European Workshop for PhD and post-doctoral fellows on *Salmo salar* and *Salmo trutta* research

Southampton, England
March 18th – 22nd 2009

Sessions and detailed schedule

Wednesday 18 March

Committee meeting and arrivals

Time	Activity
17:00	Committee meeting (John, Morten, David, Pauliina, Kirsteen, Sam, Niamh)
18:30	Dinner: Key-note speakers and Committee members
20:00	Ice breaker at the Alexandra Pub (Everybody welcome! http://www.thealexpub.co.uk/ Click on website link for map)

Thursday 19 March

NoWPaS day 1; Excursion

Time	Activity
08:40	Meet at coach station Highfield Interchange, University of Southampton: New Forest river restoration talk and FBA East Stoke Centre tour
12:00	Lunch and back on the coach
14:00	FBA East Stoke Research Station tour, on the River Frome, finding rooms
17:00	**Invited speaker –** BRIAN SHIELDS: REGULATION AND MANAGEMENT OF SALMONID FISHERIES IN ENGLAND AND WALES
18:15	Dinner and ice breaker

Friday 20 March

NoWPaS day 2

Time	Activity
08:00	Breakfast
09:00	**Opening** – **Morten Stickler** – NoWPaS coordinator
09:10	**Invited speaker –** DAVID SEAR: SALMON AND DIRT: A GEOMORPHOLOGISTS PERSPECTIVE ON SALMON HABITAT
09:50	Break
9:55	**Session I – Habitat – Chair Morten Stickler** ➢ **Grethe Robertsen –** *Density-dependent dispersal in juvenile salmonids – a loser's outcome or a family matter?* ➢ **Nerijus Nika –** *Coincidence of timing of brown trout* Salmo trutta *L. fry emergence and spawning of lampreys* Lampetra *spp.: Could the lamprey affect emergence success of salmonids?* ➢ **Lucy Evans** – *Sediment-bound contaminants in the redds of salmonids and their potential impact on the early life stages*
10:40	Break – Refreshments
10:45	**Session I cont. – Habitat – Chair Morten Stickler** ➢ **Paolo Vezza** – *Physical habitat evaluation for small catchments in North-Western Italy* ➢ **David McCormick** – Experimental manipulation of instream macrophytes enhances local density of juvenile salmon ➢ **Donald Reid –** *Effects of density on the optimal metabolic rate for stream-living juvenile salmon*
11:30	Break
11:35	**Session II – Habitat and modeling – Chair John Conallin** ➢ **Markus Noack** – *Knowledge-based habitat modeling – simulation of habitat suitability of Atlantic salmon using fuzzy-logic* ➢ **Mélanie Brun** – *Modelling and decision making, for Atlantic salmon (*Salmo salar *L.) population management, a Bayesian approach* ➢ **Anders Andersson –** *CFD as a tool to improve fish migration in the river Vindelälven*
12:25	**Break**
13:05	**Lunch**
14:00	**Invited speaker –** THOM HARDY: INDIVIDUAL BASED MODELING OF SALMONIDS – THE ROLE OF BIOLOGICAL RESEARCH IN ADVANCING THE STATE-OF-THE-ART
14:40	Break – Refreshments
15:00	**Session III – Physiology – Chair Pauliina Louhi**

- **Jon Ellis** – *Understanding salmon at sea: genetic assignment testing and validation of a multilaboratory microsatellite database*
- **Nora Hanson –** *Intra-otolith stable isotope profiles: reconstructing temperature and metabolic histories of Atlantic salmon at sea*
- **Kirsteen McKenzie** – *The marine life of Atlantic salmon: evidence from the chemistry scale*

15:45 Break

15:50 **Session III cont. – Physiology – Chair: Pauliina Louhi**

- **Thomas Régnier** – *Energetic status, development and early behavior of brown trout fry (*Salmo trutta*): Study of maternal effects*
- **Christian Imholt –** *Does the magnitude of diurnal temperature variability affect growth in juvenile Atlantic salmon?*
- **Sarah-Louise Counter** – *The sustainability of Atlantic salmon (*Salmo salar *L.) in southwest England.*

16:40 **Poster session**

18:15 **Dinner**

21:00 **Social**

Saturday 21 March

NoWPaS day 3

Time	Activity
08:00	Breakfast
09:00	**Invited speaker –** KEN BOVEE: ENVIRONMENTAL FLOWS IN WATER MANAGEMENT DECISIONS
09:40	Break
09:45	**Session III cont– Physiology – Chair David McCormick** ➢ ***Tim Burton*** – *Stress hormone mediated maternal effects in brown trout (*Salmo trutta) ➢ **Alice Ramsay** – *Tracing the geographical origin of* Salmo trutta *L. using scale microchemistry*
10:30	Break – Refreshments
10:35	**Session IV . – Genetics – Chair Kirsteen MacKenzie** ➢ **Charles Perrier** – *Assessing the effects of stocking on Atlantic salmon populations using microsatellite DNA analyses of historical and contemporary samples* ➢ **Jens Wollebaek** – *Incomplete life history of stocked brown trout*
11:20	Break

11:25 **Session IV –Migration – Chair Sam Bateman**

- **Johnny Norrgård** – *Downstream migration of wild and hatchery-reared smolts of* Salmo salar *and* Salmo trutta *in the River Klarälven*
- **Torbjørn Green** – *Attraction channel as a salmonid guiding device*
- **Linnea Lans –** *Why are smolts migrating?*

12:10 Break

12:15 **Session V – Climate change – Chair Sam Bateman**

- **Cyril Piou** – *Salmon shall be hot in 2030, and so what? Developing an individual-based model of* Salmo salar *to assess population dynamics under scenarios of climate change*
- **Guillaume Bal** – *Bayesian statistical modelling for analyzing and predicting the evolution of small coastal streams water temperatures*
- **Alexandra Howe** – *The detrimental effect of recent ocean warming on wild Atlantic salmon*

13:00 **Lunch**

14:00 **Invited speaker –** CLIVE TRUEMAN: GEOCHEMICAL ECOLOGY – NEW TOOLS FOR STUDYING SALMON

14:40 Break – Refreshments

Session VI – Aquaculture – Chair Niamh Burke

- **Marleen Werkman** – *The contact structure of the Scottish aquaculture industry for the control of disease transmission*

15:00

- **Sean Monaghan** – *Development of DIVA (Differentiating Infected from Vaccinated Animals) vaccine for Atlantic salmon (*Salmo salar*) against ISA (Infectious Salmon Anaemia)*
- **Eric Leclercq** – *Management of sexual maturation in ongrowing Atlantic salmon* Salmo salar *L.: Development of farm tools*

15:30 Break

15:40 **Invited speaker –** MIKE DUNBAR (TITLE TBC)

16.20 Break

16.30 **Group discussions**

- Criticism of NoWPaS 2009
- Topics for next year's technical workshop
- www.nowpas.eu - Suggestions for further development of the web page

18:00 **Conference dinner**

Sunday 22 March

NoWPaS day 4

Time	Activity
08:00	Breakfast
09:00	Closing - The committee of 2009/2010. Presentation of group works (5 min each for group)
09:30	Departure for Southampton. Bus station and train station

Preface

NoWPaS ~ European (formerly Nordic) Workshop for PhD and post-doctoral fellows on anadromous *Salmo salar* and *Salmo trutta* research

During the last few decades research on *Salmo salar* L. and *Salmo trutta* L. has increased and will intensify in the future. Research conducted by PhD and post-doctoral fellows will play an important and central role in the advancement of our knowledge of these ecologically and socially important species. In order to maximize the research quality of these studies, NoWPaS, the European (formerly Nordic) Workshop for PhD and post-doctoral fellows on anadromous *Salmo salar* and *Salmo trutta* research, was established in 2005 with the aim of building an international network to promote collaboration and knowledge exchange The previous workshops have been held in Norway, Sweden, Finland and Denmark in 2005, 2006, 2007 and 2008 respectively. In total, 100 young researchers have given oral presentations combined with extended lectures by invited speakers to each workshop.

Previous keynote speakers have been Sigurd Einum (NTNU, Norway), Eva Thorstad (NINA, Norway), Tormod Skei (Statkraft, Norway), Neil Metcalfe (Glasgow University, Scotland), Torgny Bohlin (Gøteborg University, Sweden), Rick Cunjak (New Brunswick University, Canada), Ari Huusko (Finnish Game and Fisheries, Finland), Malcolm Elliott (Freshwater Biological Association, England), John Armstrong (Fisheries Research Services Freshwater Laboratory, Scotland), Michael M. Hansen (DTU, National Institute of Aquatic Resources, Denmark), Berton Lee Lamb (US Geological Survey, USA), and Jan Heggenes (Høgskolen I Bø, Norway).

The objectives of the network are twofold:

Firstly, we arrange an annual independent workshop where the participants can gather, exchange knowledge and ideas, and hold discussions in an interdisciplinary forum. Secondly, we invite key researchers to give lectures and short courses within the field. Through this framework, we intend this workshop to be beneficial to all delegates and therefore promote research. The delegates of this workshop are the future experts within this field of research. Consequently, it is very important that these young scientists establish connections with thoughts of future collaboration in mind within an international environment. As an overview, the workshops will have the following main objectives:

- Participating doctoral and post-doctoral students will present their research and results. In this way, they will have the opportunity to receive feedback on their own work, and to be informed of the work of fellow delegates as well as developments within the field.
- Senior scientists within the field will be invited to present talks on their work and highlight areas where future research is required.
- Presented material and the discussions will form the basis for a report which will be published and sent to all participants and members of the network.
- Present homepage (www.nowpas.eu) is to be improved so that publications and information on international conferences, workshops etc. can be easily accessed. This homepage will therefore act as an information centre.

Acknowledgements

NoWPaS-2009 has primarily been based on voluntary work. It is not possible to put words on the effort that a number of people have put into this network. Their contribution and quality of work have been tremendous and of vital importance. On behalf of the committee great thanks goes to first of all the participants and their contributions which make the basis for this network; without them this would of course not be possible. Further, thanks go to key-note speakers for their oral presentations, and for giving up their time to participate and interact with the network: Brian Shields (Environment Agency, England & Wales), David Sear (University of Southampton, England), Larry Greenberg (Karlstad University, Sweden), Thom Hardy (Utah State University, USA), Ken Bovee (USGS, USA) and Clive Trueman (University of Southampton, England). And finally, our investors that have contributed greatly and that believe in the work we are doing: Roskilde University, ENSPAC, Denmark, Villaksprogrammet (The Norwegian Research Council, Norway), Statkraft Energy AS and Statkraft Development AS (Norway), The Norwegian Directorate of Nature (Norway), The University of Science and Technology (Norway), Karlstad University (Sweden), SINTEF Energy Research AS (Norway), The University of Jyväskylä (Finland), NNCOLD (Norway), Elforsk (Sweden), and The Nordic Marine Academy (NMA, NordForsk), The Atlantic Salmon Trust, and Wessex Salmon and Rivers Trust.

NoWPaS as an organisation recognises the importance not only of our scientific obligations to the scientific community, but also our moral obligations to society. As many of our members travel large distances to the workshops and the resources consumed during the workshops, we realise our commitment to keep our environmental impact to a minimum. This is the reason why NoWPaS supports an organisation dedicated to preserving rainforests. The organisation is called Rainforest Rescue www.rainforestrescue.org.au. To date NoWPaS has preserved 10 hectares of Ecuadorian cloud forest, a biodiversity hotspot and an important carbon sink. This allows NoWPaS to operate as a completely carbon neutral organisation and we will continue to support Rainforest rescue to remain carbon neutral

Thank you!

The organizing committee of NoWPaS-2009 has consisted of following people:

- John Conallin, Denmark, President
- Morten Stickler, Norway, Coordinator/finance
- Dave McCormick, Ireland, Web Administrator
- Pauliina Louhi, Finland
- Sam Bateman, England
- Niamh Burke, England
- Kirsteen MacKenzie, England

Morten Stickler and John Conallin

March 2009.

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DENSITY-DEPENDENT DISPERSAL IN JUVENILE SALMONIDS - A LOSER'S OUTCOME OR A FAMILY MATTER?

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Key words: Brown trout, density-dependent dispersal, family-groups, growth rate.

Abstract:
Dispersal of stream-dwelling juvenile salmonids has often been considered an effect of competition for territories, with less fit individuals being forced to disperse. However, in addition to cost (increased predation) there might be benefits (potentially decreased conspecific competition) associated with dispersing. Depending on local environmental factors and an individual's phenotype, dispersing could be a beneficial behaviour. In this study we investigate if dispersal probability of juveniles varies between families, and whether this is linked to variation in family growth rates and body size. Brown trout juveniles (0+) from nine captivity-reared full-sib families were stocked at high and low densities in two artificial streams (110 m long, with fish-traps at the outlets) with equal proportions from each family. After stocking, a high proportion of the fish dispersed (i.e. were caught in the fish-traps) within the first four days. There was a second dispersal wave between 12-18 days. Interestingly, the same dispersal pattern was observed in both rivers.
We found large variation in dispersal probabilities between families. Even though the level of competition, given by the different stocking densities, influenced the overall probability of dispersal within the first period, the proportion of each family dispersing was consistent between rivers. The family dispersion probabilities were also correlated in the second wave. However, the families had different dispersal probabilities in the two periods. The variation in dispersal was not related to differences in body size or to family growth rate (measured in parallel tank experiments). Based on these results we conclude that 1) there is a family component in dispersal probability in juvenile brown trout, and 2) dispersion need not be induced by competition as there were relatively high rates of dispersal regardless of local density.

COINCIDENCE OF TIMING OF BROWN TROUT *SALMO TRUTTA* L. FRY EMERGENCE AND SPAWNING OF LAMPREYS *LAMPETRA* SPP.: COULD THE LAMPREY EFFECT EMERGENCE SUCCESS OF SALMONIDS?

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Key words: brown trout, fry emergence, alevin, lamprey, spawning site.

Abstract:
The emergence from the native nest gravel is one of the crucial life moments for young salmonids. In the middle latitudes the fry of brown trout *Salmo trutta* L. emerge from the gravel in the mid spring, as well as the lampreys spawn. We hypothesized that the timing and places of these two processes could coincide together and there could be an effect of lamprey spawners on emerging brown trout fry. The research was conducted in small lowland stream Blendziava (western Lithuania), where intensive brown trout and lamprey spawning are observed. The emergence period of brown trout fry were observed by catching emerging fry from 14 natural spawning redds capped with traps. The spawning places and timing of brook lampreys and river lampreys were registered too. Our hypothesis was supported by research results; the peak of trout fry emergence and lamprey (*Lampetra fluviatilis* and *L. planeri*) spawning highly coincides. The spawning sites of trout and lampreys at the microhabitat scale also were strongly overlapped. In the downstream reaches where the spawning activity of river lampreys were the highest, up to 90 % of the brown trout nests were partly or fully overdigged by spawning lampreys. One of the main requirements for lamprey spawning sites is proper streambed angle against the flow. Brown trout also select these sites for spawning; moreover the structure of spawning nest of brown trout itself creates the suitable bed gradient for lamprey spawning. This makes redds of salmonids to be highly susceptible to overdigging by lamprey spawners. There will be discussed the possible effect of lamprey digging activities during their spawning on the emerging brown trout fry.

SEDIMENT-BOUND CONTAMINANTS IN THE REDDS OF SALMONIDS AND THEIR POTENTIAL IMPACT ON THE EARLY LIFE STAGES

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Key words: salmonids, sediment-bound, pollutants, redds, survival

Abstract:
Few studies have examined the effects of sediment-bound contaminants on salmonid embryonic survival and development. The present study measured levels of sediment-bound contaminants from five natural spawning grounds in three chalk rivers; the rivers Nadder, Wylye and Avon. Artificial redds consisting of a hyporheic sampler and sediment infiltration basket were created in close proximity to natural redds at each field site. Netlon® egg boxes were also implanted into the artificial redds during the natural spawning season, so that *in situ* survival could be observed. Egg boxes were removed at set time intervals until alevin emergence. Mortality rates differed markedly between the sites. The weight and diameter of the eggs showed a significant difference between the River Nadder and River Wylye sites ($P<0.001$ and $P=0.013$ respectively). Also, a significant difference between the same sites was found in the egg weights when sampled 7 days later ($P=0.001$). The levels which were measured in the rivers were replicated in the laboratory for both water and sediment exposure experiments to assess the survival and development of salmonids at environmental levels of contamination. There were no significant differences for the water exposure trial. However, there were some significant differences between the treatments for the sediment exposure trial at d47PF and d68PF. Further analysis at a molecular level of the emerged fry (d134PF) showed a significant difference in the DNA damage between the fry exposed to contaminated sediment and the controls ($P=0.001$). Data shows that sediment-bound contaminants can influence the survival and development of salmonids at different life stages. Funded by DEFRA.

PHYSICAL HABITAT EVALUATION FOR SMALL CATCHMENTS IN NORTH-WESTERN ITALY

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Key words: Environmental flows, habitat evaluation, small catchments

Abstract:
In the context of regional-scale water planning, instream habitat assessment provides adequate information for environmental flow requirements. In this study the problem is faced for small catchments (smaller than 50 km2) in North-western Italy in order to evaluate the ecological discharge which will have to be released from existing and new water abstractions. As a reference for low flows regime we analysed the q95 discharge (i.e., the specific discharge that is exceeded on 95% of all the time) performing an hydrological regionalization of low flows characteristics. Using the regional regression approach, we divided the study domain into homogeneous sub-regions extending to ungauged small catchments the available regional streamflow information. The evaluation of the ecological discharge necessarily needs to relate low flows to the total habitat area available for organisms. Especially for small rivers, changes in morphology caused by low flows period affect the distribution and abundance of stream biota. In our work we have chosen 35 little catchments within our study domain in order to build up the habitat-flow relationship and estimate the environmental quality of small rivers. In these basins Brown Trout, Marble Trout (*Salmo trutta* and *Salmo trutta marmoratus*) and reophilic cyprinids at different life stage, are the most common target species chosen in the analysis. The fish habitat model is obtained from the observation of habitat use by a selected organism described with a relationship between habitat characteristics and fish presence at the same river segment. Our on-going activities consist in comparing two different habitat models: the Physical Habitat Simulation Model (PHABSIM) using microscale suitability curves and a mesoscale simulation model (MesoHABSIM) with a multivariate habitat suitability criteria. Nowadays we are estimating flow-habitat rating curves for steeper rivers where the high variability of stream geometry and flow dynamics can cause inaccuracies in the habitat model definition.

EXPERIMENTAL MANIPULATION OF INSTREAM MACROPHYTES ENHANCES LOCAL DENSITY OF JUVENILE SALMON

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Key words: Atlantic salmon, habitat, stream management

Abstract:
Riverine salmonid populations are affected by a number of different factors, including instream physical and chemical habitat, inter- and intra- specific competition and the nature of riparian vegetation. While it is known that dense riparian canopy can reduce the growth and abudance of epilithic algae, higher plants and their invertebrate consumers in a stream, little is known about the complex interactions between riparian shade, instream plants such as Ranunculus, and salmonid ecology. Surveys carried out on seven rivers in 2007 demonstrated a positive effect of instream macrophytes on the density and foraging success of young-of-year salmon. A manipulation experiment was carried out the following year on a single length of river, using a modified Before-After-Control-Impact (BACI) design. An artificial macrophyte analogue was added to a 30m stretch of river under moderate to heavy riparian canopy and fish density was estimated before and after the manipulation in the treatment and multiple control stretches using single-pass electrofishing. A reciprocal manipulation was carried out simultaneously, with all of the instream macrophytes removed from a stretch with open riparian canopy. Despite the decline in density in all stretches over the summer, our results show a large relative increase in local young-of-year salmon density following the addition of macrophytes, and a large decrease following their removal. The management of riparian canopy along nursery streams therefore has the potential to highly impact the survival of Atlantic salmon juveniles during their first summer.

EFFECTS OF DENSITY ON THE OPTIMAL METABOLIC RATE FOR STREAM-LIVING JUVENILE SALMON

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Key words: Atlantic salmon, SMR, density, growth, dominance

Abstract:
Physiological traits can vary greatly within a species and consequently have great impact on other aspects of performance. Atlantic salmon (*Salmo salar*) exhibit striking variation in standard metabolic rate (SMR) which has been seen to influence their life-histories. The effect of variation in SMR under different natural population densities on the feeding and growth rate of 1+ Atlantic salmon was examined using an artificial stream at FRS Almondbank. SMR was strongly correlated with dominance rank, but no overall relationship existed between SMR and growth. While high SMR individuals tended to occupy the best feeding territories, growth rate within holders of good territories was negatively correlated with SMR, presumably due to high costs of metabolism. Of the subordinate individuals who attained a poorer feeding territory, lower SMR individuals exhibited highest growth. Higher densities led to increased aggression and competition, and decreased food capture and growth. There is a context dependent energy budget trade-off where the minimal SMR to achieve dominance over conspecifics (and hence acquisition of a good territory) is favoured. This minimal required SMR increases with population density.

KNOWLEDGE-BASED HABITAT MODELLING – SIMULATION OF HABITAT SUITABILITY OF ATLANTIC SALMON USING FUZZY-LOGIC

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Key words: physical habitat modelling, fuzzy-logic, CASiMiR, Atlantic salmon

Abstract:
Within the last few years, the term "Ecohydraulics" has been commonly used to describe the connection between the hydromorphologic conditions due to man-made modifications and those of the natural environment. Such a linkage represents the basis for physical habitat models, in which the biological requirements of aquatic organisms are linked with the prevailing environmental conditions. Habitat simulation usually aims at using assessment criteria such as the flow velocity, flow depth, and substrate.
This presentation is about the habitat simulation tool CASiMiR that contrary to other habitat models applies a knowledge-based simulation approach. Within this approach the habitat requirements are not described by exact preference functions because of their complexity and the fact that the combination of several habitat parameters is decisive in determining whether a habitat can be deemed "suitable" or "unsuitable". To interface biological knowledge in CASiMiR a set of expert-based fuzzy-rules are applied to define the coherence of selected parameters. Additionally fuzzy-sets are used to assign parameter class ranges, (e.g. "high" flow velocity or "medium" water depth) in close collaboration with the expert knowledge obtained from fish biologists. The implementation of the biological input data into the simulation process in CASiMiR is based on literature review, electro-fishing evaluations, and/or expert knowledge. As a result the predicted habitat quality can be analyzed for each cell of the computer model separately and illustrated as habitat maps or as integrated values over the observed reach.
This definition methodology works well when considering ecological issues due to the fact that ecological systems are highly interrelated and there responses to changing conditions cannot be adequately described through the use of exact functions, but can be fairly well estimated. The application of the multivariate fuzzy-logical approach at a study-site of the Upper Rhine investigating different definitions of habitat requirements for Atlantic salmon illustrates the feasibility and robustness of knowledge-based modelling in riverine habitat modelling.

MODELLING AND DECISION MAKING, FOR ATLANTIC SALMON (SALMO SALAR L.) POPULATION MANAGEMENT, A BAYESIAN APPROACH.

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Key words: Decision theory, bayesian hierarchical models, *Salmo salar* L., population dynamic models, State Space Model.

Abstract:
In a context of increasing scarcity of aquatic living resources, due mainly to human activities, concerns to preserve them are growing. Tools to predict population evolution, according to different scenarios of environment evolution and diverse management options are requested in order to advise the various stakeholders and managers in their choices. By combining Bayesian population dynamics modelling and Bayesian decision theory, my PhD project aims at improving methodology for decision making under uncertainty. Special consideration should be given to trade-offs between conflicting goals.

This work is applied to the case of the Atlantic salmon (*Salmo salar* L.) population of the River Nivelle (Southwest of France). This remarkable and threatened species is the focus of a conflict between fishery exploitation and conservation interests. The modelling of population renewal will be grounded on recent advances about Bayesian State Space Models which allow the implementation of a complex dynamic model, structured in space. But the PhD should tackle several challenging questions as well: How to model the exploitation and management processes? How to couple population dynamic model and management model? How to reflect and combine in a relevant way with mathematic objects (i.e. utilities functions) the somehow contradictory aims of the various stakeholders?

CFD AS A TOOL TO IMPROVE FISH MIGRATION IN THE RIVER VINDELÄLVEN

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Key words: CFD fish migration ladders

Abstract:
The development of hydro power in the northern parts of Sweden during the last two centuries had a massive influence on the aquatic life. Vindelälven is one of the few rivers which still have a natural production of salmon and sea trout. Stornorrfors power station is located about 10km downstream from where Vindelälven merges with Umeälven and is a massive obstacle for fish migrating upstream to find its natural spawning grounds in Vindelälven. Earlier studies show that only one third of the migrating fish make it past the power plant. One of the major issues is that the fish can't find the old river bed where the current fish ladder is located but are instead lured into a small bay where the outlet from the turbines is located and the flow is much higher. One possibility to increase the number of fish that successfully make it past the power plant is to construct a fish ladder inside the tunnel outlet area where a majority of the fish is passing. A computational fluid dynamics (CFD) model of the tunnel outlet area was created to evaluate this solution. The main purpose of the model is to investigate the flow field at different turbine discharges and later compare it with the movement of the fish. The numerical model can also be used to investigate the attraction water created by adding a fish ladder to the existing geometry and find an optimal location for it. It is of great interest to find how big the discharge from the ladder needs to be to create sufficient attraction water for different turbine discharges.

UNDERSTANDING SALMON AT SEA: GENETIC ASSIGNMENT TESTING AND VALIDATION OF A MULTI-LABORATORY MICROSATELLITE DATABASE.

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Key words: Salmon, microsatellites, genotyping error, genetic assignment.

Abstract:
Despite unprecedented management efforts to conserve Atlantic salmon, *Salmo salar*, many populations are in decline and some even face extinction. An important aspect of this decline is increased mortality at sea during marine migration. SALSEA-Merge is an EU-funded collaborative research programme aimed to further understanding of Atlantic salmon during the marine phase of the life-cycle. A key aspect involves using a population genetics approach to genetically assign salmon caught at sea to their river or region of origin. Accuracy and robustness of assignment is primarily dependent upon level of coverage of baseline populations against which fish sampled in the marine environment are compared. In Europe, Atlantic salmon range from northern Spain to northern Norway and the White Sea coast of Russia. To achieve full coverage of such a vast range of the species has necessitated collaboration between a large number of laboratories in different European countries, each laboratory typing salmon populations from the major rivers within a region. Inter-laboratory differences in microsatellite characterisation, for example due to different genotyping platforms and technologies, are well recognised and, accordingly, the final multi-laboratory baseline genetic data set will require thorough cross-laboratory calibration if it is to be fit for purpose. This calibration exercise for the SALSEA-Merge project is currently being carried out at the University of Exeter. This presentation will provide a background to the project, including details of validation of a microsatellite database generated by the 8+ laboratories. Sources of genotyping error in such studies will be discussed in a general context.

INTRA-OTOLITH STABLE ISOTOPE PROFILES: RECONSTRUCTING TEMPERATURE AND METABOLIC HISTORIES OF ATLANTIC SALMON AT SEA

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Key words: salmon, temperature, stable isotope, growth condition

Abstract:
Long term declines in Atlantic salmon abundance and growth condition have been linked to reductions in marine survivorship and rises in sea surface temperature anomalies in the Northeast Atlantic. Direct observations of marine migration and feeding preferences within the North Atlantic are difficult to achieve. However, the otoliths of Atlantic salmon have the potential to provide insight into environmental conditions experienced by the fish during this elusive stage. High resolution sub-sampling of $\delta^{18}O$ and $\delta^{13}C$ values of sagittal otoliths allows detailed reconstruction of thermal – and potentially metabolic – regimes experienced by maturing one sea-winter Atlantic salmon. This provides an avenue to address the hypothesis that fish returning to the north coast of Scotland in relatively poor condition (i.e. underweight) inhabit warmer waters during their marine residence than those returning in relatively good condition. Preliminary analyses indicate that both $\delta^{13}C$ and $\delta^{18}O$ otolith profiles reflect the transition from freshwater to marine residence, with the area of greatest change in values corresponding to a visual demarcation between translucent and opaque zones of the otolith. We found no significant relationship between the temperatures calculated for the portion of otolith growth representing marine residence and the growth condition of returning salmon, suggesting that thermal habitat is not a driver of the decline in growth condition. Similarly, $\delta^{13}C$ values were not different between fish. The implications of these results and future research directions are discussed.

The marine life of Atlantic salmon: evidence from the chemistry of scales.

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Key words: stable isotopes, marine, scales, archive

The wild Atlantic salmon has been in severe decline since the early 1970s. Most mortality is thought to occur in the marine stages of the life history, but the key reasons for this are unclear. The difficulty and expense of tracking and monitoring salmon at sea are often prohibitive, making indirect methods of study invaluable. Fish scales contain chemical records of diet and migration in both the collagen and apatite components, and, unlike commonly used tissues such as muscle or otoliths, can be obtained without sacrificing the fish. The isotopic composition of carbon and nitrogen in fish tissues can potentially provide information on the trophic level and nutritional status of the fish, and the state of primary production at feeding sites. We are using the isotopic composition of collagen in scales of Atlantic salmon from historical archives to investigate whether changes in ocean conditions correlate with periods of high or low marine mortality. Scale archives dating back decades, traditionally used for salmon ageing studies, exist around Europe, and may be used to analyse long-term changes in populations.

Here we present results from 2 contemporaneous, multi-decadal archives from English rivers. Both archives display large, systematic fluctuations in both C and N isotope composition, but the magnitude and timing of these fluctuations are not consistent between archives, indicating a complex, population-specific relationship between ocean productivity, migration and fish survival.

ENERGETIC STATUS, DEVELOPMENT AND EARLY BEHAVIOUR OF BROWN TROUT FRY (*SALMO TRUTTA*) : STUDY OF MATERNAL EFFECTS

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Key words: Metabolic rate, energetic status, *Salmo trutta*, emergence from gravel.

Abstract:
Energetic stores condition a number of traits linked to growth or reproduction, such as maternal investment, migration decision at the individual level. However, these stores are also linked to their rate of depletion i.e. metabolism which represents the costs of different function, as maintenance for a resting individual, synthetic processes for growth, feeding and activity. A growing body of literature, dealing with behavioural traits variability, tends to link them to physiological processes, including metabolism. For instance, metabolic rate has been linked to several personality traits such as aggressiveness and dominance in different species. So both energetic stores and metabolism, representing the Energetic status of an individual, appear of relevant interest for the understanding of life history-strategies. Yet emergence from gravel is thought to be one of the most critical phases for young salmonids due to high predation and starvation pressure combined with the acquisition of swimming behaviours and the acquisition of a feeding territory. Emergents have also to choose to reside on the emerging site or to disperse downstream. Until yolk depletion, the energetic status of an individual is only conditioned by maternal provisioning and the yolk absorption rate. Metabolic rate may be the missing link between energetic status and behavioural strategies at the onset of emergence.

To our knowledge, neither inter-individual variability of metabolic rate throughout embryonic and larval development nor the role of different metabolic rates on early behaviour has been investigated. The aim of this study is to compare the ontogeny of metabolic rate of different *Salmo trutta* families by means of flow through micro-respirometry. Routine metabolic rate (RMR) was monitored from fertilization to yolk sac resorption. Intra-family and also inter-family variations in RMR were investigated by means of Bayesian modelling in order to look for any maternal effect on metabolic rate ontogeny across embryonic development. The in fine purpose is to gather clues for the understanding of emergence patterns heading towards further researches.

DOES THE MAGNITUDE OF DIURNAL TEMPERATURE VARIABILITY AFFECT GROWTH IN JUVENILE ATLANTIC SALMON?

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Key words: Temperature, growth, condition

Abstract:
Growth and performance of juvenile Atlantic salmon have been shown to be sensitive to changes in water temperature; most dramatically this is evident in lethal and sub-lethal effects of extremely high temperatures. Most studies of the thermal performance of juvenile salmonids have typically assessed the effects of thermal regime using constant temperatures, whereas in reality stream temperatures can vary over much of the reported performance range (>7°C) over short (i.e. diurnal) temporal scales. This study focused on quantifying the effects of variation in thermal regimes on the performance of 1+ salmon. Experimental manipulation of water temperature was used to simulate (a) constant and (b) naturally varying thermal regimes with similar mean values. Data from 2 replicates of 4 treatments (2 thermal and 2 feeding regimes) with 125 fish per tank were collected over a 6 month period corresponding to the main spring and summer growth period. Fish growth and performance was assessed at fortnightly intervals. Small but significant differences in length were found, with the constant regime having larger fish under both feeding regimes. The research showed that more variable thermal regimes can cause a reduction in growth rates and ultimately fish performance.

THE SUSTAINABILITY OF ATLANTIC SALMON (*SALMO SALAR* L.) IN SOUTHWEST ENGLAND

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Key words: sustainability, salmon, population genetics, temporal stability, supportive breeding

Abstract:
Atlantic salmon populations in the southwest of England are thought to have suffered a decline. As such the research group I am a part of has been collaborating with Tamar Consulting to determine the current status of salmon in southwest rivers. In the past, detailed studies have been carried out on the river Tamar and the river Dart. In this study, the focus will be primarily on the Exe with a view to assessing the effectiveness and potential for supportive breeding and hatchery applications where necessary. As well as assessing sustainability from a biological, genetic and fisheries perspective, I also aim to assess social and economic factors. This study will feed into a detailed action plan to ensure the long-term maintenance of sustainable populations of Atlantic salmon in the river Exe, as well as providing a template that can be adapted for use in other salmon rivers. In addition, Atlantic salmon populations from a selection of major rivers in the South West for which we have time-series data, will be compared in order to gain an overview of if, how and why salmon populations are changing over time in this region.

STRESS HORMONE MEDIATED MATERNAL EFFECTS IN BROWN TROUT (*SALMO TRUTTA*)

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Key words: Intraspecific variation, Standard Metabolic Rate

Abstract:
Interspecific variation in Standard Metabolic Rate (SMR) is well known and SMR also varies intraspecifically. Within-family variation in SMR is common in salmonids where it has significant effects on performance, predicting dominance status, future growth and survival. Heritability estimates for SMR are low, suggesting that the intraspecific variation may be due to a non-genetic maternal effect. I hypothesise that the maternal pre-spawning environment may influence offspring SMR, specifically that maternal steroid hormones (stress hormones) 'programme' fry metabolism. I also propose that any fitness effects of variation in SMR will be evident under contrasting environmental conditions, since offspring fitness should depend upon an interaction between individual SMR and local environmental conditions. In my PhD I intend to adopt an experimental approach, in which either the quality of the pre-spawning maternal environment or egg steroid hormone concentrations are manipulated and any subsequent effects on offspring are recorded in different environmental conditions.

TRACING THE GEOGRAPHICAL ORIGIN OF *SALMO TRUTTA* L. USING SCALE MICROCHEMISTRY

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Keywords:

Abstract:
Understanding the origin and movements of salmonids in marine and freshwater environments is critical to the development of effective management strategies. In recent years, the chemical analysis of fish otoliths and scales, has proved a useful tool for tracing geographical locations inhabited by fish populations. Chemical elements in the aquatic environment exhibit spatial variation in both freshwater and marine habitats and are known to be incorporated into the structure of otoliths and scales. The present study aims to determine whether scale chemistry can be used to identify the origin of *Salmo trutta* L. to sites within a freshwater catchment in the U.K. Scale samples collected from tributaries of the Dee river system in North Wales were analysed by Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) to quantify a suite of element:Ca ratios. The elemental composition of the scales differed significantly between sites. Discriminant Function Analysis revealed a high percentage of *Salmo trutta* could be classified to their site of origin based the elemental composition of their scales. The results suggest this may be a useful technique for elucidating the natal origins and movements of *Salmo trutta* in a small freshwater system.

ASSESSING THE EFFECTS OF STOCKING ON ATLANTIC SALMON POPULATIONS USING MICROSATELLITE DNA ANALYSES OF HISTORICAL AND CONTEMPORARY SAMPLES

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Key words: *Salmo salar*, introgression, stocking, conservation

Abstract:
Supplementation of wild salmonids populations with hatchery-reared fish is a common practice. However, native and non-native fishes generally differ both genetically and ecologically, which could produce negative effects on wild populations. We studied the effect of stocking in four French Atlantic salmon populations located in the Bay of Mont Saint Michel in Normandy (Sienne, Sée, Sélune and Couesnon) by comparing microsatellite data from historical (1977 to 1987) and recent samples (2002 and 2003). We also included historical (1969 and 1984) and recent samples (2003 and 2005) from the two source populations used for stocking: the Aulne (Brittany) and Adour (Aquitania) rivers. A total of 605 Atlantic salmons were genotyped with 17 microsatellite markers. The analysis of historical samples revealed a high differentiation between the Normandy rivers and the source populations used for stocking (Fst values from 0.07 to 0.10). However, we found no differentiation among the four populations from Normandy. Using recent samples, we observed a lower differentiation between Normandy stocks and the two stocks used for supplementation. Assignation and admixture analyses revealed variable genetic introgression rates in managed populations (from 12 % to 60 %). We also analyzed the effects of population size, stock origin, and supplementation conditions on genetic introgression of managed populations.

INCOMPLETE LIFE HISTORY OF STOCKED BROWN TROUT

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Keywords: brown trout, supportive breeding, stocking, introgression

Abstract:
Introgression into natural salmonid populations from stocked conspecifics has been widely studied. The outcome varies from no effect even after decades of stocking, to population replacement after only a couple of generations. Supportive breeding is commonly performed as a precautionary approach to avoid non-native gene flow. However, limited knowledge and resources often result in use of an admixture of native populations as broodstock, following stocking of hybrid progeny. Potential introgression caused by stocking sympatric population hybrids is however not known. We investigated genetic structure of brown trout (*Salmo trutta*) in a regulated lake with three natural and environmentally contrasting tributaries used as spawning and rearing habitat, and where lake stocking of admixed local strains have been implemented for decades. Stocked trout have substantial post-release survival, reflecting a large potential for introgression and reduced inter-population genetic variation. Nevertheless, using 13 polymorphic microsatellite loci we found evidence for retained genetic structure across tributaries. Assignment and migration analyses also suggest high rates of straying among natural populations, and initial survival of natural born hybrids. Consequently, reared trout and wild born hybrids do not contribute to the gene pool despite high survival rates.

DOWNSTREAM MIGRATION OF WILD AND HATCHERY-REARED SMOLTS OF *SALMO SALAR* AND *SALMO TRUTTA* IN THE RIVER KLARÄLVEN

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Key words: *Salmo salar*, smolt, migration, fitness, aquaculture

Abstract:
The River Klarälven is the largest tributary to Lake Vänern, the third largest lake in Europe. The landlocked Atlantic salmon (*Salmo salar*) and migratory brown trout (*Salmo trutta*) found in Lake Vänern historically migrated at least as far as 410 km upstream (Lake Femunden in Norway) to spawn in Klarälven and its tributaries. During the 20th century nine dams were built in the Swedish part of the main river, and by the 1950's the majority of salmon and trout returning to the river were hatchery-reared. The hatchery stock is captured as it migrates upstream to Forshaga, the first migration barrier, from which most of the spawning adults are transported upstream of a series of eight dams and released so that they can spawn naturally. The return rates of hatchery-reared fish have declined sharply the past years. Interestingly, return rates of wild smolts appear to be more stable than do those of hatchery smolts. In recent years, both professional fishing and recreational catches of hatchery-reared trout and salmon have decreased in Lake Vänern, similar to the pattern observed in Lake Vättern and the Baltic Sea.

The main question addressed by my PhD is why returns of hatchery fish have declined. To address this question, I pose the following questions: (1) Are the migration patterns of hatchery-reared and wild smolt similar? (2) Do feeding conditions in the hatcheries, both in terms of food quantity and quality, affect smolt migration and return rates of hatchery fish.

ATTRACTION CHANNEL AS A SALMONID GUIDING DEVICE

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Key words: Fishway, Attraction water, Migration, Guiding device

Abstract:
When Atlantic salmon (*Salmo salar*) and sea trout (*Salmo trutta*) migrate upstream in rivers they encounter obstructions such as hydropower plants. To overcome such hinders different types of fishways have been developed. Although fishways works, migrating salmonids are attracted to higher flows from turbine tailrace, for example, postponing the migration. To make fish inlet of a fishway more attractive it has previously been suggested to utilize a U-shaped attraction channel that accelerates the attraction water, or any free stream, to guide the salmonids towards the inlet. The acceleration is generated by a bump at the downstream inlet. The attraction channel design has been evaluated in three field test and lab scale experiments. Field experiments show that fish make use of the attraction channel. In lab scale experiments the flow in and down stream the attraction channel have been examined. Results show a 38 % velocity increase of the attraction water compared to the surrounding velocity. Also it is shown that the attraction water is traceable as far down as 18 times the depth over the bump in the channel.

WHY ARE SMOLTS MIGRATING?

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Key words: Brown trout, Atlantic salmon, migration, Standard Metabolic Rate, behaviour

Abstract:
Due to the loss of spawning areas in regulated rivers, reared smolts are released every spring. In Klarälven it has been seen that the recapture rate of these salmonids has decreased during the last decade. One possible explanation could be that the reared smolts are much larger and have a higher condition factor compared to their wild counterparts. The effect of ration size on the smolts' ability to migrate was investigated by giving groups of salmonids a reduced food ration (15%). Their ability to migrate was compared with a control group given as much food as recommended by the fish-farming industry. The salmon (*Salmo salar*) fed reduced rations in 2007 migrated at a higher rate compared to the control group. This was not seen for salmon in 2006 and trout (Salmo trutta) in 2007. For both species the individuals in the treatment groups migrated faster; the difference was significant for salmon in 2006 and trout in 2007. It was also found that migrating trout had a higher standard metabolic rate than resident individuals. This was not seen for salmon. To further investigate the influence of individual behaviour on the decision to migrate a laboratory study was performed. The aggressiveness, boldness and dominant behaviour of individual salmonids was examined. Dominant fish had a higher standard metabolic rate than subdominants.

SALMON SHALL BE HOT IN 2030, AND SO WHAT? DEVELOPING AN INDIVIDUAL-BASED MODEL OF *SALMO SALAR* TO ASSESS POPULATION DYNAMICS UNDER SCENARIOS OF CLIMATE CHANGE

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Key words: *Salmo salar*, individual-based modelling, climate change, life history decisions

Abstract:
Anadromous fish species such as Atlantic salmon, *Salmo salar*, are supposed to be influenced by climate change both in their river life history phase and their ocean one. In the river phase, increase of temperatures should speed up life history decisions such as maturation and smoltification through enhanced growth conditions. However, in the southern limit of its biogeographical distribution, decrease in precipitations in summer and general increase in environmental variance might create periodic limiting conditions for the growth of juveniles in river. Smolt size, and thereby ocean survival, are dependent on these growth processes and life history decisions in river. Additionally, growth conditions at sea determine the decisions of individuals to return as grilse (1 sea winter) or latter. The grilse vs. multi sea winter ratio is of particular interest for fisheries. Mature male parr proportion of a population is a second important indicator to look at for population structure changes as it should impact on the size of the anadromous fraction of the population.

Within this context, the objective of this work is to develop a cohesive model structure based on individual decisions and heritability of characters to analyze the probable dynamics of *S. salar* population under scenarios of climate change in small rivers of France. In a first part, the model structure is described with the underlying hypothesis of behaviour and heritability of characters. The second part presents the method of parameterization and a typical population dynamic with the tuned model. Finally, some preliminary results of scenarios of temperature increase in a typical French salmon river are presented.

BAYESIAN STATISTICAL MODELLING FOR ANALYZING AND PREDICTING THE EVOLUTION OF SMALL COASTAL STREAMS WATER TEMPERATURES

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Key words: Bayesian analysis - Global Warming - Freshwater temperature - Projection - Atlantic salmon

Abstract:
Water temperature is a key factor that influences many other physical and chemical parameters as well as the biology of aquatic organisms like Atlantic salmon by controlling both their metabolism and growth. The research program GICC2 (*) seeks to address questions such as: In the context of global warming, could salmon populations adapt to climate change? To address this question, a proper analysis of water temperature time series is necessary. However these series are often short and/or incomplete. By contrast, time series of air temperature are more easily available and often of better quality. Moreover, they are often the only available output of models for global warming scenarios. Therefore, providing proper and robust statistical method to analyze times series of water temperature and to predict the evolution of these temperatures from other environmental variable such as air temperature and/or water flow is a key methodological issue.
In this study, we provide a Bayesian statistical modeling approach to analyze time series of water temperature on three French small coastal streams together with the correlation with time series of air temperature and water flow.
This approach is based on the decomposition of the time series in two components: a long term trend, represented by the evolution of the annual mean temperature, and a seasonal (sinus) component. Correlation analyses reveal that in spite of a very high positive correlation between air and water temperature at fine temporal scale (due to synchrony in the seasonal component), the correlation between the annual mean temperature is much weaker (for example, $R^2 = 0.219$, p-value =1.61x10-2). This result indicates that long term trends in air temperature are weak predictor of long term trends in water temperatures. Therefore, the prediction of small stream water temperatures under global warming scenario seems to be quite uncertain. By adding up water flow parameters in our model, we provide better estimations of water temperature.

THE DETRIMENTAL EFFECT OF RECENT OCEAN WARMING ON WILD ATLANTIC SALMON

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Key words: salmon, temperature, lipids, microsatellites, growth condition

Abstract:
A rise in sea temperature is generally accepted to be an ongoing global phenomenon, and with unexpectedly high temperatures seen in recent years in the North Atlantic, a trend which correlates with decreasing condition of returning salmon. These two problems have been shown to be correlated in studies considering the relationship between plankton (a salmon prey item) and sea temperatures: indicating that these thermal conditions may be important to salmon productivity as well. Salmon rely upon these food sources over winter, thus we would expect their nutrition to be compromised by planktonic declines. Lipids are an important indicator of this relationship as salmon must obtain many essential fatty acids through their diet alone. Once the salmon return to the rivers to spawn, they stop feeding. Thus these stores are an excellent indicator of not only reproductive ability, but the likelihood of a salmon surviving to reach the point of spawning. Genetically healthy *Salmo salar* populations are essential to achieve long term stability and sustainability of such a key economic species. The genetic diversity of salmon found in river populations is a key indicator of environmental variation affecting populations. The distinction of each river population as an evolutionarily significant unit increases the need to understand the workings of each salmon-housing river to maintain a satisfactory level of genetic variation. The ideas surrounding this work and future research are considered.

THE CONTACT STRUCTURE OF THE SCOTTISH AQUACULTURE INDUSTRY FOR THE CONTROL OF DISEASE TRANSMISSION

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Keywords: salmonids, network modelling, disease transmission, fish movement

Abstract:
Movement of live fish is a necessary activity within the aquaculture industry, but provides a route for spreading diseases between otherwise isolated sites. Network modelling is a powerful tool to assess the risk of transmission of disease between sites, taking into account all manner of heterogeneities amongst sites and their patterns of contact. Networks consist of nodes (representing sites), which are connected by edges (undirected links) or more appropriately for movements, arcs (directed links). The contact structure of the Scottish aquaculture is highly aggregated; certain nodes are highly connected by many edges or arcs. The objective for this PhD is to examine the contact structure between and within sites of the Scottish aquaculture industry in a network model. These models can help us to understand and predict the transmission of disease between and within sites. In addition, they can help us prevent or better control epidemics and evaluate disease control and surveillance strategies. Fish movements in Scotland are registered by Fisheries Research Services (Aberdeen): Source site, destination, movement date, species, number of animals and developmental stage are all recorded.
Epidemic diseases that affect salmonids will be classified based on their infectivity, pathogenicity, virulence and acuteness of symptoms. Creating a model based on the characteristics of diseases should give a more accurate (detailed) description of their transmission. In and out degree of nodes, path lengths and estimates of R0 (the basic reproduction number) can help to analyse and interpret the data.
The model will be evaluated and compared with real disease data. To judge if the model is valid, we see how model outputs respond to extreme changes in model inputs (sensitivity analysis). In addition, the model could be examined using cross validation.

DEVELOPMENT OF A DIVA (DIFFERENTIATING INFECTED FROM VACCINATED ANIMALS) VACCINE FOR ATLANTIC SALMON (*SALMO SALAR*) AGAINST ISA (INFECTIOUS SALMON ANAEMIA)

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Keywords: Atlantic salmon, DIVA vaccine, Infectious salmon anaemia, marker vaccine, *Salmo salar*

Abstract:
ISA (Infectious Salmon Anaemia) represents one of the most significant viral diseases threatening the Atlantic salmon industry today. The various routes of transmission make prevention difficult and subsequently ISA is now listed as a 'Class 1 Notifiable Disease'. It may be possible to implement a ring-fencing disease-control strategy in which infected animals would still be slaughtered but those in surrounding regions would be vaccinated to provide a biological barrier against transmission. This could be achieved with a marker vaccine.
The current PhD project aims to develop a marker vaccine for ISAV. The feasibility of adding suitable exogenous markers to conventional ISA vaccines will be compared to endogenous marker vaccine development. We aim to develop a sensitive specific diagnostic test that will indicate if fish serum contains antibodies specific to the marker and/or ISAV, thus indicating vaccine status. The ultimate goal of this project is to develop a DIVA vaccine against ISA and provide a quick diagnostic test that can be used in the field. The use of DIVA vaccines in the salmon industry could improve ISA disease surveillance and prevent mass culling.

MANAGEMENT OF SEXUAL MATURATION IN ONGROWING ATLANTIC SALMON *SALMO SALAR* L.: DEVELOPMENT OF FARM TOOLS

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Key words: sexual maturation, photo-manipulation, sexual size dimorphism, selective harvest

Abstract:
Atlantic salmon sexual maturation is nowadays greatly reduced in Scottish stocks. Nonetheless high maturation rates are still sporadically encountered and are in practice difficult to predict. This leads to occasional but economically significant emergency harvest and downgrading. The aim of this project was to investigate sexual size dimorphisms (SSD) with the view to develop an early maturation rate detection tool that can be used on site to manage stocks and harvest planning and to assess the efficiency of shortened light-windows and new lighting technology that could significantly reduce running costs.

A cross-sectional survey on harvest batches of four Scottish sea-sites under commercial management was performed to assess the prevalence of skin colour discrepancies, sexual recruitment and sexual size dimorphism (SSD). The power of morphological parameters to predict maturity status was assessed by discriminate analysis. The effect on maturation rate of shortened window of additional light and low-energy light technology was also assessed on a commercial scale.

Immature males had a significant AW advantage but lower K than immature females. This can lead to significant variations in pen sex-ratio due to weight-grading and in turn affect harvest quality. In the present study maturation related SSD modelled in one site in early summer could be successfully applied on other sites to predict their maturation rate. Prediction errors on site maturation rates were: +5.1%; -6.1%; -5.0%. This could be used as a non-invasive maturation detection strategy. An average of 35% of the population and 72% of the recruited individuals were over the discriminating AW modelled from discrete sites. Following detection, top-grading at this time could selectively harvest a high proportion of recruited individuals ahead of their deterioration. Biomass scanning could greatly facilitate stock morphological assessment in situ and, when applied to grading protocols, could improve selective harvest.
With respect to photoperiod management, present results showed no differences in maturity rate between any of the regimes tested suggesting that running costs could be significantly reduced by switching lights off earlier but also by using energy efficient light technology.

Taken, together, these results show potential improvements that can be made in the management of commercial salmon stocks to help make the industry more sustainable.

SPATIAL SCALE AND DEGREE OF SYNCHRONY IN BROWN TROUT (*SALMO TRUTTA*) POPULATION DYNAMICS

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Key words: Brown trout, synchrony, France, regulated and unregulated streams

Abstract:
Spatio-temporal variability in the physical conditions of streams are known to influence freshwater population dynamics. However, the complex relationship between these physical factors (mainly available habitat, water temperature, discharge, sediment transport) and the biological response is not yet clearly understood in either natural or regulated streams. In order to investigate this relationship, it is essential to understand how these physical factor influences differ in time and space.
In the present study, we analysed the spatio-temporal patterns of fluctuation of more than 30 Brown trout populations spread across France, in both natural and regulated (i.e. by-passed sections downstream of hydroelectric water intakes) sites. This data is a result of annual fish monitoring surveys carried out continuously over a minimum of 5 years. Using statistical methods, we estimated the degree of synchrony among Brown trout cohort densities (young-of-the-year, juveniles and adults), and we evaluated the scale at which synchrony is best identified. We also investigated whether synchrony patterns differ between natural and regulated sites. Results are then discussed according to fluctuations in local physical factors. This study demonstrates the utility of multi-site approaches for a better understanding of freshwater population dynamics. It is indeed of major importance to evaluate what the most structuring physical factors are at regional or local scales, in order to design consistent management schemes.

MODELLING AS A TOOL IN ASSESSING IN-STREAM REHABILITATION – SHOWY GUESSES OR A WINDOW TO THE FUTURE?

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Key words: salmon, restoration, habitat, model

Abstract:
This work combines habitat hydraulic modelling with monitoring data on fish populations before and after in-stream restoration. Monitoring of ecological changes using short term designs may seriously under- or overestimate the actual outcome of the restoration work. Physical habitat modelling may provide a tool to envision the potential of restored sites for the target species. We established a BACI (Before-After-Control-Impact) sampling scheme to assess in-stream restoration in the River Kiiminkijoki, Finland. Six reaches, three study sites each, were chosen to represent restored and natural stream condition. All areas were electrofished annually, three years before and three years after the restoration. For hydraulic modelling (by River2D), we collected data before and after the restoration from all six sites. At each site, geographically-referenced data were collected along 100 meters of river length. The WUA (Weighed Usable Area) output for each target species and life stage was then simulated over a range of stream flows. The data show that the modelled increases in WUA may be reflected as an increase in salmon populations only in the long term - if at all. Three years after the restoration no positive signs in salmon population densities were seen.

SALMONID ALEVIN EMERGENCE: DOES SEDIMENT LOADING INDUCE AN ONTOGENETIC NICHE SHIFT?

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Key words: emergence, survival, sediment loading, predation

Abstract:
One of the most intensive disturbances for developing salmonid embryos is increased mobilisation of fine sediments from stream catchments. Alevins remain in the gravel until their yolk sacs are nearly depleted, where after they move into open water to feed exogenously. In open water, alevins face intense predation pressures during the establishment of individual feeding territories. Therefore, the timing of the ontogenetic niche shift from gravel into open water has far-reaching consequences for the growth and survivorship of alevins.

We assessed whether alevin emergence into open water is affected by both sedimentation and chemical cues from a predator. The amount of fine sediment was manipulated (< 2.0 mm) in 24 laboratory channels containing fertilized eggs of brown trout (*Salmo trutta*). Chemical cues from a predator (*Lota lota*) were introduced into 12 of the channels a week prior to the expected date of emergence. Sediment loading and fish growth were monitored at three stages during the experiment: (i) when alevins had recently hatched, (ii) when alevins neared the yolk sac depletion inside the gravel and (iii) during the open water fry-phase.

Very fine sediment loading (<0.074 mm) reduced survival of fish. Fry receiving high sediment loading had larger yolk sacs at the time of emergence and displayed earlier emergence. Larger yolk sacs may increase vulnerability to predators due to poorer swimming ability. However, fry preferred to stay inside gravel longer, when predator odour was present. Therefore, immature emergence due to sedimentation may also be disadvantageous when facing competition for future territories.

ANCHOR ICE FORMATION AND HABITAT CHOICE OF ATLANTIC SALMON (*SALMO SALAR* L.) PARR IN STEEP STREAMS

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Key words: Salmo salar L., winter, dynamic ice formation, rivers

Abstract:
Recent studies report an overall decline in northern populations of Atlantic salmon. As the winter in northern streams can be a critical period for juvenile salmonids, the cold season needs further attention to preserve sustainable populations of the species. Until today, most field and experimental studies have focused on open water conditions (e.g. spring, summer, fall), and less on winter conditions with presence of ice. As river ice has profound impacts on the lotic environment, interdisciplinary studies in natural environments focusing on the linkage between different types of ice and behavioural responses by salmon parr are thus needed. In this PhD study, a multidisciplinary approach have been used focusing on (1) formation of anchor ice and its influence on the physical habitat in steep streams, and (2) habitat use by Atlantic salmon parr in anchor ice affected streams. Results demonstrate that anchor ice formation significantly alter the in-stream heterogeneity by changing riffles into pools on a short temporal scale, leading to a dynamic environment despite stable discharge. Findings suggest that anchor ice may be distinguished between two types according to its formation process: Type I: less dense and forming on top of the substrata. Type II: Dense and forming between the substrata, filling interstitial spaces. Observations of habitat use by Atlantic salmon parr in anchor ice affected streams imply that despite hydraulic (depth, velocity) changes caused by ice formation, parr seem unaffected, and hence question the importance of hydraulic features as single habitat factors. However, findings also imply that parr inhabit two different strategies related to anchor ice formation: First, parr affected by anchor ice Type I demonstrate no or small changes in habitat use, and second, parr affected by Type II experience habitat exclusion and/or entrapment and are forced to relocate into other suitable areas, preferable surface ice covered stream margins. Moreover, observations indicate that pool habitats can be less important winter refuges, whereas riffle habitats are largely utilized, dependent on the type of anchor ice. In view of these findings, the degree of substrata shelter may be the predominant factor in habitat selection of parr during winter. Finally, results indicate that winter may not necessarily result in negative growth, whereas in contrast, the spring ice break-up may lead to a decrease in body mass and hence imply a critical period for parr. The results may be of importance to cold environment freshwater fisheries management in which habitat evaluation and preservation are core objectives. Results may further be of importance in future development of cold water stream habitat modeling tools and in evaluation of thermal changes of natural and anthropogenic environments.

EFFECT OF BIOFOULING ON CAGE DEFORMATION AND FISH WELFARE

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Funding bodies: Ronald Miller foundation.
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Key words:

Abstract:
With the continued growth of the aquaculture sector, a finite coastal area and stringent environmental legislation concerning site selection, fish producer are seeking sites in more exposed locations with current speeds higher than that considered in the past.
It has been suggested that exposed sites are advantageous as they are normally associated with higher levels of water movement, which provide better dispersion of both particulate and dissolved wastes, while reducing the risk of deoxygenation within the cages.
However, water movement between and within cage systems is poorly understood. Cages in high water currents often deform which increases stocking density and fish stress levels, a problem often exacerbated by increased drag as a result of net biofouling.

Biofouling is a seasonal, site specific and extremely costly to manage. The initial component of the study will quantify biofouling communities and structures over varying spatial and temporal scales, using photographic stills of cage netting from underwater video footage collected using a remotely operated vehicle (ROV).
The photographs will be processed using imaging software, to discern the type and percentage fouling cover.

The second component concerns cage deformation, which has rarely been studied *in situ*. More frequently used scaled laboratory simulations, which map whole-net telemetry, are insufficient to simulate the full range of tidal and wind pressures.
This study will use pressure sensors mounted on cage net panels in the field under standard culture conditions to take geometric measurements throughout the tidal cycle
These measurements when converted to XYZ coordinates will allow cage deformation to be monitored under real, varying conditions.

Data from the net biofouling will be incorporated into a model factoring cage deformation and current velocity. Sites and cages can then be directly compared. Further development could see the tool being used to predict deformation at proposed cage sites.

The work outlined in this project is part of a wider investigation into the effect of deformation on fish welfare, whether through direct abrasion or as a result of deterioration in water quality.
Water quality parameters, productions statistics, fin condition and blood cortisol, will be recorded throughout the course of the study. Sites of different energy can then be compared using an index created from relating deformation to resultant welfare parameters.

ASSESSING DYNAMICS OF SEDIMENT ACCUMULATION IN SALMONID REDDS & THE RELATED FITNESS OF SALMON EMBRYOS IN THE RIVER LUGG

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Key words: alevin, survival, fitness, cohort, Lugg

Abstract:
The project looks at a number of sites on the rivers Lugg and Arrow with contrasting characteristics in terms of sediment input and intragravel DO levels and survival as found from a first field season undertaken from January to April 2008. The study will quantify Salmon egg survival to emergence in relation to sediment content, DO, ICP-MS and other characteristics of the pore water in the redds - such as groundwater influx.

After eyeing-stage, egg baskets from the river sites containing the pre-emergent alevin will be retrieved at ten-day intervals (up to emergence time) and brought to a nearby hatchery to finish their egg sac absorption.

As well as quantifying survival of the various cohorts (6 in total) in relation to hatchery control specimens and weight/length/yolk sac comparisons, tests for alevin 'fitness' will be carried out for sublethal effects on alevin brought from the river sites. These will involve such trials as swimming against a current and video observation of routine swimming.
Lab procedures on a preserved fraction of each cohort will be analysed for comparative developmental stage and biological stress state.

ORGANIC MATTER SOURCING AND SOD CHARACTERISTICS OF INFILTRATED SEDIMENT INPUTS TO SALMONID REDDS ON THE RIVER ITCHEN AND AFFECTS ON SALMONID EGG SURVIVAL

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Key words: sediment oxygen demand, sediment fingerprinting, fluorescence, absorbance, Itchen.

Abstract:
Following last years field campaign where 9 sites on the Itchen were characterised in terms of spawning habitat quality (DO, temp, sediment accumulation and intra-gravel flow), sites have been chosen this year to highlight areas of the river which are representative of Itchen spawning sites. This year sediment fingerprinting techniques will hopefully aim to source sediment throughout the catchment, with a view, specifically to characterising the organic matter content of infiltrated sediment within the redd environment, using UV/vis absorbance, fluorescence and DOC laboratory techniques. In addition to this, sediment oxygen demand (SOD) laboratory experiments will be run emulating field conditions on sediment found at these sites. This will help to quantify whether differing rates occur across the catchment and to potentially determine the extent to which these rates could impact on salmonid egg/embryo survival.

FISH TELEMETRY STUDIES – POST SPAWNING MIGRATION OF SALMON AND SEA TROUT IN LITHUANIAN RIVERS

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Key words: salmon and sea trout, post spawning migration, radio telemetry,

Abstract:
Study area – one of the longest Atlantic salmon and sea trout spawning migration route in Europe - more than 500 km migration way from spawning site (Siesartis river) to Baltic sea.
Data basis – 32 taged fishes, 7 automated radio tracking stations (Lotek).
Hypothesis: 1. Post spawning migration patterns (speed, migration activity, duration and etc.) are different for salmon and sea trout. Moreover it depends on fish size, age, sex, river hidrology, climatic conditions and etc. 2. One of the main negative impacts for post spawning salmonids (on the way back to the sea) is human activity. Initial data of radio telemetry revealed that salmon start post spawning migration almost at the same time when spawning ends. Salmon post spawning migration lasts significantly shorter than sea trout. Some of tagged sea trout stay in the spawning and/or receiving river for quite long term periods. Post spawning migration strongly depends on factors listed above (hypothesis 1). Fish telemetry studies in Lithuanian rivers revealed that the main negative factor limiting salmon and sea trout stocks - is anthropological impact. More than 35% of tagged fishes were caught during all post spawning migration.

REGULATION AND MANAGEMENT OF SALMONID FISHERIES IN ENGLAND AND WALES

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Key words: salmonid, fisheries, regulation, management

Abstract:
The regulation and management of fisheries in England and Wales is the responsibility of the Environment Agency. We enforce the Salmon and Freshwater Fisheries Act (SaFFA) and undertake fisheries management through our statutory duty to maintain, improve and develop fisheries. Our aims for fisheries in England and Wales are defined in our Strategies: Better Fisheries for Our Nations, and specifically for salmonids; National Trout & Grayling Fisheries Strategy and Better Sea Trout and Salmon Fisheries.
We monitor the health of populations through an extensive network of juvenile monitoring sites, a small number of adult salmonid monitoring facilities, and through rod and net fishery catch returns. For salmon in particular, we use a conservation limit based procedure to assess the health of populations and to guide our management actions to ensure favourable conservation status is achieved.
Our policies are very much guided by scientific evidence. An example of some of our recent research has been directed to the issue of the impacts of stocking of farmed brown trout on indigenous trout populations - the range of projects that will be presented in summary has lead us to change our current policy on trout stocking. Our future priorities for salmonid research and management include: impacts of Climate Change; genetic stock structuring of populations; reducing land management impacts and potential research into the fate of sea trout at sea.

SALMON AND DIRT: A GEOMORPHOLOGIST'S PERSPECTIVE ON SALMON HABITAT

Sear, David[(1)]

Keywords:

Abstract:
The physical template for habitat is created over time by the erosion of the landscape. The patterns created by this basic process create a patchwork of habitat and linkages that influence salmonids. At the continental scale, populations have been influenced by successive phases of ice advance and retreat, and the resulting structure influences spawning habitat quality via controls on upwelling groundwater. At the catchment scale, the action of dirt moving around the landscape, creates the pockets of different freshwater habitat that are required to sustain Atlantic salmon requirements. Taking a long term view, we can identify key differences between the habitats in which Atlantic salmon have adapted over the past 8000 years; with marked changes arising within the period of intensive human activity. Loss of wood, simplification of habitat and the disconnection of channels from floodplains it can be argued has created lower productivity in European rivers. Understanding the movement of dirt in the landscape, is vital of we are to stand any chance of delivering resilient habitats that will continue to support sustainable populations of salmon.

INDIVIDUAL BASED MODELING OF SALMONIDS – THE ROLE OF BIOLOGICAL RESEARCH IN ADVANCING THE STATE-OF-THE-ART

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Key words:

Abstract:
The Instream Flow Council, representing 50+ US States and Canadian Provinces, convened an instream flow symposium in 2008 with over 250 practitioners, researchers, and resource managers with a goal to define critical research needs. One main theme that emerged from this effort is that better ecology needs to be brought into the discipline of instream flow science. One area that is emerging as a critical focus at the international level is the development, validation, and application of individual based models of salmonids. Although existing efforts have incorporated important aspects of bioenergetics and other key ecological factors more extensive work is needed in basic model formulation, incorporation of competitive interactions between species, and community level dynamics such as linear dominance predation, and resource competition. This presentation is intended to highlight the basic fundamentals of individual based models of salmonids, current model structures in terms of both intrinsic and extrinsic factors, and where future research needs can make significant contributions to this area of salmonid research.

ENVIRONMENTAL FLOWS IN WATER MANAGEMENT DECISIONS

Bovee, K.[(1)]

Abstract:
Environmental flow issues are commonly resolved in water management decisions through a process of negotiation and compromise among the various stakeholders. Every environmental flow problem has its own constituency, context, and concerns. In this setting, the environmental flow specialist is seldom, if ever, one of the principal decisionmakers. Rather, the primary role of the environmental flow specialist is commonly one of influencing water management decisions. Good science is critical to fulfill this role, but the technical information and the language of the science provided by the scientist may be foreign to many of the parties to the negotiation. Technical clarity is essential in order to maximize influential potential and can be enhanced if the information addresses the basic criteria of relevance, effectiveness, feasibility, risk, transparency, and accessibility. Relevance implies that the information provided is pertinent to the problem in the eyes of the decision makers and is comprehensible to them. To some degree, the relevance of technical information may be influenced by stakeholder values, background, and experience, by statutory requirements, and by familiarity with the content and format of the information being provided. The essential point is that if the decision makers do not understand the technical information or consider it irrelevant, the influence of the underlying science may be diluted in the decision process. Effectiveness refers to the degree to which a negotiated alternative meets the objectives of the stakeholders. In order to evaluate effectiveness, changes in state variables resulting from implementation of an alternative must be quantifiable and interpretable. It is unlikely that any alternative will completely satisfy the objectives of all the stakeholders, so it is helpful to pre-define criteria for success or failure. Feasibility refers to the practicality to implement an alternative and typically consists of at least three elements: physical feasibility, statutory limitations, and economic considerations. Physical feasibility examines the capabilities of the water management infrastructure, such as reservoir storage, outlet capacities, and network effects (how a change in operations at one reservoir affects the operation at other reservoirs, for example). Statutory constraints include, but are not restricted to, issues of water rights, flood control mandates, existing permits, compacts and treaties, and endangered species laws. Economic considerations examine the costs and benefits for the various stakeholders as a result of implementing an alternative. Risk analyses are concessions that it is unlikely that any alternative will be effective or feasible 100 percent of the time. A risk assessment can also identify undesirable side effects associated with implementing an alternative water management strategy. Common elements of a risk assessment include determination of the frequency of failures (either of effectiveness or feasibility), the causal mechanisms associated with failures, and the development of contingency plans. Transparency refers to the ability of the participants of a negotiation to understand the technical information being provided. In some respects, transparency and relevance are related. If a decision maker cannot understand the model algorithms, statistics, or other data treatments involved in developing the information, it becomes easier to dismiss the information as being irrelevant. Because individuals process information differently, it often becomes necessary to present it in different formats and at varying levels of resolution in order to increase comprehensibility. Accessibility means more than simply making information available. The amount of information to be processed in an environmental flow negotiation can be overwhelming. Therefore, organization and navigability are important to enable decision makers to find needed information quickly and easily. Archiving and documentation capabilities are also important components of accessibility. Without sufficient attention to these aspects, it is entirely possible to develop an effective, feasible, low-risk alternative with no recollection of how it was produced. The need for decision makers to process a wide array of information with many dynamic and countervailing state variables has lead to the advent of the "Environmental Flows Decision Support System," henceforth referred to as an EFDSS. Attributes of a useful EFDSS include: incorporation of all state variables considered relevant to stakeholders and decision makers, capability to generate water management scenarios, quantification of changes to state variables relative to a pre-established baseline, tabulation and summarization of results in a variety of formats, and capability to organize, archive, and document results. An EFDSS may be designed to operate in one of two modes, hind casting or forecasting. Most recent applications for water management have featured the hind casting mode, where different operating rules are applied to historical hydrological and meteorological data to generate scenarios. Long range planning for global climate change, demographic shifts, and changes in land use or agricultural practices will necessitate the development of forecasting models. The Yakima River DSS is presented as an example of a hind casting EFDSS and the Columbia River Climate Change Model as a prototype for a forecasting EFDSS.

GEOCHEMICAL ECOLOGY – NEW TOOLS FOR STUDYING SALMON

Trueman, C.N.[(1)]

Keywords: Geochemistry, trace elements, isotopes, otolith, scale

Abstract:
The Atlantic salmon has been studied scientifically for well over 100 years, and yet much key information concerning its biology and behavioural ecology is still missing. Salmon populations suffer pressure from habitat destruction, direct and indirect effects of fishing and aquaculture and from climatic change; so it is increasingly important to understand the responses of wild populations to these pressures. Unfortunately obtaining ecological information is difficult, particularly in the relatively neglected marine phase of life. In this talk I will describe a suite of techniques developed from geochemistry which are increasingly being applied, often retrospectively, to study aspects of fish biology and ecology.

I will briefly explain the fundamental principles underlying the use of geochemical techniques, but will largely focus on showing how geochemistry can be applied to study salmonids - using trace elements to investigate stock composition and origin, migration and aquaculture-related forensics and using stable isotopes to reconstruct diet, location, thermal habit and nutritional information.

Member list NoWPaS-2008

Name	Country	E-mail	Research area / Key words
Anders Finstad	Norway	anders.finstad@nina.no	Effects of changes in winter habitat on overwinter survival of juvenile Atlantic salmon
Anja Celine Winger	Norway	Anja.Winger@nfh.uit.no	Gyrodactylus salaris in northern Norway: Population dynamics and parasite induced effects upon host behaviour and physiology.
Anni Tonteri	Finland	anni.tonteri@utu.fi.	Population genetics of north European Atlantic salmon
Anna Palmé	Sweden	anna.palme@popgen.su.se	
Bakimchandra oinam	Germany	bakimchandra.oinam@iws.uni-stuttgart.de	'Developing an Extended version of Meso-CASiMiR: a new habitat mapping and visualization approach in GIS framework
Bart Adriaenssens	Sweden	bart.adriaenssens@zool.gu.se	Complex behavioral tasks and divided attention in fishes.
Cecilia Håkansson	Sweden	cecilia.hakansson@sekon.slu.se	Salmon and Hydropower: Dynamic Cost-Benefit Analysis
Conor Graham	Ireland	grahamconor@gmail.com	The impact of nutrient enrichment on salmonid ecology in Irish streams
Daniela Riviola	Sweden	naniriaya@yahoo.com.ar	Parasites
Daniel Palm	Sweden	daniel.palm@vabr.slu.se	Ecology of egg and juvenile salmonids with emphasis on habitat restoration
David McCormick	Ireland	mccormick.dave@gmail.com	Interaction between young-of-year salmonids and instream macrophyte beds in Irish streams
Elianne Wassvik	Sweden	Elianne.Wassvik@ltu.se	Fish lock as an entrance to fish ways at hydropower plants
Donald Reid	United Kingdom	d.reid.2@research.gla.ac.uk	Links between foraging, energetic and digestive strategies in juvenile Atlantic salmon (*Salmo salar)*
Elina Halttunen	Norway	Elina.Halttunen@nfh.uit.no	The importance of repeat spawners and late autumn migrants on the production of Atlantic salmon - Implications for management, conservation and angling based business
Eli Kvingedal	Norway	eli.kvingedal@nina.no	Quantifying interactions among density, phenotype and environment on performance
Friðþjófur Árnason	Iceland	friddi@veidimal.is	Atlantic salmon male parr maturation. Frequency and influence on behaviour, mortality and smolting in wild populations.
Gwenäelle Fahrner	France	Gwenäelle.fahrner@edf.fr	Brown Trout habitat in regulated rivers

Haakon Hansen	Norway	haakon.hansen@nhm.uio.no	Gyrodactylus salaris; molecular systematics and phylogeography etc.
Hans Petter Fjeldstad	Norway	Hans-Petter.Fjeldstad@sintef.no	Fish ladders
Ignacio Serrano	Sweden	ignacio.serrano@emg.umu.se	Early marine survival, movement, and habitat use of wild and hatchery-reared anadromous brown trout (Salmo trutta L.) smolts determined by acoustic telemetry
Ivan Olsson	Sweden	ivan.olsson@kau.se	Partial migration
Jaan Kiviloog	Sweden	jaan.kiviloog@wet.chalmers.se	Hydraulic modelling,
Jan Grimsrud Davidsen	Norway	Jan.Davidsen@nfh.uit.no	Sea migration by post smolts and adults of Atlantic salmon (Salmo sala L.)
Jens Hultman	Sweden	jens.hultman@kau.se	Partial migration
Jill Ashton	United Kingdom	jcash@ceh.ac.uk	Costs and benefits of following life history strategies in brown trout and sea trout.
jin.zhang	Germany	jin.zhang@iws.uni-stuttgart.de	CASiMIR habitat modeling of Salmo salar and trutta
John Conallin	Denmark	joco@ruc.dk	Development, application and validation of habitat suitability criteria (for brown trout) for use in habitat modelling under Danish conditions.
Johan Östergen	Sweden	johan.ostergren@vabr.slu.se	Migration biology and genetic population structure of anadromous trout (Salmo trutta L.) in two northern Swedish rivers
Johan Spens	Sweden	johan.spens@vabr.slu.se	Biologist
Jon Svendsen	Denmark	jonsvendsen@yahoo.com	'salmon and sea trout [smolts and adults] migration in streams and mitigation of the impact of migratory barriers'.
Juha-Pekka Vähä	Finland	juha-pekka.vaha@helsinki.fi	consevation gentics of Teno river salmon
Jukka Syrjänen	Finland	jtsy@bytl.jyu.fi	Stream restoration and population dynamics of brown trout
Kai Korsu	Finland	kai.korsu@oulu.fi	alien species - native brown trout versus alien brook trout
Karen Jane Millidine	Scotland	k.millidine.1@research.gla.ac.uk	Individual variation in field energy budgets of Atlantic salmon
Karl Øystein Gjelland		Karl.Gjelland@nfh.uit.no	Trophic relationships in a subarctic, pelagic freshwater food web
Kęstutis Skrupskelis	Lithuania	kskrupskelis@gmail.com	
Lars Forsberg	Sweden	lars.forsberg@sh.se	Mate choice and genetic compatibility in Brown trout
Lasse Fast Jensen	Denmark	lfj@dfu.min.dk	Population genetics and local adaptations in brown trout
Lena	Sweden	lena.neregard@zool.gu.se	Effects of growth hormone in salmonids

Neregård			
Linnea Lans	Sweden	linnea.lans@kau.se	Partial migration of trout (*Salmo trutta* L.)
Line Sundt-Hansen	Norway	line.sundt-hansen@nina.no	Costs of enhanced growth in Atlantic salmon
Marie-Laure Acolas	France	Marie-Laure.Acolas@rennes.inra.fr	
Martin Kesler	Estonia	martin.kesler@ut.ee	Current state of Baltic salmon in Estonia.
Magnus Lindberg	Sweden	Magnus.Lindberg@vabr.slu.se	Invasion ecology of salmonids
Markus Noack	Germany	markus.noack@iws.uni-stuttgart.de	Ecohydraulic modeling of riverine habitats
Martin Olsen	Denmark	maol@ruc.dk	Climate change impacts on ecological conditions in Danish streams with special emphasis on brown trout (Salmo trutta) and macrophytes – combining habitat -, hydrological catchment - and climate modelling.
Mikko Kiljunen	Finland	mikkilj@bytl.jyu.fi	Accumulation of dioxin-like organ chlorines in Baltic salmon and salmon bioenergetics (Salmo salar)
Martin Österling	Sweden	Martin.osterling@kau.se	Interactions between trout and parasitic larvae of freshwater mussels.
Morten Stickler	Norway	Morten.stickler@ntnu.no	Physical winter habitat for Atlantic salmon (Salmo salar)
Nerijus Nika	Lithuania	nerijus@corpi.ku.lt	How successful is spawning of brown trout (Salmo trutta L.) in lowland streams of Lithuania?
Núria Plantalech	Norway	nplantalech@hotmail.com	Atlantic salmon post-smolts' migration through a Norwegian fjord system
Olle Calles	Sweden	Olle.Calles@kau.se	Migration and remedial measures
Panu Orell	Finland	panu.orell@rktl.fi	Atlantic salmon, migrations (both adult and smolts), stock evaluation (underwater video surveillance, surface diving), conservation spawning limits, etc.
Patricia Johnston,	Canada	Patricia_Johnston@ete	the influence of habitat structure on Atlantic salmon parr (Salmo salar) movements, growth and survival.
Pär Gustafsson	Sweden	par.gustafsson@kau.se	Fish and forestry. Influences of the riparian zone on stream ecology with particular interest in brown trout (Salmo trutta).
Pauliina Louhi	Finland	pauliina.louhi@oulu.fi	Spawning and intra-gravel stages of Salmo sp. with emphasis on habitat restoration
Peter Rivinoja	Sweden	peter.rivinoja@vabr.slu.se	Salmon migrations in regulated rivers (work on both adult + smolts with

			tagging + tracking + echo sounding)
Petri Karpinen	Finland	petri.karppinen@rktl.fi	Spawning, migration, Salmo salar
Pia Kiilerich	Denmark	Pia.k@biology.sdu.dk	Role of glucocorticoid and mineralocorticoid receptors in smoltification in Atlantic salmon
Rasmus Kaspersson	Sweden	rasmus.kaspersson@zool.gu.se	Inter- and intra-cohort competition in brown trout.
Saija Koljonen	Finland	Saija.Koljonen@bytl.jyu.fi	Ecological responses of stream habitat rehabilitation to salmonid rivers.
Silje Brenna-Hansen	Norway	Silje.brenna.hansen@umb.no	Resolving duplicated regions in Atlantic salmon
Sofia Brockmark	Sweden	sofia.brockmark@zool.gu.se	Effects of environment and density on performance and development in Atlantic salmon and trout
Tomas Ruginis	Lithuania	tomas@corpi.ku.lt	The feeding resource of brown trout (Salmo trutta L.) in western part of Lithuania
Tommi P. Linnansaari	Canada	tommi.linnansaari@unb.ca	Effects of winter conditions on the biology and habitat of juvenile Atlantic salmon (Salmo salar L)
Torstein Kristensen	Norway	torstein.kristensen@niva.no	Physiological and respiratory responses in Atlantic salmon to metals and varying gas pressures
Tore Svendsen	Denmark	ts@bio.auc.dk	PCB concentrations in Salmo salar in relation to migrations
Vidar Wennevik	Norway	Vidar.Wennevik@imr.no	Genetic interaction of farmed and wild salmon
Wendy Fernandes	United Kingdom	wfe@ceh.ac.uk	Interactions between family traits and environment affect growth, survival and migration strategies in Atlantic Salmon.
Guillaume Dauphin	Ireland	guillaume.dauphin@loughs-agency.org	Modelling pre-fisheries abundance in The Foyle catchment (Northern Ireland), a Bayesian framework
Øyvind Garmo	Norway	Oyvind.garmo@chem.ntnu.no	