MSI RESEARCH SHOWCASE

2016

Our oceans
Our future

THE UNIVERSITY OF SYDNEY

Marine Studies Institute

Mission

In early 2016, the University of Sydney: Institute of Marine Sciences (USIMS) was renamed to Marine Studies Institute (MSI) to differentiate from the Sydney Institute of Marine Sciences (SIMS). The institute's mission and purpose however, remains unchanged.

MSI is the public face of marine science at the University of Sydney, where past and present students and community members can extend their knowledge on courses, events and scientific exploits and breakthroughs. It is envisioned that this platform will promote innovative, cross disciplinary marine research that can be applied to national and international investigations.

MSI is amongst the largest marine research and education centres in Australia. The university hosts many nationally and internationally recognised research groups, currently spanning 10 disciplines, with more than 30 academic staff and over 100 postgraduate students. The marine network within the university includes:

- The Australian Centre for Climate and Environmental Law (ACCEL)
- The Australian Centre for Field Robotics
- The Byrne Laboratory
- The Centre for Wind, Waves and Water
- The Charles Perkin Centre
- The Costal and Marine Ecosystems Group (CMEG)
- The EarthByte Group
- The Geocoastal Research Group (GRG)
- The Georeef Laboratory
- The Ocean Technology Group (OTG)
- The Sydney Law School
- The Sydney Centre in Geomechanics and Mining Materials (SciGEM)
- The Vibrational Spectroscopy Core Facility

MSI RESEARCH SHOWCASE 2016

Covering topics including carbon emissions from a drowned river valley estuary (Sydney harbour) to ocean governance in the Anthropocene

The University of Sydney Marine Studies Institute (MSI) held a showcase at the end of 2016 to provide an overview of marine research throughout the university. The MSI showcase spotlighted high-calibre research and projects that were being undertaken by marine academics and postgraduate students. Each talk was roughly 3 minutes in duration demonstrating research snapshots with a focus on current projects. In addition to the formal presentations, there were opportunities to more fully discuss topics of interest and network with colleagues. This platform was a useful forum to promote innovative, cross disciplinary marine research that could be applied to national and international investigations.

This document has been put together from the research snapshots provided by the scientists at the Marine Bites Showcase with additional research interest summaries from academics who could not attend the showcase. The outlines include the following metadata:

Researcher:

Department/ Institute:

Project Title:

Project Summary:

Images:

A list of MSI publications from 2015-2016 has been included at the end of the document illustrating the national and global extent of collaborations of the University of Sydney Marine Studies Institute researchers.

Research Projects Summary

Lead Researcher	Marine Bites Showcase 2016 Project Titles or Research Interests
Prof Elaine Baker	The Big Sargassum Pile Up
Dr Joy Becker	Production-limiting infectious diseases affecting global aquaculture.
Prof Gavin Birch	Human-induced change and biological risk posed by contaminants in estuarine/harbour sediments: Sydney Harbour/estuary (Australia)
Dr Michelle Blewitt	Marine mammal research
Dr Eleanor Bruce	Integrated Geospatial Management System Sydney Harbor Area
Prof Maria Byrne	Impacts of ocean acidification on the interaction between tropical sea cucumbers, sediment biota and lagoon carbonate dynamics - direct and indirect effects of high CO_2
Prof Doug Cato	The Behavioural Response of Australian Humpback Whales to Seismic Surveys (BRAHSS)
A/Prof Peter Cowell	Geomorphology of coasts and continental shelves
Dr Navneet Dhand	The use of epidemiological and statistical tools to improve public health and to solve intricate problems confronting animal industries
Dr Olivia Evans	Pacific Oyster Mortality Syndrome – closing knowledge gaps to continue farming Crassostrea gigas in Australia.
Dr Renata Ferrari	3D Reefs Project
A/Prof Will Figueira	Spatial Ecology of Marine Ecosystems, Marine Resource Management & Conservation, Population Ecology of Marine Fish (Temperate-Tropical)
Dr Daniel Harrison	Saving the Great Barrier Reef
Dr Paul Hick	Pacific Oyster Mortality Syndrome
Dr Tom Hubble	Can submarine landslides trigger tsunamis?
Prof Ian Jones	Saving the Great Barrier Reef and Fertilising the ocean to help food security
Prof Peter Lay	Vibrational Spectroscopic Analysis of Microplastics and Microfibres in Fish
Dr Gabriel Machovsky-Capuska	Nutritional Ecology of Marine Predators: challenges and opportunities

Dr Bree Morgan	**The mobility, bioavailability and toxicity of trace metals in natural and disturbed coastal systems.**
Dr Phil Mulhearn	Changing water depths in Sydney Harbour and History of the charting/surveying of major NSW estuaries and the accuracy of early charts.
Prof Dietmar Müller	Marine geophysics and geodynamics, plate tectonics. Machine Learning Approaches to Analysing Global Sea Surface and Seafloor Data
Dr Maria Seton	Zealandia: Earth's Hidden Continent
Prof Tim Stephens	Ocean Governance in the Anthropocene – The Carbonation Challenge
Edwina Tanner	Oceanography and global warming (CO_2 emissions)
Dr Emma Thompson	Future Proofing the Sydney Rock Oyster
A/Prof Ana Vila-Concejo	Geocoastal research at the University of Sydney
Dr Ashley Ward	Behavioural ecology of fish
A/Prof Jody Webster	Spur and Groove Evolution, Formation and Paleoclimate: Great Barrier Reef and French Polynesia
Prof Richard Whittington	Aquatic Animal Health and Environmental Immunology
Prof Stefan Williams	Marine Systems at the Australian Centre for Field Robotics (navigation and mapping, clustering and classification, novel sensing, survey designs and platform designs)

Researcher: Professor Elaine Baker

Department/ Institute: School of Geoscience – Marine Studies Institute

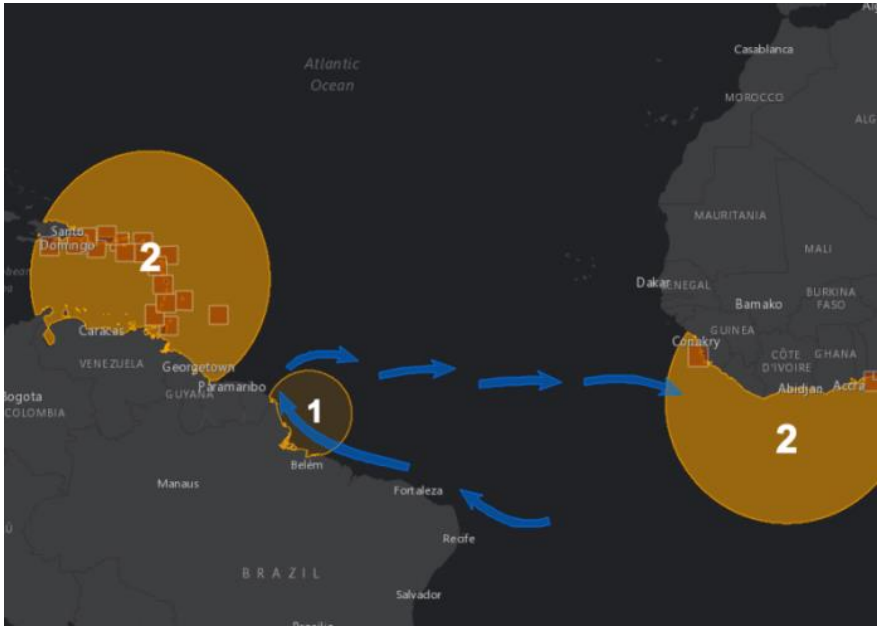
Project Title: Sargassum pile up

Project Summary:

There are many species of the seaweed genus Sargassum distributed throughout the oceans of the world. They can be found in shallow waters attached to the sea floor or free floating in the open ocean. In the past, studies tracking Sargassum have found a consistent pattern of movement from year to year, corresponding to prevailing surface currents and wind movements. The Gulf of Mexico acts as a nursery between March and June each year. In the spring, the Sargassum is exported by the Loop Current and Gulf Stream to the Sargasso Sea. Once there, it is trapped by eddies and accumulates over the summer, forming massive rafts tens of meters in diameter before dying off in the winter.

But in recent years this pattern has changed. Now we are seeing periodic ocean-wide explosions of Sargassum that can stretch from the Caribbean to the coast of Africa. The Sargassum washes onto beaches on both sides of the Atlantic. The large volumes of seaweed have affected tourism in the Caribbean and coastal fishing in West Africa. As the seaweed rots, it consumes oxygen, killing fish and other organisms. When washed onto turtle nesting beaches, it poses a major threat to baby turtles, who struggle through the Sargassum barrier to reach open water. The reasons for the change in distribution are uncertain, but may include increased nutrients from the Amazon and Orinoco Rivers (as a result of deforestation and agriculture), warmer sea surface temperatures and changes in ocean circulation patterns associated with climate change. The university is working with partners to solve the puzzle.

Two types of *sargassim natans and fluitans*



Map of *sargassum* pile up 2001

Researcher: Dr Joy Becker

Department/ Institute: Aquatic Animal Health and Production, School of Life and Environmental Sciences

Research interests: My research program is focused on production-limiting infectious diseases affecting global aquaculture.

Project Summary:

Improving fish health management and production protocols in marine finfish aquaculture in Indonesia and Australia

Aquatic animal health subprogram: Strategic approaches to identifying pathogens of quarantine concern associated with the importation of ornamental fish;

Aquatic Animal Health and Biosecurity Subprogram: quarantine risks and disease preparedness for the meglocytivirus ISKNV for Australia

Researcher: Professor Gavin Birch

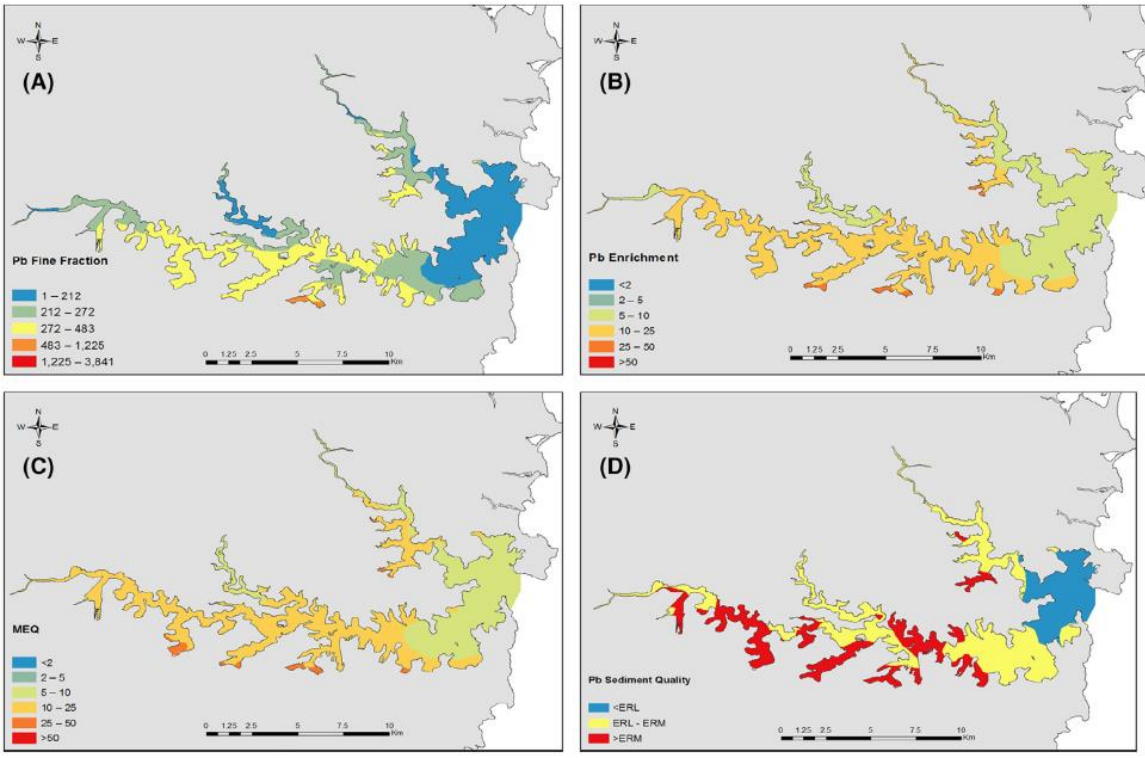
Department/ Institute: School of Geosciences

Project Title: Human-induced change and biological risk posed by contaminants in estuarine/harbour sediments: Sydney Harbour/estuary (Australia)

Project Summary:

A rapid, simple yet scientifically sound scheme providing two important types of information used in assessment of estuarine sediments is presented. The mean enrichment quotient (MEQ) (fine contemporary sediment metal concentration/fine fraction background metal concentration) for Cu, Pb and Zn provides the magnitude of human-induced change, (deviation fromthe pristine condition), while sediment quality guidelines (SQGs) assess the risk posed by sedimentary contaminants to the benthic community.

Maximum metal enrichment for sediment in Sydney estuary (Australia) is N100 times for Cu, Pb and Zn and the MEQ is N10 times formost of the estuary. Adverse effect on benthic populations due to Cu, Pb and Zn are expected in 2%, 50% and 36% of the waterway, respectively. SQGs for contaminant mixtures predict ~2% of the estuary has the highest risk of adverse effects, while 25% has intermediate risk. The scheme is well suited to initial assessments of estuarine sediments worldwide.



Distribution of Pb in surficial sediments in Sydney estuary. (A) in fine (<62.5µm) sediment; (B) as times of Pb enrichment over background; (C) mean enrichment quotient (MEQ) for three metals (Cu, Pb and Zn), and (D) as sedimentary risk for Pb. ERL – effects range low; ERM-effects range median.

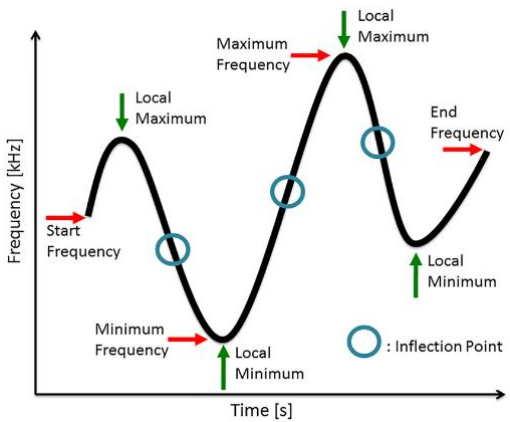
Researcher: Dr Michelle Blewitt

Department/ Institute: School of Biological Sciences

Project Title: Vocalisations of Killer Whales (Orcinus orca) in the Bremer Canyon, Western Australia

Project Summary:

To date, there has been no dedicated study in Australian waters on the acoustics of killer whales. Hence no information has been published on the sounds produced by killer whales from this region. Here we present the first acoustical analysis of recordings collected off the Western Australian coast. Underwater sounds produced by Australian killer whales were recorded during the months of February and March 2014 and 2015 in the Bremer Canyon in Western Australia. Vocalisations recorded included echolocation clicks, burst-pulse sounds and whistles. A total of 28 hours and 29 minutes were recorded and analysed, with 2376 killer whale calls (whistles and burst-pulse sounds) detected. Recordings of poor quality or signal-to-noise ratio were excluded from analysis, resulting in 142 whistles and burst-pulse vocalisations suitable for analysis and categorisation. These were grouped based on their spectrographic features into nine Bremer Canyon (BC) "call types".



The frequency of the fundamental contour.

Researcher: Dr Eleanor Bruce

Department/ Institute: School Geosciences – Development & Marine Biology

Project Title: Integrated Geospatial management of Sydney Harbour area

Project Summary:

Eleanor Bruce's research interests are in environmental spatial analysis and modelling. More specifically this research has focused on examining processes of habitat loss in urban coastal environments, the use of GIS and remote sensing in vegetation change detection and landscape heritage management, marine zone planning and evaluating the impact of spatial data uncertainty in environmental decision-making. Current research projects include examining coastal wetland response to changes in inter-tidal sedimentation rates in Sydney Harbour and developing an integrated geospatial management system of the of Sydney Harbour area.

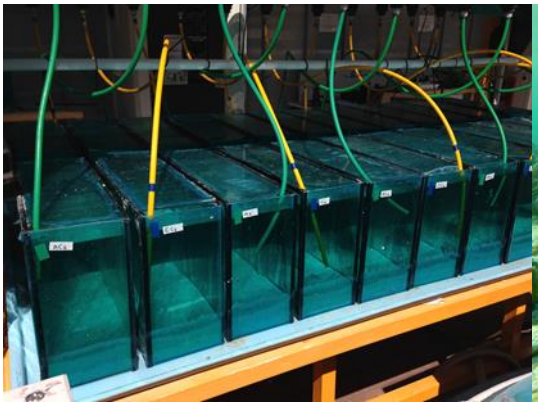
Researcher: Professor Maria Byrne

Department/ Institute: School of Medical Science – Development & Marine Biology

Project Title: Impacts of ocean acidification on the interaction between tropical sea cucumbers, sediment biota and lagoon carbonate dynamics - direct and indirect effects of high CO_2

Project Summary:

The effects of global change on biological systems and functioning are already measureable, but how ecological interactions are being altered is poorly understood. Ecosystem resilience is strengthened by ecological functionality, which depends on trophic interactions between key species. The feedbacks between marine climate change and trophic interactions of non-coral invertebrates are understudied. Sea cucumbers, some of the largest benthic inhabitants of the vast tropical lagoon habitat, can influence diel changes in reef carbonate dynamics. In this study, the potential for the sea cucumber, Stichopus herrmanni, a bêche-de-mer (fished) species listed as vulnerable to extinction, to buffer the impacts of ocean acidification on reef carbonate chemistry was investigated in lagoon sediment mesocosms. Stichopus herrmanni directly reduced the abundance of meiofauna and benthic primary producers through its deposit-feeding activity under present-day and near-future CO_2. These changes in benthic community structure, as well sediment dissolution and respiration by S. herrmanni, played a significant role in modifying seawater carbonate dynamics night and day. This work shows the important role of large tropical sea cucumbers in shaping lagoon sediment communities and seawater carbonate chemistry, in support of resilience of coral reefs in the face of global change. This previously unappreciated role is an important consideration in context of the bêche-de-mer trade to ensure sea cucumber populations are sustained in a future ocean.



Experimental tank setup representing lagoon ecosystems, including sea cucumbers, carbonate sand, algae and micro-organisms.

Sea cucumbers in their lagoon habitats could benefit surrounding corals and fishes

Prof. Maria Byrne taking sea cucumber faecal samples on SCUBA at One Tree Island

The sea cucumber, *Stichopus herrmanni*, contributing to bioturbation and seawater chemistry through its digestion of carbonate sand

Researcher: Adjunct Professor Doug Cato

Department/ Institute: School of Geoscience – Marine Studies Institute

In collaboration with The Defence Science and Technology Group, University of Queensland, Curtin University in Perth, University of Newcastle and Blue Planet Marine in Canberra.

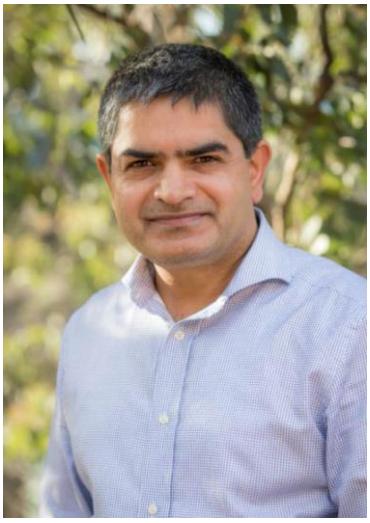
Project Title: The Behavioural Response of Australian Humpback Whales to Seismic Surveys (BRAHSS – www.brahss.org.au).
This is a collaboration with University of Queensland, Curtin University in Perth, University of Newcastle, the Defence Science and Technology Group, and Blue Planet Marine in Canberra (Doug Cato is the Chief Scientist). It is a multimillion dollar project partly funded by an international research consortium supported by the oil and gas industry and partly by the U.S. Bureau of Ocean Energy Management.

Project Summary:

A project aims to observe and understand the behavioural response of humpback whales to seismic surveys. Seismic surveys are commonly used to map rock structure beneath the sea floor in the exploration for oil and gas and research into the nature of ocean. The project has completed four major experiments off the coasts of Australia, the last of which, in 2014, conducted a series of trials with a commercial seismic vessel under full experimental control. Almost 100 scientists, engineers and technical staff were involved in this final experiment.

2016 was the final year of the project and involved the completion of publications, though further publications will be produced in 2017.

Humpback Whales breaching



Researcher: Dr Navneet Dhand

Department/ Institute: Biostatistics and Epidemiology, Sydney School of Veterinary Science, Faculty of Science

Research interests: Navneet aims to use epidemiological and statistical tools to improve public health and to solve intricate problems confronting animal industries.

Project Summary:

POMS - Closing knowledge gaps to continue farming C. gigas in Australia; Whittington R, Hick P, Dhand N, Rubio A; Fisheries Research and Development Corporation/Research and Development Grant.

Aquatic animal health subprogram: Strategic approaches to identifying pathogens of quarantine concern associated with the importation of ornamental fish; Becker J, Crane M, Dhand N, Hick P, Hutson K, Miller T, Robinson A, Stephens F, Toribio J, Whittington R; Fisheries Research and Development Corporation.

Improving fish health management and production protocols in marine finfish aquaculture in Indonesia and Australia; Whittington R, Rimmer M, Dhand N, Hick P, Becker J; Australian Centre for International Agricultural Research (ACIAR)/Research and Development Programs (R&D Programs).

Navneet is a veterinary epidemiologist with interests in designing and conducting epidemiological studies, investigating infectious disease outbreaks, evaluating biosecurity perceptions and practices, and developing tools for statistical modelling. His research focusses on preventing and controlling infectious and zoonotic diseases. He is passionate about improving public health and works with international organisations for developing capacity in developing countries in combating emerging infectious diseases. His research interests include investigating and controlling infectious diseases of aquatic animals. He currently provides epidemiological and statistical input to a project aimed to improve fish health management in marine finfish aquaculture in Indonesia and another project to investigate the environmental and husbandry risk factors for Pacific Oyster Mortality Syndrome in Australia.

Researcher: Dr Olivia Evans

Postdoctoral Research Associate in Environmental Immunology.

Department/ Institute: Aquatic Animal Health and Environmental Immunology, Sydney School of Veterinary Science, Faculty of Science.

Research interests: Key interest in the fields of aquatic animal health, aquaculture production, mollusc production (particularly oysters/bivalves), environmental immunology and in emerging and endemic diseases of aquatic organisms. Analysis of the complex host, pathogen and environment interaction(s) and the ways in which these interactions lead to outbreaks of disease in estuarine environments is also a key area of interest.

Project Title: Pacific Oyster Mortality Syndrome – closing knowledge gaps to continue farming *Crassostrea gigas* in Australia.

Project is funded by the University of Sydney and in part by the Australian Government through the Fisheries Research and Development Corporation (FRDC).

Project Summary:

Pacific Oyster Mortality syndrome (POMS) is caused by *Ostreid herpesvirus-1* microvariant(s) (OsHV-1). OsHV-1 is a member of the family *Malacoherpesviridae* within the order *Herpesvirales*. OsHV-1 microvariants have been responsible for mass mortality events in commercially produced Pacific oysters (*Crassostrea gigas*) in Australia, New Zealand and Europe, since their first detection in France and Australasia in 2008 and 2010, respectively. OsHV-1 presents a significant threat to the Australian *C. gigas* industry (worth AU$53 million in 2007/08), with all age and size classes of *C. gigas* affected by the virus. Oysters less than 1 year of age are the most susceptible age class in the production cycle, with mortalities of 60% to 100% observed in both France and Australia.

Dr. Evans completed her PhD thesis in October 2016. Her thesis, entitled "Transmission of *Ostreid herpesvirus-1* in the Pacific oyster (*Crassostrea gigas*)", was focused on assessing the transmission,

detection and distribution of OsHV-1 in seawater, the occurrence of OsHV-1 disease outbreaks to identify periods of high and low risk, the persistence of OsHV-1 in farmed and wild oysters and the potential for them to act as sources of virus in subsequent outbreaks, and possible risk factors for OsHV-1 transmission and expression of clinical disease.

Olivia's current research follows on from the work completed during her PhD and includes: analysis of the susceptibility and survivability of adult *C. gigas* exposed to OsHV-1, and the role of surviving oysters in the transmission cycle of OsHV-1; and further assessment of the multiple pathways by which the environment, the pathogen and the host interact with one another to cause outbreaks of POMS within Australian estuaries.

Photos: Seawater and plankton sampling in the Hawkesbury River and Georges River estuaries, Pacific oyster (*Crassostrea gigas*) production in the Hawkesbury River estuary, resectively

Researcher: Associate Professor Will Figueira and Dr Renata Ferrari

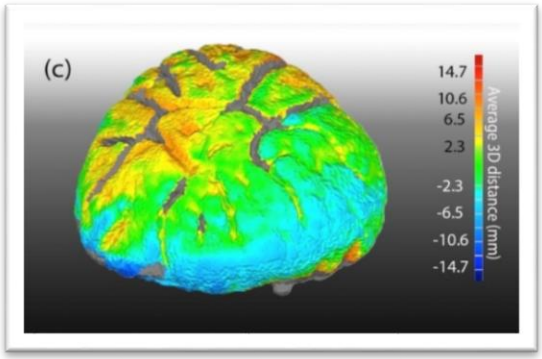
Department/ Institute: School of Life and Environmental Sciences – Coastal & Marine Ecosystems Group in collaboration with Sydney Institute of Marine Science (SIMS)

Project Title: Habitat Structure Quantification

Project Summary:

There are currently several projects within the coastal and marine ecosystems group including 3D reefs: spatial ecology of marine ecosystems, marine resource management and conservation and population ecology of marine fishes (temperate-tropical).

Dr Renata Ferrari's current project is the 3D Reefs Project to develop 3D tools for application to monitoring programs; establish a baseline dataset of Habitat Structure for selected sites on the Great Barrier Reef (Lizard, Heron and One Tree Islands) and to assess the precision and accuracy of 3D monitoring tools.

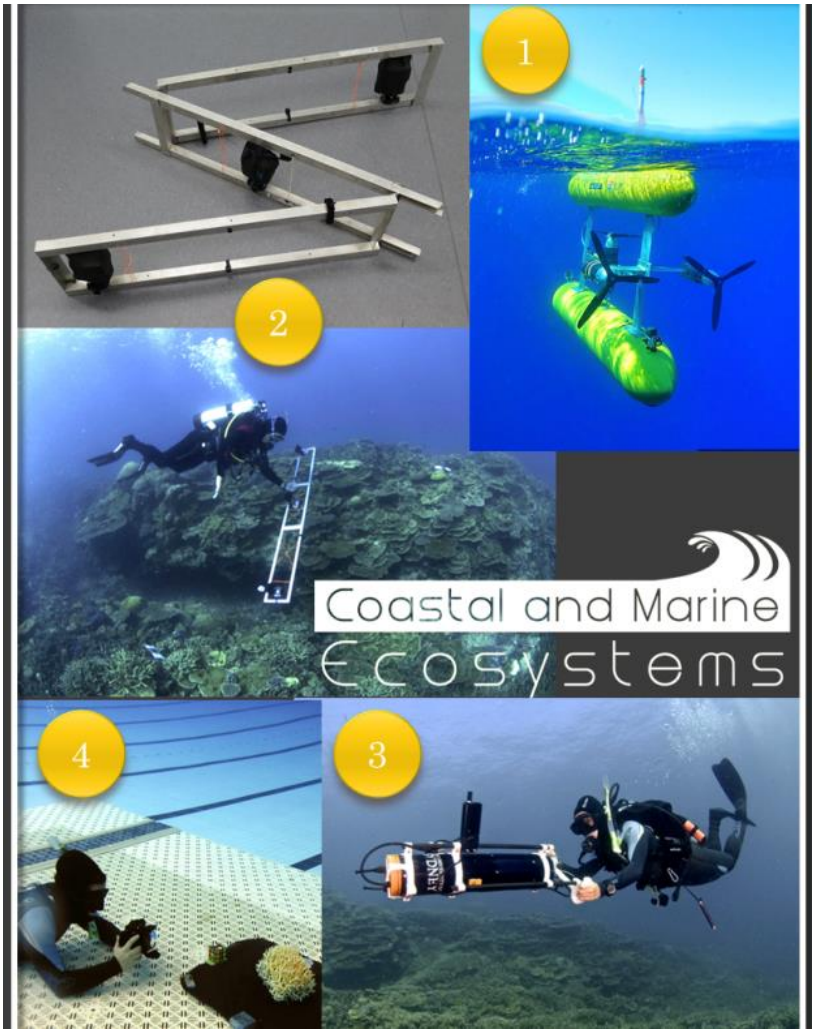


remote sensing

Article

Accuracy and Precision of Habitat Structural Complexity Metrics Derived from Underwater Photogrammetry

Will Figueira [1,2,*,†], Renata Ferrari [1,2,†], Elyse Weatherby [1,2], Augustine Porter [1,2], Steven Hawes [1,2] and Maria Byrne [1,2]



4 types of different management ready 3D monitoring tools

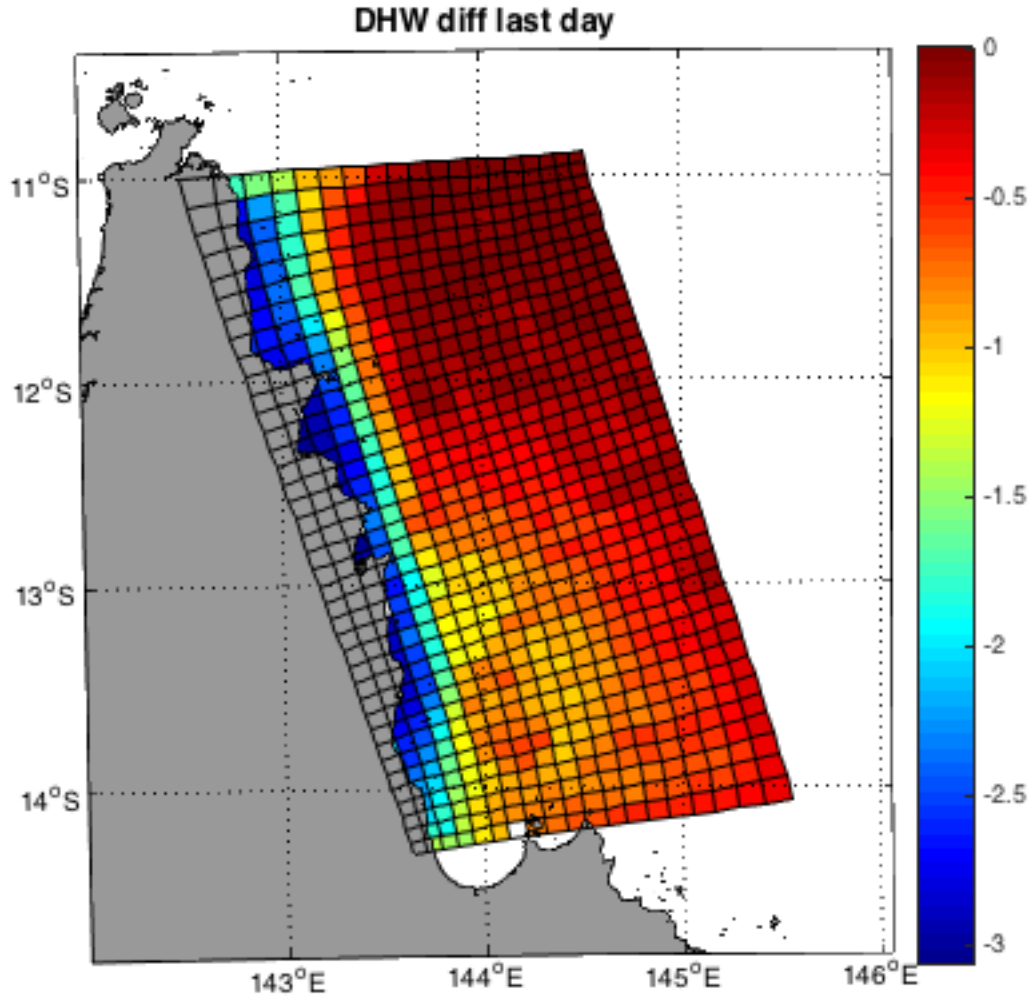
Lead Researcher: Dr Daniel Harrison

Department/ Institute: School of Geoscience – Ocean Technology Group

Project Title: Saving the Great Barrier Reef

Project Summary:

During 2016 and 2017 the Great Barrier Reef has experienced unprecedented bleaching leading to extensive coral mortality. Since 1985 it is now estimated that ~75% of the coral cover on the Great Barrier Reef has been lost due to a range of stressors. The increasing frequency of bleaching has now been directly connected to climate change, and predictions for the future of the reef are dire. Researchers at the University of Sydney School of Geoscience and the Sydney Institute of Marine Studies are looking at technologies which could cool the reef and prevent bleaching while greenhouse emissions are brought under control. Marine Cloud Brightening is a technology originally proposed to cool the planet and offset global warming, applied in a regional manner over especially hot summers of the Great Barrier Reef this technology might just be able to cool the reef enough to prevent or greatly reduce bleaching. The technology uses only sea water sprayed in nano sized droplets to increase the reflectivity of clouds over the reef sending more solar energy back into space and cooling the waters of the reefs below.



Modelling results using the CSIRO eReefs Biogeochemical model to simulate limited cloud brightening over the GBR for 1 month during the Summer of 2016. The cooling is shown in units of Degree Heating Weeks (DHW).

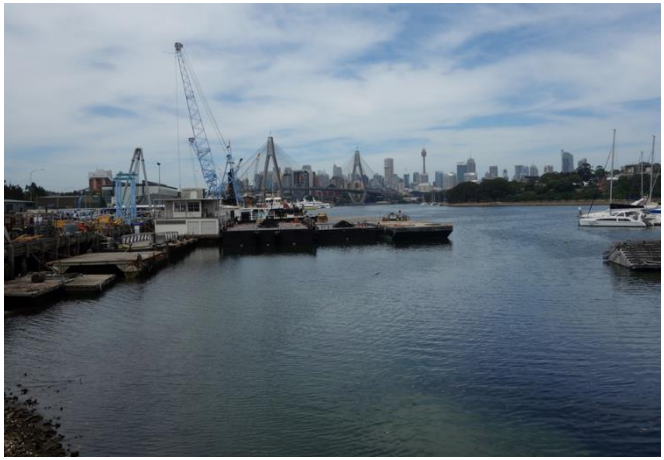
Researcher: Giselle Firme

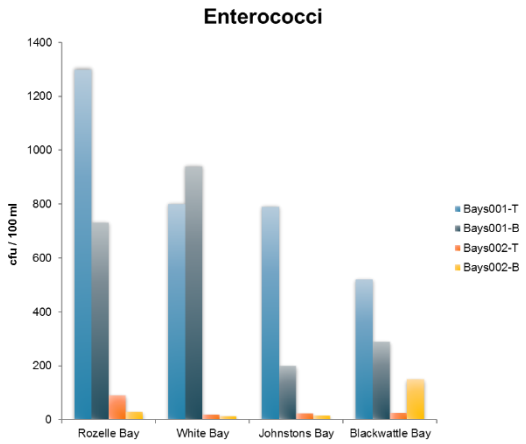
Department/ Institute: School of Geoscience – Ocean Technology Group

Project Title: Marine Ecological Restoration through Urban Redevelopment

Project Summary:

In 2015, the NSW government issued an open call for 'Great Ideas' in order to seek community input and solicit innovative and imaginative thinking for cities. Dan Harrison and Ian Jones of the Ocean Technology Group were one of the selected ideas, with their project to improve the water quality of Sydney harbour. In particular the project was to determine the current state of the Three Bays (Blackwattle Bay, Rozelle Bay and White Bay) and identify the major sources of pollution to the Bays, and ways of improvement. This year-long project involved monthly samplings after heavy rain.





Three Bays Urban Transformation

Research: Dr Paul Hick

Senior Lecturer Veterinary Virology (Aquatic, Farm Animal and Ecosystem Health)

Department/ Institute: Aquatic Animal Health Sydney School of Veterinary Science, Faculty of Science

Research interests: Epidemiologic approaches to investigate and control aquatic animal disease with a focus on viral pathogens that impact aquaculture production and ecosystem health. Development and validation of laboratory tests for infectious diseases with expertise in the correct implementation and interpretation of these tools to provide sound disease investigation and surveillance data.

Project Summary:

Oysters Australia IPA: Pacific Oyster Mortality Syndrome – closing knowledge gaps to continue farming C. gigas in Australia

Improving fish health management and production protocols in marine finfish aquaculture in Indonesia and Australia; and

Aquatic Animal Health and Biosecurity Subprogram: quarantine risks and disease preparedness for the meglocytivirus ISKNV for Australia

OIE reference Laboratory: World Organisation for Animal Health (OIE) designated expert at the OIE reference laboratories for Epizootic haematopoietic necrosis virus (EHNV) and Ranavirus infections of amphibians which are co-hosted at the University of Sydney. Current research interests related to this activity include the validation and international proficiency evaluation of serologic and molecular tests for these viral pathogens and full genome sequencing approaches to

NATA accredited infectious diseases laboratory: Authorised NATA (National Association of Testing Authorities) representative and signatory for the Farm Animal Health Infectious Disease Laboratory which holds ISO17025 accreditation to test for pathogens of fish and oysters including Nervous necrosis virus, Megalocytivirus, Ranaviruses, Ostreid herpesvirus 1.

Post graduate research

A deeper understanding of the pathobiology and epidemiology of Pacific oyster mortality syndrome (POMS) for the benefit of the edible oyster industry is being approached in two ways:

Mrs Erandi Pathirana is undertaking detailed studies of changes in the commensal microbial communities associated with oysters and how these change in response to perturbations in challenging intertidal estuarine environments. The impact of commensal microbiota on the physiology and in response to pathogenic microbial infection is being investigated using a combination of traditional microbial culture is being combined with microbiome studies based on data rich bacterial genomic sequence analyses.

Mr Max de Kantzow has identified risk factors for disease caused by *Ostreid herpesvirus 1* in the field and is evaluating potential mitigating management factors through laboratory and field experimentation. He is developing an interest adaptive innate immune responses of Pacific oysters to viral infection.

Mr Cahya Fusianto holds a John Allwright Fellowship and is studying aspects of the pathobiology and epidemiology of Megalocytivirus infections of fish that impact aquaculture in Indonesia and are a threat for Australia's biosecurity.

Researcher: Professor Tom Hubble

Department/ Institute: School of Geosciences

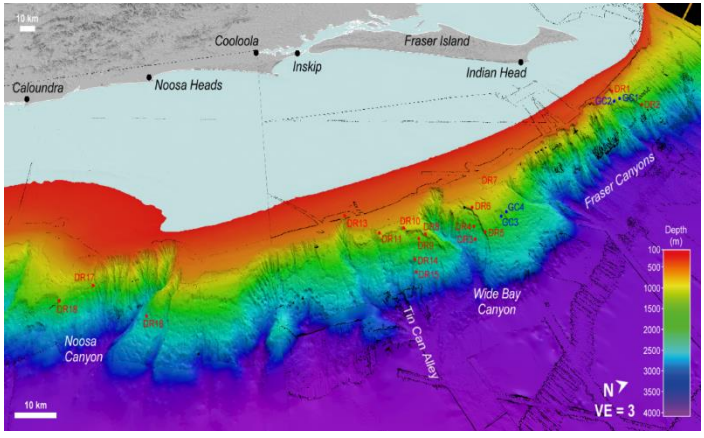
Project Title: Can submarine landslides trigger tsunamis?

Project Summary:

Sedimentology, structure and age estimate of five continental slop submarine landslides (Eastern Australia)

Submarine landslides are common features along continental slopes and oceanic islands. Larger slides are thought to be capable of generating damaging or catastrophic tsunami and therefore the suggested landslide triggers include earthquake loading, pore pressure effects, gas generation, storm waves and rapid sedimentation. However there is no clear indication to identify triggers for submarine landslides and the boundary surfaces of the landslides area are either erosional features developed after the removal of a large landslide mass of detachment surfaces which near-surface sediments were removed during landslides.

Submarine landslides have been occurring intermittently on the eastern Australian coastal margin for about 15 million years and can be expected to reoccur in the future. This project aims to identify past and future submarine landslide sites, determine the morphology of slide scars, and characterise the slopes that the slides moved over, in order to determine the size and frequency of occurrence of submarine landslides on this margin. This information will improve evaluation of the hazard and risk to the eastern Australian seaboard communities posed by locally-generated, submarine-landslide induced tsunami.



Map of Fraser Island Coast Currents and Landslides

Researcher: Professor Ian Jones

Department/ Institute: School of Geoscience – Ocean Technology Group

Project Title: Saving the Great Barrier Reef and Fertilising the ocean to help food security

Project Summary:

The Ocean Technology Group carries research into ocean engineering and are looking at 5 ways to save the Great Barrier Reef.

1. Whitening clouds to reduce GBR lagoon temperatures in summer
2. Adding finely ground olivine to water to reduce acidity
3. Extracting phosphate from agricultural run off to reduce sediment load on reef
4. Reduce sediment runoff by trapping sediment on shore.
5. Improve agricultural fertiliser management.

Fertilising the ocean to help food security in collaboration with Sun Yat Sen University in China is another current project of the Ocean Technology Group.

One tonne of nitrogen should produce 300 kg wet weight of sardines

Researcher: Professor Peter Lay

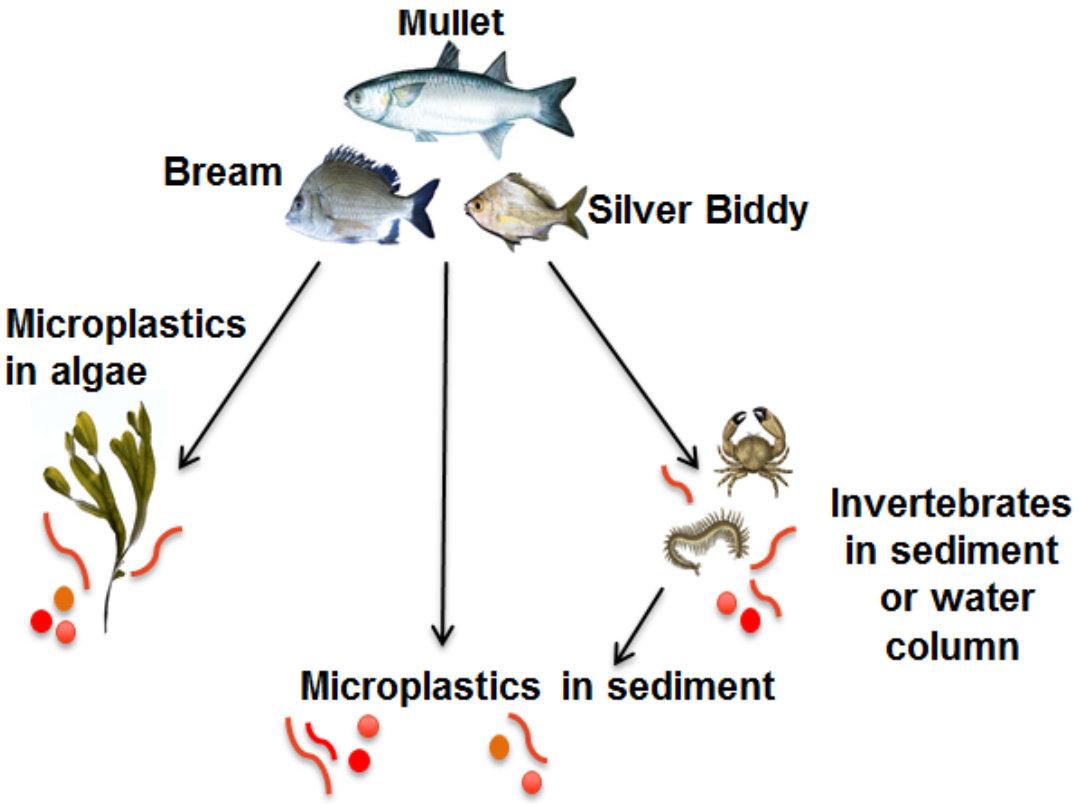
Department/ Institute: School of Chemistry – Vibrational Spectroscopy Core Facility

In collaboration with UNSW (Jennifer Halstead)

Project Title: Vibrational Spectroscopic Analysis of Microplastics and Microfibres in Fish

Project Summary:

Microplastics is the major cause of marine toxic pollution worldside and threat to ecology of marine environment and human food chain. These microplastics have been found in different places including algae, sediments and invertebrates in sediments and in the water column where they are then fed by marine fish. There have been different methods of detection and with the assistance of Fourier Transform Infrared and Raman Spectroscopies, it is possible to identify and distinguish the type of microplastics. Using 3D imaging with Raman Spectroscopy it is possible to distinguish whether the plastic or fibre materials is a surface contamination or underlying in the organism. This study focuses on microplastics and microfibers in the gut of fish in Middle Harbour Sydney.



Microplastics and microfibers, Microplastics in Marine food web

Researcher: Dr Gabriel Machovsky-Capuska

Department/ Institute: Charles Perkins Centre and School of Life and Environmental Sciences (SOLES)

Project Title: Nutritional Ecology of Marine Predators: Challenges and Opportunities

Project Summary:

The foraging challenge for predators is to find and capture food with adequate levels of energy and nutrients. Marine predators (e.g. predatory fish, marine reptiles, seabirds and marine mammals) forage in a complex nutritional environment in which prey is sparse and patchily distributed and are subject to oceanic and climatic fluctuations, as well as additional human pressures.

Successful predators require particularly sophisticated foraging strategies that enable them to balance self- and offspring-feeding, and also in many circumstances simultaneously consider the nutritional constraints of their partners.

This multidisciplinary project aims to understand the nutrient requirements and foraging goals of marine predators as a tool to predict how they will respond to environmental changes in prey availability.

Challenges and opportunities for nutritional ecology of marine predators

Researcher: Dr Bree Morgan

Department/ Institute: The University of Sydney, Department of Geosciences

Research interests:

I am a low-temperature environmental geochemist with expertise in chemical sedimentology and mineralogy. The mineralogical and biogeochemical signatures recorded in sediments tell us a story about Earth surface processes, environmental perturbations and past environmental conditions. My research teases apart these signatures to better understand the complex interactions that shape natural processes at the Earth's surface, and the impact that humans have on these. Some of my specific research interests include:

- Exploring minerals as contaminate traps, including:

(a) The capture, storage and long-term security of CO_2 in carbonate mineral hosts.

(b) The mobility, bioavailability and toxicity of trace metals in natural and disturbed coastal systems.

- Formation, transformation and oxidation chemistry of sedimentary sulfides.
- Acid sulfate soils: Chemical processes, environmental impacts and remediation strategies.
- Rare earth elements signatures as tracers of biogeochemical processes and anthropogenic influences.
- Biogeochemical element cycling during sediment diagenesis.
- Untangling the intricate associations between the carbon, sulfur, iron and trace element cycles in coastal systems.

Project Title:

Exploring the mystery of natural carbon mineralisation in Australian lakes

Project Summary:

This research feeds into a collaborative ARC-funded project (with Monash University, VIC), assessing rare formations of low-temperature dolomite in the marine-influenced Coorong Lakes of South Australia. Dolomite captures CO_2 as it forms, and while it has been observed in a handful of sedimentary systems at the Earth's surface, it remains difficult to precipitate under ambient laboratory settings due to kinetic constraints. Our novel research works to unravel the complex biogeochemical processes and conditions that promote low-temperature dolomite formation in these coastal hypersaline settings. Ultimately, our findings will create pathways for innovating mechanisms to achieve low-cost synthesis of CO_2-host phases as a strategy to mitigate global warming.

Researcher: Dr Phil Mulhearn

Department/ Institute: School of Geosciences, Faculty of Science

Research interests:

Changing water depths in Sydney Harbour and causes of these, in particular determining if the deeper areas west of the Harbour Bridge are silting up;

History of the charting/surveying of major NSW estuaries and the accuracy of early charts.

Project Title 1: Sediment deposition in the deeper holes in Sydney Harbour

Project Summary: There has been some speculation regarding the deeper locations in Sydney Harbour as to whether or not they are silting up at all. A series of old charts will be digitised and compared in a GIS to determine what changes, if any, have occurred since the late 19th century. Because these deeper locations are relatively sheltered from currents and ship motions they should provide a good record of sediment build up in the harbour.

Project Title 2: Early charting/surveying of major NSW estuaries.

Project Summary: A number of NSW's major estuaries and the rivers feeding them have been charted or surveyed since the late 18th century. Copies of a number of the early charts and maps will be obtained and compared to modern surveys to determine the accuracy of the early surveys. The history of these survey efforts and of the surveyors will also be summarised.

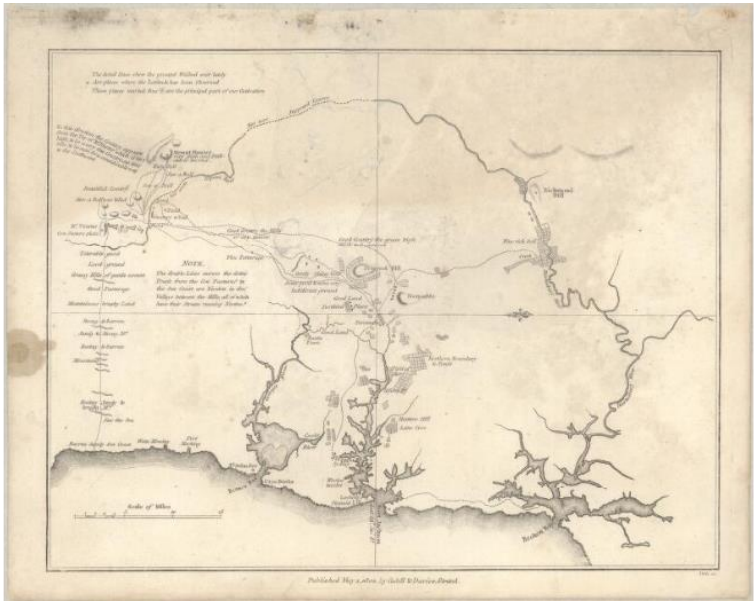


Chart of the three harbours of Botany Bay, Port Jackson, and Broken Bay; shewing the ground cultivated by the colonists, with the courses of the rivers Hawkesbury, Nepean, &c, &c. [Cartographic material] / Neele sc

From: Collins, David, 1756-1810. An account of the English colony in New South Wales from its first settlement in January 1788 to August 1801 (Courtesy of National Library of Australia. Bib ID 4199870)

Researcher: Professor Dietmar Muller

Department/ Institute: School of Geosciences– EarthByte Group (Geophysics)

In collaboration with Data 61 and CSIRO

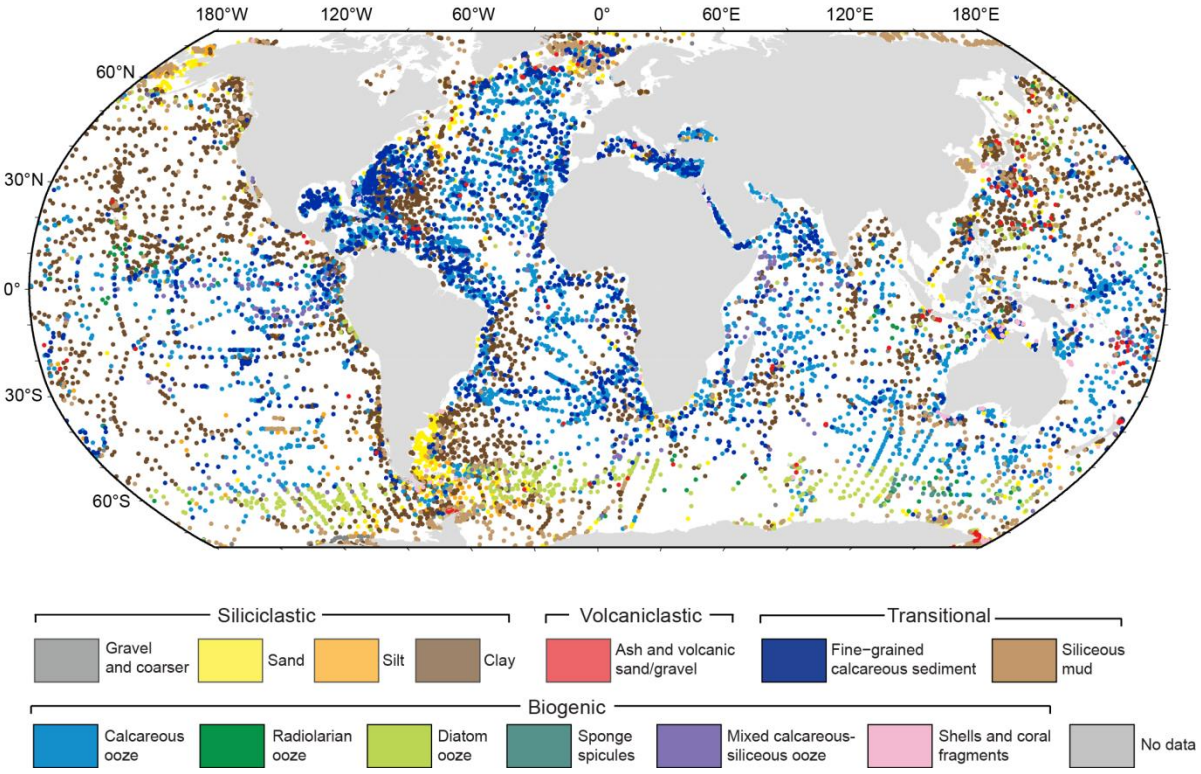
Project Summary: Machine Learning Approaches to Analysing Global Sea Surface and Seafloor Data

One of the pressing global challenges in science involves that amalgamation and analysis of a large variety of data. While researchers accumulating new data, old data is left unused as each researcher prefers to obtain their own data. After time passes, the geoscience community has become good at designing and maintaining databases (for collection and organisation of data).

For example, in a recent project a digital map was coded with around 14,500 points of lithologies to explore the relationship of the seafloor to the sea-surface. However the seafloor sedimentation is time-dependent so they focused on mean global relationships between key surface parameters, bathymetry and lithology.

Supervised learning algorithms are extremely powerful. The algorithm receives a set of inputs along with the corresponding correct outputs, and it learns by comparing its actual output with correct outputs to find errors. It then modifies the model accordingly.

Research opportunities will continue to grow as designing and maintaining databases are a gradual process and will change over time as technology advances.



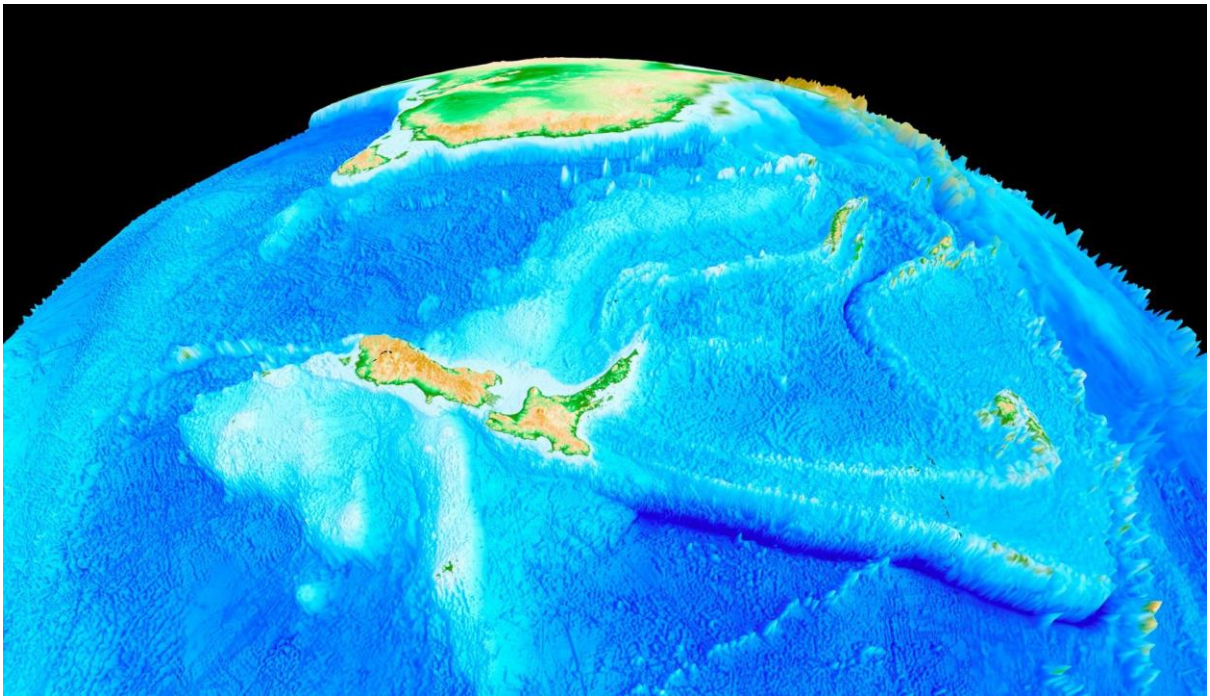
Connection between seafloor sediments and sea surface

Researcher: Dr Maria Seton

Department/ Institute: EarthByte Group, School of Geosciences

Project Title: Zealandia: Earth's Hidden Continent

Project Summary: Dr Maria Seton, with other researchers have for the first time clearly defined Zealandia, a continent that includes New Zealand, New Caledonia, and the Lord Howe and Norfolk Islands, that is today 94% submerged beneath the Pacific Ocean. A paper published in GSA Today, "Zealandia: Earth's Hidden Continent", by Nick Mortimer and colleagues, including EarthByte's Dr Maria Seton, went viral. According to GSA Today's editors, the article is "by a long shot" their most downloaded article ever. Picked up by hundreds of media outlets worldwide, the findings of the paper have reached an estimated 720 million readers! This study builds upon Maria's long-standing research interest on the tectonic evolution of Zealandia and surrounding ocean floor, including two recent research voyages to the northern parts of Zealandia where some of the only known submarine continental samples from Zealandia were obtained.



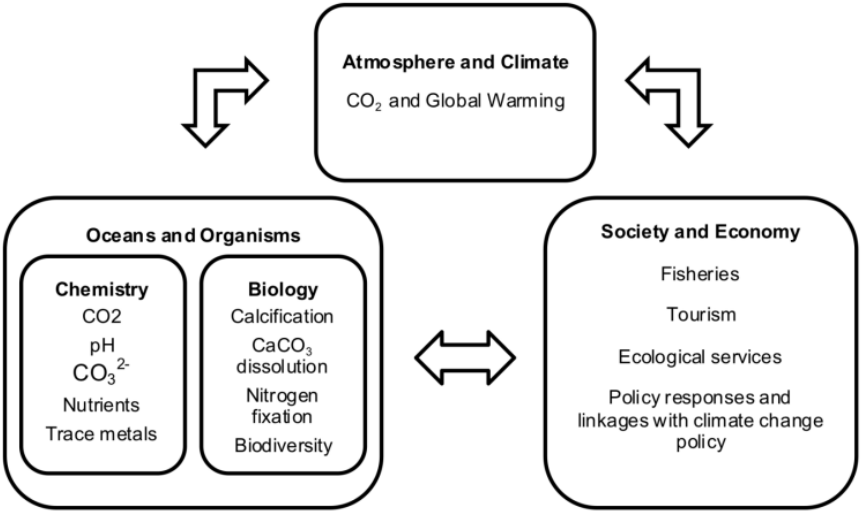
Researcher: Professor Tim Stephens

Department/ Institute: Sydney Law School – International Law

Project Title: Ocean Governance in the Anthropocene – The Carbonation Challenge

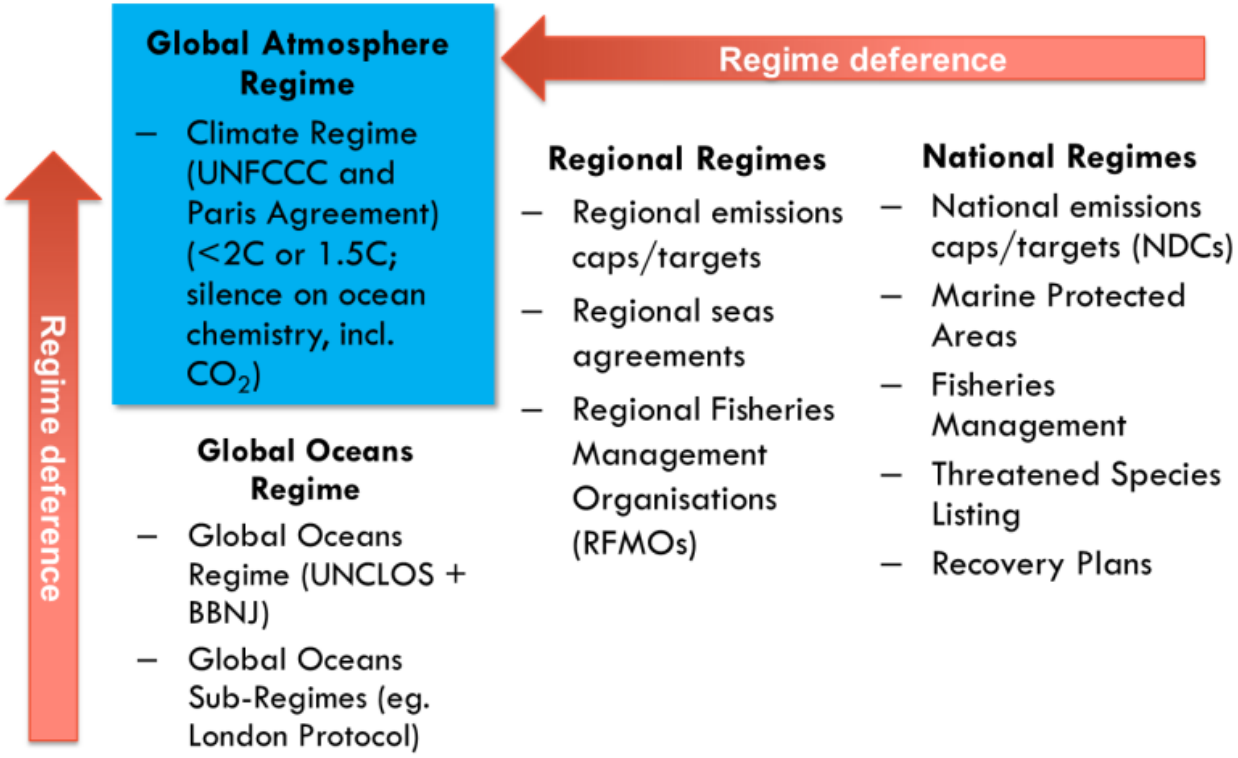
Project Summary:

Tim Stephens is Professor of International Law and Australian Research Council Future Fellow at the University of Sydney. He is President of the Australian and New Zealand Society of International Law. Tim teaches and researches in public international law, with his published work focussing on the international law of the sea, international environmental law and international dispute settlement. His ARC Future Fellowship project is examining implications of the Anthropocene for international environmental governance regimes, including for the management of ocean spaces under pressure from Earth system changes.



Ocean carbonation a signature of the Anothropocene

Ocean Carbonation Governance – The Problem of Regime Deference



Researcher: Edwina Tanner

Department/ Institute: School of Geoscience – Marine Studies Institute

Project Title: CO_2 Emissions from a Drowned River Valley Estuary adjacent to an emerging megacity (Sydney Habour)

Project Summary:

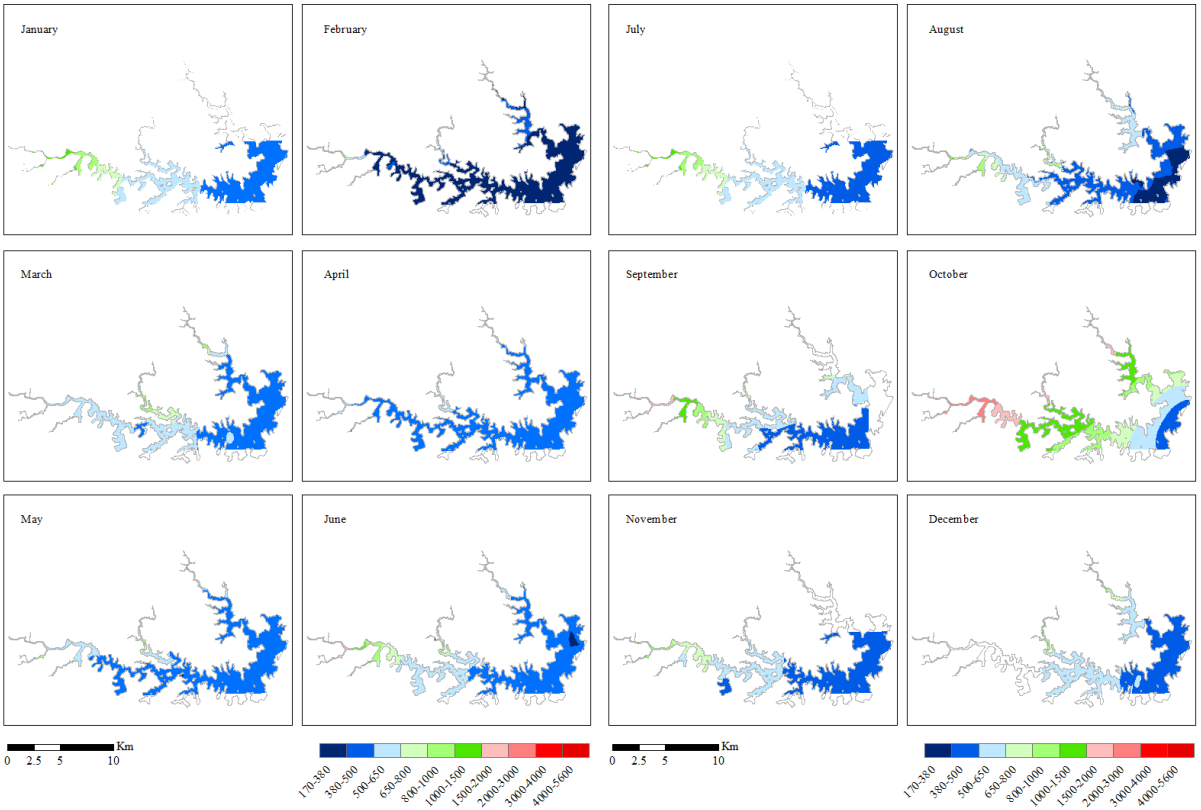
Drowned river valley estuaries are important as they have influence over the global carbon cycle. These large drowned river estuaries are located at temperate latitudes in areas of high population density. They act as an ecotone between adjacent communities for air-water exchange of CO_2 fluxes as well as goods and services that they provide to humankind.

CO_2 emissions from the Sydney Harbour Estuary were net heterotrophic over the year with highest emissions during spring and lowest during autumn and winter. After an episodic high rainfall event nutrient-stimulated biological pumping promoted a large uptake of CO_2 that transitioned the mid and lower sectors of the estuary into a net carbon sink.

The drowned river valley geomorphology provided topographic sheltering of the upper estuary sections and substantial tidal flushing of the lower estuary that together with the sustained photosynthetic activity over the major proportion of the estuary, contributed to the low overall level of CO_2 emissions of this highly urbanised estuary.

The Sydney Harbour Estuary's vulnerability to increased CO_2 emissions from anthropogenic nutrient impacts as it emerges into a megacity is lowered by having a small catchment to estuary ratio with the pollutant content of stormwater flows becoming well diluted on reaching the large lower estuary.

Emissions from the Sydney Harbour Estuary were similar to other natural drowned river valleys in the USA including the York River, the Neuse and the Hudson River (4.7 to 5.9 mol C m^{-2} y^{-1}). As such, discharge per unit area only appears to be a good predictor of CO_2 emissions for estuaries of a similar geomorphic class.



pCO_2 measurements in Sydney Harbour for monthly surveys during 2013

Researcher: Dr Emma Thompson

Department/ Institute: School of Life and Environmental Sciences

Project Title: Future Proofing the Sydney Rock Oyster

Project Summary:

For a number of years Emma has worked closely with the NSW Department of Industries, Port Stephens Fisheries Institute (PSFI) analysing the differences between their selectively bred disease resistant line of Sydney rock oysters and wild Sydney rock oysters. Over the past few decades oyster production has declined due to diseases such as Winter Mortality syndrome and QX disease. As a consequence the PSFI developed a selective breeding program in the early 1990s to try to combat deaths from disease and to promote fast growth.

Image: http://www.dpi.nsw.gov.au/fishing/pests-diseases/animal-health/aquaculture/qx-oyster-disease

To better understand the genetic basis for disease resistance analyses of differences in transcriptome and proteome expressions between the two populations of oysters has been done. Collaborations with Macquarie University aim to 'future proof the oyster industry' by using next generation sequencing to find beneficial disease resistant genes, and oysters with these genes, to use in new selective breeding lines. All the signs are positive!

In addition, during the course of trials by other USYD researchers on the selectively bred lines it was discovered that these oysters may also have some resilience to ocean acidification. In conjunction with these researchers the focus was to analyse the sub-cellular protein basis for this resilience and help guide full transcriptome analysis to assess the molecular processes affected by elevated CO_2 and increasing water temperatures.

Researcher: Associate Professor Ana Vila-Concejo

Department/ Institute: School of Geoscience – Geocostal Research Group

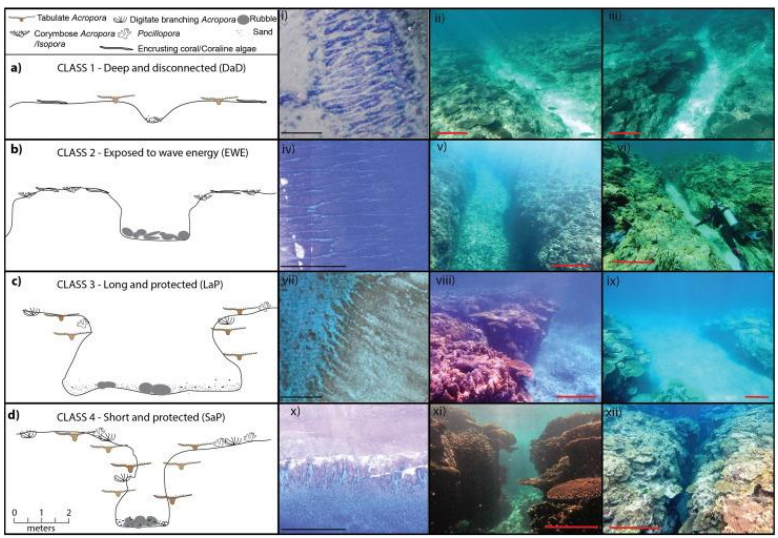
Research theme: Contemporary processes and morphodynamics of coastal systems in temperate and tropical settings

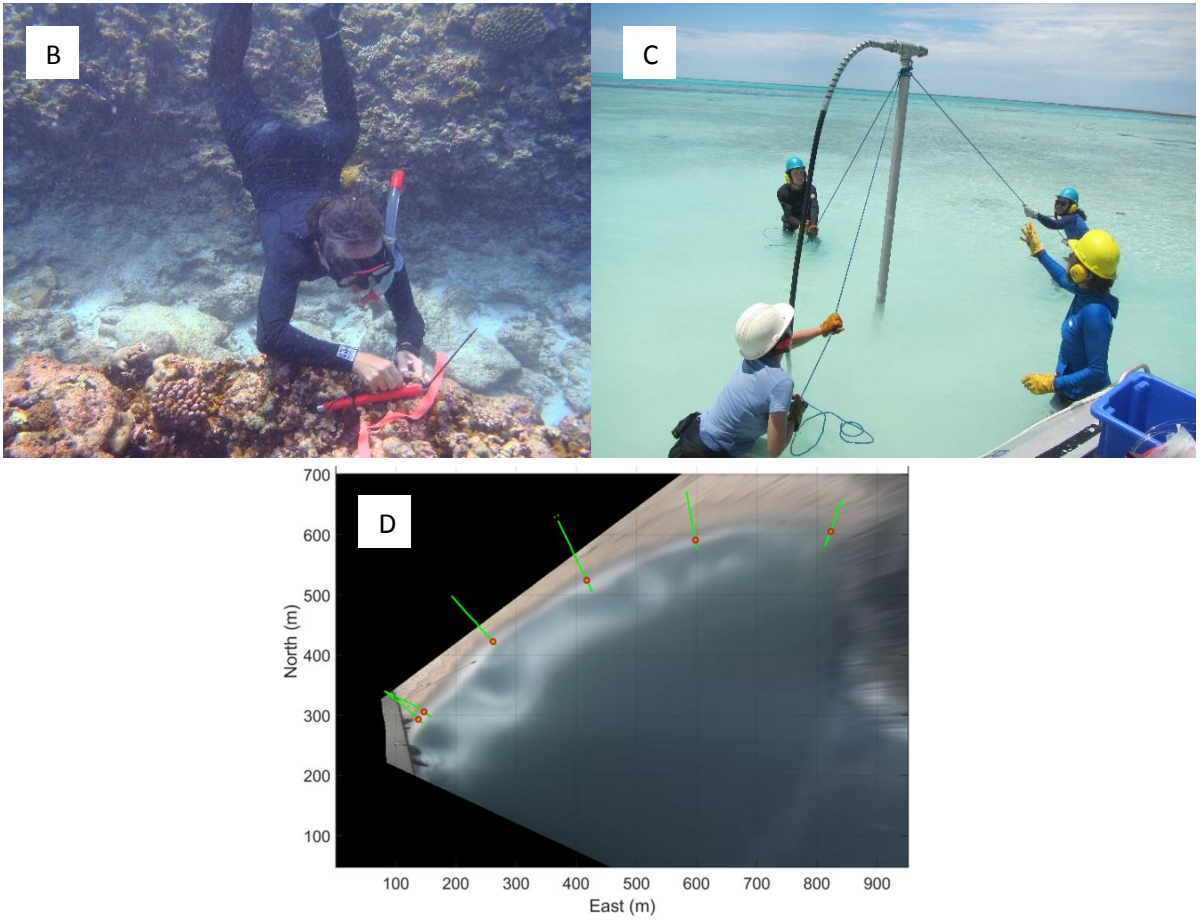
Project Summary:

My research links different temporal and spatial scales in coastal geomorphology, including sediment transport and coastal change in the immediate, event, decadal, and Holocene scales. I have two main areas of research.

1. Morphodynamics of Coral Reefs. Since 2010 we are looking into the processes that transport and accumulate sand in backreef environments. We are also investigating formation, function and evolution of spurs and grooves, and, the role of coral reefs as wave dissipaters. Another part of this research is determining how reef morphodynamics change with changing climate and changing sea levels.
2. Morphodynamics of Embayed beaches. A monitoring programme including beaches in Sydney's eastern suburbs started at the end of 2015. Currently we are monitoring Bondi, Tamarama, Bronte, Coogee and Maroubra. In collaboration with Dr Shari Gallop from Macquarie University, we are also monitoring estuarine beaches in the Pittwater and Botany Bay.

A





(A) Morphometric classification of spurs and grooves (Duce et al., 2016, Geomorphology); (B) deploying pressure transducers in the Maldives in February 2017; (C) Vibro-coring at One Tree Island Research Station in November 2016; (D) Rectified video image showing surf zone at Bondi beach.

Researcher: Professor Ashley Ward

Department/ Institute: Animal Behaviour Lab – Biological Science

Research interests: Ashley and his group focus on questions about the mechanisms and the functions of animal behaviour, integrating our extensive experimental work with theoretical approaches to better understand how and why animals do what they do.

As well as being of great intrinsic interest, the study of animal behaviour can provide vital insight into a variety of other disciplines, both within the biological sciences (physiology, conservation biology, toxicology, ecology) and beyond (psychology, sociology, economics).

Project Title: Integrating Behaviour and Physiology

Project Summary:

Physiology is the driver of animal behaviour and by combining behavioural and physiological approaches to research questions, we can gain fascinating insights into what makes animals 'tick'. For example, how do animal respond to stress? What determines fighting ability? Why do individuals vary in their willingness to accept risk in order to gain rewards, thereby occupying different positions on the so-called 'bold-shy continuum?'

These and many other areas of animal behaviour can benefit hugely from the adoption of a multi-disciplinary research perspective. While these four topics represent the bulk of our research, we do not restrict ourselves to these. In recent years we have also researched and published on allied topics, including predator-prey interactions, sexual and mate-choice behaviour, and aquatic toxicology.


SEATEC

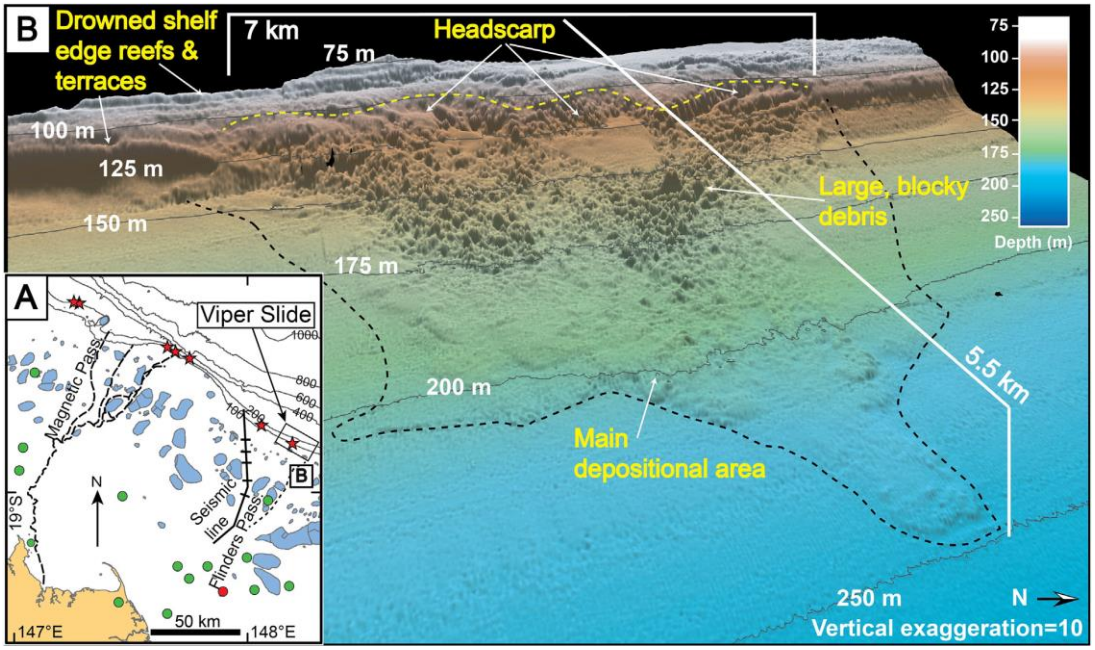
Researcher: Associate Professor Jody Webster

Department/ Institute: School of Geosciences- Geocoastal Research Group

Research interests:

Jody Webster's research in sedimentology and stratigraphy focuses on carbonate sedimentology, climate change, and tectonics and it tends to take him to all the beautiful places in the world (e.g. the Great Barrier Reef, Tahiti, Hawaii, Papua New Guinea, Seychelles, and Brazil).
Jody is particularly interested in coral reef and carbonate platform systems, both modern and ancient, and their associated sedimentary systems; as tools to address fundamental questions in paleoclimate variability and tectonics, and in turn the influence of these factors on the geometry, composition and evolution of these sedimentary systems.
His research is multidisciplinary nature, encompassing traditional elements of sedimentology and stratigraphy, combined with the novel use of marine geology and geophysics, GIS, paleobiology, paleoecology, and geochemistry (stable isotopes, trace elements, radiometric dating). Jody is also heavily involved in several large international research programs including the Integrated Ocean Drilling Program (IODP) which is focused on recovering sediment cores from the sea bed to understand past sea level and climate changes.

Project Summary: Jody, along with colleagues from ANU, UWO, Uni. Edin and Uni. Tokyo, were awarded a large ARC Discovery grant ($372,000) over 3 years to support work on this project. With colleagues from UQ, QUT and international partners, Jody was also awarded another large ARC Discovery grant ($490,000) to investigate reef growth sea level and palaeoclimate histories in the Southern Great Barrier Reef.



Undersea landslide discovered edge off Townsville (After Webster et al. 2016)

Researcher: Professor Richard Whittington

Department/ Institute: Aquatic Animal Health and Environmental Immunology Sydney, Sydney School of Veterinary Science and School of Life and Environmental Sciences (SOLES)

Research interests: Ensuring food production and environmental services through disease prevention and control in marine and freshwater systems. This aim reflects the global challenge for aquaculture: how to prevent diseases and so increase production while protecting the environment? According to FishStat and International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) projections, by 2030 half of all seafood will be from a farm and 50% of all production will be lost through disease.

Project Title: Aquatic Animal Health and Environmental Immunology

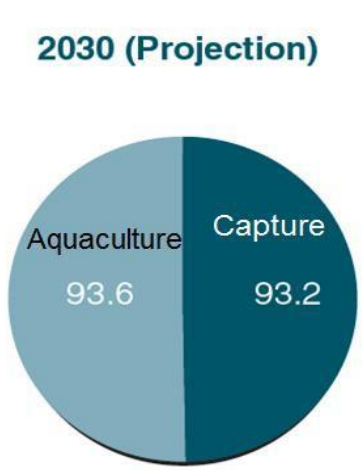
Project Summary:

Research is focused on ensuring food production and environmental services through disease prevention and control in marine and freshwater systems. This requires knowledge of how aquaculture health is affected by disturbance to environments by human activities, including urban development, agricultural practices, estuarine pollution and climate change. We use the foundation disciplines in animal health including veterinary pathology, immunology, microbiology, virology, parasitology and epidemiology and combine these with environmental and marine sciences to understand, explain, control disease and prevent disease occurrence. Graduate students work on farm and in the field as well as in cutting edge laboratories, with both farmers and experienced scientists, for a truly balanced and industry- relevant approach.

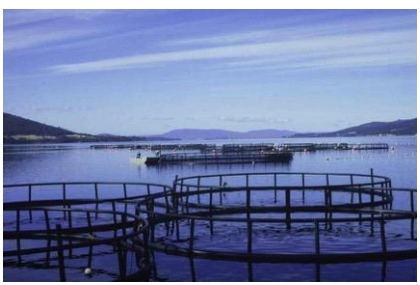
Current Projects include infectious disease control in the edible oyster industry, biosecurity of imported marine and freshwater ornamental fish, reducing risks to native fish populations, investigating environmental parameters involved in transmission of viral and parasitic diseases in coastal aquaculture, marine and estuarine aquaculture development in Indonesia, and new methodological approaches for disease diagnosis and aquaculture vaccine development.

By 2030 half of all seafood will be from a farm

50% of all production is lost through disease



Sources: FishStat and IMPACT model projections.



Researcher: Professor Stefan B. Williams

Department/ Institute: School of Aerospace, Mechanical and Mechatronic Engineering – Australian Centre for Field Robotics (ACFR) Marine Systems Group (Marine Robotics)

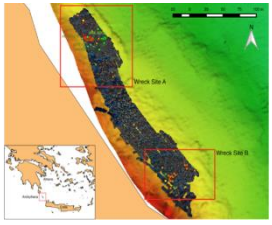
Project Title: Marine Systems at the Australian Centre for Field Robotics

Project Summary:

The ACRF is a centre that focuses on projects that involve navigation and mapping, clustering and classification, novel sensing, survey designs and platform design.

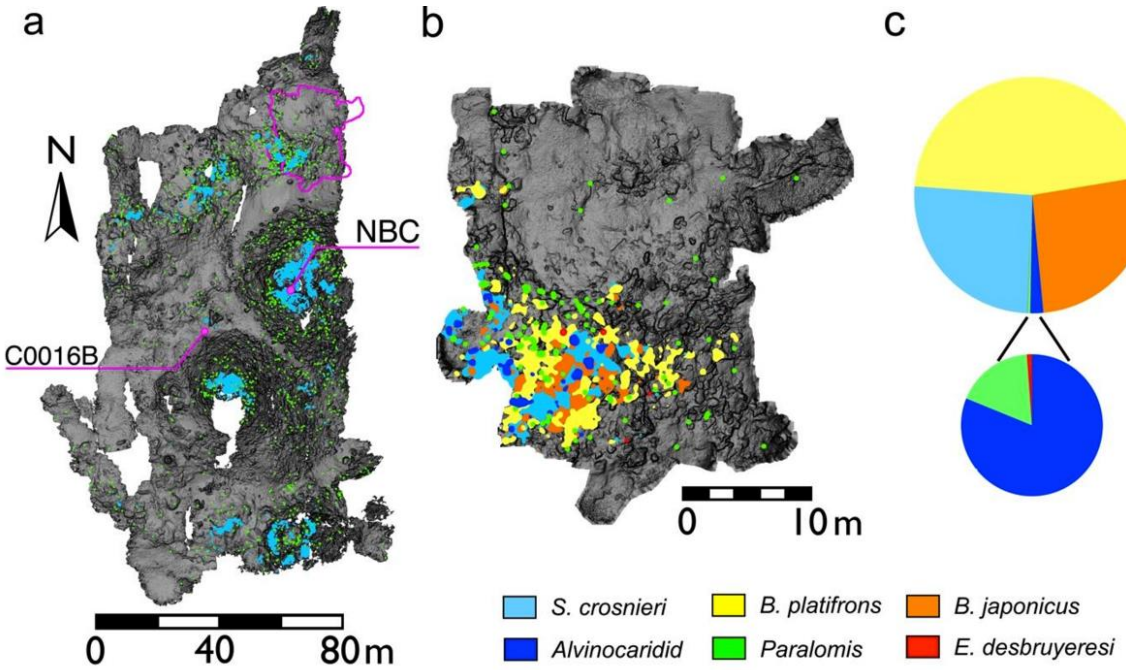
Research opportunities include underwater image colour correction, plenoptic imaging, automated image analysis and autonomous repeatable surveying. They also manage large geospatial image archives online.

Current projects involve the monitoring the recovery of cyclone impacted reefs (2014) by surveying 21 reefs in 7 days and resurveying 6 months later for document recovery.



Mapping the first century B.C. wreck site at Antikythera, Greece, ecology surveys off the coast of Japan using artificial hydrothermal vents and estimating population densities of different species of organisms.

- Autonomous Systems present novel tools for collecting rich data and undertaking a variety of tasks in land, air and marine domains
- Managing the data and transforming it into data products continues to be a key challenge
- Engaging with end user communities in exploring the application of these technologies to a variety of application domains
- Exciting challenges and novel applications likely to drive developments in these areas



Estimating Population Densities

Marine Studies Institute Publications 2015-2016:

Albright, R., Anthony, K., Baird, M., Beeden, R., **Byrne, M**., Collier, C., Dove, S., Fabricius, K., Hoegh-Guldberg, O., Kelly, R., et al (2016) Ocean acidification: Linking science to management solutions using the Great Barrier Reef as a case study. Journal of Environmental Management, 182, 641-650.

Alfthan, B., Semernya, L., Ramola, A., Adler, C., Peñaranda, L.F., Andresen, M., Rucevska, I., Jurek, M., Schoolmeester, T**., Baker, E.**, Hauer, W. & Memon, M. (2016) Waste Management Outlook for Mountain Regions – Sources and Solutions. UNEP, GRID-Arendal and ISWA. Nairobi, Arendal and Vienna. www.unep.org, www.grida.no, www.iswa.org

Anderson, Kelli, Daisy A. Taylor, **Emma L. Thompson**, Aroon R. Melwani, Sham V. Nair, and David A. Raftos (2015) Meta-analysis of studies using suppression subtractive hybridization and microarrays to investigate the effects of environmental stress on gene transcription in oysters, *PloS One*, 10(3), e0118839

Baker E., Gaill F., Karageorgis A., Lamarche G., Narayanaswamy B., Parr J, Raharimananirina C., Santos R., Sharma R. and Tuhumwire J. (2016) Offshore Mining Industries. World Ocean Assessment Ch. 23. United.
Nations http://www.un.org/depts/los/global_reporting/WOA_RPROC/Chapter_23.pdf

Baker E., Sorensen M., Thygesen K. and Westerveld L. (2016) World Ocean Assessment Overview, GRID-Arendal and UNEP 2016. http://www.grida.no/publications/world-ocean-assessment-overview/ http://www.grida.no/publications/shelf-impact/

Baker, E. and Westerveld, L. (2016) The Spread of Sargassum Seaweed, GRID-Arendal Story Map. http://grid-arendal.maps.arcgis.com/apps/MapJournal/index.html?appid=f616ec1db45f4e898970bd448b190f50

Baker, E.K., Puglise, K.A. and Harris, P.T. (Eds.) (2016) Mesophotic coral ecosystems — A lifeboat for coral reefs? The United Nations Environment Programme and GRID-Arendal, Nairobi and Arendal, 98 p. http://www.grida.no/publications/mesophotic-coral-ecosystems/

Becker J.A., Tweedie A., Gilligan D., Asmus M., & Whittington R.J. (2016) Susceptibility of Australian Redfin perch, *Perca fluviatilis* experimentally challenged with Epizootic haematopoietic necrosis virus (EHNV). Journal of Aquatic Animal Health 28:122-130.

Bewley, M., Friedman, A., Ferrari, R., Hill, N., Hovey, R., Barrett, N., Pizarro, O., Figueira, W., Meyer, L., Babcock, R., Byrne, M., Williams, S., et al (2015) Australian sea-floor survey data, with images and expert annotations. Scientific Data, 2, 1-12.

Biggs, E., Bruce, E., Boruff, B., Duncan, J., Horsley, J., Pauli, N., McNeill, K., Neef, A., Van Ogtrop, F., Curnow, J., Haworth, B., Duce, S., et al (2015) Sustainable development and the water-energy-food nexus: A perspective on livelihoods. Environmental Science and Policy, 54, 389-397

Birch, G., Drage, D., Thompson, K., Eaglesham, G., Mueller, J. (2015) Emerging contaminants (pharmaceuticals, personal care products, a food additive and pesticides) in waters of Sydney estuary, Australia. Marine Pollution Bulletin, 97(1-2), 56-66.

Birch, G., Gunns, T., Chapman, D., Harrison, D. (2016) Development of an estuarine assessment scheme for the management of a highly urbanised catchment/estuary system, Sydney estuary, Australia. Environmental Monitoring and Assessment, 188(5), 1-14.

Birch, G., Gunns, T., Olmos, M. (2015) Sediment-bound metals as indicators of anthropogenic change in estuarine environments. Marine Pollution Bulletin, 101(1), 243-257.

Birch, G., Lean, J., Gunns, T. (2015) Growth and decline of shoreline industry in Sydney estuary (Australia) and influence on adjacent estuarine sediments. Environmental Monitoring and Assessment, 187(6), 1-17.

Birch, G., Lean, J., Gunns, T. (2015) Historic change in catchment land use and metal loading to Sydney estuary, Australia (1788-2010). Environmental Monitoring and Assessment, 187(9), 1-15.

Birch, G., Nath, B., Chaudhuri, P. (2015) Effectiveness of remediation of metal-contaminated mangrove sediments (Sydney estuary, Australia). Environmental Science and Pollution Research, 22(8), 6185-6197.

Brazao, S., Chen, M., Murphy, R., Simpson, S., **Coleman, R.** (2016) A method for growing a monospecific epilithic cyanobacterial biofilm for use in marine ecological experiments. Journal of Experimental Marine Biology and Ecology, 480, 17-25.

Brothers, C., Harianto, J., McClintock, J., **Byrne, M.** (2016) Sea urchins in a high-CO2 world: the influence of acclimation on the immune response to ocean warming and acidification. Proceedings of the Royal Society B, 283(1837), 1-10.

Bryson, M., Johnson-Roberson, M., Pizarro, O., **Williams, S.B.** (2015) True Colour Correction of Autonomous Underwater Vehicle Imagery. Journal of Field Robotics.

Bryson, M., Duce, S., Harris, D., **Webster, J.** M., Thompson, A., **Vila-Concejo, A.**, and **Williams, S. B**. (2016) Geomorphic changes of a coral shingle cay measured using Kite Aerial Photography. Geomorphology, 270. pp. 1-8.

Bugnot, A., **Coleman, R., Figueira, W.**, Marzinelli, E. (2015) Community-level impacts of the invasive isopod Cirolana harfordi. Biological Invasions, 17(4), 1149-1161.

Byrne, M., Gall, M., Wolfe, K., Aguera, A. (2016) From pole to pole: the potential for the Arctic seastar Asterias amurensis to invade a warming Southern Ocean. Global Change Biology, 22(12), 3874-3887.

Byrne, M., Koop, D., Cisternas, P., Strbenac, D., Yang, J., Wray, G. (2015) Transcriptomic analysis of Nodal- and BMPassociated genes during juvenile development of the sea urchin Heliocidaris erythrogramma. Marine Genomics, 24(1), 41-45.

Byrne, M., Martinez, P, Morris V 2016 Evolution of a pentameral body plan was not linked to translocation of anterior Hox genes: the echinoderm HOX cluster revisited. Evolution and Development 18: 137-143

Camoin, G., **Webster, J.** (2015) Coral reef response to Quaternary sea-level and environmental changes: State of the science. Sedimentology, 62(2), 401-428.

Carey, N., Harianto, J., **Byrne, M.** (2016) Sea urchins in a high CO_2 world: partitioned effects of body-size, ocean warming and acidification on metabolic rate. Journal of Experimental Biology, 219, 1178-1186.

Cato, D., Dunlop, R., Noad, M., McCauley, R., Kniest, E., Paton, D., Kavanagh, A. (2016) Addressing challenges in studies of behavioral responses of whales to noise. In Arthur N. Popper and Anthony Hawkins (Eds.), The Effects of Noise on Aquatic Life II, (pp. 145-152). New York: Springer

Clarke, S., Hubble, T., Webster, J., Airey, D., De Carli, E., Ferraz, C., Reimer, P., Boyd, R., Keene, J. (2016) Sedimentology, structure and age estimate of five continental slope submarine landslides, eastern Australia. Australian Journal of Earth Sciences, 63(5), 631-652

Clarke, S., **T. Hubble**, J.Webster, D. Airey, E. de Carli, C. Ferraz, P. Reimer, Boyd, and J. Keene (2016) Sedimentology, Structure and Probable Age of Five Continental Slope Submarine Landslides, Nerrang Plateau, Eastern Australia. Australian Journal of Earth Sciences. DOI: 10.1080/08120099.2016.1225600.

Cole, V., Parker, L., O'Connor, S., O'Connor, W., Scanes, E., **Byrne, M**., Ross, P. (2016) Effects of multiple climate change stressors: ocean acidification interacts with warming, hyposalinity, and low food supply on the larvae of the brooding flat oyster Ostrea angasi. Marine Biology, 163(5), 1-17.

Cole, VJ, Parker, L, O'Connor SJ, O'Connor WA, Scanes, E, **Byrne, M**, Ross PM (2016). Effects of multiple climate change stressors: ocean acidification interacts with warming, hyposalinity, and low food supply on the larvae of the brooding flat oyster *Ostrea angasi*. Mar Biol 163:125

Coleman, R., Williams, E., Fraser, C. (2015) Self-ordering in the distribution of limpets: The role of previous occupants. Journal of Experimental Marine Biology and Ecology, 471, 23- 29.

Corte, G., Yokoyama, L., Coleman, R., Amaral, A. (2015) Population dynamics of the harvested clam Anomalocardia brasiliana (Bivalvia: Veneridae) in Cidade Beach, south-east Brazil. Journal of the Marine Biological Association of the United Kingdom, 95(6), 1183-1191.

De Figueiredo Salette A. and Peter J. Cowell (2016) Sensitivity of shoreline-recession forecasts to sediment budget uncertainties. Journal of Coastal Research: Special Issue 75 - Proceedings of the 14th International Coastal Symposium, Sydney, 6-11 March 2016: pp. 947 – 951.

De Kantzow M., Hick P., Becker J.A., & Whittington R.J. (2016) The effect of water temperature on mortality of Pacific oysters (*Crassostrea gigas*) caused by the microvariant of *Ostreid herpesvirus-1* (OsHV-1 µVar). Aquaculture Environment Interactions 8:419-428.

Dechnik, B., Webster, J., Davies, P., Braga, J., Reimer, P. (2015) Holocene "turn-on" and evolution of the Southern Great Barrier Reef: Revisiting reef cores from the Capricorn Bunker Group. Marine Geology, 363, 174-190.

Dechnik, B., Webster, J., Nothdurft, L., Webb, G., Zhao, J., Duce, S., Braga, J., Harris, D., Vila-Concejo, A., Puotinen, M. (2016) Influence of hydrodynamic energy on Holocene reef flat accretion, Great Barrier Reef. Quaternary Research, 85(1), 44- 53.

Drage, D., Mueller, J., Birch, G., Eaglesham, G., Hearn, L., Harrad, S. (2015) Historical trends of PBDEs and HBCDs in sediment cores from Sydney estuary, Australia. Science of the Total Environment, 512-513, 177-184.

Duce, S., Vila-Concejo, A., Hamylton, S., Webster, J., Bruce,E., Beaman, R. (2016) A morphometric assessment and classification of coral reef spur and groove morphology. Geomorphology, 265, 68-83.

Duffus, A.L., Waltzek, T.B., Stöhr, A.C., Allender, M.C., Gotesman, M., Whittington, R.J., **Hick, P.,** Hines, M.K., & Marschang, R.E., 2015. Distribution and host range of ranaviruses in: Gray, M.J., Chincahr, V.G. (Eds.), Ranaviruses: Lethal pathogens of ectothermic vertebrates. Springer, pp. 9-57.

Dunlop, R., Noad, M., McCauley, R., Kniest, E., Paton, D., **Cato, D**. (2015) The Behavioural Response of Humpback Whales (Megaptera novaeangliae) to a 20 Cubic Inch Air Gun. Aquatic Mammals, 41(4), 412-433.

Dunlop, R., Noad, M., McCauley, R., Kniest, E., Slade, R., Paton, D., **Cato, D.** (2016) Response of humpback whales (Megaptera novaeangliae) to ramp-up of a small experimental air gun array. Marine Pollution Bulletin, 103(1-2), 72-83.

Dutkiewicz, A., **Muller, R**., Hogg, A., Spence, P. (2016) Vigorous deep-sea currents cause global anomaly in sediment accumulation in the Southern Ocean. Geology, 44(8), 663-666.

Dutkiewicz, A., **Muller, R**., O'Callaghan, S., Jonasson, H. (2015) Census of seafloor sediments in the world's ocean. Geology, 43(9), 795-798.

Dutkiewicz, A., O'Callaghan, S., **Muller, R.** (2016) Controls on the distribution of deep-sea sediments. Geochemistry, Geophysics, Geosystems, 17(8), 3075-3098.

Dutton, A., **Webster, J**., Zwartz, D., Lambeck, K., Wohlfarth, B. (2015) Tropical tales of polar ice: evidence of Last Interglacial polar ice sheet retreat recorded by fossil reefs of the granitic Seychelles islands. Quaternary Science Reviews, 107, 182-196

Eriksson, H., **Byrne, M.** (2015) The sea cucumber fishery in Australia's Great Barrier Reef Marine Park follows global patterns of serial exploitation. Fish and Fisheries, 16(2), 329- 341.

Evans, O., Hick, P. & Whittington, R. (2016) Distribution of *Ostreid herpesvirus*-1 (OsHV-1) microvariant in seawater in a recirculating aquaculture system. *Aquaculture* 458**,** 21-28.

Evans, O., Hick, P. Whittington, R. J. (2016) Comparison of two external tagging methods used for the identification of individual adult *Crassostrea gigas*. *Journal of Shellfish Research,* 35, 1-4.

Evans, O., Hick, P., Dhand, N., Whittington, R. J. (2015) Transmission of *Ostreid herpesvirus*-1 in *Crassostrea gigas* by cohabitation: effects of food and number of infected donor oysters. *Aquaculture Environment Interactions,* 7, 281-295.

Falkner, I., Sewell, M., Byrne, M. (2015) Evolution of maternal provisioning in ophiuroid echinoderms: Characterisation of egg composition in planktotrophic and lecithotrophic developers. Marine Ecology Progress Series, 525, 1-13.

Ferguson, E.L., Ramakrishnan, R., Williams, S.B., Jin, C.T. (2016) Deep learning approach to passive monitoring of the underwater acoustic environment. The Journal of the Acoustical Society of America, 140(4): 3351

Ferrari, R., Bryson, M., Bridge, T., Hustache, J., Williams, S., Byrne, M., Figueira, W. (2016) Quantifying the response of structural complexity and community composition to environmental change in marine communities. *Global Change Biology*, 22(5), 1965-1975

Ferrari, R., McKinnon, D., He, H., Smith, R., Corke, P., Gonzalez-Rivero, M., Mumby, P., Upcroft, B. (2016) Quantifying Multiscale Habitat Structural Complexity: A Cost-Effective Framework for Underwater 3D Modelling. *Remote Sensing*, 8(2), 1-21.

Figueira, W., Ferrari, R., Weatherby, E., Porter, A., Hawes, S., Byrne, M. (2015) Accuracy and Precision of Habitat Structural Complexity Metrics Derived from Underwater Photogrammetry. Remote Sensing, 7(12), 16883-16900.

Foo, S., Byrne, M. (2016) Acclimatization and Adaptive Capacity of Marine Species in a Changing Ocean. Advances in Marine Biology, 74, 69-116.

Foo, S., Dworjanyn, S., Poore, A., Harianto, J., **Byrne, M.** (2016) Adaptive capacity of the sea urchin Heliocidaris erythrogramma to ocean change stressors: responses from gamete performance to the juvenile. Marine Ecology Progress Series, 556, 161-172.

Foo, S., Sparks, K., Uthicke, S., Karelitz, S., Barker, M., **Byrne, M**., Lamare, M. (2016) Contributions of genetic and environmental variance in early development of the Antarctic sea urchin *Sterechinus neumayeri* in response to increased ocean temperature and acidification. Marine Biology, 163(6), 1- 11.

Fraser, C., **Coleman, R**., Seebacher, F. (2015) Inter-individual variation partially explains patterns of orientation on steeply sloped substrata in a keystone grazer, the limpet Cellana tramoserica. Aquatic Ecology, 49, 189-197

Fraser, C., **Coleman, R**., Seebacher, F. (2015) It's not where you are, it's what you do after that matters: Tide-in patterns of orientation do not predict where or when limpets forage. Journal of Experimental Marine Biology and Ecology, 471, 119- 125.

Fraser, C., **Coleman, R**., Seebacher, F. (2015) Orientation in a keystone grazer: interactions between habitat and individual identity drive patterns of resting behaviour. Marine Ecology Progress Series, 522, 145-156.

Fraser, C., Seebacher, F., Lathlean, J., **Coleman, R**. (2016) Facing the Heat: Does Desiccation and Thermal Stress Explain Patterns of Orientation in an Intertidal Invertebrate? PloS One, 11(3), 1-16.

French, J., Payo, A., Murray, B., Orford, J., Eliot, M., **Cowell, P.** (2015) Appropriate complexity for the prediction of coastal and estuarine geomorphic behaviour at decadal to centennial scales. Geomorphology, 256. 3-16.

Gardner, I.A., **Whittington, R.J.**, Caraguel, C.G.B., **Hick, P.,** Moody, N.J.G., Corbeil, S., Garver, K.A., Warg, J.V., Arzul, I., Purcell, M.K., Crane, M.S., Waltzek, T.B., Olesen, N.J., Lagno, A.G. (2016) Recommended reporting standards for test accuracy studies of infectious diseases of finfish,

amphibians, molluscs and crustaceans: the STRADAS-aquatic checklist. Diseases of Aquatic Organisms. 118, 91-111.

Goncalves, P., Anderson, K., **Thompson, E.L.., Melwani, A.**, Ross, P.M, Raftos, D.A. (2016) Rapid transcriptional acclimation following transgenerational exposure of oysters to ocean acidification, *Molecular Ecology*, 25(19), 4836-4849

Gonzalez-Rivero, M., Bozec, Y., Chollett, I., **Ferrari, R.**, Schonberg, C., Mumby, P. (2016) Asymmetric competition prevents the outbreak of an opportunistic species after coral reef degradation. *Oecologia*, 181, 161-173.

Hansen, M., Morrell, L., **Ward, A**. (2016) The effect of temporally variable environmental stimuli and group size on emergence behavior. Behavioral Ecology, 27(3), 939-945.

Hansen, M., Schaerf, T., Krause, J., **Ward, A**. (2016) Crimson Spotted Rainbowfish (Melanotaenia duboulayi) Change Their Spatial Position according to Nutritional Requirement. PloS One, 11(2), 1-17.

Hansen, M., Schaerf, T., Simpson, S., **Ward, A**. (2016) Group foraging decisions in nutritionally differentiated environments. Functional Ecology, 30, 1638-1647.

Hansen, M., Schaerf, T., **Ward, A**. (2015) The influence of nutritional state on individual and group movement behaviour in shoals of crimson-spotted rainbowfish (Melanotaenia duboulayi). Behavioral Ecology and Sociobiology, 69(10), 1713-1722.

Hansen, M., **Ward, A.**, Furtbauer, I., King, A. (2016) Environmental quality determines finder-joiner dynamics in socially foraging three-spined sticklebacks (Gasterosteus aculeatus). Behavioral Ecology and Sociobiology, 70(6), 889- 899.

Hansen, M.J. **Ward A.J.W.**, Fürtbauer, I., King, A.J. (2016) Environmental quality determines finder-joiner dynamics in socially foraging three-spined sticklebacks (Gasterosteus aculeatus) Behavioral Ecology and Sociobiology 70 (6), 889-899 2016

Hansen, M.J., Schaerf, T.M., Krause, J., **Ward A.J.W.** (2016) Crimson Spotted Rainbowfish (Melanotaenia duboulayi) Change Their Spatial Position according to Nutritional Requirement PloS One 11 (2), e0148334

Hansen, M.J., Schaerf, T.M., Simpson, S.J., **Ward A.J.W.** (2016) Group Foraging Decisions in Nutritionally Differentiated Environments. Functional Ecology

Harper, B., Puga-Bernabeu, A., Droxler, A., **Webster, J.**, Gischler, E., Tiwari, M., Lado-Insua, T., Thomas, A., Morgan, S., Jovane, L., et al (2015) Mixed carbonate-siliciclastic sedimentation along the Great Barrier Reef upper slope: A challenge to the reciprocal sedimentation model. Journal Of Sedimentary Research, 85(9), 1019-1036.

Harris, D., **Vila-Concejo, A., Webster, J.**, Power, H. (2015) Spatial variations in wave transformation and sediment entrainment on a coral reef sand apron. Marine Geology, 363, 220-229.

Harris, D., **Webster, J.**, **Vila-Concejo, A.**, Hua, Q., Yokoyama, Y., Reimer, P. (2015) Late Holocene sea-level fall and turn-off of reef flat carbonate production: Rethinking bucket fill and coral reed growth models. Geology, 43(2), 175-178.

Herbert-Read, J., Buhl, J., Hu, F., **Ward, A.**, Sumpter, D. (2015) Initiation and spread of escape waves within animal groups. Royal Society Open Science, 2(4), 1-11.

Hick, P., **Evans, O.**, Looi, R., English, C., & **Whittington, R.J.** (2016) Stability of *Ostreid herpesvirus-1* (OsHV-1) and assessment of disinfection of seawater and oyster tissues using a bioassay. Aquaculture. 450, 412-421.

Hick, P.M., Ariel, E., & **Whittington, R.J.** (2016) Chapter 4. Epizootic Hematopoietic Necrosis and European Catfish Virus. in: Woo, P.T.K., Cipriano, R.C. (Eds.), Fish Viruses and Bacteria: Pathobiology and Protection. CABI (in press), Oxfordshire, UK.

Hick, P.M., Becker, J.A., & Whittington, R.J. (2016) Chapter 8. Iridoviruses of Fish. in: Kibenge, F.S.B., Godoy, M. (Eds.), Aquaculture Virology. Elsevier Inc. http://dx.doi.org/10.1016/B978-0-12-801573-5.00008-5.

Hick, P.M., Subramaniam K., Thompson P., Whittington R.J., & Waltzek T.B. (2016) Complete genome sequence of a Bohle iridovirus isolate from ornate burrowing frog (*Limnodynastes ornatus*) in Australia. Genome Announcements on-line.

Hinestrosa, G., **Webster, J.**, Beaman, R. (2016) Postglacial sediment deposition along a mixed carbonate-siliciclastic margin: New constraints from the drowned shelf-edge reefs of the Great Barrier Reef, Australia. Palaeogeography, Palaeoclimatology, Palaeoecology, 446, 168-185.

Hubble, T. C. T., **J. M. Webster**, P. Yu, M. Fletcher, D. Volker, D. W. Airey, **S. L. Clarke**, P. B. Angel, D. Mitchell, F. Howard, S. Gallagher and T. Martin (2016) Submarine landslides and incised canyons of the southeast Queensland continental margin. Submarine Mass Movements and Their Consequences (7th), edited by G. Lamarche, J. J. Mountjoy, S. Bull et al., pp. 529-538, Springer International Publishing.

Hutchings, J., **Stephens, T.**, VanderZwaag, D. (2016) Marine Species at Risk Protection in Australia and Canada: Paper Promises, Paltry Progressions. Ocean Development and International Law, 47(3), 233-254.

Insua, L., Hamel, L., Moran, K., Anderson, L., **Webster, J.** (2015) Advanced classification of carbonate sediments based on physical properties. Sedimentology, 62(2), 590-606.

Israel, J., Martik, M., **Byrne, M.**, Raff, E., Raff, R., McClay, D., Wray, G. (2016) Comparative Developmental Transcriptomics Reveals Rewiring of a Highly Conserved Gene Regulatory Network during a Major Life History Switch in the Sea Urchin Genus Heliocidaris. PLoS Biology, 14(3), 1-28.

Jabour, J., **Stephens, T.**, VanderZwaag, D. (2016) Introduction. Ocean Development and International Law, 47(3), 219-220.

Jabour, J., **Stephens, T.**, VanderZwaag, D. (2016) Introduction. Ocean Development and International Law, 47(4), 346-347.

Jaramillo, D., Durr, S., **Hick, P., & Whittington, R.** (2016) Bayesian estimation of diagnostic sensitivity and specificity of a nervous necrosis virus antibody ELISA. Preventive Veterinary Medicine. 123, 138-142.

Jaramillo, D., **Hick, P.,** Deece, K., Tweedie, A., Kirkland, P., Arzey, E., & **Whittington, R.J**. (2016) Comparison of ELISA formats for detection of antibodies specific for nervous necrosis virus (Betanodavirus) in the serum of immunized barramundi *Lates calcarifer* and Australian bass *Macquaria novemaculeata*. Aquaculture. 451, 33-38.

Jeffries, T., Curlevski, N., Brown, M., **Harrison, D**., Doblin, M., Petrou, K., Ralph, P., Seymour, J. (2016) Partitioning of fungal assemblages across different marine habitats. Environmental Microbiology Reports, 8(2), 235-238.

Jeffries, T., Schmitz Fontes, M., **Harrison, D**., Van-DongenVogels, V., Eyre, B., Ralph, P., Seymour, J. (2016) Bacterioplankton dynamics within a large urban estuary. Frontiers in Microbiology, 6(1438), 1-17.

Johnston, E., Mayer-Pinto, M., Hutchings, P., Marzinelli, E., Ahyong, S., Birch, G., Booth, D., Creese, B., Doblin, M., **Figueira, W.,** et al (2015) Sydney Harbour: What we do and do not know about a highly diverse estuary. Marine and Freshwater Research, 66(12), 1073-1087

Kamya, P., **Byrne, M**., Graba-Landry, A., Dworjanyn, S. (2016) Near-future ocean acidification enhances the feeding rate and development of the herbivorous juveniles of the crownof-thorns starfish, Acanthaster planci. Coral Reefs, 35(4), 1241- 1251.

Karelitz, S.E., Uthicke, S., Foo S.A., Barker, M.F., **Byrne M.**, Pecorino D. Lamare, M.D. (2016) Ocean acidification has little effect on developmental thermal windows of echinoderms from Antarctica to the tropics. Global Change Biology 23: 657-672

Keith, S., Woolsey, E., Madin, J., **Byrne, M.**, Baird, A. (2015) Differential establishment potential of species predicts a shift in coral assemblage structure across a biogeographic barrier. Ecography, 38(12), 1225-1234.

Kelaher, B., Tan, M., **Figueira, W.**, Gillanders, B., Connell, S., Goldsworthy, S., Hardy, N., Coleman, M. (2015) Fur seal activity moderates the effects of an Australian marine sanctuary on temperate reef fish. Biological Conservation, 182, 205-214

Kinsela, M.A., Daley, M.J.A., **Cowell, P.J.** (2016) Origins of Holocene coastal strandplains in Southeast Australia: Shoreface sand supply driven by disequilibrium morphology. Marine Geology, 374, 14-30.

Lajus, D., Yurtseva, A., **Birch, G.**, Booth, D. (2015) Fluctuating asymmetry as a pollution monitor: The Australian estuarine smooth toadfish Tetractenos glaber (Teleostei: Tetraodontidae). Marine Pollution Bulletin, 101(2), 758-767.

Lathlean, J., Ayre, D., **Coleman, R.**, Minchinton, T. (2015) Using biomimetic loggers to measure interspecific and microhabitat variation in body temperatures of rocky intertidal invertebrates. Marine and Freshwater Research, 66(1), 86-94.

Lau, Q., Chow., N., Gray, R., Higgins, D.P. (2015) Diversity of MHC DQB and DRB genes in the endangered Australian sea lion (Neophoca cinerea). The Journal of heredity, 106(4).

Lee, J., Birch, G. (2016) The mismatch of bioaccumulated trace metals (Cu, Pb and Zn) in field and transplanted oysters (Saccostrea glomerata) to ambient surficial sediments and suspended particulate matter in a highly urbanised estuary (Sydney estuary, Australia). Environmental Monitoring and Assessment, 188(4), 1-17

Lee, J., **Birch, G.**, Cresswell, T., Johansen, M., Adams, M., Simpson, S. (2015).Dietary ingestion of fine sediments and microalgae represent the dominant route of exposure and metal accumulation

for Sydney rock oyster (Saccostrea glomerata): A biokinetic model for zinc. Aquatic Toxicology, 167, 46-54.

Lee, J., Birch, G., Simpson, S. (2016) Metal-contaminated resuspended sediment particles are a minor metal-uptake route for the Sydney rock oyster (Saccostrea glomerata) - A mesocosm study, Sydney Harbour estuary, Australia. Marine Pollution Bulletin, 104(1-2), 190-197.

Lee, J., Richards, R.G., and Birch, G.F. (2016) A novel coupled biokinetic-equilibrium model to capture oyster metal bioaccumulation in a contaminated estuary (Sydney estuary, Australia). Environmental Modelling and Software, 82 152-166. doi:10.1016/j.envsoft.2016.04.021

Lewandowski, J., Luczkovich, J., Cato, D., Dunlop, R. (2016) Summary Report Panel 3: Gap Analysis from the Perspective of Animal Biology: Results of the Panel Discussion from the Third International Conference on the Effects of Noise on Aquatic Life. In Arthur N. Popper and Anthony Hawkins (Eds.), The Effects of Noise on Aquatic Life II, (pp. 1277-1281).

Lewis, S., Wust, R., Webster, J., Collins, J., Wright, S., Jacobsen, G. (2015) Rapid relative sea-level fall along northeastern Australia between 1200 and 800cal.yrBP: An appraisal of the oyster evidence. Marine Geology, 370, 20-30.

Liggins, L., Booth, D., Figueira, W., Treml, E., Tonk, L., Ridgway, T., Harris, D., Riginos, C. (2015) Latitude-wide genetic patterns reveal historical effects and contrasting patterns of turnover and nestedness at the range peripheries of a tropical marine fish. Ecography, 38(12), 1212-1224.

Ling, S.D., Mahon, I., Marzloff, M., Williams, S.B. (2016) Stereo-imaging AUV detects trends in sea urchin abundance on deep overgrazed reefs. Limnology and oceanography, methods 14(5).

Lopez-Cabrera, F., Puga-Bernabeu, A., Webster, J., Beaman, R. (2016) Morphometric analysis of the submarine landslides in the central Great Barrier Reef margin, north-eastern Australia. Geogaceta, (60), 43-46.

Malcolm, H., Jordan, A., Schultz, A., Smith, S., Ingleton, T., Foulsham, E., Linklater, M., Davies, P., **Ferrari, R.**, Hill, N., et al (2016) Integrating Seafloor Habitat Mapping and Fish Assemblage Patterns Improves Spatial Management Planning in a Marine Park. *Journal of Coastal Research*, 1(75), 1292-1296.

March, D., Brown, D., **Gray, R.** (2015) Auditory anatomy of beaked whales and other odontocetes: Potential for cochlear stimulation via a "vibroacoustic duct mechanism". Marine Mammal Science, 32(2).

Marcus, A.D., Higgins, D.P., **Gray, R.** (2015) Ivermectin treatment of free-ranging endangered Australian sea lion (Neophoca cinerea) pups: effect on hookworm and lice infection status, haematological parameters, growth, and survival. Parasitology research, 114(7).

Martinez, A., **Byrne, M., Coleman, R.** (2016) What and when to eat? Investigating the feeding habits of an intertidal herbivorous starfish. Marine Biology, 163(7), 1-13.

Martino, C, Bonaventura, R, **Byrne, M**, Roccheri, M, Matranga V. (2016) Effects of exposure to gadolinium on the development of geographically and phylogenetically distant sea urchins species. Marine Environmental Research doi.org/10.1016/j.marenvres.2016.06.001

Marzinelli, E., **Williams, S.B.**, Babcock, R.C., Steinberg, P. (2015) Large-Scale Geographic Variation in Distribution and Abundance of Australian Deep-Water Kelp Forests. PLoS ONE, 10(2):e0118390.

Mayer-Pinto, M., Johnston, E., Hutchings, P., Marzinelli, E., Ahyong, S., **Birch, G.**, Booth, D., Creese, B., Doblin, M., Figueira, W., et al (2015) Sydney Harbour: A review of anthropogenic impacts on the biodiversity and ecosystem function of one of the world's largest natural harbours. Marine and Freshwater Research, 66(12), 1088-1105.

Mayer-Pinto, M., Matias, M., **Coleman, R**. (2016) The interplay between habitat structure and chemical contaminants on biotic responses of benthic organisms. PeerJ, 4(5), 1-19.

McCauley, R., Cato, D., Duncan, A. (2016) Regional Variations and Trends in Ambient Noise: Examples from Australian Waters. In Arthur N. Popper and Anthony Hawkins (Eds.), The Effects of Noise on Aquatic Life II, (pp. 687-696).

McElroy, D., Doblin, M., Murphy, R., Hochuli, D., Coleman, R. (2016) A limited legacy effect of copper in marine biofilms. Marine Pollution Bulletin, 109, 117-127.

McElroy, D., O'Gorman, E., Schneider, F., Hetjens, H., Le Merrer, P., Coleman, R., Emmerson, M. (2015) Size-balanced community reorganization in response to nutrients and warming. Global Change Biology, 21, 3971-3981.

McNeil, M., Webster, J., Beaman, R., Graham, T. (2016) New constraints on the spatial distribution and morphology of the Halimeda bioherms of the Great Barrier Reef, Australia. Coral Reefs, (338), 1-13.

Medagoda, L., Williams, S.B., Pizarro, O., Jukuba, M.V. (2016) Mid-water current aided localization for autonomous underwater vehicles. Autonomous Robots, 40(7).

Meissner, K., Abram, N., Armand, L., Chase, Z., De Deckker, P., Ellwood, M., Exon, N., Gagan, M., Goodwin, I., Howard, W., Webster, J., et al (2015) Dealing with Climate Change: Palaeoclimate Research in Australia. Quaternary Australasia, 32(1), 19-24.

Mella, V., Ward, A., Banks, P., McArthur, C. (2015) Personality affects the foraging response of a mammalian herbivore to the dual costs of food and fear. Oecologia, 177(1), 293-303.

Melwani, A.R., Thompson, E.L., Raftos, D.A. (2016) Differential proteomic response of Sydney rock oysters (*Saccostrea glomerata*) to prolonged environmental stress, *Aquatic Toxicology*, 173, 53-62

Miller, D., Pessier, A., **Hick, P.,** & **Whittington, R.** (2015) Comparative Pathology of Ranaviruses and Diagnostic Techniques. in: Gray, M.J., Chinchar, V.G. (Eds.), Ranaviruses. Springer International Publishing, pp. 171-208.

Monk, J., Barrett, N.S., Hill, N.A., **Williams, S.B.** (2016) Outcropping reef ledges drive patterns of epibenthic assemblage diversity on cross-shelf habitats. Biodiversity and Conservation, 25(3).

Morris, R., Deavin, G., Donald, S., **Coleman, R.** (2016) Ecoengineering in urbanised coastal systems: consideration of social values. Ecological Management and Restoration, 17(1), 33-39.

Mos, B, **Byrne, M**, Dworjanyn SA, 2016 Biogenic acidification reduces sea urchin gonad growth and increases susceptibility of aquaculture to ocean acidification. Marine Environmental Research 113:39-48

Mos, B., **Byrne, M**., Cowden, K., Dworjanyn, S. (2015) Biogenic acidification drives density-dependent growth of a calcifying invertebrate in culture. Marine Biology, 162(8), 1541- 1558

Muller, R., Qin, X., Sandwell, D., Dutkiewicz, A., Williams, S., Flament, N., Maus, S., Seton, M. (2016) The GPlates Portal: Cloud-Based Interactive 3D Visualization of Global Geophysical and Geological Data in a Web Browser. *PloS One*, 11(3), 1-17.

Muller, R., Qin, X., Sandwell, D., **Dutkiewicz, A.**, Williams, S., Flament, N., Maus, S., Seton, M. (2016) The GPlates Portal: Cloud-Based Interactive 3D Visualization of Global Geophysical and Geological Data in a Web Browser. PloS One, 11(3), 1-17.

Muller, R., Seton, M. (2015) Paleophysiography of Ocean Basins. In Harff, J., Meschede, M., Petersen, S., Thiede, J. (Eds.), *Encyclopedia of Marine Geosciences*, (pp. 638-648). Netherlands: Springer Netherlands.

Muller, R., Seton, M., Zahirovic, S., Williams, S., Matthews, K., Wright, N., Shephard, G., Maloney, K., Barnett-Moore, N., Hosseinpour, M., Cannon, J., et al (2016) Ocean Basin Evolution and Global-

Scale Plate Reorganization Events since Pangea Breakup. *Annual Reviews of Earth and Planetary Science*, 44, 107-138.

Patiño, S Keever, CC Sunday, JM Popovic, I, **Byrne M**, Hart MW 2016- Sperm bindin divergence under sexual selection and concerted evolution in sea stars. Molecular Biology and Evolution 33 (8): 1988-2001

Paul-Pont I, **Evans O.**, **Dhand, N.K.** , **Whittington, R.J.** (2015) Experimental infections of Pacific oyster Crassostrea gigas using the Australian ostreid herpesvirus-1 (OsHV-1) µvar strain. Diseases of Aquatic Organisms 113, 137-147.

Pearson, S., Windupranata, W., Pranowo, S., Putri, A., Ma, Y., **Vila-Concejo, A.**, Fernandez, E., Mendez, G., Banks, J., Knights, A., et al (2016) Conflicts in some of the World harbours: what needs to happen next? Maritime Studies, 15(1), 1-23.

Pendleton L., Jungwiwattanaporn M., Beaudoin Y., Neumann C., Solgaard A., Cavaliere C., and **Baker E.** (2015) Greening the Ocean Economy. In Smith, Hance D., Juan Luis Suárez de Vivero, and Tundi S. Agardy, eds. Routledge Handbook of Ocean Resources and Management. Routledge, 2015.

Peters, C., Piazolo, S., Webb, G., **Dutkiewicz, A**., George, S. (2016).In search of early life: Carbonate veins in Archean metamorphic rocks as potential hosts of biomarkers. Earth and Planetary Science Letters, 453, 44-55.

Pirotta, V., Slip, D., Jonsen, I., Peddemors, V., **Cato, D.**, Ross, G., Harcourt, R. (2016) Migrating humpback whales show no detectable response to whale alarms off Sydney, Australia. Endangered Species Research, 29(3), 201-209.

Poore, A., Graham, S., **Byrne, M**., Dworjanyn, S. (2016) Effects of ocean warming and lowered pH on algal growth and palatability to a grazing gastropod. Marine Biology, 163(5), 1- 11.

Power, H. E., S. L. Clarke, O. Wilson and **T. C. T. Hubble** (2015) Tsunami hazard from submarine landslides: 3D inundation modelling in New South Wales, Australia. In: Australasian Coasts & Ports Conference 2015: 22nd Australasian Coastal and Ocean Engineering Conference and the 15th Australasian Port and Harbour Conference. Auckland, New Zealand: Engineers Australia and IPENZ, 2015: 696-701.

Przeslawski, R., **Byrne, M.**, Mellin, C. (2015) A review and meta-analysis of the effects of multiple abiotic stressors on marine embryos and larvae. Global Change Biology, 21(6), 2122-2140.

Puga-Bernabeu, A., **Webster, J**., Braga, J., Clague, D., Dutton, A., Eggins, S., Fallon, S., Jacobsen, G., Paduan, J., Potts, D. (2016) Morphology and evolution of drowned carbonate terraces during the last two interglacial cycles, off Hilo, NE Hawaii. Marine Geology, 371, 57-81

Purcell, S., Uthicke, S., **Byrne, M**., Eriksson, H. (2015) Rotational harvesting is a risky strategy for vulnerable marine animals. Proceedings of the National Academy of Sciences of the United States of America (PNAS), 112(46), e6263-e6263.

Raftos, D., Melwani, A., Haynes, P., Muralidharan, S., **Birch, G.**, Amaral, V., **Thompson, E**., Taylor, D. (2016) The biology of environmental stress: Molecular biomarkers in Sydney rock oysters (Saccostrea glomerata). Environmental Science: Processes and Impacts, 18(9), 1129-1139.

Renema, W., Pandolfi, J., Kiessling, W., Bosellini, F., Klaus, J., Korpanty, C., Rosen, B., Santodomingo, N., Wallace, C., **Webster, J**., et al (2016) Are coral reefs victims of their own past success? Ecology, 2(4), 1-6.

Rimmer A.E., **Becker J.A.**, Tweedie A., Lintermans M., Landos M., **Whittington R.J.** (2015) Detection of dwarf gourami iridovirus (*Infectious spleen and kidney necrosis virus*) in populations of ornamental fish prior to and after importation into Australia, with the first evidence of infection in domestically farmed Platy (*Xiphophorus maculatus*). Preventative Veterinary Medicine, 122: 181-194.

Ross, P., Parker, L., **Byrne, M.** (2016) Transgenerational responses of molluscs and echinoderms to changing ocean conditions. ICES Journal of Marine Science: journal du conseil, 73(3), 537-549.

Rothwell, D., **Stephens, T.** (2016) The International Law of the Sea - 2nd Edition. Oxford: Hart Publishing.

Schaerf, T., Herbert-Read, J., Myerscough, M.R., Sumpter, D.J.T. **Ward A.J.W.** (2016) Identifying differences in the rules of interaction between individuals in moving animal groups. arXiv preprint arXiv:1601.08202

Hansen, M.J. Morrell, L.J., **Ward A.J.W.** (2016) The effect of temporally variable environmental stimuli and group size on emergence behaviour. Behavioral Ecology, arv237

Seebacher, F., Webster, M., James, R., Tallis, J., **Ward, A.** (2016) Morphological differences between habitats are associated with physiological and behavioural trade-offs in stickleback (Gasterosteus aculeatus). Royal Society Open Science, 3(6), 1-12.

Seebacher, F., Webster, M.M., James, R.S., Tallis, J. **Ward A.J.W.** (2016) Morphological differences between habitats are associated with physiological and behavioural trade-offs in stickleback (Gasterosteus aculeatus). Open Science 3 (6), 1603162016.

Sewell, T., Stephens, R., Dominey-Howes, D., **Bruce, E.**, Perkins-Kirkpatrick, S. (2016) Disaster declarations associated with bushfires, floods and storms in New South Wales, Australia between 2004 and 2014. Scientific Reports, 6, 1-11.

Smith, A.M., **Byrne, M.**, Clark, D.E., Lamare, M.D., Winter, D.J. (2016) Risk and Resilience: variations in magnesium in echinoid skeletal calcite. Marine Ecology Progress Series 561: 1-16,

Soars, N., **Byrne, M., Cato, D.** (2016) Characterization of the Sounds Produced by Temperate and Tropical Sea Urchins During Feeding (Diadematidae and Echinometridae). In Arthur N. Popper and Anthony Hawkins (Eds.), The Effects of Noise on Aquatic Life II, (pp. 1075-1080). New York: Springer.

Sparks, K., Foo, S., Uthicke, S., **Byrne, M.**, Lamare, M. (2016) Paternal identity influences response of Acanthaster planci embryos to ocean acidification and warming. Coral Reefs, 36(1), 325-338.

Stephens, T. (2016) Australia and the United States in Antarctica: Warm Partners on the Coldest Continent, (pp. 1 - 9). Sydney, NSW, Australia: United States Studies Centre.

Stephens, T. (2016) China's Claims Dashed in South China Sea Arbitration. Law Society Journal, 25.

Stephens, T. (2016) Disasters, international environmental law and the Anthropocene. In Susan C. Breau, Katja L.H. Samuel (Eds.), Research Handbook on Disasters and International Law, (pp. 153-176). Cheltenham: Edward Elgar Publishing.

Tan, T. L. S., Paul-Pont, I., **Evans, O.**, M., Watterson, D., Young, P., **Whittington, R.**, Fougerouse, A., Bichet, H., Barnes, A. C. & Dang, C. (2015) Resistance of Black-lip pearl oyster, *Pinctada margaritifera*, to infection by Ostreid herpes virus 1 mu var under experimental challenge may be mediated by humoral antiviral activity. *Fish & Shellfish Immunology,* 44**,** 232-240.

Thompson, **E.L.,** Parker, L.M., Valter Amaral, Melanie J. Bishop, Wayne A. O'Connor, David A. Raftos (2016) Wild populations of Sydney rock oysters differ in their proteomic responses to elevated carbon dioxide, *Marine and Freshwater Research*, 67(12), 1964-1972

Thompson, E.L., Wayne A. O'Connor, Laura M. Parker, Pauline M. Ross, David A. Raftos (2015) Differential proteomic responses of selectively bred and wild-type Sydney rock oyster populations exposed to elevated CO_2, *Molecular Ecology*, 24, 1248-1262

Thygesen, K. and **Baker, E.** (2015) A decade of successfully helping to secure the sovereign rights of developing coastal states. GRID Arendal.

Trindade, W., Pereira, L., **Vila-Concejo, A.** (2016) Tidal Modulation of Moderate Wave Energy on a Sandy Tidal Flat on the Macrotidal Amazon Littoral. Journal of Coastal Research, 75, 487-491.

UNEP and GRID-Arendal (2016) Marine Litter Vital Graphics 60pp. United Nations Environment Programme http://www.grida.no/publications/vg/marine-litter/

Vaibhav, Vineet, Maxime Lepretre, **E.L. Thompson,** David A. Raftos, Paul A Haynes. 2016, Biomarkers of Winter Mortality resistance in selectively bred Sydney rock oysters (Saccostrea glomerata), *Aquaculture*, 465, 323-329.

Verges, A., Doropoulos, C., Malcolm, H., Skye, M., GarciaPiza, M., Marzinelli, E., Campbell, A., Ballesteros, E., Hoey, A., **Vila-Concejo, A.**, et al (2016) Long-term empirical evidence of ocean warming leading to tropicalization of fish communities, increased herbivory, and loss of kelp. Proceedings of the National Academy of Sciences of the United States of America (PNAS), 113(48), 13791-13796.

Wainwright, D.J., Ranasinghe, R., Callaghan, D.P., **Cowell, P.J.** (2015) Moving from deterministic towards probabilistic coastal hazard and risk assessment: Development of a modelling framework and application to Narrabeen Beach, New South Wales, Australia. Coastal Engineering 96.

Ward, A. (2015) Intraspecific Social Recognition in Fishes via Chemical Cues. In P.W. Sorensen, & B.D. Wisenden (Eds.) Fish Pheromones and Related Cues, (pp. 113-130). Ames: John Wiley & Sons.

Ward, A., Webster, M. (2016) Sociality: The Behaviour of Group-Living Animals. Switzerland: Springer.

Webster, J., George, N., Beaman, R., Hill, J., Puga-Bernabeu, A., Hinestrosa, G., Abbey, E., Daniell, J. (2016) Submarine landslides on the Great Barrier Reef shelf edge and upper slope: A mechanism for generating tsunamis on the north-east Australian coast? Marine Geology, 371, 120-129.

Wellard, R., Erbe, C., Fouda, L., **Blewitt, M.** (2015) Vocalisations of Killer Whales (Orcinus orca) in the Bremer Canyon, Western Australia. PLos ONE, 10(9) and Correction 10(10).

Whittaker, J., Afonso, J., Masterton, S., **Muller, R**., Wessel, P., Williams, S., Seton, M. (2015) Long-term interaction between mid-ocean ridges and mantle plumes. *Nature Geoscience*, 8(6), 479-483.

Whittington RJ, **Hick PM, Evans O,** Rubio A, Alford B, **Dhand N** & Paul-Pont I (2015) Protection of Pacific oyster (Crassostrea gigas) spat from mortality due to ostreid herpesvirus 1 (OsHV-1 µVar) using simple treatments of incoming seawater in land-based upwellers. Aquaculture 437, 10-20.

Whittington, R. J., **Dhand, N. K., Evans, O**. & Paul-Pont, I. (2015) Further observations on the influence of husbandry practices on OsHV-1 mu Var mortality in Pacific oysters *Crassostrea gigas*: Age, cultivation structures and growing height. *Aquaculture,* 438**,** 82-97.

Whittington, R. J., **Hick, P., Evans, O.**, Rubio, A., Alford, B., **Dhand, N.** & Paul-Pont, I. (2015) Protection of Pacific oyster (*Crassostrea gigas*) spat from mortality due to *ostreid herpesvirus 1* (OsHV-1 mu Var) using simple treatments of incoming seawater in land-based upwellers. *Aquaculture,* 437**,** 10-20.

Whittington, R.J., **Dhand, N.K.**, **Evans ,O**., Paul-Pont, I. (2015) Further observations on the influence of husbandry practices on OsHV-1 µVar mortality in Pacific oysters Crassostrea gigas: Age, cultivation structures and growing height. Aquaculture 438, 82-97.

Williams, S.B., Pizarro, O., Steinberg, D, **Bryson, M.** (2016) Reflections on a decade of autonomous underwater vehicles operations for marine survey at the Australian Centre for Field Robotics. Annual Reviews in Control 42.

Wolfe, K., Graba-Landry, A., Dworjanyn, S., **Byrne, M.** (2015) Larval starvation to satiation: Influence of nutrient regime on the success of Acanthaster planci. PloS One, 10(3), 1-17.

Wood, G., Lynch, T., Devine, C., Keller, K., **Figueira, W.** (2016) High-resolution photo-mosaic time-series imagery for monitoring human use of an artificial reef. Ecology and Evolution, 6(19), 6963-6968.

Woolsey, E., Keith, S., **Byrne, M.**, Schmidt-Roach, S., Baird, A. (2015) Latitudinal variation in thermal tolerance thresholds of early life stages of corals. Coral Reefs, 34(2), 471-478.

Wright, N., Seton, M., Williams, S., **Muller, R.** (2016) The Late Cretaceous to recent tectonic history of the Pacific Ocean basin. *Earth-Science Reviews*, 154, 138-173.

Zahirovic, S., Flament, N., **Muller, R.**, **Seton, M.**, Gurnis, M. (2016) Large fluctuations of shallow seas in low-lying Southeast Asia driven by mantle flow: Geochem. Geophys. Geosys, v. FRONTIERS IN GEOSYSTEMS: Deep Earth - surface interactions. *Geochemistry, Geophysics, Geosystems*, 17(9).

Sydney Institute of Marine Science Chowder Bay