International Cooperative Salmon Research Board

ICR(04)6

Inventory of Research Relating to Salmon Mortality in the Sea

(updated June 2004)

Table 1: 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, E7, E8, E12, E13, E16, I1, N3, N8, R1, U4	Medium	Low
	b. Time series of marine survival in relation to environmental parameters (e.g. SST)	Desk studies on time series.	E9, E11, I2, I3, I4, N2	Medium	Medium
2. Distribution/ migration in the sea	a. Distribution of salmon in the sea	Marine surveys of post-smolt distributions in NEAC and NAC areas; identification of fish caught (e.g. tagging, genetics).	C1, N4, U5	High	High
	b. Migratory behaviour of individual fish	Active smolt tracking; automated data collection by DSTs.	C4, E4, E15, N5, U1, U2, U3, U8	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	High	Low
	d. Migration and bioenergetic models	Desk studies based on data obtained from other studies.	E2, U6	Medium	Medium
	e. By-catches in pelagic fisheries	Can be conducted as part of marine surveys of post-smolt distributions; sample commercial pelagic catches.	N6, R2	High	High
3. Life history/biological processes	a. Freshwater factors	Age, growth, migration timing, etc.	E14	Low	Low
	b. Pre-fishery recruitment marine factors	Environment, food, predation, growth, parasites and diseases, etc.	N1, U7	High	High
	c. Post-fishery recruitment marine factors	Environment, food, predation, maturation processes, growth, etc.		High	High
4. Development of methods	a. Post-smolt survey methods	Development of trawls with cameras, tag detection, etc.		Medium	Medium
	b. Electronic tag technology	Development of smaller/smarter/cheaper tags.		Medium	High
5. Specific natural and anthropogenic factors	a. Fish farms	Increased sea lice infestations.	C5, N7	Low	Low
	b. Predation	Predation by seals, birds, fish, etc. in estuaries/coastal areas.	E10	Low	Low
	c. Obstructions to fish movements	Barrages, etc.	E3	Low	Low
	d. Pollutants	Acidification; freshwater contaminants.	C2, E1, E5	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 2: Summary of research relating to salmon mortality in the sea

(a) ONGOING PROJECTS

Project no.	Title	Summary of objectives	Topic Area	Dates of research	Area of research	Approx-imate annual cost (Pounds Sterling)	Main research methods	Collabo-rating countries
	CANADA							
C1	Atlantic salmon distribution and abundance at sea	Determine salmon distribution and abundance at sea; collect biological and other data; investigate the relationship between salmon and prey; investigate the relationship between oceanographic parameters and salmon abundance; tag and release salmon.	Distribution/ migration in the sea	Autumn 2001, 2003 (postponed until 2004) and 2005	Labrador Sea and Northern Grand Banks	£146,500 in 2004 and 2005	Drift gill nets. Surface trawls.	None
C2	Integrated field and laboratory assessment of the effects of endocrine-disrupting substances on Atlantic salmon smolts	Laboratory and field tests of the effects of endocrine-active substances in municipal and industrial effluents; field tests of 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	2002-2005	Atlantic Canada and Co. Mayo, Ireland	£115,000	Trap nets and holding cages in rivers.	Ireland
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	£564,500	Smolt and adult fences and traps, trap nets, rotary screw smolt traps.	None
C4	Atlantic salmon smolt migration and survival within the Miramichi River and its estuary	Determine the fraction of smolts tagged in fresh water that move down-river to the head of tide. Determine the fraction of smolts tagged at head of tide that successfully transit estuary of Miramichi River.	Distribution/ migration in the sea	2003	Miramichi River and Estuary	£273,000	Acoustic tags and receivers, smolt wheels.	None
C5	Tracking experimentally 'escaped' farmed salmon	Determine the course tracks and fates of sonically tagged farmed salmon released in winter and spring.	Specific natural and anthropogenic factors	**New entry** Winter/ spring 2004	Cobscook Bay, Maine, USA; Quoddy region, NB, Canada	£273,000	Acoustic tags and receivers, smolt wheels	None
	DENMARK (FAROE ISLANDS AND GREENLAND)							
D1	Origin of Atlantic salmon captured in a mixed stock fishery at West Greenland	Estimate size and river/sea age composition and relative composition of European and North American origin salmon in the catch at West Greenland.	Distribution/ migration in the sea	Annually during the fishing season, usually August – September	West Greenland	£88,500	Catch sampling, scale analysis, genetic analysis.	USA, UK, Ireland, Canada

Project no.	Title	Summary of objectives	Topic Area	Dates of research	Area of research	Approx-imate annual cost (Pounds Sterling)	Main research methods	Collabo-rating countries
	EUROPEAN UNION							
	UK – England and Wales							
E1	Impact of intensive in-river aquaculture on wild salmonids	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.	Specific natural and anthropogenic factors	**New entry** November 2001- April 2005	England and Wales	£72,000	Monitoring concentrations and effects of contaminants. Modelling.	None
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 2004	Desk study	£40,000	Modelling.	None
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	1990-2006	Cardiff Bay at mouth of rivers Taff and Ely, South Wales, UK	£250,000	Contained acoustic and radio tags, monitoring return rates of tagged/finclipped smolts.	None
E4	Salmonid migration and climate change	Describe and model environmental factors affecting migration of salmonids and predict the effects of climate change on salmonid migration and survival at sea.	Distribution/ migration in the sea	April 1999 – April 2004	Coastal waters around the UK and extending to salmon feeding grounds in Faroes and Greenland Seas	£140,000	Acoustic transmitters and automated acoustic receivers.	None
E5	Impacts of agricultural contaminants on wild salmonids	Describe the nature and extent of the impact of aquatic contaminants derived from agriculture on migration and marine survival of smolts and post-smolts.	Specific natural and anthropogenic factors	April 1999 – April 2004	Laboratory study	£85,000	Laboratory studies and life-cycle models.	Sweden and Canada
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 stocks.	Long-term monitoring	Ongoing annual monitoring programme	River Dee (North Wales), River Tamar (SW England)	-	Rotary screw traps, microtagging, adult traps and counters.	None
	UK – Northern Ireland							
E7	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	1973-2003, project renewed in 2004 for three years	River Bush, N. Irish/Irish coastal waters and distant water fisheries	£27,000	Microtagging, traps, run-reconstruction models.	Ireland
	UK - Scotland							

Project no.	Title	Summary of objectives	Topic Area	Dates of research	Area of research	Approx-imate annual cost (Pounds Sterling)	Main research methods	Collabo-rating countries
E8	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	-	Traps, counters, screw traps, electro-fishing, PIT tags and detectors.	None
E9	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	Desk study utilising samples from around Scotland	-	Scale analysis.	USA and Canada
E10	Protecting salmonid fisheries from seal damage	Develop and apply new molecular tools for discriminating among species of fish remains in seal scats. Develop and deploy cetacean-friendly seal-scarer. Characterise behavioural interactions between salmon and their predators and seals and their prey.	Specific natural and anthropogenic factors	April 2003 - March 2008	Scottish estuaries, principally the Cromarty Firth and Shieldaig	£121,000	DNA analysis, acoustic tags and receivers, sonar.	None
	Ireland							
E11	Oceanic factors influencing marine survival of Irish salmon stocks	Provide information on marine survival at various stages of ocean migration.	Long-term monitoring	August 2001 – 2004	Desk study	£25,000	Analysis of data on marine survival of salmon and marine environmental conditions.	USA
E12	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	North Atlantic	£300,000	Micro-tagging and tag recovery programmes.	Norway, UK, Faroes
	France							
E13	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	**New entry** 1994-2003, to be continued beyond 2003	River Scorff (Southern Brittany)	-	Adult and smolt trapping facilities.	None
E14	Evolution of biological characteristics in Atlantic salmon from all the Armorican massif rivers (Brittany and Low-Normandy, France)	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.	Life history/ biological processes	**New entry** 1972-2002, to be continued beyond 2003.	Salmon rivers in the Armorican massif (about 25-30)	-	Desk study based on rod catch and counting fence data.	None
	Denmark							

Project no.	Title	Summary of objectives	Topic Area	Dates of research	Area of research	Approx-imate annual cost (Pounds Sterling)	Main research methods	Collabo-rating countries
E15	Mortality of Atlantic salmon smolts during estuary migration	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.	Distribution/ migration in the sea	**New entry** April 2000 to June 2007	River Skjern Å (North Sea) and River Guden Å (Kattegat) and their estuaries	£334,000	Rotary screw traps, radio and acoustic telemetry equipment.	None
	Finland							
E16	Long-term variation in population dynamics, life history characteristics, sea growth and origin (wild/reared) of salmon in the rivers Tana (Teno) 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 Tana and Näätämöjoki. Relate the population dynamics of the juvenile salmon and returning adult salmon in preceding and subsequent generations	Long-term monitoring	**New entry** Ongoing since 1972, electrofishing since 1979	River Teno (Tana) River Näätämöjoki (Neidenelva)	£275,000	Collection of catch statistics and sampling. Analysis of scale samples (2,000-8,000 annually). Electro-fishing.	Norway
	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	£96,000	Electro-fishing, smolt traps, microtagging, scale analysis, adult counts, analysis of environmental data.	EU (Salmodel) and ICES
I2	Survival of 1- and 2-sea-winter salmon in relation to oceanic conditions	Study changes in the ratio of 1SW:2SW salmon in Iceland.	Long-term monitoring	Ongoing	Desk study	£64,000	Analysis of catch and environmental data.	EU (Salmodel) and ICES
I3	Variation in growth and return rates of Atlantic salmon from three Icelandic rivers	Increase knowledge of growth and environmental factors influencing return rates and life-history of different salmon stocks.	Long-term monitoring	2001-2004	River Elliðaár, River Vesturá and River Vesturdalsá	£30,000	Scale analysis, analysis of environmental data, microtagging.	None so far
I4	Growth of Atlantic salmon in the river Hofsa, north-east Iceland, in relation to ocean and in-river conditions	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.	Long-term monitoring	**New entry** 2004	Desk study (samples from north-east Iceland)	£1,800	Scale analysis, analysis of environmental data.	None
	NORWAY							

Project no.	Title	Summary of objectives	Topic Area	Dates of research	Area of research	Approx-imate annual cost (Pounds Sterling)	Main research methods	Collabo-rating countries
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	£153,000 in 2004	Trawls with live fish capture facilities.	Canada
N2	Development of models to predict marine survival and return of salmon to Norway	Identify and examine feasibility of applying time series of marine environmental data, zooplankton productivity, productivity of pelagic fish and salmon life-history information for model development. Develop appropriate models.	Long-term monitoring	2002-2005	Desk study of existing data	£55,000	Analysis of existing data. Computer models.	USA, Canada, EU
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	£104,000	Smolt tagging and tag recovery programme.	None
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 marine life-history in order to explain observed variations in salmon survival.	Distribution/ migration in the sea	2002-2005	West of Ireland – Faroes, Northern North Sea, Norwegian Sea	£120,000	Pelagic trawl with live fish capture facilities.	Faroe Islands
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)	To investigate the temporal and spatial distribution of DST-tagged salmon, with emphasis on spatial distribution and temperature preferences; growth in relation to environmental parameters; diurnal depth distributions.	Distribution/ migration in the sea	2003-2004	Northern North Sea, Norwegian Sea	£210,000	Pelagic trawls with live fish capture facilities. DSTs.	Faroe Islands, Iceland
N6	By-catch in pelagic fisheries as a population-regulating factor in wild salmon stocks	Estimate extent of by-catch in a pelagic fishery for mackerel in the Norwegian Sea and develop management advice which could reduce by-catch.	Distribution/ migration in the sea	2001-2005	Norwegian Sea	£80,000	Pelagic trawls with live fish-capture facilities, underwater video.	Russia (probably), Scotland
N7	Sea lice as a population-regulating factor in Norwegian salmon: status, effects of measures taken and future management	Clarify the effects of sea lice on wild salmon populations and make proposals for measures to reduce sea lice infections in wild salmon.	Specific natural and anthropogenic factors	2002-2004	Sognefjord and Altafjord	£140,000	Pelagic trawls with live fish-capture facilities.	None

Project no.	Title	Summary of objectives	Topic Area	Dates of research	Area of research	Approx-imate annual cost (Pounds Sterling)	Main research methods	Collabo-rating countries
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 on variation in salmon abundance and life-history parameters. Evaluate the impact of predation on salmon abundance. Develop an index of marine survival.	Long-term monitoring	2002-2006	River Tana	£60,000	Analysis of abundance and marine survival data, scale analysis, analysis of ocean climate data, stomach content analysis.	Finland, Russia, Canada
	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 (since 1958)	Rivers Umba, Varzuga, Ponoi, Jokanga, Varzina, Tuloma, Kola, Ura, B.Z.Litsa, Pechora, Severnaya Dvina, Mezen, Onega	£80,000	Barrier fences, electro-fishing, smolt traps, external tagging.	None
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	June – August 2002 – 2004	International waters of Norwegian Sea	£80,000	Standard pelagic trawl and observer programme.	None
	USA							
U1	Estuary movements of pre- and post-spawning adults: Dennys River adult stocking assessment	Eight objectives including study of the riverine and estuarine movements of netpen-reared adults using ultrasonic telemetry.	Distribution/ migration in the sea	October 2000 – October 2006	Dennys River, Cobscook Bay and Gulf of Maine	£14,000	Ultrasonic tags and receivers.	Canada
U2	Estuary and nearshore movements of migrating Atlantic salmon smolts: ultrasonic telemetry of smolts and post-smolts in the Narraguagas River and Narraguagas Bay	Evaluate migration timing and pathways and estimate survival of migrating smolts and post-smolts.	Distribution/ migration in the sea	April – June, 2002-2004	Narraguagas River and Narraguagas Bay	£49,000	Ultrasonic tags and receivers.	Canada
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 – October, 2001-2005	Dennys River, Cobscook Bay	£28,000	Ultrasonic tags and receivers.	Canada

Project no.	Title	Summary of objectives	Topic Area	Dates of research	Area of research	Approx-imate annual cost (Pounds Sterling)	Main research methods	Collabo-rating countries
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	April – October, 2002-2005	Dennys River, Cobscook Bay	£14,000	Weir-based smolt and adult traps.	Possible identification of marked fish in West Greenland sampling programme
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 relative contribution of stocked hatchery smolts to overall post-smolt populations; evaluate the relative contribution of spatially and temporally distinct smolt releases in post-smolt populations; evaluate the physiology and condition of post-smolts in marine environments.	Distribution/ migration in the sea	May – June, 2002-2004 (2003 and 2004 field work contingent on continued funding)	Penobscot Bay, Gulf of Maine	£105,000	Post-smolt trawl.	Parallel trawling in Bay of Fundy, Canada
U6	Forecasts of Atlantic salmon transoceanic migration: climate change scenarios and anadromy in the North Atlantic	Develop and evaluate marine migration models for Atlantic salmon for North America and Europe; evaluate the potential effects of climate change on migration patterns of Atlantic salmon.	Distribution/ migration in the sea	2002-2004 (project continuation contingent on additional funding)	Desk study	-	Modelling of migrations throughout North Atlantic.	Canada
U7	Stable isotope composition of Atlantic salmon scales	Develop retrospective time series of stable isotope ratios to evaluate feeding patterns over time.	Life history/ biological processes	2001-2002 (Project continuation contingent on additional funding)	Desk study	-	Analysis of scale samples collected at West Greenland and from US returns.	International collaboration in obtaining samples
U8	Estuary movements of pre- and post-spawning adults: St Croix River adult stocking assessment	The assessment programme includes studying the post-spawning disposition (immediate out-migrants, kelts, or presumed deceased) and timing of estuary entrance. Kelt movements in the sea will be detected using existing arrays to monitor smolt emigration.	Distribution/ migration in the sea	October 2000 – October 2006	St Croix River Cobscook Bay Gulf of Maine	£14,000	Ultrasonic tags and receivers.	Canada

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, Spain and Sweden) with salmon interests.

(b) PROJECTS COMPLETED BUT PREVIOUSLY INCLUDED IN THE INVENTORY

Party	Title	Summary of Objectives	Summary of Project
Canada	Marine migration and survival of post-smolt Atlantic salmon from Bay of Fundy rivers Coordinating scientist: Gilles L Lacroix, DFO, St Andrews Biological Station, St Andrews, New Brunswick, Canada e-mail: 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.	Atlantic salmon smolts were tagged in the spring of 2002 (n=378) and released from inner and outer Bay of Fundy rivers (241 inner bay, 137 outer bay). Two lines comprising 132 receivers (VR-2, Vemco Ltd.) were deployed for tracking inner and outer bay movements of post-smolt salmon. Data is being analyzed to publish in 2004. Field components of this post-smolt tracking project were completed in 2002. Results from the 1999, 2001, and 2002 tracking of tagged smolts were combined in an overall analysis which took place during 2003. The results of these analyses will be summarized in a series of manuscripts to be completed during 2004. At this stage, all results are preliminary. Results will be made available as soon as manuscripts have been completed and approved by the Department for submission and distribution. No resources were allocated to this project in 2003, and no resources will be allocated in 2004. The project represented the first phase of research to define the migration and early marine survival of post-smolts from rivers of the Bay of Fundy, and it has now been completed. Findings from this project will be made available as soon as the draft manuscripts are completed (in 2004) and they receive approval for submission and release. In the interim the summary of findings submitted last year can be used since no new research was conducted during 2003.
Canada	Distribution, health and condition of Atlantic salmon from Bay of Fundy rivers while at sea Coordinating scientist: Gilles L Lacroix, DFO, St Andrews Biological Station, St Andrews, New Brunswick, Canada e-mail: 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.	Atlantic salmon *Salmo salar* post-smolts migrating through the Bay of Fundy and Gulf of Maine were surveyed and sampled in 2001-2003 by trawling in surface waters. Post-smolts were aggregated in several areas while in the Bay of Fundy and then dispersed over a broader area in the Gulf of Maine, and their distribution reflected major surface current patterns. There was considerable spatial and temporal overlap between migrating post-smolts and the herring fishery. Post-smolt origin (e.g., wild vs. hatchery, inner vs. outer Bay of Fundy) did not affect their distribution. The low density of post-smolts indicated that they were too scarce to form large schools that offer protection from pelagic predators. The recapture rate of marked post-smolts was higher for wild than for hatchery fish, but it was nil for wild fish from the salmon farming area. The health and condition of post-smolts was excellent; they had no bacterial or viral pathogens and no salmon sea lice. Environmental conditions and food supply apparently did not limit growth of post-smolts; new circuli on scales and their spacing indicated that growth at sea had started and was accelerating. Post-smolts had shifted to a pelagic foraging behaviour feeding opportunistically on different prey depending on location; the main food items were amphipods, euphausiids, and fish larvae. Post-smolts of hatchery and wild origin consumed the same prey but the larger hatchery fish did so in much greater quantity than the wild post-smolts possibly giving them a growth and survival advantage. A trawling survey for post-smolts was conducted 4-18 June 2003 in Canadian waters of the outer Bay of Fundy and northern Gulf of Maine. Catches (n = 42 post-smolts) were lower than in the previous two years, and only 24% of the post-smolts captured were wild. They were in good health and free of diseases and sea lice. Analyses of growth and feeding habits were completed. The observed distribution confirmed and extended the distribution and origin data obtained in 2002. Results from surveys conducted in 2001, 2002, and 2003 were combined in a manuscript, “Distribution, origin and health of Atlantic salmon post-smolts migrating through the Bay of Fundy and Gulf of Maine”, that has been completed and will be submitted in 2004 pending Departmental approval. No resources will be allocated to this project in 2004. No marine survey will be conducted in 2004 for several reasons; the availability of ship time in the region is severely constrained because of a recent fire aboard the research vessel CCGS Alfred Needler, and the initial goals of the project have been met. The project is therefore considered as completed. The draft manuscript completed for this project will be made available when it receives Departmental approval for submission and release. In the interim, the abstract of the manuscript as a short summary of findings is included.

Party	Title	Summary of Objectives	Summary of Project
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: Dr Walter Crozier, DARDNI, Bushmills Salmon Station, 21 Church St, Bushmills, Co Antrim BT57 8QJ, Northern Ireland e-mail: 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.	- examined current models used to estimate PFA, including that used by ICES - assessed sensitivity of the ICES model to data types and variation, and tested assumptions of incorporation of natural mortality "m" into PFA models, this resulting in a change to the default value of "m" used at ICES - SALMODEL also evaluated the basis of the NEAC stock groupings being used in the catch advice process - evaluated options for developing a predictive PFA model from the historic time series employing environmental and other data, producing for the first time forecasts of PFA of southern European stocks at West Greenland - investigated predictive PFA models based on smolt production estimates/indices for the NEAC area - examined approaches for model validation and examined scales at which the various model types can be applied Further details are presented in NASCO document CNL(03)9.
European Union	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: Dr Patrick Gargan, Central Fisheries Board, Balnagowan, Mobhi Boreen, Glasnevin, Dublin 9, Ireland e-mail: 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.	No summary provided.
Iceland	Migration of smolts through the estuary of the River Ellidaar, Iceland Coordinating scientist: Dr Sigurdur Gudjonsson, Institute of Freshwater Fisheries, Reykjavik, Iceland e-mail: sg@veidimal.is	Monitor the migratory behaviour of smolts.	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 in to the open ocean.

Party	Title	Summary of Objectives	Summary of Project
Norway	Identification of salmon by geochemical signatures; further development and testing of methods Coordinating scientist: Peter Fiske	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.	No summary provided.

The following completed project was not previously included in the inventory but is relevant to it.

Party	Title	Summary of Objectives	Summary of Project
EU (Denmark)	Estuarine migration of smolts in the Rivers Skjern Å (North Sea) and River Guden Å		In Skjern Å estuary we have demonstrated very high smolt mortalities during two research seasons caused by cormorants (28 and 44 %). European rivers and their floodplains are generally severely affected by human activity. As a consequence, both the water and the river habitat quality have been seriously degraded in numerous European rivers during the twentieth century. In Denmark less than 5% of the rivers have been left in a natural physical state. During the 1960s the lower part of River Skjern Å was regulated and adjacent bogs, ponds, marshes and meanders drained. In the beginning of the 1990s the Danish government decided to restore the River Skjern Å and its floodplain and in 2002 the River Skjern Nature project was implemented. The project consisted of several parts, including returning the straight, regulated river back to its former meanders and introducing better hydraulic interaction between the river and its meadows. Before implementation of the restoration project the causes of mortality of wild salmon *Salmo salar* and trout *Salmo trutta* smolts in River Skjern Å and its estuary Ringkøbing Fjord were investigated in 2000. A follow-up comparable study was performed in the spring of 2002 after the majority of the project was implemented, aimed towards assessing the effect of the restoration project on the salmon and trout smolt runs. This study indicated that the river restoration had an indirect slightly negative effect on the smolt run, mediating bird predation within the river system. As also demonstrated in 2000, bird predation in the estuary had a major adverse effect on the smolt run and jointly the smolt mortality in the river and in the estuary may threaten a self-sustaining salmon population in River Skjern Å. In the River Guden Å and its estuary the migration of salmon smolts was investigated in 2002 and 2003 by acoustic telemetry.

Annex 1

Inventory of Research relating to Salmon Mortality in the Sea

(updated June 2004)

1. CANADA

Project No. C1 (formerly C3) Status: Ongoing

Party or relevant jurisdiction	Department of Fisheries and Oceans, Newfoundland Region
Title of project	Atlantic salmon distribution and abundance at sea
Objective of research project	(1) Determine the distribution and abundance of salmon, particularly post-smolts, in the Labrador Sea and northern Grand Banks; (2) Collect biological, meristic, morphometric, and biochemical data on salmon; (3) Investigate the relationship between salmon and prey by collecting stomach contents; (4) Investigate the relationship between sea temperature and other oceanographic parameters and salmon abundance; (5) Tag and release salmon in good condition.
Brief description of research project	The distribution of Atlantic salmon will be studied using multiple mesh drift nets, and if available, a surface trawl in the autumn. Relative abundance with respect to spatial distribution and sea temperature will be inferred from catch rates. Fishing will take place between 49° 00' N and 57° 00' N and 40° 00' W and 60° 00' W.
Dates during which research will take place	September, 2001 Autumn 2003 and 2005
Area in which research will take place	Labrador Sea and Northern Grand Banks
Estimated number and weight of salmon to be retained	500 post-smolts, ~ 0.5 t
Resources	
Estimated cost of the research project	£146,500 (including overheads) per year in 2004 and 2005
Number of participating scientists	1
Name of coordinating scientist in charge of project	David Reddin, e-mail: ReddinD@dfo-mpo.gc.ca
Details of research vessels, e.g. name, registration, call sign and description of vessel	CCGS Wilfred Templeman Canadian CGDV 50 m long of 925 GRT
Type and amount of gear and other equipment to be used	~2000 fathoms of monofilament drift gill nets of 77, 89, 102, 115, and 127 mm stretched measure. Surface trawl
Details of any collaborating countries	

Summary of Progress

Vessel trip to the Labrador scheduled for the fall of 2003 was postponed to 2004 due to unavailability of the vessel.

Project No. C2 (formerly C4) 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	- Laboratory tests of the effects of endocrine-active substances in municipal and industrial effluents, including estrogens, androgens, phytosterols and nonylphenol ethoxylates - 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) - Field tests caging smolts near sites with potential for significant agricultural runoff - 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)
Brief description of research project	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 (*Salmo salar*) 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 1950's. 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.
Dates during which research will take place	2002-2005

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).
Resources	
Estimated cost of the research project	About £115,000 per year, majority from DFO ESSRF plus other funds and in-kind support from Environment Canada, DFO, Marine Institute, Ireland, and others
Number of participating scientists	12 (DFO, Env Can, UNB, Marine Institute) plus two graduate students
Name of coordinating scientist in charge of project	Joint coordination between: Dr. Wayne L. Fairchild, Fisheries and Oceans Canada, Gulf Fisheries Centre, P.O. Box 5030, Moncton, NB, E3B 9B6, tel: 506-851-2056 fax: 506-851-2079 e-mail: FairchildW@mar.dfo-mpo.gc.ca And Dr. Scott B. Brown, Environment Canada, National Water Research Institute, 867 Lakeshore Road, P.O. Box 5050, Burlington, ON, L7R 4A6, Tel: (905)336-6250, Fax: (905)336-4735, e-mail: 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.

Summary of Progress

Publications in scientific journals:

Brown, S.B. and W.L. Fairchild. 2003. Evidence for a causal link between exposure to Matacil^{R} 1.8D and declines in catch of Atlantic salmon. International Journal of Human and Ecological Risk Assessment. 9:137-148.

Arsenault, J.T.M., Fairchild W.L., MacLatchy, D.L., Burridge, L., Haya, K. and Brown, S.B. 2003. Effect of water-borne 4-nonylphenol and 17 beta estradiol exposures during parr-smolt transformation on growth and plasma IGF-1 of Atlantic salmon (*Salmo salar* L.). Aquatic Toxicology 66(3):255-265.

Jardine, T.D., D.L. MacLatchy, W.L. Fairchild, R.A. Cunjak, and S.B. Brown. Rapid carbon turnover during growth of Atlantic salmon (*Salmo salar*) smolts in sea water, and evidence for reduced food consumption by growth-stunts. Hydrobiologia (submitted August 2003, accepted January 2004)

Technical reports:

Fairchild, W., K. Haya, L. Burridge, J. Arsenault, G. Eales, J Sherry, D. Bennie, K. Burnison, D. Maclatchy, R. Evans, and S. Brown. 2003. Effects of endocrine disruptors on parr-smolt transformation in Atlantic salmon (S*almo salar* L.). In E.C.E. Potter, N. O'Maoileidigh, and G. Chaput (Eds.). Marine mortality of Atlantic salmon, *Salmo salar* L: methods and measures. DFO Can. Science Adv. Secr. Res. Doc. 2003/101.

Media interactions:
Documentary was released from interviews during 2000 in St. Andrews, NB.
National Film Board of Canada. 2003. Crapshoot: the gamble with our wastes. Directed and edited by Jeff McKay. Produced by Joe MacDonald. C9103 064. Running time 53 mins. (WLF was interviewed on salmon smolt/endocrine research, and there is footage of salmon, St. Andrews Biological Station labs and area). Presented at the Montreal World Film Festival, August/September 2003.

Project No. C3 (formerly C5) Status: Ongoing

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

	Quebec: Smolt trap to estimate smolt run by mark-recapture, counting adult return in a fishway (de la Trinité) or direct observation (St-Jean), characteristics of adult returns using recreational catch. For the FAPAQ projects, stocked smolt returns are determined by scale analysis of all returning adult salmon. This data permits estimation of sea survival of the stocked fish. For the CIRSA project stocked fish returns are determined by scale analysis (smolts) and genetic analysis (fry). Reproductive success is determined by genetic analysis.
Dates during which research will take place	April – November, annually
Area in which research will take place	On Canadian rivers named in 'objectives' section
Estimated number and weight of salmon to be retained	Generally not applicable, although in some studies a few smolts are retained (less than 500 overall) for biological sampling
Resources	
Estimated cost of the research project	Newfoundland (£287,000 sub-total): DFO - £209,000 per year, incl overhead NGO Partners - £78,000 per year Maritimes (£27,000 sub-total): DFO - £21,500 per year, incl overhead NGO Partners - £5,500 per year Gulf (£109,000 sub-total): DFO - £73,000 per year (includes DFO operating costs, capital investment and salaries, incl overhead) Partners: £36,000 spent in 2001/02 by NGO partners (Northumberland Salmon Protective Association, Miramichi Salmon Association, First Nations) for capital acquisitions, and O&M for assistance. Same level of support anticipated in 2004-2005 Quebec (£141,500 sub-total): FAPAQ - £41,500 per year, incl overhead Hydro Quebec – £22,200 per year CIRSA - £77,800 per year --- Canada Total - £564,500
Number of participating scientists	Newfoundland (5), Maritimes (3), Gulf (2), Quebec (10)
Name of coordinating scientist in charge of project	C. Bourgeois (Rocky River), B. Dempson (Conne River), C.Mullins (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 (FAPAQ), L.Bernatchez (CIRSA, U.Laval)
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 fences and traps, trap nets, rotary screw smolt traps
Details of any collaborating countries	

Summary of Progress

Newfoundland:
Smolt production in 2003 declined in four of five stocks, by comparison with 2002. Decreases ranged from 13% at Conne River and Western Arm Brook to more than 40% at both Northeast Brook (Trepassey) and Rocky River, the latter achieving its lowest smolt production on record. At Campbellton River, smolt production increased by 8% relative to the previous year. With the exception of Conne River, the other four stocks have smolt production values in 2003 that are 21 to 59% less than corresponding average values for the period 1997 to 2002. Four of the five rivers experienced peak production in 1997, but since then precipitous declines have occurred at Western Arm Brook, Campbellton and Rocky rivers. In rivers where smolt production declined, returns of small salmon in 2004 are expected to be lower unless there is a compensatory increase in marine survival. Marine survival, corresponding to adult small salmon returns in 2003, averaged 5.6% across all five rivers, ranging from a high of 9.4% at Western Arm Brook, to a low of 2.4% at Conne River, the lowest ever recorded. At two south coast rivers, Conne River and Northeast Brook (Trepassey), survival was about 20% lower than that recorded for adult salmon returns in 2002. In contrast, survival increased by 28% at Campbellton River and 35% at Rocky River. With the exception of Conne River, survival in 2003 was 15 to 37% higher than the average recorded from 1997 to 2002. 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.

Maritimes:
The return rate for wild 1SW fish at Morgans Falls, LaHave River in 2003 was 1.95%, which is less than the previous 5-year average. The return rate of wild smolts as 2SW fish was 0.63%, up from the five year average of 0.56%. The return rate for hatchery 1SW fish was 1.18%, up from 0.86% in 2002, while the return rate for hatchery 2SW fish was 0.13%, and nearly three times that of 2002 which was the lowest of record. The return rate for hatchery-origin 1SW fish at Mactaquac, Saint John River, was 0.34%, second lowest on record and 75% of the 2002 value. The return rate for hatchery origin 2SW fish at Mactaquac was 0.15% and a little more than 3 times higher than the record low observed in 2002. On the Nashwaak River (tributary of the Saint John River) the pattern was similar with return rates of 1.91% for wild 1SW and 0.28% for wild 2SW salmon, 61% and 321% of the 2002 values, respectively.

Gulf:
Smolt production from the Miramichi River in 2003 was estimated at 900,000 fish, similar to 2002, and greater than the 600,000 smolts estimated to have migrated to sea in 2001. The return rate of smolts in 2002 to 1SW salmon in 2003 was 3.3%, a decrease from 6.3% for the 2001 smolts.

Quebec:
Wild smolt production decreased 32% from the previous 5 years on river Saint-Jean and 10% on river de la Trinité. Sea survival from smolt (year class 2001) to adult has decreased on river Saint-Jean to 1.38%, the 1989-2002 average being 1.28%. On river de la Trinité, sea survival has increased at 0.83%, 1984-2002 average being 2.48%.

Sea survival estimate for stocked salmon monitored on rivers Aux Rochers, A Mars and Malbaie will be obtained next year.

Project No. C4 (formerly C6) Status: Ongoing

Party or relevant jurisdiction	Canada Gulf Region NGO (Atlantic Salmon Federation)/ DFO collaboration
Title of project	Atlantic salmon smolt migration and survival within the Miramichi River and its estuary
Objective of research project	Determine the fraction of smolts that have been tagged in fresh water that move downriver to the head of tide Determine the fraction of smolts tagged at the head of tide that successfully transit the Miramichi River estuary
Brief description of research project	Atlantic salmon smolts will be fitted with acoustic tags. They will be captured in smolt wheels positioned in the Northwest Miramichi (Catamaran Brook) or in the Southwest Miramichi (Rocky Brook, Clearwater Brook) or downstream in the mainstem near the head of tide. Acoustic receiving arrays will be positioned in the river, 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	Spring/summer 2003
Area in which research will take place	Miramichi River and estuary
Estimated number and weight of salmon to be retained	200 smolts, tagged and released
Resources	
Estimated cost of the research project	Approx. £114,000 for operations, salaries and acoustic tags Approx. £68,000 for receiver arrays Approx £91,000 for smolt wheels (Partner contribution: 6 wheels and their operation) Total Approx £273,000 Principal Supporting Partners: Miramichi Salmon Association Bowaters J D Irving Ltd
Number of participating scientists	8
Name of coordinating scientist in charge of project	Dr. Fred Whoriskey, Atlantic Salmon Federation, e-mail: asfres@nb.aibn.com
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 100 VR 2 acoustic receivers 200 acoustic tags
Details of any collaborating countries	Canadian collaboration only to this point

Summary of Progress

Smolts were tagged in 2003 up to 130 km upstream from the headwaters, as well as in DFO head-of-tide traps. Success of fish in transiting freshwater to the head of the tide averaged 91%. By contrast, success in moving through the estuary was much less, averaging about 31% of all the fish tagged. Causes for the losses remain to be determined. Concurrent tracking was undertaken by DFO of striped bass movements (a potential smolt predator) in the estuary, which may help identify their impacts on the smolts.

In 2004, we will return to repeat some of the work, with a more focused receiver array positioned in the estuary. In addition, for comparative purposes fish will also be concurrently tagged in the headwaters of the Restigouche River, and their success in transiting to the head of the tide, and out of the Baie des Chaleurs determined.

Project No. C5 Status: New entry

Party or relevant jurisdiction	Canada Scotia Fundy Region NGO (Atlantic Salmon Federation)/DFO collaboration (St. Andrews Biological Station)
Title of project	Tracking experimentally "escaped" farmed salmon
Objective of research project	Determine the course tracks and fates of sonically tagged farmed salmon released in winter and spring
Brief description of research project	Salmon are being obtained from a commercial grower in Cobscook Bay, Maine, fitted with tags and released. Their short-term displacements will be compared to current circulation models developed by DFO for the region. Receivers will be placed in rivers during the upcoming spawning season to determine if the fish survive to enter them. Results will be used to evaluate the potential to recapture escaped farmed salmon in this fast (3kn – 5kn) environment.
Dates during which research will take place	Winter/spring 2004
Area in which research will take place	Cobscook Bay, Maine,USA; Quoddy Region, NB, Canada
Estimated number and weight of salmon to be retained	400 fish, tagged and released
Resources	
Estimated cost of the research project	Approx. £114,000 for operations, salaries and acoustic tags Approx. £68,000 for receiver arrays Approx £91,000 for smolt wheels (Partner contribution: 6 wheels and their operation) Total Approx £273,000 Principal Supporting Partners: Heritage Salmon
Number of participating scientists	8
Name of coordinating scientist in charge of project	Dr. Fred Whoriskey, Atlantic Salmon Federation, e-mail: asfres@nb.aibn.com
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 76 VR 2 acoustic receivers 400 acoustic tags
Details of any collaborating countries	Canadian collaboration only to this point
Summary of Progress New entry	

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

Faroe Islands

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

Greenland

Project No. D1 Status: Ongoing

Party or relevant jurisdiction	Greenland (Denmark)
Title of project	Origin of Atlantic salmon captured in a mixed-stock fishery at West Greenland
Objective of research project	1) estimate the size and river/sea age composition of the commercial fisheries catch of Atlantic salmon 2) evaluate the relative composition of North American and European origin salmon in the commercial catch
Brief description of research project	One of the key data inputs to international stock assessments of Atlantic salmon is the origin of Atlantic salmon harvested in mixed stock fisheries. An international sampling programme collects biological data, scale and genetic samples from Atlantic salmon sampled from commercial fisheries catch at West Greenland. Both scale and genetic samples are used to characterise the continent-of-origin of captured salmon. Results from the 1999 sampling indicated that almost 91% of Atlantic salmon sampled in the West Greenland fishery were of North American origin. The proportion of North American fish has increased steadily during the 1990s, prompting concerns about trends in pre-fishery abundance of North American and European stocks. Results of this research are integral to the completion of stock assessments of Atlantic salmon through the ICES North Atlantic Salmon Working Group. Monitoring of the mixed-stock fishery has occurred nearly continuously over the past 3 decades, and is likely to continue as long as there is a fishery at West Greenland.
Dates during which research will take place	Annually during the fishing season, usually August – September.
Area in which research will take place	West Greenland, Sisimiut, Maniitsoq, Kangaamiut, Nuuk, Fiskenescent, Narsaq and Qaqortoq, Greenland
Estimated number and weight of salmon to be retained	

Resources	
Estimated cost of the research project	Greenland - approximately £10,000 per annum (includes salaries, travel, lodging and equipment) Canada - £45,300 per annum (including £10,000 from Atlantic Salmon Federation) EU (United Kingdom) - £10,000 - £15,000 per annum EU (Ireland) - £3,750 per annum USA - £17,000 per annum Total: £86,050 - £91,050 per annum
Number of participating scientists	4-6 scientists from Greenland working with scientists from U.S.A., Canada, UK, and Ireland
Name of coordinating scientist in charge of project	Helle Siegstad / Per Kanneworff
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).

Summary of Progress

In 2003, the sampling programme included sampling teams from Greenland, United States, Canada, United Kingdom and Ireland. Teams were in place at the start of the fishery on August 11 and continued until 14 September. After that date some sampling late in the season was carried out in Nuuk by the Greenland Institute of Natural Resources. In total, about 1,800 specimens were sampled for presence of tags, fork length, weight, scales, and tissue samples for DNA analysis. Samples were obtained from three landing sites, Qaqortoq (NAFO Division 1F), Nuuk (1D) and Maniitsoq (1C). The sampled salmon were measured, scales were removed for ageing, and gutted weight recorded. A total of 1,799 tissue samples were removed and preserved for DNA analysis.

3. EUROPEAN UNION

Project No. E1 **Status: New entry**

Party or relevant jurisdiction	EU (UK – 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	Previous studies have demonstrated that sublethal concentrations of agricultural pesticides and contaminants may significantly affect salmon reproduction, embryo survival and 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. Recent studies have also indicated that these hormones/pheromones have an important role in increasing the reproductive status of wild salmon prior to spawning. However, it is not clear to what extent the contaminants within fish farm effluents may affect reproduction, migration and survival of wild salmonids and whether they could result in serious declines in salmonid stocks. The aim of the present research programme is to describe the impact of environmentally relevant concentrations of fish farm contaminants on salmonid reproduction and migration. Firstly, the concentrations of relevant contaminants (pesticides and hormone/pheromones) entering the freshwater environment will be determined and described. Secondly, the effects of these contaminants on reproduction/spawning and survival of post-smolts in the marine environment will be assessed and described. 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 – April 2005
Area in which research will take place	England and Wales
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project *Details of the full economic costs of each study are requested, including staff costs, equipment and overheads.*	£325,000 (over 4.5 years) £72,000 per annum
Number of participating scientists	4

Name of coordinating scientist in charge of project	Dr Andy Moore
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	N/A
Details of any collaborating countries	N/A
Summary of Progress New entry.	

Project No. E2 Status: Ongoing

Party or relevant jurisdiction	EU - UK (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 smolt 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 smolt growth and survival in the sea.
Dates during which research will take place	April 2002 – April 2004
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
Resources	
Estimated cost of the research project	£40,000 per annum
Number of participating scientists	2 CEFAS scientists
Name of coordinating scientist in charge of project	Dr Andy Moore
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

A working Individual Based Model (IBM), which simulates the energy balance of migrating salmon in the Atlantic, has been developed based on a model for simulation of Pacific sockeye salmon marine bioenergetics. 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. OCCAM is an ocean circulation model that simulates ocean currents throughout the marine water column using several layers in the vertical dimension for the entire globe.

Project No. E3 Status: Ongoing

Party or relevant jurisdiction	EU – UK (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 rivers Taff and Ely
Brief description of research project	1. Tracking movements of adult salmon up to and past barrage and through impoundment using contained acoustic and radio tags. 2. Tracking movements of smolts through impoundment and past barrage. 3. Monitoring changes in the return rates of microtagged smolts (hatchery origin) before, during and after construction.
Dates during which research will take place	Through years 1990-2006
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
Resources	
Estimated cost of the research project	c. £250,000 per annum
Number of participating scientists	5/6 per annum
Name of coordinating scientist in charge of project	Peter Gough
Details of research vessels, e.g. name, registration, call sign and description of vessel	'Challanger' M00WB70085 7-4 Metres long
Type and amount of gear and other equipment to be used	<60 C.A.R.T tags pa. 40-50 smolt tags pa. 10,000 - 70,000 micro-tagged and/or fin-clipped smolts stocked each year.
Details of any collaborating countries	None

Summary of Progress

Monitoring programmes on the Cardiff Bay Barrage have continued. These have included releasing tagged and/or finclipped 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	EU - UK (England and Wales)
Title of project	Salmonid migration and climate change
Objective of research project	The main objective of the research is to describe and model the environmental factors affecting the migration of salmonids and to predict the effects of climate change on salmonid migration and survival in the sea.
Brief description of research project	Telemetry studies at CEFAS on the movements of post-smolts in coastal waters have provided information on the importance of water currents and tidal streams to the speed and direction of migration. The research project will further develop the migration studies to examine the movements and distribution of salmon and sea trout smolts in the marine environment. Models will be developed to describe the migration routes of post-smolts in relation to marine currents and sea surface temperature and the results will be used to predict the impact of oceanographic and climatic conditions on distribution and migration of salmonids in the marine environment.
Dates during which research will take place	1 April 1999 - 31 March 2004
Area in which research will take place	Coastal waters around the UK and extending to salmon feeding grounds in Faroes and Greenland seas
Estimated number and weight of salmon to be retained	250 salmon smolts
Resources	
Estimated cost of the research project	£140,000 per annum
Number of participating scientists	5 CEFAS scientists
Name of coordinating scientist in charge of project	Dr Andrew Moore
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	Acoustic transmitters and automated acoustic receiver systems
Details of any collaborating countries	N/A

Summary of Progress

Tracking of emigrating smolts in coastal water (as part of this project) has continued. Salmonid smolts were tagged on the River Tees and tracked through the lower estuary and into coastal waters. The diurnal patterns of movement were described and related to changes in the coastal tidal currents. Further smolts were sampled for blood and gill tissue, which were analysed for plasma ion concentrations and gill Na+K+ATPase activity in order to assess the physiological readiness of the smolts to adapt to the marine environment. The data from the coastal tracking has been included in a model to predict the migration route of post-smolts from southern England chalk streams to the Norwegian Sea. A new 5-year proposal to further develop this work and to start in April 2004 is being prepared for submission to Defra.

Project No. E5 Status: Ongoing

Party or relevant jurisdiction	EU (UK - England and Wales)
Title of project	Impacts of agricultural contaminants 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 agriculture (e.g. pesticides) on migration and marine survival of salmonid smolts and post-smolts.
Brief description of research project	Recent research has demonstrated that the freshwater and the marine environments cannot be considered in isolation and that the conditions within the freshwater zone experienced by Atlantic salmon may be critical to their subsequent survival within the sea. In particular, exposure of juvenile salmon to a range of sub-lethal concentrations of freshwater contaminants such as pesticides and endocrine-disrupting chemicals (EDCs) may operate to reduce survival in fish once they have emigrated to sea. The research project will describe how freshwater contaminants such as the pesticide atrazine can interfere with the parr-smolt transformation and reduce the ability of the fish to physiologically adapt to saline conditions. Laboratory studies have indicated that smolts exposed in freshwater to environmental levels of the pesticide atrazine have reduced levels of gill Na+K+ATPase activity and plasma ion concentrations. Subsequent exposure to seawater resulted in poor hypo-osmoregulatory performance and mortality. In addition, modification of the physiological processes involved during smoltification by pesticides may also delay or inhibit smolt migration. The results of the studies will be incorporated into existing life-cycle models to determine the impact of freshwater contaminants on salmon at the stock and population level.
Dates during which research will take place	April 1999 - April 2004
Area in which research will take place	England and Wales
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	£425,000 (over 5 years)
Number of participating scientists	6
Name of coordinating scientist in charge of project	Dr Andy Moore
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	Sweden and Canada

Summary of Progress

Studies have continued on the effects of contaminants in freshwater on smolt emigration and salt water tolerance. The results of these studies have been incorporated into a life-cycle model to predict the impact of contaminant exposure in freshwater on the numbers of returning adult salmon. The work has demonstrated that the freshwater and marine environments cannot be considered in isolation and that conditions experienced by juvenile salmon in freshwater may have a significant effect on their subsequent survival in the sea. A new 5-year proposal to further develop this work and to start in April 2004 is being prepared for submission to Defra.

Project No. E6 Status Ongoing

Party or relevant jurisdiction	EU (UK - 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	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 available 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. 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. Smolt run estimates will be derived using mark-recapture methods. Both rivers also have existing facilities (counters/traps) for estimating the adult run, although these will be upgraded as necessary (e.g. installation of adult trap on the River Tamar). The investigations are being run on a collaborative basis by Centre for Environment, Fisheries and Aquaculture Science (CEFAS) and the Environment Agency.
Dates during which research will take place	Ongoing annual monitoring programme (subject to annual review).
Area in which research will take place	River Dee (North Wales) River Tamar (SW England)
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	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 of coordinating scientist in charge of project	Ian Russell (CEFAS), Ian Davidson (Environment Agency – Dee), Simon Toms (Environment Agency– Tamar)

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 counters.
Details of any collaborating countries	N/A
Summary of Progress CEFAS and the Environment Agency have established joint programmes on the rivers Dee and Tamar to monitor marine survival of these salmon stocks and obtain information on their exploitation outside home waters. Smolt trapping was undertaken on the Rivers Dee (North Wales) and Tamar (SW England) using rotary screw traps. During 2002 and 2003 over 8000 smolts were tagged on the River Tamar and 4000 smolts on the River Dee.	

Project No. E7 Status: Ongoing

Party or relevant jurisdiction	EU - UK (N. 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 R. Bush 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 R. 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	1973-2003, project renewed in 2004 for 3 years.
Area in which research will take place	R. 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 R. Bush retained alive as broodstock for hatchery programme.
Resources	
Estimated cost of the research project	£27,000 per annum
Number of participating scientists	2 project scientists and 3 technical staff
Name of coordinating scientist in charge of project	Dr Walter Crozier/Dr Gersham Kennedy
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 single marine survival project previously listed has continued, with new data on marine survival and exploitation of R. Bush wild and hatchery salmon being made available to ICES. 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 has resulted in a buy-out scheme for commercial net fisheries, together with restrictions on rod exploitation. The proposal is expected to continue as before.

Project No. E8 Status: Ongoing

Party or relevant jurisdiction	EU - UK (Scotland)
Title of project	Post-smolt mortality of Atlantic salmon
Objective of research project	Assess post-smolt mortality rates of Atlantic salmon from the rivers North Esk, Aberdeenshire Dee (two tributaries) and Conon (a river harnessed for hydro-electricity generation) and their contribution to fisheries that exploit them
Brief description of research project	North Esk: Project started in 1964. Annual smolt production estimates are made using stratified mark-recapture models. Fish are tagged using coded-wire microtags or modified Carlin tags. An alternative method using river flow characteristics is currently being developed. Age distribution and sex ratio data are collected by sampling trap catches of smolts. Analysis of recapture data yields information on post-smolt mortality levels and contribution of North Esk salmon to fisheries. River Dee: Juvenile surveys by electro-fishing and traps have been operated in the Girnock Burn since 1966, and in the Baddoch Burn since 1989. Fish are tagged using coded-wire microtags. Salmon and grilse entering the tributaries to spawn are trapped and age and length distribution data are collected. Stock-recruitment relationships are investigated. Analysis of recapture data yields information on post-smolt mortality levels and contribution of Upper Dee salmon to fisheries. Both tributary populations are driven by early-running salmon (2SW plus a minor proportion of early-running grilse). Return rates have declined markedly in recent years. Smolt production from the streams has altered qualitatively, as a result, with a shift to younger smolt age. Statistical analysis strongly associates return rates of adults to the traps with the size of the annual spring fishery in the main River Dee, suggesting that the monitored sites typify a wider area of production. The Dee fishery, in turn, is strongly correlated with the Scottish fishery, as a whole, indicating generalised effects of marine mortality across river catchments. River Conon: Collaborative project with Conon District Salmon Fishery Board and Scottish and Southern Energy started in 1996. Juvenile salmon are captured by electro-fishing and trapping exercises in selected parts of the River Conon catchment. The fish are tagged using a variety of tags including coded-wire microtags (occasionally) and PIT tags (annually). Returning adults are registered automatically as they pass through a Borland lift in Torr Achilty Dam. Occasional surveys and trapping exercises have recorded the proportion of tagged fish in the net-and-coble and rod-and-line fisheries. Work is also being undertaken to provide information on the contribution of seals to the marine mortality of Conon salmon (see E10).
Dates during which research will take place	Ongoing
Area in which research will take place	North Esk, Western catchment of River Dee, River Conon salmon fishery district
Estimated number and weight of salmon to be retained	N/A

Resources	
Estimated cost of the research project	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 of coordinating scientist in charge of project	North Esk - Julian MacLean River Dee - Alan Youngson River Conon - John Armstrong
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	North Esk - Purpose-built smolt trap and resistivity counter on the lower reaches of the North Esk. One additional resistivity counter and two rotary screw traps deployed to assess trends in sub-catchment populations. Electrofishing gear used for juvenile surveys. River Dee - Purpose-built traps, electro-fishing River Conon - Electro-fishing gear, traps, PIT tagging equipment and detectors
Details of any collaborating countries	N/A
Summary of Progress No report provided.	

Project No. E9 Status: Ongoing

Party or relevant jurisdiction	EU – UK (Scotland)
Title of project	Analysis of post-smolt life history by scale reading
Objective of research project	Investigate the relationship between growth and mortality in Atlantic salmon, particularly during the marine phase, by analysis of scale growth patterns
Brief description of research project	Scale samples of fish of known age (recaptures from smolt tagging operations) and from salmon catches generally are examined to assess growth characteristics. Associations between growth performance and independent measures of mortality are examined with the aim of identifying the periods crucial to survival.
Dates during which research will take place	Continuing project under longer-term remit.
Area in which research will take place	Samples from around Scotland and from the North Esk and Girnock Burn (Aberdeenshire Dee) in particular
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	N/A – subsumed within general scale-reading programme
Number of participating scientists	3 (also employed on other projects)
Name of coordinating scientist in charge of project	Julian MacLean
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	N/A
Details of any collaborating countries	USA and Canada
Summary of Progress Insights about the factors affecting early marine mortality and possible mechanisms emerging.	

Project No. E10 Status: Ongoing

Party or relevant jurisdiction	EU – UK (Scotland)
Title of project	Protecting salmonid fisheries from seal damage
Objective of research project	Develop and apply new molecular tools for discriminating among species of fish in the diets of seals from their remains in scats. Test the possibility of using molecular tools to quantify the occurrence of diet components. Identify factors influencing the migration routes of salmon in estuaries and relate to the presence of predators. Examine the occurrence of seal-damaged salmon on a wide geographic scale.
Brief description of research project	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. A pilot study will be undertaken in 2004 tracking salmon in the Cromarty Firth. Migration routes will be 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 will be made using acoustic observations, visual observations and side-scan sonar. This part of the work is dependent upon successfully obtaining external funding. 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.
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

Resources	
Estimated cost of the research project Details of the full economic costs of each study are requested, including staff costs, equipment and overheads.	2004/05 - £142,000 2005/06 - £100,000
Number of participating scientists	Multi-disciplinary work will involve scientists from a number of teams within Fisheries Research Services.
Name of coordinating scientist in charge of project	Dr John Armstrong
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, side-scan sonar
Details of any collaborating countries	

Summary of Progress

A significant step forward has been made by the development of a technique, using DNA analysis, to differentiate between the remains of salmon and sea trout in the scats of seals.
Feeding experiments, undertaken in conjunction with the Sea Mammal Research Unit, allow production of correction factors to account for the digestion and loss of salmonid otoliths. The results suggested that few smolt otoliths would survive digestion to appear in scats.

Project No. E11 Status: Ongoing

Party or relevant jurisdiction	EU – Ireland
Title of project	Oceanic factors influencing marine survival of Irish salmon stocks
Objective of research project	The programme was initiated in 1999 to: Provide information on marine survival at various stages of ocean migration.
Brief description of research project	Marine Institute have funded a fellowship for an entry level scientist to enter a PhD programme in the University of Massachusetts. The fellowship will enable the researcher to avail of the extensive information sets on oceanographic parameters relevant to survival of salmonids at sea. The long-term objective is to examine the relationships between marine survival indices available for Irish salmon stocks with corresponding marine environmental data sets.
Dates during which research will take place	August 2001 – 2004
Area in which research will take place	Oceanic data will be examined for: Post-smolts Norwegian Sea, Wyville Thompson Ridge, North of Scotland, North of Faroes Grilse West Greenland, Irish coast MSW North of Faroes, Irish coast
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	£25,000 per annum (Phase 1 – studentship)
Number of participating scientists	5
Name of coordinating scientist in charge of project	Dr Kevin Friedland (US), Dr Niall O' Maoileidigh (Ireland)
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

Summary of Progress

Progress in 2003 –

- Continued to gather information on salmon coherence studies, time series analysis and hydrography in the North-East Atlantic;
- Initiation of code writing to download SST datasets for the Irish thermal habitat in spring and training on creating thermal habitats;
- Irish data on marine survival (up to 20 years' data) and pre-fishery abundance estimates for Ireland's 17 fisheries districts (30 years' data) compared with SST for West Coast of Ireland (Reynolds OI), Gulf Stream (North Wall) and North Atlantic Oscillation for synchrony, coherence, etc.;
- Building and analysis of salmon thermal habitats according to specific areas of interest around Ireland;
- Examination of scale impressions and setting up of an image processing system has been initiated. Initial training in image processing was obtained (ImagePro).

The analyses of the marine survival time series on Irish salmon were investigated in more detail. Specifically, as these are relatively short (max. 20 years), they will be most useful in identifying high-frequency variability. Other sources of biological information will need to be investigated to provide longer time series to examine low-frequency processes which, for example, are known to influence Pacific salmon stocks and which have been used to identify regime shifts over longer time periods.

Project No. E12 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-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
Resources	
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	Dr Niall O' Maoileidigh
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 and new CLs for each river have been adopted in 2004. 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. Total Allowable Catches have been imposed in each of the districts for the 2004 season based on the attainment of CLs for the period 1997 to 2003.

Project No. E13 Status: New entry

Party or relevant jurisdiction	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 –2003, to be continued beyond 2003.
Area in which research will take place	The River Scorff (Southern Brittany)
Estimated number and weight of salmon to be retained	No fish are retained, all animals trapped for tagging or mark control are released
Resources	
Estimated cost of the research project *Details of the full economic costs of each study are requested, including staff costs, equipment and overheads.*	N/A, part of a larger long-term monitoring programme
Number of participating scientists	2 scientists + 2 technicians
Name of coordinating scientist in charge of project	Dr Etienne Prévost
Details of research vessels, e.g. name, registration, call sign and description of vessel	N/A
Type and amount of gear and other equipment to be used	Adult and smolt trapping facilities specially designed to minimize impacts on wild fish due to handling
Details of any collaborating countries	None

Summary of progress

First estimates of sea survival are indicative of higher marine mortality than for more northern stocks (UK, Scandinavia, Iceland). Combined with information on freshwater survival, they reveal the precarious status of the stock. The stock is still able to maintain itself at a reasonably high level of abundance, but may not stand any additional increase in fishing or marine mortality.

Project No. E14 Status: New entry

Party or relevant jurisdiction	France
Title of project	Evolution of biological characteristics in Atlantic salmon from all the Armorican massif rivers (Brittany and Low-Normandy, France)
Objective of research project	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.
Brief description of research project	This project focuses on the analysis of biological data (biometric and demographic) from rod catches and other information (catches by trapping, dead fish, etc.) to identify the biological changes in salmon populations. A long-term data series (biological and catches statistics) since the beginning of the 1970's (more than 30 years) is available for all the Armorican massif rivers. Furthermore, the sampling effort has been improving in space and time since 1987 with the obligatory registration of salmon catches and an extension of the fishing season towards the summer and autumn periods. Moreover, we have a lot of additional information from smolt and adult trapping on two index rivers, the Oir River in Low-Normandy and the Scorff River in Brittany. At the same time, a climatological and freshwater quality time series (temperature and rainfall mainly) might be analysed. The joint analysis of the different data series might allow better understanding of the natural and anthropogenic factors responsible for the biological changes in Atlantic salmon stocks. The project is operated jointly by the National Institute for Agronomical Research (INRA) and the Conseil supérieur de la pêche (CSP).
Dates during which research will take place	1972 –2002, to be continued beyond 2003.
Area in which research will take place	All salmon rivers in the Armorican Massif (about 25-30).
Estimated number and weight of salmon to be retained	No fish are retained; all fish come from the rod fishery and all individuals trapped are released.
Resources	
Estimated cost of the research project *Details of the full economic costs of each study are requested, including staff costs, equipment and overheads.*	N/A, part of a larger long-term monitoring programme
Number of participating scientists	2 scientists + 2 technicians
Name of coordinating scientist in charge of project	Dr Jean-Luc Baglinière
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 counting fence
Details of any collaborating countries	None

Summary of progress

First results confirmed at a multi-regional scale the decrease in the two-sea-winter component in stocks. Furthermore, they showed a decrease in the freshwater age, a strengthening of the semelpare character of the species (strong decrease in the multi-spawner population) and the near extinction of the large multi-sea-winter salmon (three years at sea). All the modifications seem to lead to a shorter turn-over in populations and so to their greater sensitivity to environmental factors.

Project No. E15 Status: New entry

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	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. 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. 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.
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
Resources	
Estimated cost of the research project *Details of the full economic costs of each study are requested, including staff costs, equipment and overheads.*	River Skjern Å: £143,000 River Guden Å: £143,000 River Stor Å: £48,000
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
Summary of Progress New entry.	

Project No. E16 Status: New entry

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

Details of any collaborating countries	Norway
Summary of progress New entry.	

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 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 100's of smolts are being sacrificed every year
Resources	
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 of coordinating scientist in charge of project	Thorolfur Antonsson
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 and Salmodel (EU project)

Summary of Progress

The project is ongoing. 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 a published paper: "Variability in Timing and Charactirististics of Atlantic Salmon Smolt in Icelandic Rivers". Antonsson Th. and Gudjonsson G., 2002. Transactions of the American Fisheries Society. 131: 634-655.

Project No. I2 Status: Ongoing

Party or relevant jurisdiction	Iceland Institute of Freshwater Fisheries, Reykjavik
Title of project	Survival at sea of 1- and 2-sea-winter salmon in relation to oceanic conditions
Objective of research project	Study the changes in the ratio of 1SW:2SW salmon in Iceland
Brief description of research project	Accurate catch statistics reflect the trends in stock size and composition of Icelandic salmon. These changes are studied in relation to oceanic and climatic factors. Environmental factors from various sources, satellite data, data on the internet, etc.
Dates during which research will take place	Ongoing
Area in which research will take place	Iceland. Desk study
Estimated number and weight of salmon to be retained	0
Resources	
Estimated cost of the research project	£64,000 per annum (includes cost of assembling environmental data and catch data (approximately 70% of total) and their subsequent analysis (approximately 30% of total)
Number of participating scientists	3
Name of coordinating scientist in charge of project	Sigurdur Gudjonsson
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	
Details of any collaborating countries	Within ICES and Salmodel (EU project)

Summary of Progress

The project is ongoing and is in its final phase. A report will be finished in 2004. In brief, a relationship is seen between the salmon catch in rivers in west Iceland and ocean climate (SST, NEO index, habitat size and abundance of food species in the ocean west of Iceland).

Project No. I3 (formerly I4) Status: Ongoing

Party or relevant jurisdiction	Iceland Institute of Freshwater Fisheries; University of Iceland, Dept. of Biology
Title of project	Variation in growth and return rates of Atlantic salmon from three Icelandic rivers.
Objective of research project	Increase knowledge of growth and environmental factors influencing return rates and in general life history of different salmon stocks in Iceland.
Brief description of research project	Series of scale samples are studied to estimate growth rate in fresh water and at sea in three Icelandic salmon stocks from three distinct geographical areas. The data is correlated to environmental data and return rates. The second research interest is to compare groups of smolts, individually microtagged from those rivers, to see possible differences in growth history in fresh water between recaptured salmon and those which do not return to the river. The data is also used to estimate the accuracy of different back-calculation methods.
Dates during which research will take place	2001-2004
Area in which research will take place	River Elliðaár in S- Iceland River Vesturá in N- Iceland River Vesturdalsá in NE- Iceland
Estimated number and weight of salmon to be retained	Scale samples taken from 2,000-3,000 adults. Microtagging and scale sampling from 6,000-8,000 smolts
Resources	
Estimated cost of the research project	£20,000 - £40,000 per annum
Number of participating scientists	3-5
Name of coordinating scientist in charge of project	Thorkell Heidarsson (thorkell@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	Car for field work Microtagging gear Dissecting microscope Image analyses software/hardware Database for data handling Computers, etc.
Details of any collaborating countries	None so far

Summary of Progress

The project is ongoing and will probably be completed in 2004 for west and south Iceland, but will continue for North Iceland. Interesting, and new, information for corrections for back-calculated smolt size have been found. This will be of importance for calculating growth parameters from salmon scales. Differences in ocean post-smolt growth and adult spring growth were found in relation to timing of the smolt migration.

Project No. I4 Status: New entry

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
Area in which research will take place	North-east Iceland and adjacent areas.
Estimated number and weight of salmon to be retained	
Resources	
Estimated cost of the research project *Details of the full economic costs of each study are requested, including staff costs, equipment and overheads.*	Approximately £1,800
Number of participating scientists	Two
Name of coordinating scientist in charge of project	Sigurdur Gudjonsson Sigurdur Mar Einarsson
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
Summary of Progress New entry	

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	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: • Analyse spatial variation in early marine post-smolt feeding and growth along a north-south geographic scale (comparative study) • 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)
Brief description of research project	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.
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	

Resources	
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 of coordinating scientist in charge of project	Bengt Finstad
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

Summary of Progress

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. & Holm, M. 2004. Geographical differences in early marine feeding of Atlantic salmon post-smolts in Norwegian fjords. J. Fish. Biol. 64: 1655-1679. Doi:10.1111/j.1095-8649.2004.00425.x, available online at http://blackwell-synergi.com

Project No. N2 Status: Ongoing

Party or relevant jurisdiction	Norway
Title of project	Development of models to predict marine survival and return of salmon to Norway
Objective of research project	Develop models to predict marine survival and return of Atlantic salmon to Norway.
Brief description of research project	1. Identify and examine the feasibility of applying time series of marine environmental data, zooplankton productivity, productivity of pelagic fish, and salmon life-history information for model development. 2. Develop appropriate models 3. Cooperate with scientists from other countries working with similar research.
Dates during which research will take place	2002-2005
Area in which research will take place	Utilize information already available
Estimated number and weight of salmon to be retained	None
Resources	
Estimated cost of the research project	£50,000 - £60,000 per annum
Number of participating scientists	7-10
Name of coordinating scientist in charge of project	Lars Petter Hansen
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	Umass/NOAA CMER Program, University of Massachussetts, Amherst, MA USA Dep. Fisheries and Oceans, Newfoundland, Canada, Scientists from EU (details not available yet)

Summary of Progress

Time series on hydrography, plankton production, life history of salmon and other pelagic fish species have been established. Provisional analyses suggest a potential to develop regional forecasts for salmon return to Norway. There is potential to forecast runs of 2 and 3 SW salmon in years n+1 and n+2 based on the run of 1SW fish in year n. Forecasts of 1 SW salmon may probably be developed from environmental variables, plankton production and condition factor of herring.

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	
Resources	
Estimated cost of the research project	Approximately £104,000 per annum
Number of participating scientists	3
Name of coordinating scientist in charge of project	Lars P. Hansen; Nina Jonsson
Details of research vessels, e.g. name, registration, call sign and description of vessel	
Type and amount of gear and other equipment to be used	Fish traps, electric fishing
Details of any collaborating countries	

Summary of Progress

The long-time monitoring of salmon from the three rivers has revealed that marine survival has improved compared with the poor survival in the late 1990s. 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.

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: 1. Independence of relationships between food availability and post-smolt feeding and growth 2. Post-smolt migration and distribution in time and space 3. Salmon stock separation/overlap in time and space
Brief description of research project	The oceanic phase of the Atlantic salmon and the influence of the marine environment encountered upon 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. The project proposal is a follow-up and expansion of a project started in 1995. Based on data needs identified during 1995 – 2002, new data will be collected on cruises in 2003- 2005 and 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 asses influences of environmental traits on post-smolt growth and survival and may prove useful to separate northern and southern European salmon stocks. Due to reduction in available ship time, there will be no cruise dedicated to post-smolt surveys in 2004, but the project will work on data already collected.
Dates during which research will take place	2002 – 2005 2004: May 19 – June 10 (post-smolts may be caught in conjunction with a mackerel spawning-/egg survey) August 1 – 17 (post-smolts may be captured in conjunction with the annual herring surveys)
Area in which research will take place	West of Ireland – Faroes, northern North Sea, the Norwegian Sea
Estimated number and weight of salmon to be retained	• 5-10 salmon, total 30kg • 150-250 post-smolts, total 15kg
Resources	
Estimated cost of the research project	£120,000 per annum, including Ph.D. grant, and running costs, matching funds for ships and scientists at IMR and cooperative institutes
Number of participating scientists	8 scientists
Name of coordinating scientist in charge of project	Marianne Holm, Senior Scientific Officer, Institute of Marine Research, P O Box 1870 Nordnes, N-5817, Bergen

Details of research vessels, e.g. name, registration, call sign and description of vessel	• R/V "Johan Hjort", Norway, LDGJ, 65 m research vessel fully equipped for year-round high-seas research operations
Type and amount of gear and other equipment to be used	The ship will be 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

Summary of Progress

By June 2004 a total of 1,767 post-smolts (850 and 917 in 2002 and 2003 respectively) and 124 adults have been captured since 2002 within this project. Of the adults, 27 have been tagged and released (cfr. project N5). The age structure of these fish is in conformity with earlier observations and, except for near the Norwegian coastline, smolt ages 1 and 2 are dominating the captures, i.e. these are fish of "southern origin". The post-smolts have been distributed over the same areas as previously recorded. The northern extension of the densest cohorts in recorded in June-July may vary somewhat within a couple of weeks, probably influenced by conditions at the time of migration and meteorological conditions at sea. Within the framework of the PhD scholarship the stomach contents have been analysed and fish larvae/0-group of varying species followed by amphipods seem 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. In 2002 and 2003, 9 Irish, 1 Norwegian and 4 Irish microtags were recovered from the Norwegian Sea. High catches of mackerel have been recorded in the same hauls as post-smolts. In May – June 2004 around a hundred post-smolts were captured during a mackerel survey going from northwest Ireland to the Faroes. The salmon trawl was used for mackerel sampling. Results from the project are published in ICES reports, several scientific journals and 2 books.

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: - Spatial distribution and temperature preferences - Growth in relation to environmental parameters - Vertical distribution of salmon during day and night (relating to possibility of intercepting fisheries)
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 are captured with a special salmon trawl with live-capture device. Viable fish (approx. 2/3 of the catch) will be tagged with DSTs inserted into the body cavity and released. The research will be 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 will consist of retrieving tags and recapture data from angling catches in home waters, but recapture may also be performed from research ships.
Dates during which research will take place	2003-2004 In 2004: January 2004 (Iceland); April - May 2004 (Norway); October -November 2004 (Faroes)
Area in which research will take place	The Northern North Sea, the Norwegian Sea
Estimated number and weight of salmon to be retained	In 2004, 250 large post-smolts and older salmon (approx. 350kg)
Resources	
Estimated cost of the research project	£210,000 per annum
Number of participating scientists	5 scientists
Name of coordinating scientist in charge of project	Marianne Holm, Senior Scientific Officer
Details of research vessels, e.g. name, registration, call sign and description of vessel	R/V "Johan Hjort", Norway, LDGJ, 65 m research vessel fully equipped for year-round high-seas research operations R/V "Magnus Heinason", Faroes, vessel fully equipped for high-seas investigations R/V "Arni Fridriksson", Iceland, 70 m research vessel fully equipped for high-seas investigations
Type and amount of gear and other equipment to be used	A specially designed trawl with live fish capture device attached to the cod end is used on all ships.
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 613 large post-smolts (October -captures) and 1- 2 SW salmon had been captured in the North Atlantic by June 2004. Of these 360 were captured and 228 tagged with DSTs and released north of the Faroes, 28 captured and 11 tagged and released SE of Iceland and 225 captured and 109 tagged and released in the Norwegian Sea. In 2002 one tagged fish released in the Norwegian Sea returned to the mouth of river Namsen in mid-Norway after 18 days and 480 km. In the Icelandic catch in January 2003 one Irish microtag was retrieved, and in the Norwegian Sea in April 2004, 5 adipose fin-clipped salmon were found, but none of them carried a microtag. The 2004 material is not analysed yet, but most fish from the earlier cruises had made their transition to sea as 1-2 year-old smolts. Genetic samples and scales have been taken from most of the fish.

Project No. N6 Status: Ongoing

Party or relevant jurisdiction	Norway
Title of project	By-catch in pelagic fisheries as a population-regulating factor in wild salmon stocks
Objective of research project	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. The main aim of this project will be to carry out investigations to estimate the extent of such by-catch and, through cooperation with Russian scientists, to carry out investigations in order to estimate the by-catch and to develop management advice which could reduce by-catch of salmon while, at the same time, maintaining the catch rates in the mackerel fishery.
Brief description of research project	The ongoing Norwegian investigations on marine migration paths of Atlantic post-smolts of salmon will be intensified and focused in areas where interceptory fisheries have been described. Based on the data obtained, combined with data from the commercial fisheries, management advice which could lead to reduced salmon by-catch in the mackerel fisheries while maintaining the catch rates of the fishing fleet will be sought.
Dates during which research will take place	2001 - probably 2005
Area in which research will take place	Norwegian Sea
Estimated number and weight of salmon to be retained	500-1000 pcs pr year 500-3000 kg pr year
Resources	
Estimated cost of the research project	Approx £80 000 per annum
Number of participating scientists	3-5
Name of coordinating scientist in charge of project	Jens Christian Holst
Details of research vessels, e.g. name, registration, call sign and description of vessel	R/V Johan Hjort (65 m) R/V G.O.Sars (70 m)
Type and amount of gear and other equipment to be used	Pelagic trawls Ocean Fish Lift (Live catching device for trawls) Underwater video techniques

Details of any collaborating countries	Probably PINRO, Murmansk Scotland
Summary of Progress No report provided	

Project No. N7 Status: Ongoing

Party or relevant jurisdiction	Norway
Title of project	Sea lice as a population-regulating factor in Norwegian salmon: status, effects of measures taken and future management
Objective of research project	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.
Brief description of research project	The project is a combined field and modelling exercise of interactions between farmed fish, wild fish and sea lice. The project will include estimating the mortality in seaward-migrating post-smolts due to sea lice infections in major fjordic systems, counting of sea lice infections in wild and farmed salmon in the areas studied and developing a sea lice/salmon interaction management model and the development of additional measures for critically affected wild salmon stocks.
Dates during which research will take place	2002-2004. The project has amalgamated with a completed project on some of the same themes.
Area in which research will take place	Sognefjord and Altafjord
Estimated number and weight of salmon to be retained	Up to 3000 post-smolts pr year (Weight max 60 kilos)
Resources	
Estimated cost of the research project	Approx £140,000 per annum
Number of participating scientists	7
Name of coordinating scientist in charge of project	Jens Christian Holst (IMR)
Details of research vessels, e.g. name, registration, call sign and description of vessel	R/V Johan Hjort (65 m) R/V Fangst (17 m) R/V Hyas (15 m) R/V Johan Ruud (45 m) R/V G.M.Dannevig (20 m)
Type and amount of gear and other equipment to be used	Pelagic trawl Ocean-Fish-Lift (live catching device for trawls) CTD
Details of any collaborating countries	
Summary of Progress No report provided	

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	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 (*Salmo salar*), with emphasis on the River Tana. Sub-goals: - • 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 • Evaluate the impact of predation by marine fish and birds on the abundance of River Tana salmon • Determine smolt and adult salmon abundance, initially from one tributary, as an index of marine survival for the River Tana system • Develop management plans for northern Atlantic salmon rivers by integrating biological and local knowledge of the resource.
Brief description of research project	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 (*Salmo salar*). 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.
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	
Resources	
Estimated cost of the research project	£ 60,000 per annum
Number of participating scientists	4-6
Name of coordinating scientist in charge of project	Martin Svenning
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

Summary of Progress

Ocean climate: The northern rivers (in Eastern Finnmark and on Kola) show no consistent trend for declining abundance. Variations in abundance in, for example, Tana and Neiden were generally synchronous for the total catch and numbers of 1SW and 2SW salmon during a period of 1972-2003.

Predation: The sandeel is the key species for a massive annual congregation of up to 25-30,000 male European goosanders in the Tana estuary, which consume approximately 600 tons of fish annually. In two summers 288 goosanders were sampled and based on 2,308 otoliths only one pair of salmon otoliths were found. Thus, we conclude that predation from goosanders on salmon smolts was insignificant, at least in those two years.

Smolt migration: By use of submerged video cameras we observed that the smolt migration was mainly diurnal and the smolts migrated in the deepest half of the water column (2002). The results differ from earlier studies in temperate areas. We have also followed the smolt migration in 2003. Similar observation will be conducted in 2004 and 2005.

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, estimate allowable catch.
Brief description of research project	Information is collected on the quality of spawning habitat of Atlantic salmon, the impact of human activities on the habitat, and the biology of salmon (age structure, size distribution, weight, sex composition, fecundity, proportion of various biological groups in the spawning run, dynamics of smolt migration and spawning run). The behaviour of adults during the freshwater period of life is studied, estimates of parr density are derived, spawning requirements are determined, the level of attainment of spawning requirements is monitored, the condition and success of spawning is assessed, and the harvestable surplus is determined. Freshwater fish fauna and interactions of Atlantic salmon with other species are studied, trophic and territorial competitors, and predators of juveniles are identified. Estimates of natural and fishing mortality of salmon are derived. Estimates of survival and adult return rates are derived. To study the population characteristics, tagging of adults and smolts with external tags is carried out.
Dates during which research will take place	Annual monitoring programmes (since 1958).
Area in which research will take place	Rivers Umba, Varzuga, Ponoi, Jokanga, Varzina, Tuloma, Kola, Ura, B.Z.Litsa, Pechora, Severnaya Dvina, Mezen, Onega.
Estimated number and weight of salmon to be retained	About 6,500 salmon and 5,500 parr and smolts
Resources	
Estimated cost of the research project	Approximately £80,000 for 2003
Number of participating scientists	~ 25 scientists from PINRO and SevPINRO
Name of coordinating scientist in charge of project	Alexander Zubchenko (PINRO), Igor Studenov (SevPINRO)
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, electrofishing, smolt traps, external tags
Details of any collaborating countries	N/A
Summary of Progress No report provided	

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 in a sample record card.
Dates during which research will take place	June-August 2002-2004
Area in which research will take place	International waters of the Norwegian Sea
Estimated number and weight of salmon to be retained	N/A
Resources	
Estimated cost of the research project	Approximately £240,000 in total.
Number of participating scientists	~ 12 inspectors and scientists
Name of coordinating scientist in charge of project	B. Prischepa (Murmanrybvod), A. Zubchenko (PINRO)
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 2003 assessment of by-catch of post-smolts of Atlantic salmon was conducted on five fishing vessels operated in the international waters of the Norwegian Sea in the period from 17 April to 26 September 2004. Hauls were taken in the depth range from 30 to 400 m.

According to provisional data, one post-smolt weighing 260g and 11 adult salmon with lengths of 45-65cm and weights of 1.2 to 5kg were caught in the mackerel fishery during that period. On 22 July 2003 a salmonid with the features typical of a sea trout was caught during the mackerel fishery. One adult salmon, with length and weight of 80cm and 3.2 g respectively, was caught in June 2003 during the blue whiting fishery. The fish was in very poor condition and had 53 sea lice *Lepeophtheirus salmonis* on it. The origin of that fish was not established.

7. UNITED STATES OF AMERICA

Project No. U1 Status: Ongoing

Party or relevant jurisdiction	United States of America
Title of project	Estuary Movements of Pre- and Post-Spawning Adults: Dennys River Adult Stocking Assessment
Objective of research project	This assessment programme consisted of 8 objectives: 1) riverine and estuarine movements of netpen-reared adults using ultrasonic telemetry; 2) evaluation of spawning characteristics of these stocked adults as compared to wild adults; 3) assess spawning habitat selection; 4) post-spawning disposition (immediate out-migrants, kelts, or presumed deceased) and timing of estuary entrance; 5) monitoring the stage-specific contribution attributable to natural reproduction by these stocked adults; 6) estimate fry emergence rates for progeny of these stocked adults; 7) develop stage-specific survival estimates within a control site; 8) evaluate the reproductive success of progeny originating from these stocked adults.
Brief description of research project	During October 2000, 96 netpen-reared, two-sea-winter, mature, Dennys River-specific Atlantic salmon were stocked into the mainstem and estuary areas of the Dennys River. This represents 100% of the minimum egg deposition rate for the Dennys River drainage as determined by stock-specific fecundity estimates and habitat survey data according to established management guidelines. A Memorandum of Understanding outlining this trial programme and the need to fully evaluate it was drafted and is intended to be signed by the National Marine Fisheries Service, U.S. Fish & Wildlife Service, State of Maine natural resource agencies, and Atlantic Salmon of Maine. Additional netpen-reared adults were stocked in the Dennys River and estuary areas in October 2001. A comprehensive Assessment Plan was developed to monitor the progress of these adults and the progeny of these adults over a period of 6 years.
Dates during which research will take place	October 2000 – October 2006
Area in which research will take place	Dennys River Cobscook Bay Gulf of Maine
Estimated number and weight of salmon to be retained	It is anticipated that no Atlantic salmon will be retained during this project.

Resources	
Estimated cost of the research project	Approximately £14,000 per annum
Number of participating scientists	~3
Name of coordinating scientist in charge of project	Tim Sheehan NOAA Fisheries, Woods Hole, MA
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 (~50-60 annually) Stationary Ultrasonic Receivers (12-15 annually)
Details of any collaborating countries	An ultrasonic receiver array deployed by a Canadian investigator (G. Lacroix) is capable to detecting and recording tagged fish.
Summary of Progress The telemetry portion of the study has been completed and the data are being analysed. Additional data related to potential progeny resulting from this adult stocking effort are still being collected. These studies are expected to continue until the year 2006.	

Project No. U2 Status: Ongoing

Party or relevant jurisdiction	United States of America
Title of project	Estuary and Nearshore Movements of Migrating Atlantic Salmon Smolts: 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	Analysis of telemetry data collected from 1997-1999 in the Narraguagus River system continued during 2001. During these years, minimums of 100 wild Atlantic salmon smolts were surgically implanted with ultrasonic tags. We prepared, tested, and deployed stationary detection units during mid-April in Narraguagus Bay to monitor the emigration of Atlantic salmon smolts. We deployed a total of 26 units in the Narraguagus River (4), Estuary (4), and Bay (18) to evaluate the number of smolts passing ecological transition zones. Preliminary results suggest that a substantial portion of marine mortality may be occurring in nearshore habitats. We also determined the migration routes as they enter the Gulf of Maine. The mouth of Narraguagus Bay has two major corridors: Trafton (3.5 km) and Strout (1.6. km) that are delineated by Dyer Island. Of the smolts detected in the outer marine array, 90% exited the Trafton corridor. Within the Trafton Channel, the majority of smolts were travelling closer to Trafton Island than either shore. These results were consistent in all three years. The results from this study will be used to design an expanded programme in 2002 that will include monitoring outside embayments, further into the Gulf of Maine. If feasible we will try to encircle where the Bay encounters the Eastern Maine Coastal Current in 2002. A second river has been added to the study for 2004. The Pleasant River shares a common embayment with the Narraguagus River and Pleasant River hatchery origin smolts are being stocked into the system. Releasing tagged Pleasant river origin smolts into the system will allow researchers to compare naturally reared versus hatchery reared smolt behaviour within this common embayment.
Dates during which research will take place	April-June, 2002-2004
Area in which research will take place	Narraguagus River Narraguagus Bay
Estimated number and weight of salmon to be retained	It is anticipated that no Atlantic salmon will be retained during this project. Ultrasonic transmitters will be implanted in up to 100 wild smolts annually.

Resources	
Estimated cost of the research project	Approximately £49,000 per annum
Number of participating scientists	~3
Name of coordinating scientist in charge of project	Dr. John Kocik NOAA Fisheries, Orono, Maine
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) Stationary Ultrasonic Receivers (30-40 annually)
Details of any collaborating countries	Collaborative work with Canada was initiated to determine if US fish enter the Bay of Fundy and if Canadian fish enter Gulf of Maine regions that NEFSC monitors. This will be accomplished through a coordinated effort where all units deployed will be capable of detecting tags released by both programmes.

Summary of Progress

Telemetry efforts continue on the Narraguagus River and hatchery origin Pleasant River fish have been added to the study. Additional receiver units have been added to the estuarine and outer bay areas to better track emigrating smolts through these environments.

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	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). Ultrasonic telemetry investigations were initiated in 2001 to estimate nearshore marine mortality and migration routes of these stocked smolts. Seventy fish with surgically implanted ultrasonic pingers will be released and their movements evaluated with an array. 12 Automated Pinger Detection Units will be deployed to provide 100% coverage of migration routes through Cobscook Bay. A weir-based smolt trap will be operated and utilized to evaluate survival immediately prior to entering the marine system.
Dates during which research will take place	April – October, 2001-2005
Area in which research will take place	Dennys River Cobscook Bay
Estimated number and weight of salmon to be retained	It is anticipated that no Atlantic salmon will be retained during this project. Up to 200 hatchery smolts will receive surgically implanted ultrasonic tags annually.
Resources	
Estimated cost of the research project	Approximately £28,000 per annum
Number of participating scientists	~3
Name of coordinating scientist in charge of project	Tim Sheehan NOAA Fisheries, Woods Hole, MA
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	Vemco Ultrasonic Tags Vemco VR2 Receivers
Details of any collaborating countries	Collaborative work with Canada (G. Lacroix) was initiated in 2001 that will determine if US fish enter the Bay of Fundy and if Canadian fish enter Gulf of Maine regions that the United States monitors. This will be accomplished through a coordinated effort where all units deployed will be capable of detecting tags released by both programmes.

Summary of Progress

Telemetry efforts continue on the Dennys River with acoustic receivers throughout the lower river, Cobscook Bay and the Bay of Fundy. 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. Additional receiver units have been added to the estuarine and outer bay areas to better track emigrating smolts through these environments.

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. A total of 52,000 smolts were stocked in 2001, and an estimated 50,000 will be released in 2002. 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. A weir-based smolt trap will be operated and utilized to evaluate survival immediately prior to entering the marine system. Returning adults will be enumerated and identified at a weir-based adult trap.
Dates during which research will take place	April – October, 2002-2005
Area in which research will take place	Dennys River Cobscook Bay
Estimated number and weight of salmon to be retained	It is anticipated that no Atlantic salmon will be retained during this project.
Resources	
Estimated cost of the research project	Approximately £14,000 per annum
Number of participating scientists	~3
Name of coordinating scientist in charge of project	Mr Tim Sheehan NOAA Fisheries, Woods Hole, MA
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	Weir-Based Smolt Trap Weir-Based Adult Trap Elastomer Marks and Marking Equipment
Details of any collaborating countries	Elastomer marks may be recovered during the NASCO international cooperative sampling programme at West Greenland.

Summary of Progress

Long-term monitoring of hatchery-origin smolts on the Dennys River has continued since 2001. Stocking groups of Visual Implant Elastomer marked smolts are released at different times and from different stocking sites. Rotary screw traps and adult weir traps are used to monitor the contribution of each stocking group at these life history points. Preliminary results indicate high survival in fresh water with very low marine survival. Only one cohort has returned as adults and future monitoring is expected to provide further information related to annual variations in marine survival.

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. In May 2001, a surface pelagic trawl survey was initiated 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. To capture post-smolts in open marine waters, we pair-trawled a Norwegian-designed pelagic net through surface waters. During the 9-day survey, a total of 1,458 Atlantic salmon post-smolts were captured, and salmon were detected at 49 of 61 stations occupied during the survey. Biological data including size, scale samples, genetic samples, physiology samples, and diet composition were collected from a subsample of fish. Preliminary analyses of scale samples indicate a low proportion of naturally reared fish among captured fish. A total of 355 visual implant elastomer marked fish stocked in the Penobscot River were recovered during the survey, allowing for assessment of the relative contribution of hatchery-stocked fish to post-smolt populations. Analysis of collected physiology samples is expected to provide information on saltwater transition.
Dates during which research will take place	May-June, 2002-2004 2003-2004 field work contingent on continued funding
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 mortality was estimated to be 8% during the 2001 survey.
Resources	
Estimated cost of the research project	2001: Approximately £98,000 2002-2004: Approximately £105,000 per annum 2003-2004 field work contingent on continued funding
Number of participating scientists	2
Name of coordinating scientist in charge of project	Mr Tim Sheehan NOAA Fisheries, Woods Hole, MA

Details of research vessels, e.g. name, registration, call sign and description of vessel	F/V Nobska (United States) 30-m commercial trawler F/V Morue (United States) 30-m commercial trawler Vessel leases are bid on an annual basis and vessels utilized are subject to change.
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 Parallel post-smolt trawling programme in the Bay of Fundy (G. Lacroix) offers potential for future direct collaboration.

Summary of Progress

The post-smolt trawl survey in Penobscot Bay continued in 2003 and 2004. Survey operations were expanded both temporally and spatially to better describe the smolt emigration through Penobscot Bay. Preliminary data have been compiled and are currently being analysed to estimate contribution by stocking group, physiological status of post-smolts, survival estimates and emigration patterns of post-smolts in Penobscot Bay.

Project No. U6 Status: Ongoing

Party or relevant jurisdiction	United States of America
Title of project	Forecasts of Atlantic Salmon Transoceanic Migration: Climate Change Scenarios and Anadromy in the North Atlantic
Objective of research project	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
Brief description of research project	Atlantic salmon undertake transoceanic migrations as part of their complex anadromous life history. In addition to the impact of climate on growth, maturation, and distribution in the ocean, salmon must home to their natal rivers to spawn, the success of which is likely impacted by ocean conditions. After rearing in fresh water, salmon juveniles employ a range of migration cues to time their seaward migrations. Since they are entering a new set of habitat regimes, the climate-related timing of this migration and the conditions they find in the coastal ocean are critical. We have developed a migration model that can be validated for most stocks of Atlantic salmon from North America and Europe. The probability of migration distribution is determined as a function of swimming potential, current vectors, and migration orientation. The absence of foraging behaviour in the model has not significantly compromised its performance, owning to the likelihood that prey co-vary with other environmental variables. The model was run with forecasted surface temperature and currents for the North Atlantic segment of the Climate System Model developed at the National Center for Atmospheric Research. These simulations attempt to define the range of possible impacts climate change may have on salmon populations.
Dates during which research will take place	2002-2004 Project continuation contingent on additional funding
Area in which research will take place	Area to be modelled includes North Atlantic Ocean
Estimated number and weight of salmon to be retained	No Atlantic salmon will be sampled or retained during the course of this project.
Resources	
Estimated cost of the research project	Not Available
Number of participating scientists	1
Name of coordinating scientist in charge of project	Dr. Kevin Friedland
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	Computers, Databases
Details of any collaborating countries	Some collaboration with Canadian investigators

Summary of Progress

No report provided.

Project No. U7 Status: Ongoing

Party or relevant jurisdiction	United States
Title of project	Stable Isotope Composition of Atlantic Salmon Scales
Objective of research project	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.
Brief description of research project	Atlantic salmon populations in the North Atlantic have experienced unprecedented declines in abundance during the past two decades. Of greater concern for the management of US salmon populations are the trends in the two-sea-winter salmon, especially those comprising the populations in the ESA distinct population segment. Although studies of climate and salmon survival suggest recruitment is patterned by events early in the post-smolt year, the apparent tele-connection between stock complexes suggests that factors related to life history events later in the post-smolt year or during the one-sea-winter year may be important as well. If growth has decreased in salmon during the post-smolt or one-sea-winter years, survival would likely be negatively impacted. Concomitant with the decline in stock abundance of salmon in the North Atlantic, a number of lines of evidence suggest that growth has also declined in the same time period. It is not known if this decline in size-at-age is a reflection of decreased growth during the post-smolt year or a decline in feeding opportunity when the fish are on the feeding grounds as one-sea-winter salmon. It is also not known if fish from the DPS are suffering the same decreased growth and tracking with the general pool of salmon in the Northwest Atlantic. There is no direct feeding data to approach these problems; however, many investigators have had success in evaluating feeding position with the analysis of stable isotopes in fish hard parts, such as scales. Furthermore, retrospective time series of growth will also be developed to provide an explanatory variable in regard to the feeding patterns.
Dates during which research will take place	2001-2002 Project continuation contingent on additional funding.
Area in which research will take place	Scale samples collected during West Greenland sampling programme and from returning adults in the United States.
Estimated number and weight of salmon to be retained	It is anticipated that no Atlantic salmon will be retained during this project.

Resources	
Estimated cost of the research project	Not Available
Number of participating scientists	1
Name of coordinating scientist in charge of project	Dr. Kevin Friedland, NOAA Fisheries, Amherst, MA
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 laboratory and isotope analysis equipment
Details of any collaborating countries	Collaboration with some international investigators to secure scale samples.
Summary of Progress No report provided.	

Project No. U8 Status: Ongoing

Party or relevant jurisdiction	United States of America
Title of project	Estuary movements of pre- and post-spawning adults: St. Croix River adult stocking assessment
Objective of research project	This assessment programme consists of 6 objectives: 1) evaluation of spawning characteristics of these stocked adults as compared to wild adults 2) assess spawning habitat selection 3) post-spawning disposition (immediate out-migrants, kelts, or presumed deceased) and timing of estuary entrance 4) monitoring the stage-specific contribution attributable to natural reproduction by these stocked adults 5) estimate fry emergence rates for progeny of these stocked adults and 6) evaluate the reproductive success of progeny originating from these stocked adults.
Brief description of research project	During October 2000, 750 netpen-reared, two-sea-winter, mature Atlantic salmon originating from river-specific brood stock from the Dennys, East Machias, and Machias rivers were stocked into the St. Croix River. During October 2001, 524 adults were also stocked into this system. These adults were reared in a similar manner as the 2000 stocked adults and originated from river-specific brood stock from the Dennys, Machias, Sheepscot and the Narraguagus rivers. Stocking rates were determined by stock-specific fecundity estimates and habitat survey data according to established management guidelines. Kelt movements could be detected at sea in conjunction with existing arrays in place to monitor smolt emigration. With battery life of adult tags movements at sea could be documented through early 2003.
Dates during which research will take place	October 2000 – October 2006
Area in which research will take place	St. Croix River Cobscook Bay Gulf of Maine
Estimated number and weight of salmon to be retained	It is anticipated that no Atlantic salmon will be retained during this project.
Resources	
Estimated cost of the research project	Approximately £14,000 per annum
Number of participating scientists	~3
Name of coordinating scientist in charge of project	Tim Sheehan NOAA Fisheries, Woods Hole, MA
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 (~50-60 annually) Stationary Ultrasonic Receivers (12-15 annually)
Details of any collaborating countries	An ultrasonic receiver array deployed by a Canadian investigator (G. Lacroix) Department of Fisheries and Oceans is capable to detecting and recording tagged fish.

Summary of Progress

The field assessments and data collection aspects of the project have been completed. The data are undergoing auditing procedures and will be available for analysis after that.