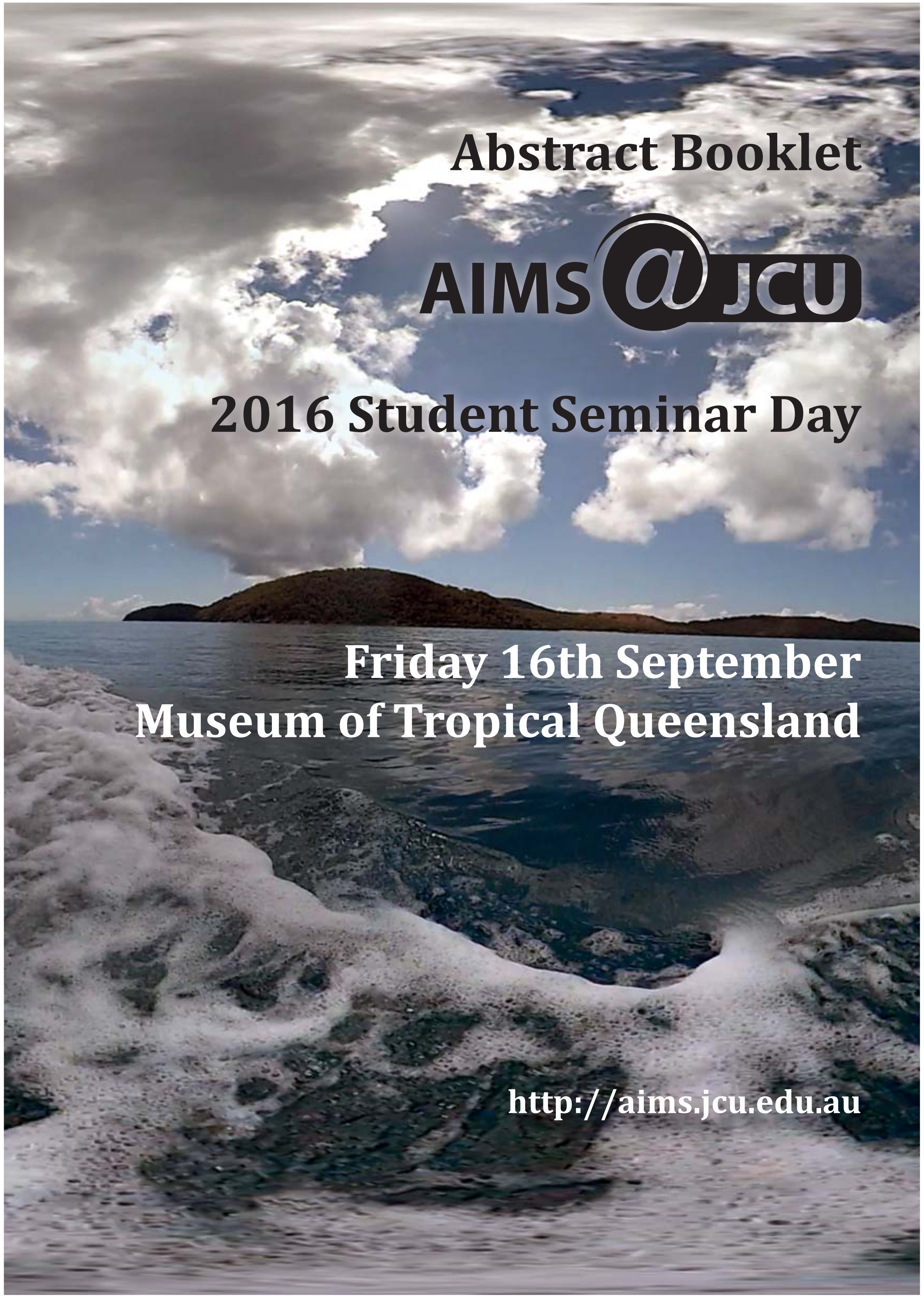

Abstract Booklet

AIMS@JCU

2016 Student Seminar Day

Friday 16th September
Museum of Tropical Queensland

http://aims.jcu.edu.au

AIMS@JCU Student Seminar Day 2016 Schedule

Time	Title	Presenter
9:00 am	**Opening address**	**Libby Evans-Illidge**
	Session 1 - Impacts & adaptation in the holobiont	
9:15 am	Chemically dispersed oil impacts on coral microbiome	Prashant Nair
9:30 am	Rapid temperature adaptation in photosymbionts of reef-building corals	Leela Chakravarti
9:45 am	Long-term seasonal variation of microbes in a brooding coral	Hannah Epstein
10:00 am	The effect of a changing marine environment on the bioeroding sponge *Cliona orientalis*	Blake Ramsby
10:15 am	**Morning tea, view posters and photographs**	
	Session 2 - The role of viruses in the holobiont	
11:00 am	How a coral pathogen fights viral infections?	Patrick Buerger
11:15 am	A PCR-based assay to study a *Symbiodinium* ssRNA dinornavirus-like virus	Jose Montalvo Proano
11:30 am	Diversity and function of viruses in coral reef sponges	Cecília Pascelli
	Session 3 - Fish Physiology	
11.45 am	Hypoxia tolerance in fish: assessing phenotypic diversity and temporal repeatability among populations	Geoff Collins
12 midday	Diel CO_2 fluctuations modulate the severity and onset of behavioural impairments caused by ocean acidification in coral reef fish	Michael Jarrold
12:15 pm	**Lunch with poster session and view/vote on photographs**	
1:30 pm	**AIMS@JCU Alumni Keynote**	**Dr. Chiara Pisapia**
	Session 4 - Coral reef ecology	
2:00 pm	Dynamic coral cover model for the Great Barrier Reef: Growth, disturbance and recovery	Sam Matthews
2:15 pm	Revisiting depth-diversity gradients in reef-building corals	Thomas Roberts
2:30 pm	Diving into the deep-end: Fish assemblages on deep shelf-break reefs vary with depth and habitat	Tiffany Sih
2:45 pm	**Speed talks**	
3.00 pm	**Closing remarks and judges deliberation**	**Prof. Helene Marsh**
3:30 pm - 6.30 pm	**Presentation of awards and prizes; end of day function with drinks and canapés provided**	

9.15am

Chemically dispersed oil impacts on coral microbiome

Prashant Nair[b], Lone Hoj[a], Michael Oelgemöeller[b] & Kirsten Heimann[b]

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Oil spills are extremely harmful to coral ecosystems. Currently, synthetic chemical dispersants are used to diffuse floating oil slicks into the seawater column. This sudden petrochemical flux presents opportunity for unique obligate hydrocarbon remediating bacteria (OHCB) that rapidly multiply on hydrocarbons as sole energy source. Recent scientific reports suggest however that the performance of such natural bacterial oil assimilators can be limited by dispersant toxicity. The dispersants alter marine microbial community structure and slow down the natural oil removal processes. Moreover, persistence of dispersant-oil fractions in sensitive reef habitats can significantly disrupt vital coral-bacterial symbiotic associations. Unfortunately, data on the impacts of oil dispersants on coral microbiomes is absent to date. Regional port expansions and resulting increase in maritime traffic significantly increases oil spill risk at the Great Barrier Reef (GBR). This project aims to explore the diversity and efficiency of indigenous bacterial populations to degrade oil and dispersants in Australian environments by using next generation sequencing technologies. It will investigate the physicochemical needs for OHCB performance in tropical GBR conditions. Dispersant impacts on oil degrading bacterial oligotypes will be studied by algorithm-based oligotyping. Finally, oil and/or dispersant-induced toxicity assessment on selected Pacific coral-bacterial assemblages will be performed for the first time. Using a combination of standardised toxicity tests, bacterial toxicogenomics and dispersant safety evaluation on coral health, this project will generate useful data to make informed decisions for future dispersant usage in reef waters.

9.30am

Rapid temperature adaptation in photosymbionts of reef-building corals

Leela J. Chakravartia,[b,c,d]*, Victor H. Beltran[a] & Madeleine J. H. van Oppen[a,e]

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Climate warming is occurring at a pace not experienced by life on Earth for at least 10s of millions of years and has negatively affected terrestrial and marine ecosystems. On coral reefs, rising seawater temperatures cause the breakdown of the critical association between the coral animal and its intracellular photosymbionts, *Symbiodinium* spp., leading to bleaching and often coral mortality; it is unknown whether the coral-microalga symbiosis can evolve to withstand further climate warming. Here we present evidence for an increase in the upper temperature tolerance of *Symbiodinium* C1 after only ~78 asexual generations of laboratory thermal selection; selected cells outperformed wild type cells *in vitro* for photosynthetic performance, growth rate and oxidative stress tolerance at 31°C and performed no worse at ambient (27°C). In symbiosis, the selected *Symbiodinium* were able to enhance coral performance under thermal stress by slowing the rate of bleaching for two of three coral species tested. Our results will help refine predictive models of reef futures in an era of climate warming, and indicate that experimental evolution of *Symbiodinium* is a valuable strategy to increase thermal tolerance of reef-building corals, with potential applications in coral reef conservation and restoration.

9.45am

Long-term seasonal variation of microbes in a brooding coral

Epstein H[a,b], Torda G[a,b], Cantin N[a], Munday P[b,c] & van Oppen M[a,b,d]

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Scleractinian corals are some of the most diverse holobionts ever studied. Corals harbor unique symbioses with an abundant variety of eukaryotic and prokaryotic microorganisms that are crucial to their health and functioning, which include photosynthetic dinoflagellates (*Symbiodinium*), protists, fungi, bacteria, archaea and acellular viruses. Research surrounding the basic community structure of the coral microbiome has increased recently with the use of new technologies and innovations that allow researchers to study microbes *in-situ*. However, the natural dynamics and variations of these coral-associated microbial communities over long time frames and how these variations may affect the health and survival of corals are poorly understood. Microbial communities of tagged *Pocillopora acuta* colonies were examined over one year at Orpheus Island, central Great Barrier Reef. Sampling was conducted during the 2015-2016 summer to assess seasonal variation as well as the initial changes and potential recovery in coral-associated microbial communities through a natural temperature stress event. The diversity of *Symbiodinium*, bacteria, archaea and fungi has been and will be assessed using amplicon next generation sequencing. Preliminary results suggest limited variation in the *Symbiodinium* community, but are as of yet inconclusive of the other microbial community dynamics. Understanding the seasonal and long-term changes in the microbial community, as well as changes that occur throughout a major temperature stress event, will provide insight into how the coral-associated microbiome may be affected by variations in sea surface temperatures due to future climate-related environmental change, and how this may influence the health and survival of the coral host.

10.00am

The effect of a changing marine environment on the bioeroding sponge *Cliona orientalis*

Blake Ramsby[a,b], Steve Whalan[c], Mia Hoogenboom[b], Marcus Sheaves[b] & Nicole Webster[a]

[a]*Australian Institute of Marine Science*
[b]*James Cook University*
[c]*Central Caribbean Marine Institute*

Excavating sponges, such as *Cliona* spp., break up the coral reef substratum, thereby influencing net reef accretion. Sponge erosion is expected to accelerate as oceans become warmer and more acidic, with *Cliona* spp. expected to play a major role in future reef erosion. In addition, a greater abundance of *Cliona* is evident at sites with poor water quality, suggesting that sponge erosion may have a greater impact on inshore reefs. This project investigated the effects of temperature, dissolved nutrients, and ocean acidification on *Cliona orientalis* and its associated *Symbiodinium*. Sponges were exposed to temperatures increasing from 23-32°C to quantify the ability of *C. orientalis* to acclimate to elevated temperature. As seen in many coral species, the sponge symbiosis bleached at high temperatures and the photosynthetic capacity of *Symbiodinium* was compromised. In a separate experiment, cores of *C. orientalis* and *Porites sp.* were simultaneously exposed to elevated *p*CO2 and dissolved nutrients to evaluate whether the two taxa respond similarly to stressors associated with inshore coral reefs. Erosion, calcification, and oxygen flux rates indicate that *C. orientalis* had less-severe responses to elevated nutrients and elevated *p*CO2 than *Porites* sp., suggesting that the bioeroding sponge is more likely to tolerate future conditions on inshore reefs.

11.00am

How a coral pathogen fights viral infections?

Buerger P[a,b,c,d], Weynberg, K. D.[a], Wood-Charlson E.M.[d], Willis B.L.[b] & van Oppen M.J.H.[a,e]

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The majority of known bacteria are equipped with an immune system that prevents infection by viruses and mobile genetic elements. Foreign intruders are identified via a short fingerprint of their DNA that is stored as a template in the bacterial genome, the so-called "clustered regularly interspaced short palindromic repeats" (CRISPR). We demonstrate that the dominant cyanobacterium in the black band disease mat, is equipped with such a CRISPR immune system. Analyzing CRISPR templates reveals previous bacteriophage infections and provides insights into interactions between viruses and the pathogenic cyanobacteria. Our results suggest that the black band disease mat is a hot spot for viral infections and that cyanobacteria are in a constant arms race with bacteriophages. This presentation summarizes the cyanobacterial CRISPR system and associated DNA fingerprints stored in the cyanobacterial genome. A role for viruses in black band disease has not been previously considered.

11.15am

A PCR-based assay to study a *Symbiodinium* ssRNA dinornavirus-like

Jose Montalvo-Proaño[a,b], Karen Weynberg[a], Patrick Buerger[a], Bette Willis[b] & Madeleine J. H. van Oppen[a,c]

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[b]*ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, Qld, Australia*
[c]*University of Melbourne, Melbourne, Vic, Australia*

The *Symbiodinium*-coral association is unquestionable as an evolutionary mechanism of scleractinian corals to obtain energy and maintain tropical reefs. The endosymbiosis breakdown (i.e. coral bleaching), has been mostly attributed to environmental stressors or bacterial infection, and only recently hypothesized as a potential consequence of viral lysis of *Symbiodinium*. This study used a metavirome dataset generated from coral tissue to develop novel primers for a PCR-based assay for examining the presence and diversity of the dinornavirus-like targeting *Symbiodinium*. Our results confirm the possibility of targeting viral groups, with 99.8% of reads showing its closest taxonomic affiliation with the ssRNA dinornavirus-like, *Heterocapsa circularisquama* RNA virus (HcRNAV), and high sequence diversity encompassing a 26-52% similarity to its major capsid protein (MCP) gene. Also, the majority of reads were clustered into a few large-OTUs, with some similarities on the distribution among samples, which may be a representation of a dominant strain of dinornavirus-like present in the corals tested. The phylogenetic analysis of our RNA viromes revealed similarities to previous published data on viruses associated with corals and *Symbiodinium* cultures. Therefore, evaluating presence and diversity of specific viral groups, rather than whole communities, improves our understanding of the role of viral lysis on coral bleaching events.

11.30am

Diversity and Function of Viruses in Coral Reef Sponges

Cecília Pascelli[a,b,c], Patrick Laffy[c], Marija Kupresanin[d], Emmanuelle Botte[c], Karen Weynberg[c], Thomas Rattei[e], Timothy Ravasi[d] & Nicole Webster[a,c]

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[e]*CUBE University of Vienna*

Viruses are ubiquitous biological entities that regulate diverse biological processes. However, despite their abundance, we have limited knowledge about how viruses interact with marine hosts, particularly with sponges, which are ecologically important components of coral reef environments. As marine holobionts, sponges can harbor dense communities of microorganisms and this high symbiont complexity makes them an ideal model for studying host-virus interactions. Morphological and molecular approaches were used to describe the diversity and function of viruses in some of the most representative coral reef sponge species from the Great Barrier Reef (GBR) and the Red Sea (RS). Sponge viruses were isolated from their hosts, viral metagenomes were sequenced and taxonomic composition and function were assessed using a customized bioinformatic pipeline designed specifically for analysis of holobiont metaviromes. In addition, Transmission Electron Microscopy (TEM) was used to morphologically characterize the viral particles within the holobiont. Initial molecular analyses indicate that sponges host a wide diversity of bacterial and eukaryotic viruses including abundant Caudovirales and representatives of Poxviridae, Phycodnaviridae and Microviridae. TEM analysis of different sponge species further revealed that distinct icosahedral virus-like particles were associated with both sponge and bacterial cells. Multivariate analysis demonstrated that the viral communities are sponge host specific, and indicated that the viral community associated with each sponge species does not vary with geographic location. Functional gene analysis demonstrated the presence of environmental accessory genes associated with heavy metal resistance and nylon degradation in the Red Sea sponges, indicating that viral genes may contribute to local sponge acclimation.

11.45am

Hypoxia tolerance in fish: assessing phenotypic diversity and temporal repeatability among populations

Geoffrey M. Collins[a,b], Alexander G. Carton[a] & Timothy D. Clark[b,c]

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Dissolved oxygen (DO) displays large spatial and temporal variation in coastal and freshwater aquatic systems throughout the tropics. Hypoxia occurs in many natural systems, however sustained pressure from human development and deteriorating water quality can amplify the selection pressure on individual phenotypes within fish populations. Despite an increasing focus on dissolved oxygen (DO) as an environmental parameter of concern, intra-specific variability in hypoxia tolerance and its influence on metabolic regulation, growth and survival remain poorly understood.

We compared metabolic and growth performance traits in barramundi (*Lates calcarifer*) that had been assigned to three hypoxia tolerance groups (sensitive, intermediate or tolerant), based on loss of equilibrium (LOE) tests. Groups of fish were subjected to further LOE tests after ~3 months to assess the temporal repeatability of hypoxia tolerance. The group-level time to LOE did not correlate with feeding or growth rates in normoxia but was weakly, yet significantly, repeatable. Surprisingly, we found no relationship between the median time to LOE (LT_{50}) and critical oxygen tension (P_{CRIT}) across the tolerance groups.

This study highlights the broad range of hypoxia tolerance phenotypes present within barramundi populations, and the difficulties in characterising environmental tolerance in fish on the basis of single measurements.

12 midday

Diel CO_2 fluctuations modulate the severity and onset of behavioural impairments caused by ocean acidification in coral reef fish

Michael D. Jarrold[a,b,c]*, Craig Humphrey[c], Mark I. McCormick[a,b] & Philip L. Munday[a]

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Sensory performance and behavioural responses of coral reef fishes are impaired by CO_2 levels projected to occur by the end of the century. Experiments to-date on behavioural effects of elevated CO_2 have used steady-state treatments. However, coral reefs experience diel CO_2 fluctuations that can be greater than the projected increase in CO_2 levels this century. It is therefore unknown how natural CO_2 fluctuations will interact with rising mean CO_2 levels to affect the behavioural performance of coral reef fishes under ocean acidification. Here, we reared juvenile damselfish, *Acanthochromis polyacanthus*, and clownfish, *Amphiprion percula*, under a series of stable (400, 750, 1000 µatm) and diel fluctuating CO_2 treatments (400 ± 300, 750 ± 300 and 1000 ± 300 µatm) before assessing their behavioral performance. Lateralization of *A. polyacanthus* was significantly reduced by exposure to 750 and 1000 µatm. However, juveniles reared under 750 ± 300 exhibited full restoration of lateralization. In contrast, no change in performance was observed for juveniles reared under 1000 ± 300 µatm. Predator cue response of Am. percula was also negatively impacted by exposure to 1000 µatm. However, juveniles reared under 1000 ± 300 µatm demonstrated partial restoration of antipredator behavior. Overall we show that diel CO_2 fluctuations can reduce the severity of behavioural impairments caused by ocean acidification. However, the extent of this reduction is dependent on the mean CO_2 level experienced. Finally, our results suggest that diel CO_2 fluctuations will delay the onset of behavioural impairments in natural populations, potentially allowing more time for acclimation/adaptation.

2.00pm

Dynamic Coral Cover Model for the Great Barrier Reef: Growth, Disturbance and Recovery

Matthews, Samuel[a,b], Mellin, Camille[b] & Pratchett, Morgan[a]

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[b]*Australian Institute of Marine Science, 1526 Cape Cleveland Road, Cape Cleveland 4810, Queensland, Australia*

Coral cover on the Great Barrier Reef has been in significant decline over the last 30 years. Despite innumerable reports quantifying the coral cover loss at varying spatial and temporal scales, a framework has yet to be developed to model the growth, disturbance and recovery of corals on the GBR. Here we develop a dynamic coral cover model for the GBR, integrating long term monitoring data from AIMS with modern modelling techniques to hindcast and predict coral cover over the past 30 years across the entire GBR (1x1km resolution). Coral growth is modelled using spatially explicit Gompertz growth curves derived from historical data and then generalised across the GBR using Boosted Regression Trees (BRT's) and Multivariate Regression Trees (MRT's). These methods respectively classify the environmental characteristics and benthic community assemblages for each surveyed reef and then predict for every reef in the GBR. Stochastic disturbances (Cyclones, Crown-of-thorns-Starfish, Bleaching and Disease) are interpolated from historical data and validated models and then applied probabilistically across the GBR. This approach incorporates the best data available coral cover and disturbances in order to understand past patterns of coral cover loss as well as predict coral cover recovery in the future. This model will be integral in identifying areas of the GBR disproportionately affected by disturbances, and identifying where we are likely to see further declines or recovery of coral cover in the near future.

2.15pm

Revisiting depth-diversity gradients in reef-building corals

T. Edward Roberts[a,b], Thomas C. Bridge[a,c], M. Julian Caley[d] & Andrew H. Baird[a]

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Species are not distributed evenly across geographical space, and understanding the mechanisms generating species' distributions is a fundamental goal of ecology. Among the most prominent of these patterns are changes in species richness over gradients (e.g. latitude, altitude, or depth). Depth is a strong environmental gradient on coral reefs, with depth zonation recognized as a ubiquitous feature of coral ecosystems. However, depth ranges of reef-building corals at any particular site are influenced by a combination of factors (e.g. turbidity, latitude). Species richness is considered to either decline with depth, or peak at intermediate depths (15-35 m), mirroring altitudinal richness gradients in terrestrial ecosystems. Understanding depth-diversity patterns is a crucial component of revealing how species occupy ecological and geographical space. However, robust analyses of depth-diversity relationships have been compromised by a chronic under-sampling of deeper habitats (> 20 m), and considerable changes in coral nomenclature in recent decades. As such, the generality of this pattern is questionable. Here, we use modern statistical techniques and a novel comprehensive, species-level data set conducted over a large depth gradient to revisit fundamental questions about depth-diversity relationships in reef-building corals. We show how species richness changes over depth, and identify ecological factors influencing depth ranges and depth-diversity relationships in corals.

2.30pm

Diving into the deep-end: Fish assemblages on deep shelf-break reefs vary with depth and habitat

TL Sih[a], M Cappo[b] & MJ Kingsford[c]

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Information on fish communities and habitats on deeper reefs (below 50m) is limited, despite greater fishing pressures worldwide. Baited Remote Underwater Video Stations (BRUVS) and multi-beam bathymetry were used to investigate deep-reef fish communities of the Great Barrier Reef shelf-break (Australia) between 50-300m depths. Fish species richness, diversity and habitat information in the field-of-view were recorded at the same locations where bathymetry and backscatter were collected. There were significant differences in fish assemblages across depths, with different dominant families and groups of species characterising broad depth categories. For the particular reefs studied, epibenthic encrusting organisms and filterers, and substrate categories such as calcified reefs, boulders, sand and rubble were important indicators of species richness. Multi-beam habitat derivatives such as shallower depth, multiple measures of rugosity, and steeper slopes were correlated with higher species diversity and greater overall abundance. This study resulted in novel geographic fish species records and also identified potential new species. BRUVS have proved useful as a fishery-independent method to survey fish communities, to identify potential "hot-spots" of biological diversity and new species, and to explore surprisingly diverse deep reefs.

Speed Talk

Microplastic contamination in Great Barrier Reef sediments

Kathryn Berry[a]

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There are increasing concerns that emerging contaminants such as microplastics may be harming marine species and ecosystems. Due to their ubiquitous presence, all ma-rine biota are at risk of interacting with microplastics and ingestion by marine biota is well-documented. Research into impacts and risks posed by these contaminants is increasing in Australia, and we are currently developing increased baseline information on the quantity and distribution of microplastics within the coastal environment of the World Heritage listed Great Barrier Reef (GBR). This presentation highlights new findings of microplastic contamination in beach and reef sediments from the GBR.

Speed Talk

Photo-dynamic inactivation of trouble algae in public marine aquaria

Carlos Bohórquez[a], Michael Oelgemöller[a] & Kirsten Heimann[a]

[a]*College of Science and Engineering, James Cook University, Townsville, QLD 4811, Australia.*

Bloom invasion events of marine flora are frequent. Public aquaria control incursions using a "good seawater quality" approach through sterilization, i.e. ozonification, ultraviolet light irradiation, chlorination and filtering. These techniques leaves toxic residues, are costly and not complete effective. A novel approach is to use a photo-dynamic inactivation treatment. Photo-dynamic inactivation produces single oxygen, by exposing a natural dye to visible light. Singlet oxygen cause death in microorganisms through membrane damage. This research will determine the effectiveness of this technique to control incursions of troublesome invasive algae in public aquaria.

Speed Talk

Microbes as future indicators for water quality and environmental stress assessment of coral reef ecosystems

Bettina Glasl[a]

[a]*Australian Institute of Marine Science, PMB3, Townsville, Queensland, Australia*

Microorganisms have a fundamental role in the functioning and stability of coral reef ecosystems. Environmental disturbances can trigger alterations of the natural community structure and/or the functional traits of coral reefs with potentially detrimental consequences for host organisms, such as corals, sponges and macroalgae and concomitant implications for the entire coral reef ecosystem. Defining the natural reef microbiome and microbial response patterns upon disturbances will allow the identification of environmental stressors at an early stage of environmental stress. Microbial indicators should provide useful indications on the ecological integrity of reefs and facilitate early management interventions.

Poster

Effects of coal contamination on tropical marine organisms

Kathryn LE Berry[a,b,c,d], Mia O Hoogenboom[b,c], Florita Flores[d] & Andrew Negri[d]

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[d]*Australian Institute of Marine Science, Townsville QLD, Australia*

Coal is a major export commodity of Australia and a large percentage of coal mined in Queensland is shipped through the Great Barrier Reef World Heritage Area (GBRWHA). Consequently, reef organisms such as corals, can be at risk from suspended and deposit-ed coal particles that might result from ship loading or spill events. Coal particles and dust are physically abrasive, block light penetration into the water column and contain potentially toxic hydrocarbons and trace metals. Despite this risk, the effects of suspended and deposited coal on tropical marine organisms of high conservation value remains largely unknown, making accurate environmental impact assessments of coal contami-nation difficult. This study conducted a series of controlled experiments exposing three taxa abundant in the GBRWHA (the coral *Acropora tenuis*, the reef fish *Acanthochromis polyacanthus*, and the seagrass *Halodule uninervis*) to a range of suspended coal dust (<63µm) concentrations (0-275mg/L) over 28d. Results demonstrate that chronic coal exposure can cause considerable lethal effects on corals, and reductions in seagrass and fish growth rates. Coral survivorship and seagrass growth rates were inversely related to increasing coal concentrations (≥ 38mg/L) and effects increased between 14 and 28d, whereas fish growth rates were similarly depressed at all coal concentrations tested. This investigation provides novel insights into direct coal impacts on key tropical taxa for application in the assessment of risks posed by increasing coal shipments in globally threatened marine ecosystems.

Poster

Connectivity and self-replenishment patterns of the coral reef fish *Lutjanus carponotatus* (Lutjanidae), along the Great Barrier Reef

Rodrigo Gurdek[a,b], Lynne van Herwerden[a], Jessica Benthuysen[b], Hugo Harrison[c] & Mark Baird[d]

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[b]*Australian Institute of Marine Sciences (AIMS), PMB No. 3, Townsville 4810, Australia*
[c]*Centre of Excellence for Coral Reef Studies (ARC), James Cook University, Townsville 4811, Australia*
[d]*Oceans and Atmosphere, CSIRO, Hobart 7000, Australia*

With relatively small home ranges and long pelagic larval phases, *L. carponotatus* is largely dependent on currents to link their Great Barrier Reef (GBR) sub-populations. Due to the ecological importance, life history characteristics and fishing pressure, a comprehensive understanding of the population connectivity of the species at contemporary time scales is required. To date no larval dispersal simulations, or extensive genetic studies, have been applied to analyse connectivity/ self-replenishment of *L. carponotatus* in the GBR. The present project aims to determine those patterns, among and within different islands (Palm, Whitsunday, Percy, Keppel and Capricorn groups), along the GBR. A combination of genetic and genomic analyses (SNPs, DArT sequences), along with hydrodynamic and biogeochemical model simulations (eReefs), will be included. The connectivity tools, Connie 3 (4km scale) and the Connectivity Modeling System (500m), will be accessed to estimate connectivity and self-replenishment levels, in contrasting weather events: El Niño/ La Niña/ Neutral. The phylogeography of the species around Australia, will also be described. Primary outcomes have determined differences in the dispersal patterns according to weather events. La Niña events were accompanied by further north larvae dispersions, as well as longer dispersal patterns, in contrast to El Niño scenarios. Likely destinations of larvae occurred in inshore areas along the GBR, with connectivity scales of hundreds of kilometers. Outcomes of the project will enable effective designation of MPAs, management policies, and predictive scenarios for the dynamics of the species.

Poster

Cost-efficient management of cumulative impacts on coral reef ecosystems under uncertainty

Vanessa Haller[a,b], Michael Bode[a,d], Garry Russ[b], Ken Anthony[c] & Terry Walshe[c,d]

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[b]*College of Science and Engineering, James Cook University, Townsville*
[c]*AIMS@JCU, Australian Institute of Marine Science , Townsville*
[d]*University of Melbourne, Melbourne*

Coral reef ecosystems are valuable, charismatic and well-researched marine ecosystems, but they are still only partly understood. Critical uncertainties remain because coral reef ecosystem are socio-ecologically complex; because the dynamics of the ecosystem and anthropological threats are changing constantly; and because marine research is costly. Although more research could resolve these uncertainties, managers need to act without delay since coral reefs are impacted by multiple threats that degrade the system quickly. To achieve this, management has to work constructively with uncertainty rather than wait until it is resolved. My PhD will develop a suite of methods which can both identify robust, effective decisions under current uncertainty, while also highlighting future research priorities with the highest value of information. Central to my approach, will be a complex ecosystem including multiple threats that will be calibrated to two coral reef ecosystems, one in the Great Barrier Reef and one in the Philippines using existing data. This model will be used to prioritise management and future research direction. The consideration of two systems will enable me to consider the influence of prior information from the two different systems on remaining uncertainty and the prioritisation. Here, I will present my proposed research including background, objectives, methodology and possible implications.

Poster

Photodynamic Antimicrobial Chemo-Therapy: a promising tool for aquaculture pathogen eradication

Danilo Malara[a], Gabriella Citarrella[a], Kirsten Heimann[a], Michael Oelgemöller[a] & Lone Hoj[b]

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Encouraging result in pathogen eradication and control has been shown applying Photodynamic Antimicrobial Chemotherapy (PACT), as consequence of singlet oxygen' ($^1O_2$) irreversible damage to microbial cells.
In this study, the suitability of PACT to treat aquaculture water was tested against a model naturally luminescent aquaculture pathogen, *Vibrio campbellii* strain ISO7. The initial identification of the bacterium and its pathogenicity was confirmed towards *Penaeus monodon* post-larvae. Koch's postulates were satisfied by identification of re-isolated strains by multiplex PCR and sequencing of housekeeping genes.
The efficiency of one cationic and one anionic porphyrin was tested in separate time-course experiments. Aquaculture water seeded with ISO7 strain and diluted porphyrins, were irradiated for 24 h using 150 W LED light. To assess the bacterial viability, we adopted four methods; luminescence signal, absorbance at 570 nm, viable counts on agar plates and 7 days regrowth.
Controls samples showed no toxic effect, confirming that porphyrins and light alone were not toxic to the indicator bacterium, or anionic porphyrin. The generated $^1O_2$ was both time- and dose-dependent cytotoxicity, and continuous irradiation within 24 h of the cationic porphyrin achieved LC_{100}(complete lethality) of indicator bacterium.
In conclusion, this work demonstrated that the cationic porphyrin caused complete bacterial eradication while anionic counterpart only a slightly drop in luminescence signal. PACT using cationic dyes and visible or solar light is a promising, cost-effective and environmentally friendly method to generate pathogen-free aquaculture water.

Poster

Reconstructing and forecasting outbreaks of crown-of-thorns starfish on the great barrier reef: A metapopulation modelling approach

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Outbreaks of the coral eating crown-of-thorns starfish (CoTS), *Acanthaster planci*, have contributed greatly to sustained declines in live coral cover on the Great Barrier Reef (GBR), accounting for 48% of coral loss over the past 30 years. Unlike other disturbances (e.g., cyclones and coral bleaching), CoTS outbreaks may be amenable to direct management, especially if reef-wide outbreaks originate in small, well-defined areas. This study reconstructs reef-wide outbreaks using extensive empirical data on population structure and distribution, to help establish when, where and why outbreaks originate. We define habitat suitability for CoTS using an ensemble Species Distribution Modelling approach coupled with larval connectivity estimates across the GBR, allowing us to identify the probabilistic pathway of the southward propagation of CoTS outbreaks. Higher proportions of suitable habitat and high between-reef connectivity were found in the northern GBR, supporting the hypothesis that this area acts as an "initiation zone" for reef-wide outbreaks. These results will be coupled with a stage-based, spatially explicit meta-population model, allowing us to simulate the initiation and propagation of CoTS outbreaks under a range of management strategies. Our model will provide invaluable predictions for decision makers, identifying the key locations for control measures to help prevent the spread of future outbreaks. These predictions are an integral step towards reducing coral loss caused by CoTS outbreaks, and hence protecting live coral cover on the GBR

Poster

Reef fish hybridisation: lessons learnt from butterflyfishes (genus *Chaetodon*)

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Natural hybridisation is widespread among coral reef fishes. However, the ecological promoters and evolutionary consequences of reef fish hybridisation have not been thoroughly evaluated. Butterflyfishes form a high number of hybrids and represent an appropriate group to investigate hybridisation in reef fishes. This study provides a rare test of terrestrially-derived hybridisation theory in the marine environment by examining hybridisation between *Chaetodon trifasciatus* and *Chaetodon lunulatus* at Christmas Island. Overlapping spatial and dietary ecologies enable heterospecific encounters. Non-assortative mating and local rarity of both parent species appear to permit heterospecific breeding pair formation. Microsatellite loci and mtDNA confirmed the status of hybrids, which displayed the lowest genetic diversity in the sample and used a reduced suite of resources, suggesting decreased adaptability. Maternal contribution to hybridisation was unidirectional, and no introgression was detected, suggesting limited, localised evolutionary consequences of hybridisation. Comparisons to other reef fish hybridisation studies revealed that different evolutionary consequences emerge, despite being promoted by similar factors, possibly due to the magnitude of genetic distance between hybridising species. This study highlights the need for further enquiry aimed at evaluating the importance and long-term consequences of reef fish hybridisation.

Poster

Sticking and sinking: When sediments rise, coral gametes fall

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Sediments can impact the reproduction and developmental stages of coral and therefore threaten the resilience and recovery of reefs following disturbances. In a series of controlled experiments, we examined how suspended sediments typical of dredging operations may affect the ascent of coral egg-sperm bundles and impede fertilisation on the water's surface. We reveal that sediment grains can ballast and delay the ascent of egg-sperm bundles during spawning, and quantitatively model scenarios to predict the conditions that cause ballasting, and the subsequent reduction in egg-sperm encounter rates. Next, we reveal that successfully surfaced gametes are also threatened by sediment exposure due to flocculation of the sperm. We detail the components of sediment that can trigger this mechanism, and can cause decreases in fertilisation at suspended sediment concentrations as low as 3 mg L^{-1}. This research forms part of a broader question of how sediments impact the early life history stages of corals and quantification of each of these interactions are improving our understanding of the risks that sediments from dredging, allowing for improved management around these events.

Poster

Heart-less pulses: measuring sponge pumping rates

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Sponges pump water through their tissues in order to: capture food, eliminate waste and exchange gas. Given the physiological importance of pumping, measuring excurrent flow is like taking the pulse of a sponge. We developed a digital, four-channel thermistor flowmeter as an experimental tool for measuring pumping rates in marine sponges, particularly those with small (< 5 mm) excurrent pores (oscula). Diel trends in pumping activity were observed, with sponges increasing their pumping activity to peak at midday and decreasing pumping and contracting oscula at night. Combining flowmeters with time lapse imagery yielded valuable insights into the contractile behaviour of oscula in *Cliona orientalis*. Osculum area was positively correlated to measured excurrent velocities, indicating that sponge pumping and osculum contraction are coordinated behaviours. Short-term elevation of suspended sediment concentrations (SSCs) decreased pumping rates by up to 90%, ultimately resulting in closure of the oscula and cessation of pumping. Oscula remained closed after continued exposure to elevated SSC (> 50 nephelometer telemetry units [NTUs]) for multiple days. After two weeks of exposure at 90 NTU, 10% mortality was observed (n=20). Mortality increased to 20% after four weeks. Therefore, high sediment loads decreased pumping activity and caused oscula closure, which contributed to mortality by limiting pumping.

Poster

Pathways of the diversity-stability relationship in natural reef fish communities

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Understanding diversity effect on community stability is critical for large-scale conservation planning of biodiversity and ecosystem functioning. However, little is known about whether and how species richness increases community stability in high-diversity systems at large-spatiotemporal scales. In these systems, the effect of species richness interacts with different demographic components of high-dimensional species-abundance dynamics, such that their effects on community stability are often confounded and too complicated to measure. To date, there is no holistic framework to simultaneously test pathways of the diversity-stability relationship and account for dynamics of species-abundances. Here, we developed and applied such analysis to long-term community dynamics of coral reef fishes at the regional-scale of the Great Barrier Reef. We showed that (i) species richness increases community stability mainly through reducing correlations of fluctuations among species, and (ii) more niche structure (less magnitude of environmental stochasticity) of species-abundance dynamics mediates the richness effect by reducing population-level variability and increasing correlations of fluctuations among species. The two pathways to community stability are not correlated across the large-scale coral reef seascape. Spatial planning of large-scale marine reserves should consider not only species diversity but also attributes of community dynamics if the goal is to sustain ecosystem stability.

Image courtesy of Patrick Buerger