

CLIMATE CHANGE AND THE FISHES OF BRITAIN AND IRELAND: FSBI BRIEFING PAPER 4

Chris Harrod, Jennie Mallela and Conor Graham

This, the fourth in a series of FSBI briefing papers, aims to provide an objective account of the current understanding of climate change and its likely consequences for the fishes of Britain, Ireland and the surrounding seas. There is a wide scientific consensus that human activities have modified the composition of the atmosphere, and that this will result in significant future climatic change. Current predictions for the next 80 years indicate that British air temperatures will increase between 2-3.5°C. Environmental change has been a feature of life on earth, playing a key role in the evolution and global distribution of biodiversity. However, the predicted rate of change is such that it will exceed any that has occurred over recent geological time. Climate change is considered as a major threat to biodiversity and to the structure and function of ecosystems that may already be subject to anthropogenic stress (e.g. overfished or nutrient-enriched seas).

Our societies rely heavily on aquatic systems for goods and services, and climate change is likely to have widespread implications for fish, their exploitation and conservation. Our Governments have a legal obligation to maintain, protect and conserve biodiversity, but to do this they require reliable information on the effects of climate change. It is clear therefore that scientists face a fundamental challenge to provide data and advice to managers regarding the response of natural systems to environmental conditions that have no parallel in recent time.

Climatic variation has a major influence on the ecology and distribution of fishes, for instance most fishes are thermal conformers, and body temperatures reflect that of the surrounding water. Temperature is an important controlling factor for biotic and abiotic processes at all levels of ecological organisation: cellular, individual, population, community and ecosystem, and influences many aspects of the physiology and ecology of fishes. Any modifications in the quality and quantity of water following climate change will have consequences

for fish and their habitats. Fish can be considered as excellent indicators of the expected changes from global climate change. However, any responses by wild fish to climate change are likely to be complex and difficult to predict.

In BP4, we describe how the climate of Britain and Ireland has changed in recent decades and used the future climate predictions from the UKCIP02 report (<http://www.ukcip.org.uk>). UKCIP02 predicts significant changes in the climate of Britain and Ireland over the next 80 years, which will undoubtedly lead to significant abiotic and biotic changes in aquatic ecosystems and shifts in the structure, productivity and the ecology of freshwater, marine and brackish water fish communities.

BP4 examines the current understanding of the role of climatic variation as a factor in the ecology of aquatic systems and fishes, and presents a series of case studies detailing the likely response to climate change of the five marine species, Atlantic cod, herring, pilchard, sandeels and basking shark, the three inshore species, flounder, sole and eelpout and the three freshwater species, Arctic charr, perch and roach.



A road ends abruptly on the North Yorkshire, UK coast with the North Sea in the background. Sea level rises that will be a result of climate change are likely to make this process of land loss more common and with more severe consequences for human life.

CLIMATE CHANGE AND THE FISHES OF BRITAIN AND IRELAND: FSBI BRIEFING PAPER 4 – *Continued*

Atlantic salmon are included as a model of the response of anadromous fishes to climate change.

Changes in water temperature and the quality and quantity of water inputs will modify the suitability of aquatic habitats for fish and other aquatic taxa. One positive aspect of climate change is that increased temperatures are likely to result in increases in production due to improved growth rates in many fishes. However, the ability to adapt to the predicted changes in climate will vary between species. There will be winners and losers; changes in fish community structure may include the loss of desirable species and a shift to undesirable, perhaps invasive, species.

In marine habitats, the changes in fish community structure that have been recently reported in the literature and witnessed by fishermen will continue as fishes shift their distributions relative to their temperature preferences. This may lead to the loss of some economically important cold-adapted species such as cod and herring from some areas around Britain and Ireland, and the establishment of some new, warm-adapted species. However, changes in food web dynamics and physiological adaptation, for example due to climate change, may obscure or alter predicted responses.

Increased temperatures are likely to favour cool adapted species such as perch and warm-adapted freshwater fishes such as roach and other cyprinids, rather than cold-adapted species like salmonids. The distribution and reproductive success of these species may currently be constrained by temperature in Britain and Ireland, and their future range may increase. Increased water temperatures and longer growing seasons will increase the potential for growth and production of cold-adapted freshwater species in northern and upland populations. However, southern or lowland populations may face unsuitable temperatures and loss of habitat following climate change and their potential ranges will shrink. Populations of importance to conservationists such as Arctic charr and *Coregonus* spp. may be lost.

Routine monitoring has played a

vital role in revealing the controlling role of climatic variation on aquatic ecosystems and fish population/ community dynamics. Although modelling and simulation studies are important, it is only by collecting relevant data through routine monitoring that ecologists can record and understand the effects of climatic change and better parameterise models with non-linear dynamics. Funding for such basic science needs to be available if the UK and Irish Governments are going to fulfil their national and international obligations to conserve and protect aquatic biodiversity.

Our predictions of the consequences of climate change on the ecology, exploitation and management of fishes are based on information available in the published literature, which is based on field and laboratory studies. During our review it became apparent that the results of field and laboratory studies often contrast. A reliance on unrepresentative laboratory studies to estimate environmental optima or tolerances of wild fish is a valid criticism that can be levelled at many studies, which includes our review. In future, it is likely that such data will be increasingly determined from wild fish through modern techniques such as electronic tags that record or transmit environmental or physiological data such as temperature, from free-ranging individuals. The predictions included in the Briefing Paper include a level of uncertainty that is difficult to quantify and make it difficult to ascribe certainty to our conclusions, but reflect a best attempt to provide guidance on the likely consequences of climate change for fish function, their ecology, management and exploitation.

As a species, we are extremely plastic and it is clear that climate change will lead to changes in human behaviour. Recreational patterns will shift, and demand for water will increase. Those involved in fisheries and aquaculture will face challenges as some long-exploited and economically important species move or are lost from increasingly warm waters. However, potential changes also present opportunities to exploit new species.

Climate change will increase the probability that invasive species and new parasites and pathogens become established in Britain and Ireland. Aquaculturists, aquarists and recreational fishery managers involved in the import and movement of fish and those regulating and managing these activities need to appreciate the risks.

The UK and Irish Governments have launched some initiatives to limit the use of fossil fuels and to restrict emissions of the gases associated with climate change. However, to date, these have not been particularly successful, and the residual inertia in climate systems is such that even a complete cessation in emissions would still leave fishes exposed to continued climate change for at least half a century. Hence, regardless of the success or failure of programmes aimed at curbing climate change, we can expect major changes in fish communities over the next 50 years.

The authors:

Chris Harrod is a lecturer in Fish Ecology and Conservation at Queen's University, Belfast. He has recently moved from the Max Planck Institute for Limnology in Plön, Germany. His research largely revolves around the use of stable isotope analysis as a means of understanding the ecology and evolution of within population variation in fishes. Recently however, he has become increasingly aware of the scientific challenge that climate change represents to those interested in the capture, study, management, and conservation of fishes.

Jennie Mallela is a postdoctoral researcher at the University of the West Indies, Trinidad and Tobago. Her interest in fish includes studying their role as ecological engineers on the coral reefs she studies, and how good they taste on the table. Conor Graham is a Ph.D. student at University College, Cork, studying the role of nutrient enrichment on riverine salmonid production. He is keenly involved in the recreational pursuit of fish of all kinds.

EDITORIAL

2007 is the 40th Anniversary of the founding of the FSBI

The Inaugural meeting of the FSBI took place on 21st October 1967 in rooms of the Zoological Society, London. So, in October the Society will be 40 years old. There were 31 members at the end of 1967, several of whom are still around. Jimmy Chubb, John Hellowell, Clive Kennedy and David LeCen are a selection.

In contrast, the American Fisheries Society was formed in 1870. We in Britain tend to think that we always have the oldest this or the oldest that, but in the case of Societies concerned with fisheries, this assumption seems not be true. But think again because in fact there was a fisheries society in Britain established well before either the FSBI or the AFS. The British Fisheries Society was established by Act of Parliament in 1786 and was in existence until 1893 (Dunlop 1978). The full title of the Society betrays it's true function: 'The British Society for Extending the Fisheries and Improving the Sea Coasts of the Kingdom'. 'The Kingdom' referred to was the United Kingdom, only 79 years old in 1786 but it really meant the Highlands of Scotland. During its existence the BFS established or helped develop the towns of Ullapool, Pultenytown, which is on the south bank of the Wick River in Caithness, Tobemory and Lochbay near Dunvegan.

It's worth quoting at some length from the preamble to the document setting up the BFS written in a gloriously baroque style.

'It has often been observed with wonder and regret, that a very considerable part of the Coast of Great Britain [which really meant the Scottish Coast from the Clyde to Dungsby Head, Caithness, Ed.] continues destitute of the blessings of Art, Industry, and Independence, though inhabited by a numerous tribe of British Subjects, not less capable, nor less inclined than their Fellow citizens to become useful Members of the Community: and that many of the Inhabitants emigrate from thence, in large bodies, to cultivate, under incredible

hardships, the distant wilds of America, while the surface of their native land is exceedingly short of sufficient cultivation, and while the very numerous adjoining Firths and Seas teem with a wonderful and inexhaustible store of Fish, which has hitherto remained in a great degree an untouched and unprofitable treasure'.

In the current climate in Britain, this statement demonstrates a problem that is the reverse of what we face today. Modern movers and shakers are concerned more with too many people coming too Britain, rather than losing them to other countries. In addition the 'untouched treasure' of the firths and seas has been touched too much. Of course, the BFS was founded only ten years after the American Revolution, and the new land beckoned to those, particularly in Scotland, who had been deprived of land or were having a hard time making ends meet.

The aims and objectives of the FSBI at its founding were more prosaic, but defined the role of a Society that is different from the one that exists forty years later. The first three aims were:

1. To encourage, promote and support all branches of fish biology and fisheries science.
2. To promote the conservation, development and proper utilization of fisheries.
3. To disseminate regular technical and other information on all aspects of fish biology and fishery research and management.

The interest is in the clear inclusion of 'fishery science', 'development and ... utilization' of fisheries and 'fishery research and management'. With these included one can see that the name of the Society was not a misnomer, but inclusive of the aims as envisaged by J. W. Jones and his colleagues. Over the forty years of its existence, the Society has cut out the applied side and now deals mostly with fish biology, which is a loss. The change was partly due to the later foundation of the Institute of Fisheries Management, almost by

the same people who founded the FSBI. It would be interesting to know why it was felt necessary to create a new organisation specifically for management, when the FSBI seemed to have it covered.

For many years Peter Miller attempted to persuade successive AGMs that the name of the Society should be changed to reflect its altered brief. His pleas were rejected as it was thought that the name and acronym of the Society was too well known and changing it would be detrimental. An alternative suggestion might be to begin a movement back to the original aims of the Society as defined in 1967. Why not begin to include again aspects of fishery management and utilization? There is a strong need for leadership in this area, given the parlous state of so many fish species and the rapid growth of aquaculture. In some ways the Society's Briefing Papers are a move in that direction as they have all dealt with applied topics and the latest, on the effects of climate change on British and Irish fish, summarised in the leading article in this issue, is a case in point. The Society is also funding a fisheries project through the PhD grant to Kirsten Abernethy as described in the lead article in the last issue.

I think that Jack Jones, Peter Tomblason and Lionel Mawdesley-Thomas would be proud to see how the Society, formally brought into existence on that October day in London in 1967, has grown into a flourishing organisation with a global reach. We have much to live up to and a challenging tasks ahead.

Reference

Dunlop, Jean (1978) *The British Fisheries Society 1786-1893*. John Donald Publishers Ltd, Edinburgh.

Paul Hart
University of Leicester
June 2007
newsletter@fsbi.org.uk

Next deadline for copy:
1st August 2007

Travel Grant Report

6th International Symposium on Ecohydraulics Christchurch, New Zealand, 18-23 February 2007

The 6th International Symposium on Ecohydraulics was held in Christchurch, New Zealand. Approximately 300 professionals from around the world working in hydraulics and environmental research and applications attended the symposium, which was promoted by the Ecohydraulics Section of the International Association of Engineering and Research (IAHR) and the International Aquatic Modelling Group. The symposium focussed especially on bridging the gap between hydraulics and biology. The diversity and high quality of numerous multidisciplinary presentations throughout the symposium emphasized the importance of the symposium's objective for a multidisciplinary approach to the study of the ecological implications of moving water.

The symposium kicked off on Sunday evening with a welcome reception, which provided a superb opportunity to meet with peers after the long journey to New Zealand. In the following days, excellent plenary talks considering the state of the art in diverse fields such as aquatic biology, fluvial geomorphology, flow management, and environmental engineering providing an inspiring start to the symposium's program. In four parallel sessions, presentations addressing the latest understanding on performance of biota as a function of hydraulic habitats and flow regimes, and how these dependencies can be better modelled were presented.

My key interest laid in the theme session on "Fish Passage" with an astonishing number of very stimulating and rewarding presentations. In this context, I had the chance to present the findings of two studies on the 'Effects of vortices on upstream migrating brook charr' and on the 'Energetics of Atlantic salmon in migratory fishways'. Between sessions, I found it particularly encouraging to

network and discuss with a group of young scientists interested in the effects of turbulence on fish behaviour and swimming performance. In the theme session on "Habitat and Flow Regimes", I had the opportunity to present a 'Conceptual model of the Natural Flow Paradigm applied to the management of Atlantic salmon populations', developed at Fisheries and Oceans Canada, which aroused a lot of interest and was well discussed.

On Wednesday, technical field trips provided a break from the symposium and an excellent opportunity to discover New Zealand's splendid countryside. The field trips were designed to expose the delegates to many of the current and future water issues of the Canterbury region such as hydropower, irrigation, ground water reserves, fisheries and habitat management, whilst presenting the scenery and natural wonders of the region.

The local organising committee can be congratulated on a very well organised and successful symposium. I would like to take this opportunity to thank the Fisheries Society of the British Isles for this travel grant allowing me not only to present the findings of our work and to expand my knowledge in ecohydraulics but also to meet up with many excellent scientists which has already led to collaboration. I encourage everybody interested in ecohydraulics to attend the 7th Symposium on Ecohydraulics held in Concepción, Chile in January 2009.

Eva Enders
Fisheries and Oceans Canada
80 East White Hills Road
St. John's, NL, A1C 5X1
Canada

Wyn Wheeler Research Grant Fund

FSBI are pleased to announce the Wyn Wheeler Research Grant Fund. This is to commemorate the pre-and post-retirement contribution made to the biology of fishes by Wyn Wheeler.

The fund is to enable retired scientists who are not eligible for Research Council Funding as a principal investigator to undertake scholarly research activities. The fund consists of £6000 per annum.

The deadline for applications is 1st September of each year.

For further details see the application form on the FSBI website; <http://www.fsbi.org.uk/grants.htm>.

NOTICE TO STICKLEBACK RESEARCHERS

We would like to inform all those working on sticklebacks that we released about a hundred sticklebacks from unknown origin into a channel connected to the waters just east of Haarlem (de Veerplas, de Mooie Nel), which is west of Amsterdam, the Netherlands. The released sticklebacks are the progeny of 10 sticklebacks bought in a shop in Haarlem. In this part of the Netherlands all waters seem to be interconnected, so these sticklebacks

might spread to other waters in the area.

The reason we inform you is because we would hate to see that some time in the future somebody will do research on sticklebacks caught in this region and make inferences about morphological, behavioural, or genetic adaptation or divergence through evolution of this population in their environment. Examples of such work would be the recent study by Spoljaric & Reimchen 2007, *J Fish*

Biol 70, 1484-1503, based on fish which had actually evolved somewhere else entirely.

So the message is: do not use sticklebacks caught "in the wild" near to Haarlem for such research! And please let your students know as well, for the future.

Sarah Kraak and Beat Mundwiler, former stickleback researchers

Conference Report

4th Indian Fisheries Science Congress, 12-13 April 2007 Ecology and Fisheries of Wetlands India, Patna, India

These meetings draw together the numerous regional strands of fish and aquaculture research in India and are presented under the banner of the Indian Society of Fisheries Professionals. The Chief Organiser was Dr MP Kohli Singh of CIFE, Versova, Antheri (west), Mumbai and the conference was held at ICAR Research Complex for Eastern Region, Patna, India where Dr DK Kaushal is the Principal Scientist. Dr MP Kohli Singh was assisted and encouraged by many senior Indian scientists in fisheries and aquaculture including Dr PV Dehedrai and Dr KG Kumar. The theme of the meeting was Ecology and Fisheries of Wetlands in India, areas of significant economic importance for freshwater and marine fisheries. Many of the papers stressed the importance of integration of biological, agricultural and economic enterprises with the objective of optimising conditions to achieve maximum production from the wetlands. The scope and scale of these operations are impressive and the papers addressed academic as well as applied aspects of wetland aquaculture. A large variety of species are cultured including several species of carp, facultative air breathers such as catfish (*Clarias batrachus*) and obligatory air breathers including various species of *Channa*. Brian Eddy gave a short presentation introducing the Fisheries Society of the British Isles and explaining the aims and objectives of the Society followed by an introduction to the *Journal of Fish Biology*. Leaflets for the *Journal* and the Society were made available at the poster session.

Future collaboration between Societies may be best achieved through the organisation of joint sessions at each others meetings. Also to maintain active links and explore ways to help Indian scientists attend our Symposia. This would apply not only to the FSBI and Indian Societies but to Societies throughout the world. In this connexion the next meeting of the World Congress of Fisheries Societies in Japan in September 2008 was briefly discussed as a possible starting point for future interactions.

My chief contact and host was Dr MP Kohli Singh who is an energetic, charming and highly respected senior scientist in India. I am grateful for his help and hospitality and for introducing me to many senior scientists from various regions of India.

Contacts

8th Asian Fisheries Forum, Kochi, India
<http://www.asianfisheriessociety.org/>
5th World Fisheries Congress, Yokohama, Japan
<http://www.5thwfc2008.com>
Indian Society of Fisheries Professionals,
PO Box 11950, Azadnagar, Andheri (West),
Mumbai-400053,
e-mail isfp@vsnl.com cife@rediffmail.com

Brian Eddy
University of Dundee
April 2007

Travel Grant Report

XI International Congress of Parasitology (11th ICOPA)

The focus of the research for my PhD is the globally important pathogen of freshwater fish *Ichthyophthirius multifiliis* Fouquet, 1876 commonly known as "white spot" or "Ich". This parasite is a freshwater ciliate protozoan. Through an FSBI travel grant, I was able to attend the 11th International Congress of Parasitology, which was held in Glasgow (Scotland) from 6th to the 11th of August of 2006.

My poster presentation entitled "The use of a mechanical device to reduce infections of *Ichthyophthirius multifiliis* (Ciliophora) in raceways on a commercial rainbow trout, *Oncorhynchus mykiss*, farm" was very well received as an innovative environmentally safe and non-chemical alternative to control white spot infections in rainbow trout fish farms.

At the conference, I was able to meet other fish parasitologists which helped me to discover and

consider new possibilities and ideas for my research. Thanks to this conference, I have established a link with researchers from a Spanish University, which will allow me to run some trials in the next few months. This collaboration will be very useful for my PhD.

I was also able to attend talks focusing on the immunology and genetics of the monogenean species *Gyrodactylus salaris* Malmberg, 1957, which helped me to review recent progress in fish parasitology and to discuss upcoming trends and perspectives within international aquaculture.

I would like to thank the FSBI for the travel grant, which allowed me to attend this conference, so giving a big boost to my research.

Sara M.P. Camacho

Aquatic Parasitology Research Laboratory,
Institute of Aquaculture at the University of Stirling

The Society website has a new home which is WWW.FSBI.ORG.UK.

The FSBI Annual Symposium in Exeter 23rd-27th July 2007

Non-Native Fishes: Integrated Biology of Establishment Success & Dispersal

THEMES

Introductions & establishment
Introduction pathways & dispersal processes
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Life history & ontogeny
Disease implications

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Michael Fox
Emili García-Berthou
Vladimír Kováã
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Bernd Hänfling

Space left for final few extra posters

For full programme and all further details see <http://www.fsbi.org.uk/>

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5th World Fisheries Congress



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• **Plenary Lecture**

Mr. Ichiro Nomura
Food and Agriculture Organization of the United Nations, Italy
Prof. John G. Field
University of Cape Town, South Africa
Prof. Gudrun Marteinsdottir
University of Iceland, Iceland
Prof. Raymond Hilborn
University of Washington, USA
Prof. Michael A. Crawford
London Metropolitan University, UK
Prof. Benjamin F. Koop
University of Victoria, Canada
Dr. Chua Thia-Eng
Partnerships in Environmental Management
for the Seas of East Asia, Philippines

• **Tentative Schedule**

July 2007 :
Distribution of Second Circular
February 2008 :
Deadline for Submission of Abstracts
and Early Registration
July 2008 :
Deadline for Hotel Reservation and Late
Registration
August 2008 :
Final Circular

**"Fisheries for Global Welfare and
Environmental Conservation"**

**Oct. 20 (Mon) – 24 (Fri),
2008**

**Pacifico Yokohama
(Yokohama, Japan)**

Contact to : **Secretariat of WFC2008**

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<http://www.5thwfc2008.com>

2007 Society medal winners

At the April 19th Council meeting, nominations for the Beverton Medal and the FSBI Medal were considered and two winners chosen.

Beverton Medal

This year the senior medal, named in honour of its first recipient, goes to Professor Richard H. K. Mann. Richard is now retired, but for many years he worked for the Freshwater Biological Association at their Wareham laboratory. The last part of his career was spent at the Monks Wood Experimental Station near Huntingdon where he was working on the ecology of fish in lowland rivers. Richard's research revolved around the population dynamics of freshwater fish with particular reference to non-salmonids. He produced some of the best data of its time on the abundances, growth rates and reproductive strategies of many British freshwater species such as pike, roach, chub, dace and bream. Richard was a graduate of the University of Leicester, although when he graduated it might still have been a University College giving University of London degrees. For several years Richard was a co-editor

of the *Journal of Animal Ecology*. More details will be given in the next Newsletter.

FSBI Medal

The FSBI Medal for promising scientists under 40 has been awarded this year to Dr David Sims who is a Research Fellow at the Marine Biological Association, Plymouth. David works on the behavioural ecology of fish, mostly elasmobranchs. He is probably most famous for his work on basking sharks which has attracted the attention of the media and made the front cover of *Nature*. Together with others at the MBA, David has also been working on the long term changes in marine fish in the Western English Channel as shown by the data set accumulated since the end of the 19th century by the MBA. David has been a member of the FSBI Council and has also supervised at least two FSBI funded students, one of whom, Josh Filer is now in his second year of research. Another, Vicki Wearmouth, finished her PhD at the end of 2006. Again, more detail will be given in the next newsletter.

Nominations for Council

Every year Council asks members to nominate people to be on Council. Rarely if ever do people not on Council make any nominations. This is not healthy as it makes it possible for Council to become an inward looking group who just spend time furthering their own interests. Consequently, you, as a member of the Society

have a duty to nominate people. Please do. A Council member serves for three years. As a Council member you are also a Trustee of the charity and this does have legal obligations. You would also be required to be on one of the sub-committees that deal with Travel Grants, Research Grants, Finance, or the Studentships. The

Council is particularly keen to attract more women members and members from outside the UK as the Society now has a significant number of members who are not from the United Kingdom and Eire. If you are interested or know someone who is then please contact Brian Eddy, the Honorary Secretary before the AGM in July.

INFORMATION DESK

All enquiries about FSBI membership, fees, travel grants and research grants

should be made to:

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