

FRDC People Development Programme: International Travel Bursary Development Award

Benjamin M. Chuwen



**MURDOCH
UNIVERSITY**
PERTH, WESTERN AUSTRALIA



Centre for Fish and
Fisheries Research



Australian Government

**Fisheries Research and
Development Corporation**

Project No. 2008/314.14

Fisheries Research and Development Corporation Report
FRDC project 2008/314.14

FINAL REPORT (DEVELOPMENT AWARD)

2008/314.14

FRDC People Development Programme:

International Travel Bursary

AWARD RECIPIENT: Benjamin M. Chuwen

HOST ORGANISATION: Murdoch University

ADDRESS: South Street, Murdoch WA 6333

DATE: January 2010

ACTIVITY UNDERTAKEN

Attendance at the 4th International Otolith Symposium in Monterey, California 2009, including a presentation at the conference and meetings with professionals concerned with the implementation of marine protected areas.

OUTCOMES ACHIEVED TO DATE

My attendance at the 4th International Otolith Symposium and presentation of innovative methods that were developed as part of an FRDC research project (FRDC Project 2006/044) to assess the effects of interannual variations in environmental characteristics on the growth of fish generated a great deal of discussion and debate on an international level. This Development Award thus brought appreciable international attention to the work of staff at Murdoch University's Centre for Fish and Fisheries Research and the involvement of the FRDC in world-class cutting edge research. This feedback on the methods that we developed are invaluable for fine-tuning their application and will greatly assist in their uptake by the international and thus, also, the Australian, scientific community. My interaction with many international leaders in various fields concerned with fisheries biology and otolith research has resulted in a number of professional associations that are likely to lead to future collaborations and has expanded the breadth and scope of the types of projects that I will develop in the future. Such increased knowledge and the potential of collaborative partnerships with international leaders in otolith research have thus broadly expanded my professional capacity. Moreover, the dissemination of the recent trends in otolith research to fisheries researchers at Western Australia's peak fisheries research training centre, Murdoch University's Centre for Fish and Fisheries Research, will contribute to the on-going high quality and contemporary delivery of fisheries research training in Western Australia.

Acknowledgments

I would first like to thank Professors Ian Potter and Norm Hall for their assistance in developing the analytical approaches that I presented at the 4th International Otolith Symposium in Monterey, California in August 2009. Gratitude is also extended to Mr Richard Stevens (Western Australian Fishing Industry Council) for his support and suggestions to include meetings with professionals concerned with the implementation and monitoring of the Monterey Bay Marine Sanctuary as part of this professional development award. Thanks are given to staff of the National Oceanographic and Atmospheric Administration, Monterey Bay Aquarium and Seymore Marine Discovery Center for giving their time to meet with me to discuss various issues associated with marine protected areas. I greatly appreciate the opportunity granted by the FRDC to undertake this professional development project and I also thank Murdoch University for supporting my development.

Background

Australia requires the development of fisheries scientists to assist the fishing industry to meet its future needs. This includes the development of scientists who possess a suite of professional attributes, including leadership and technical skills. As an early-career scientist, I participated in the 2007 National Seafood Industry Leadership Programme, which enabled me to develop a number of the skills necessary for an effective career that will assist in sustaining the Australian fishing industry. My PhD studies have involved working on the biology of Black Bream in Western Australian estuaries and included the development of a technique using otolith increment measurements to assess the effects of interannual differences in environmental conditions on the growth of this commercially and recreationally important estuarine fish species. I have recently completed a Postdoctoral Research Fellowship at Murdoch University and was employed under a FRDC Tactical Research Fund project that has developed an agent-based model to communicate the implications of recruitment variability of finfish to recreational fishers. This project relies upon the use of otoliths for ageing fish and is an example of the many applications to fisheries management of otolith related research. The rapid development of the use of otoliths for fisheries management has led to an international meeting of scientists each 4-5 years to discuss advances in this field, with the 4th International Otolith Symposium having been held in Monterey, California in August 2009.

Monterey, California is a major management and research centre for one of the world's largest marine protected areas (MPAs), the Monterey Bay National Marine Sanctuary. Given the increasing rate of implementing MPAs in Australia, the lessons learnt from the development of the Monterey Bay National Marine Sanctuary are likely to be useful in assisting in the smooth transition into such management approaches for our natural resources in Australian waters.

Need

The Australian fishing industry requires the development of people that will assist in ensuring the sustainability of Australia's fish resources. Such development must include aspects that will enhance leadership capabilities, industry capacity and the transfer of knowledge throughout the sector. One of the most important aspects of fisheries biology is the ageing of fish for use in fisheries management. This is a rapidly expanding area of research and leading scientists convene each 4-5 years to present and discuss recent developments in this field, with the 4th International Otolith Symposium having been held in Monterey, California in August 2009. Murdoch University's Centre for Fish and Fisheries Research is Western Australia's peak fisheries research training centre and it is thus necessary for staff to continue to be skilled in the most up-to-date techniques and methods to enable the centre's high calibre training to continue. My attendance at the 4th International Otolith Symposium was thus important not only for my personal professional development, but also for the development of future fisheries researchers in Western Australia.

Objectives

1. Further develop the capacity of an early-career fisheries research scientist.
2. Enhance the scientific capacity of the Australian fishing industry.

Methods

During my PhD studies, I have, together with Professors Ian Potter and Norm Hall, developed a technique that allows an assessment of the effects of interannual variations in environmental characteristics on the growth of fish. I presented the methods and the results of their application to Black Bream in Western Australian estuaries at the 4th International Otolith Symposium in Monterey, California in August 2009.

My attendance at the symposium enabled me to gather information on the development of this growing aspect of fisheries biology and create professional contacts that are likely to lead to future collaborations. I presented a synopsis of the conference to staff from Murdoch University and other colleagues and stakeholders at a meeting at Murdoch University in December 2009, at which I also gave a presentation on the innovative methods that I developed during my PhD.

Whilst in northern California, I took the opportunity to meet with a number of professionals concerned with the management and/or monitoring of the Monterey Bay National Marine Sanctuary. Thus, I met with Mike Eng (National Oceanographic and Atmospheric Administration), Chris Burns (Seymore Marine Discovery Center) and numerous staff of the Monterey Bay Aquarium and Monterey Bay Aquarium Research Institute.

Results/Discussion

This professional development award has had a number of very positive outcomes for both my professional development and for the capacity of fisheries researchers in Australia and overseas. The methods that we have developed as part of FRDC Project 2006/044 “Implications of environmental change and mortality estimates for sustaining fish populations in south coast estuaries” to assess the effects of interannual variations in environmental characteristics on the growth of fish will have broad applicability and were well received at the otolith conference. My work generated a large amount of discussion among the conference delegates, many of who are international leaders in the various fields of fisheries biology that focus on otoliths. The publication of the methods and results as a case study on Black Bream in south-western Australian estuaries in a peer-reviewed international journal is likely to lead to an appreciable number of citations as fisheries biologists adopt these new and innovative methods. The many professional contacts that I

attained during the proceedings of the conference are very likely to lead to future collaborations, which will be invaluable for my personal professional development and ultimately for increased capacity of fisheries researchers in Australia.

One of the most striking outcomes of the symposium was the emergence of a relatively new field of otolith related research, namely sclerochronology, which is the study of growth zones in otoliths that are usually related to past environmental conditions. The methods that Professors Ian Potter, Norm Hall and I have developed have broad applicability to this field of research as they have resulted in a mechanistic model that describes the relationship between the age and growth of fish and their otoliths. Thus, these methods address some of the principal assumptions that are made in sclerochronological studies and enable the decoupling of otolith and fish growth to be accounted for in this type of work. Other trends that were of interest in otolith research include an approximate 9% increase in the dominance of chemistry-related otolith research since the previous otolith conference in Cairns (2004) and an approximate 18% decrease in the prevalence of traditional age and growth studies using otoliths in fishes. An important output from the conference was the development of a web-based forum for the dissemination of information concerned with chemistry-related otolith research (see www.otochem.net). The dissemination of these trends to researchers at Murdoch University has provided such workers with information on the emerging foci of otolith research and will ultimately lead to Australian fisheries researchers being up-to-date and thus also competitive with the international scientific community concerned with such research.

As a result of meetings with professionals concerned with the management and/or monitoring of the Monterey Bay National Marine Sanctuary, a number of very clear “lessons learnt” have emerged. 1) It should be made very clear at the outset of the development of a marine protected area (MPA) what the level of proposed protection will be, *e.g.* will the area be a no-take zone or only restrict such commercial operations as mining. 2) Proponents of such MPAs should not promise stakeholders results that MPAs, and particularly no-take zones, do not necessarily deliver, *e.g.* that such areas will inevitably lead to increased fisheries production in areas adjacent to the MPA. The aim of a MPA should thus be to protect a certain area and its biota. 3) Community members and stakeholders must be consulted through every step of the MPA development process such that these groups feel stewardship for the areas and their management plans and do not feel

that implementation will occur “with or without” their input. 4) Adequate resources must be made available for monitoring the effects of MPAs, including the environmental, social and economic effects of such protected areas. Such research should include baseline surveys to which any future changes as a result of a MPA can be compared.

Benefits and Adoption

All sectors of the fishing industry could potentially benefit from the increased capacity of fisheries researchers concerned with studies involving the age and growth of fishes and, particularly those that are responsible for training an appreciable proportion of fisheries scientists in Western Australia, *i.e.* staff of Murdoch University’s Centre for Fish and Fisheries Research. Thus, the increased capacity of Australian fisheries scientists concerned with the age and growth of fish will contribute to more robust management of Australia’s fisheries resources and thus also to the sustainability of these important natural resources.

The publication and dissemination of the methods that were developed for assessing the effects of interannual variations in environmental characteristics on the growth of fish will contribute to the adoption of these methods by fisheries scientists in Australia and throughout the world.

Further Development

The next stage of the development and dissemination of the methods for the assessment of the effects of interannual variations in environmental characteristics on the growth of fish is to publish those methods and the results of their application to Black Bream in south-western Australian estuaries in an appropriate peer-reviewed international journal. Once published, the methods will be made available free-of-charge on the Murdoch University Centre for Fish and Fisheries Research website, which will assist in their widespread uptake and use. Further studies investigating the application of the methods to other fish species in south-western Australia are currently being developed.

A number of Australian delegates at the otolith symposium have since arranged a series of workshops in Perth and Adelaide that were presented by Dr Bryan Black (Oregon State University) and focused on developing historical chronologies based on otolith increment analysis, similar to that developed by dendochronologists using annual growth

rings in trees. These workshops have led to potential international collaborations and the use of the methods that I presented at the otolith symposium, which challenge a number of the assumptions of such chronologies, will help to ensure the correct interpretation of the patterns of growth in fishes' otoliths and thereby lead to stronger outputs in this field of fisheries and related climate research.

Further development of my professional capacity will continue through my appointment as a Postdoctoral Research Fellow at Murdoch University's Centre for Fish and Fisheries Research.

Appendix 1



Group photograph of the delegates who attended the 4th International Otolith Symposium in Monterey, California in August 2009. The author is circled in red.