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	**Totals by Topic Area**
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
Totals by Party	**£1,079,000 6**	**£62,200 1**	**£2,664,290 22 (4)**	**£563,000 6**	**£430,750 8**	**£160,000 2**	**£165,000 6**	**£5,124,240 51 (4)**

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

SALSEA Work Packages	Ongoing Projects	SALSEA costing
Work Package 1: Supporting Technologies		
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
Work Package 2: Early Migration through the Inshore Zone: fresh waters, estuaries and coastal waters		
Task 1: Investigate the influence of biological characteristics of Atlantic salmon smolts on their marine mortality	-	-
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	
Work Package 3: Investigating the distribution and migration of salmon at sea		
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
Appendix 1: Supporting technologies, further development of which will support the SALSEA programme		
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)

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
CANADA							
C1: Use of stable isotopes to assess long-term changes in marine trophic ecology of Atlantic salmon (*Salmo salar)*	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	**New entry** 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) *Collaborating countries:* Finland	J. Brian Dempson dempsonb@dfo-mpo.gc.ca	£27,500	Stable isotope analysis from scales.
C2: 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 *Collaborating countries*: 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.
C3: Marine survival of Canadian Atlantic salmon stocks: long-term monitoring	Long-term monitoring of smolt production and adult return estimates from a number of rivers in Newfoundland, 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.
C4: 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.

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
C5: 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.
C6: River and extended estuary acoustic tracking of Atlantic salmon (*Salmo salar*) 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	**New entry** 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 recivers.
DENMARK (FAROE ISLANDS AND GREENLAND)							
D1: 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 *Collaborating countries:* USA, UK, Ireland, Canada	Helle Siegstad helle@natur.gl	£62,200	Catch sampling, scale analysis, genetic analysis, disease and parasite screening.
EUROPEAN UNION							
UK – England and Wales							
E1: 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.
E2: 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.
E3: 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.

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
E4: 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.
E5: 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.
E6: 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.
E7: 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.

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
E8: 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 *Collaborating countries:* Spain, France, Ireland, Scotland, USA, Iceland	Dylan Bright dylan@wrt.org.uk	£370,000	Genetic analysis.
UK – Northern Ireland							
E9: 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 *Collaborating countries:* 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.
UK - Scotland							
E10: 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.maclean@ 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.
E11: Analysis of post-smolt life history by scale reading	Investigate the relationship between growth and mortality, particularly during the marine phase, by analysis of scale growth patterns.	Long-term monitoring	Continuing project under longer-term remit	Samples from around Scotland but North Esk and Girnock Burn in particular *Collaborating countries:* USA and Canada	Julian Maclean j.c.maclean@marlab.ac.uk	-	Scale 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
E12: 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.
Ireland							
E13: 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 *Collaborating countries:* Norway, UK, Faroes	Niall O'Maoileidigh niall.omaoileidigh@marine.ie	£300,000	Micro-tagging and tag recovery programmes.
E14: 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 *Collaborating countries:* UK	Russell Poole, russell.poole@marine.ie Deirdre Cotter deirdre.cotter@marine.ie Niall O'Maoileidigh niall.omaoileidigh@marine.ie	£24,000	Acoustic tags, receiver arrays, echo sounders.
E15: 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	**New entry** 1960-2006	Burrishoole River	Russell Poole russell.poole@marine.ie	£72,000	Upstream and downstream traps.
E16: 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	**New entry** 2003-2006	Kilkerran Bay, Bertraghbouy Bay, Connemara *Collaborating countries:* UK, Norway	Paddy Gargan paddy.gargan@cfb.ie Niall O'Maoileidigh niall.omaoileidigh@marine.ie	£48,000	Traps, microtagging, commercial fishery.
E17: 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	**New entry** 2006-2007	All Irish rivers *Collaborating countries:* UK, Spain	Tom Cross t.cross@ucc.ie Paddy Gargan paddy.gargan@cfb.ie Philip McGinnity phil.mcginnity@marine.ie	£270,000	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
E18: Interactions between aquaculture and wild salmonid fish	Assess efficacy of prophylactic treatments for salmon smolts migrating through aquaculture bays.	Specific natural and anthropogenic factors	**New entry** 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.
France							
E19: 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.
Denmark							
E20: 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.
Finland							
E21: Long-term variation in population dynamics, life history characteristics, sea growth and origin (wild/reared) of salmon in the rivers Teno (Tana) and Näätämöjoki (Neidenelva)	Collect long-term data on variation in the stock components, life histories, sea growth and abundance of escaped farmed salmon in the salmon stocks of the rivers Teno and Näätämöjoki. Relate the population dynamics of the juvenile salmon and returning adult salmon in preceding and subsequent generations	Long-term monitoring	Long-term ongoing	Northern Finland and Norway *Collaborating countries:* Norway	Jaakko Erkinaro jaakko.erkinaro@rktl.fi	£275,000	Collection of catch statistics and sampling. Analysis of scale samples (2,000-8,000 annually). Electro-fishing.
Sweden							
E22: 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 Åtran and estimate sea survival, growth and exploitation for wild and reared fish.	Long-term monitoring	Ongoing	Rivers Åtran, Lagan and Nissan	-	£35,000	Adult and smolt traps.
ICELAND							
I1: 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 *Collaborating countries:* Through ICES	Thorolfur Antonsson thorolfur.antonsson@ veidimal.is	£96,000	Traps, tagging, scale sampling.

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
I2: 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.
I3: 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).
I4: 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.
I5: 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.
I6: 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 *Collaborating countries:* Faroe Islands, Norway	Johannes Sturlaugsson johannes@laxfiskar.is	£230,000	DSTs (Star-Oddi).
NORWAY							
N1: 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 *Collaborating countries:* Canada	Bengt Finstad bengt.finstad@nina.no	£68,250 in 2006	Fish lift trawl.

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
N2: 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	**New entry** 2006-2007	Western Norway, River Dale, Matre Aquaculture Station	Ove Skilbrei ove.skilbrei@imr.no	£37,500	Smolt trap, tags, SLICE.
N3: 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.
N4: 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 *Collaborating countries:* Faroe Islands	Marianne Holm marianne.holm@imr.no	£20,000 in 2006	Data analysis only in 2006.
N5: 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 *Collaborating countries:* Faroe Islands, Iceland	Marianne Holm marianne.holm@imr.no	£4,000 in 2006	Data analysis only in 2006.
N6: 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	**New entry** 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.
N7: 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	**New entry** January 2006 – December 2008	Norway *Collaborating countries:* 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
N8: 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 *Collaborating countries:* 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.
RUSSIAN FEDERATION							
R1: 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.
R2: 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
USA							
U1: Penobscot hatchery versus wild smolt telemetry	Evaluate migration timing and pathways in the Penobscot Estuary and Bay and estimate survival of migrating smolts and post-smolts.	Distribution/ migration in the sea	**New entry** 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
U2: 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) *Collaborating countries:* 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
U3: 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 *Collaborating countries:* Canada	James Hawkes James.Hawkes@noaa.gov Tim Sheehan Tim.Sheehan@noaa.gov	£28,000 (public funding)	Ultrasonic tags and receivers. Electro-fishing gear.
U4: 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 *Collaborating countries:* 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.
U5: 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.
U6: 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)

Party	Project Title and Details of Coordinating Scientist(s)	Summary of Objectives	Year removed from inventory
Canada	Marine migration and survival of post-smolt Atlantic salmon from Bay of Fundy rivers *Coordinating scientist:* Gilles L Lacroix LacroixG@dfo-mpo.gc.ca	Provide knowledge about marine habitat (migration routes and feeding grounds) used by salmon post-smolts from Bay of Fundy rivers. Determine the location, timing and extent of salmon post-smolt mortality at sea. Investigate the causes and mechanisms of marine mortality of salmon post-smolts. Provide information to fuel the recovery programme for inner Bay of Fundy salmon stocks.	2003
Canada	Distribution, health and condition of Atlantic salmon from Bay of Fundy rivers while at sea *Coordinating scientist:* Gilles L Lacroix LacroixG@dfo-mpo.gc.ca	Provide knowledge about marine habitat and health of salmon post-smolts from Bay of Fundy rivers. Investigate the causes and mechanisms of marine mortality of salmon post-smolts. Provide information to fuel the recovery programme for inner Bay of Fundy salmon stocks.	2004
Canada	Tracking experimentally 'escaped' farmed salmon *Coordinating scientist:* Fred Whoriskey asfres@nb.aibn.com	Determine the course tracks and fates of sonically tagged farmed salmon released in winter and spring.	2006
Canada	Atlantic salmon distribution and abundance at sea *Coordinating scientist:* David Reddin reddind@dfo-mpo.gc.ca	Determine salmon distribution and abundance at sea, particularly post-smolts in the Labrador Sea and Northern Grand Banks; collect biological and other data; investigate the relationship between salmon and their prey; investigate the relationship between oceanographic parameters and salmon abundance; tag and release salmon.	2006
European Union	SALMODEL Concerted Action - A co-ordinated approach towards the development of a scientific basis for management of wild Atlantic salmon in the north-east Atlantic *Coordinating scientist:* Walter Crozier walter.crozier@dardni.gov.uk	Improve our ability to set salmon conservation limits (CLs), addressing transportability and dynamic change issues, also taking into account underlying stock structure, and; Examine methods of estimating pre-fishery abundance (PFA) for north-east Atlantic (NEAC) salmon stocks and to determine whether and how PFA estimates can be used to give catch advice.	2003
European Union – Denmark	Estuarine migration of smolts in the Rivers Skjern Å (North Sea) and River Guden Å *Coordinating scientist:* Gorm Rasmussen gr@dfu.min.dk	To assess the effect of restoration of habitat in the River Skjern Å on the smolt runs of salmon and sea trout, in particular with regard to predation by piscivorous birds. To investigate the migration of salmon smolts in the River Guden Å.	Not previously included
European Union – France	Evolution of biological characteristics in Atlantic salmon from all the Armorican massif rivers (Brittany and Low-Normandy, France) *Coordinating scientist:* Jean-Luc Baglinière Jean-Luc Bagliniere:rennes.inra.fr	Examine relationships between the cumulative effects of climate warming and other anthropogenic stresses and changes in biological features in populations in the Southern part of the European distribution range of the species.	2005

Party	Project Title and Details of Coordinating Scientist(s)	Summary of Objectives	Year removed from inventory
European Union – Ireland	Assessment of the levels of the parasite *Lepeophtheirus salmonis* on Atlantic salmon post-smolts in salmon aquaculture bays along Ireland's western seaboard *Coordinating scientist:* Paddy Gargan paddy.gargan@cfb.ie	Determine whether sea lice from marine salmon farms are a contributory factor in increased marine mortality of salmon post-smolts migrating from bays with salmon aquaculture. Gather information on salmon post-smolt migration patterns.	2003
European Union – Ireland	Oceanic factors influencing marine survival of Irish salmon stocks *Coordinating scientist:* Niall O'Maoileidigh niall.omaoileidigh@ 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 *Coordinating scientist:* Andrew Moore a.moore@cefas.co.uk	Describe and model the environmental factors affecting the migration of salmonids and investigate the effects of climate change on salmonid migration and survival both in fresh water and the sea	2005
European Union - United Kingdom (England and Wales)	Impacts of agricultural contaminants on wild salmonids *Coordinating scientist:* Andrew Moore a.moore@cefas.co.uk	Identify and describe the effects of environmental levels of agricultural pesticides on salmonid embryo survival, smolt emigration and marine survival and model their potential impacts at the population level. In addition, the role of pheromones in sea trout biology was investigated in order to predict the effects of water quality on sea trout reproduction.	2005
European Union - United Kingdom (Scotland)	Testing and development of Institute of Marine Research (IMR), Bergen, Norway, salmon trawl gear *Coordinating scientist:* Julian MacLean j.c.maclean@marlab.ac.uk Jens Christian Holst jens.christian.holst@imr.no Dick Shelton freda.shelton@btopenworld.com	Test a prototype trawl developed by IMR, Bergen, Norway, which, rather than capturing post-smolts, records, by use of CCTV, their passage as they pass through an open-ended trawl net. A supplementary objective, dependent on the success of the gear trials, was to conduct a post-smolt survey at the shelf edge.	2006
Iceland	Migration of smolts through the estuary of the River Ellidaar, Iceland *Coordinating scientist:* 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. *Coordinating scientist:* 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

Party	Project Title and Details of Coordinating Scientist(s)	Summary of Objectives	Year removed from inventory
Iceland	Variation in growth and return rates of Atlantic salmon from three Icelandic rivers *Coordinating scientist:* 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 *Coordinating scientist:* Peder Fiske peder.fiske@nina.no	The main objectives of this project were to: • test if geochemical signatures are stable from year to year • test if geochemical signatures of salmon scale samples can be used to discriminate among fish from different rivers • develop analytical procedures (otolith core sampling, chemical and statistical analyses) for application of this method in ecological studies on Atlantic salmon.	2003
Norway	Development of models to predict marine survival and return of salmon to Norway *Coordinating scientist:* Lars Petter Hansen 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. *Coordinating scientist:* Jens Christian Holst jens.christian.holst@imr.no	Investigate the extent of by-catch and develop management advice to reduce by-catch while maintaining catch rates in the mackerel fishery.	2006
Norway	Sea lice as a population-regulating factor in Norwegian salmon: status, effect of measures taken and future management *Coordinating scientist:* Jens Christian Holst jens.christian.holst@imr.no	Further clarify the effects of sea lice on wild salmon populations and propose measures to reduce sea lice infections in wild salmon and develop alternative measures in critically affected stocks.	2006
United States	Forecasts of Atlantic salmon transoceanic migration: climate change scenarios and anadromy in the North Atlantic *Coordinating scientist:* Kevin Friedland friedlandk@forwild.umas.edu	Develop and evaluate marine migration models for Atlantic salmon from North America and Europe; evaluate the potential effects of climate change on migration patterns of Atlantic salmon.	2005
United States	Stable isotope composition of Atlantic salmon scales *Coordinating scientist:* Kevin Friedland friedlandk@forwild.umas.edu	Develop a retrospective time series of stable isotope ratios to evaluate feeding patterns over time.	2005