



CARM NEWS *September 2019*

RECENT IMPACT

Mastering metabolism for shark and ray survival

Anthony Richardson and PhD scholar Chris Lawson have their new study, in press, in [Trends in Ecology and Evolution](#). They describe the state-of-the-art in measuring and modelling the bioenergetics of large sharks and rays to answer key ecological questions and predict the impacts of climate change.

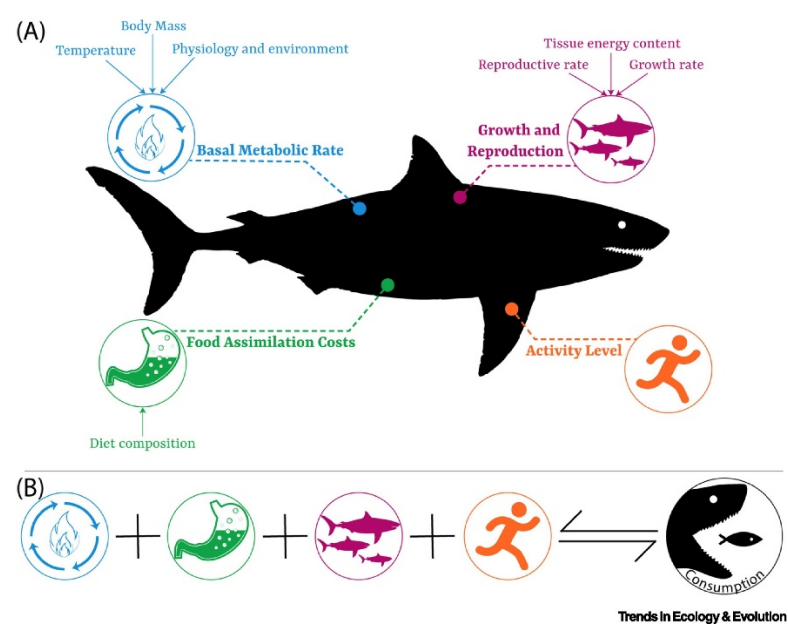
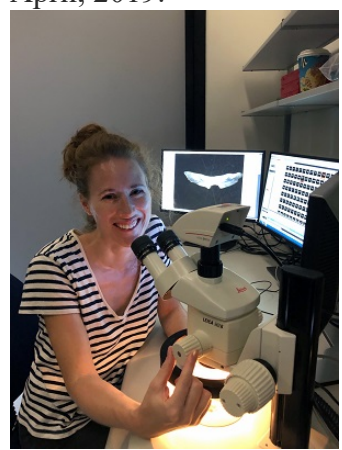


Figure 1: Energy consuming processes in the body used in bioenergetics modelling SOURCE: Lawson, C.L., Halsey, L.G., Hays, G., Bennett, M., White, C.R., Richardson, A.J. (2019). Powering ocean giants: The energetics of shark and ray megafauna. *TREE* p.2. (In press, 1/7/2019).

Mathematical modelling for a fishy future.

Sabrina Streipert was featured in a news article by the UQ, Faculty of Science News on 3rd April, 2019.



Sabrina discussed the state of barramundi stocks in Australia and how they are, “heading for a healthier future thanks to the powers of mathematical modelling”.

Through the collaboration of CARM and the Queensland Department of Agriculture and Fisheries the team are developing applied mathematical methods for accurate estimates of fish stock populations.

The full article can be accessed on the [UQ, Faculty of Science website](#).

Photo 1: Sabrina Streipert analysing barramundi samples under the microscope



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AMSI OPTIMISE Perth, Australia, 17-21 June, 2019

Jerzy Filar presented an invited talk titled, "Threshold risk and uncertainty quantification in environmental modelling."



Photo 2: Jerzy Filar with speakers Alysson Costa and Pulkit Jain



Photo 3: Jerzy Filar presenting his talk

Abstract: Mathematical models of environmental problems often demand understanding of complex dynamics and interactions between many physical and biological variables on the one hand, and human inputs on the other. Uncertainties accompanying such models stem from multiple sources. Sometimes they manifest themselves as cascading errors and at other times they involve the risk of key variables crossing undesirable thresholds. In both cases they undermine confidence in either the model or, worse still, the underlying science. We discuss these issues with illustrations from certain generic areas such as models of fishery management and integrated climate change models.

International Congress on Conservation Biology, Kuala Lumpur, Malaysia, 24th August, 2019

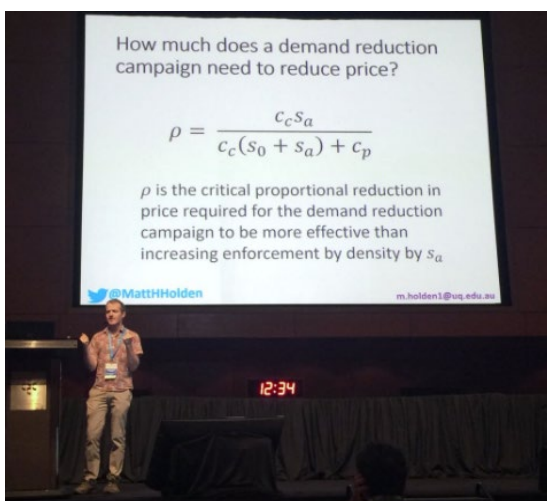


Photo 4: Matthew Holden delivering his talk

Matthew Holden delivered his talk to the Congress titled, "Predicting the outcomes and cost-efficacy of anti-poaching interventions"



Dr Chris Brown's research, "Restoring fish habitat to improve sustainability of fisheries", acknowledged in the, [Making a Difference. Outcomes of ARC supported research 2018 – 2019](#). Chris is a regular presenter of the annual February CARM R workshops.

RESTORING FISH HABITAT TO IMPROVE SUSTAINABILITY OF FISHERIES

Research led by an ARC Discovery Early Career Researcher Award (DECRA) recipient, Dr Chris Brown of Griffith University's Australian Rivers Institute, has found that protecting fish habitats is critical to recovering the world's fisheries.

It had previously been estimated that 31% of fish stocks globally are over-exploited, meaning that catches could be higher if fishing pressure was reduced. The study reviewed the habitat requirements for fish stocks across the globe and found that these previous estimates ignored the effects of habitat loss on the productivity of fisheries. In fact, nearly half of the world's best researched fish stocks are using habitats that are in decline, like seagrass and mangroves.

Dr Brown says that the work is significant because overfishing is often seen as the only cause of decline in the productivity of fisheries, which implies stricter fisheries regulations are the sole solution to overfishing. Restoration of critical fish habitats such as mangroves, seagrass, and floodplains will also help to increase the resilience of fish populations against overfishing.

Mangrove half and half with fish and jellyfish.
Credit: iStock.com/Damoclean.

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Research has looked at how protecting or restoring lost habitats can improve the status of fisheries, so that the fisheries can sustainably support higher catches.

ADVANCING ENVIRONMENTAL SCIENCE AND MANAGEMENT 43

The special Workshop on **Applications in Natural Resource Mathematics (WANRM)** issue is now published online in The Journal of Environmental Modeling & Assessment. Available at <https://link.springer.com/journal/10666/24/4>

Congratulations to the Applied² Probability Organizing Committee Ivo Adan, Konstanin Avrachenkov, John Boland, Mark Fackrell, Jerzy Filar, David Goldberg, Matthew Holden, Roxanne Jemison, Ross McVinish and Joshua Ross. The survey feedback was positive and attendees particularly liked the diversity of sessions and talks. Thank you to Phil Dyer and Zhihao Qiao for assisting the speakers all day and helping with the smooth running of the workshop.



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Satellite Workshop Applied² Probability 2 July, 2019 9am – 5pm

The CARM satellite workshop dealing with concrete applications (Applied² Probability) took place at The Global Change Institute, The University of Queensland, Brisbane. Professor Jenny Seddon, Associate Dean Research & Deputy Executive Dean, Faculty of Science, The University of Queensland opened the workshop themed, “Uncertainty quantification applications” to an interested crowd of 90 attendees.



Photo 3: Jerzy Filar introducing Jenny Seddon at the Workshop opening



Photo 4: Attendees at the opening session

The attendees then had to make choices all day as to which parallel session they would attend. Thank you to George Leigh (DAF) and Trevor Hutton (CSIRO) for speaking alongside Jerzy Filar and Wen-Hsi Yang in the Sustainable Fisheries session.



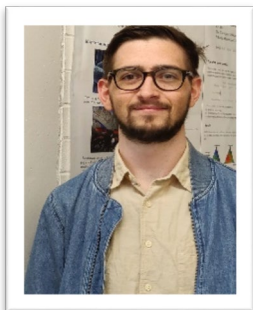
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WELCOME



We welcome **Dr Jason Everett**, Senior research Fellow with Antony Richardson. Jason is a biological oceanographer, with an interest in how oceanographic processes structure planktonic ecosystems. His research has focused on how flow regimes, boundary currents, eddies and upwelling events drive changes in the biomass, species distribution and size structure of zooplankton communities. In addition, he has extensive experience working with satellite data and numerical model output.

His current research focus is to quantify how the size, abundance and biomass of zooplankton and fish change across local, regional and global scales. By quantifying the size-based ecosystem through modelling and observations, we can better understand processes such as metabolism, predation or movement, which constrain the role of an individual in its food web. In particular, the biomass and size distribution of zooplankton is poorly understood relative to phytoplankton and fish in our oceans, yet it is critical to understanding the efficiency of energy transfer through to fisheries.



We welcome **Patrick Sykes** undertaking his PhD with Anthony Richardson. Patrick's title is, "Using size spectrum models to understand fisheries productivity in the ocean now and in the future". Wild fisheries and aquaculture provide 17% of the global human consumption of animal protein, and fishing is important to local economies and cultures across the world. The magnitude and distribution of fish caught in the ocean are related to the productivity of phytoplankton, microscopic "plants" which form the base of the marine food web. Current models show a decline in global phytoplankton production under climate change, and such declines constrain

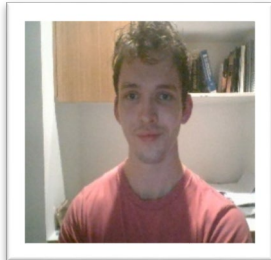
the size and distribution of future fish biomass. Our work is to develop a global model of energy transfer in the oceans that spans from bacteria (from 10^{-11} kg) to large fish (up to 10^4 kg). In particular, our model takes account of the complex roles that zooplankton, animals that float but cannot swim against currents, play in marine food webs.

We will use this model to better understand the structure and stability of ocean food webs that underpin fisheries productivity, and forecast how these are likely to be altered under climate change. Of particular interest is the question of how massive tuna are able to thrive in nutrient-poor "marine deserts". Quantifying how zooplankton mediate the efficient transfer of energy through the food chain will improve our ability to manage marine ecosystems and their valuable services now and in the future.

We welcome **Samuel Nolan** to CARM. Samuel is undertaking his honours within CARM with Matthew Holden as his supervisor. Project titled, "Optimal harvest of populations governed by stochastic difference equations."

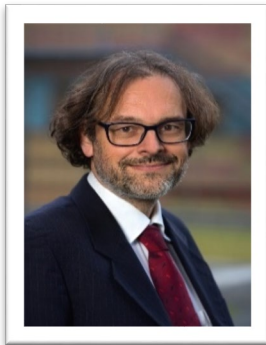


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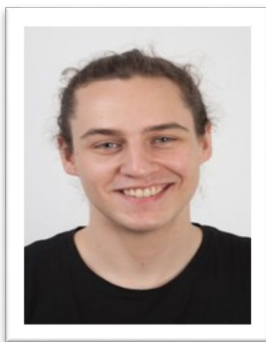


We welcome **Jakeb Lockyer** to CARM who is supervised by Matthew Holden while undertaking his honours at UQ. Project titled, “A dynamical systems approach to modelling management and enforcement to reduce elephant poaching for ivory.”

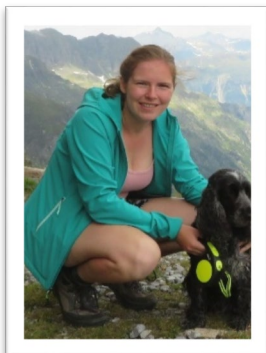
VISITORS TO CARM



Professor Michel Mandjes visited from 23 June to 10 July, 2019 to work on collaborative research within the CARM. Michel is the Programme leader of ‘NETWORKS’; consortium on stochastic and algorithmics with University of Amsterdam, CWI, University of Leiden (UL), and Eindhoven University of Technology (TUE).



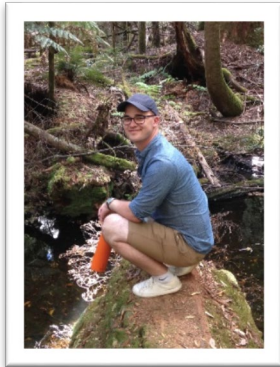
Krzysztof Bisewski from Centrum Wiskunde & Informatica (CWI), The Netherlands visited from 8th July to 7th August, 2019 who is researching rare event simulation for climate extremes (RESCLIM).



Femke van der Schoot from Eindhoven University of Technology (TUE), the Netherlands is graduating in a Master’s Degree which entails working on a six month full-time project and is visiting from 1st August to 1st December, 2019. Two years ago Femke decided that she would like to complete her graduation year abroad and with the help of her Eindhoven supervisor she has been able to study in Brisbane. Femke will complete the last two months of the project in the Netherlands. Femke has noticed that the Australian people are very welcoming and the animals and country is beautiful.



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Philip Erm is visiting Matthew Holden from Tuesday 20th August 2019 to Friday 24th August 2019 to collaborate on a marine conservation project. Although based at the University of Melbourne up until this time, this project is part of Philip's PhD that he will start in October 2019 at the University of Cambridge Conservation Science Group.

UPCOMING WORKSHOPS

The 2020 workshops will run from the 18-21 February at the St Lucia campus.

[Registration is open](#)

Introduction to R:

18th February 2020 Professor Anthony J. Richardson, Professor Dave Schoeman and Dr Chris Brown

Day 1 is ideal if you have had little or even no experience with R and want to produce robust analyses and effective graphics.

Intermediate to R:

19th – 20th February 2020 Professor Anthony J. Richardson, Professor Dave Schoeman and Dr Chris Brown

Days 2 and 3 are ideal for intermediate users or beginners wanting to go beyond the basics. The focus throughout is on ecological applications, particularly marine.

Advanced R:

18th – 20th February 2020 Dr Bill Venables

For those who know R well. Advanced data manipulation and visualisation. Advanced graphics. Statistical model building using traditional and machine learning techniques. Programming and software development in R.

tidyr and ggplot in R:

21 February 2020 Professor Anthony J. Richardson, Professor Dave Schoeman and Dr Chris Brown

Use ggplot for basic plots and advanced multilayer mapping.



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PROJECTS NEARING COMPLETION

- FRDC Project titled, “Stock predictions and spatial population indicators for Australia's east coast saucer scallop fishery” joint with M.F. O'Neill, A.J. Courtney, G. Leigh., M.M. Campbell (DAF) W-H, Yang, J.Filar (CARM).
- AFMA funded project led by CSIRO titled, “Harvest strategies for the Torres Strait Finfish fishery”. Joint with T. Hutton (CSIRO) M.F. O'Neill, G. Leigh (DAF) A, Tobin (Tobin Fish Tales) K, Basford, J.Filar, M. Holden (CARM).

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