THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

CARM Report

April 2010 – March 2015

Centre for Applications in Natural Resource Mathematics

Solving Australia's pressing natural resource and environmental problems

www.smp.uq.edu.au/CARM

Cover photos/images courtesy of:

DAFF	Department of Agriculture, Fisheries and Forestry (DAFF)	Kathy Townsend of University of Queensland (UQ)
'A unified likelihood approach' from the poster 'Modelling Growth Data from Crustaceans' by CARM Ph.D. student Chuan Hui Foo (UQ), under the supervision of Prof. You-Gan Wang (CARM) & Prof. Geoff McLachlan (UQ)		DAFF
Tony Courtney & Peter Kyne of DAFF		Tony Courtney & Peter Kyne of DAFF
CSIRO		DAFF

CENTRE FOR APPLICATIONS IN NATURAL RESOURCE MATHEMATICS (CARM)

Establishment, Aims and Growth

Initiated by DAFF to strengthen ties with UQ in the area of quantitative fisheries science, the Centre for Applications in Natural Resource Mathematics (CARM) in the School of Mathematics and Physics, at The University of Queensland was established in April 2010 to promote applied mathematics/statistics.

We are actively developing links with government and industry, particularly with the Queensland Department of Agriculture, Fisheries and Forestry (DAFF) and CSIRO. We share many post-graduate students with researchers from these institutions and these students are solving applied resource management problems.

We are training the next generation of applied mathematicians and statisticians to solve Australia's pressing natural resource and environmental problems.

Current Staff

You-Gan Wang: Director (2010 - present)
Prof. Wang's interests are statistical modelling and data analysis in environmental research, in particular for stock assessment and management strategy evaluation. In statistics, his interests are robust inference, dynamic decision theory and model selection in correlated data analysis.

Anthony Richardson: Deputy Director (2010 - present)
Assoc. Prof. Richardson has research interests in using mathematical tools and statistics to understand the impacts of humans on marine systems, particularly climate change.

Clare McGrory: Lecturer (Jan 2012 – present)
Dr McGrory is a Bayesian statistician. Her research focuses on developing efficient and practical Bayesian statistical methodology, in particular in the area of variational Bayes and MCMC-based techniques. Her interests include applications in analysing spatial data, wave direction modelling and genomic predictions within cattle breeds.

Dr Liya Fu: Research Fellow (Feb 2014 – present)
Dr Fu is a Research Fellow. Her research interests include rank regression; longitudinal data; and survival analysis.

Previous Staff

Peter Baxter: Lecturer (Jan 2011 – Dec 2014)
Dr Baxter's main research focuses on applied ecological modelling, in particular using decision theory with ecological and environmental models to find optimal strategies for invasive species control and threatened species conservation.

Ricardo Lemos: Lecturer (Jan 2012 – Nov 2014)
Dr Lemos develops Bayesian spatio-temporal methods and applies them to biological and environmental data. His research interests include high performance computing, multivariate data blending, and fingerprinting of human and natural causes of marine population fluctuations.

Shen Wang: Research Assistant (Jun 2012 – Dec 2014)
Mr Wang is finishing his PhD from the University of Wollongong and is interested in Markov Chain Monte Carlo, variational Bayesian methods, semiparametric regression, statistical modelling and data analysis. He is also interested in statistical computing and statistical software, such as R, Infer.NET and WinBUGS.

Current PhD Students

Andrew Harvey
Movement, population genetics, and ecology of manta rays in northern Australia and Indonesia

Andrew Jones
Estimation of genetic effective population size in fisheries

Chang Liu
Optimal dynamic allocation with consideration of return uncertainties and competing projects

Eunice (Chuan) Hui Foo
Stochastic growth models for analysing crustacean data

Katherine Burgess
Feeding ecology, movements and behaviour of *Manta birostris* in Ecuador

Michael Macbeth
Improving the utility of genetic markers in fish populations

Michael O'Neill
Standardisation of catch and effort in fisheries stock assessment

Mingzhu Sun
Applications of mixtures of skew distributions

Na Wang
Sustainability and optimality in fisheries management

Nanxi Zhang
Robust inferences for analysis of longitudinal data

Peter Rankin
State-space fisheries models: applying hierarchical Bayesian modelling to fisheries biomass dynamics

Rinat Akter
Bayesian Regression Model for Water Quality Data

Ryan Heneghan
Bioenergetics modelling of phytoplankton communities

Sarah Pausina
Zooplankton dynamics in Moreton Bay

Viv Tulloch
Ecosystem modelling and fisheries in tropical and temperate systems

Current Honours Students

Jacob Rogers
Modelling Crown-of-thorns outbreaks on the Great Barrier Reef

Madeleine Nargar
Robust metrics of climate change

Natsumi Nishikawa
Do cleaner fish *Labroides dimidiatus* indirectly affect demersal zooplankton?

Sophie Horsfall
Issues with jellyfish in Australia

Current Masters Students

Jessica Savage
The impact of the 2011 heat wave on plankton communities at Rottnest Island

Ysharda Clement
Climate variability and change in zooplankton off eastern Australia

COMPLETED STUDENT PROJECTS

Year	Degree	Student	Project Title	Supervisor
2014	Ph.D.	Kate Helmstedt	Mathematical modelling and optimisation in applied conservation ecology	H. Possingham, P Baxter, P. Maswon and J. Shaw
2014	Ph.D.	Luke Lloyd-Jones	Growth model estimation in fisheries	Y-G. Wang and A. Richardson
2014	Ph.D.	Tessa Rawson	Conservation planning of the Mediterranean	A. Richardson
2014	Honours 1st Class	Jack McDonnell	Dynamics and control of a ratio-dependent predator-prey system	P. Baxter
2014	Honours	Joshua Volkmann	Optimisation of dynamic reserve design	M. Forbes and P. Baxter

Year	Degree	Student	Project Title	Supervisor
2014	Honours	Maria (Marike) De Waard	A survey of modern geostatistics methods for modelling Saucer Scallop populations in Queensland	R. Lemos
2014	Honours 1st Class	Peter Rankin	An alternative surplus production model - using hierarchical Bayesian inference in fisheries models	R. Lemos and H. Possingham
2014	Honours	Ryan Heneghan	A review of the canonical Dynamic Energy Budget model and a bioenergetics model for diatoms with Bayesian parameter estimation	R. Lemos
2014	M.Sc.	Jesse Thomas	Scallop larval advection modelling in the Queensland fishery	R. Lemos
2014	M.Sc.	Qianying Liu	Weed-crop image segmentation and weed management	C. McGrory and P. Baxter
2013	Ph.D.	Lydie Couturier	The biology and ecology of the manta ray, *Manta alfredi*, in eastern Australia	A. Richardson
2013	Ph.D.	Fabrice Jaine	The movement ecology of the manta ray *Manta alfredi*: a case study off eastern Australia	S. Weeks, A. Richardson, M. Bennett and K. Townsend.
2013	Ph.D.	Chris Rohner	Biological and oceanographic influences on whale shark abundance and feeding ecology	A. Richardson, M. Bennett, S. Pearce and S. Weeks
2013	Ph.D.	Lucy Robinson	Potential impacts of future climate change on the distribution of pelagic fish and fisheries off the east coast of Australia	A. Richardson and H. Possingham
2013	Ph.D.	Will Probert	Methods for decision theory in conservation biology	H. Possingham , P. Baxter and A. Richardson
2013	Honours 1st Class	Alex Coughlan	Understanding effects of climate change on Australian phytoplankton communities	A. Richardson
2013	Honours 1st Class	Amelia Armstrong	The size spectrum of zooplankton communities along the Australian east coast: effects of oceanography, season and latitude	A. Richardson
2013	Honours 2A	Maxime Marin	Oceanography of southeast Queensland in relation to kelp distribution	A. Richardson
2012	Ph.D.	Chris Brown	Effects of climate change on marine ecosystems and potential management responses	A. Richardson
2012	Honours 1st Class	Kate Picone	Plankton dynamics in relation to climate variability	A. Richardson
2012	Honours 1st Class	Robbie Pearce	Dynamics of managed consumer-resource systems	P. Baxter and C. Holmes

Year	Degree	Student	Project Title	Supervisor
2012	Honours 1st Class	Kirsty Howard	Potential effects of the re-zoning of the Great Barrier Reef Marine Park on commercial fisheries catch	A. Richardson, J. Kirkwood and P. Moss
2012	Honours 1st Class	Natalie Kerr	Identifying cost-efficient approaches for managing weeds: applying an economic sensitivity analysis to matrix population models of invasive plant species	Y. Buckley and P. Baxter.
2011	Honours 1st Class	Andrew Jones	Genetic estimates of effective population size	Y-G. Wang and J. Ovenden
2011	M.Sc.	Na Wang	Population dynamics with continuous recruitment for multiple short-lived species: a case study for Australia's Northern Prawn Fishery	Y-G. Wang
2010	Honours	Liza Roger	Comparison of shell structure of two tropical thecosome pteropods (*Creseis acria* and *Diacavolini longirostris*) over a 45-year period	A. Richardson

RESEARCH GRANTS

ARC

Suthers, I. & **Richardson, A.J**. (2015-2017). *Linking phytoplankton to fisheries using zooplankton size spectra.* ARC Discovery, $350,000

Wang, Y-G. (2013-2015). *Robust inferences for analysis of longitudinal data*. ARC Discovery, total ARC fund: $330,000

Li, L., Bringemeier, D., **Wang, Y-G.** & Scheuermann, A. (2013-2015). *Multi-scale, multi-phase flows in complex coal seam systems*. ARC Linkage, $377,800

Hallegraeff, G.M. & **Richardson, A.J.** (2013-2015). *Climate-driven windblown dust and flood runoff can increase marine diseases by fungal pathogens*. ARC Discovery, $268,000

Bennett, M., **Richardson, A.J.,** Weeks, S. & Townsend, K. (2011-2013). *An integrated examination of the drivers of movements of large filter feeding organisms of high ecotourism, value: a case study,* $380,000

Richardson, A.J. (2010-2013). *The resilience of marine ecosystems and fisheries to climate change: exploring adaptation strategies.* ARC Future Fellowship, $789,000

ARC Centre of Excellence

Possingham, H.P., McCarthy, M.A., Hobbs, R.J., Lindenmayer, D.L., Pannell, J., Wintle, B.A., **Richardson, A.J.**, Wilson, K.A., Buckley, Y., Vesk, P.A., Bekessy, S., Rhodes, J., Bode, M., McDonald-Madden, E., Drechsler, M., Kark, S., Knight, A., Martin, T., Milner-Gulland, E.J., Moilanen, A. & Nichols, J. (2011-2017). ARC Centre of Excellence*, ARC Centre of Excellence for Environmental Decisions*, $17,000,000.

Invasive Animals CRC

Carwardine, J., Westcott, D., Martin, T., Fletcher, C., Chadès, I., Nicol, S., Walters, B., Jones, D., **Baxter, P.**, McDonald-Madden, E., Possingham, H., Vitelli, S., Dryden, B., Simmons, T. & Sydes, T. *Prioritising adaptation actions for managing invasive animals under climate change.* Invasive Animals Cooperative Research Centre, $566,000.

Harris, S., **Baxter, P.**, Ramsey, D., Caley, P., Barclay, C., Saunders, G., & Elliott, C. *Long-term strategy for the Tasmanian Fox Eradication Program.* $282,000.

Baxter, P., Cacho, O., McDonald-Madden, E., Possingham, H. *Reliable pest animal decisions*. Invasive Animals Cooperative Research Centre, $116,000. (subject to final approval).

Others

Courtney, T., Leigh, G. & **Lemos, R.T**. (2013- 2015). *Physical oceanographic influences on Queensland reef fish and scallops.* FRDC & GBRMPA, $170,000.

Richardson, A.J. & Hosie, G. (2010-2013)*., Extension and enhancement of AusCPR survey within the Integrated Marine Observing System*, DIISR, $1,719,000.

Lynch, T., Middleton, J., Brando, V., Feng, M., Roughan, M., McCauley, R., Steinberg, C., **Richardson, A.J.**, Tilbrook, B., & Thompson, P. (2010-2013). *Extension and enhancement of zooplankton at national reference stations within the Integrated Marine Observing System*, DIISR, $300,000.

Jones, A. (2012-2014). *Smart Futures PhD Scholarship*, Queensland Government, Department of Information, Technology, Innovation and the Arts, $36,000. (Supervisors – **Prof Y-G Wang & Dr J Ovenden**)

Helmstedt, K. (Jan 7 to April 5 2013). *Travel award to visit the Institut Henri Poincare (attendance for 1 trimester),* Fondation Sciences Mathématiques de Paris, €6660.

Wang, Y-G & Pandolfi, J. (2012). *Genetic stock assessment of Queensland and New South Wales snapper (*Pagrus auratus*) fishery*, UQ FirstLink, $4500.

TEACHING AND SUPERVSION

Collectively CARM staff have a wealth of specialised knowledge and skills in research areas in which there is a recognised skills shortage both nationally and internationally. The School of Mathematics and Physics has invited us to contribute to teaching established undergraduate courses. In addition, we have also taken part in expanding student learning opportunities through the introduction of new courses such as our “flagship” course in Natural Resource Mathematics, a special topic in longitudinal data analysis, and a reading course in Bayesian statistics which was run in response to student demand. These courses help to bridge a crucial gap in students’ training, that is, the gap between mathematical theory and the ability to apply these skills in real world or workplace settings.

As well as undergraduate teaching we also provide expert supervision to research students from mathematics and other departments who may not otherwise have been able to access this knowledge. For example, recently CARM staff have given training in the highly specialised area of state-space modelling to UQ research students. This was applied to the significant problems of modelling Queensland fish movements and building Bayesian economics models; this work was achieved through CARM’s collaboration with students working in environmental sciences and economics, respectively.

Mathematical skills will be even in more demand in the future as technology advances rapidly and pressure on natural resources increases. In this way, CARM’s active and enthusiastic role in helping to train new generations of scientists in these fields not only brings value to this leading institution, but also strengthens the key capacities that will ensure that our graduates will continue to make Australian scientists internationally competitive into the future.

Natural Resource Mathematics – CARM Flagship Course

MATH2070/MATH7704. Semester 2. (2012-2014). Baxter. P.W.J, Lemos, R.T. & Richardson, A.J. This course in Natural Resource Mathematics started in July 2012. Students taking this course learn to: apply modern mathematical and statistical methods for dynamic systems; model populations and investigate impacts of climate change, overfishing, pollution and habitat destruction; and communicate their work to scientists and decision makers. All practicals are delivered in MATLAB. CARM members have designed the course so students will be employable in a number of growing fields of natural resource management and conservation, especially with State and Federal Governments, universities and NGOs. The course received **the highest overall approval rating** for semester 2 courses in the School of Mathematics and Physics in 2014. Student numbers, 2014: 14 / 2013: 18 / 2012: 9.

Other Courses

SCIE1000. Theory and Practice in Science. **(2014-2015).** Adams, P., O'Donoghue. P., & **Richardson, A.J.** Basic mathematical modelling. Student numbers, 2015: 880 / 2014: 880

COSC3000. Semester 1. (2012-2014). Baxter, P.W.J., Hanan, J.S. (2012-13) & Hobson T. (2014), Visualization, Computer Graphics & Data Analysis. An introduction to these topics as tools to understand and interpret real world data and computational-model output. Student numbers, 2014: 40 / 2013: 31 / 2012: 19.

STAT3003/STAT7003. Semester 1. (2013 & 2012). Wood, I., McLachlan, G., **Wang, Y-G. & Lemos, R.T.** Experimental Design. Student numbers, 2013: 20 + 1 MSc student (taken as STAT7003) / 2012: 16.

Reading Course in Bayesian Statistics. Semester 2. (2013). McGrory, C. Student numbers, 2 (Honours Level). This course introduces Bayesian statistical inference and teaches students how to implement Bayesian inference solutions to real world problems. This course was provided in response to demand from School of Mathematics and Physics honours students.

HRSS3100/7806. Semester 1. (2013). McGrory, C. Research Methodology. This is a service course in which basic statistical methodology is taught to health science students. There are a large number of students (around 330-360) enrolled in this course.

MARS3012. Semester 1. (2013 & 2012). Richardson, A.J & Weeks, S. This an Introduction to Oceanography course that covers physical, chemical and biological oceanography, including remote sensing.

STAT6003/STAT7703/MATH4001. Semester 2. (2013). Wang, Y-G. Longitudinal Data Analysis. This is a new course developed to fill the gap in statistical curriculum in the discipline of Mathematics at UQ.

2010 Wang, Y-G., Dynamic programming ready course.

Guest Lectures

Wang, Y-G. Semester 2 (2014). 'Why Statistics', SCIE2111

Wang, Y-G. Semester 1 (2013). 'Efficient designs for sampling and sub sampling in fisheries research', STAT3003 Experimental design, School of Mathematics and Physics, UQ.

Richardson, A.J. Semester 1 (2013): 'Marine systems and climate change', BIOL3236 Biological adaptation to climate change, School of Biological Sciences, UQ.

POTENTIAL NEW PHD PROJECTS

CARM has potential PhD projects. Information on these projects is available on the CARM web site http://www.smp.uq.edu.au/CARM/projects **Examples of some of our potential student projects:**

1. Management strategy evaluation of Queensland's east coast trawl fishery
Joint project with DAFF Queensland
Objectives:

- Quantify annual fishing power increases and changes in prawn abundance.
- Quantify prawn catchability coefficients.
- Develop models and data rules for identifying target fishing effort and catch rates.
- Develop multi-species spatial assessment models for evaluating management and stock status reference points.

Background on Fisheries
Tiger Prawn, Endeavor Prawn and Red-spot king prawn sectors.
Stock assessment reports - http://www.dpi.qld.gov.au/28_11062.htm
Stock status reports - http://www.dpi.qld.gov.au/28_10916.htm

2. Assessments of the status of Queensland's east coast and Gulf of Carpentaria shark fisheries
Joint project with DAFF Queensland
Objectives:

- Develop standardised indices of abundance for the major species/taxa.
- Reviewing monitoring strategies and developing assessment modelling tools.
- Reviewing the status of the "stock" in relation to the commercial catch quota
- Develop empirical management procedures.

Background on Fisheries
http://www.environment.gov.au/coasts/fisheries/qld/east-coast-finfish/submission-11.html
Stock status reports - http://www.dpi.qld.gov.au/28_10916.htm

3. Estimation of recreational fish catches
Joint project with DAFF Queensland
Objectives:

- Develop hierarchical and conditional mixed models for estimation of recreational fish catch and catch rates
- Investigate the standardisation of recreational survey data collected from multiple survey methods
- From survey to analysis: dealing with differences in the scale survey data are collected at and the scale data are analysed at.
- Assess changes in angler avidity and recall bias between survey years and methodologies
- Examine appropriate estimation methods for different species.
- Develop methods for low abundance or recreational species caught by 'hard-to-reach' fishers.

Background on Fisheries
http://www.dpi.qld.gov.au/28_18273.htm

4. Fishery-dependent monitoring of Queensland's fisheries: Reviewing routine collection of length and age data, and routine analysis.
Joint project with DAFF Queensland
Objectives:

- Review and evaluate efficient sampling programs: Is the right amount of sampling occurring for each species? Are there any significant biases in the sampling programs for each species?
- Assess whether routine analyses are being carried out correctly, and to develop new analyses for fisheries management.

Background on Fisheries
Fisheries Queensland monitors commercial and recreational fisheries throughout the state. The objectives of this routine fishery-dependent monitoring include collecting the data required to assess the status of key fish stocks and the effectiveness of

current management arrangements (especially fisheries with catch / effort quotas), as well as helping develop new, effective management arrangements (http://www.dpi.qld.gov.au/28_10714.htm).
Turning data into advice about the status of Queensland's fish stocks or the sustainability of Queensland's fisheries occurs in a number of different ways. The most regular assessments now occur annually for key species, as outlined in the "Framework for Defining Stock Status" (http://www.dpi.qld.gov.au/28_16916.htm). The main activity in defining stock status each year is a workshop, which involves assessing all the available, contemporary data for each species. Formal stock assessments are carried out less frequently (http://www.dpi.qld.gov.au/28_11062.htm) using mathematical modelling to reconstruct the history of species-specific fisheries from all available data.

5. Hydrological Modelling (discharge, rainfall, water quality and load)
With Professor You-Gan Wang
This is to develop catchment models for annual water discharge and pollutant using advanced statistical techniques. Formulation of most powerful predictive models requires elegance of mathematics and wisdom of statistics. This project will be joint with hydrologists.

6. Rank-based inference for clustered data
With Professor You-Gan Wang
This is a project on statistical methodology. The aim is to develop statistical methods to extract desirable information from datasets using "appropriate tools". With the right tools, we will also need to take account of nonlinear spatial and temporal trends.

7. Variance and covariance model selection
With Professor You-Gan Wang
This is to develop new modelling paradigms in generalized linear model framework with random effects, in particular, investigating the impact of choices of variance and correlation structure as 'working' tools. Develop more powerful selection criteria for time series data and longitudinal data analysis by better approximating the Kullback-Leibler distance in presence of heteroskedasticity and unknown correlation patterns, which is often the case in environmental studies (and even stock returns).

8. Optimal resource allocation in environmental/asset management
With Professor You-Gan Wang
This project is to deal with uncertainty in a stochastic reward process for maximising final returns. The traditional gain function is based on mean does not incorporate potential risks associated, it is therefore of great interest to develop more appropriate gain functions that reflect clients interests. The applications are in pharmaceutical industries and portfolio management.

9. Incorporating climate change into management of marine protected areas
(Joint project with CSIRO and University of Sunshine Coast)
With Assoc. Prof. Anthony Richardson
Marine biodiversity will be impacted by climate change. Expectations for the rates of species' range shifts and changes in the timing of biological events can be generated by combining spatial and seasonal temperature gradients with predictions of temperature under globalwarming. This project will use the new concepts of climate velocity and seasonal shift to investigate factors that might drive the reshuffling of biodiversity at a community level in time and space. The focus will be on both pelagic and benthic systems. Results will feed into an assessment of the adequacy of biodiversity protection within marine protected areas under various future scenarios.
We are seeking a student with strong quantitative and programming skills. It is likely that the successful candidate will attract a top-up scholarship of $7k per year and up to $10k operating per year. The student will be collaborating with research groups in Australia and the UK.
Supervisors: Anthony J. Richardson (UQ/CSIRO), David Schoeman (University of the Sunshine Coast), Elvira Poloczanska (CSIRO), Hugh Possingham (UQ)
Collaborators: Chris Brown (UQ), Mike Burrows (Scottish Association of Marine Science), Simon Ferrier (CSIRO)

COMMUNICATION

Presentations

You-Gan Wang: Key note speaker at Applied Statistics and Public Policy Analysis Conference, December 2014, Wagga Wagga, Australia.

Anthony J. Richardson: "Plankton and Climate Change", November 2014, UQ Marine Biological Research Station Open Day, Dunwich, North Stradbroke Island, Australia.

Anthony J. Richardson: "The Great Barrier Reef and Climate Change", November 2014, Yeronga State School, Brisbane, Australia. 80 Year 3 students.

Anthony J. Richardson: "Marine Life and Climate Change", September 2014, Marine Biological Association of the UK, Plymouth, UK.

Anthony J. Richardson: "Climate Change", August 2014, Lyceum Club, Brisbane, Australia.

Anthony J. Richardson: "Plankton and Climate Change in Australia", August 2014, NSW IMOS meeting, Sydney, Australia.

Anthony J. Richardson: "Manta ray movements, feeding and population size: why do we need mathematics?", August 2014, Open Day, University of Queensland, Brisbane, Australia.

Anthony J. Richardson: "Why is plankton important to manta rays, cars, movies, the bible and our climate", June 2014, Lady Elliot Island, Australia.

Anthony J. Richardson: "How to write a scientific paper", June 2014, Perth, Australia. 11 participants from CSIRO.

Peter Baxter (invited speaker): "Optimisation of management strategies for nature conservation", November 2014, The BAM (Biarri Applied Mathematics) Conference 2014, Maths Everywhere, RMIT University, Melbourne, Australia.

Clare McGrory: poster titled'Weighted Gibbs Sampling for Mixture Modelling of Massive Datasets via Coresets', December 2014, Spring Bayes Meeting, Surfers Paradise, Australia. Clare's honours student Thomas Erben also attended and presented a poster titled 'Gibbs Sampling for Truncated Normals with Estimation of Truncation Parameters'.

Clare McGrory: "Transdimensional sequential Monte Carlo for hidden Markov models using variational Bayes – SMCVB". September 2014, Federated Conference on Computer Science and Information Systems (FedCSIS) (WCO'14), Warsaw, Poland.

Clare McGrory: Invited presentation at the 2014 Australian Statistical Conference, July 2014, Sydney, Australia.

Clare McGrory: Invited presentation at the MCMSki conference on Bayesian Statistics, January 2014, Mont-Blanc, France.

Clare McGrory: 'Transdimensional Sequential Monte Carlo using Variational Bayes: SMCVB'. September/October 2013, Annual meeting of the Australian Mathematical Society, University of Sydney, Australia.

Anthony J. Richardson (with Rochester, W. & Hosie, G.): 'Plankton 2013: an assessment of Australia's oceans using plankton as ecosystem indicators', July 2013, Australian Marine Science Association, Gold Coast, Australia.

Kate Helmstedt: 'Cost-efficient fenced exclosures for conservation: large or small?', July 2013, Mathematics of Planet Earth AMSI conference, Melbourne, Australia.

Ricardo Lemos: 'Growth, reproduction and death: an integrated model for fish stocks', June 2013, Eighth workshop on Bayesian inference in stochastic processes, CNR-IMATI, Milan, Italy.

Clare McGrory: 'An efficient approach for estimating the volume of primary tissue types in animals from CT scan images', June 2013, Annual conference of the International Environmetrics Society, Anchorage, Alaska, USA.

Ricardo Lemos: 'Fisheries stock assessment', May 2013, NOAA National Marine Fisheries Service, Southwest Fisheries Science Center, Environmental Research Division, Pacific Grove, USA.

You-Gan Wang (invited speaker): 'Covariance model selection in longitudinal data analysis', February 2013, International Conference on Mathematical Sciences and Statistics 2013, Kuala Lumpur, Malaysia.

Kate Helmstedt: 'Prioritizing the eradication of invasive species on islands', January 2013, Institut Henri Poincaré, Paris, France.

Ricardo Lemos: 'Parallel log-linear fisheries models', July 2012, World Conference on Natural Resource Modeling', Brisbane, Australia.

Peter Baxter: 'Cost-effective conservation for recovery of Swedish White-backed Woodpecker populations', July 2012, World Conference on Natural Resource Modeling, Brisbane, Australia.

Ricardo Lemos: 'Getting the facts right on the climate change debate', June 2012, ISBA (International Society for Bayesian Analysis) 2012 World Meeting, Kyoto, Japan.

You-Gan Wang: 'Statistical modelling for load estimation', May 2012, School of Civil Engineering, University of Queensland, Brisbane, Australia.

Peter Baxter: 'Optimising on-ground actions for White-backed Woodpecker recovery', January 2012, presented at a one-day symposium 'White-backed Woodpecker in Sweden: prospects for the future', for forest managers, government officials and other researchers, Stockholm, Sweden.

Peter Baxter: 'Cost-effective habitat management strategies for White-backed Woodpecker recovery in Sweden', December 2011, 25th International Congress for Conservation Biology, Auckland, New Zealand.

You-Gan Wang: 'Performance of model selection criteria in longitudinal data analysis', December 2011, Biometrics by the Blowholes, Kiama, Australia.

Peter Baxter: 'Cost-efficient forest management for endangered woodpecker recovery', November 2011, ARC Centre of Excellence in Environmental Decisions, The University of Melbourne, Melbourne, Australia.

Peter Baxter: 'Cost-efficient forest management for endangered species recovery', October 2011, Brisbane Applied Mathematics Seminar Series, Queensland University of Technology, Brisbane, Australia.

You-Gan Wang (invited speaker): 'Living with uncertainties in fisheries and environmental research', July 2011, Australasian Applied Statistics Conference, Cairns, Australia.

You-Gan Wang: 'Modelling issues in estimating sediment and nutrient transport in catchments', June 2011, SM 1, University of Queensland, Brisbane, Australia.

Conferences/Workshops Organised

CARM has taught 100s of students and researchers from the Queensland and Commonwealth Government how to analyse their data in robust ways using the statistical package R.

Advanced R Workshop (November 2014). Delivered by **Bill Venables** (CSIRO/CARM Fellow). 20 participants

Introduction to R Workshop (November 2014). Delivered by **Anthony J. Richardson (UQ) and Dave Schoeman (USC).** 60 participants

Introduction to R Workshop (July 2014). Delivered by **Anthony J. Richardson (UQ) and Dave Schoeman (USC)**. 50 participants

Bayesian Modelling Using R. (July 2014). Delivered by **McGrory, C. & Alston, C.** Introduces the Bayesian approach to statistical inference and teaches participants how to implement some commonly used statistical models in the Bayesian setting using R programming. 10 participants

Advanced R Workshop (November 2013). Delivered by **Bill Venables (CSIRO/CARM Fellow).** 15 participants

Introduction to R Workshop @ UQ (4-6 **November 2013**). Delivered by **Anthony J. Richardson (UQ) and Dave Schoeman (USC).** 60 partipants

Bayesian Modelling Using R. (November 2013). Delivered by **McGrory, C. & Alston, C.** 9 participants

Functional Data Analysis (October 2013). Delivered by **v**isiting Scholar Sen Roy, S. & Ethel Raybould Visitor Ganguli, B. Organised by Professor You-Gan Wang.

Time Series Analysis Workshops, (October 2013). Delivered by **v**isiting Scholar Sen Roy, S. & Ethel Raybould Visitor Ganguli, B. Organised by Professor You-Gan Wang.

Opportunities for mathematical careers in industry. (September 2013). Delivered by **Gibbs, M.** CARM staff arranged this career advice session for mathematics students, with Dr Mark Gibbs (AECOM director and UQ adjunct) hosting a discussion on quantitative careers in the consulting, development, construction, and environmental management sectors.

Special session for Joint conference ASFB/NZMSS/NZFSS, "At the interface of food production, ecosystem conservation, and economic growth: future fisheries", in Hamilton, New Zealand, 19-23 August 2013, organized by Dr. **Shijie Zhou** and Professor **You-Gan Wang**.

MCMC Workshop. (June 20, 2013). Delivered by **Lemos, R., and McGrory, C.** This workshop was organized as part of the grey mackerel project, it described state-space approaches to stock assessment modelling, parallel algorithms for rapid implementation on multicore machines and computer clusters, and Variational Bayes techniques.

Advanced R Workshop (November 2012). Delivered by **Bill Venables (CSIRO).** 20 participants

Introduction to R Workshop (November 2012). Delivered by **Anthony J. Richardson (UQ) and Dave Schoeman (USC)**. 50 participants

Workshop on Global Marine Climate Impacts. (April/May 2012). Delivered by **Richardson A.J.,** NCEAS (National Centre for Ecological Analysis and Synthesis), Santa Barbara, USA.

World Conference on Natural Resource Modelling, (July 2012). Baxter, P.W.J.: Peter Baxter hosted the 2012 World Conference on Natural Resource Modelling, here at UQ, along with ARC-CEED director and CARM affiliate Prof. Hugh Possingham. Almost 80 participants from around the world converged for a successful four day meeting comprised days of research presentations under the theme of Natural Resource Modelling, backed up by an enjoyable social program. CARM was represented by Dr Ricardo Lemos, Kate Helmstedt and Peter, who all presented talks, as did CARM affiliate Dr Tony Courtney (DAFF). Feedback on the conference was very positive, with praise for the strong interdisciplinary program and the high level and quality of student participation.

Advanced R Workshop (November 2011). Delivered by **Venables, W. (CSIRO).**

CARM/SMOR/CSTAT Seminar Series

To better engage with the Mathematics Department CARM has been running research seminars jointly with the Operations Research and Statistics research groups. This seminar series is the successor of the CARM/CSTAT seminar series and commenced in early 2013.

Prof. Murray Cameron: '*Preparing mathematical game-changers'*, University of Technology, Sydney, October 2014.

A/Prof. Ross Ihaka: '*Graphical perception as a basis for drawing graphs*', University of Auckland, New Zealand, February 2014.

Dr Bhaswati Ganguli and Dr Sugata Sen Roy: '*Alternative approaches to modelling the effect of short term particulate matter*

Prof. Bean San Goh: '*Numerical Method in Optimization as a Multi-stage Decision Control System*', Curtin University, Sarawak, Malaysia, February 2013.

CARM and the Centre for Statistics in the School of Mathematics and Physics worked together during 2011 and 2012 to host a series of seminars.

Prof. Bruno Sansó: *'Hierarchical Models to Assess Climate Predictions'*, University of California, October 2012.

Prof. Denis Leung: *'Shrinkage empirical likelihood estimator in longitudinal analysis with time-dependent covariates - An application to modelling the health of Filipino children'*, School of Economics, Singapore Management, University Ethel Raybould Visiting Fellow, June 2012.

Adam Grace: *'Rare-Event Estimation for Density Dependent Models'*, PhD in Statistics, School of Mathematics and Physics, UQ, June 2012.

Dr Nina Welti: *'Nitrogen cycling in restored and disturbed riverine floodplains',* National Centre for Groundwater Research and Training at the University of QLD, March 2012.

Prof. Volker Schmidt: *'Model-based 3D simulation of tomographic image data, with applications to virtual materials design'*, Ulm University, February 2012.

Prof. Marti J. Anderson: *'Measurements and pitfalls in the analysis of broad-scale patterns of ecological beta diversity',* New Zealand Institute for Advanced Study (NZIAS), Massey University, Albany Campus, Auckland, New Zealand, December 2011.

Dr Sven Arnold: *'Decision making under uncertainty – examples from Namibia and Australia',* Centre for Mined Land Rehabilitation, Sustainable Minerals Institute, University of QLD, November 2011.

Dr Christine Dudgeon: *'Estimating population sizes of marine megafauna using mark-recapture methods',* Cetacean Ecology and Acoustics Laboratory, School of Veterinary Sciences, University of QLD, November 2011.

Prof. Chris Lloyd: *'Computing highly accurate parametric inference from discrete data',* Professor of Business Statistics Associate Dean (Research) Melbourne Business School, University of Melbourne, August 2011.

Dr Yvonne Buckley: *'Comparing populations dynamics of multiple plant species and identifying drivers of spread of plant populations',* School of Biological Sciences (UQ) and CSIRO Ecosystems Sciences, August 2011.

Dr Eva Plaganyi-Lloyd: *'The likelihood of lobsters and mathematics of MICE!',* CSIRO Division of Marine and Atmospheric Research, July 2011.

CARM Student Group Meetings

Fortnightly CARM Student Group Meetings started in June 2011. These Wednesday meetings expose students to other ideas and ongoing work in the Centre. Students have the opportunity to give an update of what they are doing in a 'round the table' discussion followed by a student or staff presentation.

Some examples of student talks include:

Eunice (Chuan) Hui Foo (December 2014), Modelling growth of reared and tag-recapture data

Jesse Thomas (October 2014), Modelling larval advection in the Queensland fishery: a spatial connectivity approach

Andy Jones (October 2014), Approximate Bayesian computation for calculating genetic effective population size: is this a good idea?

Nanxi Zhang (October 2014), Comparison of parametric and non-parametric machine learning methods in sheep and bovine GWAS

Michael O'Neill (June 2014), Catch curve mixture model for setting the stout whiting (*Sillago robusta*) harvest quota.

Michael Macbeth (June 2014), Finding Nemo's friends - a mark-recapture estimate of abundance

Andy Jones (May 2014), Improved confidence intervals for estimates of genetic effective population size (mid-can)

Nanxi Zhang (April 2014), Literature review for variable selection in GLM & GLMM

Eunice Foo (April 2014), Determination of molting events and growth parameters in crustaceans from tagging data

Shen Wang (November 2013). Statistical Modeling and Power Analysis for Detecting Trends in Total Suspend Sediment loads

Daniel Ahfock & Joshua Horsley (November 2013). Finite Mixture Modelling via Coresets

Mingzhu Sun (October 2013). A Common Factor-Analytic Classification Approach for Gene Expression Data

Bo Chen (October 2013). Efficient implementation of spatio-temporal linear models: example of sea surface temperature decomposition

Luke Lloyd-Jones (September 2013). A potential solution for the negative growth increment in von Bertalanffy growth matrices

Chang Liu (September 2013). Simultaneous Project Evaluation Architecture

Alex Campbell (August 2013), One-step fishery models: investigations into a statistically coherent unification of catch rate standardisation and population dynamics modelling

Michael O'Neill (June 2013), Catch curve mixture model for setting the stout whiting (*Sillago robusta*) fishery harvest quota

Eunice Foo (June 2013), Stochastic Growth Model of lobsters

Na Wang (June 2013), Sustainable management and economic optimisation in Australian Commonwealth fisheries

Kate Helmstedt (May 2013). Prioritizing the eradication of pests on islands

Luke Lloyd-Jones (March 2013). Population Growth Modelling of Aquatic Species

Andy Jones (May 2012), Estimation of genetic effective population size in fisheries

MAJOR COLLABORATIONS

DAFF

Management strategy evaluation of Queensland's east coast trawl fishery
Objectives: (i) Quantify annual fishing power increases and changes in prawn abundance; (ii) Quantify prawn catchability coefficients; (iii) Develop models and data rules for identifying target fishing effort and catch rates; (iv) Develop multi-species spatial assessment models for evaluating management and stock status reference points.

Assessments of the status of Queensland's east coast and Gulf of Carpentaria shark fisheries
Objectives: (i) Develop standardised indices of abundance for the major species/taxa; (ii) Reviewing monitoring strategies and developing assessment modelling tools; (iii) Reviewing the status of the "stock" in relation to the commercial catch quota; (iv) Develop empirical management procedures.

Estimation of recreational fish catches
Objectives: (i) Develop hierarchical and conditional mixed models for estimation of recreational fish catch and catch rates; (ii) Investigate the standardisation of recreational survey data collected from multiple survey methods; (iii) From survey to analysis: dealing with differences in the scale survey data are collected at and the scale data are analysed at, (iv) Assess changes in angler avidity and recall bias between survey years and methodologies; (v) Examine appropriate estimation methods for different species; (vi) Develop methods for low abundance or recreational species caught by 'hard-to-reach' fishers.

Fishery-dependent monitoring of Queensland's fisheries: Reviewing routine collection of length and age data, and routine analysis.
Objectives: Review and evaluate efficient sampling programs: Is the right amount of sampling occurring for each species? Are there any significant biases in the sampling programs for each species? Assess whether routine analyses are being carried out correctly, and to develop new analyses for fisheries management.

Physical oceanographic influences on Queensland reef fish and scallops
Objectives: (i) review recent advances in the study of physical oceanographic influences on fisheries catch data and describe the major potential influences on Queensland reef fish and saucer scallops; (ii) collate Queensland's physical oceanographic and fisheries data; (iii) develop stochastic population dynamics models for reef fish and saucer scallops, which can link environmental influences (e.g. sea surface temperature) to catch rates, biological parameters (e.g., growth, reproduction, natural mortality) and ecological aspects (e.g., spatial distribution); (iv) forecast the dispersion of reef fish and scallop larvae in the southern GBR region.

East Queensland grey mackerel stock assessment
Objectives: Develop a regional, sex- and age-structured population model for the east Queensland grey mackerel; estimate east coast wide and regional quota levels; suggest regional management responses.

Other External Collaborations

Australia
CSIRO; Institute of Geography and Limnology, Charles Darwin University; University of New England; University of Adelaide; University of Melbourne; CSIRO; Queensland University of Technology; University of Sydney; University of the Sunshine Coast.

Other
Chinese Academy of Sciences, China; Harvard University, USA; Landcare Research, New Zealand; Swedish University of Agricultural Sciences, Sweden; University of Glasgow, UK; University of the Western Cape, South Africa; University of Cape Town, South Africa; Sir Alister Hardy Foundation for Ocean Science, UK; University of Alberta, Canada.

Ricardo Lemos April USA Visit - Research collaboration with UC Santa Cruz and NOAA staff, under project LEMOS 12 UQNSRSF. Full names of collaborators: Bruno Sansó (UCSC) and Roy Mendelssohn (NOAA).

UQ Collaborations

We have ongoing collaborative research with the following UQ institutions:

Global Change Institute: collaboration in the IPCC Fifth Assessment Report on Climate Change.

School of Civil Engineering: Coal seam gas modelling (ARC Linkage grant) and water discharge at Three Gorges Dam.

School of Geography Planning and Environmental Management: Joint supervision of PhD and honours students, thesis committees, lectures.

School of Biological Sciences: Joint supervision of PhD and Honours students, Thesis committees, Guest lectures.

School of Biological Sciences: Joint UQ FirstLink Genetic stock assessment of Queensland and New South Wales snapper (Pagrus auratus) fishery.

ARC Centre of Excellence for Environmental Decisions (CEED): Joint supervision of PhD and Honours students.

Centre for Medical Diagnostic Technologies in Queensland (MedTeQ), Centre for Magnetic Resonance (CMR) and Imaging Research Laboratory: Joint research.

Queensland Alliance for Agriculture and Food Innovation (QAAFI): Exploring collaborative opportunities in the area of genomic research for cattle, image analysis, population modelling.

Sustainable Minerals Institute and Seqwater: Potential opportunities to collaborate with the Sustainable Minerals Institute and Seqwater via ARC linkage grants on Phytoremediation of mined land and water quality.

Centre for Clinical Research and Royal Brisbane and Women's Hospital: Establishing joint PhD student supervision.

Visitors

Natalie (Na) Wang, (November 2014 – June 2015), Occupational Trainee, Hubei University of Science and Technology, China

Dr Olena Kravchuk, (October 2014), University of Adelaide

Dr Liya Fu, (March 2014 - current), returning Research Fellow, School of Mathematics and Statistics, Xi'an Jiaotong University, China

A/Prof. Yousaf Hayat, (March – September 2014), Department of Mathematics/Statistics and Computer Science, University of Agriculture, Peshawar-Pakistan

Dr Yonghong Hu, (January – April 2014), School of Statistics and Mathematics at Central University of Finance and Economics, China

A/Prof. Deepak Sanjel, (January 2014), Department of Mathematics and Statistics, Minnesota State University, Mankato, USA

Dr Olena Kravchuk, (5-12 October, 2013), University of Adelaide

Profs Bhaswati Ganguli and Sugata Sen Roy, (September 28 to October 14, 2013), University of Calcutta, India

Dr John Ormerod, (19 to 23 August, 2013), University of Sydney

Prof. Bean San Goh, (14 to15 February, 2013), Curtin University Sarawak, Malaysia

Prof. Laiqing Chen and fellow researchers, (January 25, 2013), Guangzhou Academy of Social Sciences, China

Dr Jianwen (Owen) Xu, (July 10, 2012 to July 5, 2013), Department of Statistics and Actuarial Science at Chongqing University in China, visited UQ (funded by his University).

Prof. Bruno Sansó, (October 29 to November 4, 2012), Department of Applied Mathematics and Statistics, University of California Santa Cruz, USA

Dr Kiki Dethmers, (September 17 to 18, 2012), post-doctoral fellow, North Australian Marine Research Alliance, Charles Darwin University, Australia

Prof. Denis Leung, (June 18 to July 25, 2012), Ethel Raybould Visiting Fellow, Singapore Management University, Singapore. (Ethel Raybould Fellowship)

Dr Liya Fu, (January 11, to December 31, 2011), visiting postdoc fellow, School of Mathematics and Statistics, Xi'an Jiaotong University, China

SERVICE

External Committees

Forum on technical developments in the detection and eradication of red imported fire ant', February and December 2012, **Baxter, P.W.J.** Peter Baxter was a member of 'Forum on technical developments in the detection and eradication of red imported fire ant' which submitted an evaluation report to the national management group (via the tramp ant consultative committee) for the national red imported fire ant eradication program.

Memberships and Awards

Resource Modeling Association (RMA) Board of Officers, **Dr Baxter, P.W.J:** Dr Baxter was appointed a Director of the RMA in 2013. Peter is an active RMA member, serving as the Conservation Editor for its journal *Natural Resource Modeling* as well as hosting the 2012 World Conference on Natural Resource Modeling.

Biometrics Editorial Board, **Prof Wang, Y-G:** Invited to join the *Biometrics* Editorial Board.

Editorial Board of the Electronic Journal Statistics: **Prof Wang, Y-G**

International Statistical Institute, **Prof Wang, Y-G**: Elected as a member of the International Statistical Institute, the worldwide network of statisticians in all statistical disciplines.

Outreach and Media

Richardson, A.J. (14 February 2014). Live interview on ABC Mackay on *Nature* Velocity of Climate Change paper

Richardson, A.J. (11 February 2014). 'Live interview on ABC Toowoomba on *Nature* Velocity of Climate Change paper

McGrory, C., Baxter, P.W.J., & Wang, Y-G. (August 2013 and 2014). 'Maths in the Wild', UQ Open Day, University of Queensland

Richardson, A.J. (May 2013). 'Maximising your publishing success', UWA Oceans Institute, The University of Western Australia

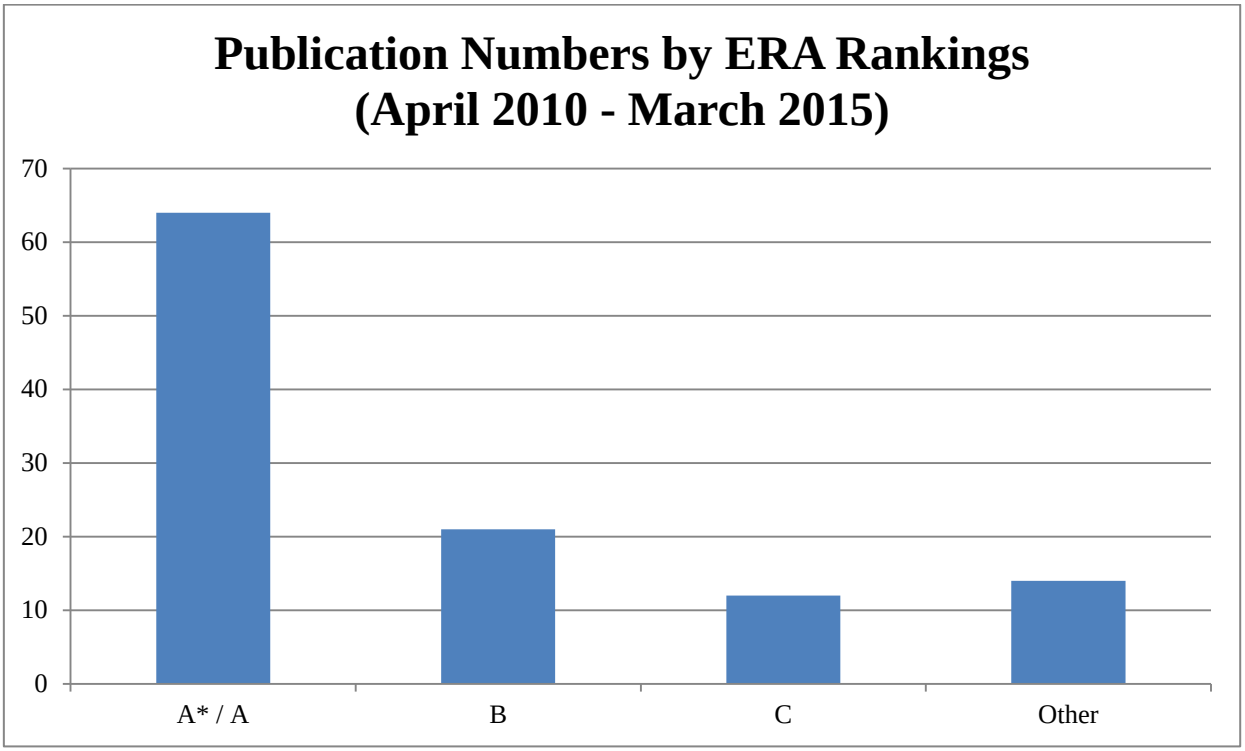
Richardson, A.J. with Poloczanska, E.S., Schoeman, D., Burrows, M. & **Brown, C.J.** (May 2013). 'Climate change and marine life: global analysis and collaboration', UWA Oceans Institute, The University of Western Australia

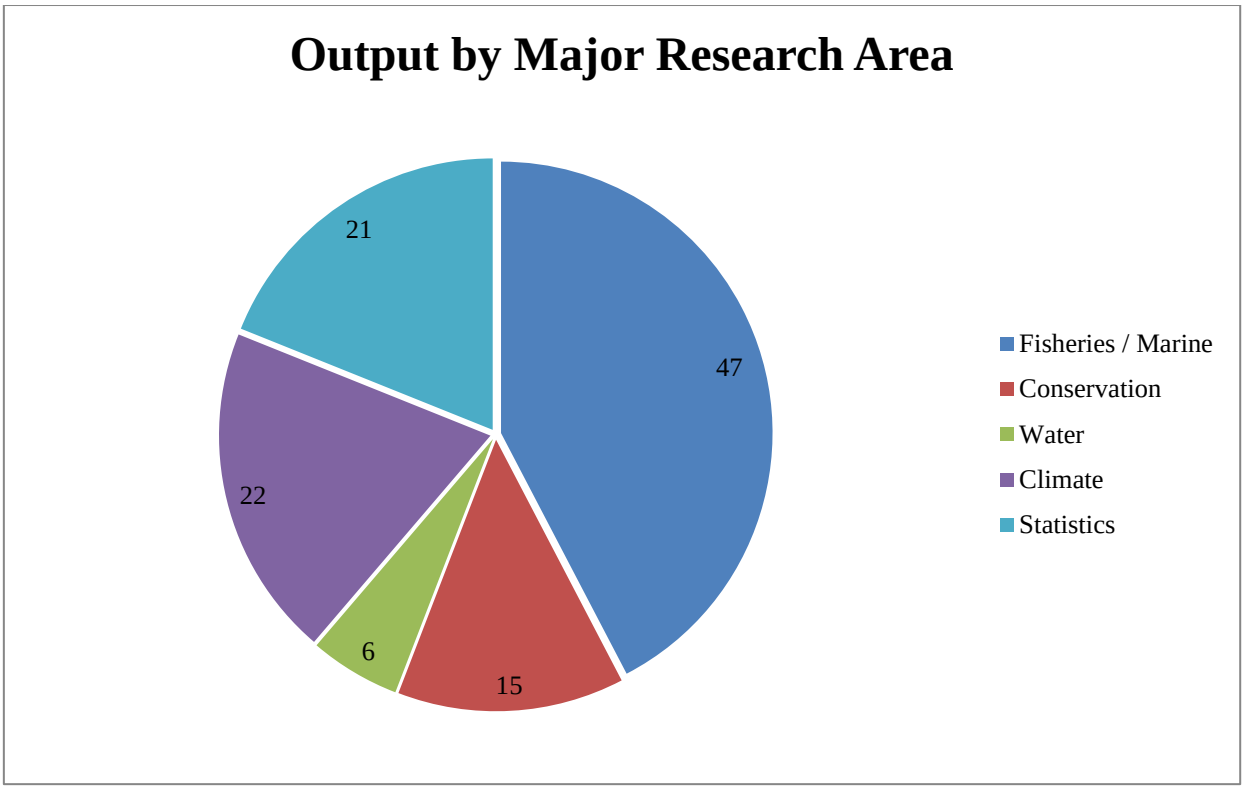
Wang, Y-G. (January 2013) 'Predicting the top 100 songs in Australia's JJJ Hottest 100', The Vine

Richardson, A.J. (July 2013). Tertiary Studies Expo, RNA Showgrounds, Brisbane

Richardson, A.J. & Baxter, P.W.J. (July 2012) Tertiary Studies Expo, RNA Showgrounds, Brisbane

PUBLICATIONS





CARM has published in the top-ranked journals globally: 2 in *Science*, 1 in *Nature*, and 2 in *Nature Climate Change*

1. **McGrory, C.A**., Pettitt, A.N., Titterington, D.M., Alston, C.L., and Kelly M. (2015). Transdimensional Sequential Monte Carlo using Variational Bayes – SMCVB. *Computational Statistics and Data Analysis*, (in press).

2. Hallegraeff, G.M., **Richardson, A.J.**, **Coughlan, A.** (2015) Marine phytoplankton bioregions in Australian seas. In *Handbook of Australasian Biogeography* by M Ebach (Ed). CRC/Taylor and Francis Press (in press).

3. **Rohner, C.A., Armstrong, A.J.**, Pierce, S.J., Prebble, C., Cagua, E.F., Cochran, J.E.M., Berumen, M.L., **Richardson, A.J.** (2015) Whale sharks target dense prey patches of sergestid shrimp off Tanzania. *Journal of Plankton Research* (in press).

4. Weeks, S.J., Magno-Canto, M.M., **Jaine, F.R.A.,** Brodie, J., **Richardson, A.J.** (2015) Unique sequence of events triggers manta ray feeding frenzy in the southern Great Barrier Reef, Australia. *Remote Sensing* (in press).

5. Falk, M.G., Alston, C.L., **McGrory, C.A**., Clifford, S., Heron, E. A., Leonte, D., Moores, M., Walsh, C.D., Pettitt, A. N. and Mengersen, K.L. (2015). Recent Bayesian Approaches for Spatial Analysis of 2-D Images with Application to Environmental Modelling. *Environmental and Ecological Statistics (EEST)* (to appear).

6. **Fu, L., Wang, Y-G**., & Zhu, M. (2015). A gaussian pseudolikelihood approach for quantile regression with repeated measurements. Computational Statistics and Data Analysis, 84, 41-53. doi:10.1016/j.csda.2014.11.002.

7. **Wang, Y-G., Wang, S**. & Dunlop, J. (2015). Statistical Modeling and Power Analysis for Detecting Trends in Total Suspended Sediment loads. Journal of Hydrology, 520, 439-447. doi:10.1016/j.jhydrol.2014.10.062.

8. Zhao, YD., Brown, B. and **Wang, Y-G** (2014). Smoothed Rank-based Procedure for Censored Data. *Electronic Journal of Statistics*. **8(2)**, 2953-2974. doi:10.1214/14-EJS975.

9. **Wang, N., Wang, Y-G.,** Courtney, T. & **O'Neill, M.** (2014). Deriving optimal fishing effort for managing Australia's Moreton Bay multi-species trawl fishery with aggregated effort data. Accepted by *ICES Journal of Marine Science, advance access*.

10. Dufois F, Hardman-Mountford N, Greenwood J, **Richardson AJ**, Feng M, Herbette S, Matear R (2014). Imprint of eddies on surface chlorophyll in the South Indian Ocean, *Journal of Geophysical Research - Oceans*. doi:10.1002/2014JC010164.

11. Ooi M, Townsend KA, Bennett MB, **Richardson AJ**, Fernando D, Villa C, Gaus C (2014). Levels of arsenic, cadmium, lead and mercury in the branchial plate and muscle tissue of mobulid rays, Marine Pollution Bulletin.

12. Davies, C., **Armstrong, A.,** Baird, M., Coman, F., Gaughan, D., Greenwood, J., Gusmao, F., Henschke, N., Koslow, T., Leterme, S.C., McKinnon, A.D., **Pausina, S.**, Uribe Palomino, J., Roennfeldt, R-L., Rothlisberg, P., Slotwinski, A., Strzelecki, J., Suthers, I., Swadling, K., Talbot, S., Tonks, M., Tranter, D., Young, J., & **Richardson, A.J.** (in press). Over 75 years of zooplankton data in Australia. *Ecology.* doi:10.1890/14-0697.1.

13. **Jaine, F.R.A., Rohner, C.A., Richardson, A.J.**, **Couturier, L.I.E.,** Weeks, S.J., Bennett, M.B., Townsend, K.A., & Canto, M. (in press). Movements and habitat use of reef manta rays off eastern Australia: offshore excursions, deep diving and eddy affinity revealed by satellite telemetry. *Marine Ecology Progress Series*, **510**, 73-86. doi:10.3354/meps10910.

14. O'Connor, M.I., Holding, J., Kappel, C.V., Duarte, C.M., Brander, K., **Brown, C.J.,** Bruno, J.F., Buckley, L., Burrows, M.T., Halpern, B.S., Kiessling, W., Moore, P., Pandolfi, J.M., Parmesan, C., Poloczanska, E.S., Schoeman, D.S., Sydeman, W.J., & **Richardson, A.J.** (in press). Strengthening confidence in climate impacts science. *Global Ecology and Biogeography*. doi:10.1111/geb.12218. 13 pp.

15. Arnold, S., Attinger, S., Frank, K., **Baxter, P.W.J.**, Possingham, H.P. & Hildebrandt, A. (in press). Ecosystem management along ephemeral rivers: trading off socio-economic water supply and vegetation conservation under flood regime uncertainty. *River Research and Applications.* doi:10.1002/rra.2853.

16. Anderson, D., Byrom, A., **Baxter, P.**, Cassey, P., Ramsey, D. & Woolnough, A. (2014). How can science guide best practice pest management? *Kararehe Kino (Vertebrate Pest Research)* **24,** 26-27.

17. Xu, J. & **Wang, Y-G**. (2014). Intra-cluster Correlation Structure in Longitudinal Data Analysis: Selection criteria and Misspecification tests. *Computational Statistics and Data Analysis*, **80**, 70-77. doi:10.1016/j.csda.2014.06.013.

18. **Macbeth, M.** & **Wang, Y-G**. (2014). Rapid assessment of genotype-by-environment interactions and heritability for growth rate in aquaculture species using in vitro fertilisation and DNA tagging. *Aquaculture*, **434**, 397-402. doi:10.1016/j.aquaculture.2014.08.026.

19. Blicharska, M., **Baxter, P.W.J.** & Mikusiński, G. (2014). Practical implementation of species recovery plans – lessons from the White-backed Woodpecker Action Plan in Sweden. *Ornis Fennica* **91,**108-128.

20. Ahfock, D., Alston, C.L., Horsley, J. & **McGrory, C.A.** (2014). Weighted Gibbs Sampler for Mixture Modelling of Massive Datasets via Coresets, *STAT,* **3(1)**, 291-299. doi:10.1002/sta4.62.

21. Ahfock, D. & **McGrory, C.A.** (2014). Transdimensional sequential Monte Carlo for hidden Markov models using variational Bayes – SMCVB, *Proceedings of the 7th Workshop on Computational Optimization, Federated Conference on Coputer Science and Information Systems (FedCSIS).*

22. Xu, L., **Wang, Y-G.**, Zheng, S. & Shi, N-Z. (2014). Model Selection with Misspecified Spatial Covariance Structure. *Journal of Statistical Computation and Simulation*. doi:10.1080/00949655.2014.926551. ARC rank C.

23. Hirst, A.G., Keister, J.E., **Richardson, A.J.,** Ward, P., & Escribano, R.V. (2014). Re-assessing copepod growth results from the Moult Rate Method. *Journal of Plankton Research,* **36(5)**, 1224-1232. doi:10.1093/plankt/fbu045.

24. Gershwin, L., Condie, S., Mansbridge, J.V., & **Richardson, A.J.** (2014). Dangerous jellyfish blooms are predictable. *Journal of the Royal Society Interface*, **11(96)** doi:10.1098/rsif.2013.1168.

25. **Lloyd-Jones**, **L.R.,** Nguyen, H.D., **Wang, Y-G.** & **O'Neill, M.F.** (2014). Improved estimation of size-transition matrices using tag-recapture data. *Canadian Journal of Fisheries and Aquatic Sciences*, **71(9)**, 1385-1394. doi:10.1139/cjfas-2014-0080.

26. **Lemos, R.T.**, **Wang, Y-G.**, **O'Neill, M.F.,** Leigh, G.M., & Helmke, S. (2014). East Queensland Grey Mackerel Stock Assessment, DAFF-UQ technical report: 87 pp.

27. Burrows, M.T., Schoeman, D.S., **Richardson**, **A.J.,** Molinos, J.G., Hoffmann, A., Buckley, L.B., Moore, P.J., **Brown, C.J.**, Bruno, J.F., Duarte, C.M., Halpern, B.S., Hoegh-Guldberg, O., Kappel, C.V., Kiessling, W., O'Connor, M.I., Pandolfi, J.M., Parmesan, C., Sydeman, W.J., Ferrier, S., Williams, K.J. & Poloczanska, E.V. (2014). Geographical limits to species-range shifts are suggested by climate velocity. *Nature*, **507(7493),** 492-495. doi:10.1038/nature12976.

28. **O'Neill, M.F.,** Leigh, G.M., **Wang, Y-G.,** Braccini, J.M., & Ives, M.C. (2014). Linking spatial stock dynamics and economics: Evaluation of indicators and fishery management for the travelling eastern king prawn (*Melicertus plebejus*), *ICES Journal of Marine Science*, **71(7)**, 1818-1834. doi:10.1093/icesjms/fst218.

29. Hallegraeff, G., Coman, F., Davies, C., Hayashi, A., McLeod, D., Slotwinski, A., Whittock, L., & **Richardson, A.J.** (2014). Australian dust storm associated with extensive *Aspergillus sydowii* fungal "bloom" in coastal waters. *Applied and Environmental Microbiology* **80(11)**, 3315-3320. doi:10.1128/AEM.04118-13.

30. **Robinson, L.M.,** Hobday, A.J., Possingham, H.P., & **Richardson, A.J.** (2014). Trailing edges projected to move faster than leading edges for large pelagic fish under climate change. *Deep Sea Research II: Topical Studies in Oceanography.* doi:10.1016/j.dsr2.2014.04.007.

31. Xin, P., **Wang, S.**, Robinson, C., Li, L., **Wang, Y-G.** & Barry, D. A. (2014). Memory of past random wave conditions in submarine groundwater discharge, *Geophysical Research Letters*, **41(7)**, 2401-2410. doi:10.1002/2014GL059617.

32. **Couturier, L.I.E.,** Dudgeon, C.L., Pollock, K.H., **Jaine, F.R.A.,** Bennett, M.B., Townsend, K.A., Weeks, S.J. & **Richardson, A.J.** (2014). Population dynamics of the reef manta ray Manta alfredi in eastern Australia. *Coral Reefs*. **33(2)**, 329-342. doi:10.1007/s00338-014-1126-5.

33. Raitsos, D.E., Pradhan, Y., Lavender, S.J., Hoteit, I., McQuatters-Gollop, A., Reid, P.C., & **Richardson, A.J.** (2014). From silk to satellite: half a century of ocean colour changes in the Northeast Atlantic. *Global Change Biology* **20(7)**, 2117-2123. doi:10.1111/gcb.12457.

34. Henschke, N., Everett, J.D., Doblin, M.A., Pitt, K.A., & **Richardson, A.J.**, Suthers, I.M., (2014). Demography and interannual variability of salp swarms (*Thalia democratica*). *Marine Biology* **161(1)**, 149-163. doi:10.1007/s00227-013-2325-2.

35. Hoegh-Guldberg, O., Cai, R., Poloczanska, E.S., Brewer, P.G., Sundby, S., Hilmi, K., Fabry, V.J. Jung, S. and 21 contributing authors including **Richardson, A.J.** (2014).Chapter 30: The Ocean. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Barros, V.R., Field, C.B., Dokken, D.J., Mastrandrea, M.D., Mach, K.J., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R. & White, L.L. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1655-1731.

36. Lynch TP, Morello EB, Evans K, **Richardson AJ**, Steinberg CR, Roughan M, Thompson P, Middleton JF, Feng M, Sherrington R, Brando V, Tilbrook B, Ridgway K, Allen S, Doherty P, Hill K, Moltmann TC (2012). IMOS National Reference Stations: a continental scaled physical, chemical and biological coastal observing system, *PLoS ONE*. doi:10.1371/journal.pone.0113652.

37. Foo, C. & **Wang, Y-G**. (2013). Stochastic growth models for analyzing crustacean data. In Piantadosi, J., Anderssen, R.S. and Boland J. (eds) MODSIM2013, 20th International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, 566-572. ISBN: 978-0-9872143-3-1.

38. **Wang, Y-G.** & Tian, T. (2013). Sediment concentration prediction and statistical evaluation for annual load estimation, *Journal of Hydrology*, **482**, 69–78. doi:10.1016/j.jhydrol.2012.12.043.

39. **Lloyd-Jones, L.R., Wang, Y-G.**, Nash, W.J., (2013).Generalised growth models for aquatic species with an application to blacklip abalone (Haliotis rubra). *Ecological Modelling*, **272**, 311-322. doi:10.1016/j.ecolmodel.2013.10.012.

40. **Wang, Y-G.** & Wang, Na. (2013) Rejoinder to Pascoe et al (2013)'s comment paper. Fisheries, **38 (11),** 509-510. doi:10.1080/03632415.2013.848346.

41. **Couturier , L.I.E., Rohner, C.A., Richardson, A.J.**, Marshall, A.D., **Jaine, F.R.A.,** Bennett, M.B., Townsend, K.A., Weeks, S.J. & Nichols, P.D. (2013) Stable isotope and signature fatty acid analyses show reef manta rays snack on surface zooplankton and feast on demersal zooplankton. *PLoS One* **8(10)**, e77152. 15 pp. doi:10.1371/journal.pone.0077152.

42. Hoegh-Guldberg O, Poloczanska E, **Richardson A** (2013). Four Degrees of Global Warming: Australia in a Hot World. Australia's marine resources in a warm, acid ocean, *published by Routledge Taylor and Francis Group*.

43. **Brown, C.J.,** Saunders, M.I., Possingham, H.P. & **Richardson, A.J.** (2013), Interactions between global and local ecosystem stresses determine effectiveness of cumulative impact mapping. *Diversity and Distributions,* **20(5)**, 538-546. doi:10.1111/ddi.12159.

44. Parmesan, C., Burrows, M.T., Duarte, C.M., Poloczanska, E.S., **Richardson, A.J.**, Schoeman, D.S. & Singer, M.C. (2013), Beyond climate change attribution in conservation and ecological research. *Ecology Letters,* **16 SI,** 58-71. doi:10.1111/ele.12098.

45. Ponce-Reyes, R., Nicholson, E., **Baxter, P.W.J.**, Fuller, R.A. & Possingham, H. (2013) Extinction risk in cloud forest fragments under climate change and habitat loss, *Diversity and Distributions,***19(5-6) SI**, 518-529. doi:10.1111/ddi.12064.

46. **Macbeth, G.M.**, Broderick, D., Buckworth, R.C. & Ovenden, J.R. (2013) Linkage Disequilibrium Estimation of Effective Population Size with Immigrants from Divergent Populations: A Case Study on Spanish Mackerel (Scomberomorus commerson), *G3,* **3(4),** 709-717. doi:10.1534/g3.112.005124.

47. Mazor, T., Levin, N., Possingham, H.P., Lvey, Y., Rocchini, D., **Richardson, A.J.** & Kark, S. (2013). Can satellite-based night lights be used for conservation? The case of nesting sea turtles in the Mediterranean, *Biological Conservation*, **159**, 63-72. doi:10.1016/j.biocon.2012.11.004.

48. Catry, P., **Lemos, R.T.**, Brickle, P., Phillips, R.A., Matias, R., & Granadeiro, J.P. (2013). Predicting the distribution of a threatened albatross: the importance of competition, fisheries and annual variability. *Progress in Oceanography,* **110**, 1-10. doi:10.1016/j.pocean.2013.01.005.

49. Gusmão, L.F.M., McKinnon, A.D. & **Richardson, A.J.** (2013), Female-biased sex ratios in marine pelagic copepods: Response to Hirst et al.(2013), *Marine Ecology Progress Series*, **489,** 299–301. doi:10.3354/meps10523.

50. **Rohner, C.A., Couturier, L.I.E., Richardson, A.J.**, Pierce, S.J., Prebble, C., Gibbons, M.J. & Nichols, P.D. (2013), Diet of whale sharks *Rhincodon typus* inferred from stomach content and signature fatty acid analyses. *Marine Ecology Progress Series,* **493***,* 219-235. doi:10.3354/meps10500.

51. **Rohner, C.A.,** Pierce, S.J., Marshall, A.D., Weeks, S.J., Bennett, M.B. & **Richardson, A.J.** (2013), Trends in sightings and environmental influences on a coastal aggregation of manta rays and whale sharks.*Marine Ecology Progress Series*, **482,** 153-168. doi:10.3354/meps10290.

52. Gusmão, L.F.M., McKinnon, A.D. & **Richardson, A.J.** (2013), No evidence of predation causing female-biased sex ratios in marine pelagic copepods. *Marine Ecology Progress Series*,**482:** 279-298. doi:10.3354/meps10265.

53. Gershwin, L-A., **Richardson, A.J.**, Winkel, K.D., Fenner, P.J., Lippmann, J., Hore, R., Avila-Soria, G., Brewer, D., Kloser, R., Steven, A.& Condie, S. (2013) Biology and ecology of Irukandji jellyfish (Cnidaria: Cubozoa). *Advances in Marine Biology,* **66,**1-86. doi:10.1016/B978-0-12-408096-6.00001-8.

54. Ceccarelli, D., McKinnon, D.A., Adrefouet, S., Alain, V., Young, J., Gledhill, D., Flynn, A., Bax, N., Beaman, R., Borsa, P., Brinkman, R., Bustamante, R., Campbell, R., Cappo, M., Cravatte, S., D'Agata, S., Dichmont, C., Dunstan, P.K., Dupouy, C., Edgar, G., Farman, R., Furnas, M., Garrigue, C., Hutton, T., Kulbick, M., Letourneur, Y., Lindsay, D., Menkes, C., Mouillot, D., Parravicini, V., Payri, C., Pelletier, B., Richer de Forges, B., Ridgway, K., Rodier, M., Samadi, S., Schoeman, D., Skewes, T., Swearer, S., Vigliola, L., Wantiez, L., Williams, A., Williams, A. & **Richardson, A.J.** (2013) The Coral Sea: Physical environment, ecosystem status and biodiversity assets. *Advances in Marine Biology*, **66,** 211-287. doi:10.1016/B978-0-12-408096-6.00004-3.

55. Gren, I-M., **Baxter, P.W.J.**, Mikusiński, G. & Possingham, H.P. (2013). Cost-effective biodiversity restoration with uncertain growth in forest habitat quality, *Journal of Forest Economics*., 20(1), 77-92. doi:10.1016/j.jfe.2013.09.003.

56. **Couturier, L.I.E., Rohner, C.A., Richardson, A.J.**, Pierce, S.J., Marshall, A.D., **Jaine, F.R.A.,** Townsend, K.A., Bennett, M.B., Weeks, S.J. & Nichols, P.D. (2013). Unusually high levels of omega-6 polyunsaturated fatty acids in whale sharks and manta rays. *Lipids,* **48(10),** 1029-1034. doi:10.1007/s11745-013-3829-8.

57. **Couturier, L.I.E.,** Bennett, M.B. & **Richardson, A.J.** (May 2013), Mystery of giant rays off the Gaza strip solved. *Oryx,* **47(4),** 480. doi: http://dx.doi.org/10.1017/S0030605313000793.

58. Gibbons, M.J. & **Richardson AJ** (2013), Beyond the jellyfish joyride and global oscillations: advancing jellyfish research. *Journal of Plankton Research*, **35(5),** 929-938. doi:10.1093/plankt/fbt063.

59. McKinnon, D.A., Campbell, R., Ceccarelli, D., Dugan, S., Dunstan, P., Lindsay, D., Ridgway, K., Williams, A. & **Richardson, A.J.** (2013) Tropical Marginal Seas: Priority Regions For Managing Threats To Marine Biodiversity And Ecosystem Function. *Annual Reviews in Marine Science,* **6**, 17.1-17.23. doi: 10.1146/annurev-marine-010213-135042.

60. **Brown, C.J.,** Saunders, M.I., Possingham, H.P. & **Richardson, A.J.** (2013), Managing for interactions between local and global stressors of ecosystems. *PLoS One*. **8(6),** 1-10. doi:10.1371/journal.pone.0065765.

61. Poloczanska, E.S., **Brown, C.J.,** Sydeman, W.J., Kiessling, W., Moore, P.J., Brander, K., Bruno, J.F., Buckley, L., Burrows, M.T., Duarte, C.M., Halpern, B.S., Holding, J., Kappel, C.V., O'Connor, M.I., Pandolfi, J.M., Parmesan, C., Schoeman, D.S., Schwing, F., Thompson, S.A. & **Richardson, A.J.** (2013). Global imprint of climate change on marine life, *Nature Climate Change,* **3(10),** 919-925. doi:10.1038/NCLIMATE1958.

62. **Wang, Y-G.**(2013). Water Quality: Indicators, Human Impact and Environmental Health, edited by Y-G Wang, book **ISBN:** 978-1-62417-111-6, Nova Science Publishers.

63. **Wang, Y-G.** (2013). Book Review of "Generalized Estimating Equations" by A. Ziegler, Australian & New Zealand Journal of Statistics, **55(1),** 61. doi:10.1111/anzs.12017.

64. **Richardson, A.J**., Pauly, D., Gibbons, M.J. (2012) Keep jellyfish numbers in check. *Nature,* **483(158)**, doi:10.1038/483158b

65. Burrows, M.T., Schoeman, D.S., Duarte, C.M., O'Connor, M.I., Buckley, L.B., Kappel, C.V., Parmesan, C., Halpern, B.S., **Brown, C.,** Brander, K.M., Bruno, J.F., Pandolfi, J.M., Sydeman, W.J., **Richardson, A.J.** & Poloczanska, E.S. (2012). Response to "Invasive Species Unchecked by Climate Response", *Science,* **335(6068),** 538-539. doi:10.1126/science.335.6068.538-a.

66. Zhang, Q., Li, L., **Wang, Y-G.**, Werner, A. D., Xin, P., Jiang, T. & Barry, D. A. (2012). Has the Three-Gorges Dam made the Poyang Lake wetlands wetter and drier? Geophysical Research Letters, doi:10.1029/2012GL053431, **39**, L20402. doi:10.1029/2012GL053431.

67. Brewer, D.T., Morello, E.B., Griffiths, S., Fry, G., Heales, D., Apte, S.C., Venables, W.N., Rothlisberg, P.C., Moeseneder, C., Lansdell, M., Pendrey, R., Coman, F., Strzelecki, J., Jarolimek, C.V., Jung, R.F. & **Richardson, A.J.** (2012) Impacts of gold mine waste disposal on a tropical pelagic ecosystem, *Marine Pollution Bulletin*, **64 (12)**, 2790-2806. doi:10.1016/j.marpolbul.2012.09.009.

68. Young, J.W., McKinnon, A.D., Ceccarelli, D., Brinkman, R., Bustamante, R.H., Cappo, M., Dichmont, C., Doherty, P., Furnas, M., Gledhill, D., Griffiths, S., Hutton, T., Ridgway, K., Smith, D., Skewes, T., Williams, A., **Richardson, A.J.** (2012). Workshop on the ecosystem and fisheries of the Coral Sea: an Australian perspective on research and management, *Reviews in Fish Biology and Fisheries*, **22(3)**, 827-834. doi:10.1007/s11160-011-9251-5.

69. Shin, Y-J., Bundy, A., Shannon, L.J., Blanchard, J.L., Chuenpagdee, R., Coll, M., Knight, B., Lynam, C., Piet, G., **Richardson, A.J.** (2012). Global in scope and regionally rich: an IndiSeas workshop helps shape the future of marine ecosystem indicators, *Reviews in Fish Biology and Fisheries*, **22(3)**, 835-845. doi:10.1007/s11160-012-9252-z.

70. **Jaine, F.R.A., Couturier, L.I.E.,** Weeks, S.J., Townsend, K.A., Bennett, M.B., Fiora, K. & **Richardson, A.J.** (2012) When giants turn up: Sighting trends, environmental influences and habitat use of the manta ray *Manta alfredi* at a coral reef. *PLoS ONE*, **7(10).** doi: 10.1371/journal.pone.0046170.

71. **Wang, Y-G.** & **Wang, N**. (2012). A Retrospective Evaluation of Sustainable Yields for Australia's Northern Prawn Fishery, *Fisheries*, **37(9),** 410-416. doi:10.1080/03632415.2012.714326.

72. Dobbie, M. J., **Wang, Y-G**., Zammit, R., Offer, A., Negus, P., & Blessing, J. (2012). Optimising the sampling effort in riparian surveys, *Environmental Monitoring and Assessment,* **185(5)**, 3721-3733. doi:10.1007/s10661-012-2823-6.

73. Beltrán, F., Sansó, B., **Lemos, R. T.**, & Mendelssohn, R. (2012). Joint projections of North Pacific sea surface temperature from different global climate models, *Environmetrics (Special Issue: Advances in Statistical Methods for Climate Analysis)*, **23(5) SI**, 451–465. doi:10.1002/env.2150.

74. **Lloyd-Jones, L.R., Wang,Y-G.**, Courtney, A.J., Prosser, A. J. & Montgomery, S.S. (2012). Latitudinal and seasonal effects on growth of the Australian eastern king prawn (Melicertus plebejus), *Canadian Journal of Fisheries and Aquatic Sciences*, 69(9), 1525–1538. doi:10.1139/F2012-072.

75. **Fu, L.**, **Wang, Y-G** & Liu, C.J. (2012). Rank regression for analysing ordinal qualitative data for treatment comparison. *Phytopathology*, **102(11)**, 1064-1070. doi:10.1094/PHYTO-05-11-0128.

76. **Richardson, A.J.**, Brown C.J,Brander, K., Bruno, J.F., Buckley, L., Burrows, M.T., Duarte, C.M., Halpern, B.S., Hoegh-Guldberg, Holding, J., Kappel, C.V., Kiessling, W., Moore, P., O'Connor, M.I., Pandolfi, J.M., Parmesan, C., Schoeman, D.S., Schwing, F., Sydeman, W.J., Poloczanska, E.S. (2012) Climate change and marine life, *Biology Letters*, **8(6)**, 907-909. doi: 10.1098/rsbl.2012.0530.

77. **Couturier, L.I.E.,** Marshall, A.D., **Jaine, F.R.A.,** Kashiwagi, T., Pierce, S.J., Townsend, K.A., Weeks, S.J., Bennett, M.B., **Richardson, A.J.** (2012). Biology, ecology and conservation of the Mobulidae, *Journal of Fish Biology*, **80(5) SI**, 1075-1119. doi:10.1111/j.1095-8649.2012.03264.x.

78. McLeod, D.J., Hallegraeff, G.M., Hosie, G.W., **Richardson, A. J.** (2012). Climate-driven range expansion of the red-tide dinoflagellate Noctiluca scintillans into the Southern Ocean, *Journal of Plankton Research*, **34(4)**, 332-337. doi:10.1093/plankt/fbr112.

79. Flynn, B.A., **Richardson, A.J.,** Brierley, A.S., Boyer, D.C., Axelsen, B.E., Scott, L., Moroff, N.E., Kainge, P.I., Tjizoo, B.M., Gibbons, M.J. (2012). Temporal and spatial patterns in the abundance of jellyfish in the northern Benguela upwelling ecosystem and their link to thwarted pelagic fishery recovery, *African Journal of Marine Science*, **34(1)**, 131-146. doi:10.2989/1814232X.2012.675122.

80. Griffith, G., Fulton, B., Gorton, B., & **Richardson, A.J.** (2012). Predicting interactions among fishing, ocean warming, and ocean acidification in a marine system with whole-ecosystem models, Conservation Biology, **26(6)**, 1145-1152. doi:10.1111/j.1523-1739.2012.01937.x.

81. Fan, S.K., Lu Y. & **Wang, Y-G.** (2012). A Simple Bayesian Decision-Theoretic Design for Dose Finding Trials, *Statistics in Medicine*, **31 (28),** 3719-3730. doi:10.1002/sim.5438.

82. **Wang, Y-G**. & Wang N. (2012) Implications of Gain Functions in Fisheries Management, *Reviews in Fisheries Science,* **20(2)**, 103-109. doi:10.1080/10641262.2012.663421.

83. **Fu, L. & Wang, Y-G. (2012).** Statistical Tools for Analyzing Water Quality Data, Kostas Voudouris and Dimitra Voutsa (eds), Water Quality Monitoring and Assessment, Chapter 6, 143-168. doi:10.5772/35228. (InTech - free access)

84. Boyce, M.S., **Baxter, P.W.J.** & Possingham, H.P. (2012) Managing moose harvests by the seat of your pants, *Theoretical Population Biology,* **82(4) SI**, 340-347. doi:10.1016/j.tpb.2012.03.002.

85. **Fu, L.** & **Wang, Y-G**. (2012). Quantile regression for longitudinal data with a working correlation model, *Computational Statistics and Data Analysis*, **56(8)**, 2526-2538. doi:10.1016/j.csda.2012.02.005.

86. **Fu, L.** & **Wang, Y-G.** (2012). Efficient estimation for rank-based regression with clustered data. *Biometrics,* **68 (4),** 1074 - 1082. doi:10.1111/j.1541-0420.2012.01760.x.

87. Mackas, D.L., Greve, W., Edwards, M., Chiba, S., Tadokoro, K., Eloire, D., Mazzocchi, M.G., Batten, S., **Richardson, A.J.**, Johnson, C., Head, E., Converssi, A. & Peluso, T. (2012). Changing zooplankton seasonality in a changing ocean: Comparing time series of zooplankton phenology, *Progress In Oceanograpahy*, **97 SI**, 31-62. doi:10.1016/j.pocean.2011.11.005.

88. **Brown, C.J.,** Fulton, B.A., Possingham, H.P & **Richardson, A.J.** (2011). How long can fisheries managers afford to delay action on ecosystem and climate change?, *Ecological Applications*, **22(1)**, 298-310. doi:10.1890/11-0419.1.

89. **Brown, C.J.,** Schoeman, D., Sydeman, W, Poloczanska, E.S., Moore, P., Venables, W., Burrows, M., Pandolfi, J., Buckley, L., Duarte C.M, Brander K. & **Richardson A.J.** (2011). Quantitive approaches in climate change ecology, *Global Change Biology*, **17(12)**, 3697-3713. doi:10.1111/j.1365-2486.2011.02531.x.

90. Burrows, M.T., Schoeman, D.S., Buckley, L.B., Moore, P., Poloczanska, E.S., Brander, K.M., Brown C., Bruno, J.F., Duarte, C.M., Halpern, B.S., Holding, J., Kappel, C.V., Kiessling, W., O'Connor, M.I., Pandolfi, J.M., Parmesan, C., Schwing, F.B., Sydeman, W.J. & **Richardson, A.J.** (2011). The pace of shifting climate in marine and terrestrial systems, *Science*, **334(6056)**, 652-655. doi:10.1126/science.1210288.

91. Carey, V.J. & **Wang, Y-G.** (2011). Working covariance model selection for generalized estimating equations, *Statistics in Medicine*, **30(26)**, 3117-3124. doi:10.1002/sim.4300.

92. **Couturier, L., Jaine, F.R.A.,** Townsend, K., Weeks, S., **Richardson, A.J**. & Bennett, M.B. (2011). Distribution, site affinity and regional movements of the manta ray, Manta alfredi, along the east coast of Australia, *Marine and Freshwater Research*, **62(6)**, 628-637. doi:10.1071/MF10148.

93. **Fu, L.** & **Wang, Y-G.** (2011). Nonparametric Rank Regression for Analyzing Water Quality Concentration Data with Multiple Detection Limits, *Environmental Science and Technology*, **45(4)**,1481-1489. doi:10.1021/es101304h.

94. Garcia-March, J.R., Marquez-Aliaga A., **Wang, Y-G**., Surge, D. & Kersting D.K. (2011). Study of Pinna nobilis grow the from inner record: How biased are posterior adductor muscle scars estimates?, *Journal of Experimental Marine Biology and Ecology*, **407(2)**, 337-344. doi:10.1016/j.jembe.2011.07.016.

95. Grantham, H.S., Game, E.T., Lombard, A.T., Hobday, A.J., **Richardson, A.J**., Beckley, L.E., Pressey, R.L., Huggett, J.A., Coetzee, J.C., van der Lingen, C.D., Petersen, S.L., Merkle, D. & Possingham, H.P. (2011). Accommodating Dynamic Oceanographic Processes and Pelagic Biodiversity in Marine Conservation Planning, *PLoS ONE*, **6(2)**, e16552. doi:10.1371/journal.pone.0016552.

96. Griffith, G.P., Fulton, E.A. & **Richardson, A.J.** (2011). Effects of fishing and acidification-related benthic mortality on the southeast Australian marine ecosystem, *Global Change Biology,* **17(10)**, 3058-3074. doi:10.1111/j.1365-2486.2011.02453.x.

97. Parmesan, C., Duarte, C.M., Poloczanska, E.S., **Richardson, A.J.** & Singer, M.C. (2011). Overstretching Attribution, *Nature Climate Change,* **1(1)**, 2-4. doi:10.1038/nclimate1056.

98. Johnson, C.R., Banks, S.C., Barrett, N.S., Cazzasus, F., Dunstan, P.K., Edgar, G.J., Frusher, S.D., Gardner, C., Helidoniotis, F., Hill, K.L., Holbrook, N.J., Hosie, G.W., Last, P.R., Ling, S.C., Melbourne-Thomas, J., Miller, K., Pecl, G.T., **Richardson, A.J**., Ridgway, K.R., Rintoul, S.R., Ritz, D.A., Ross, D.J., Sanderson, J.C., Shepherd, S., Slotwinski A., Swadling K.M. & Taw, N. (2011). Climate change cascades: shifts in oceanography, species' ranges and marine community dynamics in eastern Tasmania, *Journal of Marine Experimental Biology and Ecology,* **400(1-2) SI**, 17-32. doi:10.1016/j.jembe.2011.02.032.

99. Macbeth, G.M. & Palmer, P.J. (2011). A novel breeding program for improved growth in barramundi Lates calcarifer (Bloch) using foundation stock from progeny-tested parents , *Aquaculture,* **318**, 325-334.

100. Percival, D., Lennox, S., **Wang, Y-G.** & Darnell, R. (2011). Wavelet-Based Multiresolution Analysis of Wivenhoe Dam Water Temperatures, *Water Resources Research,* **47**, W05552. doi:10.1029/2010WR009657.

101. Poloczanska, E.S., Smith, S., Fauconnet, L., Healy, J., Tibbetts, I., Burrows, M.T. & **Richardson, A.J.** (2011). Little change in distribution of rocky shore faunal communities on the Australian east coast after 50 years of warming, *Journal of Experimental Marine Biology and Ecology*, **400(1-2) SI**, 145-154. doi:10.1016/j.jembe.2011.02.018.

102. **Probert, W.J.M.,** Drechsler, M., **Baxter, P.W.J.** & Possingham, H.P. (2011). Resource allocation in two species systems: Is it worth acknowledging species interactions? *Ecological Modelling,* **222(10)**, 1781-1789. doi:10.1016/j.ecolmodel.2011.02.026.

103. **Robinson, L.,** Hobday, A.J., Pearson, R.G., Elith, J., Kendall, B.E., **Possingham, H.P.** & **Richardson, A.J**. (2011). Pushing the limits in marine species distribution modelling: lessons from the land present challenges and opportunities, *Global Ecology and Biogeography*, **20(6)**, 789-802. doi:10.1111/j.1466-8238.2010.00636.x.

104. **Roger, L.M.,** McKinnon, A.D., Knott, B., Matear, R., Scadding, C. & **Richardson, A.J.** (2011). Comparison of shell structure of two tropical thecosomata (Creseis acria and Diacavolinia longirostris) from 1963-2009: potential implications of declining aragonite saturation state, *ICES Journal of Marine Science,* **69(3)**, 465-474. doi:10.1093/icesjms/fsr171.

105. **Rohner, C.A., Richardson, A.J.**, Marshall, A.D., Weeks, S.J. & Pierce, S.J. (2011). How large is the world's largest fish? Measuring whale sharks Rhincodon typus with laser photogrammetry, *Journal of Fish Biology,* **78(1)**, 378-385. doi:10.1111/j.1095-8649.2010.02861.x.

106. **Wang, Y-G.** & **Fu, L.** (2011). Rank regression for the accelerated failure time model with clustered and censored data, *Computational Statistics and Data Analysis*, **55(7)**, 2334-2343. doi:10.1016/j.csda.2011.01.023.

107. **Wang, Y-G.**, Keuhnert, P. & Henderson, B. (2011). Load estimation with uncertainties from opportunistic sampling data - A semiparametric approach, *Journal of Hydrology*, **396(1-2)**, 148-157. doi:10.1016/j.jhydrol.2010.11.003.

108. Breitung, J., Chaganty, N.R., Daniel, R.M., Kenward, M.G., et al (inc **Wang, Y-G.**) (2010). Discussion of "generalized estimating equations: Notes on the choice of the working correlation matrix", *Methods of Information in Medicine*, **49(5)**, 426-432.

109. Liu et al. (**inc Wang Y-G.**) (2010). Plant Height Affects Fusarium Crown Rot Severity in Wheat, *Phytopathology*, **100(12)**, 1276-1281. doi:10.1094/PHYTO.05.10.0142.

110. **Wang, Y-G.** & **Fu, L.** (2010). Rank Regression Analysis of Correlated Water Quality Data from South East Queensland, *Environmental and Ecological Statistics*, **18(4)**, 781-793. doi:10.1007/s10651-010-0165-5.

111. Mokany, K., **Richardson, A.J.**, Poloczanska, E.S., Ferrier, S., (2010). Uniting marine and terrestrial modelling of boidiversity under climate change, *Trends in Ecology & Evolution,* **25(10) SI**, 550-551. doi:10.1016/j.tree.2010.06.014.