



FINAL REPORT (DEVELOPMENT AWARD)

AWARD CODE and TITLE

2008/328.22 People development program: 2014 FRDC Visiting Expert Award

AWARD RECIPIENT: Dr Dan Gwinn

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HOST ORGANISATION: Fisheries Victoria, Department of Economic Development, Jobs, Transport and Resources, Victoria.

DATE: 15 May 2015

ACTIVITY UNDERTAKEN

Enabling Dr Dan Gwinn, internationally renowned quantitative fisheries ecologist, to meet and collaborate with Australian fisheries researchers and managers to optimise outcomes for high profile/value species and fisheries.

OUTCOMES ACHIEVED TO DATE

- Model developed to estimate site specific abundance of Murray cod using multiple data types including SRA style fish sampling, cod-targeted electrofishing, and angler catch data.
- Experimental design to evaluate the performance of the various data types and the model for providing estimates of abundance of Murray cod.
- Collaboration on an evaluation of analytical methods for dealing with the abundant data that is collected with acoustic telemetry data for game fish. Analytical options for improving environmental flow science and, hence, the ability to management riverine fish populations through flow manipulation.
- Networks and collaborations developed through this visit have be maintained beyond completion of this initiative.

Acknowledgments

The following organisations and individuals are thanked for assisting with Dr Dan Gwinn's visit to Australia. Fisheries Victoria (Department of Economic Development, Jobs, Transport and Resources (DEDJTR) as host organisation and staff including Anthony Forster and Taylor Hunt. Staff at the Arthur Rylah Institute (Department of Environment, Land, Water & Planning), including Charles Todd and Jarod Lyon. Matt Taylor on behalf of the NSW Department of Primary Industries at the Sydney Institute of Marine Science. Belinda Quinton and Malcom Robb (Department of Water, WA). Paul Close (University of Western Australia).

Background

Optimising fisheries management outcomes for high profile/value species and fisheries requires high-quality, science-based, monitoring and assessment of stocks. As a consequence large, long-term, datasets have been accumulated for many of these species and fisheries.

Interpreting these existing fisheries datasets, that often contain unique or species/fishery specific information, requires an innovative analysis and modelling approach to ensure that accurate and unambiguous conclusions can be drawn to inform management decisions. Equally, modifying existing, and designing new cost effective and efficient monitoring programs should take into account data analysis to optimise outcomes.

As an example, the value of this approach has been recognised by the National Murray Cod Fishery Management Group as a means to improve the understanding of the status of Murray cod throughout its distribution. Historical fishery data, which is limited spatially, has been collected across different jurisdictions using different methods that has prevented easy aggregation/comparison of data. A FRDC Project (2013/022) has been commissioned to develop an innovative and cost effective approach for monitoring and analysing data from Murray cod populations, in partnership with recreational fishers, utilising both historical and contemporary datasets in an integrated manner to establish the status of this species.

Need

Dan Gwinn is an internationally renowned quantitative fisheries ecologist with technical expertise in several key areas that will benefit the management of Australia's fisheries. Of particular interest to FRDC are his expertise in parameter estimation, monitoring design, and fisheries modelling. Dr Gwinn is experienced in developing innovative estimation methods to specifically deal with the inherent issues with imperfect data as is the case for fisheries and ecological research. Dr Gwinn's work in this area has focused on the customization of statistical models to account for the specific idiosyncrasies of data sets to best extract biological information and inform the management decision process. Often, this work had included developing innovative analyses of existing data sets to answer new questions. Dr Gwinn also has expertise in use of analysis tools including the application of stochastic simulations for evaluating and optimizing experimental and monitoring designs, which are particularly useful for determining the most fiscally efficient sampling designs for meeting monitoring objectives.

We proposed to facilitate a study tour for Dr Gwinn to enable him to meet with fisheries researchers and managers from several jurisdictions to review and discuss key freshwater and marine projects, present to the research and management community on innovative methods being employed in the United States to address common issues, and workshop strategies to enhance adoption of R&D outputs.

We believe that this visit has delivered significant benefits to the future management of several Australia's fisheries resources.

Objectives

To enable Dr Dan Gwinn to meet with Australian leaders in fisheries research and management as part of a coordinated program of meetings, workshops and presentations, to optimise outcomes delivered for high profile/value species and fisheries in eastern Australia.

Methods

Dr Gwinn travelled to Australia and engaged in a program of meetings, workshops and presentations in New South Wales, Western Australia and Victoria.

Dr Gwinn travelled to Victoria to meet with the project team for FRDC project 2013/022 "Integrating fisher-derived and fishery-independent survey data to better understand and manage the Murray Cod fishery in the Murray-Darling Basin" and provide technical assistance through a review of proposed experimental design prior to implementation of this nationally-significant project. Dr Gwinn also met with Dr Jim Thompson to discuss environmental flow research. Additionally, Dr Gwinn delivered presentations to Victorian researchers and managers, including members of the Murray Cod Fishery Management Group under the Australian Fisheries Management Forum, on new research which is prompting the international fisheries community to rethink length-based fisheries regulations.

Dr Gwinn travelled to the Sydney Institute of Marine Science/Port Stephens in NSW to meet with key managers and researchers. Discussions focused on monitoring and managing game fish fisheries (dolphinfish and kingfish), and refining stocking modelling which incorporate predator/prey relationships and habitat variables to estimate carrying capacity.

In Western Australia, Dr Gwinn met with researchers to discuss methods of analysing and interpreting environment flow data for improving management of fish stocks through flow manipulation

Results/Discussion

Visits, meetings and workshops conducted during the visit by Dr Gwinn resulted in outputs and outcomes across a number of species and fisheries of commercial and recreational value. These are summarised below (see Appendix I for further details).

Murray cod. As part of the FRDC project 2013/022 "Integrating fisher-derived and fishery-independent survey data to better understand and manage the Murray Cod fishery in the Murray-Darling Basin", several meetings were conducted with project collaborators to develop the experimental design for project, and develop a model for the estimation of Basin-wide Murray cod abundance that incorporates multiple data types including SRA style fish sampling, cod-targeted electrofishing, and angler catch data.

Environmental flows and fisheries management. Discussions with researchers from University of Western Australia (Paul Close and Leah Beesley), LaTrobe University (Ben Gawne), Monash University (Jim Thompson), the Arthur Rylah Institute and Fisheries Victoria to evaluate use of environmental flow for managing fish. These discussions resulted in a draft manuscript being prepared for publication. The manuscript is titled, "Managing fish with environmental flows: can the prevailing scientific practices guide us?" (Gwinn, D.C., L.B. Beesley, P. Close, and B. Gawne

(In prep)) and addresses solutions to key scientific limitations that hinder our ability to manage fish with environmental flows.

Australian bass recreational fishery. Began collaboration with Gavin Butler of NSW DPI to summarize results and evaluate a long-term monitoring program that employs angler catch cards over multiple systems. Plans are to analyse current data and evaluate the program to improve cost efficiency and the quality of data.

Recreational game fisheries. Discussions with NSW DPI researchers and managers on analysis of diverse game fish datasets and monitoring CPUE trends among sites over differing time series

Sharks: Discussions with Matt Broadhurst (NSW DPI) to improve evaluation of shark catch statistics.

A list of presentations given by Dr Gwinn during his visit is provided in Appendix II.

Benefits and Adoption

The visit by Dr Gwinn has been invaluable to Australian fisheries researchers and managers, in terms of design and evaluation of fish monitoring and assessment methods.

Murray cod. The experiment design for the FRDC project 2013/022, which uses both fishery-dependent and fishery-independent data, and draws on historic fishery datasets, was finalised and adopted in field surveys conducted by NSW and Victoria during 2014/15. Dr Gwinn will continue to work with the project team to analyse the data as it becomes available. The model developed will estimate site specific abundance of Murray cod using multiple data types including SRA style fish sampling, cod-targeted electrofishing, and angler catch data. Field trials conducted during the project will evaluate the performance of the various data types and the model for providing estimates of abundance of Murray cod. The novelty of this work is that it seeks fiscally efficient monitoring designs through the integration of both existing and new sampling methods/data, thus, providing the potential for basin-wide indices of Murray cod abundance at a cost lower than could be achieved with current methods. One manuscript has been prepared from the work (Gwinn, D., Todd, C., Butler, G., Kitchingman, A. and Coggins, L. (in prep.). "Monitoring a threatened fish in the third largest river basin in the world: accounting for incomplete detection under budgetary limitations").

Recreational game fisheries. Discussions with NSW DPI through Dr Matt Taylor will lead to ongoing work and collaboration. An evaluation of analytical methods for dealing with the abundant data that is collected with acoustic telemetry has commenced.

Environmental flows and fisheries management. Key outcomes from discussions focused on improving environmental flow science and, hence, the ability to management riverine fish populations through flow manipulation. A collaboration was formed with the University of Western Australia to assess the use of a decision support tool (Zonation) to identify priority patches of an urban landscape for protection.

Further Development

This bursary has demonstrated the value of the program in advancing the use of quantitative fisheries ecology to improve species and fisheries assessment. The visit by Dr Gwinn was considered successful and productive given the number of new collaborative links established. Participation in meetings and presentations is a strong indicator of the interest in further development of quantitative fisheries ecology across fisheries agencies and research and education institutions.

While on-going support of the bursary program is recommended, consideration should be given to developing a training program specifically for application of quantitative ecology for analysis of large and complex fisheries datasets. This may be achieved through collaboration of education institutions and fisheries agencies to deliver an appropriately funded training package.

References

Gwinn, D.C., L.S. Beesley, P. Close, and B. Gawne. (In prep) Managing fish with environmental flows: can the prevailing scientific practices guide us?

Gwinn, D.C., C. Todd, P. Brown, G. Butler, A. Kitchingman, and L. Coggins (In prep) Monitoring a threatened fish in the third largest river basin in the world: accounting for incomplete detection under budgetary limitations.

Intellectual property

No intellectual property was generated as a result of this project.

Appendix I. Activities undertaken

What event	Location (date)	Key participants	Activity	Outcomes/outputs
Meeting	ARI, Melbourne (23/9/14)	Gavin Butler (NSW DPI)	<ul style="list-style-type: none"> Met with Gavin Butler to discuss monitoring of Australian bass in NSW. 	<ul style="list-style-type: none"> Began collaboration to summarize results and evaluate the Australian bass long-term monitoring program in NSW that employs angler catch cards over multiple systems. Plans are to analyse current data and evaluate the program to improve cost efficiency and the quality of data.
Meetings and Seminar	NSW Department of Primary Industries, Sydney (25-26/9/14)	Matt Taylor 40 participants. etc.	<ul style="list-style-type: none"> Met key managers and researchers including to discuss stocking modelling which incorporates predator/prey relationships and habitat variables to estimate carrying capacity Presentation - <i>Rethinking length-based fisheries regulations: The value of protecting old and large fish with harvest slots</i> (see Appendix II) 	<ul style="list-style-type: none"> Topics which were discussed included the analysis of kingfish and dolphinfish telemetry data, monitoring CPUE trends among sites over differing time series, analysis of recreational survey data, analysis of long-term Game fish mark-recapture data, estimating mortality from tag and fishery-dependent recapture data, analysis of telemetry data from dispersed arrays, long-term monitoring of stocking programs. Most of these discussion will lead to ongoing work and collaboration between Dr. Gwinn and NSW DPI fisheries researchers. Began collaboration with Matt Taylor to evaluate analytical methods for dealing with the abundant data that is

What event	Location (date)	Key participants	Activity	Outcomes/outputs
				collected with acoustic telemetry. The aim is to provide guidance for analysis methods and sample size when using acoustic telemetry to investigate patterns in the movement of coastal fishes.
Meeting	Government of WA, Department of Water (DoW), Perth (1/10/14)	Belinda Quinton and Malcom Robb	<ul style="list-style-type: none"> Met with Belinda Quinton, Malcom Robb (DoW), and Leah Beesley (UWA) to discuss possible collaboration on Water Sensitive Cities CRC research project. 	<ul style="list-style-type: none"> Formed collaboration to assess the use of a decision support tool (Zonation) to identify priority patches of an urban landscape for protection. Also discussed the potential to use biometric methods to validate stream typologies.
Meeting	University of Western Australia , Albany	Paul Close	<ul style="list-style-type: none"> Met with Paul Close and Leah Beesley to synthesize major problems with empirical evaluations of environmental flow for managing fish. 	<ul style="list-style-type: none"> Wrote a draft perspective manuscript for publication. Intended long-term outcome is to improve environmental flow science and, hence, our ability to management fish with flows.
Teleconference	ARI, Melbourne (22/10/14)	Matt Broadhurst (NSW DPI)	<ul style="list-style-type: none"> Teleconferenced about fisheries research methods 	<ul style="list-style-type: none"> Began collaborating on research evaluating shark catch statistics for conservation.
Seminar	ARI, Melbourne (23/10/14)	ARI and FV researchers and managers	<ul style="list-style-type: none"> Presentation - <i>Juvenile fish response to wetland inundation: implications for flow policies</i> (see Appendix II) 	<ul style="list-style-type: none"> Began collaboration with ARI scientists on evaluating the impacts of flows variation on Murray cod condition.
Meeting	ARI, Melbourne (23/10/14)	Jim Thompson (Monash University)	<ul style="list-style-type: none"> Met to discuss environmental flow research. 	<ul style="list-style-type: none"> Discussed problems and potential solutions for using SRA fish data for environmental flow research.

What event	Location (date)	Key participants	Activity	Outcomes/outputs
Seminar and Discussion	DEPI, 8 Nicholson St., Melbourne (24/10/14)	Anthony Foster, Paulo Lay, John Douglas, others	<ul style="list-style-type: none"> • Presentation – <i>Emerging tools for population monitoring: some fishy case studies</i> (see Appendix II) • Discussed knowledge gaps in the use of environmental flows to manage fish and possible solutions to the difficulties in field evaluations. 	<ul style="list-style-type: none"> • Provided an update on novel tools to resolve knowledge gaps in the management of fish and fisheries with regulations such as environmental flows and harvest slots.
Seminar	ARI, Melbourne (27/10/14)	ARI and FV researchers and managers	<ul style="list-style-type: none"> • Presentation – <i>Rethinking length-based fisheries regulations: the value of protecting old and large fish with harvest slots</i> (see Appendix II) 	<ul style="list-style-type: none"> • Provided an update on novel tools to resolve knowledge gaps in the management of fish and fisheries with regulations such as environmental flows and harvest slots. • Presented case studies from the USA and Australia where length-based fisheries regulations have been successfully applied.
FRDC Murray cod fishery project	Melbourne, Vic. (various dates)	ARI and FV researchers	<ul style="list-style-type: none"> • Developed model for the estimation of Basin-wide Murray cod abundance that incorporates multiple data types including SRA style fish sampling, cod-targeted electrofishing, and angler catch data. • Aided in the design of a field experiment to evaluate the performance of the various data types and the model for providing estimates of abundance of Murray cod. 	<ul style="list-style-type: none"> • Experimental design for evaluating angler-derived data for monitoring Murray cod. • A model that estimates site specific abundance of Murray code using multiple data types including SRA style fish sampling, cod-targeted electrofishing, and angler catch data. • Draft manuscript of SRA data evaluation for monitoring Murray cod.

What event	Location (date)	Key participants	Activity	Outcomes/outputs
			<ul style="list-style-type: none">• Evaluated the sole use of SRA electrofishing data for monitoring basin-wide abundance of Murray cod.	

Appendix II. Presentations

Date: 26/09/2014, 1-2 pm and 27/10/2014 1-2pm

Location: ARI, Melbourne and Sydney Institute of Marine Science, Sydney

Rethinking length-based fisheries regulations: the value of protecting old and large fish with harvest slots

Dan C. Gwinn, Micheal S. Allen, Fiona D. Johnston, Paul Brown, Charles R. Todd, and Robert Arlinghaus

Strategies for managing recreational fisheries are primarily based on theory developed for commercial fisheries in the middle of the 20th century. These methods aim to optimize the trade-off between fisheries yield and stock production by limiting harvest to fish of a minimum length, thus forcing harvest of large individuals. Furthermore, there have been few investigations of alternative length-based regulations that may optimize objectives more appropriate for recreational fisheries such as numbers harvested and trophy catch. In this paper we evaluated the relative performance of traditional minimum-length limits and less common harvest slot-length limits to optimize recreational fisheries objectives across a broad range of fish life histories, fisheries exploitation rates, and management objectives. The novelty of this paper is that we identified a universal advantage of harvest slots over minimum-length limits for optimizing recreational fisheries that value harvest, trophy catch and stock conservation. These results challenge the dogmatic application of minimum-length limits for managing recreational fisheries and support the uncommon strategy of harvesting an intermediate size while protecting both small and large fish.

Date: 23/10/2014 1-2pm

Location: ARI

Juvenile fish response to wetland inundation: implications for flow policies

Leah S. Beesley, Dan C. Gwinn, Amina Price, Alison J. King, Ben Gawne, John D. Koehn, and Daryl L. Nielsen

Increasingly, rivers are being managed with environmental flows to protect or restore aquatic ecosystems. Environmental flows are used by managers to provide an array of environmental benefits ranging from specific goals targeted at 'valuable' taxa, to more holistic goals that aim to reinstate general ecosystem patterns and processes. However, managers are faced with the challenge of balancing water used for maintaining or restoring ecosystem processes via environmental flows, with water used for other purposes such as providing drinking water, irrigation, and generating power for the public. Fresh water is consequently in great demand and if used for one purpose it cannot be used for others - this presents a substantial challenge for water managers. Because of the many competing demands placed on freshwater resources, environmental flows are often delivered sparingly and infrequently, leaving wetlands disconnected from the river for long periods of time. However, this may actually be counterproductive for native fish and beneficial for non-native fish

over the longer term. We demonstrate that the effects of environmental flows on wetland fish of the Murray River not only depends on the type of water allocation, but on the flow conditions prior to the delivery. In other words, the benefits for native fish realized from a water allocation can be dependent on the pattern of flows over the previous five years. This is an important finding because it can help managers formulate flow policies that navigate the trade-offs among the many competing demands for water in the Murray-Darling River Basin.

Date: 24/10/2014 3-4pm

Location: Nicholson St, Melbourne

Emerging tools for population monitoring: some fishy case studies

Dan C. Gwinn and Jarod Lyon

Managing fish resources is difficult because there is often tremendous uncertainty in the outcomes of management prescriptions. This is due in part to our inability to observe fish population response to policies without error. The issue is that the efficiency of sampling gears such as electrofishing, traps, and nets tend to only sample a small proportion of the true fish population and that this proportion inevitably varies across space, through time, among fish species, among sampling gears, and across environmental conditions. Thus changes in the efficiency of sampling are often incorrectly interpreted as changes in fish populations, leading to incorrect predictions of management outcomes and ultimately mismanagement. Estimating the efficiency of sampling can be done while simultaneously estimating population size, but often requires expensive sampling designs and high sampling effort and is, therefore, unobtainable for many fish resources. However, recent advances in analytical methods allow for the estimation of population size and sampling efficiency with smaller-scale efforts. The methods are a class of Bayesian hierarchical models that allow for the modelling of the biological process separately from the sampling process. These methods, when combined with sampling programs that employ multiple sampling gears can be a powerful monitoring tool. In this seminar I will present two case studies where these methods have been used successfully to learn about the management of fish diversity and fisheries when other methods failed. I will then present how we propose to use and test these methods for basin-wide monitoring of Murray cod with SRA sampling, cod-directed electrofishing, and angler catch data.
