



FRDC

FISHERIES RESEARCH &
DEVELOPMENT CORPORATION

FINAL REPORT (DEVELOPMENT AWARD)

AWARD CODE and TITLE

2008/314.45 People Development Program: 2014 FRDC International Travel
Bursary - Dr Zoe Doubleday

AWARD RECIPIENT: Dr Zoe Doubleday

ADDRESS: The University of Adelaide, DX 650 418, North Terrace, South Australia,
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HOST ORGANISATION: The University of Adelaide

DATE: 13/11/2014

ACTIVITY UNDERTAKEN

I attended the *5th International Otolith Symposium* in Mallorca (Spain) and presented a research paper. I subsequently visited IFREMER's (French Research Institute for Exploitation of the Sea) Mediterranean Fisheries Science Laboratories in Sete (France) and presented an overview of our biochronology research at the University of Adelaide.

OUTCOMES ACHIEVED TO DATE

1. The development activities undertaken provided significant networking opportunities, and have strengthened my research connections, particularly at an international level. I met with researchers informally at the conference and discussed various collaborations with my hosts at IFREMER.
2. Attending the *International Otolith Symposium* ensured that I am at the forefront of otolith-based science and that my continued research in this area is globally-relevant, up-to-date, and novel. This will also have flow-on benefits to the multiple Honours and PhD student projects I supervise, both currently and in the future.
3. The activities undertaken provided an excellent opportunity to promote my research to a global audience, both in person and via social media. I also received useful feedback on my research from experts in the field.

Acknowledgments

I would like to acknowledge my colleagues at the University of Adelaide for providing data and information for my presentation at IFREMER (Prof Bronwyn Gillanders, Ms Talia Wittmann, Ms Gretchen Grammer and Dr Chris Izzo), as well as Dr Sylvain Bonhommeau for hosting my visit at IFREMER. My activities were supported by the University of Adelaide (my host organisation).

Background

I attended the *5th International Otolith Symposium* in Mallorca (Spain) and presented the research paper (submitted abstract detailed below).

Broad and local scale drivers of growth of an estuarine fish species and implications for climate change

Zoë Doubleday, Christopher Izzo, James Haddy, Jeremy Lyle, Qifeng Ye, Bronwyn Gillanders

The analysis of annual growth increment patterns or 'growth chronologies' within the hard, calcified tissues of aquatic species, such as fish otoliths, can provide valuable information about how an individual grows throughout its lifetime and what key environmental variables influences that growth. We examine and compare broad and local scale drivers of the growth of black bream (*Acanthopagrus butcheri*), an economically important fish species found throughout temperate estuaries in southern Australia, using otolith growth chronologies. Sectioned otoliths were sourced from two pre-existing collections representing two climatically divergent regions in south-east Australia: the Lower Lakes-Coorong estuarine system in South Australia, characterised by a relatively warm, dry climate, and the east coast estuaries of Tasmania, characterised by a relatively cool, wet climate. Annual otolith growth increments were counted and measured in fish from 7 to 23 years old, encompassing the period from 1985 to 2010. Using a mixed modelling approach, we relate inter-annual growth variation to local scale changes in air temperature (proxy for water temperature) and rainfall (proxy for freshwater flows) and broad scale changes in relevant climatic indices (Multivariate ENSO Index and Southern Oscillation Index). Based on this analysis, we make predictions on how the growth of black bream, and thus the productivity of bream populations, may be impacted in the future based on climate change projections. This study further validates the use of growth chronologies, a new and emerging field of science, as a valuable tool for understanding long-term ecological responses to environmental change in aquatic systems.

I subsequently visited IFREMER's (French Research Institute for Exploitation of the Sea) Mediterranean Fisheries Science Laboratories in Sete (France) and presented an overview of our biochronology research at the University of Adelaide (submitted abstract detailed below).

Reconstructing the past using aquatic biochronologies

Zoë Doubleday, Christopher Izzo, Talia Wittmann, Gretchen Grammer, Bronwyn Gillanders

Long-term ecological datasets are vital for investigating how species respond to changes in their environment. However, there is a critical lack of such datasets from aquatic systems. Extensive archives of calcified tissues, such as fish ear bones (otoliths), mollusc shells and mammal teeth, represent an underused resource which can be used to reconstruct ecologically-relevant attributes, such as growth, as well as past environmental conditions. A key attribute of these tissues is that they typically grow incrementally relative to somatic growth. The analysis of annual growth increment patterns or 'growth chronologies' can thus be used to reconstruct continuous, annually-resolved growth histories of individuals and populations. Dendrochronological time-series modelling has been traditionally used to develop growth chronologies, however, mixed-effects modelling techniques are being increasingly applied to generate more ecologically meaningful chronologies. I present work from four studies from southern temperate Australia and New Zealand which examine the decadal and multi-decadal growth histories of several marine, estuarine and freshwater fish species, as well as New Zealand fur seals, using otolith and teeth chronologies respectively. To determine drivers of inter-annual growth variation, in each study, growth was subsequently related to relevant climatic variables. Finally, I present some recent, developing work on analogous otolith 'chemical chronologies' and their potential for reconstructing ecologically-relevant environmental histories.

Need

The *International Otolith Symposium* is only held every five years and was possibly the most important conference I could attend during my four-year post-doctoral appointment at The University of Adelaide. The Symposium provided a platform for the exchange of information and promoted the development of novel techniques and applications for otolith-based analysis in ecology and fisheries management. My research, under the direction of Prof Bronwyn Gillanders, is focussed on examining long-term changes in fish populations, associated with climatic variability and human impacts, through the use of otolith microchemistry and sclerochronology (growth pattern analysis). I also supervise multiple Honours and PhD student projects related to fish otoliths and other calcified tissues. The Symposium was thus highly relevant to my key field of research.

The Mediterranean Fisheries Science Laboratory in Sète, France, is Europe's leading research group in ecosystem focussed fisheries management. The group develops innovative tools to assess global change impacts to marine ecosystems, with a particular emphasis on the resistance and resilience of exploited populations. This complements the research strengths of Prof Gillanders research group at The University of Adelaide. Visiting the laboratories in Sète thus provided further opportunity to foster international collaboration and exchange research skills and expertise in fish and fisheries research.

Funding opportunities for travel are limited for early career researchers and the International Travel Bursary provided necessary financial support to undertake the proposed activities. I maximised the funding and benefit of the bursary by combining conference attendance with a laboratory visit.

Objectives

1. Attend the *5th International Otolith Symposium* and present a research paper entitled "Broad and local scale drivers of growth of an estuarine fish species and implications for climate change."
2. Visit IFREMER's (French Research Institute for Exploitation of the Sea) Mediterranean Fisheries Science Laboratories and present an overview of my research at the Laboratories' weekly seminar series.
3. Develop collaborative linkages with a range of researchers at the Symposium and IFREMER.

All of the original objectives were met. More specifically relating to objective 2, I presented an overview of the biochronological research our lab at the University of Adelaide has undertaken, including 3 papers I was involved with.

Methods

CONFERENCE ATTENDANCE

5th International Otolith Symposium, Palma Mallorca (Balearic Islands, Spain); 20th-24th October 2014

Activities undertaken: Presented a research paper (see Background section for more details), developed collaborative links with fellow researchers, and gained further insights into the latest otolith-based research. I also received particularly useful feedback from my presentation in regards to mix modelling techniques.

LABORATORY VISIT

Mediterranean Fisheries Science Laboratory, IFREMER, Sète (Languedoc-Roussillon, France); 30th October 2014; host: Dr Sylvain Bonhommeau

Activities undertaken: Presented a research overview at IFREMER as part of their weekly seminar series (see Background section for more details), and exchanged research ideas with fellow researchers. Several areas of research were discussed with Drs Sylvain Bonhommeau and Tristan Rouyer (IFREMER), including the incorporation of Dynamic Energy Budget modelling in otolith chronology (ie. fish growth) studies, octopus ageing techniques for fisheries management applications, and potential collaboration on a University of Adelaide project investigating global fluctuations in cephalopod abundance.

RESEARCH PROMOTION/EXTENSION

In addition to the two presentations, two posts were placed on the Australian Society for Fish Biology's (ASFB) Facebook page (and shared with FRDC's page). I am also currently involved with the production of three scientific papers from the research I presented (one of which I am lead author), and will co-write an article for FISH if requested (as outlined in the contract).

Results/Discussion

The development activities undertaken provided significant networking opportunities, and have strengthened my research connections, particularly at an international level. I met with researchers informally at the conference and discussed various collaborations with my hosts at IFREMER. Attending such an important and relevant conference ensured that I am at the forefront of otolith-based science and that my continued research in this area is globally-relevant, up-to-date and novel. This will also have flow-on benefits to the multiple Honours and PhD student projects I supervise, both currently and in the future. The activities undertaken also provided an excellent opportunity to promote my research to a global audience, both in person and via social media. I also received useful feedback on my research from experts in the field. As an early career researcher (5 years post-PhD), such benefits are timely and will undoubtedly help foster a long-term career in fish- and fisheries-related research.

Benefits and Adoption

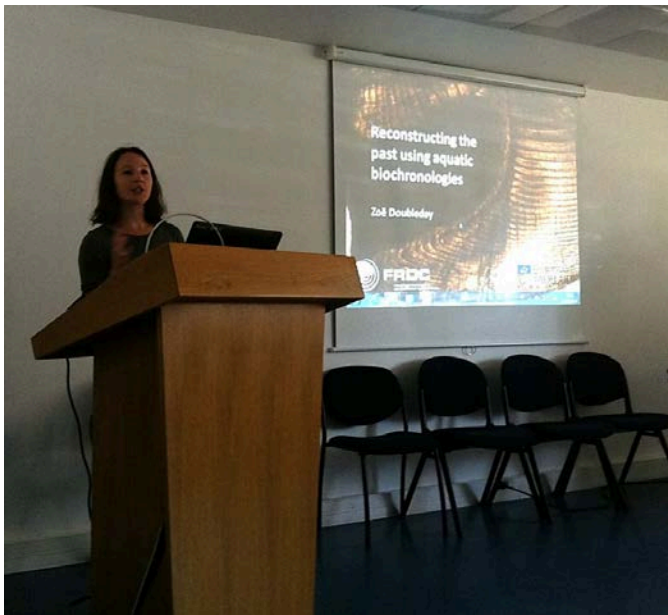
The activities undertaken promoted Australian research and the FRDC at a key international conference (highly relevant to fish- and fisheries-related research) and a leading European fisheries research laboratory. This was not only achieved through my presentations, but via social media (e.g. two posts regarding my activities were made on ASFB's Facebook page and shared with FRDC's page). The new knowledge I gained will build research skills and capacity in Australia in regards to the latest otolith-based research, which will have significant flow-on benefits to industry. My activities have also fostered collaborative links between Australian and international fish ecologists and fisheries scientists.

Further Development

Inform/invite successful applicants to FRDC training programmes, especially in regards to science communication and engagement (e.g. the media engagement workshop held at SARDI Aquatic Sciences on the 29th October 2014 in Adelaide). This would help build science communication skills, with flow-on benefits for research extension/promotion in relevant fields, as well as community engagement and outreach in line with FRDC principles.

Appendices

Photos posted on the ASFB Facebook page and shared with FRDC's page. Posts identified FRDC as the funding body for development activities.



In Sete, France



In Mallorca, Spain (myself and Dr Skye Woodcock, who also received the travel bursary)