

Conference
27–28 November 2013
Glasgow Marriott Hotel
Scotland

Boosting salmon numbers – is stocking the answer or the problem?

Speakers / Chairs

Colin Adams
Melfort Campbell
Jon Carr
Mark Coulson
Stephen Gephard
Jon Gibb
Jim Haughey
Jóhannes Hinriksson
Jörgen Johnsson
Richard Kennedy
Roger Knight
Stephen Marsh-Smith
David McEvoy
Sarah McEvoy
Philip McGinnity
Ted Potter
Tom Reed
David Solomon
Jamie Stevens
Eric Verspoor
Ken Whelan
Kyle Young



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WORKING FOR
**THE FUTURE OF
SALMON AND SEA TROUT**
IN
THE OCEAN • COASTAL WATERS • FRESH WATER

THE NUMBER OF ADULT FISH RETURNING TO EUROPEAN RIVERS TO BREED
AFTER MIGRATING TO THEIR OCEAN FEEDING GROUNDS...
HAS HALVED IN THE LAST 30 YEARS.

Our salmon and sea trout stocks also face increasing threats in coastal and freshwater habitats from human activities and climate change.

AST has long enjoyed a reputation as a leader in promoting practical, research-based strategies for the conservation and protection of wild salmon and sea trout.

AST works closely with a wide range of national and international salmon conservation and management organisations to achieve its goals and objectives.

Contents

Conference Programme	2
The Speakers & Organising Committee	4
Poster Session	15
About IBIS	23
General Information	27
Delegate List	30

Inside back cover: Speaker / Chair photos

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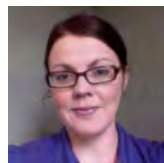


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Conference Programme

Wednesday 27 November 2013

Any last-minute changes to this programme will be announced and posted on the notice-board outside the conference room.

10:00 *Registration for Day 1*

10.30 **Opening words:** **Melfort Campbell** Chair - Atlantic Salmon Trust
 Colin Adams University of Glasgow

10:45 SESSION 1: SETTING THE SCENE Chair: Ted Potter

10:45 – 11:15 **David Solomon**
Why stock? Introductory exploration of reasons for stocking, of different types of stocking

11:15 – 11:45 **Ken Whelan** Research Director, Atlantic Salmon Trust
How Salmon populations work - explanation of salmon stock dynamics

11:45 – 12:15 **Eric Verspoor** University of the Highlands and Islands
The importance of genetics - An explanation of salmon genetics, including population structure, natural adaption etc

12:15 Questions & Answers

12:30 *Lunch*

13:30 **SESSION 2: THE PRINCIPLES & PRACTICE OF STOCKING Chair: David Solomon**
Stocking as a means of restoring salmon populations: How effective is stocking as a means of restoring salmon to a river, or rebuilding depleted populations; how well do artificially reared salmon survive to boost salmon numbers? What is the impact of stocking and husbandry practices?

13:30 – 14:15 **Steve Gephard** Inland Fisheries Division, Dept. of Energy and Environmental Protection, State of Connecticut
Overview

14:15 – 14:35 **Kyle Young** Aberystwyth University
Stocking and catches in England and Wales

14:35 – 14:55 **Jamie Stevens** University of Exeter
The Thames, the Mersey and the Clyde

14:55 – 15:15 **Eric Verspoor** University of the Highlands and Islands
The Carron

15:15 Questions & Answers

15:30 *Tea*

16:00 – 16:20 **Jörgen Johnsson** University of Gothenburg
The Smoltpro programme in Sweden

16:20 – 16:40 **Jon Gibb** River Lochy Association
The Lochy Smolt Programme

16:40 – 17:00 **Richard Kennedy** AFBI
The Bush

17:00 – 17:20 **Jon Carr** Atlantic Salmon Federation
What works: The ASF's salmon recovery programme workshop

17:20 Questions & Answers

17.30 **Discussion of Day 1 Chair: Ken Whelan**

18:30 **POSTER SESSION**

**Reception hosted by the City of Glasgow,
Conference Dinner in the Marriott Hotel**

Thursday 27 November 2013

08:45 Registration for Day 2

09:00 SESSION 2: PRINCIPLES & PRACTICE OF STOCKING (cont.) Chair: Eric Verspoor

Potential Impact of Stocking on Wild Populations: What effect does stocking have on wild salmon populations and on their ability to adapt to environmental change?

09:00 – 09:40 **Phil McGinnity** University College, Cork
Overview

09:40 – 10:00 **Mark Coulson** Rivers And Fisheries Trusts of Scotland (RAFTS)
Genetic parentage analysis of hatchery contribution of Atlantic Salmon on the River Spey

10:00 Questions & Answers

10:30 Coffee

11:00 – 11:20 **Jóhannes Hinriksson** Manager, West Ranga
The Ranga experience

11:20 – 11:40 **David and Sarah McEvoy** Fisheries Manager, Delphi; Marine Institute,
Newport
Delphi

11:40 Questions & Answers

Stocking and Climate Change: Will stocking affect wild populations' ability to respond to climate change? Is stocking a way of responding to climate change on some rivers?

12:00 **Tom Reed** University College, Cork
Stocking and Climate Change

12:40 Questions & Answers

13:00 Lunch

14:00 SESSION 3: STOCKING: COSTS, BENEFITS AND ALTERNATIVES Chair: Ken Whelan

What are the economics of stocking? Moreover, stocking does satisfy many people's desire to help improve their fishery, yet is it the best use of their time and money, and in what other ways can they help boost salmon numbers?

14:00 – 14:20 **Roger Knight** Director, Spey Fisheries Board
The Spey experience

14:20 – 14:40 **Stephen Marsh-Smith** Executive Director, Wye and Usk Foundation
The Wye and Usk experience

14:40 – 15:00 **Jim Haughey** Ulster Anglers Federation
Stocking in Northern Ireland: an angler's perspective

15:00 Questions & Answers

15.15 Final Discussion and Conclusions Chair: Ken Whelan

16.30 Tea; Departures

Conference Organising Committee

Ken Whelan
Ivor Llewelyn
Paddy Boylan

The Committee had advice and assistance from the AST's Honorary Scientific Advisory Panel

The Speakers & Organising Committee

Melfort Campbell

Chair – Atlantic Salmon Trust / Chairman, Imes Group



Melfort Campbell OBE established his own business in 1983 and has since established a group of specialised engineering businesses serving the marine, defence, energy and utility industries worldwide. Imes Group was built up to having sales of over £20m with nearly 500 employees before one of the subsidiaries was sold in 2009. The Group continues to operate in the UK, Europe, Far East and USA providing safety and integrity critical engineering support for ships and submarines, subsea production systems as well as to the power generation and process industries. In addition, Melfort served as Chairman of the Board of Governors of the Robert Gordon University and from 2005-07 was Chairman of the CBI in Scotland where he was involved in

European, UK and Scottish programmes for the development of enterprise, innovation, economic development and business and education links. Melfort now is non executive in his business interests so has the opportunity to focus on his main interests which include development of links between business communities and education; promoting business innovation and better conversion of our academic and scientific research into economic value add. Further current roles include: Member – Oil & Gas UK Contractor Council (since 2005); Chairman – Atlantic Salmon Trust (AST) (since 2010); Member – Industry Technology Facilitator (since 2011); Co-Chair – Oil and Gas Industry Leadership Group; Co-Chair – Innovation Scotland Forum (since 2013); Co-Chair – Energy North Oil & Gas Taskforce (since 2013); Chairman – RGU Foundation (since 2013); Member – Oil & Gas UKCS Technology Strategy Board (since 2013).

Welcome

The Atlantic Salmon Trust exists to encourage research into key aspects of salmon and sea trout conservation and to make all those interested in these fish aware of results of research. Our focus on these activities is a practical one: we want to ensure that developments in the scientific understanding of these fish and their environment lead to better management. We have therefore been delighted to work with the IBIS knowledge transfer programme, which has very similar objectives. Stocking is one area where there have been important developments in our knowledge of the likely effectiveness of different types of stocking and of their impact on wild fish. But these are not always well understood by those most directly involved in salmon fishing: anglers, proprietors and managers. This conference will, I hope, make many more people aware of the evidence for the successes and failures of various stocking projects, of what we can realistically expect stocking to achieve and of the circumstances in which stocking is likely to prove a cost-effective way of increasing salmon numbers.

Colin Adams

Director – Scottish Centre for Ecology and the Natural Environment,
University of Glasgow



Colin Adams is Professor of Freshwater Ecology at the University of Glasgow and Visiting Professor at the University of Tromsø. He is a Director on the board of the Rivers and Fisheries Trusts of Scotland and one of the three principal investigators on the “IBIS project”. He also runs Glasgow University's field station on east Loch Lomondside; SCENE. In research he combines controlled laboratory experimental approaches with comparative field studies to examine questions in the fields of aquatic conservation, life-history strategies and micro-evolutionary processes mostly using fish as models. He has over 100 publications in international scientific journals. In

teaching he is committed to equipping the next generation of ecologists with the intellectual and field skills necessary to make sense of the problems that this generation will leave behind.

Welcome and why are we here?

Judging by the number of people signing up to attend, this meeting is addressing a topic with considerable interest for people from a wide range of backgrounds. In the next two days we will explore a range of views on just one aspect of how we manage just one of our aquatic resources, Atlantic salmon. But our natural aquatic resources face a barrage of potential impacts for which we need to develop management and policy solutions or to import best-practice for these from else-where. I will briefly outline how the IBIS project, which has funded this workshop, is beginning to do this for some of the pressures to which our freshwater and marine resources are exposed.

Ken Whelan

Atlantic Salmon Trust



Ken studied Zoology in University College Dublin in the early 70's. He joined the Inland Fisheries Trust Incorporated in 1975 and worked for the Central Fisheries Board from 1980 to 1989, where he acted as principal advisor to the Board on salmon and sea trout stocks. He was appointed Director and CEO of the Salmon Research Agency in 1989 and served in that capacity until his appointment in July of 1999 as an Executive Director of the Marine Institute. In this role he acted as a Ministerial advisor on a broad range of policy areas: migratory fish stocks, fin fish aquaculture, freshwater fisheries, recreational fisheries, the freshwater environment, fish habitat and climate change issues.

He served as President of NASCO from 2004 to 2008. As President he helped co-ordinate and manage a recently completed major international study into the causes of marine mortality of Atlantic salmon – the SALSEA Programme. Ken was Chairman of the International Atlantic Salmon Research Board from 2007 to 2011 and is currently Chairman of the Scientific Council of the Loire Basin Salmon Restoration Programme. In December 2009 he was appointed as Adjunct Professor in the School of Biology and Environmental Science at University College Dublin and as Research Director of the Atlantic Salmon Trust. In 2009 he established a fisheries and environmental consultancy.

Chair: Day 1 Discussion; Day 2 (afternoon)

Talk: How Salmon populations work - explanation of salmon stock dynamics

To be effective at boosting or sustaining wild salmon numbers stocking programmes require an understanding of how salmon populations work. This presentation will describe how such factors as river productivity, temperature, stream flow and the presence or absence of lake systems may influence the annual productivity of a system and the stock dynamics of individual year classes of salmon. It will review the critical points in the salmon's life cycle where mortality may well have a disproportionate effect on adult returns and the mechanisms used by nature to overcome a very significant drop in the overall number of adult spawners. The talk will lay particular emphasis on the inherent variability of salmon populations and just how difficult it is to plug specific population gaps in an ever changing and complex environment.

Kyle Young

Aberystwyth University



Kyle A. Young is a lecturer at Aberystwyth University's Institute of Biological, Environmental and Rural Science (IBERS). His research on freshwater fishes spans intersections of behavioural, evolutionary, community and applied ecology. Following PhD (University of British Columbia, 2001) and postdoctoral research on Pacific salmon and trout, he has worked on whitefish, cichlids and galaxiids in Europe, Africa and South America. Before joining IBERS in 2013, he worked for four years as a fisheries and river ecologist with The Environment

Agency and Natural Resources Wales.

Talk: Stocking and catches in England and Wales

The debate over Atlantic salmon, *Salmo salar* L., stocking in Britain centres on the trade-off between enhancing rod fisheries and harming wild populations. This paper informs the debate by quantifying the relationship between stocking and angler catch statistics for 62 rivers over 15 years. After controlling for environmental factors affecting adult abundance, the 42 rivers with stocking had non-significantly lower mean catch statistics than the 20 rivers without stocking. This difference increased with the age of stocked fish. Among stocked rivers, weak relationships between mean stocking effort and catch statistics also became more negative with stocked fish age. For stocked rivers, there was no evidence for a generally positive relationship between annual stocking efforts and catch statistics. Those rivers for which stocking appeared to improve annual rod catches tended to have lower than expected mean rod catches. The results suggest the damage inflicted on wild salmon populations by stocking is not balanced by detectable benefits to rod fisheries.

Eric Verspoor



Rivers and Lochs Institute, Inverness College University of Highlands and Islands

Eric Verspoor has worked in the field of ecological genetics for 40 years. Of these, 30 have focused on the genetics of the Atlantic salmon. He is an author on more than 200 peer-reviewed papers, scientific reports and book chapters. In 2012 he helped found the Rivers and Lochs Institute, Inverness College University of the Highlands and Islands and appointed as its first Director. Previously, in 2009 he was awarded an Honorary Chair in Zoology from Aberdeen University. From 1997-2011: Principal Scientific Officer and Group Leader with Scottish Government Marine and Freshwater Laboratories (Fisheries Research Services/Marine Scotland Science). He is the lead editor and chapter author of the seminal book on salmon genetics "The Atlantic Salmon: genetics, conservation and management". In 2009, with Callum Sinclair, he set up and initially led the recently completed RAFTS-MSS FASMOP project to increase understanding of within river population structuring in Atlantic salmon. He was also a lead scientist on the NASCO-AST sponsored and EU funded SALSEA-Merge project to use an integrated ecological and genetic approach to increase understanding of the marine ecology of European Atlantic salmon stocks.

Chair: Day 2 (morning)

Talk 1: The importance of genetics. Talk 2: The Carron

A programme of stocking Atlantic salmon was initiated in the River Carron, on Scotland's West Coast, in 1995 in response to declining catches in the river and evidence of low juvenile abundance, a situation seen in many rivers at the time. Since this time, catches have recovered to and above historical levels and are correlated with stocking activity, though the actual role of stocking in the recovery is uncertain. Recoveries were seen more generally across the region after the late 1990s and are not outwith the natural capacity of salmon stocks to recover. The paper presented gives an overview of available information on what stocking was carried out and the likely causes for the decline. Additionally, it explores alternative scientific hypotheses for the observed recovery of the salmon stock. Increasing understanding of the impact of stocking on recovery in the Carron is crucial to informing the general debate on stocking practise and defining when and how stocking can be productively used in Atlantic salmon management.

Steve Gephard



State of Connecticut- DEEP/Inland Fisheries Division- USA

Steve Gephard is a Supervising Fisheries Biologist with the State of Connecticut in the USA. He has been involved with the Connecticut River Atlantic Salmon Restoration Program since 1978. He serves as the State's representative to the Technical Committee of the Connecticut River Atlantic Salmon Commission, is a long-time member of the U.S. Atlantic Salmon Assessment Committee and has served as chair of two technical committees for the Atlantic States Marine Fisheries Commission. He has published work done on Atlantic salmon in Spain and has served on the Le Conseil scientifique du saumon de Loire-Allier since its inception. He currently is a U.S. Commissioner to NASCO, having been appointed in 2002.

Talk: Principles and practice of stocking

The Connecticut River was one of the southernmost Atlantic salmon rivers in North America and one of its largest. Native runs were extirpated by 1812 and a hatchery-based restoration program was begun in 1967. Donor stocks came from Maritime Canada but mostly from the State of Maine (USA). A total of 156,851,200 juvenile salmon was stocked between 1967 and 2012, dominated by 146,669,000 fry, mostly after 1990. Total documented adult returns to date is 6,165. Ages of adults range from 1:1 to 3:2 but the dominant age is 2:2. Return rates for stocked fry (per 10,000 fry) have ranged from 0.000 to 2.791 with an overall mean of 0.472. Background information on stocking history, rationale into stocking decisions, and 'lessons learned' are provided. The Connecticut River restoration program was formally disbanded in 2012 but some stocking continues.

_Jörgen I. Johnsson



University of Gothenburg

Jörgen Johnsson is full professor and vice head of research at the Department of Biological and Environmental Sciences, University of Gothenburg. Professor Johnsson's research area is behavioural and evolutionary ecology with a multidisciplinary approach including interactions between ecology, physiology, genetics and social sciences. His research is characterized by a strong integration of basic and applied aspects, often using salmonid fish as model species.

Professor Johnsson has more than 25 years' experience of international research conducted in collaboration with a network of collaborators, including Canada, Denmark, France, Germany, Great Britain, Norway, Spain, Sweden and USA. His results have frequently been used by authorities to guide fishery management in Sweden, EU, North America and Asia. He has been invited as an expert to inform Swedish and international authorities on biological risks associated with escapes and releases of transgenic (GMO) and domesticated salmonids, including The Swedish Gene Technology Advisory Board, The Swedish GMO authorities, The Swedish National Board of Fisheries, The European Food Safety Association (EFSA); The United States Department of Agriculture (USDA), and The Atlantic Salmon Trust (AST). Professor Johnsson's research projects have been awarded numerous grants from national and international funding sources. He presently coordinates the strategic research project "SMOLTPRO – sustainable smolt production, an integrated approach" <http://www.smoltpro.science.gu.se/> funded by Formas within the strategic area "Sustainable use of Natural Resources".

Talk: SMOLTPRO – sustainable smolt production, an integrated approach

SMOLTPRO, which started in 2010, is a four year research project involving Swedish, Norwegian, Danish and Canadian research groups funded by the Swedish Research Council Formas within the strategic area "Sustainable use of Natural Resources". The main aim of SMOLTPRO is to develop ecologically and ethically sound methods for supplementary rearing of salmonids. To achieve these goals SMOLTPRO integrates the competences and resources in this field of research using a multidisciplinary approach, where experiments are conducted in a series of full-scale hatchery model systems. The results are evaluated together with novel meta-analyses of existing data, and new hatchery guidelines will be developed in close dialogue with stakeholders. In this talk I will summarize the results obtained in SMOLTPRO so far and their implications for sustainable smolt production.

_Stephen Marsh-Smith



Wye and Usk Foundation

SM-S jointly founded the Wye and Usk Foundation in the mid '90s in response to declining salmon runs. With his team, techniques have been developed to combat the effects of acid rain; restore degraded habitats, resolve farm diffuse pollution and build cost effective easements and fish passes. Several awards have been won by the Foundation for this work culminating in an OBE for SM-S for services to the environment

Talk: The Wye and Usk experience

Wye salmon numbers suffered a substantial decline, annual catches of 6000 in the late '60s and '70s to a mere 350 in 2002. The part hatcheries and other management tools played during that period are discussed along with what has been done to bring about a steady improvement this century.

_Jon Gibb



Lochaber District Salmon Fishery Board

Jon has worked in salmon fisheries for over 20 years and is particularly passionate about the protection of Scotland's West Coast salmon and sea trout. As Fishery Manager for the last 12 years on the Western Highlands' premier commercial salmon river, the Lochy, he has overseen the management of the river's salmon stocks against a background of increasing threats, including the rapid expansion of the local salmon farming industry. Jon runs one of the country's largest wild salmon hatcheries near Glenfinnan, rearing fish of all life stages for nine different local rivers. He also works as Clerk to the Lochaber DSFB, writes on fishing for magazines and newspapers and, above all, is a mad keen salmon angler.

Talk: The Lochy Smolt Programme

Following the near destruction of the Lochy's salmon stocks in the late 1990's, a programme of intensive stocking was undertaken in conjunction with management agreements and negotiations with the local fish farm companies. This talk addresses the effectiveness or otherwise of this mitigation stocking approach. In particular it focuses on the move towards sea lice 'protected' indigenous smolt stocking over the last 3 years in partnership with the largest local salmon farm company Marine Harvest. Does this approach offer a possible way forward for some locations where there is a perceived threat to commercially important wild salmon stocks from sea lice and yet a dense and thriving local aquaculture industry?

_Richard Kennedy



AFBI (Agri-Food & Biosciences Institute, Northern Ireland)

Scientific Officer based at the River Bush Salmon Station, Northern Ireland. Responsibilities include the management of the long term salmon monitoring programme on the River Bush and supervision of the salmonid monitoring network on other river systems in the DCAL area of Northern Ireland.

Talk: The Bush

Historically, stocking with juvenile Atlantic salmon has been conducted across a wide variety of river catchments in Northern Ireland. The objectives behind these stocking programmes have included fisheries enhancement, compensatory actions following anthropogenic disturbance events and the restoration of extirpated populations. Monitoring work on the River Bush had shown that freshwater survival of salmon, measured as egg -smolt survival, had declined from 1974-1983 (1.47%) to 1984-1993 (0.62%). This dramatic reduction in survival was thought to reflect progressive habitat degradation, in particular siltation/compaction of spawning gravels, and additional effects of mammalian and avian predation. Therefore, an enhancement programme was conducted on the River Bush over the period 1996 – 2005 during which c. 3.8 million 0+ age class salmon were stocked. This programme was designed to support freshwater production of juvenile salmon and enhance smolt output. The relative survival rates of stocked fish were examined using a variety of tools including survivorship models, marking studies and genetic analysis. The potential contribution of the enhancement programme to overall freshwater production was estimated and the outcome has been reviewed and critically assessed against the initial management objectives.

Mark Coulson

Rivers and Fisheries Trusts of Scotland



Mark moved to Scotland, from Canada in 2009 to take a position as Molecular Geneticist with the Rivers and Fisheries Trusts of Scotland on the Focusing Atlantic Salmon Management on Populations (FASMOP) project. Prior to this Mark's graduate work in Canada involved population and evolutionary ecology research on lobsters, cod, smelt and skates in both Newfoundland and Nova Scotia. His work focuses on the use of genetic markers applied to fisheries management questions including genetic parentage analysis, genetic interactions between farm and wild fish and identifying population structure to aid in the identification of discrete breeding units. He also holds an Affiliate Research position at the University of Glasgow.

Talk: Genetic parentage analysis of hatchery contribution of Atlantic Salmon on the River Spey

This study reports on the use of genetic parentage assignment to assess the hatchery contribution towards the rod-catch of Atlantic salmon on the River Spey. Broodstock sampled from 2004-2010 were screened for 17 genetic markers to create individual genetic profiles. In addition, hatchery records provided by the Spey Foundation and Spey Salmon Fishery Board confirmed the genetic crosses made in the hatchery over this period using the retained broodstock. This information on broodstock genetics and hatchery crosses allowed the analysis of rod caught adults in subsequent years to identify which of these returning adults could be attributed to hatchery crosses and associated stocking activities. From 2008-2012, 113-299 individuals per year were screened and compared to broodstock in the previous years. Among the rod catches, between zero and four fish in any given year could be traced back to the hatchery as both parents were identified from the genetic analysis and the cross was confirmed by the breeding records as having taken place. This translated to the proportion of the sample emanating from the hatchery between 0%-1.8% across the period considered. Given the limited access to wild fish getting above Spey Dam, this area was among the most heavily targeted areas for stocking. Therefore, it was of interest to see, among a sample of 33 adult fish caught below Spey Dam, if these were hatchery fish attempting to get back to this section of the river. Among the 33 fish caught at the trap below Spey Dam, none were identified as coming from the hatchery. Finally, 10 fish in the study were assigned a single parent from the hatchery. Several explanations are possible, from small sources of error to pre/post hatchery spawning and successful spawning of precocious parr. In these latter cases, however, the offspring in question are not considered hatchery fish. This study highlights the importance of genetically sampling hatchery broodstock and keeping records of hatchery crosses in order to evaluate the efficacy of hatchery operation. These results can be used by the Spey Salmon Fishery Board and Spey Foundation to consider and inform future hatchery stocking activities in the catchment.

Ivor Llewelyn

Atlantic Salmon Trust



Ivor has been with the AST since 2006. Before then he spent over thirty years in the Ministry of Agriculture, Fisheries and Food and subsequently Defra. From 1994 to 2000 he was responsible for policy and research funding for salmon and inland fisheries in England, and acted as Secretary to the 2000 Review of Salmon and Freshwater Fisheries.

Phil McGinnity



University College, Cork

Dr McGinnity has been working in fisheries research and management for more than a quarter of a century. He started his career in fisheries as an Inspector with the Northern Regional Fisheries Board in 1985, taking study leave from the Board to complete a BSc in Biology (Hons) at Queens University Belfast in 1989. He has a PhD (Supervisor Professor Andy Ferguson), also from Queen's, in the area of population genetics, which he completed while working as a biologist for the Salmon Research Agency of Ireland (now the Marine Institute) at its research station on the Burrishoole River in County Mayo. He was a biologist and team leader with the Institute until 2008. He did a spell on secondment as Director of Protection and Conservation in the Central Fisheries Board between 2000 and 2002 and since 2008 has been employed by University College Cork as Principal Investigator for the prestigious Beaufort Marine Research Award in Fish Population Genetics. He is probably best known for his work with Andy Ferguson on the genetic impacts of farm escapes, but has also been published widely in the areas of population biology and ecology, stock assessment, evolutionary biology, and habitat measurement and assessment.

Talk: Potential Impact of Stocking on Wild Populations: - overview

"It's [stocking] a trade off between enhancing wild fisheries and harming wild populations" (Young, 2013).

With respect to assessing the risk of unintentionally causing the latter, there are some genetic concepts that managers may wish to consider when contemplating stocking. In this overview I would like to list and talk briefly about a number of good reasons to be cautious, such as the importance of local adaptation in characterising salmonid populations, particularly the extent and geographical scale at which it occurs; the costs to productivity (fish abundance) imposed by natural selection on maladapted populations; understanding the genetics of inbreeding depression and outbreeding depression (including the possibility of hybrid vigour), largely in terms of the conservation dilemma between intentional hybridisation to save a population or making it worse by inducing outbreeding depression; appreciating the speed of adaptation to captivity, with recent research providing some new insights to how it occurs. I hope to support the more theoretical aspects of these ideas with some examples from experiments and to discuss in the context of managing salmon for biodiversity and associated wild population resilience.

Young, K. (2013). The balancing act of captive breeding programmes: salmon stocking and angler catch statistics. *Fisheries Management & Ecology*, 20, 434-444.

Jóhannes Hinriksson



Manager, West Ranga

Been working at the Ranga since 1997. Working as a regular employee, a guide, river keeper and then as a manager.

Talk: The Ranga experience

The Ranga adventure :

- How we got from 50 salmon to 14,300 salmon.
- The journey – brief history.
- The procedure – how is it done – practical.
- How is it possible to make a profit of salmon ranching with no

found or financial support?

- 6,000 salmon average catch the last 10 years.
- The fly anglers paradise.

David and Sarah McEvoy



Fisheries Manager, Delphi Marine Institute, Newport

David McEvoy first fished at Delphi in 1973 at the age of 8. He graduated from Trinity College with a Business Management Degree in 1989 and has been Fishery Manager at Delphi since 1992.

Sarah McEvoy was Hatchery Manager at Delphi from 1993 to 2007, and has spent the past 6 years working for the Fish Rearing Unit in the Marine Institute, Newport, Co. Mayo, Ireland.

Talk: Delphi

Nestled at the foot of the Mweelrea Mountains, Connemara in the west of Ireland, Delphi Lodge is the centrepiece of a pristine river system and has changed little since its construction in the early 1800's. Throughout the twentieth century, Delphi was renowned in the angling fraternity as a prolific producer of sea trout, with a small run of spring salmon and summer grilse. The fishery consists of a chain of three lakes (Glencullin, Doolough and Finlough), which empty into the Killary Harbour via the Bundorragha River.

Peter Mantle purchased the Delphi Estate, including Delphi Lodge and the Fishery in January 1986 - the first time this property had changed hands since its acquisition by the Browne family of Westport in 1648. An ambitious plan was soon put in place to restore the Lodge and develop the fishery, funded in part by the introduction of Ireland's first game fishery syndication scheme. Restoration and renovation of the Lodge and four cottages was completed in 1988.

The well documented collapse of the sea-trout stocks in the west of Ireland during the late 1980's was particularly damaging to the viability of the Delphi Fishery. On the strength of advice from the then Department of the Marine, and Salmon Research Agency, a hatchery was constructed and the Delphi Salmon Ranching Programme was introduced.

Now in its 25th year, the ranching programme has transformed Delphi from the brink of collapse to an internationally renowned salmon fly fishery, producing not only summer grilse, but more significantly, a substantial run of multi-sea-winter spring running salmon. The successful ranching of spring salmon has ensured a fully operational fishery from 1 Feb - 30 Sep thus providing valuable employment all year round in a location which is quite remote and largely dependant on the seasonal tourism industry. The Delphi Fishery operates under a mandatory catch and release of all wild salmon (with the exception of an anglers first ever salmon).

The purpose of this presentation is to provide an overview of the ranching programme at Delphi; the challenges met, its benefits and its costs.

Ted Potter



CEFAS

Ted Potter has forty years experience as a fisheries scientist working mainly on the conservation of migratory salmonid, eel and freshwater fish stocks and the sustainable management of the recreational and commercial fisheries that are dependent upon them. His principal areas of research have been related to the behaviour of migratory fish and the modelling of fish populations and fisheries to support management decision-making. He is currently the Senior Fisheries Adviser on Salmonid and Freshwater Fisheries at Cefas which involves

providing expert advice nationally and internationally on the factors affecting fish stocks, approaches for their management and related legislative controls. He has been involved in – and chaired – a wide range of national and international scientific and advisory groups, particularly under the auspices of ICES and NASCO.

Chair: Day 1 (morning)

_Tom Reed



University College Cork

Tom Reed is employed by the University College Cork as a research fellow in quantitative genetics, evolutionary biology and fish population genetics and is based at the Marine Institute of Ireland, Newport, Co. Mayo. He is particularly interested in how salmon and other organisms adapt to environments that are highly variable across space and which change through time. He has previously conducted research on evolutionary and demographic consequences of climate change for salmon species in the Pacific Northwest, songbirds in the Netherlands and seabirds in Scotland.

Talk: Stocking and Climate Change: Presentation

Global temperatures are rising and current atmospheric levels of carbon dioxide are higher than at any time in the past 3 million years. The connection here is more than coincidental and climate scientists warn that the likely rate of warming over the next century will be 10+ times quicker than at any time since the end of the Cretaceous (when non-avian dinosaurs went extinct). Salmon, being cold-blooded and confined to relatively cool freshwater and oceanic environments, are extremely vulnerable to climate change and additionally face a host of other pressures including habitat loss and harvest. Despite the best of intentions, intensive stocking may do more harm than good in the long term, even if hatcheries use locally-obtained brood stock. I will illustrate some of these issues using findings from a long-term study of Atlantic salmon in the Burrishoole system, in the West of Ireland, which show that release of captive bred, sea-ranched fish into the wild can jeopardise the ability of the wild population to cope with rising water temperatures. More generally, I emphasise how stocking practices involve a fundamental trade-off between short-term gains (e.g. enhanced rod fisheries) and long-term losses (e.g. reduced resilience of stocks). Climate change is a long-term problem with the highest burden being born by future generations (both salmon and human!), which argues for a prudent, precautionary approach to stocking practices and salmon management in a changing world.

_Roger Knight



Spey Fishery Board & The Spey Foundation

Roger Knight has been Director of the Spey Fishery Board and the Spey Foundation since June 2006. Roger is a former Army Officer who served in Cyprus, Germany, Canada, Northern Ireland and the Falklands. He subsequently joined the Diplomatic Service and worked at the Foreign & Commonwealth Office in London, before being seconded to the United Nations in New York, Bahrain and Iraq. Following a three-year Diplomatic posting to South Africa in 1997, he returned to the Foreign Office and worked on the Falkland Islands Fisheries desk, where he was a UK delegate at meetings of the South Atlantic Fisheries Commission in Argentina. He moved to Scotland in 2003 and returned to Iraq in 2005 as a UN Field Officer, responsible for coordinating the logistics for the Constitutional Referendum and National Elections in Ninewa Province and Kurdistan.

Talk: The Spey experience

Genetic research has heralded new insights into fishery management. This presentation looks at the results of the FASMOP project and how they are being translated into practical management applications. Particular emphasis will be placed on the genetic analysis of the Spey Board's hatchery operations and its contribution to the rod fishery. This is the first time such research has been undertaken and the presentation will look at its impact from a fishery management perspective.

Jim Haughey



Ulster Angling Federation

Jim Haughey is the Federation Chairman and has been a Director since 1982. He served on the old le Conservancy Board for a number of years and is presently a member of the DCAL Salmon and Inland Fisheries Advisory Forum and Loughs Agency Advisory Forum. He was a partner in a Building Services Consulting Engineering business for 20 years before retirement. He is Chairman of the North Atlantic Salmon Fund (NI) and played integral role in the first DCAL salmon net buyout in 2001. He enjoys both salmon and trout fishing and sees the maintenance of good habitat as one of the cornerstones of fisheries conservation.

Talk: Stocking in Northern Ireland: an angler's perspective

There are a number of factors limiting salmon numbers at present, mainly negative physical influences on the ability of salmon to thrive in their natural habitats. The opportunities for man to positively change these factors are discussed, and the likelihood of success examined. The conclusion is that such opportunities are limited and therefore where possible, any such options need to be fully employed. The potential contribution of the direct enhancement of salmon by means of hatcheries is discussed and supported within certain circumstances. This being not only a direct contribution to salmon numbers, but also a benefit to the overall welfare of a catchment.

Jonathan Carr



Atlantic Salmon Federation

Jonathan Carr is the Director of Research and Environment at the Atlantic Salmon Federation, located in St. Andrews, New Brunswick, Canada. He acquired his Masters of Science Degree at the University of New Brunswick (Fredericton campus) on research involving the interactions between wild and aquaculture Atlantic salmon. Jonathan has over 20 years of experience on various research programmes that include the management and conservation of wild fish populations, restoration of endangered and threatened populations, acoustic tracking of salmon migration and their survival in the marine environment, fish passage issues, exotic species, and interactions between wild and farmed salmon. Jonathan has 19 peer reviewed scientific publications (13 as first author), and more than 30 unpublished research reports.

Talk: What Works? A Workshop on Wild Atlantic Salmon Recovery Programs in North America

Wild Atlantic salmon populations are becoming severely depressed, especially across the southern range of the species. Recovery programmes that utilise various stocking strategies to restore these populations have had varying success. The Atlantic Salmon Federation hosted a workshop in September 2013 that brought together stakeholder groups, scientists, and managers to collate data on Atlantic salmon recovery programmes in eastern North America. Case studies provided examples of successes, failures, and best practices for rebuilding depleted and threatened wild salmon populations. Discussion during the workshop wrap-up concentrated on identifying how the role of hatcheries and other supportive rearing programmes have changed and the constraints and limiting factors that must be addressed to make progress in salmon recovery. I will provide an overview of the workshop findings specific to stocking strategies, including recommendations on appropriate recovery strategies for Atlantic salmon that are based on the knowledge obtained from these proceedings.

_Jamie Stevens



Department of Biosciences, University of Exeter

Jamie Stevens is a molecular ecologist at the University of Exeter. He completed his PhD at Bristol University vet school in 1991, studying the population genetics of African parasites. Since then his research has diversified and now focuses largely around the use of molecular methods in applied conservation, population genetics and evolution of salmonid fishes. Over the last 10 years his research group has played a significant role in three major European-funded projects focused on Atlantic salmon and brown/sea trout: the Atlantic Salmon Arc Project, SALSEA-Merge, the AARC project. His team works extensively with the Westcountry Rivers Trust and the Environment Agency across southern England, allowing findings from the laboratory to feed rapidly into practical fisheries management across the region. He lives with his wife and three children in Exeter.

Talk: The Thames, the Mersey and the Clyde

Despite an intensive stocking programme, since 2005 no hatchery-reared Atlantic salmon have been caught in the River Thames. In collaboration with the Environment Agency, DNA was extracted from scales taken from wild adult salmon returning to the Thames between 2005–2008 and a genetic profile was generated for each fish; using the Atlantic Salmon Arc Project microsatellite database each was then assigned to its most likely river of origin. The assignment analysis suggested that wild salmon ascending the river during this period originated not from exogenous fish stocked into the Thames, but predominantly from other rivers in southern England. Such straying highlights the potential for natural recolonisation of rivers where salmon have become locally extirpated, whilst simultaneously highlighting the futility of long-term stocking without corresponding improvements in river navigability, habitat and water quality. A similar study of Atlantic salmon re-entering the river Mersey (a river that has not been subjected to an organised stocking campaign) reconfirmed the capacity of this species to recolonize suitable habitat once water quality and river access have been restored. The findings of this research suggest that stocking with exogenous fish is not a viable solution to restoring salmon populations in rivers experiencing on-going issues of water quality, habitat loss and river access; accordingly, to ensure sustainable salmon populations, available conservation resources may be better directed to addressing these latter issues than spent on stocking.

This research received support from the Environment Agency, the European Union, Westcountry Rivers Trust, the Game and Wildlife Conservation Trust and the Atlantic Salmon Trust.

_David Solomon



David Solomon has worked on salmonid fish and fisheries throughout his career. After a PhD at the University of London he worked for 15 years at the MAFF Fisheries Laboratories in London and Lowestoft. In 1985 he left government service and set up as an independent consultant. He has recently retired to write books on the history of fisheries.

Chair: Day 1 (afternoon)

Talk: Why stock? An introductory exploration of reasons for stocking and of different types of stocking

This introductory paper will list and discuss the broad types of restocking programme, explore the reasons behind proposals, consider the implications of each type of programme, and set the scene for discussion of the justification and risks. The needs for clear objectives and a mechanism for assessing progress in achieving those objectives will be stressed.

Poster Session

Wednesday 27 November, 18:30 – 20:00

Poster put-up

Please ensure you put up your poster before 13:15 on Wednesday 27 November.

Poster Index & Abstracts

index sorted by presenting author's last name

ID	Presenting author		Title
1	Robert	Brackley	The potential effects of small-scale, low-head hydropower schemes upon migrating salmonids
2	Simon	Evans	Upland salmon restoration in Wales
3	Heikki	Hirvonen	Reduced genetic variability impairs but environmental enrichment promotes brain development and consequent foraging performance on natural prey in salmon reared for conservation
4	Hannele	Honkanen	Modelling the early life stages of Atlantic salmon to improve conservation limit estimations.
5	Luke	Murphy	The effects of cormorant predation on Atlantic salmon smolts in Northern Ireland
6	Matthew	Newton	The impacts of riverine barriers on the freshwater migration of Atlantic Salmon
7	Rebecca	Stringwell	Phenotypic shifts in juvenile Atlantic salmon following stocking

Poster ID - 1

The potential effects of small-scale, low-head hydropower schemes upon migrating salmonids

Robert Brackley ^{1 *}, Colin Bean ², Rhian Thomas ¹

¹ *University of Glasgow*, ² *Scottish Natural Heritage*, * r.brackley.1@research.gla.ac.uk

The number of small-scale hydropower schemes is rapidly increasing in the UK. The current study investigates the potential for disruption to the upstream spawning migration of adult Atlantic salmon and sea trout by such schemes. The movements of migrants will be related to scheme layout and hydrodynamics. Preliminary results are presented, and further work on the potential impacts on downstream migrating salmonid kelts and smolts is discussed.

This work is funded in IBIS through the EU INTERREG IVA Programme managed by the SEUPB.

Poster ID – 2

Upland salmon restoration in Wales

Simon Evans ¹ *, Sophie Gott ², Stephen Marsh-Smith ¹, Peter Gough ²

¹ *Wye and Usk Foundation. Unit 4 Talgarth Business Park, Trefecca Road, Talgarth, Brecon, LD3 0PQ,* ² *Natural Resources Wales (UK),* * *simon@wyeuskfoundation.org*

The Irfon Special Area of Conservation project (ISAC) is a LIFE + funded partnership between the Wye and Usk Foundation, Natural Resources Wales, The Rivers Trust and The National Museum of Wales. The project is the latest in a 15 year sequence of projects conducted by the WUF which is working to systematically to recover the Wye and Usk on a catchment scale.

The Irfon is a 327km² high energy spate river system that drains a lowly populated region within Powys in mid Wales and is an important tributary of the Wye. The poster details the results and methods employed of a successful four year LIFE+ Nature project that has corrected acid water problems, naturalised flows and completed 32km of habitat restoration. Courtesy of a comprehensive monitoring programme there is statistically valid evidence of spatial and temporal improvements (and resultant substantial increases in salmon population) which will ensure not only that this SAC feature is now in favourable condition but also that when the 10 water bodies within the Irfon sub-catchment are next assessed they will all be in Good Ecological Status.

We hope that the results of the project will be an inspiration for other river managers to instigate similar works.

Riverine SACs are by nature different to other SACs as they are a function of a much larger catchment. This poster shows how the problems in river SACs can be addressed successfully by taking in the whole catchment and explains how LIFE+ have recognised this and funded this ground breaking project.

Poster ID – 3**Reduced genetic variability impairs but environmental enrichment promotes brain development and consequent foraging performance on natural prey in salmon reared for conservation**Heikki Hirvonen¹ *¹ University of Helsinki, * heikki.hirvonen@helsinki.fi

Fish and other animals artificially bred for restoration of depleted wild populations have low post-release survival due to maladaptive behaviours including impaired ability to forage on natural prey. Foraging behaviour has an inherited component and is modified through learning which is linked to brain size and structure. Still, the underlying mechanisms contributing to inferior post-release ability to forage on natural prey in captive-bred fish are largely unknown. We examined, if post-release foraging performance on natural prey by Atlantic salmon fry from two endangered populations is dependent on total size of the brain and parts of the brain. These were compared between offspring of wild and captive salmon (reduced genetic variability). Both groups were either reared in standard or environmentally enriched (shelter, varying water current, depth and direction and food dispersion) tanks at production-scale densities. In the River Simojoki population, the slope of increase in total brain volume with increasing body size was significantly steeper in the wild-parented than in the captive-parented salmon. Both wild parentage and environmental enrichment significantly and additively contributed to increased relative cerebellum size. Thus, relative cerebellum volume was largest in wild-parented salmon reared in enriched environment, and smallest in captive-parented standard-reared salmon. Most interestingly, salmon foraging performance on natural prey improved significantly with increasing cerebellum volume when tested after release to stream environment. In naïve 1st summer fry from the River Tornionjoki population, both wild parentage and enriched rearing environment significantly promoted foraging performance on natural prey. More importantly, fry with larger brains showed higher foraging capacity on natural prey. These novel results from two independent populations confirm that using wild parents together with environmental enrichment and realistic density in producing animals for restoration could improve foraging performance via better brain development, and consequently increase post-release viability.

Poster ID – 4**Modelling the early life stages of Atlantic salmon to improve conservation limit estimations.**

Hannele Honkanen ¹ *

¹ *University of Glasgow, * h.honkanen.1@research.gla.ac.uk*

Knowledge of the species biology and habitat requirements can be linked with habitat data to create a model that predicts the distribution of that species. As salmonids have fairly strict habitat requirements, this can be used to estimate the relationship between the stream habitat and salmonid abundance. The salmonid populations in the Foyle and Carlingford catchments in the border region of Ireland and Northern Ireland are monitored by the Loughs Agency who use a model to estimate the number of Atlantic salmon (*Salmo salar*) in the rivers. The model includes collected information on redd counts, electrofishing data on juveniles, fish counters and habitat surveys, and is used to estimate river-specific conservation limits and management targets which form the basis of the fishery management in the area. This project focuses on the habitat parameter of that model, aiming to study the relationship between habitat and juvenile salmon abundance and establish which particular variables (and their potential interactions) are important in creating an optimal juvenile habitat. Additional aims include studying the accuracy of the current Loughs Agency habitat grading system, creating a revised habitat grading system if required and studying the role of suboptimal habitat for salmon productivity. Electrofishing and habitat surveys were conducted on 72 sites in three catchments (Roe, Camowen, Faughan) in Northern Ireland.

This work is funded in IBIS through the EU INTERREG IVA Programme managed by the SEUPB.

Poster ID – 5

The effects of cormorant predation on Atlantic salmon smolts in Northern Ireland.

Luke Murphy ¹ *

¹ *Queen's University Belfast, * lmurphy50@qub.ac.uk*

Cormorant predation on freshwater fish has always been a contentious issue. Many Fishery owners are experiencing an increase in cormorant numbers as they move further inland to hunt. To quantify the level of predation that is being experienced particularly during the salmon smolt run a combination of three methods are being used. Gut content analysis is at present being carried out on birds obtained from legal culls. This will determine the percentage of the diet that is made up of smolts per bird. This will be aligned with visual surveys to estimate population numbers and therefore together will give an overall picture of predation levels. Further studies starting this year will involve tracking the birds to determine whether they are migrating to certain areas to coincide with the smolt run. The practical outcomes for this research may lead to better management of the cormorant population and may define a particular season when culling should take place.

This work is funded in IBIS through the EU INTERREG IVA Programme managed by the SEUPB.

Poster ID – 6**The impacts of riverine barriers on the freshwater migration of Atlantic Salmon.**Matthew Newton ¹ *¹ *University of Glasgow, * m.newton.1@research.gla.ac.uk*

Migrating fish encounter many obstacles during their migratory cycle, one of which, and possibly the most important, is the fragmentation of the river corridor by various riverine structures. In-river structures, both natural and artificial such as; fords, dams, weirs, culverts, rapids and waterfalls can have major impacts on fish communities when they prevent free movement along the riverine corridor. Connectivity is important, if not essential within all ecosystems for a variety of reasons; gene pool maintenance, recolonisation post disturbance and population recruitment. Ecosystem functioning is also highly reliant upon longitudinal connectivity, for example, upstream salmon migration periodically transports nutrients from the ocean to the headwaters where salmonid carcasses fertilise streambeds. Complete barriers limit habitat availability, reducing distribution of populations leaving them vulnerable to isolation and extinction. Temporary or partial barriers may prevent the movement of a proportion of the population due to individual variability of swimming capabilities. Therefore both temporary impediments, partial and complete barriers increase mortality and decrease egg production.

The European Union Water Framework Directive (WFD) requires that Member states achieve 'Good ecological status of water bodies which have been heavily modified, by 2015.' One of the key requirements for the directive is the need for unimpeded fish migration, emphasizing the need to mitigate the ability of fish to migrate up and downstream unconstrained. To meet minimum requirements for the WFD the river or water course must be in a state where there is connectivity between all river zones from estuary to source in both upstream and downstream directions.

The hypothesis that delay at river barriers influences individual fitness remains unanswered. By determining how migration behaviour below river barriers relates to the overall fate of an individual is imperative to understanding how widespread and how cumulative these effects maybe on the ecology of adult anadromous fish. In order to provide successful management tools to aid in the migration of Atlantic salmon there is a clear requirement for mechanistic understanding of how initial traits, condition, behaviour and environmental conditions interact and ultimately determine migration success and reproductive ability. The possibility of telemetry studies following biopsied fish is simple, with the insight into links between fate and physiology being invaluable.

The complexity of migration along with its role in conservation and management means simply documenting migration movements is highly insufficient. By using an interdisciplinary approach, combining telemetry positioning with other disciplines such as physiology and genomics it is possible to test hypothesis for failure rather than observe behaviour.

This work is funded in IBIS through the EU INTERREG IVA Programme managed by the SEUPB.

Poster ID - 7**Phenotypic shifts in juvenile Atlantic salmon following stocking**

Rebecca Stringwell ¹ *, Alexandra Lock ¹, Charles Stutchbury ¹, John Taylor ², Peter Gough ² & Carlos Garcia de Leaniz ¹

¹ Swansea University, BioSciences (UK), ² Natural Resources Wales (UK), * 393651@swansea.ac.uk

Stocking hatchery-reared fish into the wild is a common practice in many salmon conservation projects. However the phenotype of hatchery-reared salmon can diverge greatly in captivity, and this may affect post-release survival. The question remains about how long it takes for hatchery fish to adapt to the natural environment and for how long hatchery traits persist in the wild. Answers to these questions are essential for improving the survival of stocked fish and these are addressed in this study. Changes in body shape, fluctuating asymmetry (FA), $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ stable isotopic signatures (SIS), and C:N ratios were compared among Atlantic salmon *Salmo salar* fry kept as controls in captivity and those released and subsequently recaptured in the wild. Fry recaptured in the wild displayed significantly lower growth rates, lower SIS, lower C:N ratios and a lower incidence of asymmetric individuals than fish kept in captivity. Significant differences in body shape were also apparent, and fish recaptured in the wild became more streamlined over time compared to hatchery conspecifics, though no differences in size-adjusted pectoral fin lengths were detected. Our results indicate that hatchery-reared Atlantic salmon undergo significant phenotypic shifts in the wild as early as three weeks following stocking, most likely as a result of phenotypic plasticity and non-random, selective mortality of maladapted phenotypes. These findings should be of benefit to salmon stocking programmes because they suggest that naturalised rearing systems that produce fish with more natural-looking phenotypes should increase survival.

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towards MPhil / MRes / Master by Research

M 01	1a: The use of the River Invertebrate Classification Tool (RICT) in the Foyle and Carlingford Catchments, its application in management and the link between biotic index scores and fish density grades. 1b: The porosity of river barriers and the cumulative impediment to the migration of Atlantic Salmon in the Foyle River catchment.
M 02	2a: The impact of predation on the Atlantic Salmon (<i>Salmo salar</i>) and Brown Trout (<i>Salmo trutta</i>) stocks of the Lough Foyle catchment – a bioenergetics modelling application. 2b: The use of non-invasive sampling methods for the detection of <i>Anguillicola crassus</i> , a swimbladder parasite of the European Eel (<i>Anguilla anguilla</i>), and an investigation into the morphological changes associated with swimbladder infection.
M 03	Factors influencing fecundity in the European Eel, <i>Anguilla anguilla</i>
M 04	Operating costs in the Lough Foyle oyster fishery.
M 05	The importance of size–fecundity relationships in the management of the European Lobster, <i>Homarus gammarus</i> .
M 06	Effect of infection with the swim bladder parasite, <i>Anguillicola crassus</i> , on lipid content of European eel, <i>Anguilla anguilla</i>
M 07	Aquaculture vs. other anthropogenic disturbances: the effects on water birds on Carlingford Lough.
M 08	8a: Conservations limits & Atlantic Salmon (<i>Salmo salar</i>). 8b: Methods for monitoring seabirds.
M 09	Interactions between shorebirds and aquaculture in Carlingford Lough.
M 10	Developing best practice for <i>O.edulis</i> fisheries production in Loch Ryan.
M 11	Developing best practices for <i>C.gigas</i> producers.
M 12	12a: Interactions between shellfish fisheries and wildfowl on Lough Foyle 12b: Assessment of cormorant predation on Atlantic salmon smolts on the Foyle catchment
M 13	Conservation ecology of the freshwater pearl mussel, <i>Margaritifera margaritifera</i> .
M 14	Phenotypic and genetic structuring in Brown trout populations.

M 15	Modelling the early life stages of Atlantic salmon to improve conservation limit estimations.
M 16	Piscivory in ferox trout.
M 17	Assessment of the impact of biocides on the American Signal Crayfish to aid eradication in Scotland.
M 18	Assessment of production grow out strategies for commercial development of European Perch (<i>Perca fluviatilis</i>)
M 19	Governance of the Marine Environment Around the Island of Ireland
M 20	Potential benefits and applications of thermal effluents in aquaculture
M 21	The marine acoustic environment and megafauna around the coast of the Inishowen Peninsula.
M 22	Impact assessment of anthropogenic mediated habitat alteration on the genetic structure of the Lough Derg brown trout population
M 23	Sympatric Phenotypic Polymorphism in the Brown Trout, <i>Salmo trutta</i> .
towards PhD	
P 01	The effect of in-stream barriers on the river migration of Atlantic salmon
P 02	The population dynamics and migration of the European eel
P 03	Life history strategies in the sea-trout <i>Salmo trutta</i>
P 04	The impacts of small scale hydropower schemes upon aquatic communities
P 05	The ecology underpinning conservation management of rare freshwater fishes
P 06	Developing science-based management strategies for improving yield of blue mussels, <i>Mytilus edulis</i> , in benthic cultivation
P 07	Developing science-based management strategies for environmental and commercial sustainability of native oysters, <i>Ostrea edulis</i>
P 08	Developing genomic tools for application in the management of exploited stocks of the European oyster, <i>Ostrea edulis</i>
P 09	Predicting impacts of near-future climate change on shellfish stock management
P 10	Impacts of the natural spread of non-native oysters and interactions with native oysters
P 11	Seabirds as monitors of shallow coastal habitats
P 12	The effects of Marine Protected Areas on animal populations, biodiversity and fisheries

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... The **Conference Dinner** at **8pm**

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- Sport
- Nightlife
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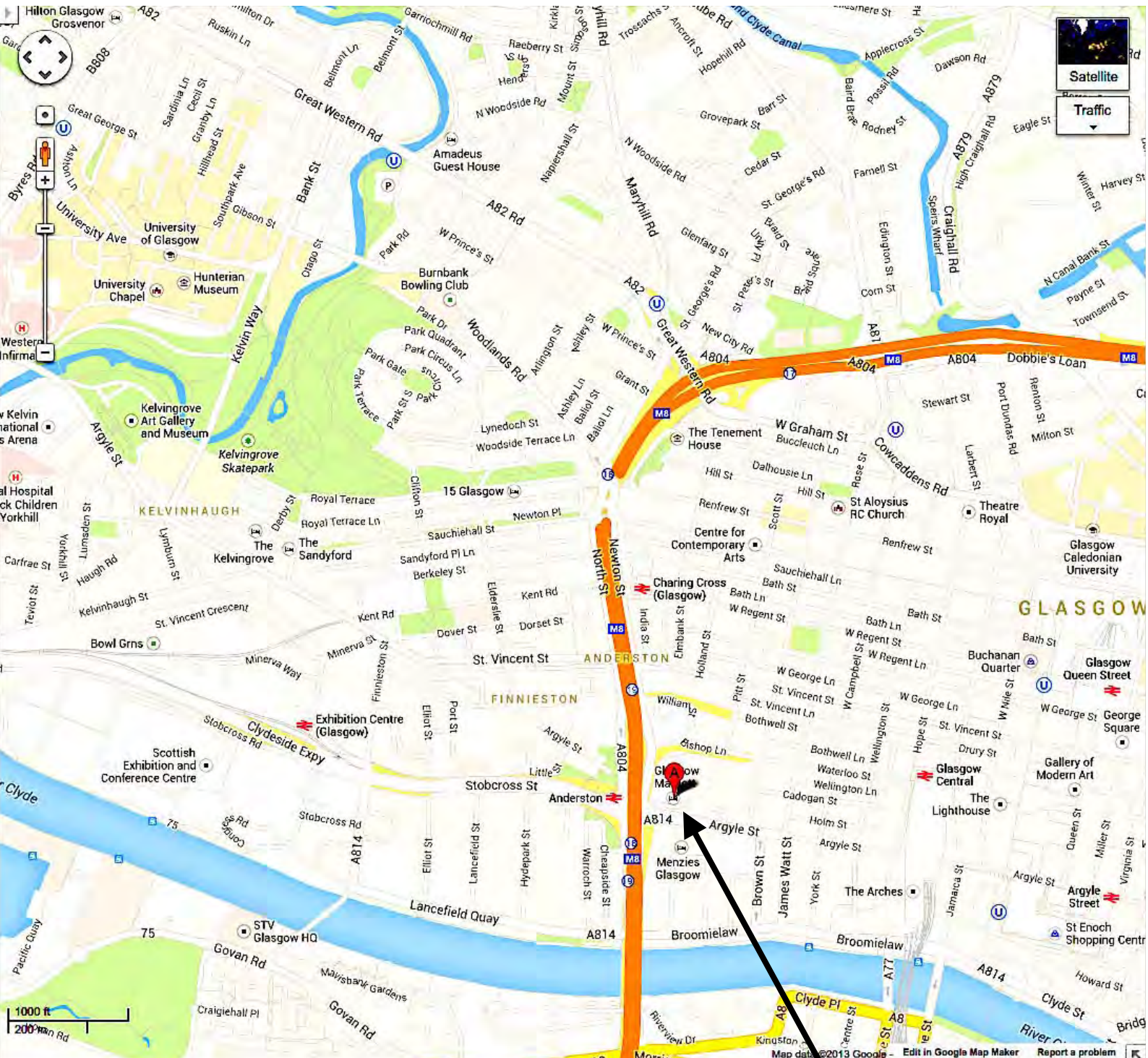
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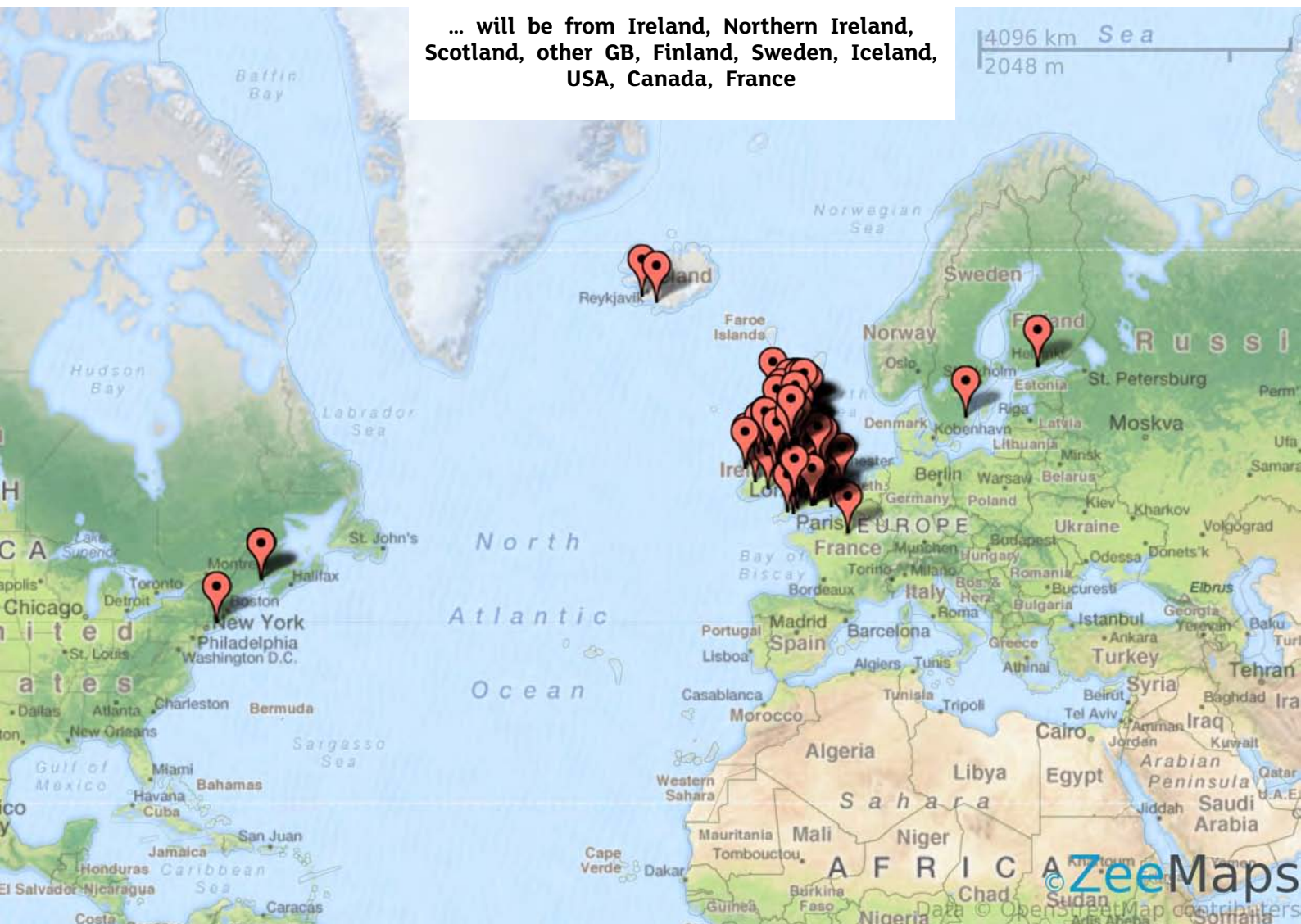
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