkes, T. F. Sheehan, P.A. Music and K. F. Beland. 2009. Assessing estuarine and coastal migration and survival of wild Atlantic salmon smolts from the Narraguagus River, Maine using ultrasonic telemetry. In: Haro, A. J., K. L. Smith, R. A. Rulifson, C. M. Moffitt, R. J. Klauda, M. J. Dadswell, R. A. Cunjak, J. E. Cooper, K. L. Beal, and T. S. Avery, editors. Challenges for Diadromous Fishes in a Dynamic Global Environment. American Fisheries Society Symposium 69. Bethesda, Maryland. pp 293-310.