

**International Atlantic Salmon Research Board**

**ICR(06)11**

*Inventory of Research Relating to Salmon Mortality in the Sea*

*(updated July 2006)*



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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 (see documents CNL(02)21, ICR(03)3, ICR(04)3, ICR(04)6, ICR(05)3 and ICR(05)10). 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. In order to achieve this the Members of the Board were asked to provide to the Secretariat by 15 February 2006, updated information for inclusion in the inventory. As agreed by the Board at its 2005 meeting, projects for which no updates were provided have been removed from the inventory of on-going projects. The updated inventory is attached as Annex 1.
2. Table 1 provides details of expenditure on research by topic area for each Party. Not all projects have been costed. 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 projects included in the inventory amounts to approximately £5.1 million. This is actually a reduction of about 13% from the costed expenditure of £5.9 million in 2005. No costings are available for 4 of the 51 projects. Based on the average expenditure on the topic area to which the projects are assigned for the Party concerned, the additional annual expenditure for the four uncosted projects might be in the region of a further £0.6 million. Last year, the Board asked that information for inclusion in the inventory be requested from France in relation to the sampling programme at St Pierre and Miquelon. We have requested this information but at the time of preparation of the paper, no response had been received. Details of the programme are, however, contained in document CNL(06)23.
3. As requested by the Board at its last meeting, those projects that fall within the SALSEA programme have been allocated to the relevant work package in Table 3. Some relevant projects were completed in 2005, including trials of trawl gear conducted by Scotland and Norway, and a Canadian programme of research cruises in the Labrador Sea. New projects of relevance to SALSEA include a number of genetic studies which will contribute to developing a baseline or genetic atlas of stocks to facilitate genetic stock identification of salmon caught in research cruises at sea if these cruises can be funded. One key area of the research envisaged in the SALSEA programme that is clearly not being addressed is Work Package 3: Investigating the distribution and migration of salmon at sea.
4. 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. In total, 51 on-going projects are included in the inventory, a reduction of 2 projects since last year. 9 projects have been completed since last year or are assumed to have been completed and have been removed from the inventory of on-going projects. These projects are:

#### Canada:

- Atlantic salmon distribution and abundance at sea;
- Tracking experimentally 'escaped' farmed salmon.

European Union:

United Kingdom (Scotland)

- Testing and development of Institute of Marine Research (IMR), Bergen, Norway, salmon trawl gear;

Ireland

- Oceanic factors influencing marine survival of Irish salmon stocks.

Iceland:

- Survival at sea of 1- and 2-sea-winter salmon in relation to oceanic conditions;
- Variation in growth and return rates of Atlantic salmon from three Icelandic rivers.

Norway:

- Development of models to predict marine survival and return of salmon to Norway;
- By-catch in pelagic fisheries as a population-regulating factor in wild salmon stocks;
- Sea-lice as a population-regulating factor in Norwegian salmon: stocks, effects of measures taken and future management.

In addition, two US projects formerly contained in the inventory have been removed completely because we were advised that they had no relevance to marine mortality of salmon. These projects were 'Estuary movements of pre- and post-spawning adults: Dennys River adult stocking assessment' and 'Estuary movements of pre- and post-spawning adults: St Croix River adult stocking assessment'.

5. In total, 10 new projects (2 for Canada, 4 for the EU, 3 for Norway and 1 for the US) have been included in the inventory. The annual expenditure on these new projects is in the region of £0.7 million. The new projects are as follows:

Canada:

- C1: Use of stable isotopes to assess long-term changes in marine trophic ecology of Atlantic salmon (*Salmo salar*).
- C6: River and extended estuary acoustic tracking of Atlantic salmon (*Salmo salar*) kelts.

European Union (Ireland):

- E15: Marine survival of Atlantic salmon from the Burrishoole River, Ireland;
- E16: Sustainable management of interactions between aquaculture and wild salmonid fish (EU SUMBAWS project, Irish component);
- E17: National Genetic Stock Identification Project;
- E18: Interactions between aquaculture and wild salmonid fish.

Norway:

- N2: Significance of salmon lice for growth and survival of salmon in the sea;
- N6: Marine growth and survival of salmon, sea trout and sea char from the River Halselva;
- N7: Individual assignment of salmon caught in the ocean to region of origin.

USA:

- U1 Penobscot hatchery versus wild smolt telemetry:

**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	Iceland	Norway	Russia	United States of America	<b>Totals by Topic Area</b>
Long-term monitoring	£564,500 1	-	£725,290 9 (4)	£159,000 3	£194,000 3	£80,000 1	£14,000 1	£1,736,790 18 (4)
Distribution/ migration in the sea	£487,000 3	£62,200 1	£1,038,000 5	£400,000 2	£131,000 3	£80,000 1	£143,000 4	£2,341,200 19
Life history/biological processes	£27,500 1	-	£267,000 2	-	£68,250 1	-	-	£362,750 4
Development of methods	-	-	-	£4,000 1	-	-	-	£4,000 1
Specific natural and anthropogenic factors	- 1	-	£634,000 6	-	£37,500 1	-	£8,000 1	£679,500 9
<b>Totals by Party</b>	<b>£1,079,000 6</b>	<b>£62,200 1</b>	<b>£2,664,290 22 (4)</b>	<b>£563,000 6</b>	<b>£430,750 8</b>	<b>£160,000 2</b>	<b>£165,000 6</b>	<b>£5,124,240 51 (4)</b>

*The figures shown are in pounds sterling. The number of projects is shown below the expenditure figure with the number of these projects for which no costings were provided in parentheses. 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 (details of these contributions are given in Annex 1).*

**Table 2: Inventory of research relating to salmon mortality in the sea – 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, E6, E9, E10, E13, E15, E19, E21, E22, I1, N3, N6, R1, U4	Medium	Low
	b. Time series of marine survival in relation to environmental parameters (e.g. SST)	Desk studies on time series.	E11, I2, I5, N8	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).	N4, U5	High	High
	b. Migratory behaviour of individual fish	Active smolt tracking; automated data collection by DSTs.	C4, C5, C6, E14, E20, I4, I6, N5, U1, U2, U3	High	High
	c. Origin of catches in directed fisheries	Catch sampling in distant water fisheries; genetic analysis and scale analysis, etc; changes over time.	D1, E8, E17, N7	High	Low
	d. Migration and bioenergetic models	Desk studies based on data obtained from other studies.	E2	Medium	Medium
	e. By-catches in pelagic fisheries	Can be conducted as part of marine surveys of post-smolt distributions; sample commercial pelagic catches.	R2	High	High
3. Life history/biological processes	a. Freshwater factors	Age, growth, migration timing, etc.	E5	Low	Low
	b. Pre-fishery recruitment marine factors	Environment, food, predation, growth, parasites and diseases, etc.	C1, N1	High	High
	c. Post-fishery recruitment marine factors	Environment, food, predation, maturation processes, growth, etc.	E7	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.	I3	Medium	High
5. Specific natural and anthropogenic factors	a. Fish farms	Increased sea lice infestations.	E1, E16, E18, N2	Low	Low
	b. Predation	Predation by seals, birds, fish, etc. in estuaries/coastal areas.	E12, U6	Low	Low
	c. Obstructions to fish movements	Barrages, etc.	E3	Low	Low
	d. Pollutants	Acidification; freshwater contaminants.	C2, E4	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: Expenditure on ongoing projects in the inventory of research of relevance to the SALSEA programme**

<b>SALSEA Work Packages</b>	<b>Ongoing Projects</b>	<b>SALSEA costing</b>
<b><i>Work Package 1: Supporting Technologies</i></b>		
Task 1: Genetic tagging to determine stock origin	D1, E8, E17, N7	£1.5 million
Task 2: Sampling equipment evolution	-	£330,000
Task 3: Signals from scales	C1, E11, E21, I1, I2, N8	£100,000
<b><i>Work Package 2: Early Migration through the Inshore Zone: fresh waters, estuaries and coastal waters</i></b>		
Task 1: Investigate the influence of biological characteristics of Atlantic salmon smolts on their marine mortality	-	-
Task 2: The impacts of physical factors in fresh water on marine mortality of Atlantic salmon	E5	-
Task 3: Preparing to migrate – investigate the influence of freshwater contaminants on the marine survival of Atlantic salmon	C2, E4	-
Task 4: The part played by key predators	E12, E20, U6	-
Task 5: The impact of aquaculture on mortality of salmon	E1, E16, E18, N2	-
<b><i>Work Package 3: Investigating the distribution and migration of salmon at sea</i></b>		
Task 1: Distribution and migration mechanisms – develop theoretical migration models	C5, E2	£25,000
Task 2: A common approach – refine the plans for a large-scale marine survey	-	£25,000
Task 3: Salmon at sea – carry out a comprehensive survey	N1, R2, U5	£5.8 million
Task 4: Distribution and migration – analyse and collate data	N4	£180,000
<b><i>Appendix 1: Supporting technologies, further development of which will support the SALSEA programme</i></b>		
1. Novel trawl sampling technologies	-	-
2. Data storage tags	I3, I4, I6, N5	-
3. Coded wire tagging	E5, E6, E9, E13, I5	-
4. Sonic tags and sonic detector arrays	C4, C6, E14, E20, U1, U2, U3	-

**Table 4: Summary of on-going and completed research projects relating to salmon mortality in the sea**

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

<b>Project No. and Title</b>	<b>Summary of objectives</b>	<b>Topic Area</b>	<b>Date of research</b>	<b>Area of research/ Collaborating countries</b>	<b>Coordinating Scientist(s)</b>	<b>Annual cost (Pounds Sterling – approx.)</b>	<b>Main research methods</b>
<b>CANADA</b>							
<b>C1:</b> Use of stable isotopes to assess long-term changes in marine trophic ecology of Atlantic salmon ( <i>Salmo salar</i> )	Assess trophic and dietary information through stable isotopes from previously compiled scale samples from various salmon stocks; compare isotopic signatures within and among stocks to infer differences in feeding ecology in time and space; examine evidence for environmental influences on trends in isotopic signatures; examine linkages of stable isotope signatures with trends in abundance.	Life history/ biological processes	<b>New entry</b> From January 2006	Desk study examining archived material and samples from Newfoundland, the Maritime Provinces, the Quebec North Shore, the Barents Sea (Tana River, Finland)  <i>Collaborating countries:</i> Finland	J. Brian Dempson dempsonb@dfo-mpo.gc.ca	£27,500	Stable isotope analysis from scales.
<b>C2:</b> Integrated field and laboratory assessment of the effects of endocrine-disrupting substances on Atlantic salmon smolts	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 to endocrine-disrupting substances and lower adult returns.	Specific natural and anthropogenic factors	2003-2006	Atlantic Canada and Co. Mayo, Ireland  <i>Collaborating countries:</i> Ireland	Wayne Fairchild Fairchildw@mar.dfo-mpo.gc.ca and Scott Brown Scott.Brown@cciw.ca	- Analysis of results only in 2006	Trap nets and holding cages in rivers.
<b>C3:</b> 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, Maritimes region, Gulf region and Quebec.	Long-term monitoring	April – November, annually	Canadian rivers in Newfoundland, Maritimes region, Gulf region and Quebec	Contact for information: Gerald Chaput chaputg@dfo-mpo.gc.ca	£564,500	Smolt and adult fences and traps, trap nets, rotary screw smolt traps.
<b>C4:</b> Atlantic salmon smolt migration and survival within Canadian rivers and their estuaries	Determine the fraction of smolts tagged in fresh water that survive to the head of tide. Determine the fraction of smolts tagged at the head of tide that successfully transit the estuaries to the open sea.	Distribution/ migration in the sea	2003-2006 (spring/ summer)	Miramichi River and Estuary, Restigouche River and Baie des Chaleurs; Cascapedia River and Estuary; St-Jean (Côte-Nord) River and Estuary	Fred Whoriskey asfres@nb.aibn.com	£282,000	Acoustic tags and receivers, smolt wheels.

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<b>C5:</b> Integrated modelling of juvenile Atlantic salmon movement and physical habitat in fluvial and estuarine environments	Develop and apply an approach capable of relating the behaviour of smolts, during their migration through the estuaries, to physical habitat characteristics in rivers and estuaries. Apply this approach to analysis of smolt migration. Detect potential changes in the migration pattern of smolts in response to the planned presence of sea cages in Baie de Gaspé.	Distribution/ migration in the sea	2005-2008 (spring/ summer)	York River and Baie de Gaspé, Quebec	Julian Dodson julian.dodson@bio.ulaval.ca	£150,000	Acoustic tags and receivers, smolt wheels.
<b>C6:</b> River and extended estuary acoustic tracking of Atlantic salmon ( <i>Salmo salar</i> ) kelts	Track and document migratory behaviour of Atlantic salmon kelts as they leave the river for the open ocean; identify possible critical habitat sites utilised by kelts during their migration; examine mortality rates of kelts during migration.	Distribution/ migration in the sea	<b>New entry</b> April 2006 – October 2006	LaHave River and estuary, Lunenburg, Nova Scotia, Northwest Atlantic Ocean, Canada 44°23'N, 64°32'W	Peter G. Amiro AmiroP@mar.dfo-mpo.gc.ca	£55,000	Acoustic tags and receivers.
<b>DENMARK (FAROE ISLANDS AND GREENLAND)</b>							
<b>D1:</b> West Greenland Salmon Fishery Sampling Programme	Continue time series of data on 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 from internal and external tags. Collect information on diseases and parasites.	Distribution/ migration in the sea	Annually during the fishing season, (August – October)	West Greenland <i>Collaborating countries:</i> USA, UK, Ireland, Canada	Helle Siegstad helle@natur.gl	£62,200	Catch sampling, scale analysis, genetic analysis, disease and parasite screening.
<b>EUROPEAN UNION</b>							
<b>UK – England and Wales</b>							
<b>E1:</b> Impact of intensive in-river aquaculture on wild salmonids	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.	Specific natural and anthropogenic factors	November 2001- August 2006	England and Wales	Andrew Moore a.moore@cefas.co.uk	£72,000	Monitoring concentrations and effects of contaminants. Modelling.
<b>E2:</b> Modelling the bioenergetics of salmon migration	Model the energetic requirements of salmon during marine migrations and predict the effects of environmental and oceanographic changes on smolt growth and survival.	Distribution/ migration in the sea	April 2002 – April 2006	Desk study	Douglas Booker dobo@ceh.ac.uk	£40,000	Modelling.
<b>E3:</b> Cardiff Bay Fisheries Monitoring Programme	Assess the impact of Cardiff Bay barrage on salmon stocks of the rivers Taff and Ely.	Specific natural and anthropogenic factors	1990-2008	Cardiff Bay at mouth of rivers Taff and Ely, South Wales, UK	Peter Gough peter.gough@environment-agency.wales.gov.uk	£250,000	Research vessel, contained acoustic and radio tags, smolt tags, microtags/ finclips.

<b>Project No. and Title</b>	<b>Summary of objectives</b>	<b>Topic Area</b>	<b>Date of research</b>	<b>Area of research/ Collaborating countries</b>	<b>Coordinating Scientist(s)</b>	<b>Annual cost (Pounds Sterling – approx.)</b>	<b>Main research methods</b>
<b>E4:</b> Diffuse pollution and freshwater fish populations	Investigate the role of diffuse aquatic contaminants in regulating populations of freshwater fish with particular reference to salmonid stocks and fisheries.	Specific natural and anthropogenic factors	April 2005 – March 2010	England and Wales	Andrew Moore a.moore@cefas.co.uk	£139,000	Integrated research programme involving ecotoxicological studies, telemetry and literature review, etc.
<b>E5:</b> The influence of the freshwater environment on salmonid populations	Investigate the impact of environmental changes 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.	Life history/ biological processes	April 2005 – March 2010	England and Wales	Andrew Moore a.moore@cefas.co.uk	£123,000	Large-scale microtagging and PIT tagging.
<b>E6:</b> Deriving estimates of marine survival and exploitation for monitored river stocks in England and Wales	Establish ‘monitored’ rivers where estimates of marine survival and exploitation in marine fisheries 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 Simon Toms simon.toms@environment-agency.gov.uk Ian Russell i.c.russell@cefas.co.uk	-	Rotary screw traps, microtagging, adult traps and counters.
<b>E7:</b> Factors affecting the distribution and behaviour of salmonid populations	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.	Life history/ biological processes	April 2005 – March 2010	England and Wales	Andrew Moore a.moore@cefas.co.uk	£144,000	Integrated research programme involving physiological studies, analysis of stable isotopes, telemetry, literature review, etc.

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<b>E8:</b> Atlantic salmon Arc Project, ASAP	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.	Distribution/ migration in the sea	May 2004 – May 2007	Europe, North Atlantic  <i>Collaborating countries:</i> Spain, France, Ireland, Scotland, USA, Iceland	Dylan Bright dylan@wrt.org.uk	£370,000	Genetic analysis.
<b>UK – Northern Ireland</b>							
<b>E9:</b> 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 – 2011	River Bush, N. Irish/Irish coastal waters and distant water fisheries  <i>Collaborating countries:</i> Ireland (tag recovery programme)	Walter Crozier walter.crozier@dardni.gov.uk and Gersham Kennedy gersham.kennedy@dardni.gov.uk	£43,290	Microtagging, traps, run-reconstruction models.
<b>UK - Scotland</b>							
<b>E10:</b> 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) j.c.maclea@marlab.ac.uk Alan Youngson (River Dee) a.youngson@marlab.ac.uk John Armstrong (River Conon) j.armstrong@marlab.ac.uk	-	Traps, counters, rotary screw traps, electro-fishing, PIT tags and detectors.
<b>E11:</b> 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 Gironck Burn in particular  <i>Collaborating countries:</i> USA and Canada	Julian Maclean j.c.maclea@marlab.ac.uk	-	Scale analysis.

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<b>E12:</b> Protecting salmonid fisheries from seal damage	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 salmon migration routes in estuaries and relate to presence of predators. Examine occurrence of seal-damaged salmon on a wide geographic scale.	Specific natural and anthropogenic factors	April 2003 - March 2008	Principally North-East Scotland (Cromarty Firth). Possible work in other estuaries and extension into West Coast	John Armstrong j.armstrong@marlab.ac.uk	£115,000 in 2006/07	DNA analysis, acoustic tags and receivers.
<b>Ireland</b>							
<b>E13:</b> National coded wire tagging and tag recovery programme	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	Ongoing programme initiated in 1980	Tag recovery from around North Atlantic  <i>Collaborating countries:</i> Norway, UK, Faroes	Niall O'Maoileidigh niall.omaoidigh@marine.ie	£300,000	Micro-tagging and tag recovery programmes.
<b>E14:</b> Migration of salmon in estuarine and coastal waters	Investigate the timing, route of migration and aspects of the biology of migrating ranched salmon smolts in comparison to native wild smolt migration.	Distribution/ migration in the sea	2005-2008 (March – June)	Burrishoole catchment, Newport and Clew Bay, Mayo  <i>Collaborating countries:</i> UK	Russell Poole, russell.poole@marine.ie Deirdre Cotter deirdre.cotter@marine.ie Niall O'Maoileidigh niall.omaoidigh@marine.ie	£24,000	Acoustic tags, receiver arrays, echo sounders.
<b>E15:</b> Marine survival of Atlantic salmon from the Burrishoole River, Ireland	Investigate factors influencing the survival at sea of salmon smolts migrating from the Burrishoole River until their return as adult salmon.	Long-term monitoring	<b>New entry</b> 1960-2006	Burrishoole River	Russell Poole russell.poole@marine.ie	£72,000	Upstream and downstream traps.
<b>E16:</b> Sustainable management of interactions between aquaculture and wild salmonid fish (EU SUMBAWS project – Irish component of project only)	Assess efficacy of prophylactic treatments for salmon smolts migrating through aquaculture bays.	Specific natural and anthropogenic factors	<b>New entry</b> 2003-2006	Kilkerran Bay, Bertraghbouy Bay, Connemara  <i>Collaborating countries:</i> UK, Norway	Paddy Gargan paddy.gargan@cfb.ie Niall O'Maoileidigh niall.omaoidigh@marine.ie	£48,000	Traps, microtagging, commercial fishery.
<b>E17:</b> National Genetic Stock Identification Project	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.	Distribution/ migration in the sea	<b>New entry</b> 2006-2007	All Irish rivers  <i>Collaborating countries:</i> UK, Spain	Tom Cross t.cross@ucc.ie Paddy Gargan paddy.gargan@cfb.ie Philip McGinnity phil.mcginny@marine.ie	£270,000	Genetic analysis.

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<b>E18:</b> Interactions between aquaculture and wild salmonid fish	Assess efficacy of prophylactic treatments for salmon smolts migrating through aquaculture bays.	Specific natural and anthropogenic factors	<b>New entry</b> 2002-2007	Burrishoole, Shannon, Lee and Screebe, and drift net fishery around Irish coast	D Jackson dave.jackson@marine.ie	£10,000	Traps, microtagging, commercial fishery.
<b>France</b>							
<b>E19:</b> 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	-	Adult and smolt trapping facilities.
<b>Denmark</b>							
<b>E20:</b> Mortality of Atlantic salmon smolts during estuary migration	Estimate mortality of salmon smolts during migration through estuaries and compare the return ratio of wild, stocked ½- and one-yearlings.	Distribution/ migration in the sea	April 2000 to June 2007	River Skjern Å (North Sea) and River Guden Å (Kattegat) and their estuaries	Gorm Rasmussen gr@dfu.min.dk	£334,000	Rotary screw traps, radio and acoustic telemetry equipment.
<b>Finland</b>							
<b>E21:</b> 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  <i>Collaborating countries:</i> 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.
<b>Sweden</b>							
<b>E22:</b> 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 salmon in the River Ätran and estimate sea survival, growth and exploitation for wild and reared fish.	Long-term monitoring	Ongoing	Rivers Ätran, Lagan and Nissan	-	£35,000	Adult and smolt traps.
<b>ICELAND</b>							
<b>I1:</b> Return rate of salmon in three index rivers in Iceland in relation to population and environmental factors	Monitor status of, and trends in, salmon stocks in three index rivers.	Long-term monitoring	Ongoing for the last 10 years and will continue	Iceland and surrounding ocean  <i>Collaborating countries:</i> Through ICES	Thorolfur Antonsson thorolfur.antonsson@veidimal.is	£96,000	Traps, tagging, scale sampling.

<b>Project No. and Title</b>	<b>Summary of objectives</b>	<b>Topic Area</b>	<b>Date of research</b>	<b>Area of research/ Collaborating countries</b>	<b>Coordinating Scientist(s)</b>	<b>Annual cost (Pounds Sterling – approx.)</b>	<b>Main research methods</b>
<b>I2:</b> Growth of Atlantic salmon in the river Hofsa, north-east Iceland, in relation to ocean and in-river conditions	Back-calculated growth from scale samples will be used to relate smolt, post-smolt and adult growth to ocean conditions.	Long-term monitoring	2004-2006	Desk study (samples from north-east Iceland and adjacent areas)	Sigurdur Gudjonsson sigurdur.gudjonsson@veidimal.is and Sigurdur Mar Einarsson sigurdur.mar@veidimal.is	£13,000 in 2006	Scale analysis, analysis of environmental data.
<b>I3:</b> Tagging mortality and time of recovery related to internal tagging of hatchery-reared salmon smolts with DST micro-tags (Star-Oddi)	Investigate the mortality and time of recovery associated with different handling and tagging techniques with dummy DSTs.	Development of methods	2004-2006	Islandlax hatchery	Ingi Runar Jonsson ingi.runar.jonsson@veidimal.is and Sigurdur Gudjonsson sigurdur.gudjonsson@veidimal.is	£4,000 in 2006	DSTs (Star-Oddi).
<b>I4:</b> DST tagging of reared salmon smolts	Record the temperature and depth of water experienced by salmon from the west of Iceland during the first year at sea.	Distribution/ migration in the sea	2005-2008	South-West Iceland	Sigurdur Gudjonsson sigurdur.gudjonsson@veidimal.is	£170,000	DSTs (Star-Oddi), Oceanographic information.
<b>I5:</b> Survival of salmon during the first and second year at sea	Evaluate the survival of hatchery-reared smolts during the first and second year at sea.	Long-term monitoring	2005-2009	South-West Iceland	Sigurdur Gudjonsson sigurdur.gudjonsson@veidimal.is	£50,000	Release site, traps, microtagging, oceanographic information.
<b>I6:</b> Distribution and behavioural ecology of salmon at sea	Investigate the distribution of DST-tagged salmon at sea with regard to spatial distribution and temperature preferences, diurnal depth distribution, growth in relation to environmental parameters and by-catch in pelagic fisheries.	Distribution/ migration in the sea	2005-2011 (pre-phase in 2003 and 2004)	River Tungufljot and River Hafnara Salmon Ranching Station and River Botnsa  <i>Collaborating countries:</i> Faroe Islands, Norway	Johannes Sturlaugsson johannes@laxfiskar.is	£230,000	DSTs (Star-Oddi).
<b>NORWAY</b>							
<b>N1:</b> The importance of early marine feeding on the growth and survival of Atlantic salmon post-smolts in Norwegian fjords	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.	Life history/ biological processes	2002-2006 (field work May/June)	Central and Northern Norway  <i>Collaborating countries:</i> Canada	Bengt Finstad bengt.finstad@nina.no	£68,250 in 2006	Fish lift trawl.

<b>Project No. and Title</b>	<b>Summary of objectives</b>	<b>Topic Area</b>	<b>Date of research</b>	<b>Area of research/ Collaborating countries</b>	<b>Coordinating Scientist(s)</b>	<b>Annual cost (Pounds Sterling – approx.)</b>	<b>Main research methods</b>
<b>N2:</b> 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	<b>New entry</b> 2006-2007	Western Norway, River Dale, Matre Aquaculture Station	Ove Skilbrei ove.skilbrei@imr.no	£37,500	Smolt trap, tags, SLICE.
<b>N3:</b> Marine survival and exploitation of salmon from the Rivers Figgjo, Imsa and Drammenselv	Estimate marine survival and marine exploitation of salmon from three rivers in Norway. Develop predictive models.	Long-term monitoring	Long-term ongoing monitoring project	Rivers Figgjo, Imsa and Drammenselv with tag recovery programme in fisheries along Norwegian coast and elsewhere	Lars Petter Hansen l.p.hansen@nina.no and Nina Jonsson Nina.jonsson@nina.no	£104,000	Fish traps, electro-fishing.
<b>N4:</b> Distribution and ecology of post-smolts and salmon at sea	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.	Distribution/ migration in the sea	2003-2006 (Compilation and analysis of data only in 2006)	Northern North Sea, Norwegian Sea  <i>Collaborating countries:</i> Faroe Islands	Marianne Holm marianne.holm@imr.no	£20,000 in 2006	Data analysis only in 2006.
<b>N5:</b> 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)	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.	Distribution/ migration in the sea	2003-2006 (Data analysis only in 2006)	Northern North Sea, Norwegian Sea  <i>Collaborating countries:</i> Faroe Islands, Iceland	Marianne Holm marianne.holm@imr.no	£4,000 in 2006	Data analysis only in 2006.
<b>N6:</b> Marine growth and survival of salmon, sea trout and sea char from the River Halselva	Estimate marine growth and survival. Use return rate of first-time migrants of char and trout as early indicators of salmon survival.	Long-term monitoring	<b>New entry</b> Commenced 1987. Long-term ongoing monitoring project	River Halselva with tag recovery programmes along Norwegian coast and elsewhere	Arne J Jensen arne.jensen@nina.no	£30,000	Fish trap, electro-fishing.
<b>N7:</b> Individual assignment of salmon caught in the ocean to region of origin	Investigate genetic variation in Norwegian 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.	Distribution/ migration in the sea	<b>New entry</b> January 2006 – December 2008	Norway  <i>Collaborating countries:</i> Finland	Oystein Skaala oystein.skaala@imr.no Vidar Wennevik vidar.wennevik@imr.no	£107,000	Electro-fishing equipment, genetic analysis.

Project No. and Title	Summary of objectives	Topic Area	Date of research	Area of research/ Collaborating countries	Coordinating Scientist(s)	Annual cost (Pounds Sterling – approx.)	Main research methods
<b>N8:</b> Temporal variation in abundance of the northern-most populations of Atlantic salmon with emphasis on the River Tana	Examine the influence of ocean climate, predation, marine fisheries and smolt production on the abundance of salmon in the River Tana.	Long-term monitoring	2002-2006	River Tana  <i>Collaborating countries:</i> Finland, Russia, Canada	Martin Svenning martin.svenning@nina.no	£60,000	Analysis of abundance and marine survival data, scale analysis, analysis of ocean climate data, stomach content analysis.
<b>RUSSIAN FEDERATION</b>							
<b>R1:</b> Monitoring of the stock status, abundance assessment and provision of advice on allowable level of harvest of Atlantic salmon	Estimate survival of juveniles and adult return rates; estimate natural and fishing mortality; study population dynamics 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	Alexander Zubchenko zav@pinro.ru, salmon@pinro.ru Igor Studenov igor@sevpinro.ru	£80,000	Barrier fences, nets, electro-fishing, smolt traps, external tagging.
<b>R2:</b> Assessment of by-catch of post-smolts of Atlantic salmon in pelagic fisheries in the Norwegian Sea	Assess occurrence of post-smolts in catches by Russian vessels engaged in the pelagic fisheries for mackerel, blue whiting and herring.	Distribution/migration in the sea	Initially 2002 – 2004, annually from 2005	Norwegian Sea	Boris Prischepa Elena@pinro.ru Alexander Zubchenko zav@pinro.ru, salmon@pinro.ru	£80,000	Standard pelagic trawl
<b>USA</b>							
<b>U1:</b> 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	<b>New entry</b> 2005-2009	Penobscot Estuary Penobscot Bay	Edward Hastings Edward.Hastings@noaa.gov James Hawkes James.Hawkes@noaa.gov	£43,000 (public funding)	Ultrasonic tags and receivers
<b>U2:</b> Ultrasonic telemetry of smolts and post-smolts in the Narraguagus River and Narraguagus Bay	Evaluate migration timing and pathways in the lower Narraguagus River and Narraguagus Bay and estimate survival of migrating smolts and post-smolts.	Distribution/migration in the sea	2002-2007 (Fieldwork April-June 2002-2005, data analysis and publication 2005-2007)	Narraguagus River (2002-2005) Narraguagus Bay (2002-2005) Gulf of Maine (2002-2004)  <i>Collaborating countries:</i> Canada	James Hawkes James.Hawkes@noaa.gov John Kocik John.Kocik@noaa.gov	£49,000 (public funding)	Ultrasonic tags and receivers.

Project No. and Title	Summary of objectives	Topic Area	Date of research	Area of research/ Collaborating countries	Coordinating Scientist(s)	Annual cost (Pounds Sterling – approx.)	Main research methods
<b>U3:</b> 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, 2001-2007 (Data analysis and publication 2005-2007)	Dennys River, Cobscook Bay, Gulf of Maine  <i>Collaborating countries:</i> Canada	James Hawkes James.Hawkes@noaa.gov Tim Sheehan Tim.Sheehan@noaa.gov	£28,000 (public funding)	Ultrasonic tags and receivers. Electro-fishing gear.
<b>U4:</b> 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, 2001-2008	Dennys River, Cobscook Bay, Gulf of Maine  <i>Collaborating countries:</i> Recovery of marked fish through NASCO cooperative sampling programme at West Greenland	Greg Mackey greg.mackey@maine.gov	£14,000 (public funding)	Elastomer marks, rotary smolt traps, weir-based smolt and adult traps.
<b>U5:</b> 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 physiology and condition of post-smolts in marine environments.	Distribution/ migration in the sea	May – June, 2001 to 2007	Penobscot Bay, Gulf of Maine	Tim Sheehan Tim.Sheehan@noaa.gov	£23,000 (public funding)	Post-smolt trawl, oceanographic instruments.
<b>U6:</b> 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	May-June 2005 Data analysis and publication 2005-2007	Lower Narraguagus River and Narraguagus Bay, Maine	Rory Saunders rory.saunders@noaa.gov James Hawkes James.Hawkes@noaa.gov	£8,000 (public funding)	Shotguns with firecracker and screamer shells, laser.

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)**

<b>Party</b>	<b>Project Title and Details of Coordinating Scientist(s)</b>	<b>Summary of Objectives</b>	<b>Year removed from inventory</b>
Canada	Marine migration and survival of post-smolt Atlantic salmon from Bay of Fundy rivers <i>Coordinating scientist:</i> 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 <i>Coordinating scientist:</i> 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	Tracking experimentally 'escaped' farmed salmon <i>Coordinating scientist:</i> 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 <i>Coordinating scientist:</i> 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
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 <i>Coordinating scientist:</i> 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 <i>Coordinating scientist:</i> 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 – France	Evolution of biological characteristics in Atlantic salmon from all the Armorican massif rivers (Brittany and Low-Normandy, France) <i>Coordinating scientist:</i> 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

<b>Party</b>	<b>Project Title and Details of Coordinating Scientist(s)</b>	<b>Summary of Objectives</b>	<b>Year removed from inventory</b>
European Union – Ireland	Assessment of the levels of the parasite <i>Lepeophtheirus salmonis</i> on Atlantic salmon post-smolts in salmon aquaculture bays along Ireland's western seaboard <i>Coordinating scientist:</i> 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
European Union – Ireland	Oceanic factors influencing marine survival of Irish salmon stocks <i>Coordinating scientist:</i> Niall O'Maoileidigh niall.omaileidigh@marine.ie and Kevin Friedland friedlandk@forwild.umass.edu	Provide information on marine survival at various stages of ocean migration.	2006
European Union – United Kingdom (England and Wales)	Salmonid migration and climate change <i>Coordinating scientist:</i> 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
European Union - United Kingdom (England and Wales)	Impacts of agricultural contaminants on wild salmonids <i>Coordinating scientist:</i> 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 (Scotland)	Testing and development of Institute of Marine Research (IMR), Bergen, Norway, salmon trawl gear <i>Coordinating scientist:</i> 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
Iceland	Migration of smolts through the estuary of the River Ellidaar, Iceland <i>Coordinating scientist:</i> Sigurdur Gudjonsson sigurdur.gudjonsson@veidimal.is	Monitor the migratory behaviour of smolts.	2004
Iceland	Survival at sea of 1- and 2-sea-winter salmon in relation to oceanic conditions. <i>Coordinating scientist:</i> Sigurdur Gudjonsson sigurdur.gudjonsson@veidimal.is	Study annual changes in the ratio of 1SW:2SW salmon and in the number of salmon caught in rivers in south-west Iceland in relation to oceanic climate.	2006

<b>Party</b>	<b>Project Title and Details of Coordinating Scientist(s)</b>	<b>Summary of Objectives</b>	<b>Year removed from inventory</b>
Iceland	Variation in growth and return rates of Atlantic salmon from three Icelandic rivers <i>Coordinating scientist:</i> Thorkell Heidarsson Thorkell@veidimal.is Thorolfur Antonsson thorolfur.antonsson@veidimal.is	Increase knowledge of growth and environmental factors influencing return rates and life-history of different salmon stocks in Iceland.	2006
Norway	Identification of salmon by geochemical signatures; further development and testing of methods <i>Coordinating scientist:</i> Peder Fiske peder.fiske@nina.no	The main objectives of this project were to: <ul style="list-style-type: none"> <li>• test if geochemical signatures are stable from year to year</li> <li>• test if geochemical signatures of salmon scale samples can be used to discriminate among fish from different rivers</li> <li>• develop analytical procedures (otolith core sampling, chemical and statistical analyses) for application of this method in ecological studies on Atlantic salmon.</li> </ul>	2003
Norway	Development of models to predict marine survival and return of salmon to Norway <i>Coordinating scientist:</i> Lars Petter Hansen lars.petter.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. <i>Coordinating scientist:</i> 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, effect of measures taken and future management <i>Coordinating scientist:</i> 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
United States	Forecasts of Atlantic salmon transoceanic migration: climate change scenarios and anadromy in the North Atlantic <i>Coordinating scientist:</i> 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	Stable isotope composition of Atlantic salmon scales <i>Coordinating scientist:</i> Kevin Friedland friedlandk@forwild.umas.edu	Develop a retrospective time series of stable isotope ratios to evaluate feeding patterns over time.	2005

## **Annex 1**

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

**Project No. C1**

**Status: New entry**

Party or relevant jurisdiction	Fisheries and Oceans Canada – Newfoundland & Labrador Region
Title of project	Use of stable isotopes to assess long-term changes in marine trophic ecology of Atlantic salmon ( <i>Salmo salar</i> )
Objective of research project	<ol style="list-style-type: none"><li>1) To assess trophic and dietary information through analyses of stable isotope signatures of carbon and nitrogen (<math>^{13}\text{C}</math> and <math>^{15}\text{N}</math>) from previously compiled scale samples of various stocks of Atlantic salmon;</li><li>2) To compare isotopic signatures within (temporal) and among (spatial) stocks to infer differences in salmon feeding ecology in time and space;</li><li>3) To examine evidence for any environmental influences on trends in isotopic signatures;</li><li>4) To examine linkages with stable isotopic signatures with trends in abundance of salmon.</li></ol>
Brief description of research project	Recent investigations have proposed that marine food webs have changed dramatically owing to ever-increasing and unsustainable levels of exploitation – the so-called ‘fishing down marine food webs’ hypothesis - while others have provided evidence of trophic cascades. In addition, evidence exists for dramatic changes in ocean climate conditions in the northwest Atlantic, particularly during the early 1990s, prompting some to suggest there has been a marine climate regime shift. Ocean climate conditions have been shown to affect productivity and survival of Atlantic salmon. Salmon are considered opportunistic feeders during the marine life-history phase, often targeting prey in the upper end of the size spectrum, with a preference for fish over crustaceans should both be available. Thus, the species lends itself well to studies associated with marine environmental conditions and food web interactions. Accordingly, we propose to examine long-term variability in the trophic ecology of Atlantic salmon using analyses of stable isotope signatures of carbon and nitrogen ( $^{13}\text{C}$ and $^{15}\text{N}$ ). Specifically, 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 should provide an additional means to understand, in whole or in part, observed variability in abundance and survival of various stocks of Atlantic salmon.
Dates during which research will take place	Research will occur on the basis of analyses of previously archived material. Project was scheduled to begin in January 2006.
Area in which research will take place	Project will examine stable isotope signatures in at least five (5) Newfoundland salmon stocks, two (2) Maritime stock and one (1) Quebec north shore stock. In addition, to provide a greater geographic contrast with Eastern Canadian populations, analyses will also be carried out on a north European stock that empties into the Barents Sea, the River Tana (Teno).

Estimated number and weight of salmon to be retained	NA
<b>Resources</b>	
Estimated cost of the research project	£27,500. Project is funded by Fisheries and Oceans Canada under the International Governance of High Seas Fisheries program.
Number of participating scientists	Two scientists are participating directly in this study; one from DFO Newfoundland Region, the other from the University of Waterloo, Waterloo, Ontario, Canada.
Name and e-mail address of coordinating scientist in charge of project	J. Brian Dempson, Fisheries and Oceans Canada, 80 East White Hills Road, P.O. Box 5667, St. John's, Newfoundland & Labrador. dempsonb@dfo-mpo.gc.ca
Details of research vessels, e.g. name, registration, call sign and description of vessel	NA
Type and amount of gear and other equipment to be used	NA
Details of any collaborating countries	Samples obtained from the River Tana (Teno) were provided by scientists from Finland.
<b>Summary of Progress</b>	
<b>New entry.</b>	

**Project No. C2**

**Status: Ongoing**

Party or relevant jurisdiction	Canada
Title of project	Integrated field and laboratory assessment of the effects of endocrine-disrupting substances on Atlantic salmon smolts.
Objective of research project	<ul style="list-style-type: none"><li>- Laboratory tests of the effects of endocrine-active substances in municipal and industrial effluents, including estrogens, androgens, phytosterols and nonylphenol ethoxylates</li><li>- Field tests of the effects of endocrine-active substances in municipal and industrial effluents, including estrogens, androgens, phytosterols and nonylphenol ethoxylates (caging and exposure and release studies)</li><li>- Field tests caging smolts near sites with potential for significant agricultural runoff</li><li>- Ocean field test of link between exposure of smolts to endocrine-disrupting substances and subsequent lower adult returns (Burrishoole River, Ireland, initially and Canada if methods prove feasible)</li></ul>
Brief description of research project	<p>This project proposal is based on research conducted over the past 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 (<i>Salmo salar</i>) during and after smoltification. Nonylphenol, and the larger group of nonylphenol ethoxylates, are in use in almost all commercial, industrial and domestic sectors. These compounds are members of the second-largest class of non-ionic surfactants in use today, the alkylphenol polyethoxylates. 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. Sewage treatment works emit about 4% of their total nonylphenolic compound input as nonylphenol itself. This is a significant percentage as nonylphenol has a greater bioaccumulation potential than the nonylphenol ethoxylates. Nonylphenol ethoxylates are also used in about 20-25% of all pesticide and herbicide formulations available today. Nonylphenol itself (4-nonylphenol) has been used in the past as a major constituent in certain pesticide formulations, some of which were applied in Canada. The current research indicating estrogenic effects on fish at low 4-nonylphenol levels (10 ug/L 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. Atlantic salmon inhabit streams and lakes for their juvenile stages, and in eastern Canada have been exposed to pesticides applied for forest protection most years since the 1950s. Sensitive life stages may be affected by exposure to nonylphenol. 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.</p>
Dates during which research will take place	2003-2006

Area in which research will take place	Atlantic Canada and Co. Mayo, Ireland
Estimated number and weight of salmon to be retained	600 wild smolts per year from Miramichi River (Canada); about 14,000 smolts per year from Burrishoole River (Ireland).
<b>Resources</b>	
Estimated cost of the research project	About £115,000 per year during 2003-2005, majority from DFO ESSRF plus other funds and in-kind support from Environment Canada, DFO, Marine Institute, Ireland, and others. In 2006 no funding is expected but analysis of results will be ongoing.
Number of participating scientists	12 (DFO, Env Can, UNB, Marine Institute) plus two graduate students
Name/e-mail of coordinating scientist in charge of project	Joint coordination between: Wayne L. Fairchild FairchildW@mar.dfo-mpo.gc.ca and Scott B. Brown Scott.Brown@cciw.ca
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	Trap nets and fish holding cages in rivers in Canada
Details of any collaborating countries	Collaboration with Ken Whelan and Deirdre Cotter of the Marine Institute, Salmon Management Services Division, Furnace, Newport, Co. Mayo, Ireland - hatchery facilities, fish husbandry, capture and counting capability for Burrishoole River salmon.
<b>Summary of Progress</b>	
<p>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. A publication is now in preparation. 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. Results from both treatment years (2003 and 2004) in will be available when data from adult returns are complete after December 2005.</p> <p>Publications:</p> <p>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. <i>Ecotoxicology and Environmental Safety</i>, 62:331-340.</p> <p>Jardine, T.D., D.L. MacLatchy, W.L. Fairchild, R.A. Cunjak, and S.B. Brown. 2004. Rapid carbon turnover during growth of Atlantic salmon (<i>Salmo salar</i>) smolts in sea water, and evidence for reduced food consumption by growth-stunts. <i>Hydrobiologia</i> 527:63-75.</p> <p>Arsenault, J.T., Fairchild W.L., Maclatchy, D.L., Burrige, L., Haya, K. and Brown, S.B. 2004. Effects of water-borne 4-nonylphenol and 17<math>\beta</math>-estradiol exposures during parr-smolt transformation on growth and plasma IGF-I of Atlantic salmon (<i>Salmo salar</i> L.). <i>Aquatic Toxicology</i> 66:255-265.</p> <p>Conference presentations:</p> <p>Fairchild, W.L., L. Burrige, K. Haya and S.B. Brown. 2005. Effects of exposure to contaminants while in freshwater on subsequent marine survival in Atlantic salmon. Atlantic Canada Coastal and Estuarine Science Society (Atlantic Canadian affiliate society of the Estuarine Research Federation) meeting May 4-5, 2005, Moncton, NB.</p>	

Fairchild, W.L., Arsenault, J.T., MacLatchy, D.L., Haya, K., Burridge, L., Brown, S.B. Effects of pulsed water-borne exposure to atrazine, hexazinone and nonylphenol mixtures on growth and survival of Atlantic salmon smolts. 32<sup>nd</sup> Annual Aquatic Toxicity Workshop, October 3-5, Waterloo, Ontario.

Arsenault, J.T., Fairchild, W.L., MacLatchy, D.L., Haya, K., Burridge, L., Brown, S.B. 2004. Effects of testosterone and 5 $\alpha$ -dihydrotestosterone on plasma IGF-1 and growth of Atlantic salmon smolts. 31st Annual Aquatic Toxicity Workshop, October 24-27, Charlottetown, PEI.

**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	<p>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.</p> <p>Spatial and temporal trends in freshwater smolt production and in marine survival are monitored at the following sites:</p> <p>In DFO's Newfoundland Region, five (5) facilities: Campbellton River; Northwest River (Trepassey) and Rocky River; Conne River; and Western Arm Brook</p> <p>In DFO's Maritimes Region, three (3) facilities: Nashwaak River, Mactaquac dam on Saint John River, and LaHave River (wild and hatchery)</p> <p>In DFO's Gulf Region, four (4) facilities: two on the Miramichi River (Northwest and Southwest tributaries), Restigouche River, Margaree River</p> <p>In Quebec, the Société de la Faune et des parcs du Québec (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.</p>
Brief description of research project	<p><i>Newfoundland:</i> 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 (&lt; 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.</p> <p><i>Maritimes:</i> 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.</p> <p><i>Gulf:</i> 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.</p>

	<p><i>Quebec:</i> 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.</p> <p>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.</p>
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
<b>Resources</b>	
Estimated cost of the research project	<p>Newfoundland (£287,000 sub-total): DFO - £209,000 per year, incl overheads NGO Partners - £78,000 per year</p> <p>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)</p> <p>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&amp;M for assistance. Same level of support anticipated in 2006-2007</p> <p>Quebec (£141,500 sub-total): MRNF - £41,500 per year, incl overheads Hydro Quebec – £22,200 per year CIRSA - £77,800 per year</p> <p>-----</p> <p><b>Canada Total - £564,500 per year</b></p>
Number of participating scientists	Newfoundland (5), Maritimes (3), Gulf (2), Quebec (10)
Name/e-mail of coordinating scientist in charge of project	<p>C. Bourgeois (Rocky River), B. Dempson (Conne River, Western Arm Brook), M. O’Connell (Northeast Brook, Trepassey), D. Reddin (Campbellton River), T. Goff, R. Jones, P. Amiro (Maritimes), G. Chaput (Gulf), F. Caron, S. Lachance (MRNF), L. Bernatchez (CIRSA, U.Laval)</p> <p>For information, contact: G. Chaput, <a href="mailto:Chaputg@dfo-mpo.gc.ca">Chaputg@dfo-mpo.gc.ca</a></p>

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	Smolt and adult traps in fishways and fences, trap nets, rotary screw smolt traps.
Details of any collaborating countries	
<p><b>Summary of Progress</b></p> <p><i>Newfoundland:</i>  Smolt production in 2004 increased in four of five stocks, by comparison with 2003. Increases ranged from 11% at Conne River to more than 40% at both Northeast Brook (Trepassey) and Western Arm Brook. At Rocky River, assuming the smolt estimate for 2003 was correct (4440), then production increased by a factor of three. In contrast, smolt production at Campbellton River decreased by 6.6% relative to the previous year. With the exception of Campbellton River, the other four stocks have smolt production values in 2004 that are 9 to 62% higher than corresponding average values for the 5-year period 1999 to 2003. Four of the five rivers experienced peak production in 1997. At Campbellton River, where smolt production declined, returns of small salmon in 2005 are expected to be lower unless there is a compensatory increase in marine survival.</p> <p>Marine survival, corresponding to adult small salmon returns in 2004, averaged 6.6% across all five rivers, ranging from a high of 9.5% at Western Arm Brook to a low of 3.8% at Rocky River. Overall, survival increased (Conne River; Northeast Brook (Trepassey)) or remained approximately the same (Western Arm Brook; Rocky River) by comparison with the previous year with the greatest improvements occurring at two south coast monitored rivers (Conne River and Northeast Brook, (Trepassey)). Marine survival, however, remains highly variable and generally low. Higher survivals have occurred in the past, even in years when directed ocean fisheries for salmon were in existence.</p> <p><i>Maritimes:</i>  Simultaneous monitoring of both wild and hatchery smolt migrations and adult returns since 1996 at two locations, Nashwaak and LaHave rivers, provide data necessary for the interpretation of the 30-year time series of hatchery return rates. This data indicates a major downward shift occurring after 1990 that has affected both wild and hatchery salmon and differs by sea age. The information collected also provides data for age structured stock and recruitment models. Interpretations of changes in these life history factors provides critical information to assess persistence and recovery strategies for threatened or endangered salmon stocks worldwide. These data are regularly contributed to the ICES, WGNAS and conversion of working papers to research documents is proceeding.</p> <p><i>Gulf:</i>  Smolt production from the Miramichi River in 2004 was estimated at 1.5 million fish, twice the levels of the previous three years. The return rate of smolts in 2003 to 1SW salmon in 2004 was 5.6%, compared to 3.5% and 7.8% in the previous two years. Return rates to 2SW salmon were 2.0% and 1.4% for the 2001 and 2002 smolt runs, respectively.</p> <p><i>Quebec:</i>  Wild smolt production decreased 33% from the previous 5 years on river Saint-Jean and 49% on river de la Trinité. Sea survival on river Saint-Jean from smolt (year class 2002) to adult is similar as year class 2000, being 1.42% vs 1.41% , the 1989-2002 average being 1.29%. On river de la Trinité, sea survival has increased to 1.33% from 0.83% the year before, 1984-2002 average being 2.48%. Sea survival estimates for stocked salmon monitored on rivers Aux Rochers, A Mars and Malbaie will be obtained next year.</p>	

**Project No. C4****Status: Ongoing**

Party or relevant jurisdiction	Canada NGO (Atlantic Salmon Federation), DFO collaboration (Gulf Region) and Province of Québec
Title of project	Atlantic salmon smolt migration and survival within Canadian Rivers and their estuaries
Objective of research project	Determine the fraction of smolts that have been tagged in fresh water that survive to the head of tide.  Determine the fraction of smolts tagged at the head of tide that successfully transit the estuaries to the open sea.
Brief description of research project	Atlantic salmon smolts are fitted with acoustic tags. They are captured in smolt wheels positioned in upstream tributaries. Acoustic receiving arrays will be positioned in both rivers, at the head of tide, and at the exit of the estuary. Additional receivers will be placed at points of opportunity. The receiver arrays will also be used to monitor striped bass, American eels, and possibly anadromous brook trout.
Dates during which research will take place	2003 - 2006 (spring/summer)
Area in which research will take place	Miramichi River and estuary; Restigouche River and Baie des Chaleurs, Magaguadavic River and estuary; Cascapedia River and estuary; St-Jean (Côte-Nord) River and estuary
Estimated number and weight of salmon to be retained	200 smolts, tagged and released
<b>Resources</b>	
Estimated cost of the research project	Approx. £114,000 for operations, salaries and acoustic tags  Approx. £68,000 for receiver arrays  Approx. £100,000 for smolt wheels (Partner contribution: 8 wheels and their operation)  Total Approx. £282,000 per annum  Principal Supporting Partners: Miramichi Salmon Association Bowater J D Irving Ltd DFO US NOAA Fisheries
Number of participating scientists	8
Name/e-mail of coordinating scientist in charge of project	Fred Whoriskey asfres@nb.aibn.com
Details of research vessels, e.g. name, registration, call sign and description of vessel	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 100 VR 2 acoustic receivers 200 acoustic tags

Details of any collaborating countries	Data sharing underway with US NOAA Fisheries tracking programs.
<p><b>Summary of Progress</b></p> <p>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 farther north. For the Miramichi and Restigouche Rivers, three and two years of data respectively have been collected, whereas a single year (2005) is available for the other sites. Results for the Miramichi and Restigouche have been consistent among years. In the Miramichi system, freshwater survival was high (about 90%) in all three years, with about 50% of the tagged smolts exiting 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 exiting the river and its associated estuary to the sea. There was no evident gradient in survivals to the sea from south-to-north. The work will be repeated in 2006.</p>	

**Project No. C5****Status:****Ongoing**

Party or relevant jurisdiction	Canada Québec, MRNF University Laval, Mc Gill, UQARimouski, UQAMontreal, INRS NGO (Atlantic Salmon Federation)/DFO collaboration
Title of project	Integrated modelling of juvenile Atlantic salmon movement and physical habitat in fluvial and estuarine environments
Objective of research project	(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. (3) In the case of aquaculture development planned in the Baie de Gaspé, to detect potential changes in the migration pattern of smolts in response to the presence of sea cages.
Brief description of research project	The spatial and temporal distribution of smolts will be assessed by tagging smolts with coded transmitters during their downstream migration. We plan to release 60 tagged smolts during year 1, 2 and 3. These smolts will be monitored by (a) a boat-mounted directional hydrophone and receiver to track their migration in the estuaries (b) an array of fixed, GPS georeferenced, hydrophones moored across the Baie de Gaspé. Particle image velocimetry and image analysis techniques and passive acoustic drifters will be used to determine surface flow velocity fields within the estuaries and Baie de Gaspé.
Dates during which research will take place	Spring/summer 2005 to 2008
Area in which research will take place	York River and Bay of Gaspé, Québec Canada
Estimated number and weight of salmon to be retained	50 smolts, tagged and released
<b>Resources</b>	
Estimated cost of the research project	Approx. £100,000 for operations, salaries and acoustic tags  Approx. £30,000 for receiver arrays  Approx. £20,000 for smolt wheels  Total Approx £150,000 per annum  <b>Principal Supporting Partners:</b> Atlantic Salmon Federation, Fred Whoriskey Centre Interuniversitaire de Recherche sur le Saumon Atlantique (CIRSA) Fédération Québécoise du Saumon Atlantique Fondation pour le saumon du Grand Gaspé Génivar Hydro-Québec Ministère des Ressources Naturelles et de la Faune BC Ministry of Sustainable Resource Management, Information Services Division, Evert Kenk

	<p><b>Principal investigators</b>  Normand Bergeron, INRS-Eau, Terre et Environnement. <u>Deputy leader</u>.  Thomas Buffin-Bélanger, Université du Québec à Rimouski.  François Caron, Ministère des Ressources naturelles et de la Faune (10%).  Michael Church, University of British-Columbia.  Stuart Lane, University of Leeds, UK.  Michel Lapointe, McGill University.</p>
Number of participating scientists	10
Name/e-mail of coordinating scientist in charge of project	Julian Dodson julian.dodson@bio.ulaval.ca.
Details of research vessels, e.g. name, registration, call sign and description of vessel	Small boats (less than 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 50 VR 2 acoustic receivers 50 acoustic tags
Details of any collaborating countries	Canadian and UK collaboration (University of Leeds)
<p><b>Summary of Progress</b></p> <p>Smolt tagging and tracking was conducted as planned. Data are being processed. Project will be repeated in 2006.</p>	

**Project No. C6****Status:****New entry**

Party or relevant jurisdiction	Fisheries and Oceans Canada – Maritime Region
Title of project	River and extended estuary acoustic tracking of Atlantic salmon ( <i>Salmo salar</i> ) kelts
Objective of research project	<ol style="list-style-type: none"> <li>1) To track and document migratory behaviour of Atlantic salmon kelts as they leave the river for the open ocean;</li> <li>2) To identify possible critical habitat sites utilized by kelts during their migration</li> <li>3) To examine the mortality rates of kelts during migration</li> </ol>
Brief description of research project	The population of Atlantic salmon in the LaHave River on the Atlantic coast of Nova Scotia has been in decline in the 1990s and continues to decline because of low marine survival of both smolts and post spawning adult salmon (kelts). Reasons could include poor physiological condition, interference with migration or increased predation. In this study acoustic tags and receivers are being used to provide evidence on the migration, timing and fate of migrating adult salmon. Thirty kelts were captured and implanted with the acoustic tags, including 5 tags that transmit depth data. Continuous recording acoustic receivers have been placed in the river 15 km above tide to 24 km below tide at the outer limits of the estuary to monitor the passage of tagged fish. Active searches are also being used to locate marine summer holding habitat and to locate missing tags that may indicate mortalities. The array will remain in place from May to October. Environmental data are also being collected at each receiver location on a periodic basis and temperature is being continuously recorded at some receiver locations.
Dates during which research will take place	Project began in April 2006, and terminates in October of 2006. Based on the success to date, there is interest in continuing the study in 2007.
Area in which research will take place	LaHave River, and estuary, Lunenburg, Nova Scotia, Northwest Atlantic Ocean, Canada. 44°23' N, 64°32' W
Estimated number and weight of salmon to be retained	NA
<b>Resources</b>	
Estimated cost of the research project	£55,000. Project is funded by Fisheries and Oceans Canada, LaHave River Salmon Association and affiliates.
Number of participating scientists	Three scientists are participating directly in this study from DFO Maritimes Region. Also one graduate student and scientist from Acadia University, Wolfville Nova Scotia, Canada.
Name and e-mail address of coordinating scientist in charge of project	Peter G. Amiro. Fisheries and Oceans Canada. 1 Challenger Drive, P.O. Box 1006, Dartmouth, Nova Scotia, B2Y 4A2. e-mail: AmiroP@mar.dfo-mpo.gc.ca
Details of research vessels, e.g. name, registration, call sign and description of vessel	NA

Type and amount of gear and other equipment to be used	26 Vemco VR2 receivers, 30 Vemco V13 transmitters, 1 Vemco VR60 receiver
Details of any collaborating countries	NA
<b>Summary of Progress</b>	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.

**Project No. D1                      Status:                      Ongoing**

Party or relevant jurisdiction	Greenland (Denmark)
Title of project	West Greenland Salmon Fishery Sampling Programme
Objective of research project	<ol style="list-style-type: none"> <li>1. Continue the time series of data (1969-2004) on the continent of origin and biological characteristics of the salmon in the West Greenland Fishery</li> <li>2. Provide data on mean weight, length and continent of origin for input to the North American and European run-reconstruction models</li> <li>3. Collect information on the recovery of internal and external tags</li> <li>4. Collect information on fish diseases and parasites of salmon and other special samples as requested.</li> </ol>
Brief description of research project	<p>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.</p> <p>Under the NASCO West Greenland Sampling Agreement 2005 (WGC(05)6). Parties to the NASCO West Greenland Commission agreed to provide staff to sample catches of Atlantic salmon in the West Greenland fishery during the 2005 fishing season.</p> <p>The sampling programme collects:</p> <ul style="list-style-type: none"> <li>• Meristic data including lengths and weights of landed fish;</li> <li>• Information on tags, fin clips and other marks;</li> <li>• Scale samples to be used for age and growth analyses;</li> <li>• Tissue samples to be used for genetic analyses;</li> <li>• Tissue samples to be used for disease sampling for the detection of ISAv and other disease and parasite organisms as requested;</li> <li>• Other biological data requested by the ICES scientists and NASCO co-operators.</li> </ul> <p>Both scale and genetic samples are used to characterise the continent-of-origin of captured salmon.</p>
Dates during which research will take place	Annually during the fishing season, usually August – October
Area in which research will take place	Qasigiannguit, Maniitsoq, Nuuk, and Qaqortoq Greenland

Estimated number and weight of salmon to be retained	
<b>Resources</b>	
Estimated cost of the research project	Greenland - approximately £9,000 per annum (includes salaries, travel, lodging and equipment) Canada - £6,000 EU (United Kingdom) - £20,000 per annum EU (Ireland) - £6,200 per annum USA - £21,000 per annum  Total: £62,200 per annum
Number of participating scientists	3 technicians and 1 scientist from Greenland working with scientists from Canada, USA, UK and Ireland
Name/e-mail 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. O'Maoileidigh) and Canada (D. Reddin). The work is coordinated via NASCO and is reported to ICES (Working Group on North Atlantic Salmon).
<b>Summary of Progress</b>	
<p>In 2005, the sampling programme included sampling teams from Greenland, United States, United Kingdom and Ireland. Teams were in place at the start of the fishery on 10 August and continued until 31 October. In total, about 800 specimens were sampled for presence of tags, fork length, weight, scales, and tissue samples for DNA analysis. Samples were obtained from four landing sites, Qaqortoq (NAFO Division 1F), Nuuk (1D), Maniitsoq (1C), and Qasigiannuit (1A). The sampled salmon were measured, scales were removed for ageing, and gutted weight recorded. Approximately 760 scale samples were collected and aged by Canadian collaborators and a total of 750 tissue samples were removed and preserved for DNA analysis with US collaborators.</p>	

### 3. EUROPEAN UNION

**Project No. E1                      Status:                      Ongoing**

Party or relevant jurisdiction	European Union – United Kingdom (England and Wales)
Title of project	Impact of intensive in-river aquaculture on wild salmonids
Objective of research project	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.
Brief description of research project	This is a large research programme examining the impact of fish farm effluent on wild salmon populations. Previous studies carried out at CEFAS have demonstrated that sublethal concentrations of agricultural pesticides and contaminants may significantly affect the ability of smolts to adapt to the marine environment. A similar variety of compounds are also known to be released within the effluents from freshwater aquaculture facilities and these include pesticides and antibiotics for the control of parasitic and bacterial diseases, and hormones and hormone metabolites from the farmed fish. The aim of the present research programme is to describe the impact of environmentally relevant concentrations of fish farm contaminants on smoltification and seawater survival. The results will be incorporated into salmonid life-cycle models currently being developed, in order to increase our understanding of the impacts of aquaculture contaminants on stocks of salmonids.
Dates during which research will take place	November 2001 – August 2006
Area in which research will take place	England and Wales
Estimated number and weight of salmon to be retained	N/A
<b>Resources</b>	
Estimated cost of the research project	£325,000 (over 5 years) £72,000 per annum
Number of participating scientists	4
Name/e-mail of coordinating scientist in charge of project	Andrew Moore a.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
<b>Summary of Progress</b>  Laboratory and field-based studies are continuing to assess the impact of the effluents on smoltification and sea water adaptation of emigrating smolts.	

**Project No. E2                      Status:                      Ongoing**

Party or relevant jurisdiction	European Union – United Kingdom (England and Wales)
Title of project	Modelling the bioenergetics of salmon migration
Objective of research project	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.
Brief description of research project	Successful migration of salmon within the marine environment requires that sufficient energy stores are either available prior to, or replenished throughout, migration. Therefore, the overall energy budget of a salmon may be an extremely important factor contributing to the migratory success, growth and survival in the sea. The project will develop a model to describe the basic energy requirements of salmon and how it is utilised for movement, maintenance and growth in the marine environment. The model will be used to predict the effects of environmental and oceanographic changes (e.g. sea surface temperature, ocean currents, food availability) on growth and survival in the sea.
Dates during which research will take place	August 2002 – August 2006
Area in which research will take place	The research will model the migrations of selected stocks of salmon from English and Welsh rivers.
Estimated number and weight of salmon to be retained	N/A
<b>Resources</b>	
Estimated cost of the research project	£40,000 per annum
Number of participating scientists	3 scientists (1 Centre for Ecology and Hydrology, 1 National Oceanography Centre, 1 University Marine Biological Station Millport)
Name/e-mail of coordinating scientist in charge of project	Douglas Booker dobo@ceh.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**

An Individual Based Model (IBM), which simulates the energy balance of migrating salmon in the Atlantic, has been developed based on published experiments on Atlantic salmon. Although the model is being designed for simulation of salmon leaving the UK, the model's spatial domain covers the entire North Atlantic Ocean. This allows testing of model predictions using information from North America and continental Europe. Ocean currents and temperature data for the North Atlantic have been extracted from the OCCAM (Ocean Circulation and Climate Advanced Modelling) model and input to the bioenergetic model. These data cover from 1993 to 1999. The model is currently being used to predict migration routes, growth and survival of individual salmon from identified populations.

**Project No. E3****Status: Ongoing**

Party or relevant jurisdiction	European Union – United Kingdom (England and Wales)
Title of project	Cardiff Bay Fisheries Monitoring Programme
Objective of research project	Assess the impact of Cardiff Bay Barrage on salmon and sea trout stocks in the rivers Taff and Ely
Brief description of research project	<ol style="list-style-type: none"> <li>1. Tracking movements of adult salmon up to and past barrage and through impoundment using combined acoustic and radio tags.</li> <li>2. Tracking movements of smolts through impoundment and past barrage.</li> <li>3. Monitoring changes in the return rates of microtagged smolts (hatchery origin) before, during and after construction.</li> </ol>
Dates during which research will take place	Through years 1990-2008
Area in which research will take place	Cardiff Bay at mouth of rivers Taff, Ely, South Wales, UK
Estimated number and weight of salmon to be retained	Up to 20 per year
<b>Resources</b>	
Estimated cost of the research project	c. £250,000 per annum
Number of participating scientists	5/6 per annum
Name/e-mail of coordinating scientist in charge of project	Peter Gough peter.gough@environment-agency.wales.gov.uk
Details of research vessels, e.g. name, registration, call sign and description of vessel	‘Challenger’ M00WB70085 7-4 Metres long
Type and amount of gear and other equipment to be used	c 60 C.A.R.T tags pa. C 100 smolt tags pa. 10,000 micro-tagged smolts and c 50,000 fin-clipped parr/smolts stocked each year.
Details of any collaborating countries	None
<b>Summary of Progress</b>	
Monitoring programmes to investigate the impact of the Cardiff Bay Barrage have continued. These have included releasing tagged and fin-clipped parr and smolts; monitoring the operation of the barrage and fish passes; monitoring returns of tagged and untagged fish; and investigating the behaviour of returning fish.	

**Project No. E4****Status: Ongoing**

Party or relevant jurisdiction	European Union – United Kingdom (England and Wales)
Title of project	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.
Brief description of research project	There is increasing 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, particularly during the parr-smolt transformation and during entry into saltwater at concentrations frequently found in the environment. Initial modelling from these laboratory-based studies has indicated that exposure at these critical stages may affect productivity at the population level. The present research programme has two principal aims. Firstly, to validate the results from previous laboratory-based studies carried out at CEFAS and determine whether exposure to these contaminants within river systems in England and Wales are affecting populations in the wild. The proposed research will test the conclusions made about the effects on populations of wild salmon by the retrospective analyses of the relationship between specific declining stocks and land management changes resulting in the occurrence of target contaminants in the aquatic environment. The proposed research will therefore determine the potential impacts of these contaminants on fish at both the individual and population level in order to support both the advice on the regulation of contaminants within aquatic ecosystems and the conservation and management of fish populations.
Dates during which research will take place	April 2005 – March 2010
Area in which research will take place	England and Wales
Estimated number and weight of salmon to be retained	N/A
<b>Resources</b>	
Estimated cost of the research project	£694,680 (over 5 years)
Number of participating scientists	3
Name/e-mail address of coordinating scientist in charge of project	Andrew Moore a.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**

The impact of brominated flame retardants (BFRs) on smoltification and marine survival are continuing. BFRs have been shown to affect thyroid metabolism which has a principal role in the adaptation of smolts to saltwater.

**Project No. E5**

**Status: Ongoing**

Party or relevant jurisdiction	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
Brief description of research project	One aspect of the research that is directly related to marine survival examines the potential role of assessment techniques in influencing marine survival of salmonid smolts. Assessment methodologies such as trapping, anaesthetisation and tagging of wild/hatchery fish could affect the ability of smolts 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. The proposed research will critically assess the techniques routinely used as the tools for population assessments and that provide the basis for the provision of advice to managers on biological reference points, the status of stocks and management measures for specific fisheries.
Dates during which research will take place	April 2005 – March 2010
Area in which research will take place	England and Wales
Estimated number and weight of salmon to be retained	N/A
<b>Resources</b>	
Estimated cost of the research project	£615,350 (over 5 years)
Number of participating scientists	3
Name/e-mail address of coordinating scientist in charge of project	Andrew Moore a.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
<b>Summary of Progress</b>	
Large-scale microtagging and PIT tagging studies have been established on the River Frome to determine the marine survival of groups undergoing various assessment techniques.	

**Project No. E6                      Status                      Ongoing**

Party or relevant jurisdiction	European Union – United Kingdom (England and Wales)
Title of project	Deriving estimates of marine survival and exploitation 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 and exploitation in marine fisheries can be derived and compared with other North Atlantic stocks.
Brief description of research project	<p>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 average. However, there are no long-term data sets for stocks in England and Wales. It is recognised that data needs to be collected in a consistent manner from year to year in order to provide a reliable time series of data and to allow trends to be identified. It has also been agreed that information on more than one stock would be preferable to allow for possible spatial differences. Two stocks have therefore been selected for investigation in the first instance; these are the River Dee (North Wales) and the River Tamar (SW England). Both these stocks have a reasonable proportion of MSW salmon.</p> <p>Smolt tagging programmes (with wild smolts) have been initiated at both sites and new sites and trapping methods (rotary screw traps) have been identified on both rivers that will enable the trapping and tagging of wild fish on the main stems of these rivers. If possible, smolt run estimates will be derived using mark-recapture methods. Both rivers also have facilities (counters/traps) for estimating the adult run. The investigations are being run on a collaborative basis by the Environment Agency and the Centre for Environment, Fisheries and Aquaculture Science (CEFAS).</p>
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
<b>Resources</b>	
Estimated cost of the research project	N/A (Part of larger monitoring and assessment programmes)
Number of participating scientists	~10 – involves staff from the CEFAS Salmon & Freshwater Team and personnel from the Environment Agency’s National Salmon and Trout Fisheries Centre and from Environment Agency regional offices.
Name/e-mail of coordinating scientist in charge of project	<p>Ian Davidson (Environment Agency – Dee) ian.davidson@environment-agency.wales.gov.uk Simon Toms (Environment Agency – Tamar) simon.toms@environment-agency.gov.uk Ian Russell (CEFAS) i.c.russell@cefass.co.uk</p>

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
<p><b>Summary of Progress</b></p> <p>The Environment Agency and CEFAS have continued the joint programmes on the rivers Dee (North Wales) and Tamar (SW England) to monitor marine survival of these salmon stocks and obtain information on their exploitation outside home waters. Smolt trapping with rotary screw traps has continued on both rivers, with more than 7,000 smolts tagged on the Tamer and 4,000 on the Dee in 2005. Upstream traps were also used to monitor the adult run throughout 2005.</p> <p>Results of the studies have been used to estimate the effects of the Irish coastal fisheries on salmon stocks in UK (England and Wales), and a paper was presented to the ICES North Atlantic Salmon Working Group in April 2005.</p>	

**Project No. E7****Status: Ongoing**

Party or relevant jurisdiction	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.
Brief description of research project	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. One potential method to test this hypothesis is to retrospectively measure the stable isotopic composition of salmon scales, which reflect the isotopic composition of the prey items. Changes in the abundance or availability of specific food items may show up as changes in the stable isotopes within salmon scales. 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. This study will also form part of the programme of research on salmon in the sea being co-ordinated by NASCO.
Dates during which research will take place	April 2005 – March 2010
Area in which research will take place	England and Wales
Estimated number and weight of salmon to be retained	N/A
<b>Resources</b>	
Estimated cost of the research project	£721,830 (over 5 years).
Number of participating scientists	4
Name/e-mail address of coordinating scientist in charge of project	Andrew Moore a.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**

Initial analysis has identified differences in the stable isotope compositions of scales derived from MSW and grilse which could signify variations in feeding areas or quality of available prey.

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

Party or relevant jurisdiction	European Union – United Kingdom (England and Wales)
Title of project	Atlantic Salmon Arc Project, ASAP
Objective of research project	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.
Brief description of research project	<p>A Europe-wide collaboration to define tools methods for genetic metapopulation studies culminating in a Europe-wide effort to collect samples from all the regions and genotype using defined methods and take first steps to assess proportional stock exploitation at sea. Microsatellite analysis will be the method used. The genetic laboratories directly involved are Exeter University and Oviedo University.</p> <p>There are many associated partners in the study helping to collect salmon samples from the rives of the North Atlantic; however, the funded partners in the study are:  Central Fisheries Board of Ireland  Westcountry Rivers Trust (Lead partner)  Association of West Coast Fisheries Trusts  Oviedo University  Asturias Government  Galician Government  Exeter University.</p>
Dates during which research will take place	May 2004 – May 2007
Area in which research will take place	Europe, North Atlantic
Estimated number and weight of salmon to be retained	N/A
<b>Resources</b>	
Estimated cost of the research project	£1.1 million Approximately £370,000 per annum
Number of participating scientists	12
Name/e-mail address of coordinating scientist in charge of project	Dylan Bright dylan@wrt.org.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	Spain, France, Ireland, Scotland, USA, Iceland

## Summary of Progress

The major outputs from ASAP and their current degree of completion are as follows:

1. Genetic Spatial Database (protocols established, most samples collected, analysis underway)
2. Web Site (complete and live [www.atlanticsalmon.org.uk](http://www.atlanticsalmon.org.uk))
3. Document on Ecosystem Approach to fisheries management (in production)
4. Document on Best Practice survey and monitoring methods in Europe (in production)
5. Economic Assessment Tool (complete, to be circulated to partners)
6. Final Report (not yet started)

In 2004 a meeting was held in West Virginia attended by most of the major researchers involved with Salmonid Genetic Stock Identification in the North Atlantic and on the Pacific coast of North America. The main outcome was an agreed suite of 12 genetic markers, which is almost double the 6-8 markers that were expected to be used in ASAP. This has meant that additional genetic sequencing has been required for the project and additional funding is being sought to complete the work. The 12 genetic markers comprise some that are highly variable within the salmon species as a whole and some that are less variable; one of the makers, for example, only discriminates between American/Canadian Atlantic salmon and European Atlantic salmon but within these regions has no discriminatory power.

The economic analysis of the Atlantic salmon recreational and commercial fisheries is now complete and currently undergoing peer review. The analysis comprises an international review of all the available published economic studies concerning the economic evaluation of the Atlantic salmon. It is hoped that the findings will allow an internationally accepted comparative evaluation of stocks, as it represents an average of all previous studies, which have been undertaken in different regions of Europe. This will theoretically enable transnational debates and agreements to be furthered using an agreed methodology for valuation, which will complement the agreed Genetic Stock Identification methods and results. An informed transnational debate on marine salmon conservation can subsequently be perused.

A report concerning the 'Best Practice for Fishery Management', will be produced from the findings of the ASAP project based on data provided on the structure of UK salmon populations. A working group is planned for March 2006 on 'Habitat Description, Measurement and Assessment in Rivers' (HDMAR). ASAP is supporting this process, co-funding the meetings, and will jointly publish the findings. The meeting and the publication will bring together Scottish, Welsh, English and Irish surveying methods.

More groups are aligning themselves with ASAP and the 'West Virginia Protocols', and several new projects are developing, which will draw in Scandinavian, Russian and Baltic populations. Irish researchers have secured funding to carry out in-depth studies on the 'within catchment' structure for all their salmon rivers.

**Project No. E9****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
Objectives 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 renewed in 2006 for 5 further years.
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.
<b>Resources</b>	
Estimated cost of the research project	£43,290 per annum
Number of participating scientists	2 project scientists and 3 technical staff
Name/e-mail of coordinating scientist in charge of project	Walter Crozier walter.crozier@dardni.gov.uk Gersham Kennedy gersham.kennedy@dardni.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 data on marine survival and exploitation of R. Bush wild and hatchery-origin salmon. These data are made available to ICES.

Work has started on updating and extending an earlier analysis of relationships between growth at sea and marine survival.

Work has continued in 2005 to analyse relationships between changes in smolt migration timing and subsequent survival at sea.

Information from this project has led to a scientific recommendation for managers to pursue reductions in exploitation of N. Irish salmon stocks in the Fishery Conservancy Board area. This resulted in implementation of a buy-out scheme for commercial net fisheries in 2002, together with restrictions on rod exploitation. Project results are being used to evaluate the impact of these management measures on an ongoing basis.

**Project No. E10**

**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	<p>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.</p> <p>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.</p> <p>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 is also being undertaken to provide information on the contribution of seals to the marine mortality of Conon salmon (see E12).</p>

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
<b>Resources</b>	
Estimated cost of the research project	N/A - subsumed within larger projects to investigate population dynamics and impacts of in-river works on mortality.
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/e-mail of coordinating scientist in charge of project	North Esk - Julian MacLean j.c.maclea@marlab.ac.uk River Dee - Alan Youngson a.youngson@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
<b>Summary of Progress</b>	
Results from the surveillance monitoring are given to the Working Group for consideration in their on-going modelling work.	

**Project No. E11****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
<b>Resources</b>	
Estimated cost of the research project	N/A – subsumed within general scale-reading programme
Number of participating scientists	3 (also employed on other projects)
Name/e-mail of coordinating scientist in charge of project	Julian MacLean j.c.maclea@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
<b>Summary of Progress</b>	
Insights about the factors affecting early marine mortality and possible mechanisms emerging. Analysis of trends in growth patterns among monthly run-timing groups continues. A paper is in preparation on growth checks and seasonal patterns of return.	

**Project No. E12**

**Status: Ongoing**

Party or relevant jurisdiction	European Union – United Kingdom (Scotland)
Title of project	Protecting salmonid fisheries from seal damage
Objective of research project	<p>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.</p> <p>Identify factors influencing the migration routes of salmon in estuaries and relate to the presence of predators.</p> <p>Examine the occurrence of seal-damaged salmon on a wide geographic scale.</p>
Brief description of research project	<p>Further development and application of a molecular tool to identify and distinguish between salmon and sea trout DNA in seal scats collected in the Moray Firth.</p> <p>A pilot study was undertaken in 2004 and 2005 tracking salmon in the Cromarty Firth. Migration routes were mapped in relation to topographical features, and examined in relation to a seal haul-out site. An additional aspect of this project, where direct observations of behavioural interactions between predators and prey was to be made using acoustic observations, visual observations and side-scan sonar, but was dependent upon successfully obtaining external funding, which was not obtained. Survival of the fish in the upper Firth was also examined.</p> <p>A scheme to categorise damage to salmon was constructed in conjunction with Aberdeen University and the Atlantic Salmon Trust. This will be used to determine the number of salmon that are damaged, and the proportion that is attributable to seals, from data collected by Fisheries Trust biologists throughout Scotland.</p>
Dates during which research will take place	April 2003-March 2008
Area in which research will take place	Principally north-east Scotland (Cromarty Firth). Possible work in other estuaries as required, and extension into the West Coast.
Estimated number and weight of salmon to be retained	Estimate not yet available
<b>Resources</b>	
Estimated cost of the research project	2004/05 - £142,000 2005/06 - £100,000 (+ £7000 from the Atlantic Salmon Trust) 2006/07 - £105,000 (plus an estimated £10,000 Spey DSFB)
Number of participating scientists	Multi-disciplinary work will involve scientists from a number of teams within Fisheries Research Services and with staff from SMRU, and the Spey District Salmon Fishery Board
Name/e-mail of coordinating scientist in charge of project	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	Laboratory – DNA analysis Field work – Acoustic tags and receivers, inflatable craft.
Details of any collaborating countries	N/A
<p><b>Summary of Progress</b></p> <p>Work has continued to refine DNA-differentiation of salmon and trout in seals' diets. Movements of 42 returning salmon were tracked through the Cromarty Firth in 2004 and 2005. Returns of damage to salmon from the River Spey in 2004 and 2005 are currently being analysed. Pilot tracking work with sea trout smolts leaving the River Shieldaig, Wester Ross, was conducted in 2005 and, based on these results, a more comprehensive programme will be carried out in 2006. AST and FRS funding has enabled development of a seal-mounted PIT tag detector, was successfully tested in the lab in spring 2005 and will be used in field trials in spring 2006.</p>	

**Project No. E13****Status: Ongoing**

Party or relevant jurisdiction	EU – Ireland
Title of project	National coded wire tagging and tag recovery programme
Objective of research project	The 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
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 and in experimental trawling 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 (150,000 to 250,000 fish) and actual tag recovery (unraised) can be as high as 6% for specific groups.
Dates during which research will take place	Tagging            November to April Recovery            Post-smolts – May to July (Norwegian Sea), September to November (Faroes) Grilse – May to November MSW – January to November
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 coastal fisheries, Irish rivers MSW                 North of Faroes, Irish coastal fisheries, Irish rivers
Estimated number and weight of salmon to be retained	Up to 200,000 adults may be examined and cored to retrieve tags. Up to 40 post-smolts may be recovered in high-seas experimental fisheries of Faroes and Norwegian Sea
<b>Resources</b>	
Estimated cost of the research project	£300,000 per annum nationally funded (does not include sampling in experimental fisheries in high seas, etc.)
Number of participating scientists	5
Name of coordinating scientist in charge of project	Niall O' Maoileidigh niall.omaileidigh@marine.ie
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, UK, Faroes

**Summary of Progress**

Transporting of stock and recruitment parameters to the wetted areas of each river in Ireland has been carried out and new CLs for each river have been adopted in 2005. Estimates of survival and exploitation rates from the CWT programme are used to estimate the PFA of salmon stocks in each of the 17 salmon fishing districts in Ireland and to provide annual catch advice for Irish salmon fisheries.

**Project No. E14****Status: Ongoing**

Party or relevant jurisdiction	EU – Ireland
Title of project	Migration of salmon in estuarine and coastal waters
Objective of research project	Investigate the timing, route of migration and aspects of the biology of migrating ranched salmon smolts in comparison to the native wild smolt migration.
Brief description of research project	<p>There are three main elements to the project:</p> <p>a) <i>Timing of wild smolt migration</i> The downstream traps will be monitored for the wild salmon smolt migration and this will be related to environmental, lunar and tidal conditions.</p> <p>b) <i>Tracking of wild smolts by acoustic sounding and ranched smolts by acoustic pinger tags and remote receivers</i> Wild and ranched smolts will be tracked using acoustic echosounders to ascertain migration patterns within fresh water and the upper estuary. Acoustic Vemco V8SC-6L-4K pingers will be inserted into 40 ranched smolts. A series of 13 automatic listening stations installed throughout the estuary and Clew Bay will monitor the seaward movements of these fish, recording timing, direction of movement, temperature and tide.</p> <p>c) <i>Biological Sampling</i> Samples of migrating smolts will be collected in the coastal waters by gill net and surface otter trawling. Analysis will include scales (growth), diet and parasite load (internal and external).</p>
Dates during which research will take place	2005-2008
Area in which research will take place	The Burrishoole Catchment, Newport, and Clew Bay, Co. Mayo
Estimated number and weight of salmon to be retained	N/A
<b>Resources</b>	
Estimated cost of the research project	£24,000 per annum
Number of participating scientists	3 Marine Institute (Irl), 2 CEFAS (UK)
Name of coordinating scientist in charge of project	Russell Poole russell.poole@marine.ie Deirdre Cotter deirdre.cotter@marine.ie Niall O'Maoileidigh niall.omaileidigh@marine.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	40 Acoustic Vemco V8SC-6L-4K pingers. A series of 13 automatic listening stations. Echo sounders.

Details of any collaborating countries	UK (Andrew Moore, CEFAS)
<p><b>Summary of Progress</b></p> <p>54 ranched salmon smolts were tagged using Vemco acoustic pingers. These were released in late April into L. Furnace. Detection was good and 70% of the fish were recorded in the middle of Clew Bay and 65% were recorded at Clare Island, some 25km out to sea. Some fish not detected in the middle bay were detected at Clare Island, making minimum survival through the estuary and inner bay of &gt;80%. Fish moved through the main channels and tidal flows and movement was influenced by outgoing tidal flows. Analysis of the data is continuing. Equipment will be upgraded in 2006 for application in 2007.</p>	

**Project No. E15****Status: New entry**

Party or relevant jurisdiction	EU - Ireland
Title of project	The marine survival of Atlantic salmon from the Burrishoole River, Ireland.
Objectives of research project	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	This 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	1960-2006
Area in which research will take place	Burrishoole River, Furnace , Newport, Co. Mayo
Estimated number and weight of salmon to be retained	None.
<b>Resources</b>	
Estimated cost of the research project	£72,000 per annum
Number of participating scientists	2 project scientists and 1 technical staff, 2 field staff
Name of coordinating scientist in charge of project	Russell Poole russell.poole@marine.ie
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	Upstream and downstream trapping facilities
Details of any collaborating countries	Ireland (tag recovery programme)
<b>Summary of Progress</b>	
Long-term monitoring programme. One of three facilities in NEAC area with total trapping. River specific stock and recruitment available for period 1970-2005.	

**Project No. E16                      Status:                      New entry**

Party or relevant jurisdiction	EU – Ireland
Title of project	Sustainable management of interactions between aquaculture and wild salmonid fish (EU SUMBAWS project – Irish component of project only)
Objectives of research project	To assess efficacy of prophylactic treatments for salmon smolts migrating through aquaculture bays
Brief description of research project	Two treated and control fish groups, differentially micro-tagged (5,000 fish in each group), released from two freshwater river systems' fisheries, in three years, 2002 to 2005. Survivors in experimental groups being recaptured in commercial fisheries and freshwater traps.
Dates during which research will take place	3 year programme 2003-2006. Final release groups due back summer 2006.
Area in which research will take place	Kilkerrin Bay, Bertraghbouy Bay, Connemara
Estimated number and weight of salmon to be retained	
<b>Resources</b>	
Estimated cost of the research project	£143,000
Number of participating scientists	2
Name of coordinating scientist in charge of project	Paddy Gargan, Central Fisheries Board. paddy.gargan@cfb.ie Niall O'Maoileidigh, Marine Institute (microtagging and tag recovery in commercial fisheries) niall.omaileidigh@marine.ie
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	Traps, Microtagging, Commercial fishery
Details of any collaborating countries	UK (Neil Hazon, Scotland); Norway (Bengt Finstad)
<b>Summary of Progress</b>	
Project commenced October 2003 and is due to finish September 2006 with recovery of final release groups. Preliminary results – prophylactic-treated fish had statistically higher returns compared to non-treated controls.	

**Project No. E17****Status: New entry**

Party or relevant jurisdiction	EU - Ireland
Title of project	National Genetic Stock Identification Project
Objectives of research project	<p>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.</p> <p>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.</p>
Brief description of research project	<p>Genetic Stock Identification (GSI), the use of genetic markers for identifying the proportions of different contributing populations in salmon fisheries and new developments in GSI such as individual assignment (IA) methodologies, have been demonstrated to be powerful and valuable tools for the management of fisheries.</p> <p>As part of ongoing efforts to improve the salmon stock assessment programme, the Marine Institute will commence, in addition to the microtag recovery programme, a genetic stock identification (GSI) project in 2005.</p>
Dates during which research will take place	2006-2007
Area in which research will take place	Comprehensive survey of all Irish salmon rivers
Estimated number and weight of salmon to be retained	None.
<b>Resources</b>	
Estimated cost of the research project	£270,000 per annum
Number of participating scientists	2 project scientists and 1 technical staff, 2 field staff
Name of coordinating scientist in charge of project	<p>Tom Cross National University of Ireland Cork t.cross@ucc.ie</p> <p>Paddy Gargan, Central Fisheries Board paddy.gargan@cfb.ie</p> <p>Philip McGinnity, Marine Institute and Chairman of Scientific Steering Committee) phil.mcginny@marine.ie</p>
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	Instream electrofishing equipment

Details of any collaborating countries	Links to ASAP Interreg Programme UK and Spain
<b>Summary of Progress</b>	
New entry.	

**Project No. E18****Status: New entry**

Party or relevant jurisdiction	EU - 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
Brief description of research project	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.
Dates during which research will take place	2003-2007: Final release groups due back summer 2007.
Area in which research will take place	Burrishoole, Shannon River, Lee River, Screebe and associated interceptory drift net fisheries around the Irish coast
Estimated number and weight of salmon to be retained	N/A Hatchery-reared only
<b>Resources</b>	
Estimated cost of the research project	£50,000 approx.
Number of participating scientists	3
Name of coordinating scientist in charge of project	D. Jackson, Marine Institute dave.jackson@marine.ie
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	Traps, Microtagging, Commercial fishery
Details of any collaborating countries	
<b>Summary of Progress</b>	
Project commenced October 2003 and is due to finish September 2007 with recovery of final release groups. Preliminary results – No difference in return rates of treated and untreated fish.	

**Project No. E19****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), the Conseil supérieur de la pêche (CSP) and Angling Associations.
Dates during which research will take place	1994 –2005 and beyond
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
<b>Resources</b>	
Estimated cost of the research project	N/A, part of a larger long-term monitoring programme
Number of participating scientists	2 scientists + 2 technicians
Name/e-mail 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
<b>Summary of progress</b>	
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.	

**Project No. E20****Status: Ongoing**

Party or relevant jurisdiction	EU – Denmark
Title of project	Mortality of Atlantic salmon smolts during estuary migration
Objective of research project	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.
Brief description of research project	<p>Since 2001 all salmon stocked (30,000 ½- and 62,000 1-yearlings annually) in River Skjern Å are microtagged and adipose fin clipped, in order to distinguish between wild and hatchery-reared smolts in a planned study in 2005 (using rotary screw traps). Since 1996, the spawning run has been estimated yearly (mark-recapture method). Thus in the future it will be possible to distinguish between wild and hatchery-reared fish. A similar programme is planned in the River Storå in 2007.</p> <p>Previously high smolt mortalities during estuarine migration through the Skjern Å estuary have been demonstrated for both sea-trout and salmon by radio telemetry. The total mortality during estuarine migration will be estimated in 2005 by acoustic telemetry.</p> <p>In Guden Å estuary, a project has been started in 2002 where wild salmon smolts are caught in a trap, and tagged with acoustic transmitters and followed through the estuaries by data-loggers at fixed stations and manual tracking. The preliminary results are promising and the project will be continued and combined with feeding studies of post-smolt and DST (data storage tags) tagging of smolt and/or spent fish.</p>
Dates during which research will take place	April 2000 to June 2007
Area in which research will take place	River Skjern Å (North Sea) and River Guden Å (Kattegat) and their estuaries.
Estimated number and weight of salmon to be retained	N/A
<b>Resources</b>	
Estimated cost of the research project <i>Details of the full economic costs of each study are requested, including staff costs, equipment and overheads.</i>	<p>River Skjern Å: £143,000</p> <p>River Guden Å: £143,000</p> <p>River Stor Å: £48,000</p>
Number of participating scientists	4
Name of coordinating scientist in charge of project	

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	Rotary screw traps, radio and acoustic telemetry equipment
Details of any collaborating countries	None
<b>Summary of Progress</b>	
<p>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.</p> <p>Year 2005. The project continued in 2005 and the results are under work.</p> <p>Year 2005. In River Skjern Å salmon and sea trout smolts were caught in a rotary 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 the 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.</p> <p>The results will be published in 2006 (Danish report) and international in 2006-07.</p> <p>In year 2007 the same research will take place in River Storå with salmon and sea trout.</p>	

**Project No. E21****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 Nääämöjoki (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 Nääämöjoki.  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 Nääämöjoki (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 Nääämöjoki 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
<b>Resources</b>	
Estimated cost of the research project	£275,000 per annum
Number of participating scientists	5
Name/e-mail 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
<b>Summary of progress</b>	
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 Nääämöjoki.	

**Project No. E22****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 <i>Gyrodactylus salaris</i> , 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. A new by-pass combined with a smolt trap is being installed at a hydro-electric power plant at the lower part of the main river Ätran in 2005-06.
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.
<b>Resources</b>	
Estimated cost of the research project	£35,000 per annum 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/e-mail address of coordinating scientist in charge of project	N/A
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	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 were particularly pronounced in River Ätran. A co-ordinated monitoring program of the parasite in 2001-2005 has not indicated any trends in abundance of the parasite in any of the infected rivers. All monitoring programs continue.

#### 4. ICELAND

**Project No. I1                      Status:                      Ongoing**

Party or relevant jurisdiction	Iceland Institute of Freshwater Fisheries, Reykjavik
Title of project	Return rate of salmon in three index rivers in Iceland in relation to population and environmental factors
Objective of research project	Monitor the status of, and trends in, salmon stocks in Iceland
Brief description of research project	Complete study of all life stages in 3 index rivers of 3 main salmon regions in Iceland. Adult count, catch statistics, spawning and juvenile surveys, smolt count and microtagging, return rate of 1- and 2SW salmon. Comparison to environmental factors at sea and in river as well as to population factors. Less extensive research done in more rivers in the regions.
Dates during which research will take place	Ongoing for the last 10 years and will continue
Area in which research will take place	Iceland and surrounding ocean
Estimated number and weight of salmon to be retained	Some 100s of smolts are being sacrificed every year
<b>Resources</b>	
Estimated cost of the research project	£96,000 per annum (includes all electrofishing surveys, operation of smolt traps, tagging, counting of adult fish, scale sampling and data analysis)
Number of participating scientists	5
Name/e-mail of coordinating scientist in charge of project	Thorolfur Antonsson thorolfur.antonsson@veidimal.is
Details of research vessels, e.g. name, registration, call sign and description of vessel	Not relevant
Type and amount of gear and other equipment to be used	Traps, tagging, etc.
Details of any collaborating countries	Within ICES

### **Summary of Progress**

This project involves three Index rivers providing extensive information on the freshwater phase of salmon stocks in these rivers, smolt numbers, adult migration and survival at sea. Results are reported to ICES and partly included in the WGNAS annual report. Results have also been reported and used in the EU-funded SALMODEL project (refer to the SALMODEL final report: Crozier *et al.* 2003). Data sampled in the project was the basis for published papers: “Variability in timing and characteristics of Atlantic salmon smolt in Icelandic Rivers”, Antonsson Th. and Gudjonsson G., 2002, Transactions of the American Fisheries Society, 131: 634-655. “Comparison of density, mean length, biomass and mortality of Atlantic salmon (*Salmo salar* L.) juveniles between regions in Iceland”, Antonsson, Th., Arnason, F., and Einarsson, S.M., 2005, Icel. Agric. Sci. 18:59-66. “Evaluation of single-pass electric fishing to detect changes in population size of Atlantic salmon (*Salmo salar* L.) juveniles”, Arnason, F., Antonsson, Th., and Einarsson, S.M. 2005, Icel. Agric. Sci. 18:67-73.

**Project No. I2****Status: Ongoing**

Party or relevant jurisdiction	Iceland Institute of Freshwater Fisheries
Title of project	Growth of Atlantic salmon in the River Hofsa, north-east Iceland, in relation to ocean and in-river conditions
Objective of research project	Investigate the use of salmon growth, back-calculated from scale samples, in relation to ocean conditions and the size and age composition of the salmon run.
Brief description of research project	Scale samples from salmon caught in the rod fishery in River Hofsa, north-east Iceland, will be aged and back-calculated for smolt, post-smolt and adult growth. The growth parameters will be related to ocean conditions, SST, NEO index, river parameters, etc. Scales sampled annually since 1986 will be analysed.
Dates during which research will take place	2004-2006
Area in which research will take place	North-east Iceland and adjacent areas.
Estimated number and weight of salmon to be retained	
<b>Resources</b>	
Estimated cost of the research project	Approximately £13,000 in 2006.
Number of participating scientists	2
Name/e-mail of coordinating scientist in charge of project	Sigurdur Gudjonsson sigurdur.gudjonsson@veidimal.is Sigurdur Mar Einarsson sigurdur.mar@veidimal.is
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	Image analyses software/hardware Database Computer etc.
Details of any collaborating countries	None
<b>Summary of Progress</b>	
<p>The aim of the study is to investigate the use of salmon growth, back-calculated from scale samples, in relation to ocean conditions and the size and age composition of the salmon run. Scale samples from salmon caught in the rod fishery in River Hofsa, north-east Iceland, will be aged and back-calculated for smolt, post-smolt and adult growth. The growth parameters will be related to ocean conditions, SST, NEO index, river parameters, etc. Scales sampled annually since 1986 will be analysed.</p>	

**Project No. I3      Status:      Ongoing**

Party or relevant jurisdiction	Iceland Institute of Freshwater Fisheries
Title of project	Tagging mortality and time of recovery related to internal tagging of hatchery-reared salmon smolts with DST Micro tags (Star-Oddi).
Objective of research project	Investigate the mortality and the time of recovery related to different handling and tagging techniques with DST tags (dummy). The study will be carried out in a hatchery and in fresh water.
Brief description of research project	A total of 310 smolts will be tagged internally with DST micro tags. The same number of fish will be held in control groups and subjected to the same handling but will not be tagged. Different handling techniques include the use, or not, of antibiotics and vitamins, location of the tag in the body cavity, size and location of injection hole, etc.
Dates during which research will take place	2004-2006
Area in which research will take place	Islandslax hatchery
Estimated number and weight of salmon to be retained	
<b>Resources</b>	
Estimated cost of the research project	Approximately £4,000 in 2006.
Number of participating scientists	2
Name/e-mail of coordinating scientist in charge of project	Ingi Runar Jonsson ingi.runar.jonsson@veidimal.is Sigurdur Gudjonsson sigurdur.gudjonsson@veidimal.is
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	DST tags (Star-Oddi) (dummy) Hatchery and tagging equipment etc.
Details of any collaborating countries	
<b>Summary of Progress</b>	
Hatchery studies were completed in 2005 and the project is in the phase of data analyses. Preliminary results indicate that there is a minimum size of smolts needed to carry the DST micro tags. Smaller smolts showed lower growth and higher mortality than larger smolts. Injections of antibiotics and vitamins improved the smolt survival significantly in the experiment.	

**Project No. I4      Status:      Ongoing**

Party or relevant jurisdiction	Iceland Institute of Freshwater Fisheries
Title of project	DST tagging of reared salmon smolts
Objective of research project	Record the seawater temperature and depth experienced by salmon from West Iceland during the first-year migration at sea.
Brief description of research project	300 hatchery-reared salmon smolts were released internally tagged with DST micro tags. Tagged smolts were released from ocean ranching release site in spring 2005. 1SW salmon are expected to return from their sea migration in 2006. The DST tags are expected to give information on temperature and depth of the fish during the first year at sea. The information will be compared to environmental parameters, to indicate the location of the fish during the ocean migration.
Dates during which research will take place	2005-2008
Area in which research will take place	South-west Iceland
Estimated number and weight of salmon to be retained	
<b>Resources</b>	
Estimated cost of the research project	Approximately £170,000 per year
Number of participating scientists	5
Name/e-mail of coordinating scientist in charge of project	Sigurdur Gudjonsson sigurdur.gudjonsson@veidimal.is
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	DST micro tags (Star-Oddi) Release site Oceanographic information etc.
Details of any collaborating countries	None
<b>Summary of Progress</b>	
The project is ongoing and will rely on the returns of tagged fish in 2006 – 2008.	

**Project No. I5****Status: Ongoing**

Party or relevant jurisdiction	Iceland Institute of Freshwater Fisheries
Title of project	Survival of salmon during the first and the second year at sea
Objective of research project	To evaluate the survival of salmon during the first and the second year at sea.
Brief description of research project	20,000 hatchery-reared salmon smolts with known sex-ratio will be micro-tagged. Tagged smolts were released from an ocean ranching release site in spring 2005. The returns will be expected after one and two years at sea and will be recorded as well as the sex and size of each returning fish. Scale samples will be analysed from each fish. Using Murphy's method it is possible to calculate the survival and mortality during the first and the second year at sea. This information will be compared to environmental parameters at the likely location of the fish at sea during the ocean migration.
Dates during which research will take place	2005-2009
Area in which research will take place	South-west Iceland
Estimated number and weight of salmon to be retained	
<b>Resources</b>	
Estimated cost of the research project	Approximately £50,000 per year
Number of participating scientists	5
Name/e-mail of coordinating scientist in charge of project	Sigurdur Gudjonsson sigurdur.gudjonsson@veidimal.is
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	Release site, ocean ranching site, traps. Oceanographic information etc.
Details of any collaborating countries	None
<b>Summary of Progress</b>	
The project is ongoing and relies on the returns of 1SW fish in 2006 and 2SW in 2007.	

**Project No. I6****Status: Ongoing**

Party or relevant jurisdiction	Iceland: Salmon & Trout Research, Hradastadir 1, P.O. Box 280, IS - 270 Mosfellsbaer, Iceland
Title of project	Distribution and behavioural ecology of salmon at sea
Objective of research project	To investigate the temporal and spatial distribution of DST-tagged salmon during their migrations in the North Atlantic. The complete migration, from home estuary to feeding grounds and back home to spawn, will be mapped, for tagged fish providing information on: <ul style="list-style-type: none"> <li>- spatial distribution of salmon and temperature pattern/preferences</li> <li>- diurnal depth distribution of salmon</li> <li>- salmon growth in relation to environmental parameters</li> <li>- by-catch of salmon in pelagic fisheries</li> </ul>
Brief description of research project	<p>The study period is 2005-2011, with the main taggings during 2005-2009. Small-scale pre-phase taggings were carried out in 2003 and 2004.</p> <p>Salmon smolts and recovered kelts are tagged internally with DSTs, prior to sea migration, in order to measure fish depth (pressure) and the corresponding water temperature. Large smolts are tagged internally with DSTs in the spring prior to their sea migration. Smolts tagged with DSTs are released at 2 release sites above trap facilities (in a salmon ranching station and in a river) in order to allow every salmon returning from the sea to be checked for tags.</p> <p>The DST data enables determination of migration patterns, including depth preference, in relation to time and environmental conditions. Also it enables geographic distribution of salmon in the sea to be estimated, based on surface temperature data from DSTs and temperature data from measurements of sea surface temperature by satellite and other sources. The DST data from migrating salmon also gives a valuable insight into the relationship between salmon growth and corresponding ambient temperatures during the marine phase.</p> <p>In April 2005 a total of 160 smolts were tagged with DSTs. The scheduled plan is to tag a total of 1,500 large smolts in the period 2005-2009. A small-scale pre-phase smolt tagging of 39 smolts was carried out in 2003 with dummy and active DSTs, in a river not monitored by trap. The project also includes small-scale tagging of kelts with DSTs in order to obtain information from that phase of the salmon's life-cycle. The study will be continued with the same setup for tagging and recaptures during 2006-2009 with final tag recoveries during 2010-2011. Analyses and reporting will be carried out concurrently.</p>
Dates during which research will take place	The study period is 2005-2011, with the main taggings during spring in the period 2005-2009 (tagging will be completed in 2007 if funds permit), but small-scale pre-phase taggings were carried out in spring-early summer 2003 and 2004.
Area in which research will take place	Release site (in Iceland): River Tungufljot and River Hafnara Salmon Ranching station (smolts) and River Botnsa (recovered kelts). Additional smolt release sites might be included later depending on available funds. Study area: the North Atlantic
Estimated number and weight of salmon to be retained	All fish will be tagged and released.

<b>Resources</b>	
Estimated cost of the research project	In addition to the contribution of companies and Institutes participating in the project, the Icelandic Research Council and the Fish Enhancement Fund in Iceland are supporting the project and additional funding will be applied for from other funds. The estimated overall cost of the project is £690,000 if all the 1,500 smolts can be tagged within the period 2005-2007 (annual expenditure £230,000). If, due to funding, tagging has to end in 2008-2009, then extra cost will be incurred (estimated overall extra cost £80-£120,000).
Number of participating scientists	5 (the number might increase later as scientific participation from other countries may benefit the project).
Name of coordinating scientist in charge of project	Johannes Sturlaugsson, Salmon & Trout Research johannes@laxfiskar.is
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	A total of 1,500 DSTs will be used for internal tagging of salmon in the period 2005-2009. The DSTs will provide information on both fish depth (pressure) and water temperature.
Details of any collaborating countries	The study is carried out in co-operation with the Marine Research Institute, Star-Oddi, Lax-A and Nordlingur in Iceland, the Faroese Fishery Laboratory, and the Institute of Marine Research, Norway.
<b>Summary of Progress</b>	
<p>In 2005 the first DST recoveries were made, from both tagged smolts and recovered kelts. The entire sea migration (round trip) of Atlantic salmon from their home estuary to the feeding grounds in the ocean and back home to spawn has therefore been mapped successfully as intended and behavioural and environmental information obtained. This is the first time that such data on fish depth have been obtained for the entire sea migration of salmon. Therefore much useful information has already been obtained from these first DST releases. The analysis of the data is ongoing but already indicates that the combined DST recordings of both fish depth (pressure) and temperature (sea/river), together with available data on environmental parameters for comparison, are providing very valuable information on both the feeding and spawning migration.</p>	

## 5. NORWAY

**Project No. N1                      Status:                      Ongoing**

Party or relevant jurisdiction	Norway
Title of project	The importance of early marine feeding on the growth and survival of Atlantic salmon post-smolts in Norwegian fjords
Objective of research project	<p>The principal objective of the project (2002-2006) is to study the importance of early marine feeding on post-smolt growth and survival in coastal areas. The sub-goals are to:</p> <ul style="list-style-type: none"> <li>• Analyse spatial variation in early marine post-smolt feeding and growth along a north-south geographic scale (comparative study)</li> <li>• Investigate how post-smolt feeding and growth is associated with: timing of smolt descent, marine prey availability, parasite infection, fjord migration and abiotic factors (case study)</li> </ul>
Brief description of research project	<p>Much of the variation observed in marine survival of Atlantic salmon may be explained by differences in early post-smolt feeding and subsequent growth. Results from a pre-project indicate a prolonged fjord migration of post-smolts and extensive feeding on energy-rich marine prey in northern Norway, while results from southern Norway suggest a shorter fjord residency and lower degree of feeding. However, feeding intensity varied annually within several of the systems, which may be related to variability in prey abundance on both temporal and spatial scales. We hypothesise that this may help explain why large variation in relative abundance is observed among years and why salmon populations are generally regarded as less sustainable in the south. Here we propose to study: (A) the importance of early marine feeding and growth of post-smolts on a north-south geographical scale (comparative study). Furthermore, a detailed explanatory case study (B) will provide complementary results that will assist in evaluating important relationships among smolt run timing, marine prey availability, fjord migratory behaviour, incidence of marine parasites, and abiotic factors as they possibly relate to the subsequent growth and variation in abundance of adult salmon. This approach will generate new knowledge important for future management of salmon populations, and contribute to a better understanding of the fluctuations in return rates of adult salmon.</p>
Dates during which research will take place	2002-2006: 5-year study, field work mainly during May/June
Area in which research will take place	Central and Northern Norway
Estimated number and weight of salmon to be retained	

<b>Resources</b>	
Estimated cost of the research project	Funding from Norwegian Research Council: 2002 - £56,000; 2003 - £96,000; 2004 - £96,000; 2005 - £64,000; 2006 - £56,000.  In addition, approximately 25% own funding from participating institutions and cost of operating research vessel (from Norwegian College of Fishery Science) estimated as: 2002 - £74,500; 2003 - £71,000; 2004 - £57,000; 2005 - £49,750; 2006 - £12,250.  Total expenditure: 2002 - £130,500; 2003 - £167,000; 2004 - £153,000; 2005 - £113,750; 2006 - £68,250.
Number of participating scientists	8
Name/e-mail 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	F/F Hyas and F/F Johan Ruud
Type and amount of gear and other equipment to be used	Fish lift trawl
Details of any collaborating countries	Department of Fisheries and Oceans, Newfoundland, Canada
<b>Summary of Progress</b>	
<p>Post-smolts from southern Norway showed low feeding intensity in the fjords, whereas extensive feeding was observed in fjords in northern and middle parts of Norway. The results indicate that extensive feeding immediately after sea entrance may be more common for post-smolts in the northern and middle parts of Norway than in southern fjords. The observed differences in post-smolt feeding may be due to spatial and temporal differences in prey availability within and between different types of fjord systems, and this might influence post-smolt growth and survival. More information from these studies is given in: Rikardsen, A.H., Haugland, M., Bjørn, P.A., Finstad, B., Knudsen, R., Dempson, J.B., Holst, J.C., Hvidsten, N.A. &amp; Holm, M. 2004. Geographical differences in early marine feeding of Atlantic salmon post-smolts in Norwegian fjords. <i>J. Fish. Biol.</i> 64: 1655-1679.</p> <p>In another paper from the present project by Knudsen, R., Rikardsen, A.H., Dempson, J.B., Bjørn, P.A., Finstad, B., Holm, M &amp; Amundsen, P.A. 2005. Tropically transmitted parasites in wild Atlantic salmon post-smolts from Norwegian fjords. <i>J. Fish. Biol.</i> 66: 758-772, it was shown that parasites of both freshwater and marine origin appear to be suitable as bio-indicators of feeding and migratory pattern of Atlantic salmon post-smolts and preadults during their seaward migration.</p> <p>A third paper from this project was recently submitted: Bjørn, P.A., Finstad, B., Kristoffersen, R., Rikardsen, A.H. &amp; McKinley, R.S. (submitted). Differences in risks and consequences of salmon lice, <i>Lepeophtheirus salmonis</i> (Krøyer) infection on sympatric populations of Atlantic salmon, brown trout and Arctic charr within northern fjords. Results from this study indicate that Atlantic salmon seemingly may have a mismatch between time of lice infection and their post-smolt fjord migration in northern fjords. In contrast, brown trout and Arctic charr feed within the fjords throughout the summer and consequently have a higher risk of harmful infections in years with suitable environmental conditions for salmon lice development, especially in fish-farming areas.</p> <p>For 2006 more papers will be produced from the present project.</p>	

**Project No. N2**

**Status: New entry**

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	1) Cultured smolts treated against salmon lice, tagged with microtags and released in the River Dale, western Norway. The fish were released on different dates from early May to early June from 2002 to 2005. Wild smolts were included from 2004. Releases will also be performed in 2006 and 2007. 2) Individually tagged (T-bar anchor tags) cultured smolts treated against salmon lice (and control groups) will be released at two different release sites; in a fjord and on the coast of western Norway, in May and in June 2006.
Dates during which research will take place	Fish will be released during May and June in 2006 and 2007.
Area in which research will take place	Western Norway; River Dale, Matre Aquaculture station.
Estimated number and weight of salmon to be retained	Catch of adult tagged fish: 100-300 fish each year.
<b>Resources</b>	
Estimated cost of the research project	Total: £75,000, 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	Smolt trap in River Dale Tags; 14,000 microtags, 16,000 T-bar anchor tags
Details of any collaborating countries	
<b>Summary of Progress</b>	
New entry.	

**Project No. N3****Status: Ongoing**

Party or relevant jurisdiction	Norway
Title of project	Marine survival and exploitation of salmon from the Rivers Figgjo, Imsa and Drammenselv
Objective of research project	1. Estimation of marine survival 2. Estimation of marine exploitation 3. Data input in predictive models
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 and Drammenselv with tag recovery programme in fisheries along Norwegian coast and elsewhere
Estimated number and weight of salmon to be retained	
<b>Resources</b>	
Estimated cost of the research project	Approximately £104,000 per annum
Number of participating scientists	3
Name/e-mail of coordinating scientist in charge of project	Lars P. Hansen l.p.hansen@nina.no and Nina Jonsson nina.jonsson@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	
<b>Summary of Progress</b>	
<p>The long-term monitoring of salmon from the three 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.</p>	

**Project No. N4**

**Status: Ongoing**

Party or relevant jurisdiction	Norway
Title of project	Distribution and ecology of post-smolts and salmon at sea
Objective of research project	By analysing age, growth, migratory paths in relation to environmental conditions and competitors, describe and expand the understanding of salmon marine life history in order to provide explanations to observed variations in salmon survival. Test hypotheses on: <ol style="list-style-type: none"><li>1. Independence of relationships between food availability and post-smolt feeding and growth</li><li>2. Post-smolt migration and distribution in time and space</li><li>3. Salmon stock separation/overlap in time and space</li></ol>
Brief description of research project	<p>The oceanic phase of the Atlantic salmon and the influence of the marine environment encountered on growth and survival of salmon stocks is increasingly recognised as an important stock regulatory factor among salmon scientists and managers. Knowledge of the migrations, the geographic distribution and general ecology of post-smolts and larger Atlantic salmon in oceanic waters is still sparse.</p> <p>The project is a follow-up and expansion of a project started in 1995. Based on data needs identified during 1995–2002, new data was collected during cruises in 2003-2004. The project will also furnish historical and new post-smolt data to several other projects. Within the scope of a post-graduate fellowship, growth potential and patterns of post-smolts will be examined by energetic content in fish and feed, and by computer-based image analysis of scale samples. The method will be useful to assess influences of environmental traits on post-smolt growth and survival and may prove useful to separate northern and southern European salmon stocks.</p> <p>In 2006 the project will consist of compilation and analysis of historical data up to 2006.</p>
Dates during which research will take place	2006: late April – mid-June (salmon may be caught in conjunction with an annual herring survey) July 5- 26 (post-smolts may be captured in conjunction with the annual mackerel surveys)
Area in which research will take place	Northern North Sea, the Norwegian Sea
Estimated number and weight of salmon to be retained	<ul style="list-style-type: none"><li>• 5 salmon, total 12 kg</li><li>• 20 post-smolts, total 2 kg</li></ul>
<b>Resources</b>	
Estimated cost of the research project	£20,000 in 2006
Number of participating scientists	4 scientists
Name/e-mail of coordinating scientist in charge of project	Marianne Holm marianne.holm@imr.no

Details of research vessels, e.g. name, registration, call sign and description of vessel	<ul style="list-style-type: none"> <li>R/V “Johan Hjort”, Norway, LDGJ, 65 m research vessel fully equipped for year-round high-seas research operations</li> </ul>
Type and amount of gear and other equipment to be used	The ship is equipped with a specially designed trawl with live fish capture device attached to the cod end (Fish Lifter MKII, Holst & MacDonald 2000).
Details of any collaborating countries	Fisheries Research Institute, Torshavn, Faroe Islands
<p><b>Summary of Progress</b></p> <p>By January 2005, a total of 1,911 post-smolts (850, 917 and 144 in 2002, 2003 and 2004 respectively) and 226 adults had been captured since 2002 within this project. Of the adults, 114 have been tagged and released (cf. project N5). Due to reduction in available ship time, there was no cruise dedicated to post-smolt surveys in 2004, but post-smolt trawling was performed during a mackerel survey from the west of Ireland to north of the Hebrides in May/June and during a herring survey in the Northern Norwegian Sea in early August. In 2004 all post-smolts were captured west of Great Britain and hence smolt ages 1 and 2 dominated the captures. The post-smolts were distributed over the same area as previously recorded when surveying this area in 1995-1997. In 2005 only 4 salmon were caught (as by-catch in other surveys). No post-smolts were captured.</p> <p>Within the framework of a PhD scholarship, the stomach contents have been analysed and fish larvae/0-group of varying species followed by amphipods appear to be dominating the diet. In 2002 when the herring larvae were abundant, the condition factor of the post-smolts was 1.19 on average, the highest recorded since the start of the marine investigations in 1995. Results from the project have been published in ICES reports, several scientific journals and two books.</p> <p>No ship time for dedicated salmon investigations was allocated in 2005 and in 2006 only occasional captures of salmon can be expected from surveys of pelagic fish other than salmon.</p>	

**Project No. N5****Status: Ongoing**

Party or relevant jurisdiction	Norway, Institute of Marine Research, P.O. Box 1870 Nordnes, N-5817 Bergen
Title of project	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)
Objective of research project	Investigate the temporal and spatial distribution of DST-tagged salmon in the Norwegian Sea and adjacent areas with special emphasis on: <ul style="list-style-type: none"> <li>- Spatial distribution and temperature preferences</li> <li>- Growth in relation to environmental parameters</li> <li>- Vertical distribution of salmon during day and night (relating to possibility of intercepting fisheries)</li> </ul>
Brief description of research project	The project is a joint effort between Norway, the Faroes and Iceland, and is based on earlier experiences in these countries. The project is partly funded by the Nordic Council of Ministers. The fish have been captured with a special salmon trawl with live-capture device. Viable fish (approx. 2/3 of the catch) have been tagged with DSTs inserted into the body cavity and released. The research was performed in June/July in the Northern Norwegian Sea, in October in the Faroes' EEZ and in January-February in Iceland's EEZ. An important part of the investigation consists of retrieving tags and recapture data from angling catches in home waters.
Dates during which research will take place	2003-2006 The project is phasing out; there will be no cruises, only data analysis in 2005/06.
Area in which research will take place	No field work will be carried out in 2006
Estimated number and weight of salmon to be retained	No fishing activities in this project in 2006
<b>Resources</b>	
Estimated cost of the research project	£4,000 in 2006.
Number of participating scientists	5 scientists
Name/e-mail of coordinating scientist in charge of project	Marianne Holm marianne.holm@imr.no
Details of research vessels, e.g. name, registration, call sign and description of vessel	No ships involved in 2006
Type and amount of gear and other equipment to be used	No trawling in 2006
Details of any collaborating countries	Fisheries Research Institute, Torshavn, The Faroes The Marine Research Institute of Iceland, Reykjavik, and Salmon and Trout Ltd, Reykjavik

### **Summary of Progress**

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 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 have been 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 1400 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 been 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.

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

Party or relevant jurisdiction	Norway
Title of project	Marine growth and survival of salmon, sea trout and sea charr from the River Halselva
Objective of research project	1. Estimation of marine growth and survival 2. Use return rates of first-time migrants of trout and charr as early indicators of salmon survival.
Brief description of research project	Maintain time series of smolt taggings (wild and hatchery-reared) and tag returns. Use the information to study fluctuations in marine survival and growth.
Dates during which research will take place	Long-term ongoing monitoring project, initiated in 1987.
Area in which research will take place	Tagging in the River Halselva with tag recovery programme in fisheries along the Norwegian coast and elsewhere
Estimated number and weight of salmon to be retained	
<b>Resources</b>	
Estimated cost of the research project	Approximately £30,000 per annum
Number of participating scientists	2
Name/e-mail of coordinating scientist in charge of project	Arne J. 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 trap, electric fishing
Details of any collaborating countries	
<b>Summary of Progress</b>	
<p>The long-time monitoring of salmon has revealed that marine survival has improved compared with the poor survival in the 1990s. A significant correlation has been found between returning rates of first-time migrants of sea trout and sea charr, and return rates of salmon of the same smolt year class.</p>	

**Project No. N7****Status: New entry**

Party or relevant jurisdiction	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.
Brief description of research project	Samples will be collected from approximately 30 Norwegian salmon rivers, spanning all geographical regions. One region will be investigated in more detail, with sampling of all major rivers in the region and one river system will also be sampled in more detail, covering all tributaries. All samples will be analysed for the set of 15 SALMAN microsatellites. The variation in these markers on three spatial scales will be investigated, to see if composite genetic signatures of rivers and regions can be built by aggregating data from individual components. The data will be calibrated and made available for a common database of salmon populations. A collection of ocean samples of salmon will also be analysed, and assignment of these samples to country, region or river of origin will be attempted.
Dates during which research will take place	January 2006 – December 2008
Area in which research will take place	Norway, nationwide
Estimated number and weight of salmon to be retained	3000 parr, 30 kg
<b>Resources</b>	
Estimated cost of the research project	Total cost: £320,000 Staff costs (incl. overheads): £258,000 (Overheads: £88,000 Consumables, field work, meetings, and equipment: £55,000 Purchase R&D services: £7,000  Cost in 2006: £107,000
Number of participating scientists	2
Name and e-mail address of coordinating scientist in charge of project	Øystein Skaala Oystein.Skaala@imr.no Vidar Wennevik Vidar.Wennevik@imr.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	Electrofishing equipment. Molecular biology laboratory at the Institute of Marine Research, Bergen, Norway
Details of any collaborating countries	Finland (Craig Primmer and Anti Vasemägi, University of Turku, Finland. Investigation of variation in EST-markers in Norwegian salmon populations)
<b>Summary of Progress</b>	
New entry.	

**Project No. N8**

**Status: Ongoing**

Party or relevant jurisdiction	Norway
Title of project	Temporal variation in abundance of the northern-most populations of Atlantic salmon with emphasis on the River Tana
Objective of research project	<p>The main objective of this project is to examine the importance of ocean climate, predation, marine fisheries, and smolt production as primary factors influencing the abundance of the northern-most and highly productive populations of Atlantic salmon (<i>Salmo salar</i>), with emphasis on the River Tana.</p> <p>Sub-goals:</p> <ul style="list-style-type: none"><li>• Examine the influence of ocean climate on temporal variation in Atlantic salmon abundance and life-history parameters of River Tana salmon and co-variation with salmon from other northern rivers</li><li>• Evaluate the impact of predation by marine fish and birds on the abundance of River Tana salmon</li><li>• Determine smolt and adult salmon abundance, initially from one tributary, as an index of marine survival for the River Tana system</li><li>• Develop management plans for northern Atlantic salmon rivers by integrating biological and local knowledge of the resource.</li></ul>
Brief description of research project	<p>Salmon rivers in northern-most Norway, Finland and the Kola peninsula (Russia) support important fisheries, both in coastal areas and in the rivers themselves, and contribute more than 40% of the world's freshwater catch of wild Atlantic salmon (<i>Salmo salar</i>). The River Tana, a large complex system that forms the border between northern-most Norway and Finland, at present supports the largest wild Atlantic salmon stock in the world and is also of particular importance to the Sami people. With the potential for increased exploitation of this and other northern stocks, interactions or impacts resulting from the proposed expansion of salmonid aquaculture into these northern areas, and uncertain consequences resulting from global climate change, it is important to study the dynamics of the world's largest salmon-producing rivers. Consequently, the objective of this proposal is to examine the importance of ocean climate, predation, marine fisheries, and smolt production as primary factors influencing the abundance of the northern-most and highly productive populations of Atlantic salmon, with emphasis on the River Tana. Biological knowledge gained from this project will be used in designing management strategies in cooperation with local managers.</p>
Dates during which research will take place	2002-2006
Area in which research will take place	River Tana

Estimated number and weight of salmon to be retained	
<b>Resources</b>	
Estimated cost of the research project	£ 60,000 per annum
Number of participating scientists	4-6
Name/e-mail of coordinating scientist in charge of project	Martin Svenning martin.svenning@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	Finland, Russia, Canada
<b>Summary of Progress</b>	
No summary provided.	

## 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 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 6,500 salmon and 5,500 parr and smolts
<b>Resources</b>	
Estimated cost of the research project	Approximately £80,000 for 2006
Number of participating scientists	~ 25 scientists from PINRO
Name of coordinating scientist in charge of project	Alexander Zubchenko (PINRO) zav@pinro.ru, salmon@pinro.ru Igor Studenov (PINRO) igor@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
<b>Summary of Progress</b>	
<p>Adult returns in 2005 to home waters are assessed. Estimates of natural and fishing mortality of salmon are derived. The level of attainment of spawning requirements is determined, the condition and success of spawning is assessed, and estimates of parr density are derived. The harvestable surplus is determined. The recommendations on TACs and quotas for 2006 are provided to the Government.</p>	

**Project No. R2****Status: Ongoing**

Party or relevant jurisdiction	Russian Federation
Title of project	Assessment of by-catch of post-smolts of Atlantic salmon in pelagic fisheries in the Norwegian Sea.
Objective of research project	Assess occurrence of post-smolts in catches by Russian vessels engaged in the pelagic fisheries for mackerel, blue whiting and herring.
Brief description of research project	Catches are screened for post-smolts. Materials are collected in accordance with the methods applied for biological sampling. In addition, all information relating to vessel name, haul serial number, trawl type, surface temperature, duration of haul (start-end), depth of haul (min-max), trawling speed, trawl details, positions, catch, sample size, etc. is recorded.
Dates during which research will take place	Initially 2002-2004 From 2005 on continued on a yearly basis.
Area in which research will take place	The Norwegian Sea
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	Approximately £80,000 per annum
Number of participating scientists	Variable
Name of coordinating scientist in charge of project	Boris Prischepa (PINRO) elena@pinro.ru Alexander Zubchenko (PINRO) zav@pinro.ru, salmon@pinro.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	Standard pelagic trawl
Details of any collaborating countries	N/A

## Summary of Progress

In 2005, the programme to assess by-catch of adult Atlantic salmon and post-smolts was carried out in the Norwegian Sea by STM-0052 "Persey-4" during pelagic fishing for mackerel, blue whiting and herring from 24 June to 27 August.

Cruise No. 19 was undertaken in accordance with PINRO's Plan of scientific research and Schedule No.4 of marine surveys of aquatic biological resources in the Northern basin for 2005 as well as decisions of the 28<sup>th</sup> Meeting of the Joint Russian-Faroese Fisheries Commission.

In the period from 25 June to 27 August biological sampling and analysis of data on biology of mackerel, blue whiting, herring and by-catch species were undertaken with the aim of studying the biology, behaviour, strength and routes of migrations of targeted species, predicting the fisheries conditions and assessing by-catch of other species.

Most of the biological data was collected in the area from 64°00 to 73°50 N, between 03°30 W and 14°30 E in the Norwegian Sea. Samples of pelagic species were taken from commercial hauls by pelagic trawl (design 103/512 "Mackerel"); mesh size in the cod-end was 125 mm, and 40 mm in the trawl liner. Trawl parameters were: vertical opening 35-65 m, distance between doors 58-65 m. Trawling speed varied from 3.9 to 4.7 for blue whiting and herring and to 5.2 knots for mackerel. A total of 182 pelagic hauls were taken during the cruise in the Norwegian Sea, 20,777 fish were measured, 3,259 were examined, the age sample contained 559 fish of various species. All fish biology studies were undertaken in accordance with methodologies adopted by PINRO.

From 24 June to 8 July fishing for mackerel took place in the international waters of the Norwegian Sea from 65°17' to 66°16' N, between 03°17' E and 00°50' W. Total catch of mackerel and herring was 276 t. No post-smolts of salmon were found.

From 8 July to 1 August fishing for mackerel took place in a strip of waters adjacent to the 200-mile limits of the Faroe Islands and Norway, from 64°00' to 65°25' N, between 00°30' and 04°00' W. Total catch of mackerel, blue whiting and herring was 601 t. No post-smolts of salmon were found.

From 1 to 13 August fishing for blue whiting took place in the international waters of the Norwegian Sea from 64°30' to 69°20' N, between 04°10' W and 03°00' E. Total catch was about 300 t. No post-smolts of salmon were found.

From 16 to 27 August fishing for Atlanto-scandian herring took place in the Bear Island-Svalbard area and Norwegian economic zone from 74° 00 to 71° 30 N, between 09° 00 and 14° 30 E. Total catch of herring and blue whiting was 354 t. Post-smolts of Atlantic salmon occurred as by-catch in the period from 17 to 20 August, when near-surface aggregations of herring (depth interval 5-100 m) were fished in the Bear Island-Svalbard area from 73°49 to 72°55 N, between 14°21 and 12°20 E. A total of 9 post-smolts were taken. Males had a length of 30-32 cm, mean 31.9 cm, females 31-34 cm, mean 32.3 cm. Mean weight was 256 g and 266 g, respectively.

## 7. UNITED STATES OF AMERICA

**Project No.** U1                      **Status:**            **New entry**

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 collected on hatchery-reared out-migrating Atlantic salmon smolts in 2005 and will continue through 2007 in the Penobscot River, Maine, USA. In 2005, 180 hatchery-reared Atlantic salmon smolts were surgically implanted with ultrasonic tags. Automated fish identification receivers were 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.
Dates during which research will take place	2005-2009
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.
<b>Resources</b>	
Estimated cost of the research project	Approximately £43,000 per annum (public funding)
Number of participating scientists	~5
Name/e-mail of coordinating scientist in charge of project	Edward Hastings Edward.Hastings@noaa.gov 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 (50-70 annually)
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.
<b>Summary of Progress</b>	
New entry.	

**Project No. U2**

**Status: Ongoing**

Party or relevant jurisdiction	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
Brief description of research project	Telemetry data was collected on wild outmigrating Atlantic salmon smolts from 1997-1999 and 2002-2005 in the Narraguagus River, Maine USA. During these years, 60-100 wild Atlantic salmon smolts annually were surgically implanted with ultrasonic tags. In 2005, Automated Pinger Detection Units (APDU) were deployed through the Narraguagus River (5), Estuary (10), Bay and nearshore environment (6), excluding the coastal arrays established in 2002 to evaluate the number of smolts passing ecological transition zones.
Dates during which research will take place	2002-2007 Fieldwork April – June 2002-2005. Data analysis and publication in 2005-2007.
Area in which research will take place	Narraguagus River (1997-1999, 2002-2005) Narraguagus Bay (1997-1999, 2002-2005) Gulf of Maine (2002-2004)
Estimated number and weight of salmon to be retained	It is anticipated that no Atlantic salmon will be retained during this project.
<b>Resources</b>	
Estimated cost of the research project	Approximately £49,000 per annum (public funding)
Number of participating scientists	~3
Name/e-mail of coordinating scientist in charge of project	James Hawkes James.Hawkes@noaa.gov John Kocik John.Kocik@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 (~60-100 annually) Automated Pinger Detection Units (20-60 annually)

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.
<p><b>Summary of Progress</b></p> <p>Telemetry efforts on the Narraguagus River on wild fish have concluded in 2005.</p> <p>Preliminary results suggest a substantial proportion of emigrating smolts migrated through the near-shore marine environment (60%). The extent of the array in 2005 does not allow identification of the migration corridors in prior years (2002-2004).</p> <p>The visualization software SDA (Spatial Data Analyzer) has been completed and is currently being used to re-audit all telemetry data. Detailed analysis and development of peer-reviewed manuscripts is scheduled for 2005-2007.</p>	

**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: 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 is scheduled to run for a minimum of five years (2001-2006). 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	April – June, 2001-2007. Data analysis and publication only in 2005-2007.
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.
<b>Resources</b>	
Estimated cost of the research project	Approximately £28,000 per annum (public funding)
Number of participating scientists	~3
Name/e-mail of coordinating scientist in charge of project	James Hawkes James.Hawkes@noaa.gov Tim Sheehan Tim.Sheehan@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 continue on the Dennys River. 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 is scheduled for 2005-2007.

**Project No. U4****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, 2001-2008
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.
<b>Resources</b>	
Estimated cost of the research project	Approximately £14,000 per annum (public funding)
Number of participating scientists	~3
Name/e-mail 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. U5**

**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	May-June to 2007
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%.
<b>Resources</b>	
Estimated cost of the research project	Approximately £23,000 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**

The post-smolt trawl survey in Penobscot Bay was conducted from 2001-2005 on an annual basis. Preliminary data have been compiled and are currently being analysed to estimate contribution by stocking group, survival estimates, emigration patterns of post-smolts, and feeding habitats in Penobscot Bay. Preliminary analyses of scale samples indicate a low proportion of naturally-reared fish among captured fish. Preliminary analyses also indicate that fall parr stocking may be contributing to a larger proportion of the smolt run than previously expected. Data from blood and gill samples collected are currently being analysed to assess the physiological status of Atlantic salmon post-smolts as they make the transition from fresh to marine waters.

Detailed analysis and development of peer-reviewed manuscripts is scheduled for 2005-2007.

**Project No. U6**

**Status: Ongoing**

Party or relevant jurisdiction	USA
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	<p>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.</p> <p>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.</p> <p>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.</p>
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 2005-2007.
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.
<b>Resources</b>	
Estimated cost of the research project	£16,000 (public funding)
Number of participating scientists	Approximately five, representing Federal and State resource management agencies
Name/e-mail address of coordinating scientist in charge of project	Rory Saunders Rory.Saunders@noaa.gov James Hawkes James.Hawkes@noaa.gov
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	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 manuscripts is scheduled for 2005-2007.



**Annex 2**

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

<b>Party</b>	Canada
<b>Title</b>	Marine migration and survival of post-smolt Atlantic salmon from Bay of Fundy rivers
<b>Coordinating Scientist</b>	Gilles L Lacroix, DFO, St Andrews Biological Station, St Andrews, New Brunswick, Canada LacroixG@dfo-mpo.gc.ca
<b>Summary of Objectives</b>	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.
<b>Year removed from inventory/completed</b>	2003
<b>Summary of Findings</b>	
<p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p>	

<b>Party</b>	Canada
<b>Title</b>	Distribution, health and condition of Atlantic salmon from Bay of Fundy rivers while at sea
<b>Coordinating Scientist</b>	Gilles L Lacroix, DFO, St Andrews Biological Station, St Andrews, New Brunswick, Canada LacroixG@dfo-mpo.gc.ca
<b>Summary of objectives</b>	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.
<b>Year removed from inventory/completed</b>	2004
<b>Summary of Findings</b>	
<p>Atlantic salmon <i>Salmo salar</i> 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.</p> <p>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.</p> <p>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.</p> <p>The draft manuscript completed for this project will be made available when it receives Departmental approval for submission and release.</p>	

<b>Party</b>	Canada
<b>Title</b>	Tracking experimentally “escaped” farmed salmon
<b>Coordinating Scientist</b>	Fred Whoriskey asfres@nb.aibn.com
<b>Summary of objectives</b>	Determine the course tracks and fates of sonically tagged farmed salmon released in winter and spring
<b>Year removed from inventory/completed</b>	2006
<b>Summary of Findings</b>	
<p>Winter and spring releases were conducted, although the winter releases were delayed due to unforeseen circumstances and fewer fish were tagged than planned. It appears that survival to exit the Passamaquoddy region to the open sea was higher for winter- than summer-release fish. Seal predation on spring release fish was apparently heavier than on the winter fish. Some individuals were entrained by tidal currents and cycled within them post release. Others moved rapidly out to sea. None of the tagged fish were detected entering any of the inner Bay of Fundy or Western Fundy rivers. Signals were found within the plume of the Pleasant River, Maine, in the vicinity of seal haul-out sites. It is not clear if the fish entered the rivers on their own or if the seals caught them elsewhere and defecated the tag in this region. The project is completed and a first paper submitted for publication.</p>	

<b>Party</b>	Canada
<b>Title</b>	Atlantic salmon distribution and abundance at sea
<b>Coordinating Scientist</b>	David Reddin ReddinD@dfo-mpo.gc.ca
<b>Summary of objectives</b>	(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 istomach contents; (4) investigate the relationship between sea temperature and other oceanographic parameters and salmon abundance; (5) tag and release salmon in good condition.
<b>Year removed from inventory/completed</b>	2006
<b>Summary of Findings</b>	
<p>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. This trip brings to a close at sea research in the Labrador Sea/Grand Banks area.</p>	

<b>Party</b>	European Union
<b>Title</b>	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
<b>Coordinating Scientist</b>	Walter Crozier walter.crozier@dardni.gov.uk
<b>Summary of objectives</b>	<ul style="list-style-type: none"> <li>- Improve our ability to set salmon conservation limits (CLs); addressing transportability and dynamic change issues, also taking into account underlying stock structure, and;</li> <li>- 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.</li> </ul>
<b>Year removed from inventory/completed</b>	2003
<b>Summary of Findings</b>	
<ul style="list-style-type: none"> <li>- examined current models used to estimate PFA, including that used by ICES</li> <li>- 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</li> <li>- SALMODEL also evaluated the basis of the NEAC stock groupings being used in the catch advice process</li> <li>- 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</li> <li>- investigated predictive PFA models based on smolt production estimates/indices for the NEAC area</li> <li>- examined approaches for model validation and examined scales at which the various model types can be applied</li> </ul> <p>Further details are presented in NASCO document CNL(03)9.</p>	

<b>Party</b>	European Union - Denmark
<b>Title</b>	Estuarine migration of smolts in the Rivers Skjern Å (North Sea) and River Guden Å
<b>Coordinating Scientist</b>	Gorm Rasmussen gr@dfu.min.dk
<b>Summary of objectives</b>	
<b>Year removed from inventory/completed</b>	This project was not previously included in the inventory.
<b>Summary of Findings</b>	
<p>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 <i>Salmo salar</i> and trout <i>Salmo trutta</i> 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.</p> <p>In the River Guden Å and its estuary the migration of salmon smolts was investigated in 2002 and 2003 by acoustic telemetry.</p>	

<b>Party</b>	European Union – France
<b>Title</b>	Evolution of biological characteristics in Atlantic salmon from all the Armorican massif rivers (Brittany and Low-Normandy, France)
<b>Coordinating Scientist</b>	Jean-Luc Baglinière Jean-Luc.Bagliniere@rennes.inra.fr
<b>Summary of objectives</b>	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.
<b>Year removed from inventory/completed</b>	2005
<b>Summary of Findings</b>	No report provided.

<b>Party</b>	European Union - Ireland
<b>Title</b>	Assessment of the levels of the parasite <i>Lepeophtheirus salmonis</i> on Atlantic salmon post-smolts in salmon aquaculture bays along Ireland's western seaboard
<b>Coordinating Scientist</b>	Paddy Gargan paddy.gargan@cfb.ie
<b>Summary of objectives</b>	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.
<b>Year removed from inventory/completed</b>	2003
<b>Summary of findings</b>	No summary provided.

<b>Party</b>	European Union - Ireland
<b>Title</b>	Oceanic factors influencing marine survival of Irish salmon stocks
<b>Coordinating Scientist</b>	Niall O' Maoileidigh (Ireland) Kevin Friedland (US),
<b>Summary of objectives</b>	The programme was initiated in 1999 to: Provide information on marine survival at various stages of ocean migration.
<b>Year removed from inventory/completed</b>	2006
<b>Summary of Findings</b>	
<p>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.</p>	

<b>Party</b>	European Union – United Kingdom (England and Wales)
<b>Title</b>	Salmonid migration and climate change
<b>Coordinating Scientist</b>	Andy Moore a.moore@cefas.co.uk
<b>Summary of objectives</b>	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
<b>Year removed from inventory/completed</b>	2005
<b>Summary of Findings</b>	
<p>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.</p> <p>The main findings of the research are as follows:</p> <p><b><i>Migratory behaviour of salmonid smolts and post-smolts</i></b></p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• The speed of migrating salmon over the ground was within the range 18-23 cm sec<sup>-1</sup>, which is similar to the migratory speeds recorded in studies on other salmon populations in UK river systems.</li> <li>• 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.</li> </ul>	

### ***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.

<b>Party</b>	European Union – United Kingdom (England and Wales)
<b>Title</b>	Impacts of agricultural contaminants on wild salmonids
<b>Coordinating Scientist</b>	Andy Moore a.moore@cefas.co.uk
<b>Summary of objectives</b>	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.
<b>Year removed from inventory/completed</b>	2005
<b>Summary of Findings</b>	
<p>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.</p> <p>The main findings of the research are as follows:</p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> </ul>	

- 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 effected 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.

<b>Party</b>	European Union – United Kingdom (Scotland) in collaboration with Norway and the Atlantic Salmon Trust
<b>Title</b>	Testing and development of Institute of Marine Research (IMR) Bergen, Norway, salmon trawl gear
<b>Coordinating Scientist</b>	Julian MacLean (Fishery Research Services) j.c.maclea@marlab.ac.uk Jens Christian Holst (IMR) jens.christian.holst@imr.no Dick Shelton (Atlantic Salmon Trust) freda.shelton@btopenworld.com
<b>Summary of objectives</b>	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.
<b>Year removed from inventory/completed</b>	2006
<b>Summary of Findings</b>	
<p>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.</p> <p>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.</p> <p>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.</p>	

<b>Party</b>	Iceland
<b>Title</b>	Migration of smolts through the estuary of the River Ellidaar, Iceland
<b>Coordinating Scientist</b>	Sigurdur Gudjonsson Sigurdur.gudjonsson@veidimal.is
<b>Summary of objectives</b>	Monitor the migratory behaviour of smolts
<b>Year removed from inventory/completed</b>	2004
<b>Summary of Findings</b>	
<p>The project is finished. A report has been written in Icelandic and further publication is intended. In brief: Smolts tagged with acoustic tags in the River Ellidaar, west Iceland, showed only a short migration delay in the estuary before migrating into the fjord and out into the open ocean.</p>	

<b>Party</b>	Iceland
<b>Title</b>	Survival at sea of 1- and 2-sea-winter salmon in relation to oceanic conditions
<b>Coordinating Scientist</b>	Sigurdur Gudjonsson sigurdur.gudjonsson@veidimal.is
<b>Summary of Objectives</b>	Study the changes in the ratio of 1SW:2SW salmon in Iceland and relation of oceanic climate to fluctuation and annual number of salmon caught in rivers in Southwest Iceland.
<b>Year removed from inventory/completed</b>	2006
<b>Summary of Findings</b>	
<p>The project was a part of MSc thesis, “<b>Fluctuations in the rod catch of Atlantic salmon (<i>Salmo salar</i> L.) stocks in west Iceland in relation to oceanographic conditions in the north West Atlantic</b>”, submitted by Jorge Fernandes to the University of Iceland in 2006.</p> <p><b>Abstract</b>  Time-series of angler rod catch data (1960-2000) of Atlantic salmon (<i>Salmo salar</i>, L.) from a range of rivers in West Iceland were correlated with sea surface temperature (SST) and Continuous Plankton Recorder (CPR) records from the north west Atlantic. The aim of the study focused in detecting temporal relationships, which may explain fluctuations in the rod catch indicative of changes in survival and attempt to explain the possible mechanisms of the interactions observed. The results provided indications that Icelandic salmon over-wintering areas are likely located in the Irminger-Iceland basin areas. Evidence of trophic effects of salmon that spend one winter at sea (1SW salmon) affecting their survival was found. The results suggested that timing of migration of sea-migrating smolts, regulated by local environmental conditions, may also play a critical role by allowing smolts access to abundant resources in neighboring areas. The strength of warm Irminger sea water the year of smolt migration appears to determine the year class strength of 1SW salmon. For multi-sea-winter (MSW) salmon the results indicate that for the period 1960-1990 the year-class strength of MSW salmon was related to good survival of 1SW and possibly good feeding opportunities in the subsequent summer-autumn in the West Greenland. Strong correlations with large-scale environmental variability, in particular SST and parallel changes in zooplankton in time/areas most likely utilized by MSW salmon, indicate that regime shift and ecosystem imbalance in the East-West Greenland may be the cause for the observed decline of MSW salmon.</p>	

<b>Party</b>	Iceland
<b>Title</b>	Variation in growth and return rates of Atlantic salmon from three Icelandic rivers
<b>Coordinating Scientist</b>	Thorkell Heidarsson thorkell@veidimal.is Thorolfur Antonsson thorolfur.antonsson@veidimal.is
<b>Summary of Objectives</b>	Increase knowledge of growth and environmental factors influencing return rates and in general life history of different salmon stocks in Iceland.
<b>Year removed from inventory/completed</b>	2006
<b>Summary of Findings</b>	
<p>The project was a part of MSc thesis submitted by Thorkell Heidarson to the University of Iceland in 2005. <b>The ocean growth of the Icelandic Atlantic salmon (<i>Salmo salar</i>).</b></p> <p><b>Abstract:</b></p> <p><b>Introduction:</b> Studies of smolt emigration, smolt characteristics and return rates indicate that environmental conditions during the sea phase is a key factor in explaining annual variation in rod catches of Atlantic salmon (<i>Salmo salar</i>) populations. In Iceland annual variation in stock size and catches of salmon are greater in the N and NE than in S and SW and the variation in environmental conditions, such as temperature, shows a similar pattern. In the study, scales were used to analyse sea growth patterns of Atlantic salmon in three Icelandic rivers, Ellidaar (SW), Vestura (NW) and Vesturdalsa (NE).</p> <p><b>Methods:</b> Scales were sampled from rod catches during the years 1985-2001. Before studying the growth, two back calculation methods used for the growth estimation were validated utilizing a tagging/recapture program for sampling of smolt and adult scale. Sea growth parameters were compared among the populations and between two sea age groups. The relationship between growth and smolt emigration time as well as return rates was investigated. Finally, the relationship between sea-temperature and growth was studied and the correlation of those factors used to gain information on migration and whereabouts of the salmon during the sea phase.</p> <p><b>Results:</b> On average both back-calculation methods overestimated actual smolt lengths, but Dahl-Lea method gave better results. The freshwater spring growth was seriously underestimated from adult scales. The fact that the spring growth in adult scales was underestimated means that overestimation by back-calculation was actually less than if the spring area in the scale had been correctly determined. Extensive, but similar pattern of inter-annual variation in sea growth was found among the populations. Absolute post-smolt growth from the SW (Ellidaar) to the NE (Vesturdalsa). The opposite pattern was seen in the spring growth. The post-smolt growth in the sea age classes followed the same inter-annual pattern. The inter-annual pattern of second sea year growth was unrelated to post-smolt growth in the subsequent cohort. An inverse relationship was found between emigration day and post-smolt growth on a global scale. Post-smolt growth was positively related to return rates in one-sea-winter salmon from Vestura. Post-smolt growth correlated positively with sea temperature in areas near the home river in the months prior to the smolt run. In Ellidaar correlations were seen between sea temperature and sea spring growth in costal areas and in area further to the West on both sides of Southern Greenland.</p> <p><b>Discussion:</b> The results show that the Dahl-Lea method should be favoured over the Fraser-Lee method when back calculation salmon lengths, using scales. The fluctuations in sea growth observed in all three populations are likely results of annual variation in marine environmental conditions in the NW-Atlantic. It appears that the global components have stronger influence on these fluctuations than local factors. The results indicate that the two sea age classes are faced with similar environmental conditions during their first year at sea implying that they are staying in the same area. Comparing the sea growth data and annual return rates suggests that mortality is highest in the</p>	

beginning of the sea phase. The relationship found between sea temperature and post-smolt growth indicates that the salmon is staying in the sea near its home river during this initial period. The correlations found between sea temperatures and growth suggests that the Ellidaar salmon migrate to areas south and west of Greenland.

<b>Party</b>	Norway
<b>Title</b>	Identification of salmon by geochemical signatures; further development and testing of methods
<b>Coordinating Scientist</b>	Peder Fiske peder.fiske@nina.no
<b>Summary of objectives</b>	The main objectives of this project were to: <ul style="list-style-type: none"> <li>• test if geochemical signatures are stable from year to year</li> <li>• test if geochemical signatures of salmon scale samples can be used to discriminate among fish from different rivers</li> <li>• develop analytical procedures (otolith core sampling, chemical and statistical analyses) for application of this method in ecological studies on Atlantic salmon.</li> </ul>
<b>Year removed from inventory/completed</b>	2003
<b>Summary of Findings</b>	
<p>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.</p> <p>This suggests that there are year to year variations in the chemical composition of the otoliths, 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.</p> <p>The usefulness of the method to identify salmon from mixed-stock fisheries to the river of origin therefore seems limited.</p>	

<b>Party</b>	Norway
<b>Title</b>	Development of models to predict marine survival and return of salmon to Norway
<b>Coordinating Scientist</b>	Lars Petter Hansen l.p.hansen@nina.no
<b>Summary of objectives</b>	Develop models to predict marine survival and return of Atlantic salmon to Norway.
<b>Year removed from inventory/completed</b>	2006
<b>Summary of Findings</b>	
<p>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.</p> <p>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.</p>	

<b>Party</b>	Norway
<b>Title</b>	By-catch in pelagic fisheries as a population-regulating factor in wild salmon stocks
<b>Coordinating Scientist</b>	Jens Christian Holst jens.christian.holst@imr.no
<b>Summary of objectives</b>	<p>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.</p> <p>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.</p>
<b>Year removed from inventory/completed</b>	2006
<b>Summary of Findings</b>	No report provided.

<b>Party</b>	Norway
<b>Title</b>	Sea lice as a population-regulating factor in Norwegian salmon: status, effects of measures taken and future management
<b>Coordinating Scientist</b>	Jens Christian Holst jens.christian.holst@imr.no
<b>Summary of objectives</b>	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.
<b>Year removed from inventory/completed</b>	2006
<b>Summary of Findings</b>	No report provided.

<b>Party</b>	United States of America
<b>Title</b>	Forecasts of Atlantic Salmon Transoceanic Migration: Climate Change Scenarios and Anadromy in the North Atlantic
<b>Coordinating Scientist</b>	Kevin Friedland friedlandk@forwild.umass.edu
<b>Summary of objectives</b>	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
<b>Year removed from inventory/completed</b>	2005
<b>Summary of findings</b>	No report provided.

<b>Party</b>	United States
<b>Title</b>	Stable Isotope Composition of Atlantic Salmon Scales
<b>Coordinating Scientist</b>	Kevin Friedland friedlandk@forwild.umass.edu
<b>Summary of objectives</b>	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.
<b>Year removed from inventory/completed</b>	2005
<b>Summary of findings</b>	No report provided.