

# MSI Annual Report/ Summary 2017





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## Executive Summary

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The Marine Studies Institute of University of Sydney (MSI) is the public face of marine science at the University of Sydney. It is the place where prospective and current students and community members can go to find out about courses, events, and fascinating scientific exploits and breakthroughs. MSI gathers the people and stories that explain what the University of Sydney does in many marine related issues, and encourages others to join us in our work.

The multidisciplinary nature of marine science and the interconnectedness of marine processes and systems lends itself to collaboration. Helping to foster collaboration, MSI has expanded its network within the university, which now spans four faculties and includes 14 research groups.

In 2016-2017, the approximately 30 MSI affiliated staff published over 300 articles in international journals, produced reports for industry and government agencies and contributed to national and international reviews and enquiries.

MSI continued to strengthen the university's engagement with external partners, including Macquarie University, UNSW Sydney and the University of Technology Sydney through the Sydney Institute of Marine Science (SIMS). The Master of Marine Science and Management, jointly offered by the SIMS partners, continues to expand, attracting high quality passionate students.

In recent years, marine science teaching at the University of Sydney has seen a major overhaul. Units of study have been streamlined to remove duplication and maximize quality by drawing on the research and expertise of staff. In 2017, there were approximately 700 marine science undergraduate students and 240 postgraduate students. Graduate projects covered a diverse range of topics, from predicting global sediment drift distribution using a high-resolution general ocean circulation model, to Modelling Coral Reef Response to Environmental Change with BayesReef: A Combined Bayesian Inference and Numerical Modelling Approach. MSI through its Research Showcase, symposia and other events, continues to build an environment that ensures excellence in teaching that reflects our research strengths.

In 2017 MSI enhanced its communication, with an improved web presence, which included accessible information on marine science units of study and courses offered, an active Facebook page (with over 1200 followers) Twitter and LinkedIn, and advertised outreach projects.

Highlights of the year include prizes and breakthroughs. Dr Daniel Harrison won the Myer Innovation Fellowship for 2017 based on his submission with respect to 'Temporary Cloud Intensification – A method to save the Great Barrier Reef for future generations'. He will be working with CSIRO and



eReefs biogeochemical model of the Great Barrier Reef to investigate coral bleaching. Dr Maria Seton, together with other researchers, for the first time clearly defined Zealandia as a continent. 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.

MSI focus in 2018 will be on continuing to support the University of Sydney in training the marine scientists of the future and encouraging marine science research that improves the lives of people and the health of the planet.

Professor Elaine Baker

Director of MSI

Professor Tim Stephens

Deputy Director of MSI



## Introduction

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In 2017, the Australian Government estimated the “blue” economy to be worth \$74.2 billion. With increases in offshore oil and gas production, marine tourism, maritime trade, shipbuilding, aquaculture and biotechnology, this figure is projected to grow to \$100 billion by 2025. However complex environmental problems continue, including for example, mass bleaching of the Great Barrier Reef, documented increases in the volume of marine debris and its impact on marine organisms and over fishing. New challenges such as range shifts in organisms like toxic northern jellyfish, and increases in pollutants of concern such as per- and polyfluorinated alkylated substances and fire retardants. MSI supports the university’s researchers to search for solutions to these and many other emerging problems.

## MSI Mission

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- To promote the strength and depth of experience in research and teaching across the wide range of marine science disciplines at the University of Sydney.
- To foster collaboration, across the University, between research units and schools engaged in marine studies.

## About MSI

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**MSI has been the face of Marine Science at the University of Sydney since 2002, promoting marine science, coordinating teaching and fostering interdisciplinary research. MSI brings together the University’s marine science capabilities, which cover a diverse range of teaching and research fields.**

In early 2016, the University of Sydney Institute of Marine Sciences (USIMS) was renamed the Marine Studies Institute (MSI), to recognise the inclusion of a broader range of disciplines, including law, gender studies, education and history. 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.

Students can pursue individual units within various degree programmes or a specialized programme in marine biology or marine geology. Undergraduate degrees majoring in Marine Science include the

Bachelor of Science, Bachelor of Science (Advanced Science), Bachelor of Environmental Science, Bachelor of Environmental Science (Advanced Science) and several combined degree programs. Students have the opportunity to undertake studies at the tropical One Tree Island Research Station, Crommelin Biological Field Research Station at Pearl Beach and the temperate research station at Chowder Bay on Sydney Harbour. There are also ranges of postgraduate programs in marine science, including the cross-institutional SIMS Master of Marine Science and Management.

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 240 postgraduate students. The marine network within the university includes:

- The Australian Centre for Climate and Environmental Law (ACCEL)
- The Australian Centre for Field Robotics (ACFR)
- 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 Environment Institute (SEI)
- The Sydney Law School
- The Sydney Centre in Geomechanics and Mining Materials (SciGEM)
- The Vibrational Spectroscopy Core Facility

## Teaching

MSI markets and coordinates the undergraduate and postgraduate degrees in marine science at the university, providing an administrative point of contact for prospective and current students. MSI aims to enhance the student experience by promoting relevant seminars across the faculties,





bringing together the universities undergraduate and postgraduate students in interdisciplinary learning. MSI also organizes many extracurricular marine related events and activities.

## Undergraduate

Marine Science Related Units (Undergraduate)	No. Enrolled			
	2014	2015	2016	2017
BIOL2024 Ecology and Conservation	176	171	129	146
BIOL2924 Ecology and Conservation (Advanced)	16	5	9	5
GEOS2115 Oceans, Coasts and Climate Change	119	87	67	103
GEOS2915 Oceans, Coasts and Climate Change (Adv)	3	6	7	6
BIOL3007 Ecology	91	100	94	81
BIOL3907 Ecology (Advanced)	18	11	14	10
BIOL3013 Marine Biology	85	91	78	83
BIOL3913 Marine Biology (Advanced)	10	9	10	10
BIOL3016 Coral Reef Biology	24	0	24	0
BIOL3916 Coral Reef Biology (Advanced)	6	0	9	0
BIOL3045 Animal Ecological Physiology	64	78	81	56
BIOL3945 Animal Ecological Physiology (Advanced)	12	13	10	6
BIOL3046 Animal Behaviour	83	68	82	67
BIOL3946 Animal Behaviour (Advanced)	15	16	13	9
GEOS3009 Coastal Environments and Processes	46	48	43	25
GEOS3909 Coastal Environments and Processes (Adv)	2	3	3	3
GEOS3014 GIS in Coastal Management	58	63	42	39
GEOS3914 GIS in Coastal Management (Advanced)	5	0	4	3
GEOS3103 Environmental and Sedimentary Geology	39	47	24	12
GEOS3803 Environmental & Sedimentary Geology(Adv)	1	3	3	4
GEOS3104 Geophysical Methods	11	3	3	4
GEOS3804 Geophysical Methods (Advanced)	1	4	5	3
<b>Total</b>	<b>885</b>	<b>826</b>	<b>754</b>	<b>675</b>

## Postgraduate

In 2017 there were more than 240 postgraduate students engaged in marine science related research across the Schools of Geoscience, Biology, Veterinary Science and Engineering and the Faculty of Law. Apart from higher degree research PhD and Masters Programs, students can also undertake the course work Master of Marine Science, Graduate Diploma in Marine Science and Management, and Graduate Certificate in Marine Science and Management.

### Units of Study

	2014	2015	2016	2017
ENVI5501 Environmental Research Project	3	3	0	0
MARS 5001 Coastal Processes and Systems	30	8	14	16
MARS 5005 Coastal Management Project	1	1	0	0
MARS 5007 Coral Reefs and Climate Change	11	7	11	11
MARS5009 Topics in Australian Marine Science	16	6	8	13
MARS5006 Coral Reefs, Science and Management	15	10	8	11
GEOG 5004 Environmental Mapping and Monitoring	27	13	13	19
RESP5001 Integrated Research Practice	30	16	18	32
LAWS6061 International Environmental Law	24	17	26	51
LAWS6047 Law of the Sea	24	19	30	50
LAWS6314 Coastal and Marine Law	11	0	15	0
CIVL5670 Reservoir, Stream and Coastal Engineering	25	27	24	38
<b>Total</b>	<b>217</b>	<b>127</b>	<b>167</b>	<b>241</b>

## Master of Marine Science and Management

MSI is a partner in the Sydney Institute of Marine Science (SIMS). SIMS headquarters is at Chowder Bay, near Taronga Zoo on the North Shore of Sydney Harbour. The Master of Marine Science and Management is a collaborative effort by the Sydney Institute of Marine Science, the University of Sydney, the University of Technology Sydney, Macquarie University and the University of New South Wales.

The program covers a wide diversity of disciplines including climate change science and mitigation, marine biology, coastal management and engineering, oceanography, marine ecology and geosciences. It allows students to customize the degree to suit their personal interest and goals. Within the course emphasis is placed on new approaches to marine science and management, such as geographic information systems, remote sensing data analyses and habitat mapping. The capstone unit Topics in Australian Marine Science, utilises the marine data provided by the national facility IMOS (Integrated Marine Observing System), which has deployed a range of instruments to measure coastal and ocean variables.

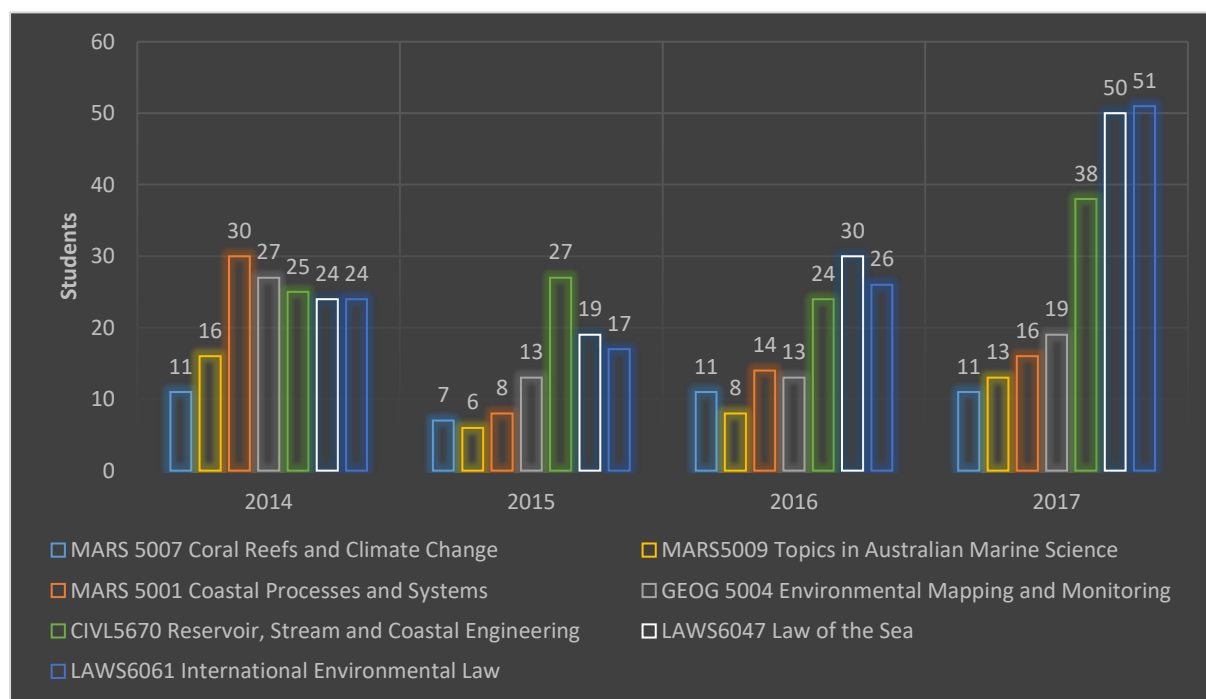


Figure 1. Master of Marine Science and Management degree; co-taught by Geosciences. This new degree, delivered through SIMS, is experiencing excellent growth in the Geo-marine offering, as we are the recognised provider.

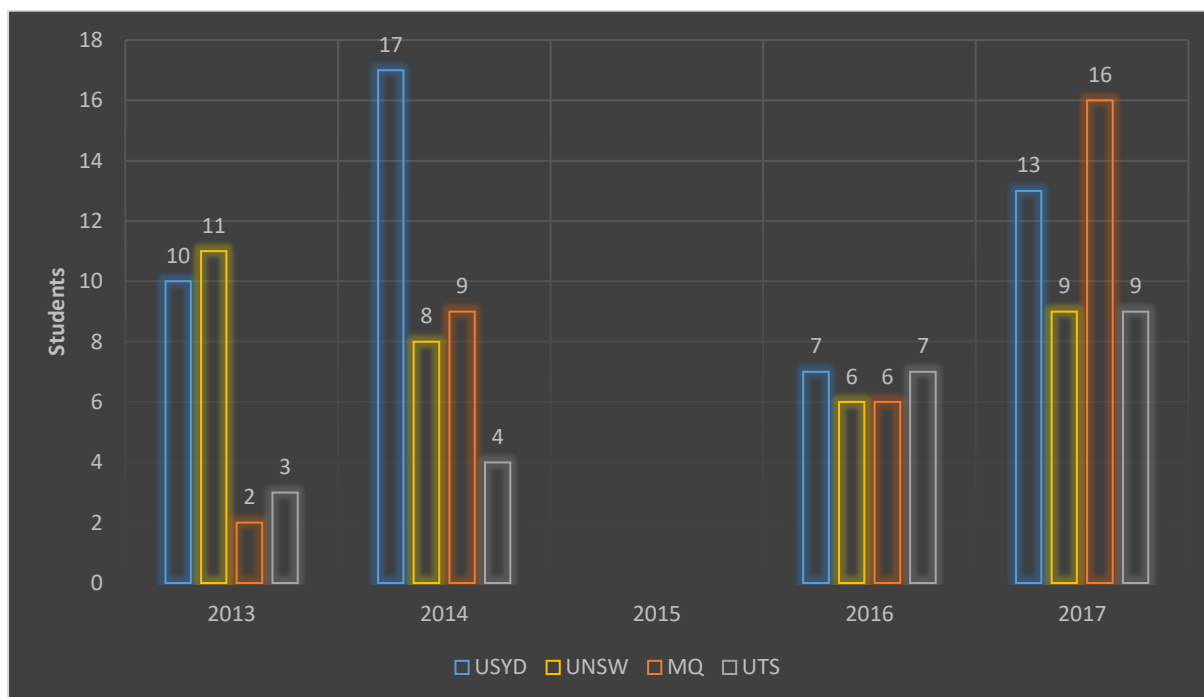


Figure 2. Master of Marine Science and Management enrolments 2013-17

## One Tree Island

One Tree Island Research Station (OTIRS) is a facility of the University of Sydney. Dr Ana Vila Concejo is the current Director and Prof Maria Byrne is Deputy Director of OTIRS. The field station has been managed by the University of Sydney since 1974 with the bibliography reaching over 300 titles.

The One Tree Island Research station provides a unique opportunity for long-term field studies in a site known to be free of other human disturbances. The island lies in the centre of the Capricorn Group of the southern Great Barrier Reef and is famous in scientific circles for the long-term studies that have been done there over the past 50 years.

One Tree Island Research Station had a busy year including the privilege of supporting a monumental project surrounding the 2017 coral-spawning event. Inspired by Professor Peter Harrison from Southern Cross University, in collaboration with a team of talented and passionate scientists from the Queensland Parks and Wild Life Service and the GBRMPA the project used custom made enclosures to concentrate coral larvae settlement to recolonize and rehabilitate degraded reef systems.

During 2017 works at One Tree Island Research Station were undertaken to replace the roof on the Teaching Lab and the installation of two new water tanks at the rear of the accommodation building to increase the water storage capacity.



Figure 3. One tree Island Research Station

## Research

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Every year MSI organises a research showcase to highlight the current marine research being undertaken at the university and to foster collaboration across the faculties. This year's showcase was run in conjunction with the highly sought after joint SIMS-MSI Work Experience Program. The event was a big success with 20 speakers providing 3 minute research bites with the gathering providing researchers from different faculties the opportunity to learn and present their marine science projects throughout the university. This provided a chance to encourage communication, comments and feedback between faculties and research groups. Due to its success, there is a plan to invite other universities next year to attract additional collaborations and students.

The product of the MSI Research Showcase 2017 is a useful booklet that compiles an overview of recent innovative marine research projects disseminated throughout the university in the one place.



# MSI RESEARCH SHOWCASE

## 2017



Figure 4 - Cover page of the MSI Research Showcase 2017

### Selected Research Projects

**Researcher:** Professor Elaine Baker

**Department/ Institute:** School of Geoscience

Director of the Marine Studies Institute

**Project Title:** Mercury Rising



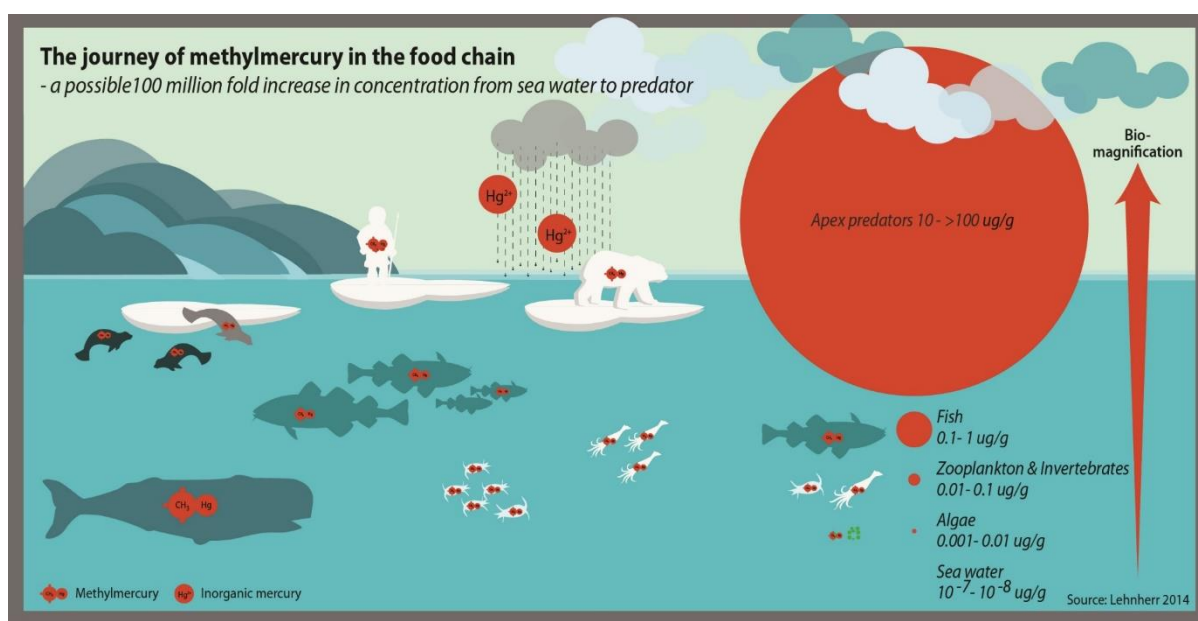
We have been aware since the 1950s that mercury exposure damages the health of people, especially children. That's why it's surprising that it's taken the world this long to do something about the release of mercury into the environment. But after nearly 17 years of negotiation we finally have a global 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:** Professor Tim Stephens

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

Deputy Director of the Marine Studies Institute

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:** Professor Dietmar Muller

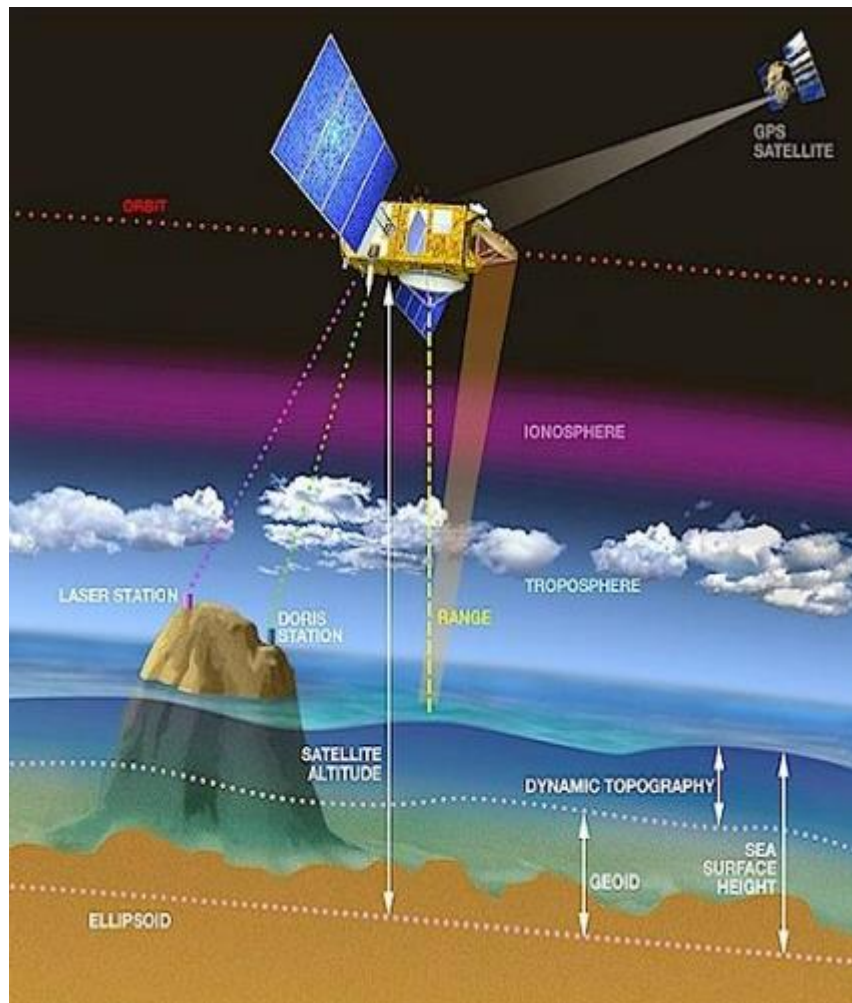
**Department/ Institute:** School of Geosciences– EarthByte Group (Geophysics)

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 compliments 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 thermochemical 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:** Dr Bree Morgan

**Department/ Institute:** School 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 CO<sub>2</sub> 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<sub>2</sub>-host phases as a strategy to mitigate global warming.



## Selected Student Projects

**Student:** 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.

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**Student:** Jodie Pall

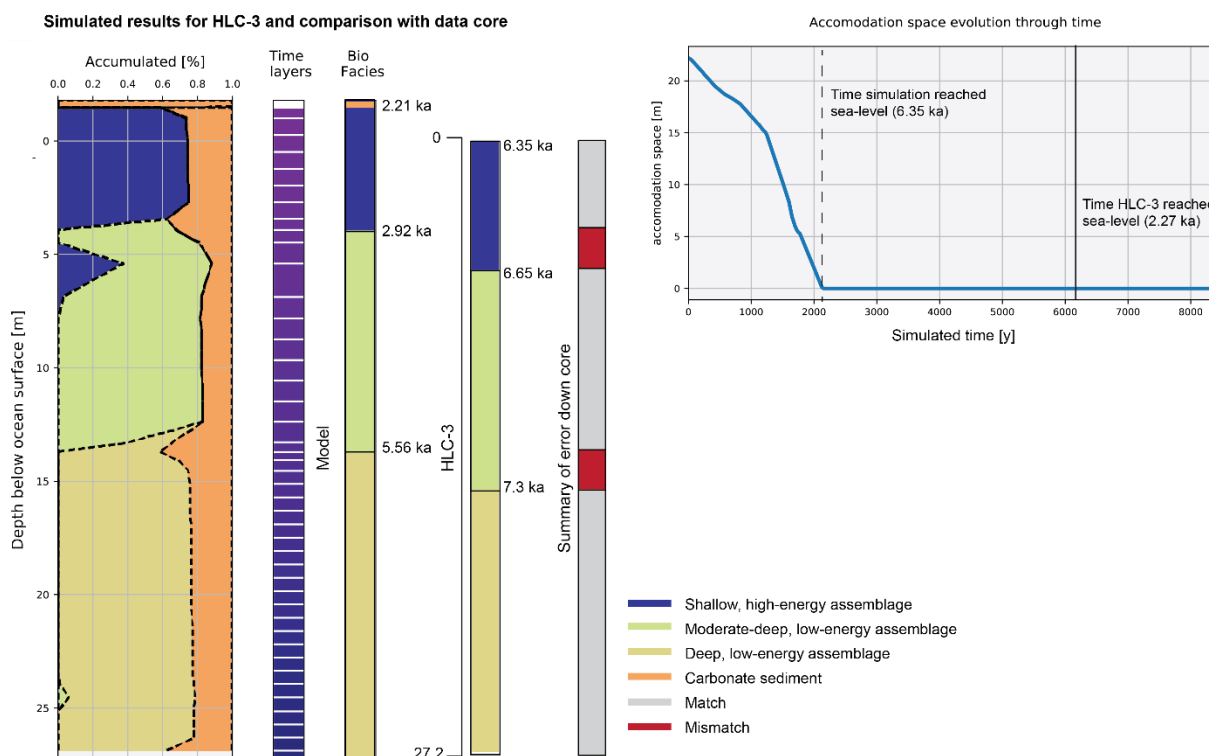
**Department/ Institute:** School of Geosciences

**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.

**Student:** Amanda Thran

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

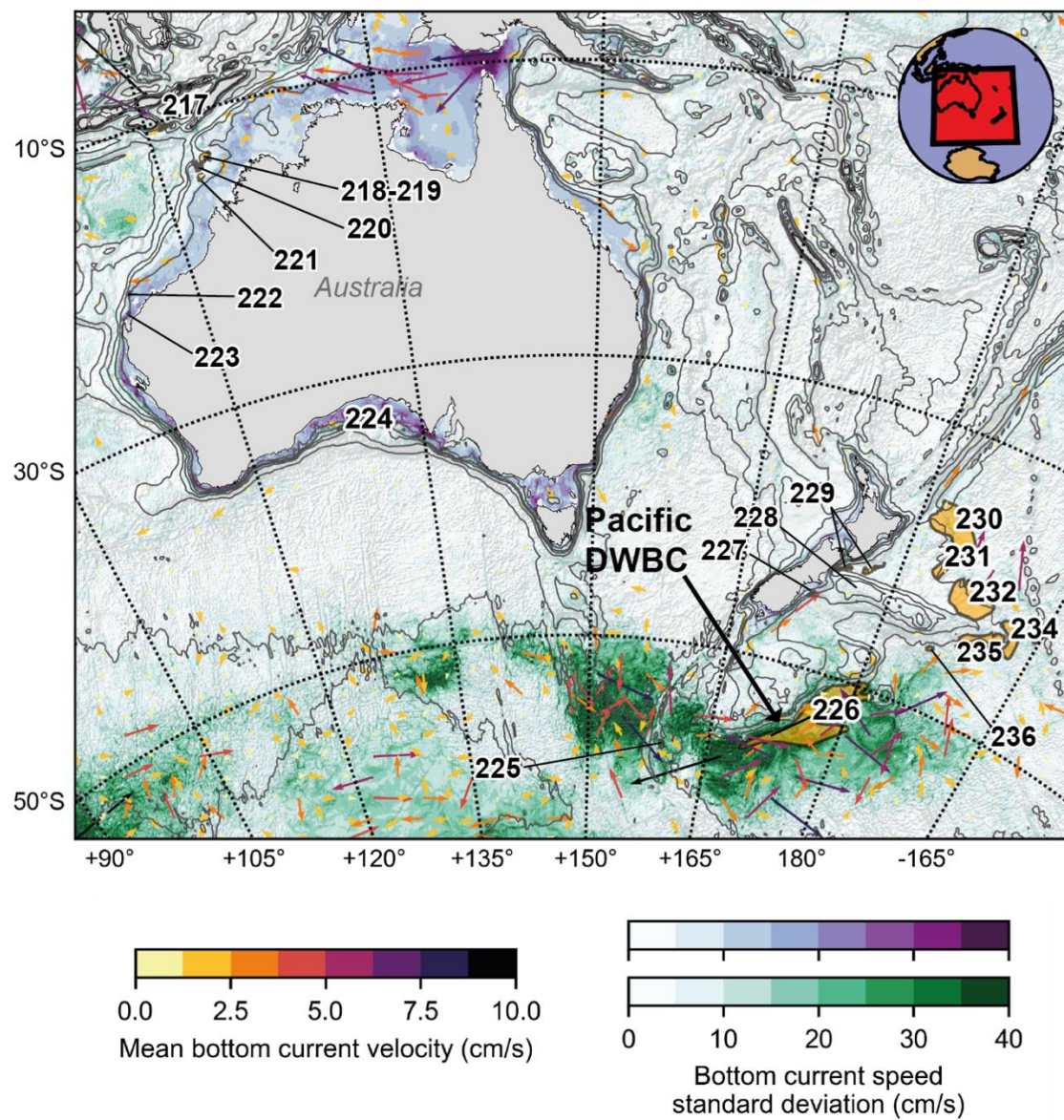
**Project Title:**

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.







Contourite distribution throughout Oceania, overlayed 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.

## Outreach

### Work Experience programme 2017

The University of Sydney has run a successful Marine Science high school work-experience program for the past 8 years in collaboration with SIMS. The program has grown from modest beginnings to the current selective process due to overwhelming response from potential marine science graduates. Over 75 applications were received in 2017 from the greater metropolitan area as well as the Central coast and Perth.

Such a high level of interest from this broad educational community demonstrates the value and uniqueness of this program. Monitoring of enrolled students has shown the success of the program in recruiting into the University of Sydney's marine science programs.

The 2017 work-experience week concluded with 15 students leaving the program successfully armed with a suite of new skills and a re-evaluated passion for the marine world.

Great feedback from one of the student, Isabel Duong Balada, was describe in her Work Experience Dairy:

*"This was a great opportunity to fill in gaps in the knowledge I'd gathered myself and through briefly studying cores at school, and extend on what we'd just learnt in the lab ...*

*Before lunch, we had the Marine Studies Showcase... As I'm particularly interested in sustainability and human interactions with the marine ecosystem, a few that I found notably interesting were the presentations on environmental livelihood in the Pacific, the oyster restoration work done in New York, the Fish Market; and Edwina's presentation... **Though restricted by time, these presentations delivered a huge amount of information about recent discoveries and work, and ongoing fascinating research...***

*I think we all left that activity with a more critical mindset towards what we buy...*

*" Isabel Duong Balada*

## Women in Marine Science

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This year **Dr Bree Morgan** joined the Women in Marine Science team. Bree is a low-temperature environmental geochemist with expertise in chemical sedimentology and mineralogy. Bree is joining a great group of successful female staff including MSI Director and UNESCO Chair **Prof Elaine Baker**, Head of Byrne Lab and Deputy Director of One Tree Island Research Station **Prof Maria Byrne**, Director of One Tree Island Research Station **Dr Ana Vila Concejo**, oceanographer **Dr Edwina Tanner**, marine biologist **Dr Michelle Blewitt**, MSI Postgraduate Coursework Advisor and Coordinator **Dr Eleanor Bruce**, Billion Oyster Project, Educational Designer **Dr Elisa Bone**, **Dr Kate Johnston** and **Prof Elspeth Probyn**.

## Women's Marine Network @ LinkedIn

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Recently a LinkedIn group was launched, **Women Marine Network**

(<https://www.linkedin.com/groups/6979933/profile>). The

Women's Marine Network aims to:

- Inspire women to pursue careers in marine science and other marine related fields
- Connect and mentor young women interested in the marine environment, including socio-economic aspects
- Celebrate the successes of female marine experts



## Appendix 1 – Financial Report

MSI has since 2013 received \$35,000/year from the Science Faculty. This covers the cost of salaries for 0.2 FTE Administrative Assistant, 0.2 FTE Web Manager and events.

	Calendar Year 2017	Calendar Year 2017	Calendar Year 2017	Calendar Year 2017	Calendar Year 2017	Calendar Year 2017	Calendar Year 2017
	YTD	YTD	YTD	YTD	YTD	YTD	YTD
	Marine Studies Institute (L1500_SCI_CE N_MSI)	Marine Studies Institute (L1501)	Marine Studies Institute (L1501)	Marine Studies Institute (L1501)	Ian F S Jones (L1512)	Ian F S Jones (L1512)	Ian F S Jones (L1512)
	Total Projects	Discretionary	Support	Tied	Discretionary	Support	Tied
<b>Balance Sheet</b>							
Equity (EQUITY)	(72,405)	33,133	1,181	0	4,056	0	(110,776)
<b>Statement Income &amp; Expenditure (STMTI&amp;E)</b>							
USYD Funding	40,068	40,068					
Research Grants	241,381	0	0	0	0	0	241,381
Investment Income	596	0	596	0	0	0	0
Donations and Bequests	50,000	0	50,000	0	0	0	0
Revenue	332,046	40,068	50,596	0	0	0	241,381
Academic Employee Benefits	58,396	0	0	0	0	0	58,396
Non-Academic Employee Benefits	36,991	31,420	0	0	0	0	5,571
Annual Leave	3,082	0	0	0	0	0	3,082
Salaries (Employee Benefits)	98,468	31,420	0	0	0	0	67,049
Employee Related Costs	10,253	0	0	0	0	0	10,253
Consumables	25,627	0	0	0	0	0	25,627
Equip Purchases & Lease <\$10,000	6,288	1,599	0	0	0	0	4,689
Utilities and Communications	321	286	0	0	0	0	35
Consultants and Contractors	42,477	0	0	0	0	0	42,477
Grants Contrib External Org	50,000	0	50,000	0	0	0	0
Insurance, Legal, Motor, Admin	844	0	0	0	0	0	844
Student, Printing, Library	7,485	5,901	0	0	0	0	1,584
Non Salaries	143,295	7,785	50,000	0	0	0	85,510
UEM Services (UEM_SERVICES)	33,996	33,996	0	0	0	0	0
UEM Chrgs, Levies, Allocations	33,996	33,996	0	0	0	0	0
Expenditure	275,759	73,201	50,000	0	0	0	152,559
Net Operating Margin	56,286	(33,133)	596	0	(0)	0	88,823
<b>Funds Available (Exc Commitments)</b>	<b>(16,119)</b>	<b>0</b>	<b>1,778</b>	<b>0</b>	<b>4,056</b>	<b>0</b>	<b>(21,953)</b>

## Appendix 2 – Grants Snapshot

### List of Grants 2016-18

	Year	Grant	
Elaine Baker	2017	Enhancing Pacific Ocean Governance, DFAT.	\$360,000
	2016		\$60,000
	2018	GRID Arendal Norway	\$46,000
	2017		\$195,000
	2016		\$195,000
Joy Becker	2017	Rapid identification of emerging pathogens in marine aquaculture; Hick P, Becker J; Sydney Southeast Asia Centre/Cluster Research Grant.	
	2016	Acquatic Animals Health and Biosecurity Subprogram: quarantine risks and disease preparedness for the meglocytivirus ISKNV for Australia; Becker J, Hick P, Lintermans M; Fisheries Research and Development Corporation/Annual Open Call Funding Round.	
	2018	Climate adaptation in disaster-prone environments of Southeast Asia; Bruce E, Van Ogtrop F; Sydney Southeast Asia Centre/Workshop Grant.	
Eleanor Bruce	2018	Climate-smart landscapes for promoting sustainability of Pacific Island agricultural systems; Bruce E; Australian Centre for International Agricultural Research (ACIAR)/Research Grant.	\$1,600,000
	2017	ARC Training Centre on Cubesats, UAVs, and Their Applications; Australian Research Council (ARC)/Industrial Transformation Training Centres (ITTC).	
	2016	Using the Environmental Livelihoods Security (ELS) framework for developing climate-smart landscapes; Biggs E, Bruce E, Boruff B; Australian Centre for International Agricultural Research (ACIAR)/Research and Development Programs (R&D Programs).	\$250,000
	2016	Geographic Information Systems for interdisciplinary education and training (Open Learning Environment - Undergraduate); Bruce E, Pritchard W, Odeh I, Evans B, Negin J, Hovorka D, Cairns I, Hiscock P, Stanton K, Fletcher R, Sarkar S; DVC Education/Large Educational Innovation Grant.	
	2016	Analysing and plotting data with R (Open Learning Environment - Undergraduate); Vervoort R, Rey P, Thomson P, Bishop T, Crowther M, Warren D, Van Ogtrop F, Bruce E, Fekete A, Murphy T, Evans B; DVC Education/Small Educational Innovation Grant.	



	2016	The role of spatial modelling and remote sensing for assessing environmental livelihood security in coastal environments; Bruce E; Faculty of Science/Seed Funding.	
	2017	Resilience on-farm: mechanisms, markers and applications; Emery D, Williamson P, Khatkar M, de Silva K, Plain K, Dhand N, Purdie (Williams) A, Whittington R; Meat and Livestock Australia Ltd/Research and Development Grant.	
Navneet Dhand	2016	A retrospective cohort study to detect emerging viral zoonotic pathogens in individuals with high-risk horse contact; Annand E, Dhand N; Marie Bashir Institute for Infectious Diseases and Biosecurity/Seed Funding Grants.	
	2016	VetCompass: Big Data and Real-time Surveillance for Veterinary Science; McGreevy P, Dhand N, Baldwin T, Gilkerson J, Mansfield C, Peaston A, Hill P, Raidal S, Combs M, Irwin P, Robertson I, Magalhaes R, Rand J, Squires R, Raubenheimer D, Irons P, Meler E; Australian Research Council (ARC)/Linkage Infrastructure, Equipment and Facilities (LIEF).	
	2016	Development of effective animal disease control programs in India; Dhand N, Ward M, Hernandez-Jover M, Brookes V; Australia India Council/Research Support.	
	2017	CDIP Industry & Community Engagement Fund 2017_ Marine Cloud Brightening Technology Development - OMNI TANKER PTY LTD _ FIGUEIRA; Figueira W; DVC Research/Community & Industry Engagement Fund.	
Will Figueira	2017	Faculty of Science Research Equipment and Infrastructure Scheme 2017	
Dan Harrison	2017	Rapid identification of emerging pathogens in marine aquaculture; Hick P, Becker J; Sydney Southeast Asia Centre/Cluster Research Grant.	\$30,000
Paul Hick	2016	Acquatic Animals Health and Biosecurity Subprogram: quarantine risks and disease preparedness for the meglocytivirus ISKNV for Australia; Becker J, Hick P, Lintermans M; Fisheries Research and Development Corporation/Annual Open Call Funding Round.	
	2017	Study of the biologically induced changes in adipocyte cells using a designed experimental protocol and FTIR-microscopy; Carter E, Lay P; Australian Synchrotron/Funding Application for Interstate User Groups.	
Peter Lay	2017	UNcle All-in-One Biologics Stability Platform with Robotic High Throughput Screening System for the Open Access, Multi-Disciplinary Bosch Molecular Biology Facility; Richardson D, Scolyer R, Murray M, Long G, Lay P, Mason R, Payne R, Kayser V, Kovacevic Z, Lee C; Cancer Institute New South Wales/Equipment Grant.	

	2017	Benchtop EPR Spectrometer; D'Alessandro D, Mackay J, Lay P; Australian Research Council (ARC)/Linkage Infrastructure, Equipment and Facilities (LIEF).	
	2017	Synchrotron X-ray and neutron scattering facilities: How "big science" can boost your research; Ling C, Kennedy B, Avdeev M, Warr G, Church W, Kwan A, Cairney J, Valix M, Lay P; DVC Education/Small Educational Innovation Grant.	
	2016	Roles of Metal Complexes in Carbohydrate Metabolism – Anti-Diabetic Drugs; Lay P; Australian Research Council (ARC)/Discovery Projects (DP).	
	2016	Mitigating the unknown: unravelling drivers of human-shark conflict; Machovsky-Capuska G, Raubenheimer D; Department of Primary Industries (NSW)/NSW Shark Management Strategy (SMS).	
Gabriel Machovsky-Capuska	2017	Environmental Geochemistry; Morgan B; Faculty of Science/Faculty Startup Scheme.	
Bree Morgan	2017	The Deep Carbon Cycle (DCC) through geological time: An interdisciplinary synthesis of the carbon cycle in the Earth's lithosphere-biosphere system, Funding Body: Alfred P. Sloan Foundation, \$135k.	\$135,000
Dietmar Muller	2017	ARC Training Centre on Cubesats, UAVs, and Their Applications; Cairns I, Dempster A, Bruce E, Khachan J, Wong K, Hughes R, Aboutanios E, Cetin E, Leon-Saval S, Evans B, Wu X, Murphy R, Held J, Li W, Michaels P, Antoniadis A, Chamitoff G, Lawrence J, Carr S, Bongiorno D, Bachmann C, Neudegg D, Barber P, Cocks T; Australian Research Council (ARC)/Industrial Transformation Training Centres (ITTC).	
	2018	Politics of Food: From Consumer to Food Citizen; Mann A, Schlosberg D, Probyn E, Jones B, Allman-Farinelli M; DVC Education/Small Educational Innovation Grant.	
Elspeth Propyn	2017	Participatory Planning for our Food Future: The Sydney City Food Policy Project; Mann A, Probyn E, Allman-Farinelli M, Schlosberg D, Pritchard W, Jones B; DVC Research/Sydney Policy Lab.	
	2017	Australian Women's Work Futures (AWWF); Baird M, Cooper R, Vromen A, Probyn E, Hill E; DVC Research/Sydney Research Excellence Initiative 2020 (SREI).	
	2018	World's first dynamic X-ray facility for measuring internal velocities of amorphous materials; Einav I, Harrowell P, Vila-Concejo A; University of Sydney/Equipment Grant.	
Ana Vila-Concejo	2017	Improving Our Iconic Harbour's Health; Coleman R, Vila-Concejo A; Maple-Brown Family Charitable Foundation/Research Donation.	\$473,000

	2016	Understanding the crowd - improving accuracy in collective motion theory; Ward A; Australian Research Council (ARC)/Discovery Projects (DP).	
Ashley Ward	2016	The physiological dimension of animal group and population dynamics; Seebacher F, Ward A, Sumpter D, James R; Australian Research Council (ARC)/Discovery Projects (DP).	
	2018	Shiptime & post cruise funding (Spain) Ministry of Economy and Competitivity of Spain (CTM2017-88237-P) Processes of platform-slope coupling and sedimentary transfer in the sea of Alboran: source-sink approach and implications for biodiversity - (C1) (2018-21).	\$326,000
Jody Webster	2018	Alfred P Sloan Foundation - The Deep Carbon Cycle (DCC) through geological time: An interdisciplinary synthesis of the carbon cycle in the Earth's lithosphere-biosphere system	\$130,000
	2017	Shiptime - (French) Program of the UMS campaigns French oceanographic fleet R/V l'ALIS Sedimentology of the Drowned Lansdowne Bank (SeDLAB) (Collaborative partner)	
	2017	State Key Laboratory of Isotope Geochemistry Open Fund (SKLabIG-KF-16-12) - Coral and microbialite based geochemical reconstruction of palaeoenvironmental changes and the response of the Great Barrier Reef (GBR) ecosystem over the past 30 ka (CI)	\$17,500
	2017	Sydney Research Excellence Initiative (SREI 2020) - Understanding the deep carbon cycle from icehouse to greenhouse climates	\$149,000
	2016	Spur and Groove Evolution, Formation and Paleoclimate: Great Barrier Reef and French Polynesia; Webster J, Hua Q; Australian Nuclear Science and Technology Organisation/Research Portal - Access to ANSTO facilities and capabilities.	\$19,300
	2016	Autonomous Acoustic Mapping and Tracking Facility; Williams S, Pizarro O, Bryson M, Ramos F, Webster J; University of Sydney/Equipment Grant.	\$190,000
	2016	Australian Membership of the International Ocean Discovery Program; Arculus R, Cohen D, Gallagher S, Vasconcelos P, Elders C, Foden J, Coffin M, Nebel O, McGregor H, Clennell M, Sloss C, Heap A, Webster J, Kemp A, George S; Australian Research Council (ARC)/Linkage Infrastructure, Equipment and Facilities (LIEF).	\$10,000,000
Stefan Williams	2017	Classification of Broadscale, Multi-resolution Visual Seafloor Mosaics; Williams S, Pizarro O, Bryson M; DVC Research/Bridging Support Grant.	

	2016	Supervised autonomy for AUVs using limited bandwidth communication channels; Williams S, Pizarro O; Australian Research Council (ARC)/Linkage Projects (LP).
	2016	High Resolution Visual 3D Reconstructions for Rapid Archaeological Characterization; Pizarro O, Williams S; University of Michigan/Research Grant.
	2016	Autonomous Acoustic Mapping and Tracking Facility; Williams S, Pizarro O, Bryson M, Ramos F, Webster J; University of Sydney/Equipment Grant.
	2017	Assessing the causes and prevalence of cloning in larval Crown-of Thorns-Seastars: implications for estimating and modeling dispersal potential; Byrne M, Allen J; Australian Museum/2018 Crown-of-Thorns Starfish Research Grant.
Maria Byrne	2017	Transgenerational Plasticity & Epigenetics - Ocean Change Adaptation; Byrne M, O'Connor W, Ross P, Parker L, Marsh A, Suter C; Environmental Trust (NSW)/Research Grant.
	2016	Anthropogenic impacts on tropical echinoderms of the Great Barrier Reef; Wolfe K, Byrne M; Australian Coral Reef Society/Research Grant.

## Appendix 3 - Affiliated Staff

### MSI Director

Professor Elaine Baker

### MSI Deputy Director

Professor Tim Stephens

### Teaching and Research Staff

Prof Elaine Baker  
 Dr Joy Becker  
 Dr Michelle Blewitt  
 Dr Alisa Bone  
 Dr Eleanor Bruce  
 Prof Maria Byrne  
 A/Prof Ross Coleman  
 Dr Navneet Dhand  
 Dr Olivia Evans  
 Dr Renata Ferrari Legorreta  
 A/Prof Will Figueira  
 Dr Daniel Harrison  
 Dr Paul Hick  
 A/Prof Tom Hubble  
 Dr Kate Johnston  
 Prof Peter Lay  
 Prof Rosmary Lyster  
 Dr Gabriel Machovsky-Capuska  
 Dr Bree Morgan  
 Prof Dietmar Müller  
 Dr Richard Murphy  
 Prof Elspeth Probyn  
 Dr Maria Seton  
 Dr Yehuda Shalem  
 Prof Tim Stephens  
 Dr Edwina Tanner  
 Dr Emma Thompson  
 A/Prof Ana Vila-Concejo  
 Dr Ashley Ward  
 A/Prof Jody Webster  
 Prof Richard Whittington  
 Prof Stefan Williams

### MSI Coordinator

Dr Edwina Tanner

### Marine Geoscience Undergraduate Advisor

Dr Daniel Harris

### Marine Science Postgraduate Advisor

Assoc Professor Ross Coleman

### Marine Science Postgraduate Coursework Advisor

Dr Eleanor Bruce

### Director of One Tree Island Research Station

Assoc Professor Ana Vila Concejo

### Deputy Director of One Tree Island Research Station

Prof Maria Byrne

### Web / Publicity

Dr Yehuda Shalem

### Honorary Associates

Associate Professor Gavin Birch  
 Adjunct Prof Douglas Cato  
 Professor Peter Cowell  
 Dr Adrienne Grant  
 Associate Professor Roslind Hinde  
 Adjunct Professor Ian SF Jones  
 Professor Tony Larkum  
 Dr John Runcie



## Appendix 4 - MSI Affiliated Staff Publications 2017

Acharya, K., **Dhand, N.**, Whittington, C., Plain, K. (2017). Culture-Independent Identification of Mycobacterium avium Subspecies paratuberculosis in Ovine Tissues: Comparison with Bacterial Culture and Histopathological Lesions. *Frontiers of Veterinary Science*, 4, 232.

Acharya, K., **Dhand, N.**, **Whittington, R.**, Plain, K. (2017). Detection of Mycobacterium avium subspecies paratuberculosis in powdered infant formula using IS900 quantitative PCR and liquid culture media. *International Journal of Food Microbiology*, 257, 1-9.

Acharya, K., **Dhand, N.**, **Whittington, R.**, Plain, K. (2017). PCR Inhibition of a Quantitative PCR for Detection of Mycobacterium avium Subspecies Paratuberculosis DNA in Feces: Diagnostic Implications and Potential Solutions. *Frontiers in Microbiology*, 8, 1-13.

Alfthan, B., Semernya, L., Ramola, A., Adler, C., Penaranda, L., Andresen, M., Rucevska, I., Jurek, M., Schoolmeester, T., **Baker, E.**, et al (2016). Waste Management Outlook for Mountain Regions – Sources and Solutions. UNEP, GRID-Arendal and ISWA. Nairobi, Arendal and Vienna. [www.unep.org](http://www.unep.org), [www.grida.no](http://www.grida.no), [www.iswa.org](http://www.iswa.org)

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Atherstone, C., Alonso, S., Grace, D., Ward, M., **Dhand, N.**, Mor, S. (2017). Ebola virus surveillance in pigs presenting for slaughter in Uganda. 4th International One Health Congress & 6th Biennial Congress of the International Association for Ecology, Australia: One Health Global Network.

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**Baker, E.**, Canals, M., C'zar, A., Fabres, J., Dudas, S., Jambeck, J., Kershaw, P., Lebreton, L., Rochman, C., Sanchez-Vidal, A., et al (2016). Marine Litter Vital Graphics, (pp. 1 - 57). Arendal, Norway: UNEP/GRID-Arendal.

**Baker, E.**, Gaill, F., Karageorgis, A., Lamarche, G., Narayanaswamy, B., Parr, J., Raharimananirina, C., Santos, R., Sharma, R., Tuhumwire, J. (2017). Offshore Mining Industries.

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**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/>

**Baker, E.**, Puglise, K., Colin, P., Harris, P., Kahng, S., Rooney, J., Clark, S., Slattery, M., Spalding, H. (2016). What are mesophotic coral ecosystems? In **Baker, E.K.**, Puglise, K.A. and Harris, P.T. (Eds.), *Mesophotic coral ecosystems - A lifeboat for coral reefs?*, (pp. 11-19). Norway: UNEP/GRID-Arendal.

**Baker, E.K.**, Puglise, K.A. and Harris, P.T. (Eds.). (2016). *Mesophotic coral ecosystems — A lifeboat for coral reefs?* United Nations Environment Programme and GRID-Arendal, Nairobi and Arendal, 98 pp.

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**Baker, E.**, Westerveld, L. (2016). *The Spread of Sargassum Seaweed*, Arendal, Norway: UNEP/GRID-Arendal.

Baral, R., **Dhand, N.**, Freeman, K. (2016). Commutability and interchangeability of commercial quality control materials with feline plasma for common biochemical analytes. *Veterinary Clinical Pathology*, 45(2), 300-310.

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**Becker, J.**, Tweedie, A., Gilligan, D., Asmus, M., **Whittington, R.** (2016). Susceptibility of Australian Redfin Perch *Perca fluviatilis* Experimentally Challenged with Epizootic Hematopoietic Necrosis Virus (EHNV). *Journal of Aquatic Animal Health*, 28(2), 122-130.

Begg, D., Purdie (Williams), A., de Silva, K., **Dhand, N.**, Plain, K., **Whittington, R.** (2017). Variation in susceptibility of different breeds of sheep to *Mycobacterium avium* subspecies *paratuberculosis* following experimental inoculation. *Veterinary Research*, 48, 1-11.

**Birch G. F.**, Cox B. M. and Besley C. H. (2018). The relationship between metal concentrations in seagrass (*Zostera capricorni*) tissue and ambient fine sediment in modified and near-pristine estuaries (Sydney estuaries, Australia). *Marine Pollution Bulletin*, doi.org/10.1016/j.marpolbul.2018.01.006

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- Byrne M.**, O'Hara T.D. (eds) (2017). Australian Echinoderms: Biology Ecology and Evolution. CSIRO Press National Library of Australia (978 1 486 30762 3 – hardback; 978 1 486 30762 0 – ePDF; 978 1 486 30762 7 – ePub)
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## Appendix 5 - linked projects/institutes

### BRAHSS

The BRAHSS study is one the largest and most comprehensive studies on the effects of noise on whales ever undertaken. This project aims to provide information that will reduce the uncertainty in evaluating impacts of seismic surveys on humpback whales leading to management and mitigation measures that allow surveys to be conducted efficiently with minimum impact on the whale. It will also assess the effectiveness of ramp-up as a mitigation measure, and the potential to improve design of ramp-up. The results will be in a form useful for designing management of seismic surveys and mitigation procedures.



BRAHSS is collaboration between the following Australian institutions:

Universities of Queensland, Sydney, Newcastle, Curtin University of Technology, the Australian Marine Mammal Centre (Australian Antarctic Division that is in the Department of Sustainability, Environment, Water, Population and Community) and the Defence Science and Technology Organisation.

[www.brahss.org.au](http://www.brahss.org.au)

### Coastal and Marine Ecosystem Group

Coastal and Marine Ecosystem group was created to reflect the wide range of marine research activities done within the School of Biological Sciences. This includes EICC world-class research on ecological problems arising

from urbanisation of coastal environments. We work with councils, regulatory agencies, Federal, State and Local Governments to identify problems and suggest valid solutions based on experimental evidence.

Many currently positive solutions lack proper support from rigorous data collection. By treating environmental problems as ecological experiments, then using appropriate experimental designs to test relevant hypotheses, we can provide better solutions. The EICC is now a subset of CMEG. We



retained the EICC name as it has substantial brand recognition among the users of marine science in NSW.

<https://www.facebook.com/cmegaustralia>

<http://sydney.edu.au/science/bio/eicc/>

## Australian Centre for Field Robotics (ACFR)

The Australian Centre for Field Robotics is dedicated to the scientific advancement and uptake of autonomous and intelligent robots for operation in outdoor environments. It is one of the largest robotics research institutes in the world and has been instrumental in developing breakthrough technologies and in conducting world-leading research and development of field robotics principles and systems.

### MARINE ROBOTICS PROGRAM

The program undertakes fundamental and applied research in a variety of areas related to the development and deployment of marine autonomous systems. The ACFR, as operator of a major national Autonomous Underwater Vehicle (AUV) Facility, conducts AUV-based surveys at sites around Australia and overseas. These AUV surveys are designed to collect high-resolution stereo imagery and oceanographic data to support studies in the fields of engineering science, ecology, and biology, geoscience, archaeology and industrial applications.

Our recent research has focused on generating high fidelity, three-dimensional models of the seafloor; precisely matching survey locations across years to allow scientists to understand variability in these environments; and identifying patterns in the data that facilitate automated classification of the resulting image sets. Providing precise navigation and high-resolution imagery lends itself to novel methods for data discovery and visualization. The ACFR leads Australia's Integrated Marine Observing System (IMOS) AUV Facility and is involved in national and international marine archaeological studies.

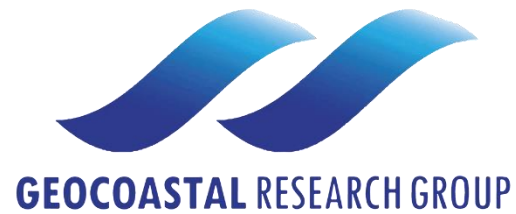
<http://marine.acfr.usyd.edu.au/>



## Geocoastal Research Group (GRG)

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Geocoastal research spans from the study of daily change in coastal environments due to meteorological events, to improving our understanding of the links between global climatic and tectonic adjustments. Spanning the



coastal sedimentary continuum from river systems to the edge of continental margins, and encompassing both clastic and carbonate environments, coastal morphodynamics is focused on the coupling between flow dynamics and geomorphic evolution enacted by sediment transport. The research approaches practiced by the group include in situ field measurement, remote-sensing techniques, and both physical-process and systems behaviour modelling. Across the spectrum of scales, research extends beyond geomorphic evolution of continental margins to habitat responses, environmental contamination and marine territorial rights.

The Geocoastal Research Group is integrated with the University's wider marine science community via the MSI, which exploits a mutual interest in process interactions to connect geocoastal research with the related fields of coastal marine ecology, marine robotics and coastal engineering. The Geocoastal Research Group has strong links with One Tree Island Research Station, one of the pristine coral cays available to the scientific community only.

Key research areas of the Geocoastal Research Group include:

- Coastal and near shore processes
- Carbonate structures and sedimentology
- Lake and estuarine sediments
- River systems and riverbank stability
- Deep marine research

[http://sydney.edu.au/science/geosciences/research/re\\_geocoastal.shtml#margin](http://sydney.edu.au/science/geosciences/research/re_geocoastal.shtml#margin)

## Byrne Lab

Research in the Byrne Laboratory investigates the biology of marine and freshwater invertebrates with a focus on the Echinodermata and the Mollusca. Current projects involve species from tropical and temperate Australia. Using a multidisciplinary approach, we addresses major paradigms in evolution, development and biology.

<http://sydney.edu.au/medicine/anatomy/research/labs/byrne/index.php>



## Charles Perkins Centre (2015)

A new research group has been established by the Charles Perkins Centre to consider the significance of human–animal interactions from a broad and multidisciplinary perspective, in an effort to understand and maximise their positive effects on our health. The Charles Perkins Centre has established a uniquely multidisciplinary project group that will study this important topic from across disciplines and research facilities, both within and beyond the University of Sydney.

## Sydney Centre in Geomechanics and Mining Materials (SCIGEM)

SciGEM was established in 2013 and incorporates the former Centre for Geotechnical Research. The overall objective of SciGEM is to both strengthen and broaden the University of Sydney's already world-leading position in geotechnical engineering and granular mechanics, and to establish a stronger focus on mining geomechanics. SciGEM incorporates the following three specialised laboratories:

- Geomechanics and Geoenvironmental Laboratory
- Particles and Grains Laboratory
- Mining Materials Laboratory

<http://sydney.edu.au/engineering/civil/research/scigem/>

## University Electron Microscope Unit

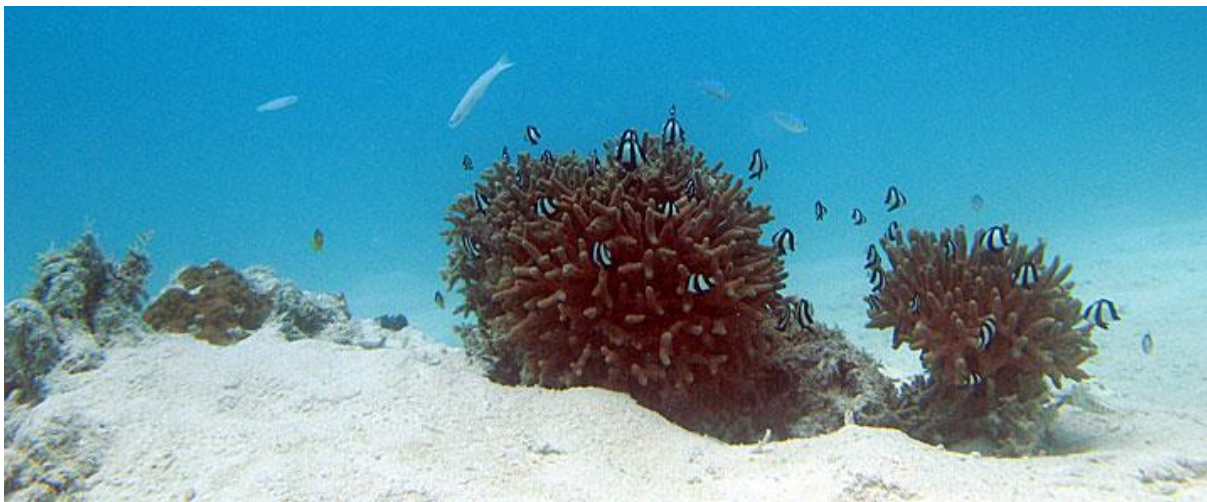
The Australian Centre for Microscopy & Microanalysis (ACMM), a cross-disciplinary research centre, explores physical and biological structures at the micro, nano and atomic scales. Sydney Microscopy & Microanalysis (SMM) is a core facility of the university, one of the largest and most comprehensive of its kind in the world. The ACMM and SMM are located in Madsen building, with additional facilities at the Charles Perkins Centre and in the Australian Institute for Nanoscale Science & Technology. <http://sydney.edu.au/acmm/>



## Animal Behaviour Lab

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The Animal Behaviour Lab comprises Associate Professor Ashley Ward and his research group, who 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).



<http://sydney.edu.au/science/biology/animalbehaviour/>

## Australian Centre for Climate and Environmental Law (ACCEL)

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The objectives of the Centre are to encourage, promote and support innovative and important scholarship including teaching, research, consultancy and public interest advocacy in all areas of environmental law and policy. These objectives are pursued within the University of Sydney, with other related Centres and institutions in Australia and overseas, with the legal profession, and with the wider community.

<http://sydney.edu.au/law/accel/>

## EXTERNAL CENTRES:

### Sydney Institute of Marine Science (SIMS)

In recognition of the core research strength in marine science, the university is a foundation member of the Sydney Institute of Marine Science (SIMS), a flagship interdisciplinary facility located on the picturesque shores of Sydney Harbour. The Master of Marine Science and Management program is taught under the framework of SIMS as a partnership between four major Australian universities. It is a unique Australian cross-institutional postgraduate marine science program, which will combine each institute's strengths in marine science research and education to provide a truly multidisciplinary learning environment.



<http://sims.org.au>



### ANSTO

Australian Institute of Nuclear Science and Engineering (AINSE), and Institute for Environmental Research



<http://www.ansto.gov.au/Resources/TEDxSydney/index.htm>

<http://www.ainse.edu.au>

<http://www.ansto.gov.au/ResearchHub/IER/>