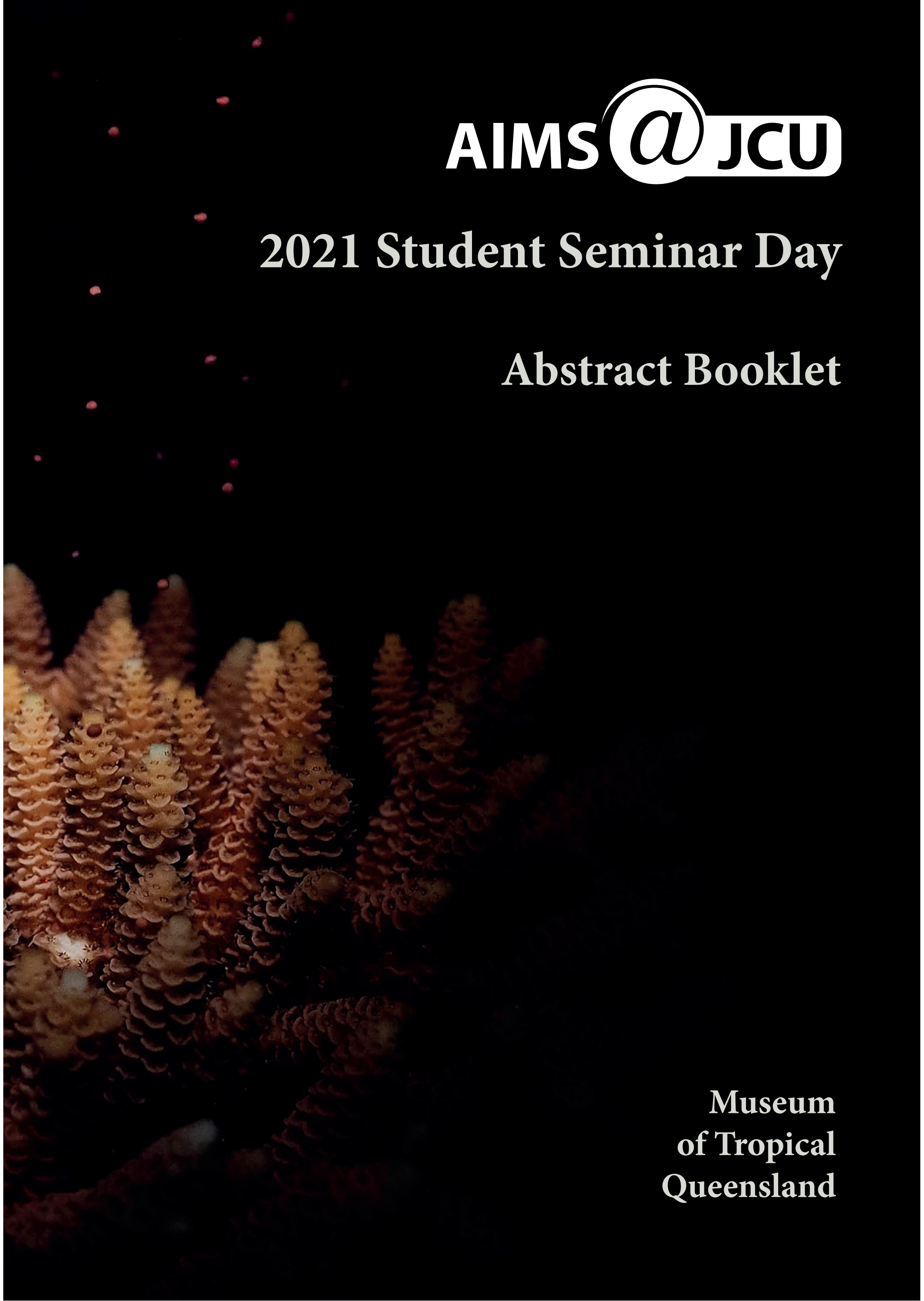
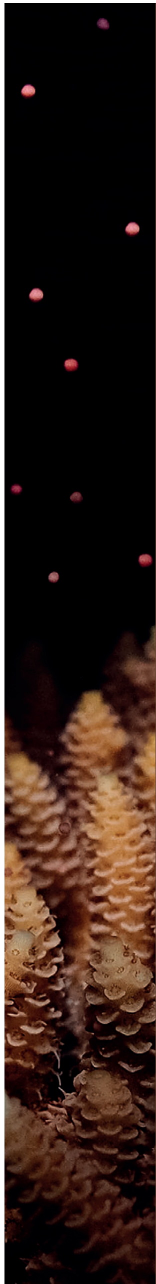


AIMS@JCU

2021 Student Seminar Day

Abstract Booklet

Museum of Tropical Queensland



Christopher Brunner

AIMS@JCU

Student Seminar Day 2021
Friday, 26th November

Museum of Tropical Queensland

Time	Title	Presenter
10.30am	A session for open discussion for students	
11.00am	Opening remarks, AIMS@JCU Research Director	Libby Evans-Illidge
	Session 1:	
11.30am	Leading practice framework for cross-cultural approaches to managing Sea Country	Redbird Ferguson
11.45am	Deriving the first species-specific sensitivity constants for oil toxicity- and risk modelling for tropical coral larvae	Mikaela Nordborg
12 noon	Characterising the leaching behaviours of plasticisers from microplastics	Alexandra Gulizia
12.15pm	Ingestion and Depuration of Microplastics by a Planktivorous Coral Reef Fish, *Pomacentrus amboinensis*	Marina Santana
12.30pm	Lunch	
	Session 2:	
1.30pm	Age determination in Pacific crown-of-thorns seastar (*Acanthaster cf. solaris*): novel molecular approaches	Sarah Kwong
1.45pm	Temporal microbial community shifts under heat stress in two thermally tolerant reef species	Emma Marangon
2.00pm	Bleached adult corals can acquire novel microalgal symbionts	Hugo Scharfenstein
2.15pm	Optimising genetic diversity of sexually produced coral stock for reef restoration	Annika Lamb
2.30pm	Posters, afternoon tea	
3.00pm	AIMS@JCU Alumni Keynote Speech: Where would I be without AIMS@JCU?	Dr Neal Cantin
	Session 3:	
3.30pm	Read-based metagenomic analysis allows to explore spatial distribution patterns in microbial composition of free-living microbes across the GBR	Marko Terzin
3.45pm	Using 3D photogrammetry to quantify coral demographic rates	Marine Lechene
4.00pm	Improving the current understanding of coral reef thermal dynamics and its implication for predicting coral bleaching	Valerie Cornet
4.15pm	Identification of polyacrylate in the skeleton of *Acropora millepora*, and its potential role in coral calcification	Felicity Kuek
	Speed Talks:	
4.30pm	Quantifying the role of grazing fishes on the survival of seeded corals for direct restoration	Taylor Whitman
4.35pm	Reef fishes only pick fights with individuals of the same species	Alfonso Ruiz Moreno
4.40pm	The potential role of dimethylsulfoniopropionate and acrylate in coral skeleton formation	Geoffrey Yau
4.45pm	The seasonal and spatial effects of algae on coral demography	Martina Burgo
4.50pm	Physio-chemical Properties of Microplastics Influence Egestion by Predatory Fish	Hannah McCarthy
5.00pm	End of Day Function - drinks and canapes provided	
	Presentation of awards and prizes, closing remarks	

James Cook University Australia · Australian Government · Australian Institute of Marine Science

11.30am

Leading practice framework for cross-cultural approaches to managing Sea Country

Redbird Ferguson[a,b], Karen Joyce[a], Christian Reepmeyer[c], Rachel Groom[d] & Kellie Pollard[e]

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The dual threats of climate change and anthropogenic impacts pose increasing challenges for Australia's Sea Country. The Indigenous Knowledges of Northern Australia's coastlines and the Great Barrier Reef are not well integrated into managing Sea Country. Indigenous Knowledges are unique local knowledges of place, connecting nature, politics, and ethics guiding relationships between people, animals, and ancestors. I aim to co-develop a leading practice framework for cross-cultural approaches to managing Sea Country using two-way knowledge sharing. I will work directly with Traditional Owners/Prescribed Bodies Corporate using geospatial and remote sensing technologies to empower Indigenous-led Sea Country management.

11.45am

Deriving the first species-specific sensitivity constants for oil toxicity- and risk modelling for tropical coral larvae

Mikaela Nordborg[a,b,c], Diane L Brinkman[c], Rebecca Fisher[d], Thomas F Parkerton[e], Michael Oelgemoeller[b] & Andrew P Negri[a,c]

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[e]*EnviSci Consulting, LLC, Houston, Texas, USA.*

Petroleum oil remains a pollutant of significant concern in shallow-water, tropical reef environments due to its continued use, extraction and transport through or close to coral reefs. While efforts are underway to characterise the sensitivity of coral reef taxa to oil pollution, tropical systems remain understudied compared to subtropical and temperate counterparts. Predictive oil toxicity modelling has been developed to improve oil spill risk assessments and can be used to fairly compare the toxicity of oils and the sensitivity of different species or life stages to exposure. However, to use predictive toxicity modelling, species-specific sensitivity constants, such as the critical target lipid body burden (CTLBB) are required.

To estimate the first CTLBB for and Indo-Pacific coral we exposed larvae of the coral *Acropora millepora* to seawater solutions containing dissolved toluene, naphthalene, 1-methylnaphthalene, phenanthrene, anthracene or pyrene for 48 h. Following exposure, the health of larvae was assessed and the no effect- and 50% effect concentrations (NEC and EC_{50}) derived using Bayesian generalized nonlinear models. Metamorphosis success was negatively affected for all compounds tested while larval survival was only affected for some of the tested compounds. The CTLBB derived for metamorphosis success EC_{50} indicate that coral larval metamorphosis is one of the most sensitive endpoints assessed using the TLM to date. These results can be used to apply oil toxicity and spill modelling tools in tropical reef environments and highlight the need for further research on the sensitivity of reef taxa to petroleum exposure.

12 noon

Characterising the leaching behaviours of plasticisers from microplastics

Alexandra Gulizia[a,b], Kishan Patel[a], Cherie Motti[a,b,c] & George Vamvounis[a,b,c]

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Microplastic contamination in the environment presents a unique threat to aquatic organisms. Plasticisers such as phthalate esters (e.g. DEHT) and bisphenols (e.g. BPA), can be incorporated into plastic materials during manufacturing to tailor the mechanical and thermal properties of the plastic polymer. However, plasticisers have been known to leach and migrate from plastic materials into their surroundings, and such have been detected in a plethora of environmental matrices worldwide; including oceans, lakes and the stomachs of aquatic animals. Furthermore, exposure to plasticised microplastics, both alone and in combination, can lead to severe physiological and behavioural impacts. Even given the ecotoxicity and leachable properties of plasticised microplastics, a large majority of related research has been conducted using consumer products under typical user conditions (e.g. the heat treatment of plastic food ware containers). Understanding the reactivity of plasticisers in the environment and how this may impact their ecotoxicity has been largely ignored in literature. In this study, the leaching of common phthalate ester and bisphenol plasticisers from microplastics were analysed in various environments and their leaching models discussed. Results obtained here will help further understand the reactivity of environmental microplastic contamination and plasticisers under relevant conditions, and how this may impact their toxicity.

12.15pm

Ingestion and Depuration of Microplastics by a Planktivorous Coral Reef Fish, *Pomacentrus amboinensis*

Marina F.M. Santana[a,b,c], Amanda L. Dawson[b], Cherie A. Motti[b,c], Lynne van Herwerden[a,c], Carine Lefevre[b] & Frederieke J. Kroon[b,c]

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This study used environmentally relevant exposure conditions to investigate microplastic ingestion and depuration kinetics of the planktivorous damselfish, *Pomacentrus amboinensis*. Irregular shaped blue polypropylene (PP) particles, and regular shaped blue polyester (PET) fibers selected based on physical and chemical characteristics of microplastics commonly reported in marine environments, including in coral reef ecosystems. Individual adult damselfish were exposed to a single dose of PP particles and PET fibers at concentrations reported for waters of the Great Barrier Reef (i.e., environmentally relevant concentrations, ERC), or future projected higher concentrations (10x ERC, 100x ERC). Throughout the 128-h depuration period, experimental fish were sampled 2, 4, 8, 16, 32, 64, and 128-h post exposure and their gastrointestinal tracts analyzed for ingested microplastics. While damselfish ingested both experimental microplastics at all concentrations, body burden, and depuration rates of PET fibers were significantly larger and longer, respectively, compared to PP particles. For both microplastic types, exposure to higher concentrations led to an increase in body burden and lower depuration rates. These findings confirm ingestion of PP particles and PET fibers by *P. amboinensis* and demonstrate for the first time the influence of microplastic characteristics and concentrations on body burden and depuration rates. Finally, despite measures put in place to prevent contamination, extraneous microplastics were recovered from experimental fish, highlighting the challenge to completely eliminate contamination in microplastic exposure studies. These results are critical to inform and continuously improve protocols for future microplastics research, and to elucidate patterns of microplastic contamination and associated risks in marine organisms.

1.30pm

Age determination in Pacific crown-of-thorns seastar (*Acanthaster* cf. *solaris*): novel molecular approaches

Sarah Lok Ting Kwong[a,b]

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[b]*ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, QLD 4811, Australia*

Population irruptions of crown-of-thorns seastar (CoTS, *Acanthaster* spp.) represent a perennial threat to coral reefs in the Indo-Pacific region. Age determination of CoTS has been challenging in the past, thus hindering the understanding of population dynamics and the development of corresponding management strategy. This project aims at developing nucleic acid-based tools to determine the chronological age of CoTS. Telomere lengths and DNA methylation patterns, which are newly emerged age markers for a diverse array of taxa, will be explored as age proxies in CoTS. Subsequently, these nucleic acid-based tools will be used to age juvenile and adult CoTS collected from the field to answer research questions such as early life stage development, recruitment pattern and density-dependent effect on population demography.

1.45pm

Temporal microbial community shifts under heat stress in two thermally tolerant reef species

Emma Marangon[a,b,c], Patrick W. Laffy[a,c], David G. Bourne[a,b,c] & Nicole S. Webster[a,c,d]

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[b]*College of Science and Engineering, James Cook University, Townsville, QLD, Australia*
[c]*AIMS@JCU, Townsville, QLD, Australia*
[d]*Australian Centre for Ecogenomics, University of Queensland, St Lucia, QLD, Australia*

Coral reefs globally are threatened by ocean warming. Host-associated microbial communities contribute critical functions that underpin holobiont health, and environmental changes may alter these microbe-host interactions. In this study, we explore temporal microbial shifts under thermal stress in the reef-building coral *Porites lutea* and the bioeroding sponge *Cliona orientalis*. We experimentally exposed the two species to increasing temperatures over 2 months, from 28˚C to 32˚C, and assessed host health as well as microbial community structure across time using physiological measurements and 16S rRNA gene amplicon sequence analyses. Our comparative analysis reveals that *C. orientalis* is more thermally tolerant than *P. lutea*, with sponge health showing signs of decline only at 13 Degree Heating Weeks (DHW). Under increasing temperatures, microbial community dynamics were relative stable in *C. orientalis* over time, though in contrast the *P. lutea* microbiome shifted, with a loss of Endozoicomonadaceae affiliated taxa under high DHW. By linking microbial community composition changes with host fitness, our study provides new insights into temporal microbial responses to heat stress in two thermally tolerant reef species.

2.00pm

Bleached adult corals can acquire novel microalgal symbionts

Hugo Scharfenstein[a], Wing Chan[b], Patrick Buerger[c], Craig Humphrey[d] & Madeleine van Oppen[e]

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Early life stages of most coral species acquire microalgal endosymbionts (Symbiodiniaceae) from the environment, but whether exogenous symbiont uptake is possible in the adult life stage is unknown. Deep sequencing of the Symbiodiniaceae ITS2 genetic marker has revealed novel symbionts in adult corals following bleaching, however these strains may have already been present at densities below detection limits. To test whether acquisition of symbionts from the environment occurs, we subjected adult fragments of corals (six species in four families) to a chemical bleaching treatment (menthol and DCMU). The treatment reduced the abundance of the native microalgal symbionts to below 2%. The bleached corals were then inoculated with a cultured *Cladocopium* C1^{acro} strain. Genotyping of the Symbiodiniaceae communities before bleaching and after reinoculation showed that the fragments of all six coral species acquired the *Cladocopium* C1^{acro} strain used for inoculation. Our results provide unequivocal evidence for the uptake of Symbiodiniaceae from the environment by adult corals. We also demonstrate the feasibility of chemical bleaching followed by reinoculation to manipulate the Symbiodiniaceae communities of adult corals, providing an innovative approach to produce corals with enhanced thermal bleaching tolerance which may be used to restore reefs.

2.15pm

Optimising genetic diversity of sexually produced coral stock for reef restoration

Annika M Lamb[a,b,c], Ary Hoffmann[b], Lesa Peplow[a], Peter Harrison[d], Craig Humphrey[a] & Madeleine van Oppen[a,b]

[a]Australian Institute of Marine Science
[b]University of Melbourne
[c]AIMS@JCU
[d]Marine Ecology Research Centre, Southern Cross University

Managed breeding has the potential to improve coral resilience and adaptive capacity – traits important for the success of coral reef restoration initiatives. Stocks of broadcast spawning coral species are often generated sexually by mixing the gametes of multiple colonies simultaneously. However, it is unknown whether random mating occurs in such crosses and unequal contribution of parents to the offspring may result in a genetically depauperate stock. Here we use genetic parentage analyses to assess random mating in bulk experimental crosses of the reef-building coral, Acropora tenuis. Our findings show that both gamete handling and biological compatibility affect cross-fertilisation success in bulk crosses. We therefore recommend minimising gamete handling to maximise the diversity of coral stock. In the case of selective breeding programs where gametes need to be separated (handled) prior to conducting specific crosses, we recommend maximising the number of parental colonies as non-random mating is likely.

3.30pm

Read-based metagenomic analysis allows to explore spatial distribution patterns in microbial composition of free-living microbes across the Great Barrier Reef

Marko Terzin[a,b,c], Dr. Sara Bell[b], Dr. Patrick Laffy[b], Dr. Steven Robbins[d], Dr. Nicole Webster[e] & Dr. David Bourne[b,c]

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Coral reefs are the most diverse and productive aquatic environments on the planet, yet they suffered major declines in recent decades due to human-induced local and global impacts. To understand how environmental stressors affect coral reefs and if reef management practices are positively maintaining coral health, historical surveys are necessary to ascertain what we had and what we now have. Most reef monitoring programs implement visual surveys (e.g coral bleaching and disease) to assess reef health, which often become evident at the point of ecosystem collapse when reef management interventions are already compromised. Marine Bacteria and Archaea (microbes) respond rapidly to environmental shifts due to their short lifespan and have a potential to be used as early-warning signs of ecosystem stress. Recently it was documented that free-living (primarily seawater, but also sediment) microbes are more accurate predictors of environmental disturbances when compared of host-associated (corals, sponges and macroalgae) microbes in the Great Barrier Reef (GBR), suggesting that there is realistic scope to complement existing reef monitoring programs by adding a ‘microbial layer’ for early detection of declining reef health. This PhD forms part of the largest sequencing effort by Australia to characterise and monitor free-living marine microbes in the GBR. Extensive metagenomic and metatranscriptomic data will be integrated with environmental and oceanographic measurements to identify how microbial activity is changing with shifting environmental parameters in the GBR, on an unprecedented scale. This knowledge will be crucial t develop microbial-based monitoring protocols for the rapid assessment of reef ecosystem health.

3.45pm

Using 3D photogrammetry to quantify coral demographic rates

Marine Lechene[a], Morgan Pratchett[b], Nicholas Murray[c], Will Figueira[d] & Renata Ferrari[e]

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Climate change is threatening the integrity of coral reef ecosystems. It is urging the need to develop relevant metrics to assess ecosystem integrity and recovery. To date, coral cover remains the most used proxy with higher levels of coverage associated with better integrity. While cover has been a valuable state variable for coral reef ecologists, this single indicator does not consider the three-dimensional (3D) structure of the reef; it is not sufficient to understand the underlying mechanisms driving variation in cover and it does not allow accurate projection of coral reef trajectories in the future. Landscape and demographic approaches seem more appropriate to meet these needs. These approaches require to quantify metrics of the reef physical 3D structure and vital rates of corals (growth, survival, fecundity). However, these metrics are very tedious to estimate using conventional methods. Photogrammetry is a promising tool to track coral demographic rates. Unlike earlier efforts to track demographic rates, the cost-effective scale of photogrammetry provides the spatial extent and resolution needed to link demography to environmental patterns and to evaluate the effects of sustained disturbances threatening the structure and function of coral reef habitats. This presentation will discuss the methods used to quantify demographic rates of corals and their application as proxies for ecosystem integrity in an emerging era of large-area, high-resolution, three-dimensional data of coral reefs. Novel technology eases the access to and improves measures of coral vital rates. In turn, improved demography metrics inform reef monitoring, management and conservation.

4.00pm

Improving the current understanding of coral reef thermal dynamics and its implication for predicting coral bleaching

Valerie Cornet[a,b]

[a]*James Cook University &* [b]*AIMS@JCU, valerie.cornet@my.jcu.edu.au*

The link between increasing water temperature and coral stress is undeniable. However, there remain questions concerning the sensitivity of coral responses to heat exposure related to past thermal history and its effect on acclimatization in corals. The project discussed will use existing satellite-derived and in situ temperature data, together with databases of coral bleaching observation. It will do so by investigating how impacts vary based on novel considerations of temperature history, including SST trends, the rate of SST increase, and the temperature variability during winter and summer months. In addition, current coral bleaching prediction outlooks will be evaluated to identify potential areas for tool improvement. Finally, drone-based change detection will be conducted as drone platforms can provide high spatial and temporal resolution imaging to provide better understanding of fine-scale changes within coral reef ecosystems over time.

4.15pm

Identification of polyacrylate in the skeleton of *Acropora millepora*, and its potential role in coral calcification

Felicity Kuek[a,b,c], Jean-Baptiste Raina[d], Peta Clode[e], Thomas Becker[f], David Bourne[b,c], David Miller[b] & Cherie Motti[c]

[a]*AIMS@JCU;*
[b]*James Cook University;*
[c]*Australian Institute of Marine Science;*
[d]*University of Technology, Sydney;*
[e]*University of Western Australia;*
[f]*Curtin University*

Acrylate is directly derived from DMSP catabolism and is produced in high concentrations by fast-growing, reef-building corals, including *Acropora millepora*, constituting a substantial carbon source in the coral holobiont. While possible functions of acrylate in corals have been hypothesized, the reason for its accumulation in these organisms is still unknown. In industrial applications, its polymerised form, polyacrylate, can produce a stable scaffold for the precipitation of calcium carbonate ($CaCO_3$), which is the major component of coral skeleton. One-week old aposymbiotic *A. millepora* juvenile corals were supplemented with ^{13}C-labelled acrylate and the coral skeleton examined using nanoscale secondary ion mass spectrometry (NanoSIMS) and confocal Raman spectroscopy, for the presence of polyacrylate. Although the NanoSIMS results were inconclusive, polyacrylate was detected by Raman at the growing edge of the skeleton, suggesting a role in the biomineralization of $CaCO_3$ and growth of the skeleton. These results suggest the presence of an alternate biomineralization mechanism that can be adopted by acrylate-producing corals, potentially contributing to the fast accretion rate of these coral genera.

4.30pm Speed Talk

Quantifying the role of grazing fishes on the survival of seeded corals for direct restoration

Taylor Nicole Whitman[a,d], A/Prof Mia Hoogenboom[c,d], Dr. Andrew Negri[b] & Dr. Carly Randall[b]

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[b]*Australian Institute of Marine Science, 1526 Cape Cleveland Road, Cape Cleveland, QLD 4810, Australia;*
[c]*James Cook University, 1 James Cook Drive, Douglas, Townsville, QLD 4811, Australia;*
[d]*ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townville, QLD 4811, Australia*

Coral seeding, harnessing the high fecundity of sexually propagating corals, shows promise to help reefs persist in an uncertain future. However, grazing-induced coral mortality from reef fishes are challenging the effectiveness of this technique. We tested devices with micro-refugia to prevent grazing dislodgement and damage on small, seeded corals. We identified recruits and micro-fragments on devices with micro-refugia were 2.5 times more likely to survive than counterparts without refuge, and in extreme cases, > 95% of exposed corals were grazed in < 48 hrs. Thus, seeding corals on optimised devices represents one method to facilitate coral survival for direct restoration.

4.35pm Speed Talk

Reef fishes only pick fights with individuals of the same species

Alfonso Ruiz Moreno[a,b,c], Sean R. Connolly[c,d] & Mike Emslie[a]

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[b]*ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, QLD 4811 Australia*
[c]*College of Science and Engineering, James Cook University, Townsville, QLD 4811 Australia*
[d]*Smithsonian Tropical Research Institute, Panama City, Panama*

Competitive interactions among reef fishes are believed to be important in structuring reef fish communities. However, quantifying these interactions using experimental manipulations of reef fish densities is logistically impossible for such a diverse assemblage. Instead, I fitted a multivariate time-series model to species-level reef fish abundance data from the AIMS LTMP to estimate community dynamics parameters. My results show that interspecific species competition is negligible, and that reef fish abundance dynamics are driven by density-dependence and variability among species in demographic rates, revealing largely individualistic dynamics and strong niche structures.

4.40pm Speed Talk

The potential role of dimethylsulfoniopropionate and acrylate in coral skeleton formation

Geoffrey Yau[a,b,c]

[a]*Australian institute of Marine Science, Townsville, Queensland, 4810, Australia.;*
[b]*James Cook University, Townsville, Queensland 4811;*
[c]*AIMS@JCU, Townsville, Queensland 4811, Australia*

Coral is one of the largest producers of dimethylsulfoniopropionate (DMSP) with most derived from the endosymbiotic Symbiodinaceae within the tissues, though the coral animal is also able to produce DMSP. DMSP and its breakdown products dimethyl sulphide and acrylate have important ecological function in global sulphur cycling. High levels of DMSP and acrylate are present in fast growing Acroporids while low or undetectable levels are found in slower growing non-Acroporid species. These compounds are hypothesised to be critical in rapid skeleton formation. Here I investigate if DMSP and acrylate have an additional function in the coral calcification process.

4.45pm Speed Talk

The seasonal and spatial effects of algae on coral demography

Martina Burgo[a,b], Andrew Hoey[a], Katharina Fabricius[c] & Morgan Pratchett[a]

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[b]*AIMS@JCU, James Cook University, Townsville, QLD 4811, Australia;*
[c]*Australian Institute of Marine Science, Townsville, QLD 4810, Australia*

Global coral cover has declined by 14% in the past decade in correspondence with a 20% increase in algal cover on reefs. While algae are natural reef components, a shift form coral- to algal- dominance reduces habitat structural complexity, leading to loss of biodiversity and key ecosystem services. To relieve competitive pressure on corals and help reef recover, proposed management strategies often involve algal removal. However, lack of knowledge of seasonal and spatial dynamics of coral-algal interactions could limit the success of these interventions. My project aims to study how algae limit coral replenishment across time and space.

4.50pm Speed Talk

Physio-chemical Properties of Microplastics Influence Egestion by Predatory Fish

Amanda Dawson[a], Marina Santana[a,b], Frederike Kroon[a,c] & Hannah McCarthy[b,c]

[a]*Australian Institute of Marine Science (AIMS), Townsville, QLD 4810, Australia*
[b]*College of Science and Engineering, James Cook University, Townsville, QLD 4811, Australia*
[c]*AIMS@JCU, Division of Research and Innovation, James Cook University, Townsville, QLD 4811, Australia*

Little is known regarding the persistence of microplastics within fish, particularly predatory fish. Microplastics are often isolated from the gastrointestinal tract of fish sampled from the environment, but the concentration and detection frequency tend to be extremely variable amongst organisms within sample populations. This study compared depuration of model microplastics with varying physio-chemical properties. Microplastic dosed pellets were offered to juvenile *Lates calcifer*, thereafter, stomach contents were sampled. To quantify depuration rates, the gastrointestinal tract was chemically digested, filtered and enumerated. Presented here is the retention and egestion rate of microplastics from the GIT based on size, shape, and polymer.

Poster

Investigating the impacts of the temperature dependence of *Trichodesmium* on the timing and distribution of *Trichodesmium* blooms in the Great Barrier Reef

Chinenye J. Ani[a,b,c], Stephen Lewis[d], Scott Smithers[d] & Barbara Robson[b]

[a]*College of Science and Engineering, James Cook University, Townsville, Australia*
[b]*Australian Institute of Marine Science, Townsville, Australia*
[c]*AIMS@JCU, James Cook University, Townsville, Australia*
[d]*Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER), James Cook University, Townsville, Australia*

Extreme temperature increases have been shown to reduce *Trichodesmium* growth and nitrogen fixation. Presently, the temperature dependence of *Trichodesmium* physiological processes is exponentially parametrised by the CSIRO Environmental Modelling Suite (EMS), which simulates the physical state and water quality of the Great Barrier Reef (GBR). However, the exponential parameterisation of the temperature dependence of *Trichodesmium* physiological processes is no longer suitable for the continuing temperature increases in the GBR. To accurately capture the effects of extreme temperature increases occurring in the GBR, the temperature dependence of *Trichodesmium* physiological processes is optimally parameterised based on observations from published literature. Further, using the generalised additive model (GAM), emergent patterns in model outputs were shown to agree with that of sparse GBR field data. This shows that the EMS *Trichodesmium* growth model captures the effects of extreme temperature increases on *Trichodesmium* abundance in the GBR. The use of GAM to compare emergent patterns in sparse field data with simulated model outputs allows the improvement of model parameterisation when there is limited field data for traditional model calibration. Our findings will help improve EMS predictions of *Trichodesmium* dynamics. Improved EMS predictions of *Trichodesmium* dynamics is of great importance as *Trichodesmium* is an important source of 'new nitrogen' in the GBR which is important for phytoplankton growth.

Poster

Spatiotemporal trends in oxygen and pH on two fringing inshore reefs

Stephanie Di Perna[a,b,c,d], Mia Hoogenboom[a,b] & Katharina Fabricius[c]

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[b]*ARC Centre of Excellence in Coral Reef Studies, James Cook University, 1 James Cook Drive, Douglas, QLD 4814*
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Successful conservation efforts and predictions in the face of climate change rely on our understanding of ecological patterns, especially for sublethal impacts such as coastal acidification. The present study aims to investigate the spatiotemporal patterns of pH and oxygen on two fringing, inshore reefs in the central Great Barrier Reef. Benthic water chemistry and environmental conditions were recorded on Magnetic Island for a full tidal cycle. Twenty sites across two bays were tracked, covering the reef slope, crest and flat as well as two offshore reference sites. At four sites (one crest and one flat site per bay), chemical (oxygen and pH) and physical (light, depth, water velocity, temperature, salinity) conditions were measured continuously. Benthic water samples and depth measurements were collected manually at the remaining sixteen sites twice a day, at daybreak and at noon. Benthic surveys were conducted at all sites except the two offshore sites (>12m). Overnight, pH dropped to ~7.8, with oxygen content below 40% saturation. During the day, depending on depth and benthic composition, pH neared 8.0 while oxygen often exceeded 120% saturation. Light and depth played an important part in driving the patterns, whereas a monsoonal event impeded our ability to track the full influence of the tidal cycle. Our statistical model thus far fits the data well in the continuous sites. Our inshore coral reefs are already experiencing pH conditions predicted for 2100 by the Intergovernmental Panel on Climate Change. Predictions used for conservation policy must be based on local conditions and variability.

Poster

Effect of age and climate stressors on the microbiome of tropical urchins across generations

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Microbes have been documented to have a critical role in the development and health of some marine invertebrate host species. However, microbial dynamics across host generations remain poorly understood in most reef species, especially in the context of climate change. Here, we use a four-year multigenerational experiment to explore microbe-host interactions under IPCC-forecast future climate scenarios in the reef urchin *Echinometra* sp. *A*. Adult urchins were exposed for 18 months to increased temperature and pCO_2 levels predicted for years 2050 and 2100 under RCP 8.5, a period which encompassed spawning. The F1 offspring were reared for two years under these treatment conditions and induced to spawn with the F2 larvae raised under treatment conditions for one week. Amplicon 16S rRNA gene sequence analysis characterized the bacterial community across major life stages, generations and climate treatments. Although each life stage was associated with a distinct microbiome, no microbial community-wide variation across climate scenarios was detected. These results suggest that the urchin microbiome is stable across life stages under projected temperature and pCO_2 conditions predicted for 2050 and 2100.

Poster

Bioaccumulation and biomagnification of microplastics in marine organisms: A review and meta-analysis of current data

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Microplastic (MP) contamination is well documented across a range of organisms in the marine environment. Consequently, bioaccumulation, and in particular biomagnification of MPs and associated chemical additives, are often inferred. Presented are the results of a systematic literature review to examine whether current findings support the premise that MPs and associated chemical additives bioaccumulate and biomagnify across a general marine food web. First, field and laboratory-derived contamination data on marine species were standardised from 116 publications. Second, following trophic level assignment of each species, the average uptake of MPs and associated chemical additives was estimated. These uptake data within and across the five trophic levels were then critically examined for any evidence of bioaccumulation and biomagnification. Findings corroborate previous studies that MP bioaccumulation occurs within each trophic level, while current evidence for associated chemical additives is much more ambiguous. In contrast, MP biomagnification across a general marine food web is not supported by current field observations, while results from the few laboratory studies supporting trophic transfer are hampered by using unrealistic exposure conditions. Further, a lack of field and laboratory data precludes an examination of potential trophic transfer and biomagnification of chemical additives associated with MPs. Combined, these findings indicate bioaccumulation of MPs occurs within trophic levels, yet no clear sign of MP biomagnification *in situ*. Recommendations to investigate ingestion, retention and depuration rates for MPs and chemical additives under realistic conditions, and on examining the potential of multi-level trophic transfer for MPs and chemical additives have been made.

Poster

Co-culture can significantly improve coral recruits' survival and growth

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High early mortality of recruits is a limiting factor in the expansion of coral aquaculture. One factor contributing to this is competition between recruits and algae, thus co-culture of corals with small herbivores has been suggested as a method to improve recruit survival and growth. We tested this method using recruits from five species of coral: *Acropora millepora*, *A. tenuis*, *A. secale*, *Porites lobata* and *Platygyra daedalea*, with three species of grazers: gastropods *Calthalotia strigata* and *Turbo haynesi*, and juvenile seastar *Acanthaster* cf. *solaris*. Using five different treatments: *Thalotia*, 30 C. *strigata* per tank, *Turbo*, 30 *T. haynesi* per tank, COTS, 30 *A*. cf. *solaris* per tank, Mix, 10 *C. strigata*, 10 *T. haynesi* and 20 *A*. cf. *solaris* per tank, and Control with no grazers, we tracked coral survival and growth over 6-months grow-out, with four replicate 50L tanks per treatment. Over six months, *C. strigata* produced the highest survival in *A. millepora* (51.6% ± 5.24%), *A. tenuis* (46.6% ± 3.16%) and *A. secale* (38.5% ± 3.48%), but *T. haynesi* resulted in higher survivals for *P. lobata* (67.3% ± 3.76%) and *P. daedalea* (100% ± 0%). These results represented significant improvements in survival compared to the Control for all coral species, and growth in Acroporid recruits was also higher under co-culture with the gastropod grazers. These results provide evidence that co-culture could be used to enhance ex situ coral propagation, particularly with species such as *A. millepora* that are used widely in both reef restoration and the ornamental trade.

Poster

Drivers of differential acute heat tolerance in *Pocillopora verrucosa* on the southern Great Barrier Reef

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Increasing seawater temperatures pose a significant challenge to the continued survival of many tropical corals due to the increased threat of bleaching. However, corals exhibit differential thermal tolerance and resilience to bleaching both within and among species and across populations. The causes of this variation are not well-understood. It is likely that genetic and physiological mechanisms as well as the capacity for plasticity in organismal stress responses underpin differential thermal tolerance in tropical corals.

To assess the variation in thermal tolerance across multiple coral populations, we conducted acute thermal stress assays on *Pocillopora verrucosa* across four reefs on the southern Great Barrier Reef (GBR). The field-collected corals were randomly distributed across four treatments (Maximum Monthly Mean temperature, +3°C, +6°C, +9°C) following standardised protocols. We quantified multiple physiological responses associated with heat stress to provide an insight into the physiological mechanisms underpinning acute heat tolerance. To compare thermal tolerance between populations, we estimated LD50 temperature thresholds based on the physiological responses across treatments and found a tolerance difference of 2.6 °C between reefs. Observed differences in thermal tolerance are then examined with respect to environmental characteristics and thermal history of each reef.

This study examines coral responses to acute heat stress using a modern field-based approach to thermal stress assays. The study forms part of a larger effort to examine whether physiological responses to acute heat stress differ between populations along the latitudinal extent of the GBR as part of a global effort to examine coral thermal tolerance throughout the tropics.

Poster

The effect of porosity on the reactivity of microplastics during extraction processes

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An exponential increase in global plastic production has led to an increase in improper disposal into the world's oceans. Microplastics (MPs, 1µm – 5mm) pose a unique threat to the marine environment as they are small and highly mobile, and thus easily ingested by a wide range of organisms. Ingested MPs can cause starvation, oxidative stress and trophic transfer in the food chain. Therefore, understanding the mechanisms of MP ingestion and toxicity is paramount, and has led to the development of extraction processes to quantify MPs in marine matrices. Recent studies show chemical processing of complex matrices can cause physical and chemical changes to MPs, resulting in misidentification and underestimations of MP abundance. Surface weathering has been postulated to make MPs more susceptible to chemical degradation.

To investigate the effects of surface characteristics on MP reactivity during chemical processing, 'weathered' polystyrene (PS) MPs were prepared. Changing the plastic:solvent ratio used to dissolve PS beads, the drying method, and grinding in the presence of NaCl produced four MPs simulating different weathered surfaces: smooth, low porosity, aerated and salted. Surface morphology of weathered MPs subjected to chemical processing did not affect reactivity under caustic or hypersaline conditions, even at high temperatures, but is a factor when MPs are exposed to nitric acid, leading to discolouration, nitration, reduction in molecular weight and reduced polydispersity.

As such, the use of HNO_3 as a processing reagent should be limited to low concentration and low temperature digestions. The findings of this study indicate that KOH, NaOH, and H_2O_2 did not significantly alter the reactivity of PS MPs regardless of porosity, morphology, or processing conditions. Due to the increased degradation of the aerated plastic, it is recommended that future studies explore how varying the shape and morphology of different MPs will impact reactivity.

Poster

How can microplastics and seawater temperature affect the behaviour of damselfish (*Acanthochromis polyacanthus*)?

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Microplastics (MP) and sea surface temperatures (SST) are predicted to reach levels that can significantly affect marine life by the end of the century. Coral reefs across the world are important and sensitive ecosystems that are already facing other significant pressures, such as climate change. The influence of rising sea surface temperatures caused by climate change is a primary driver of the degrading health of coral reefs through bleaching and habitat death. However, the effects of such interactions on coral reef organisms such as damselfish are still poorly understood. Planktivorous damselfish are abundant inhabitants of tropical coral reefs that significantly contribute to the nutrition recycling of the reef. This study examined the effect of different MP concentrations (0, 1.1 and 11 MP per litre) and SST (ambient, ambient + 1.5ºC and ambient + 3.0ºC) on the aggressive behaviour of spiny Chromis (*Acanthochromis polyacanthus*). Fish were continuously exposed to polyester (PET) fibres (including control) through an automated system and kept at elevated SST for eight weeks. Fish were recorded during feeding and non-feeding events in order to capture potential aggressive behaviour. Validation of MP uptake showed that fish ingested PET fibres across all MP treatments, with marked increases of PET fibres at higher MP concentrations and elevated SST. MP concentrations and elevated SST affected the observed behaviours separately, with MP concentration influencing the less energy-dependent swoops, and SST affected the more energy dependent chases and the overall aggression experienced by the fish. These results suggest that MP and SST affect damselfish's aggressive behaviour, but without interaction between the two stressors. These findings raise concerns about the effects of higher concentrations of MP and increasing SST predicted for the future.