



# Keeping fish happy in Saudi Arabia

Dr. Lizzie Tyler a post doctoral research, and past FSBI doctoral student, reports from the Red Sea

'I need another 0.5 g Fernando'. I repeated this request to my Colombian Masters student, Fernando Cagua, several times a day for the whole summer. But I never wanted the small sachet of white powder he gave me, for myself; it was always for one of my steady stream of patients. I had to get it right, because my patients were extremely fussy, and undergoing rather expensive operations. Over the course of six weeks this summer, the Red Sea Research Center at King Abdullah University of Science and Technology (KAUST) in Saudi Arabia implanted acoustic tags in over 400 fish in the central Red Sea; and I became a fish surgeon.

The aim of our project is to measure the extent to which coral reef fish move within and between patches of reef habitat. In short, we are looking at the connectivity of adult reef fish. If you are interested in connectivity in the marine environment on any 'meaningful' scale, you would normally choose to work on larvae. Choosing to work on adult reef fish could be likened to looking at evolution in tortoises. Or maybe not? We have had tantalizing indications over the last ten years that reef-associated fish, originally assumed to be completely resident, move surprising distances: tens of kilometers along fringing

reefs. Moving such distances would significantly influence their interactions with fisheries or spatial management and affect the distribution of reef health and recovery.

Our current knowledge of reef fish movement comes from a few detailed studies of species mostly considered in isolation. We wanted to look at connectivity comprehensively, and identify patterns across the fish community. Therefore, we needed to tag a large number of species, from healthy fish communities. I also wanted to find a set of clearly separated reefs that would allow us to examine movement both within and between reefs.

For my first month as a postdoc, I frustratedly manta-towed my way up and down the extensive, shallow reef systems just outside the Red Sea Research Center at KAUST, which lies next to the fishing town of Thuwal, on the west coast of Saudi Arabia. KAUST is a graduate-only research university with a strong focus on science and technology applicable to the Kingdom. We therefore have a Water Desalination and Reuse Center and a Plant Stress Genomics Center. Luckily, we also have the Red Sea Research Center, harbouring a full spectrum of marine scientists, from oceanographers, through

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The author implanting an acoustic tag in a Yellowmargin triggerfish (*Pseudobalistes flavimarginatus*), assisted by M Khalil. Water with low concentrations of ms-222 (fish anaesthetic) was constantly flowing over the gills during surgery. (Photo credit Fernando Cagua)



Fernando Cagua releasing an acoustically tagged Onespot snapper (*Lutjanus monostigma*). All releases were done in shallow water close to the reef crest to allow fish to quickly hide in the reef. (Photo credit Luke Thompson)

# Keeping fish happy in Saudi Arabia – *continued*

microbiologists to ecologists, and from the applied, to the pure, all of whom have projects in the Red Sea. KAUST, finished in 2009, was built on the shore, making it a short boat trip from the office to the field. But I ended up finding my study reefs by chance, 300 km to the south of KAUST, when I was assisting Michael Berumen, head of our Coral Reef Ecology Lab, on his whale shark tagging program, the largest of its kind in the world.

Overfishing is a problem in the Saudi Arabian Red Sea, but fisheries are still using fairly low technology, and the sheer length of Saudi coastline and variety of reef systems, mean that a fair few reefs slip through the net. My study reefs were the prime example. Fifty kilometers offshore, we saw at most, a couple of fishing boats a day, and only in the calmest weather, which is not common for the Red Sea. The study reefs formed a group of six with 'platform' shape, rising vertically up from depths of over 100 m, spaced at varying distances of less than one to several kilometres apart, and replete with fish, as well as other megafauna, including bewilderingly tame turtles.

Acoustic telemetry is the ideal method for measuring fish movement on this sort of scale: It provides continuous movement data, without the need for recapture. The resources available at KAUST allowed us to use telemetry in a manner unheard of for such a comprehensive study. Prior to tagging, we therefore established an array of acoustic receivers, placed to allow a good measure of movement within two reefs and between all six reefs.

Acoustic tags are typically implanted in fish body cavities for optimum retention. Working with such a variety of species, some of which, to our knowledge,

had never been acoustically tagged before, required some flexibility. We knew the routine dosages of anaesthetic and the signs of anaesthesia we wanted, but were amazed at the different responses across our spectrum of patients. Surgeonfish were stubbornly resistant to the anaesthetic, parrotfish were lightweights, and pelagics fickle. For these last the whole process sometimes rendered them almost passive with shock. To release fish, we normally just snorkelled them in buckets to the reef crest and watched them swim away (see the picture). But even this could be fraught. On one reef, a group of three silky sharks (*Carcharhinus falciformis*), decided that our 'waiting room', a floating cage tethered to the back of the boat, needed constant surveillance. Once they had been accidentally rewarded for their patrolling, they were quick to arrive on the fish-release scene, requiring us to retreat back on the boat, and find a new spot before they got there!

But medical care for such diverse species was straightforward compared to catching them in the first place. Whilst, Alex Vail, a collaborator from Cambridge University, UK, was able to bring up batches of herbivores using a barrier net, we were dismayed by the slow catch rates of the handlines. We eventually concluded that predators on these reefs just had plenty of food. Luckily our handline team comprised Saudi Arabian fishermen employed by KAUST. These people have decades of experience, and patiently listened to our shopping list of species, and patiently put back those species, like the red mouth grouper (*Aethaloperca rogoa*) that just kept on being caught. Differences in catchability were profound, and I often wished we were only studying black surgeonfish (*Acanthurus gaham*): the first

species to be caught by every fishing method, and even when filling buckets of water off the side of the boat!

Despite the challenges, we tagged all our 400 fish, and even downloaded the first set of data from our acoustic receivers, which will remain out, collecting information for at least six months. Within the first few weeks, eight fish, from five different species had already travelled across deep open water from one reef to another. Whilst we look forward to properly comparing movement across all our species, these results indicate that being a patient surgeon is worth the effort.



Silky sharks (*Carcharhinus falciformis*) were a nuisance- closely monitoring the capture and release of our adult reef fish. (Photo credit: Fernando Cagua)

# EDITORIAL

The death of David LeCren marks the exit of one more of the generation of scientists who were at their peak when my generation was at the PhD stage. During that period, in the late 1960s and early 1970s, Jack Jones at Liverpool together with his friend the angling journalist Peter Tomblason were running the so-called Coarse Fish Conferences and David LeCren, along with people such as Tim Bagenal, Winifred Frost and Charlotte Kipling, were the seniors in attendance. David LeCren was I think, a shy man, and not easy to talk to as a graduate student. He wasn't haughty or arrogant, but one felt that he didn't quite know what to say to someone at such a different stage of life from himself. Despite all this he was encouraging to myself and to Tony Pitcher and even helped us sort out a dispute we had over who should be first author on a joint paper! It was only in the past few years that I learnt that David was originally from New Zealand although as Ian Winfield's obituary reports, David left his country of birth at a young age. It is curious how where one is born can have the power to draw one back to a place at the end of life, even though the person in question has been away for most of their life.

At the other end of the career scale, it is great to see Lizzie Tyler, a former FSBI PhD student, establishing

herself in the world of fish biology. The Red Sea Research Center at King Abdullah University of Science and Technology seems to be an excellent place to begin a career in fish biology, although it might be difficult in future for Lizzie to work anywhere where the sun does not shine most of the time and the sea is grey rather than blue.

There has recently been a flood of travel grant reports and one conclusion from these is that PhD supervisors at the Institute of Aquaculture, University of Stirling are very good at drawing the travel grant scheme to the attention of their students. Ingrid Ahnesjö who is currently chair of the Travel Grant sub-committee of Council recounted to me recently on a visit to Uppsala, that she'd tried to draw the attention of the scheme to students at her university but few take up the offer. In my view the more people who apply the better and the international nature of the enterprise is to be encouraged.

Happy Christmas (Holidays) and all the best for 2012.

Paul Hart

Next deadline for copy: 1st February 2012

## FSBI President's Piece

It is far from my intention to write something for every issue of the *Newsletter*, but I thought it appropriate to break with my plans for this issue.

I am sure that every single reader will remember with absolute horror the events of Friday 11 March of this year when the Great East Japan Earthquake and its associated tsunami devastated large areas of Japan. The tsunami heavily damaged many coastal areas where fisheries were once prosperous and vital to the local economy. For those of us fortunate enough never to have experienced an earthquake of any significant magnitude, let alone a tsunami, it was difficult to take in the images and reports which dominated our media for many days. The situation was then made even worse by an explosion at the Fukushima nuclear power plant on 15 March which resulted in a significant radioactive release and further evacuation of the local population. Fallout from radioactive materials was detected not only on land but also in rivers and the ocean, including in fish caught from the

coastal areas near the Fukushima Daiichi. Fishing activities remain prohibited in this area.

In the immediate aftermath of the earthquake, the Japanese Society of Fisheries Science (JSFS) established a relief fund to be used for the recovery of academic institutions in the disaster areas, including universities and prefectural fisheries experimental stations, and also to help the education of students and pupils who lost their parents engaged in fisheries activities. As explained in detail at our AGM in July, FSBI Council quickly and unanimously approved a relatively modest but still significant contribution to this fund. This action was rapidly and profusely appreciated by JSFS. Subsequently, while I was attending the American Fisheries Society meeting in Seattle in September, Professor Shugo Watabe acting as a representative of JSFS presented me with a Certificate of Appreciation to FSBI for our contribution to their efforts to help those most affected by the Great East Japan Earthquake and its con-



sequences. A scan of this elegant document is reproduced here.

Needless to say, we would all prefer that this certificate and the reasons for its existence had not come about in 2011, but on behalf of FSBI I thank JSFS for this gesture and wish them well in the coming years as Japan and its people work to recover from this terrible event.

Ian J. Winfield

Centre for Ecology & Hydrology, U.K.  
8 November 2011

# Publication by the FSBI of a long lost manuscript: *Ferox and Char in the Lochs of Scotland Part II*

Edited by Peter Maitland & Colin Adams, both at the University of Glasgow

In 1940, R.P. Hardie's "*Ferox and Char in the Lochs of Scotland: an inquiry. Part I.*" was published in Edinburgh by Oliver and Boyd. This was an important volume in the history of our understanding of the fish fauna of Scotland. It was the first attempt to record comprehensively the distribution of two charismatic salmonids, the Arctic charr, *Salvelinus alpinus*, and the large size, and predominantly piscivorous, brown trout *Salmo trutta*, in Scotland.

Hardie outlined his plan for the volume in his preface thus:

*"My plan will be this. I shall begin with an introductory chapter dealing mainly with the classification of the Salmonidae and giving a natural history of the two genera in which we are specially interested, Salmo and Salvelinus. Then there will be chapters on ferox which is my primary subject. Next will follow naturally a chapter on the different types of loch. Next there will be a chapter on char in general (in Scotland). The rest will consist of an account of the more interesting particular lochs in Scotland. In this, as may be expected, I shall lay special stress on those which contain ferox or char. These lochs can conveniently be arranged in groups."*

In fact, the text which he produced did not follow this plan exactly, as most of the discussion of Ferox and Charr themselves was summarised in the Preface to Part I of "*Ferox and Char*". All of the main text was devoted to an account of the lochs, in chapters on the series of basins from the south of Scotland, north up the east coast to the Shin basin, where Part I ended.

Hardie was, by all accounts, a charismatic man. For 43 years he was an academic, at the University of Edinburgh. Initially graduating from the University of Oxford he was appointed as Assistant to the Professor of Logic, and later as Reader in Ancient Philosophy at Edinburgh where he was also a long-standing member of the Edinburgh Mathematical Society. He was a noted expert in Greek philosophy, particularly on Aristotle and he published several works in this field, but he also had a gift for, and interest



Figure 1. "Ferox" trout (left) and Arctic charr (right)

in, metaphysics and pure geometry. His scholarly activities however extended widely beyond ancient Greece; he conducted a comprehensive study of the origins of the breeding of the Shetland pony and he had a long-term interest in the navy of the Tudors. On the day he died, his book on "*The Roads of Mediaeval Lauderdale*" was published.

His interest in charr and ferox was borne from a life-time of interest in angling. In his obituary Smith (1942) described Hardie's interest thus:

*the fruit of a life-long study of fish and fishing in Scottish lochs. Hardie had fished hundreds of lochs and kept records for half a century.*

It is clear however that "*Ferox and Char*" was not simply derived from his own angling activities around Scotland but also the result of very considerable research, mostly resulting from correspondence with a broad range of people who were able to provide unpublished information.

Part I of "*Ferox and Char*" was published just in time, for the Second World War was in full swing by the time it appeared. The War is clearly a reason why Part II was not published at the time, and by 1946, Hardie was dead.

It was assumed for many years that Part II had either never been written or that any manuscript had been lost or destroyed. In fact, after Hardie's death, many of his papers were kept together and eventually given to Niall Campbell and, after Niall's death, passed on by his son Ronald to Peter Maitland. After much sorting and collation, it was found that there was actually a complete handwritten manuscript for Part II, some of it written, apparently, as late as 1940 and 1941.

With the generous financial support of the FSBI "*Ferox and Char in the Lochs of Scotland – Part II*" has now been published, 70 years after the publication of Part I!

Although we have by necessity, edited Hardie's original hand-written manuscript for Part II, we have tried to follow Hardie's text as closely as possible and have kept any changes to a minimum. As the famous phrase goes – the views expressed are Hardie's and not ours – it is his volume. As in Part I, he has depended extensively on Murray & Pullar's (1910) classic *Bathymetric Survey of the Freshwater Lochs of Scotland* and a large proportion of the text is taken directly from that phenomenal six-volume publication. He also draws heavily on other authorities and quotes widely, for example from Thomas Tod Stoddart, Tate Regan and Peter Malloch. Again, as in Part I, Hardie wanders down the occasional side road in his text, dealing with historical, geographical, archaeological and other accounts which are hardly relevant to his main thesis. We have included all of these in Part II and, apart from minor textual changes for clarity and to avoid the occasional error, the only extensive input we have made has been to use the names of the lochs which are found in the revised 1956 Ordnance Survey One Inch to One Mile series of maps, rather than those names in Hardie's manuscript which were often misspelled, or obscured by illegible handwriting.

In fact, Hardie's personal contribution of new information in both parts of *Ferox and Char* is quite modest and consists mainly of records of the numbers and weights of brown trout, including Ferox, and occasionally Arctic charr, found in some of the lochs.

What then is the value of "*Ferox and Char Parts I & II*"? Apart from the important work of Albert Gunther, Tate Regan and other fish biologists on the scientific aspects of Arctic charr in Scotland, and elsewhere in

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# FSBI President's obituary for E David Le Cren



It was with great sadness that I learned of the death of E David Le Cren on 9 September 2011 at the age of 89 years. Although I was aware of David's considerable age, the news still came as something of a shock because I was aware that he had been enjoying good health in his retirement in New Zealand, where he

was born. In addition, I had been exchanging e-mails with him as recently as late May on the subjects of recent research on Windermere and the general climate for scientific research in the U.K. and in New Zealand. David had also mentioned that he had recently written some personal memoirs of his working life in the U.K., a copy of which he had lodged with the library of the Freshwater Biological Association (FBA) and which I have recently consulted. They paint a remarkable history of a man intimately associated with key developments in fish and freshwater ecology from the 1940s to well after his retirement in 1983.

It is probably no coincidence that after spending the first three years of his life living on a small peninsular on New Zealand's Lake Tekapo, David subsequently spent several decades of his life working for the FBA at its headquarters on a small peninsular on England's Windermere, together with a substantial period of time developing and managing the FBA River Laboratory in Dorset. David had first encountered the FBA while he was an undergraduate student reading natural sciences at Trinity College, Cambridge, and subsequently took up a temporary war-time position with the FBA researching perch in Windermere. The rest, as they say, is history. David's employment with the FBA changed from a temporary to a permanent basis and he went on to produce what is now widely acknowledged to be classic work on the population biology of perch, as well contributing to wider interests in the fundamental population ecology of fish and aspects of fisheries management. In 1961 he was appointed Officer-in-Charge of the then

newly created FBA River Laboratory and in 1973 he became FBA Director, a post which he held for 10 years until his retirement. He subsequently became a Vice President of the FBA.

David's working life was also intimately bound up with the FSBI. In the mid 1960s he was a key participant in discussions about the formation of a British society for fisheries biology, which culminated in an inaugural meeting of the FSBI on 21 October 1967. Together with Jack Jones, Peter Tomblason, Lionel Mawdesley-Thomas and Alwyne Wheeler, David was responsible for guiding the Society through its early years. He subsequently served as President of the FSBI from 1978 to 1983 and again briefly in 1992, he was a co-convenor of its annual symposium in 1990, and he received its Beverton medal in 1996. His remarkable and sustained contribution to the Society was recognised in 2010 by the instigation of the Le Cren medal which is awarded annually to individuals who have made a lifelong contribution to fish biology and/or fisheries science, with a focus on conservation, training or public understanding of the discipline.

I first met David in 1990 at that year's FSBI annual symposium in Lancaster which, fortunately for me, was held just a few weeks after I took up a post at nearby Windermere with the then Institute of Freshwater Ecology. Subsequently, David was a frequent visitor to my office and laboratory then housed within the FBA's headquarters premises. He proved to be an apparently limitless source of information for me on the history of research on the fish populations of Windermere, including the long-term monitoring programmes which I am honoured to continue to the present. Equally importantly for me, David was a great and much appreciated source of encouragement as I balanced the conflicting demands of maintaining the invaluable long-term Windermere programmes while at the same time securing and delivering an at times bewildering variety of commissioned research projects. I will miss him.

**Ian J. Winfield**  
**Centre for Ecology & Hydrology, U.K.**  
**19 October 2011**

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Britain and Ireland, no-one else had previously attempted to put together a comprehensive picture of the distribution of Arctic charr, or indeed of Ferox trout, in Scotland. R.P. Hardie must be acknowledged as the first person to do so. There is little doubt that this subsequently

provided the stimulation for others, notably Kim Friend and those of us who have followed him in the study of these fascinating fishes in Scotland. Publication of Part II finally fills the historical gap left in Hardie's legacy.

## References

- Murray, J. & Pullar, L. 1910. Bathymetrical survey of the Scottish Freshwater lochs. Edinburgh: Challenger.  
Smith, J.C. 1941. The late R.P. Hardie. *University of Edinburgh Journal*, 10-11, 240-242.

# TRAVEL GRANT REPORTS

## **Christian Delannoy, a PhD student at Stirling University reports.**

In September 2010, I attended the 15th International Conference on Diseases of Fish and Shellfish organized by the EAAP in Split, Croatia. This conference, which is held every 2 years, is definitely one of the largest in my field: it attracted this year approximately 400 delegates from 39 countries in order to discuss and present the latest developments in terms of fish and mollusc health. The presentations were a unique opportunity to explore the diversity of approaches used in terms of epidemiological and disease investigation. I was also pleased to learn about recent findings in my own area, and as a second year PhD student, I even had the chance to present some of my own research on the "Genomic Diversity of *Streptococcus agalactiae* from aquatic hosts". My presentation was well received and I was given positive feedback.

The conference was an incredible experience from an intellectual and social point of view. I would like to express my gratitude to the FSBI for its generous travel award – without it such experience would not have been possible!

[c.m.delannoy@stir.ac.uk](mailto:c.m.delannoy@stir.ac.uk)

## **Giuseppe Paladini, also a PhD student at the Institute of Aquaculture, University of Stirling travelled first to Chile.**

In September, facilitated by an FSBI award, I travelled to Viña del Mar, Chile to participate in the 8<sup>th</sup> International Symposium of Fish Parasites (ISFP8) where I delivered two oral communications. My first talk focused on the creation of a centralised database "MonoDb" (available at [www.monodb.org](http://www.monodb.org)) which represents the collaborative output from an international team of six researchers working in five countries, i.e. Italy (myself), UK (A.P. Shinn & J.E. Bron), Mexico (M. Rubio-Godoy), Australia (I.D. Whittington) and Brazil (M.V. Domingues). This unfunded initiative aims to create a "one-stop" resource for the monogenean-researching community providing easy, open access to information (i.e. images, morphological and molecular data, museum slide holdings and references) on the 900+ currently known monogenean genera. The premise is that this resource will facilitate and accelerate species descriptions and identifications by removing the usual bottlenecks associated with accessing type specimens held in museums. I was delighted by the number of people attending this talk, the great number of positive and constructive comments I received and by the offers of further contributions to assist in populating MonoDb. My second talk, which immediately followed my first, focused on the discovery of a new morphotype of *Gyrodactylus salmonis* (Platyhelminthes, Monogenea) within Mexico which is well outside its natural distribution in Canada and northern U.S.A.

The ISFP conference, which meets every four years, was attended by approximately 200 delegates from all over the world, who descended on Viña del Mar to discuss the latest developments in aquatic parasitology. In all, 81 talks, 20 keynote speeches and 140 posters were delivered over the 5 day scientific programme. The host of the next ISFP9 in 2015 is Spain.

The entire conference experience was fantastic and unique – I met numerous researchers working on similar problems and through a number of constructive discussions I am now part of several new collaborations which, without any doubt, will significantly improve my knowledge and networking in the field of aquatic parasitology. Without the generous FSBI travel award, this personal and professional experience would not have been possible. I am extremely grateful to the FSBI and would like to thank it for its incredible assistance in giving me the opportunity to attend and to present at this high level conference. Thank you.

Giuseppe has also reported on his visit to the 15th International Conference on the Diseases of Fish and Shellfish, 12th-16th September, Split (Croatia) but as Sean Monaghan, also from Stirling has reported on this conference, I will leave it to Sean to report for them both. The conference was held at the Radisson Blu Hotel, Split, Croatia, which was recently opened. Sean writes:

Thanks to the travel grant rewarded by the FSBI, I had the chance to present my PhD work at this major international conference which was attended by around 500 delegates from around the world with 153 oral presentations and 293 poster presentations by scientists with various research backgrounds in fish disease and pathology. The range of topics included immunology, parasitology, bacteriology, toxicology, virology, vaccine development and diagnostics amongst others. I presented a poster entitled 'Molecular and Immunological Detection of Koi herpesvirus during the early stages of infection' and an oral presentation on 'Applications of serological diagnostics for Koi herpesvirus: Developments and challenges of DIVA strategies' in front of an audience of experts and peer scientists which was a fantastic experience with lots of encouraging and positive feedback as well as advice on the approaches I have taken.

There were various sessions on wild and cultured fish diseases, treatments and diagnostics thus providing an insight into research areas other than my own. This forum provided the perfect platform for me to exchange ideas and develop collaborations with researchers working on other notifiable diseases. I was able to discuss the feasibility of utilising this vaccination strategy not only for carp against koi herpesvirus but for other fish species which allows for the differentiation between infected and vaccinated animals

using specific antibody responses thus providing a potential means for vaccinating fish against notifiable diseases without compromising biosecurity programmes. The social events also provided a more open exchange of ideas which is sometimes more difficult in a formal setting.

There was a great variety of approaches to vaccination and diagnostics in fish which I found particularly interesting and useful including the use of BCG vaccination for innate protection against nodaridiosis in Japanese flounder presented by Kato et al. and the inhibition of virus virulence using RNA aptamers presented by Aoki et al. Such broad research areas as these presented at the conference have provided me with many ideas for future prophylactic approaches to fish disease.

I would again like to express my sincere gratitude to the FSBI for giving me the opportunity to communicate, collaborate and present at an international level at one of the most important conferences in my field and thank the society for offering such a useful and beneficial scheme for supporting the development of its research members with this award.

## **Tak Fung, a PhD student at the School of Biological Sciences, Queen's University Belfast, used his travel grant to attend the ICES Annual Science Conference (ASC) in Gdansk, Poland, 18th to 23rd September 2011**

On a peaceful Sunday afternoon, I arrived in Gdansk to attend the ICES Annual Science Conference (ASC), held at the city's Music and Congress Centre. The spotlight was on the application of science to marine ecosystem management. Throughout the following week, I participated in many theme sessions that enriched my knowledge of biological processes, particularly pertaining to fish, and fisheries management. Both strands can feed into the modelling work that I am doing. In particular, I presented my talk "Predicting Recovery Trajectories for the Large Species and Large Fish Indicators", in a session on projecting future states of marine fish stocks and food webs. I also presented a poster, "Signatures of Fishing on Marine Food Web Structure", which resulted in lively and constructive discussion. Interspersed among the sessions were numerous breaks; these provided the perfect window for me to network with existing collaborators and new researchers. In addition to these engaging research-oriented activities, it was also a pleasure to experience Polish culture, including a visit to the remarkable castle in Malbork. My trip to Poland has broadened and deepened my scientific and cultural worldview, and I am very grateful for the FSBI Travel Grant that made this journey possible.

10<sup>th</sup> International Congress  
on the Biology of Fish



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Madison, Wisconsin

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# Notices

## **Unique Winter Training Opportunity for Acoustic Tag & Hydroacoustic Assessments Hosted by University of Washington Student Chapter of the American Fisheries Society**

### *Using Acoustic Tags to Track Fish*

2-3 February 2012 • 9:00 am to 5:00 pm

At University of Washington School of Aquatic Fishery Sciences, Seattle, WA

[http://www.HTTIsonar.com/at\\_short\\_course.htm](http://www.HTTIsonar.com/at_short_course.htm) \_This short course addresses all aspects of tracking fish movement with acoustic tags, including three-dimensional tracking with sub-meter resolution. The course includes hands-on-operation and a variety of applications are covered. Lunch is provided.

For more info or to save a seat, [email support@HTTIsonar.com](mailto:support@HTTIsonar.com).

### *Using Hydroacoustics for Fisheries Assessment*

9-10 February 2012 • 9:00 am to 5:00 pm

At University of Washington School of Aquatic Fishery Sciences, Seattle, WA

[http://www.HTTIsonar.com/ha\\_short\\_course.htm](http://www.HTTIsonar.com/ha_short_course.htm)

\_The hydroacoustic short course covers mobile and fixed-location survey techniques, and subjects include basic hydroacoustic theory, deployment logistics, data collection and processing, as well as typical results.

Split-beam, single-beam, and multi-beam frequency techniques are discussed in detail.

Lunch is provided.

For more info or to save a seat, [email support@HTTIsonar.com](mailto:support@HTTIsonar.com).

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**Secretary:**  
Professor Brian Eddy  
Faculty of Life Sciences,  
Biological Science Institute,  
University of Dundee, Dundee,  
DD1 4HN, UK  
Tel: +44 (0)1382 344292  
Fax: +44 (0)1382 344275  
E-mail: [Secretary@fsbi.org.uk](mailto:Secretary@fsbi.org.uk)

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