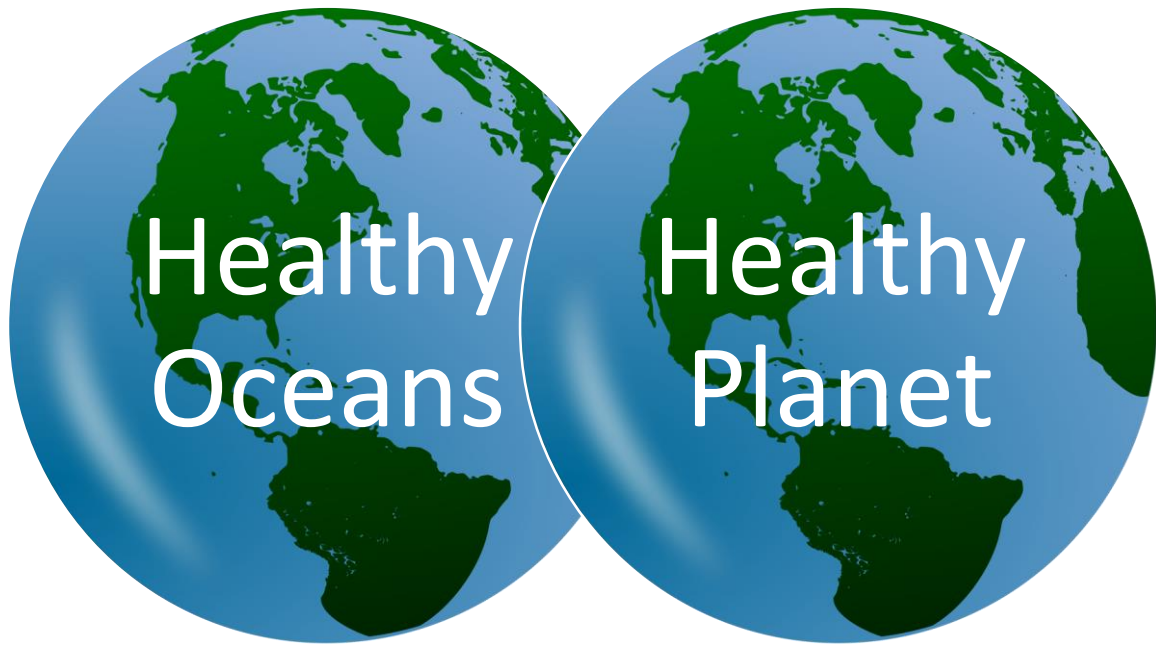


# MSI RESEARCH SHOWCASE

2017



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 Coastal and Marine Ecosystems Group (CMEG)
- The EarthByte Group
- The Geocoastal Research Group (GRG)
- The Georeef Laboratory
- The Ocean Technology Group (OTG)
- The Sydney Environmental Institute
- The Sydney Law School
- The Sydney Centre in Geomechanics and Mining Materials (SciGEM)
- The Vibrational Spectroscopy Core Facility

# MSI RESEARCH SHOWCASE 2017

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) 2017 provides an overview of marine research being undertaken throughout the university. The MSI showcase spotlights high-calibre research and projects that are being undertaken by marine academics and postgraduate students. Each talk is from 3-5 minutes in duration demonstrating research snapshots with a focus on current projects. In addition to the formal presentations, there are opportunities to more fully discuss topics of interest and network with colleagues.

## MSI Showcase 2017 Program:

	Name	Title
1	Prof Tim Stephens	Antarctic and Southern Ocean Governance in the Anthropocene
2	Prof Elaine Baker	Mercury Rising
3	Prof Dietmar Müller	Seafloor tectonic fabric mapping from satellite altimetry: a key for modelling Earth evolution through deep time
4	A/Prof Will Figueira	3D Reefs
5	Prof Elspeth Probyn	Eating the Ocean
6	A/Prof Ana Vila-Concejo	Morphodynamics of tropical and temperate coasts.
7	Dr Bree Morgan	Exploring the mystery of natural carbon mineralisation in Australian lakes

8	Prof Doug Cato	From BRAHSS to ocean soundscapes.
9	Prof Ian Jones	Cloud whitening droplet generator
10	Dr Elisa Bone	Embedding coastal science in school and community education
11	Amanda Thran	Predicting global sediment drift distribution using a high-resolution general ocean circulation model
12	Dr Gabriel Machovsky-Capuska	Nutritional Ecology of Marine Predators: Challenges and Opportunities
13	Dr Kate Johnston	The Fish Market at the Bottom of the World
14	Dr Samanth Clarke	Can submarine landslides trigger tsunamis?
15	Januar Harianto	The effect of warming on the metabolic rate and heat-shock protein response in thermally acclimated sea urchins ( <i>Heliocidaris erythrogramma</i> )
16	Dr Paul Hick	Environment and microbial communities determine the outcome of oyster diseases
17	Max de Kantzow	Epidemiologic investigation of the influence of nvironmental conditions on disease caused by Ostreid herpesvirus 1 (OsHV-1)
18	Dr Yehuda Shalem	Submarine Groundwater discharge
19	Dr Edwina Tanner	Carbon budget in Sydney Harbour Estuary

# MSI Research Project Summaries

**Researcher:** Professor Elaine Baker

**Department/ Institute:** School of Geoscience – Marine

Studies Institute

**Project Title:** Mercury Rising

We have been aware since the 1950s that mercury exposure damages the health of people, especially children. That's why it's surprising that it's taken the world this long to do something about the release of mercury into the environment. But after nearly 17 years of negotiation we finally have a global mechanism to help us deal with the increasing amount of mercury that threatens the health of people and the planet.



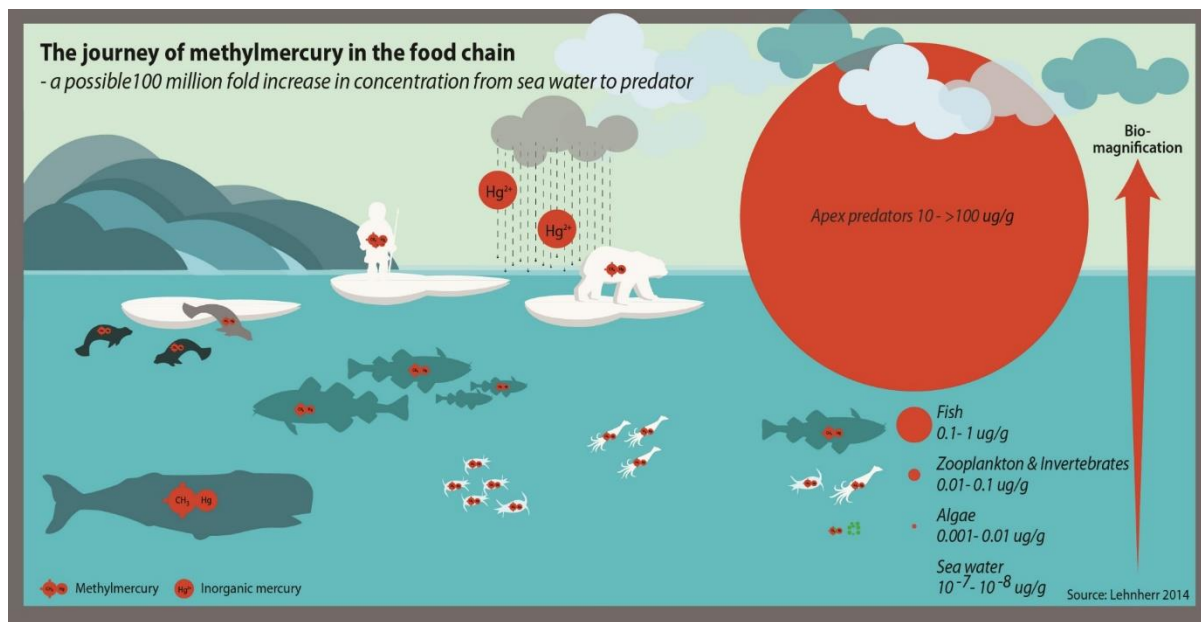
The Minamata Convention came into force in August this year - named after the Japanese town that alerted the world to the problem after thousands of people were poisoned when mercury contaminated industrial effluent was released into Minamata Bay.

Emissions to the atmosphere due to human activity have decreased in Europe as a result of increased regulation. However, they appear to be increasing in Asia (AMAP/UNEP 2015). Artisanal and small-scale gold mining is the single largest source of mercury emissions. The mercury released into the atmosphere in South East Asia is recognised as the major source of mercury to the Arctic and sub-Arctic regions. As such, it contributes to the increasing levels of mercury in fish, marine mammals and people in these areas. One of the impacts of which is that, an estimated 60 thousand children are born each year in Nordic countries with mercury levels that can cause developmental damage.

Everyone has some mercury in their body, but the World Health Organisation recognises that even small amounts can cause serious health problems. Consequently, they have set a safe limit of 0.58 µg/g

– below which, for example, there is no substantial risk of developmental neurotoxicity (e.g. deficits in fine motor skills, language and memory).

The economic costs of projected wage losses and medical expenses, related to prenatal mercury exposure resulting in loss of IQ points, have been calculated. For example, across Norway, Sweden, Denmark and Finland these costs are estimated at 180 million euros annually. So, in addition to the global health improvements that will stem from reducing global mercury emissions, the potential long term cumulative economic-wide-benefits from the Minamata Convention, highlight the need for action. This action is especially critical in supporting the many developing states, who by signing up to the Convention, have committed to drastically decreasing mercury emissions.



From Why we need action on mercury – now. Baker et al 2017. <https://news.grida.no/why-we-need-action-on-mercury-now>





**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 meglucytivirus ISKNV for Australia



**Researcher:** Professor Gavin Birch

**Department/ Institute:** School of Geosciences

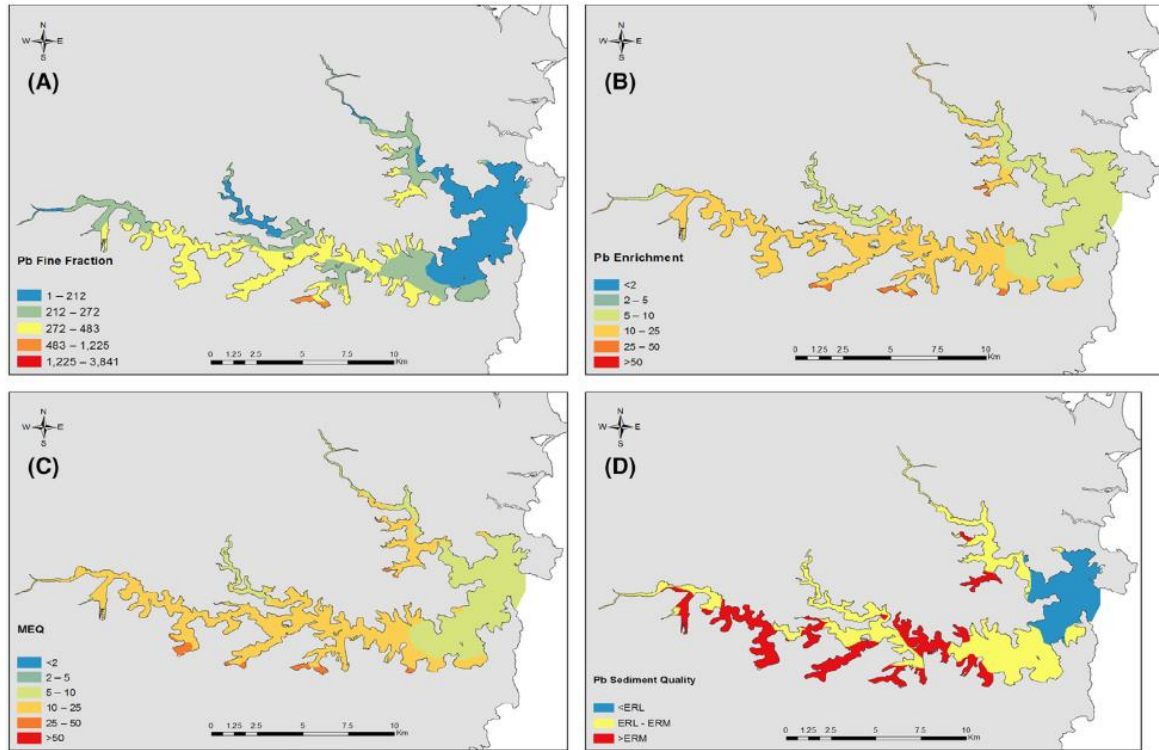
**Project Title:** Human-induced change and biological risk posed by contaminants in estuarine/harbour sediments: Sydney Harbour/estuary (Australia)

**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 from the 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 for most 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 ( $<62.5\mu\text{m}$ ) 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

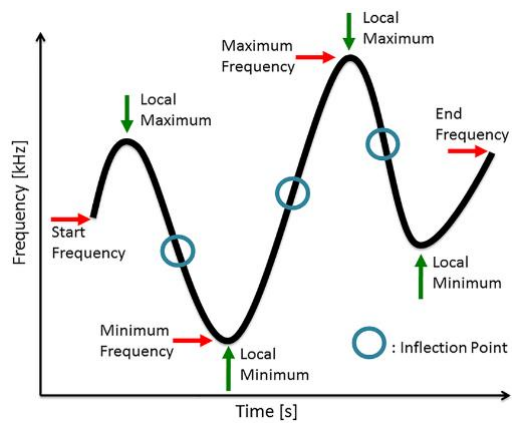
**Department/ Institute:** School of Biological Sciences

**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 Elisa Bone, Ashore Consulting

**Department/ Institute:** Faculty of Science (Education)

**Project Title:** Embedding coastal science in school and community education

**Project Summary:**

My recent research interests lie in connecting communities and schools with innovative marine science and restoration through integrated education programs. I am involved in several projects in New York and Sydney that aim to build relationships between researchers and educators and enhance scientific literacy and the capacity for positive change within urban coastal communities.



The Billion Oyster Project Curriculum and Community Enterprise for Restoration Science (BOP-CCERS), on which I am a senior consultant, is a large-scale collaborative project that extends the reach of the Billion Oyster Project in New York Harbor. The program engages middle-school students and their teachers in efforts to monitor and restore oyster populations within the New York Harbor Estuary, utilising novel field monitoring protocols and digital tools, embedding scientific enquiry in the schools' curricula and showcasing students' findings in annual symposia. Now in its final stages, the BOP-CCERS has enabled over 6000 school students from predominantly low-SES backgrounds to learn about the ecology of New York Harbor and contribute to a growing database of harbor monitoring research.

Here in Sydney, I have been building educational resources and programs with the Georges River EEC and the Sydney Institute of Marine Science (SIMS) and, with researchers from the Field Acquired Information Management Systems (FAIMS) group at Macquarie University, have recently completed development of a prototype mobile app to aid community monitoring of remnant reef-building bivalve populations across Australia. Future work on the app will involve field-testing its utility for mapping remnant bivalve populations and educating local groups in urban shoreline ecology.



Caption: Oysters settling on a Georges River seawall (left) and a device developed to monitor invertebrate communities colonising urban shorelines (right).





**Researcher:** Dr Eleanor Bruce

**Department/ Institute:** School Geosciences – Development & Marine Biology

**Project Title:** Role of coastal ecosystems for enhancing environmental livelihood security in the Pacific

**Project Summary:**

Susceptibility to the realities of climate variability and extremes is already being felt by subsistence and natural resource-dependent coastal communities of the Pacific. Livelihoods are inextricably linked with coastal ecosystem health. This research investigates how environmental conditions and biophysical interactions operating in inter-tidal environments influence coastal ecosystem resilience and local livelihoods. Integrating data on environmental setting, nearshore hydrodynamics, ecosystem status, subsistence usage patterns and land use practices using spatially explicit models and high resolution remote sensing technologies, progress towards sustainable development and environmental livelihood security will be assessed.

In collaboration regional stakeholders this research involves methods for characterising and mapping the environmental settings of mangrove coastal ecosystem services of critical value to resource dependent coastal communities in the Pacific. Outcomes will address an important gap in current understanding of how the resilience of coastal ecosystems will vary geographically and enable policy-makers to spatially prioritise efforts towards climate-smart development.



**Researcher:** Professor Maria Byrne

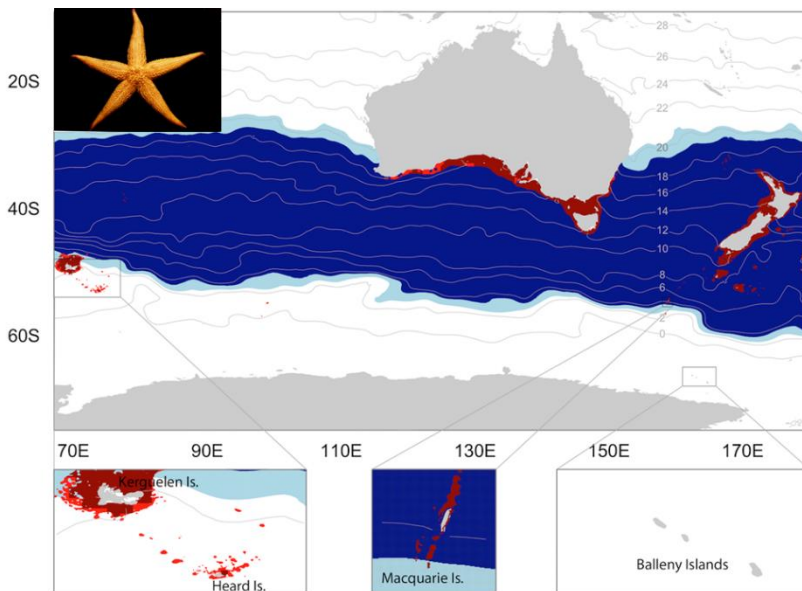
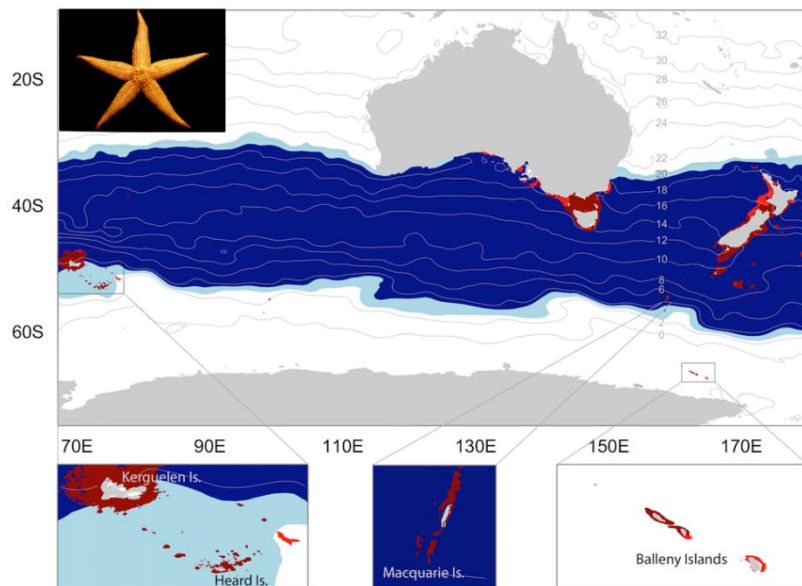
**Department/ Institute:** School of Medical Science – Development & Marine Biology

**Project Title:** From pole to pole: the potential for the Arctic seastar *Asterias amurensis* to invade a warming Southern Ocean

**Project Summary:**

Due to climatic warming, *Asterias amurensis*, a keystone boreal predatory seastar that has established extensive invasive populations in southern Australia, is a potential high-risk invader of the sub-Antarctic and Antarctic. We analysed the bioclimatic envelope of the adult and larval life stages of *A. amurensis* with respect to present day and future climate scenarios using habitat temperature data to construct species distribution models (SDM). The SDM indicated that the thermal 'niche' of the adult stage correlates with a 0-17 °C and 1-22.5 °C range, in winter and summer, respectively. As the ocean warms the range of *A. amurensis* in Australia will contract, while more southern latitudes will have conditions favorable for range expansion. Development to the early larval stage was successful from 5.5-18 °C. The optimal thermal range for survival of pelagic stages was 3.5-19.2 °C with a lower and upper critical limit of 2.6 °C and 20.3 °C, respectively. Our data predict that *A. amurensis* faces demise in its current invasive range in Australia while more favourable conditions at higher latitudes would facilitate invasion of both larval and adult stages to the Southern Ocean. Vigilance is needed to reduce the risk that this ecologically important Arctic carnivore may invade the Southern Ocean and Antarctica.





**Researcher:** Adjunct Professor Doug Cato

**Department/ Institute:** School of Geoscience and Defence Science & Technology Group (DST)

**Title:** From BRAHSS to ocean soundscapes.

**BRAHSS** (Behavioural Response of Australian Humpback whales to Seismic Surveys [www.brahss.org.au](http://www.brahss.org.au)) is a collaboration with Universities of Queensland, Newcastle and Curtin University, DST and Blue Planet (Doug Cato is the Chief Scientist). It is now in the final stage with most papers published and a few more to go. BRAHSS aimed to understand the behavioural response of humpback whales to seismic surveys in a series of rigorous experiments. A summary of the results and their significance to management of human activities at sea will be presented.



**What is next? The ocean soundscape** or ambient sea noise is the composite of all sounds present in an ocean environment. As background noise, it causes substantial variation in sonar performance, so is an important factor in the design and use of sonar. It also causes substantial variation in the ability of marine animals to use sound, e.g. to communicate, to find prey and to attract mates. It can also be an indicator of the health of marine habitats. I will briefly describe where this research is headed.



**Humpback Whales breaching**

**Researcher:** Max de Kantzow

**Department/ Institute:** PhD Candidate, Farm Animal  
Health, Sydney School of Veterinary Science

**Research interests:** Reducing the impact of emerging infectious diseases on aquaculture. The rise in aquaculture to provide food for the growing world population has been hampered by disease outbreaks, often caused by novel pathogens. Identifying and characterising novel disease agents and understanding their relationship with important aquacultured species is an important part of evidence based, effective disease management. Mitigating the effects of emerging diseases is critical to maintaining the efficiency and sustainability of the aquaculture sector.

**Project Title:** Epidemiologic investigation of the influence of environmental conditions on disease caused by Ostreid herpesvirus 1 (OsHV-1)



## **Project Summary:**

Ostreid herpesvirus 1 is an emerging global pathogen that is the cause of a mass mortality of Pacific oysters. The onset of Pacific oyster mortality syndrome (POMS) has changed generated acute uncertainty and is presently changing the nature of oyster farming. This project is focused on understanding the effect of environmental factors on the pathogenesis of OsHV-1. The combination of field epidemiology with laboratory trials, molecular epidemiology and basic virology are being used to form part of a multifaceted approach to understanding OsHV-1 and other emerging pathogens of cultured oysters. The identification of important interactions between the host, the pathogen and the environment is a key step in the development of mitigation strategies. In the aquatic environment these interactions are often complex and difficult to control, this necessitates a combined approach using both laboratory and field based experiments to fully understand the disease process. A critical aspect for disease mitigation will be characterisation of the immune response to OsHV-1 infection, and specifically to identify if an adaptive response contributes to the improved survival of pre-exposed survivors of disease outbreaks. This is critical to inform the prospect developing preventative disease management tools based on controlled pathogen exposure. In the rapidly developing aquaculture sector biosecurity and disease prevention and control are critical to the ongoing success of the industry. Oyster farming is faced with additional novel disease threats and diagnostic techniques using unbiased deep sequencing to identify novel pathogens are a second important avenue of inquiry for supporting this industry.





**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.

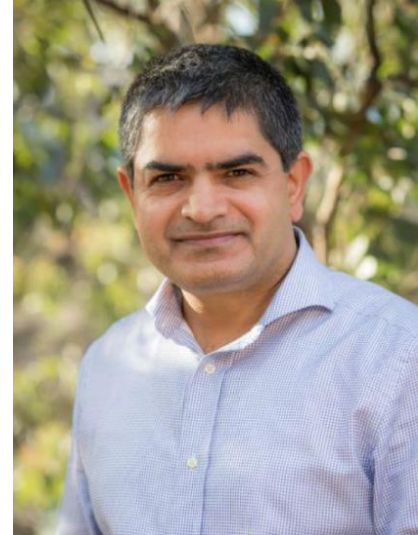
**Project Summary:**

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; respectively

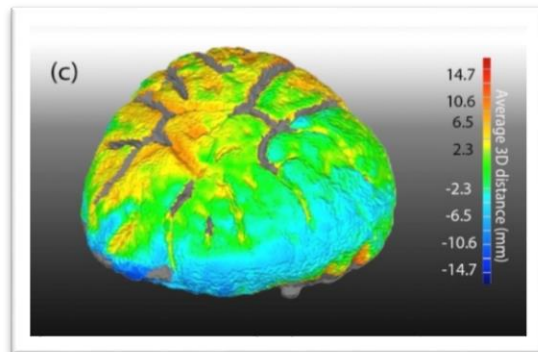
**Researcher:** Associate Professor Will Figueira

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

**Project Title:** 3D Reef

**Project Summary:**

Reef ecosystems are amongst the most productive on the planet but are also subjected to ever increasing impacts from human activities. The 3D Reefs program uses innovative but low cost imaging technology to shed much-needed light on the problems faced by these systems, and also to offer solutions.



Article

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

Will Figueira <sup>1,2,\*</sup>, Renata Ferrari <sup>1,2,†</sup>, Elyse Weatherby <sup>1,2</sup>, Augustine Porter <sup>1,2</sup>, Steven Hawes <sup>1,2</sup> and Maria Byrne <sup>1,2</sup>



4 types of different management ready 3D monitoring tools

**Lead Researcher:** Dr Daniel Harrison

**Department/ Institute:**

Myer Innovation Fellow - Sydney Institute of Marine Science

School of Geoscience – Ocean Technology Group

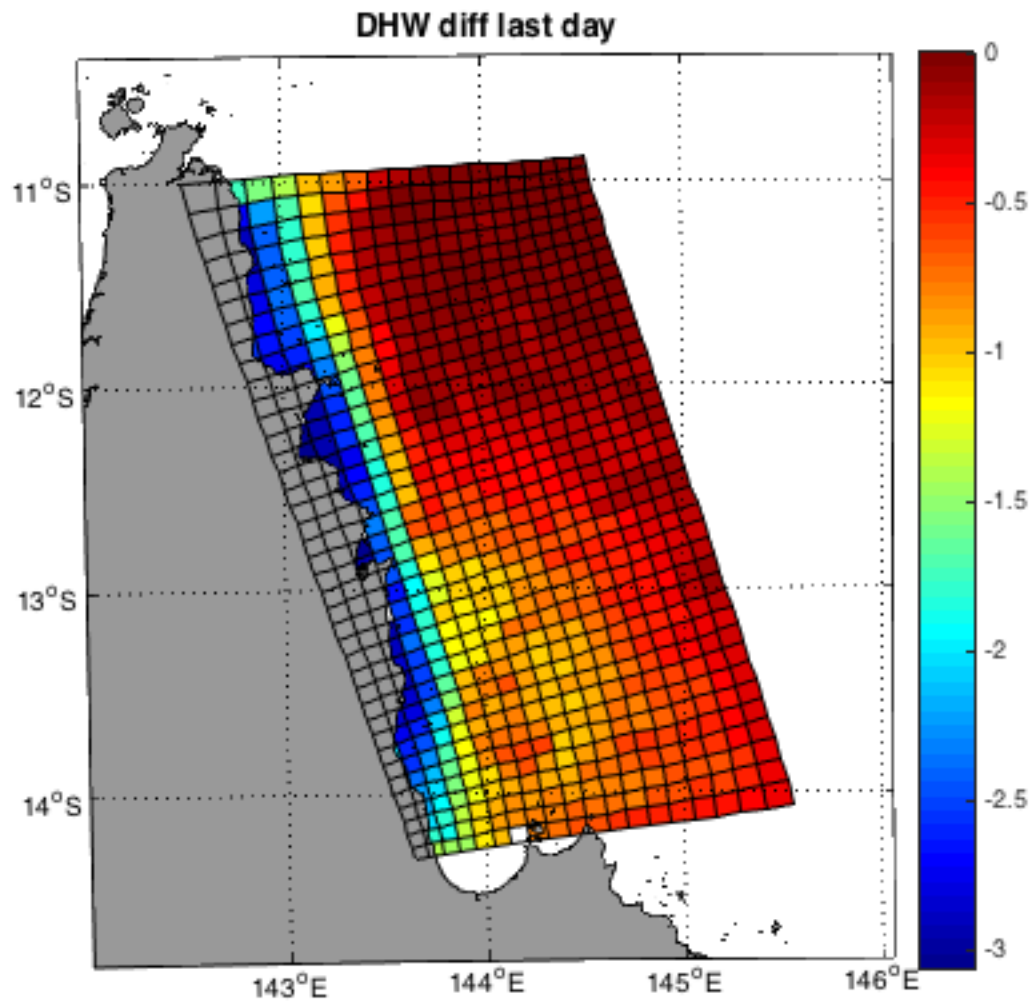
**Project Title:** Saving the Great Barrier Reef - Cloud whitening droplet generator



**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).

**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.



**Current projects you engage with:**

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

Rapid identification of emerging pathogens in marine aquaculture. SSEAC Cluster Research Grant 2017  
FRDC 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.

***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.

**Post graduate research supervision**

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:

Erandi Pathirana is studying changes in 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 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.

Max de Kantzow is evaluating potential disease mitigation strategies based on observations of controlled pre-exposure to *Ostreid herpesvirus 1* leading to resistance to subsequent pathogenic infection. This is developing an interest in the innate immune responses of Pacific oysters to viral infection and its potential for adaptation.

Cahya Fusiando 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 /Dr Samantha Clarke

**Department/ Institute:** School of Geosciences

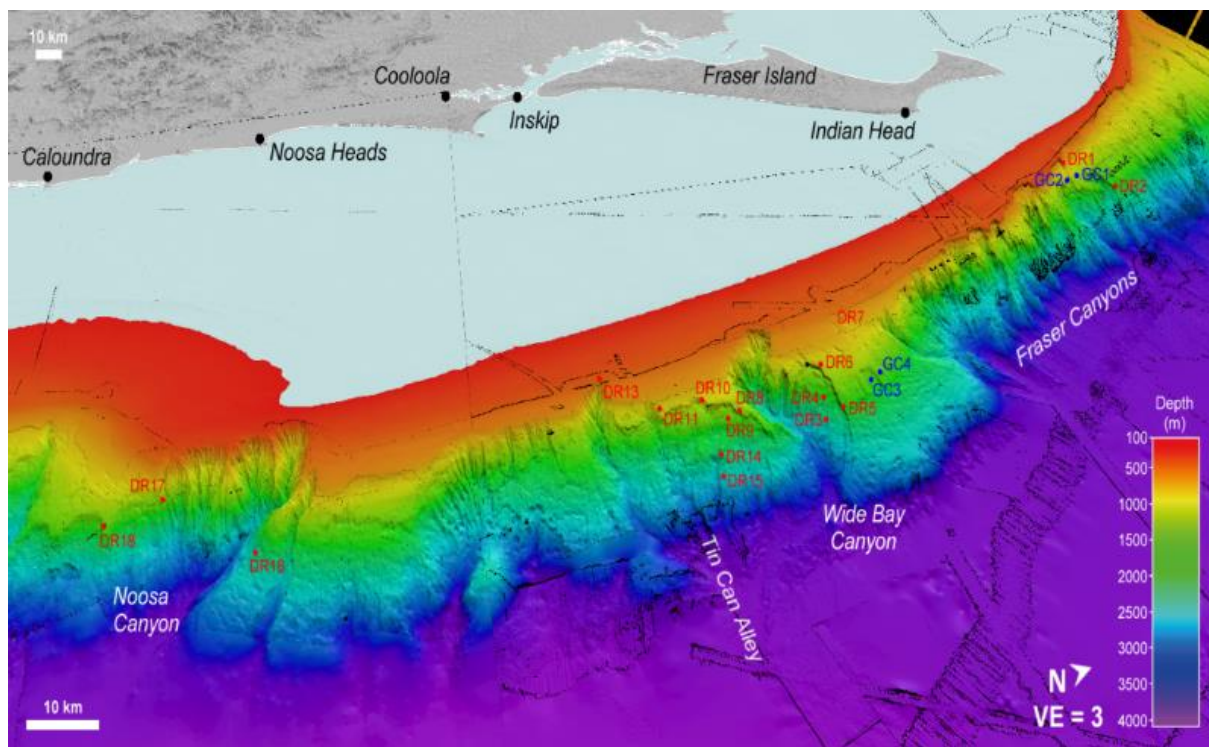
**Project Title:** Can submarine landslides trigger tsunamis?

**Project Summary:** Submarine landslides on the eastern Australian continental margin: sedimentological and geomechanical characteristics, timing and triggers, and tsunamigenic potential

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:** Dr Kate Johnston

**Department/ Institute:** Department of Gender and Cultural Studies

**Project Title:** The Fish Market at the Bottom of the World

**Project Summary:**

As part of the Sustainable Fish Lab (see [www.sustainablefishlab.org](http://www.sustainablefishlab.org)) in 2017 we are focusing on Sydney Fish Market (SFM). SFM is the largest seafood market in the Southern Hemisphere, and the third largest in the world by variety of fish sold. It is a hub where culture, history, tourism, regulation, ecology, and economics determine lively exchanges. It has become an important tourist site attracting 20% of all international visitors to Sydney.



Our research is in part motivated by suggestions that the plans for the redevelopment of the SFM may come into fruition. We want to follow these developments closely, as they raise questions about city planning and housing, the state of Sydney as a coastal city, sustainable and fresh fish, public land and the future of SFM.

We will also examine the past of the SFM and its evolution as a central hub for retail and wholesale relations with fishers and processors. Through ethnographic observation and interviews we will seek to excavate its multiple layers of significance. In the contemporary context where sustaining the oceans is of key concern and impacts the life of fish and livelihoods of fishers, we ask what role does the market play in facilitating sustainability? What models and practices of sustainability are promoted? And what are the necessary cultural conditions for ensuring seafood sustainability? We will explore ways that diverse forces – from urban planning to tourism, fishery regulation to trade, fishing cultures to stock disruptions – impact those who catch, eat and sell fish through the market.



**Researcher:** Professor Ian Jones

**Department/ Institute:** School of Geoscience – Ocean Technology Group

**Project Title:** Cloud whitening droplet generator

**Project Summary:**

The Ocean Technology Group conducts ocean engineering research and recently the group has been looking at ways to save the Great Barrier Reef from bleaching. If the solar radiation could be reduced, the water in the GBR would be cooler. Clouds influence the radiation striking the sea surface and so if we make them more reflective, bleaching could be reduced. We are developing a droplet generator that produces micron diameter salt water drops needed to whiten the clouds.



**Project Title: Increasing the productivity of the ocean**

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. Phytoplankton convert carbon dioxide to organic carbon which eventually sinks to the deep ocean. The process is termed negative carbon emission and will be needed if the world temperature rise is to be kept below 2 degrees in 2050. Phytoplankton growth is limited by the available nitrogen and providing reactive nitrogen increases the rate of export of carbon to the deep ocean.



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)

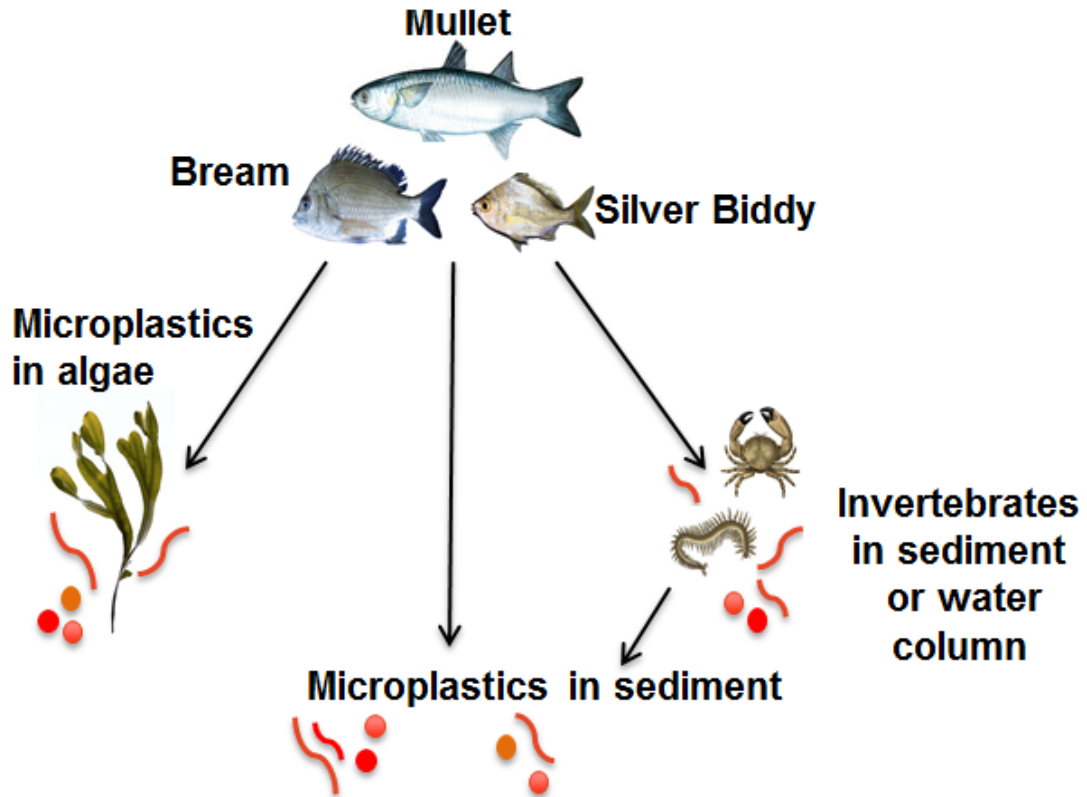
**Project Title:** Vibrational Spectroscopic Analysis of Microplastics and Microfibres in Fish

**Project Summary:**

Microplastics is the major cause of marine toxic pollution worldwide 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<sub>2</sub> 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  $\text{CO}_2$  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  $\text{CO}_2$ -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 19<sup>th</sup> 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 18<sup>th</sup> 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)

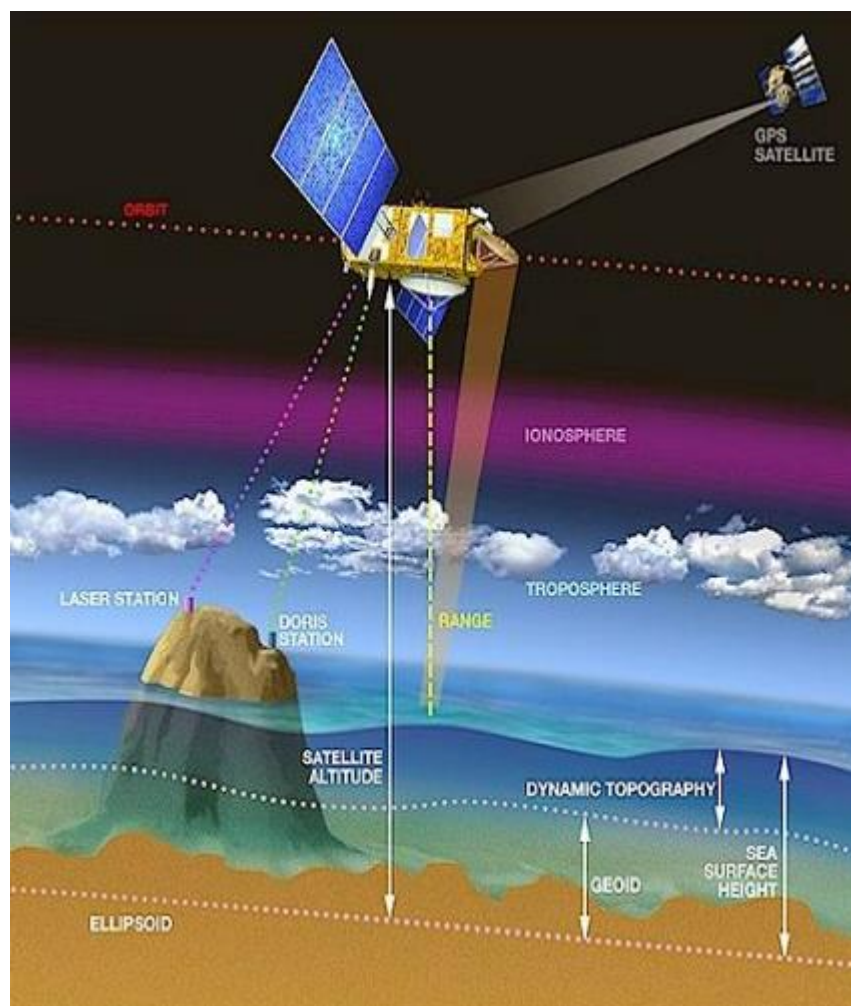
In collaboration with Data 61 and CSIRO

**Seafloor tectonic fabric mapping from satellite altimetry: a key for modelling Earth evolution through deep time**

Marine gravity anomalies derived from satellite radar altimetry now provide an unprecedented resolution for mapping small-scale seafloor and sub-seafloor tectonic fabric. Most of the new information comes from the CryoSat-2 satellite, which has routinely collected altimetry data over ice, land, and ocean since July 2010. To date it has completed more than 6 geodetic mapping cycles of the ocean surface. These data are augmented by a complete 14-month geodetic mapping of the ocean surface by Jason-1 from its lower inclination orbit of  $66^\circ$  that complements the higher inclination orbit CryoSat-2 ( $88^\circ$ ). The most recent global marine gravity anomaly map based on a combination of geodetic mission data reveals the detailed fracture zone fabric of the ocean basins, previously unmapped, now extinct oceanic microplates, and fault networks buried beneath thick sediments along continental margins. By combining satellite altimetry with marine magnetic anomalies and seafloor age dates from rock samples we are able to pinpoint the geometry and age of major plate reorganisations, which punctuate Earth's tectonic history. The combined data have been used to create a mathematical model that describes the tectonic evolution of the Earth. We use this model as a time-dependent boundary condition to model the evolution of the solid Earth to understand how subduction drives the time-dependence of thermo-chemical mantle plumes, which rise from the core-mantle boundary to the surface and produce large volcanic eruptions and volcanic hotspot chains, occasionally leading to major extinctions.







**Researcher:** Jodie Pall

**Department/ Institute:** School of Geosciences

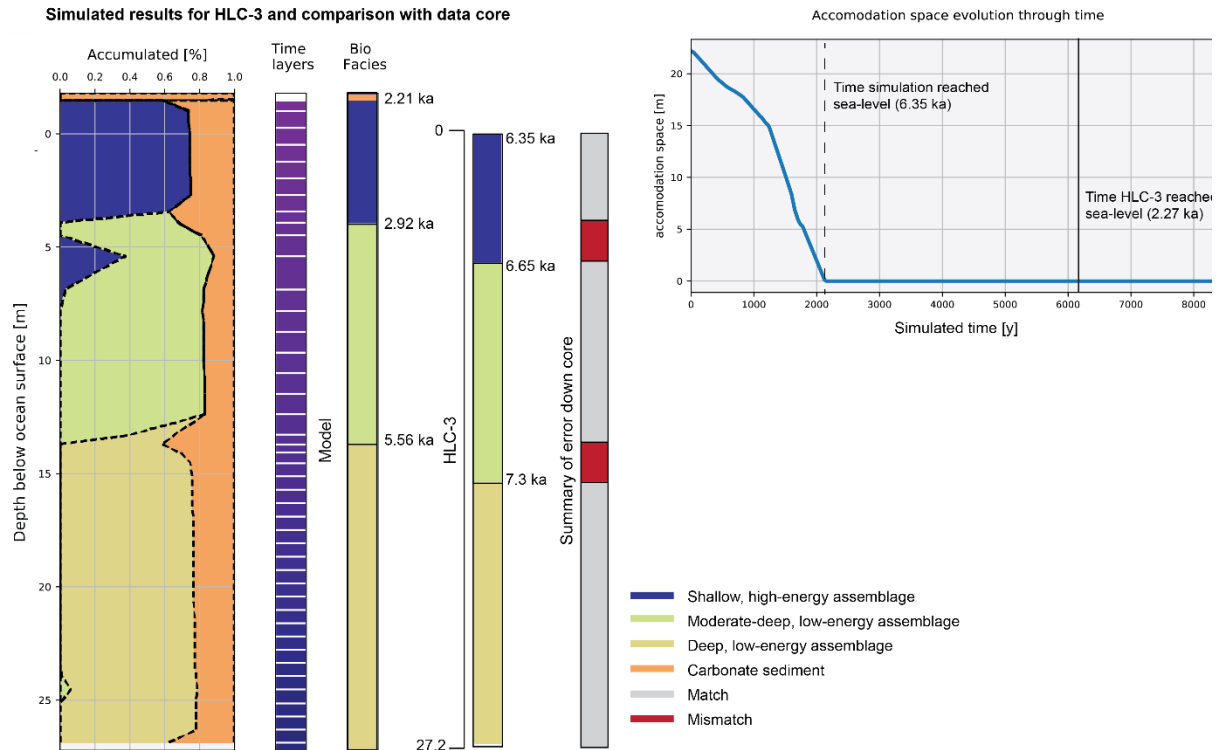
**Project Title:**

Modelling Coral Reef Response to Environmental Change with BayesReef: A Combined Bayesian Inference and Numerical Modelling Approach

**Project Summary:**

The effect of environmental conditions such as accommodation, sediment input and flow velocity on vertical coral growth are well understood on ecological timescales, but are poorly constrained at centennial to millennial time scales. PyReef-Core is a stratigraphic forward model (SFM) designed to solve the inverse problem of unobservable environmental processes controlling vertical reef development by simulating the physical, biological and sedimentological processes that determine vertical assemblage changes in drill cores. PyReef-Core is characterised by many parameters (multi-dimensionality) and having non-unique (multi-modal) solutions where numerous combinations of interacting parameters produce identical sequences. A Bayesian inference scheme has been linked with a carbonate forward stratigraphic model (SFM) pyReef-Core in software called BayesReef. Bayesian inference provides a methodology for estimation of near-optimal values and uncertainty quantification of free parameters in models. In this investigation, Bayesian inference is implemented using a Markov Chain Monte Carlo sampling method with pseudo-likelihoods (MCMC<sub>PL</sub>) to calibrate pyReef-Core simulations to drill core data, estimate near optimal values of parameters and quantify uncertainty in pyReef-Core models and parameters. The MCMC approach was able to find one of many potential solutions to the inverse modelling problem. For simple scenarios, BayesReef was able to produce accurate model estimates, but was less able with more complex, high-dimensional models. Overall, BayesReef best serves as a heuristic tool for guiding scientific inquiry to better understand the factors that control reef development.





Summary of model output (left) and comparison with the BayesReef model prediction for a core drilled on the protected side of Heron Island Reef in the southern Great Barrier Reef. The error in prediction is measured by the summary of error log. The graph of accommodation space through time (right) highlights the timing that the reef core reached sea level measured from the real data and predicted from the model data.

**Researcher:** Prof Elspeth Probyn

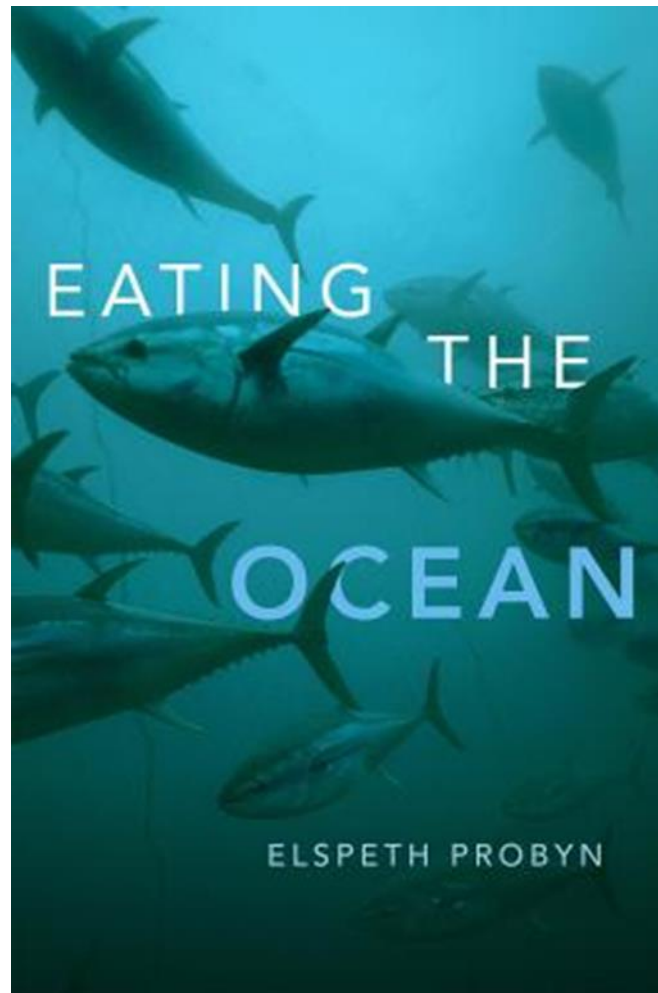
**Department/ Institute:** Department of Gender and Cultural Studies

**Project Title:** Eating the Ocean: communicating complexity

As marine scientists know, the “simplification of the sea” refers to the trophic cascading brought on by overfishing apex predators, and other human wrought disasters. In my recent book, I analyse the cultural responses that I argue are simplifying the seas. Examples of these include: NGO campaigns that try to make us care about Bluefin tuna by portraying them with panda masks – “would you care more if I were a panda” –, the plethora of parochial (e.g., northern hemisphere-centric) seafood consumer guides that rely on a spotlight system to convey choices, to the spate of well-intentioned documentaries that frame complex issues in terms of one villain, most often the fishing industry.

I want to address and question how social and marine scientists working together can conceive of how to communicate the complexities of the oceans more effectively.





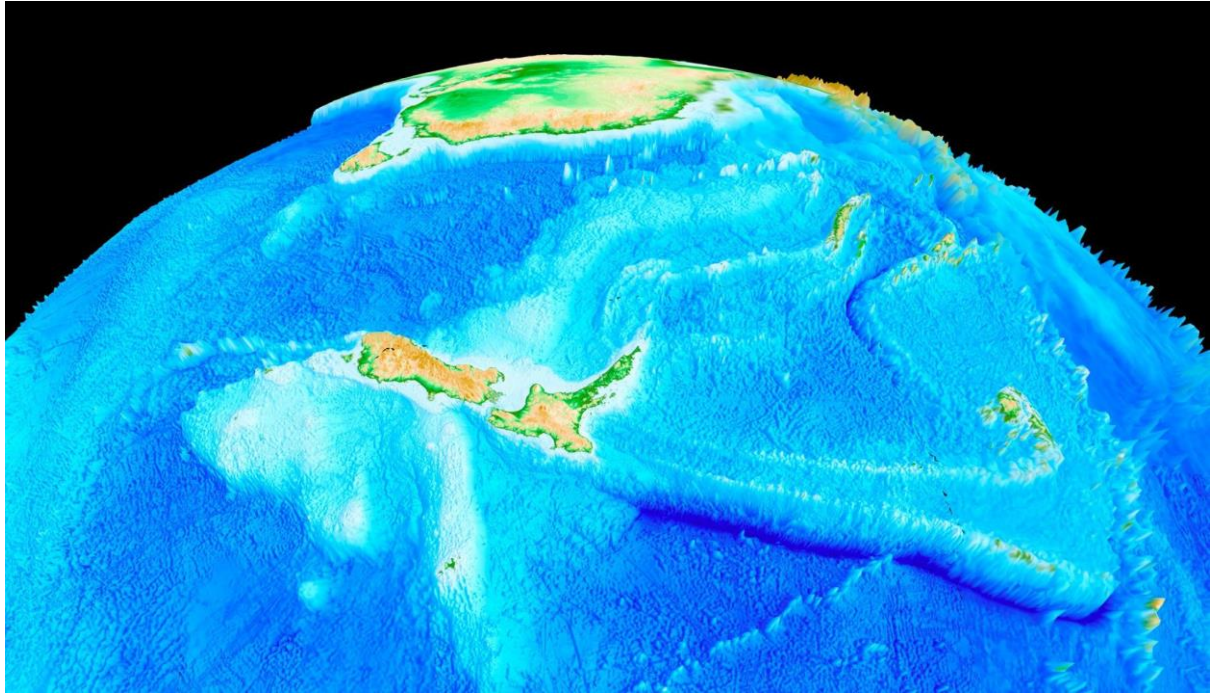
**Researcher:** Dr Maria Seton

**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:** Dr Yehuda Shalem

**Department/ Institute:** School of Geosciences –Marine Studies  
Institute

**Project Title:** Contribution of Submarine Groundwater Discharge  
on the Coastal Water

**Project Summary:**

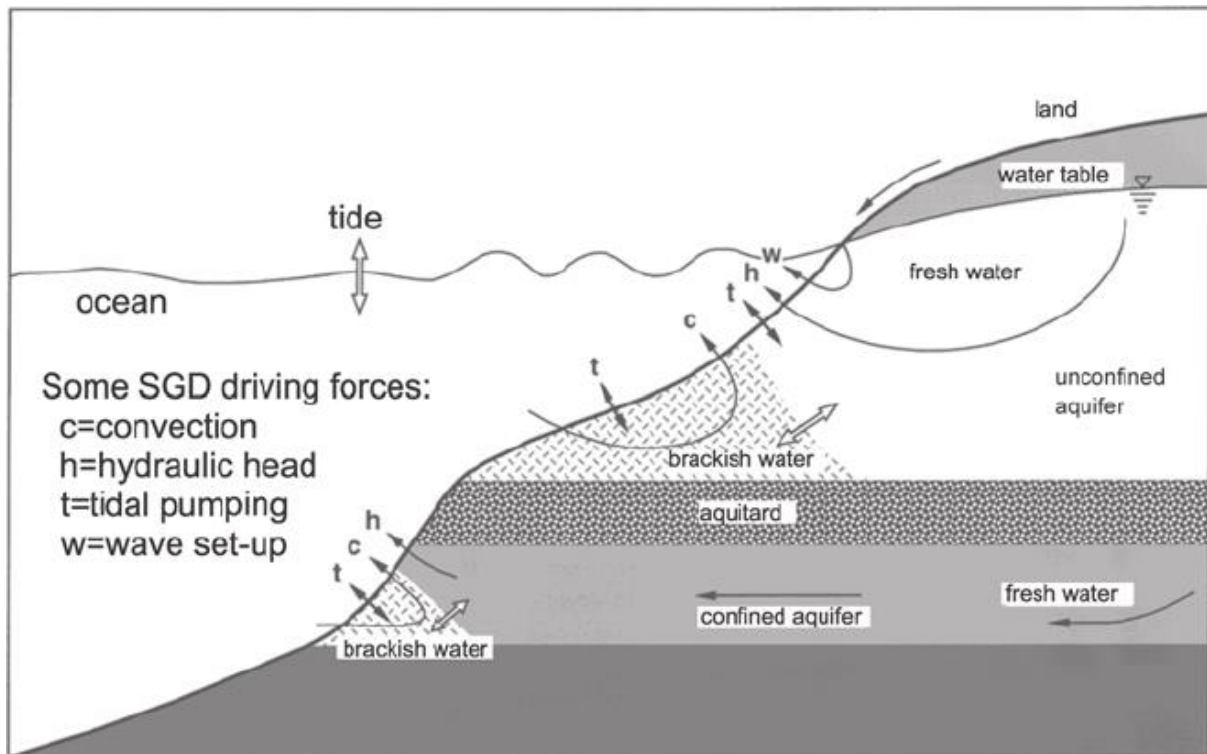
The interaction of surface water and groundwater is of major concern due to its effects on water quality and water budgets, and its accurate assessment has become increasingly important. Surface water-groundwater interactions occur both at the coastal arena and along river and estuaries, and includes the processes of seawater intrusion and submarine groundwater discharge.



Submarine groundwater discharge (SGD) is now commonly recognized as a major conveyor of dissolved matter, nutrient and contamination between land and the sea. Main driving forces include the hydraulic gradient of the coastal aquifer, as well as tidal forcing, wave setup and seasonal oscillation. Several papers have established the important role of the recirculated seawater in the transport of solutes from aquifers to the coastal water. Moore (1996) established the term “subterranean estuary” (hereafter, STE) for the aquifer zone, where recirculating seawater mixes with fresh groundwater, and where water-rock interaction affects the mobility of constituents, including nutrients, toward the sea.

These discharges typically display significant spatial and temporal variability making assessments difficult. Groundwater seepage is patchy, diffuse, temporally variable, and may involve multiple aquifers.





Processes associated with submarine groundwater discharge. Arrows indicate fluid movement (modified from Thibodeaux and Boyle 1987)

**Researcher:** Professor Tim Stephens

**Department/ Institute:** Sydney Law School – International Law

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.



**Project Title:** Antarctic and Southern Ocean Governance in the Anthropocene

**Project Summary:**

Despite Antarctica's isolation, the Anthropocene's signature is inscribed deeply there, from the ozone hole etched in the southern sky to the cleaving of the ice shelves into the Southern Ocean. The Antarctic Treaty sought to quarantine Antarctica from the nuclear technologies that heralded the advent of the Anthropocene, and the Antarctic Treaty System (ATS) is imbued with a romantic environmental ideal of Antarctica as a pristine wilderness that needs only to be left alone to be protected. But in the Anthropocene it is the global forces let loose by human hands that are transforming Antarctica and the Southern Ocean, rather than any activities there. What does this mean for our legal imaginings of Antarctica and the Southern Ocean? What might an ATS that fully understands and effectively responds to the challenges of the Anthropocene look like?



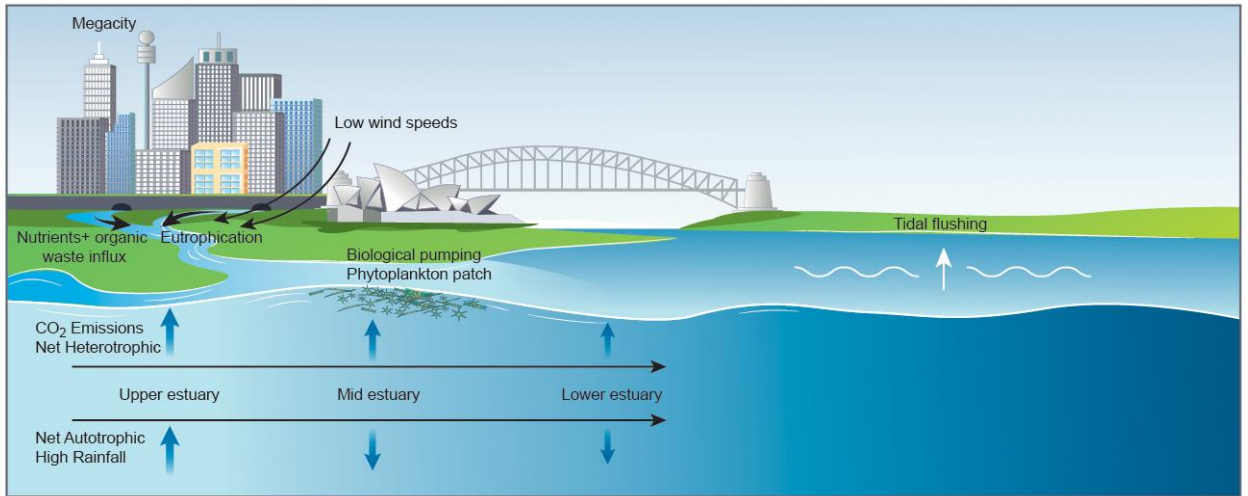
**Researcher:** Dr Edwina Tanner

**Department/ Institute:** School of Geosciences / Marine Studies Institute (MSI)

### **Carbon Budget for the Sydney Harbour Estuary**

Estuaries are dynamic systems that connect inland waterways to the coast filtering and modulating the movement of terrestrial carbon and nutrients exported to the coastal marine environment. They play a major role in the global carbon cycle including the transport, removal and long-term storage of carbon along the land-ocean continuum. Estuarine carbon budgets are critical in determining the flow of energy and material within and between ecosystems due to the substantial amount of terrestrial carbon that is transported and biogeochemically-transformed laterally through the ecosystem to the oceans and emitted to the atmosphere. Estimates show that estuaries currently export around one Petagram ( $10^{15}$  g) of carbon per year to the coastal ocean with significant exchange of greenhouse gases through the air-water interface. The carbon budget for the Sydney Harbour Estuary shows that the estuary is slightly net heterotrophic on an annual basis consistent with the expression of relatively low, for an estuary of its' size, net emissions of around 930 tonnes  $\text{CO}_2$  per annum from the water surface to the atmosphere. The inorganic carbon cycle within the estuary resulted in a surplus production and export of dissolved inorganic carbon as a result of the net ecosystem metabolism (NEM). The inorganic carbon cycle required the net import of organic carbon from the oceanic boundary into the estuary to balance the budget. This study of the Sydney Harbour Estuary has confirmed for the first time that this urban waterway is a net heterotrophic ecosystem exporting inorganic carbon to the coastal zone.





Carbon dioxide emissions of the Sydney Harbour Estuary



**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.

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<sub>2</sub> and increasing water temperatures.



**Researcher:** Amanda Thran

**Department/ Institute:** EarthByte Group - School of Geosciences

**Project Title:**

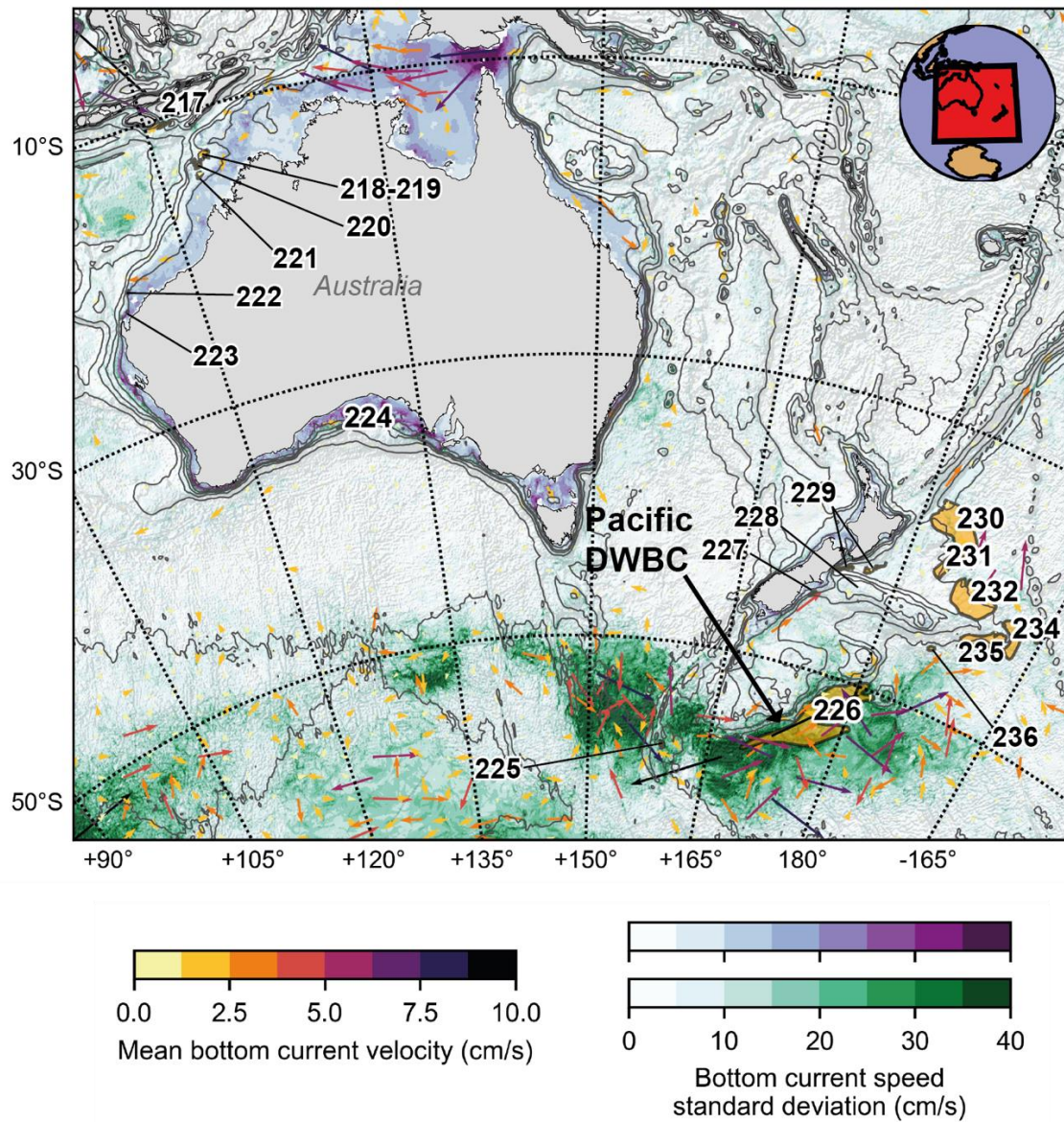
Controls on the global distribution of contourite drifts:  
insights from an eddy-resolving ocean model

**Project Summary:**

Contourite drifts are important seafloor features that host a rich record of paleoceanographic/paleoclimatic change. Though they are thought to be formed by powerful bottom currents, the link between vigorous bottom water activity and drift occurrence has yet to be demonstrated on a global scale. Using a high-resolution ocean model and newly-updated contourite coverage, we show that the global distribution of modern contourite drifts is heavily mediated by the configuration of the world's most powerful bottom currents. We find that currents fluctuate more frequently and intensely over areas with drifts, highlighting the role of intermittent, high-energy bottom current events (i.e. benthic storms) in causing sediment erosion, transport, and subsequent drift accumulation. Such fluctuations in bottom current intensity are principally mediated by instabilities that arise from fluid-obstacle interactions as well as the activity of transient eddies. Our work supports previous hypotheses which suggest that contourite deposition predominantly occurs under repeated acute events as opposed to continuous accumulation under average-intensity background flow conditions. This carries implications for how paleoflow conditions should be interpreted in the deep-sea record.







**Figure 1.** Contourite distribution throughout Oceania, overlaid on model-computed bottom current speed standard deviation. Also shown are quivers (arrows), which represent the overall mean direction and magnitude of bottom current flow.

**Researcher:** Associate Professor Ana Vila-Concejo

**Department/ Institute:** School of Geoscience – Geocoastal Research Group

**Project Title:** Morphodynamics of tropical and temperate coasts.

**Project Summary:**

My research is about how water moves sand. I do that in a variety of temporal and spatial scales and in different places of the world. I am part of the Geocoastal Research Group, I carry out my research in collaboration with graduate students and researchers from this and other institutions/research groups. My research feeds into climate change and sea-level change studies, liaising directly with numerical models to study the past and forecast the future of the world's coasts.



*Morphodynamics of coral reefs.* I look at the processes that dissipate wave energy in the fore reef and how those waves shape coral reefs by transporting sand into the back reef environments. My research includes from the instantaneous scale of wave dissipation and sediment transport, to the Holocene scale in which the overall physical processes shape the infilling of coral reef lagoons.

*Morphodynamics of temperate beaches.* My research focuses on embayed beaches, which are the prevailing beaches in Sydney and NSW. The effects that headlines have on the daily, seasonal, and decadal evolution of embayed beaches are important and we are trying to understand them. An important percentage of embayed beaches are located inside estuaries, and estuaries concentrate large proportions of population. My research on the morphodynamics of estuarine beaches focuses on understanding the links between estuarine beaches and estuarine processes such as flood-tide delta evolution. Moreover, while we (mostly) understand the processes that lead to beach erosion, we need to undertake more research on the processes driving beach recovery in estuarine beaches.

*Sediment restoration in estuaries.* I am part of a team of scientists, including ecologists, that are looking at the effects that ecologic restoration have in restoring the sediments in estuarine environments. We plan to understand how hydrodynamics and sedimentary flows change when oyster reefs are restored and the subsequent changes in sedimentary contamination.



Vibrocoring at One Tree Reef in November 2016.

**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 animals 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.





**Researcher:** Associate Professor Jody Webster

**Department/ Institute:** School of Geosciences-  
Geocoastal Research Group

**Research interests:**

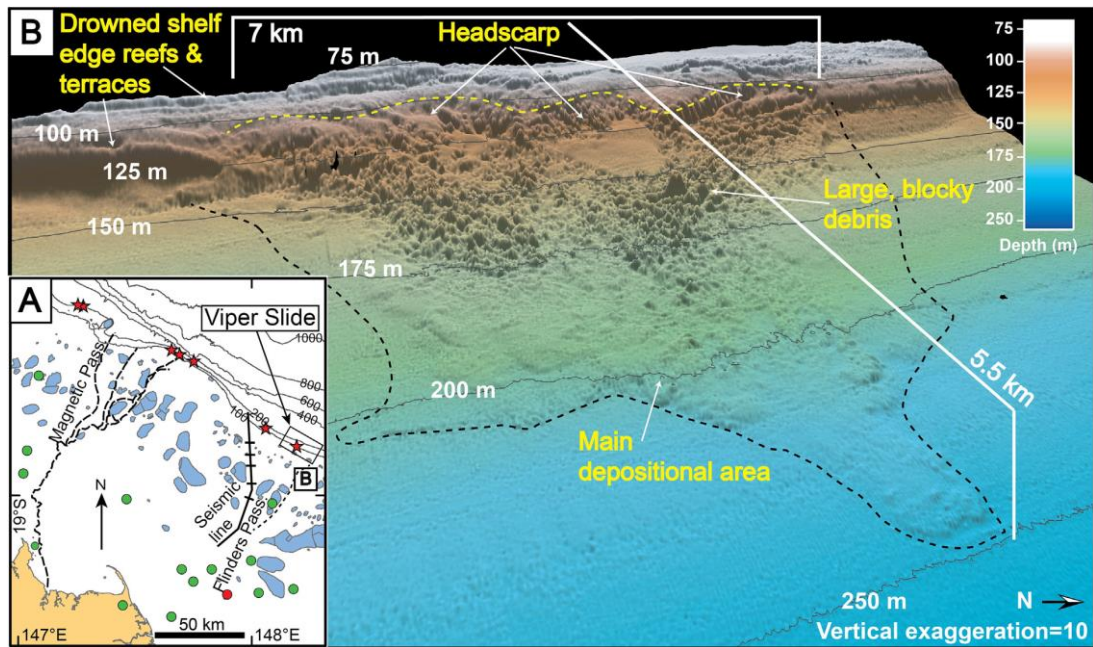
Jody Webster's research in sedimentology and stratigraphy focuses on carbonate sedimentology, climate change, and tectonics and it tends to take him to all the beautiful places in the world (e.g. the Great Barrier Reef, Tahiti, Hawaii, Papua New Guinea, Seychelles, and Brazil).

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

**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.



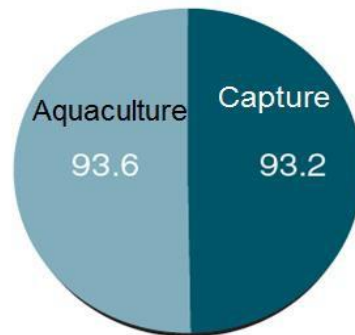
Current Projects include infectious disease control in the edible oyster industry, biosecurity of imported marine and freshwater ornamental fish, reducing risks to native fish populations, investigating environmental parameters involved in transmission of viral and parasitic diseases in coastal aquaculture, 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

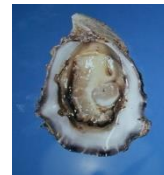
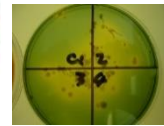
**50% of all production  
is lost through disease**

Sources: FishStat and IMPACT model projections.

**2030 (Projection)**



Total harvest  
186.3 million tons



**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:

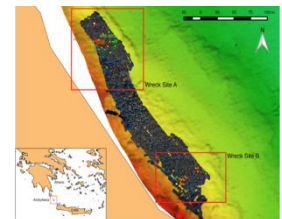
The ACRF is a centre that focuses on projects that involve navigation and mapping, clustering and classification, novel sensing, survey designs and platform design.

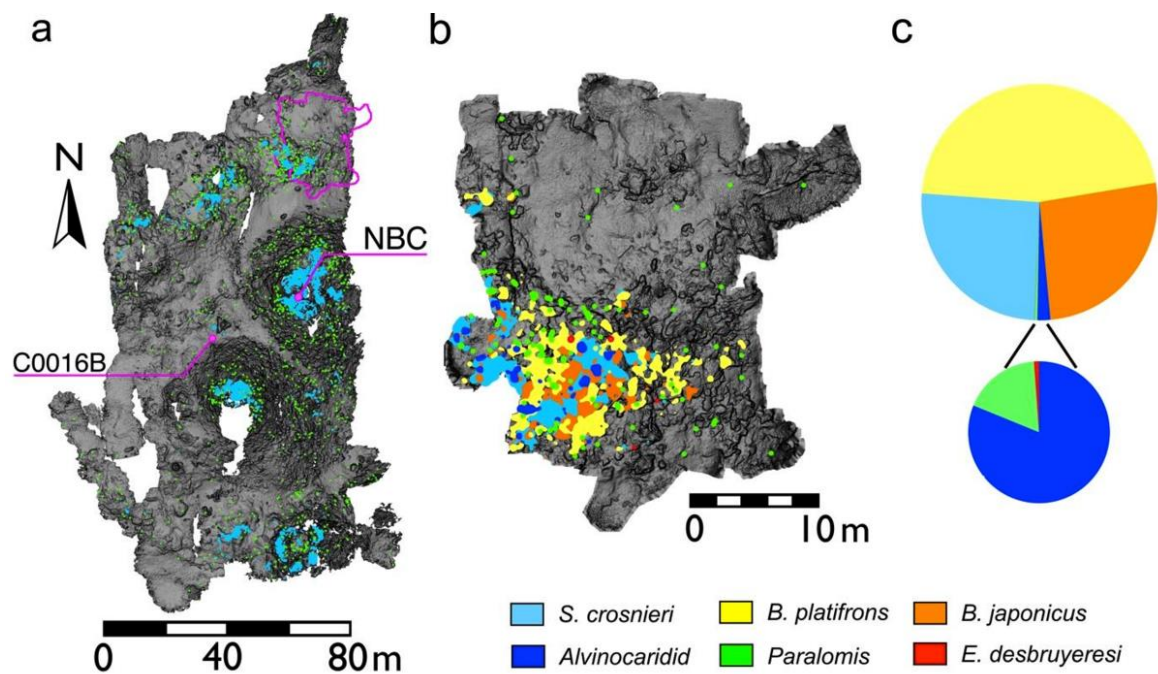
Research opportunities include underwater image colour correction, plenoptic imaging, automated image analysis and autonomous repeatable surveying. They also manage large geospatial image archives online.

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





Sydney Institute of Marine Science Chowder Bay