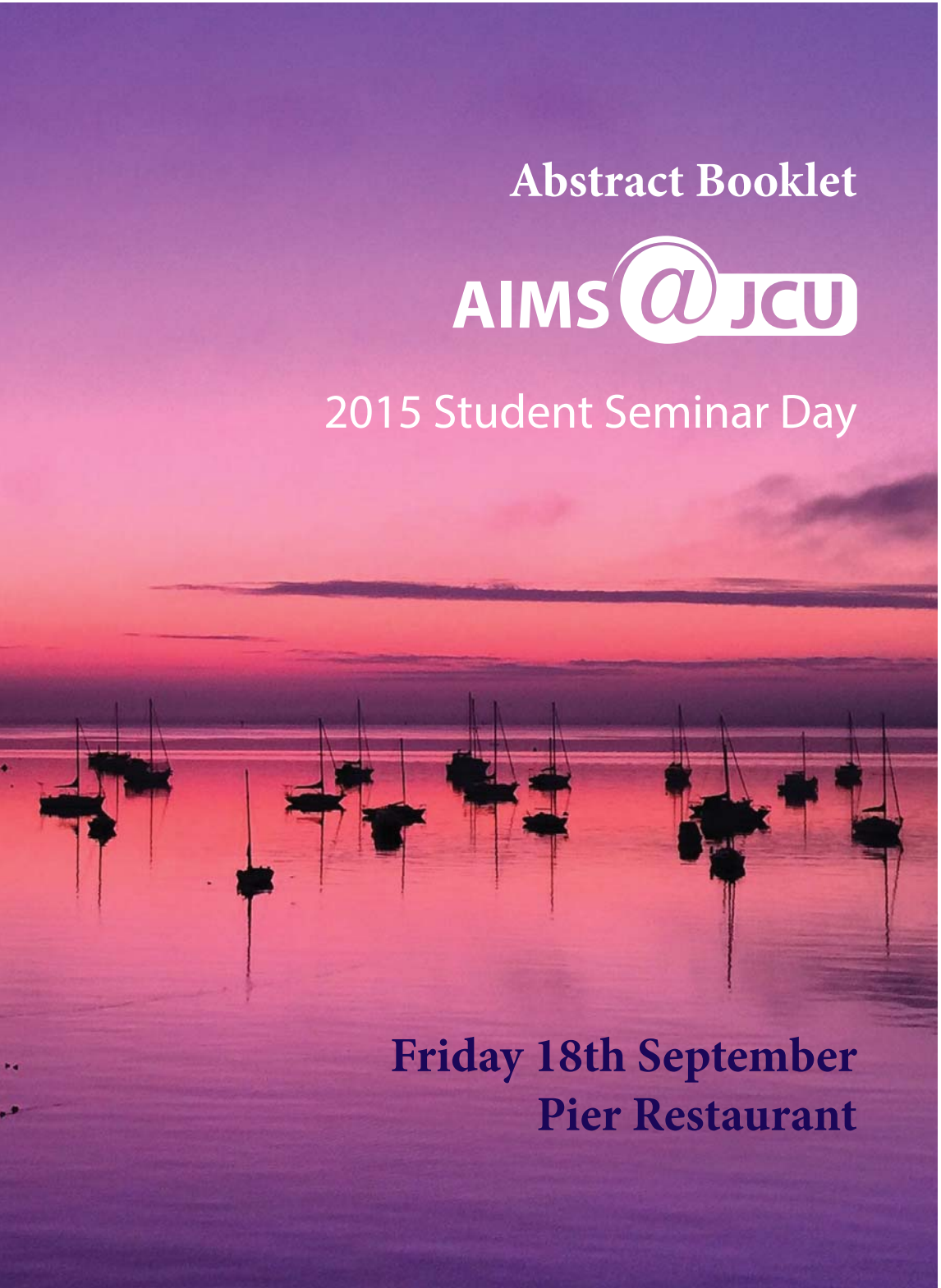

Abstract Booklet

AIMS@JCU

2015 Student Seminar Day

Friday 18th September
Pier Restaurant

AIMS@JCU

Student Seminar Day 2015
Friday, 18th September at The Pier

Time	Title	Presenter
9:00 am	**Opening address**	**Libby Evans-Illidge**
	Session 1 chaired by Dr. Samantha Munroe	
9:15 am	Identifying the movement of reef predators: a network modelling approach	Elodie Lédée
9:30 am	How effective is Australia's management of sharks in commercial fisheries?	Samantha Sherman
9:45 am	Niche partitioning of sympatric coral trout indicated by movement and dietary patterns	Jordan Matley
10:00 am	Quick fix GPS technology highlights risk to marine animals moving between protected areas	Daniel Zeh
10:15 am	**Morning tea, view posters and photographs**	
	Session 2 chaired by Dr. Gergely Torda	
11:00 am	The transcriptomic response of the coral *Acropora millepora* under hypo-saline stress	Catalina Aguilar Hurtado
11:15 am	Host transcriptome analysis during onset and establishment of coral-algal symbiosis	Amin Mohamed
11:30 am	Inshore coral health of the Great Barrier Reef	Melissa Rocker
11:45 am	Eutrophication and climate change compromise the fate of early life history stages of *Acropora tenuis*	Adriana Humanes
12 midday	The point count transect method for estimates of species richness and diversity of reef-building corals	T. Edward Roberts
12:15 pm	**Lunch with poster session and view/vote on photographs**	
1:15 pm	**Afternoon address**	**Libby Evans-Illidge**
	Session 3 chaired by Dr. Heidi Luter	
1.30 pm	Understanding the impacts of dredging on sponges	Brian Strehlow
1:45 pm	Climate change and tropical sponges: The effect of elevated pCO_2 and seawater temperature.	Holly Bennett
2:00 pm	Quantifying the effect of seagrass productivity on growth and survival of foraminifera *Marginopora vertebralis*	Victoria Hrebien
2:15 pm	Can butterflyfish and *Drupella* snail transmit coral diseases?	Katia Nicolet
2:30 pm	**Speedtalks**	
	Session 4 chaired by Leanne Currey	
	The importance of ecological and behavioural data in studies of hybridisation among marine fishes	Stefano Montanari
	Coral mucus: an effective indicator of dredge related stress	Pia Bessell-Browne
	Understanding drivers of hypoxia tolerance in a tropical estuarine fish	Geoffrey Collins
	Diversity and function of viruses in marine sponges	Cecília Pascelli
	Bioeroding sponges: victors or victims of a changing environment?	Blake Ramsby
	How coal affects water quality: a coral's perspective	Kathryn Berry
3:00 pm	**AIMS@JCU Alumni Keynote**	**Dr. Gergely Torda**
3:30 pm+	**Afternoon tea, judges deliberation and presentation of awards and prizes; end of day funtion with drinks and nibbles provided**	

9.15am

Identifying the movement of reef predators: a network modelling approach

Elodie J.I. Lédée[a,b], Michelle R. Heupel[a,c], Andrew J. Tobin[a], Mario Espinoza[a,b], Colin A. Simpfendorfer[a]

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Reef predators are known to play a central role in maintaining coral reef ecosystem structure and function. Modelling intra-reef movements provides a better understanding of the complex interaction between predators and their environment. Long-term movements of *Caranx ignobilis*, *Carcharhinus albimarginatus* and *C. amblyrhynchos* individuals were tracked using acoustic monitoring in central Great Barrier Reef from 2012 to 2014. Using network modelling, network structure of predators' intra-reef movements was examined and compared to four simulated theoretical networks with known properties. Network properties were similar between species, however, significantly different between reefs. Individuals at Helix Reef moved more and had more paths than those in Lodestone and Wheeler reefs. Individuals at Lodestone Reef had more clusters and moved more rapidly and directly than those in Wheeler Reef. All three species exhibited similar network structures with rapid and direct intra-reef movements, high number of clusters which indicated they used specific parts of a reef; characteristics that have been identified in a variety of real-world networks. However, individual network structures varied greatly, ranging from scale-free and small-world to random networks and may be due to reef differences. Network modelling provided insight into predator intra-reef movements that assist in the development of effective management plan.

9.30am

How effective is Australia's management of sharks in commercial fisheries?

Samantha Sherman[ab], Andrew Chin[a] and Colin Simpfendorfer[a]

[a]*James Cook University, Townsville, Australia*
[b]*Australian Institute of Marine Science, Townsville, Australia*

Shark populations are declining globally, mainly due to unsustainable catch in fisheries. A fishery's sustainability is directly correlated to the effectiveness of managing the catch of sharks. A management effectiveness evaluation (MEE) was developed to evaluate current management of Australian fisheries that catch sharks. The MEE examined 23 different attributes across 5 categories (management context, management arrangements, non-targeted catch, fishing patterns, and compliance and enforcement). Attributes for each fishery were score, weighted, and summed to give provide a percentage effectiveness. Almost half of Australian fisheries were found to catch sharks as either target, byproduct or bycatch; and 16% had insufficient data available to determine if sharks were caught. In over 75% of commercial fisheries sharks were caught incidentally rather than being targeted. Overall management effectiveness of Australian commercial fisheries ranged from 8-71% of a perfect score, with a mean of 42%. The best performing fisheries, on average, were those that only caught sharks as bycatch and did not keep any sharks or shark products. Within each of the 23 attributes, some fisheries performed very well while others did not. This means there are already management solutions in place for some areas of weakness in Australian fisheries management of shark catch. A fishery that scored poorly in a specific attribute could improve their management in that area by incorporating policies from a fishery that performed well in that area. This may lead to Australian commercial fisheries having improved management of their shark catch in the future.

9.45am

Niche partitioning of sympatric coral trout indicated by movement and dietary patterns

JK Matley[a], CA Simpfendorfer[a], AJ Tobin[a], AT Fisk[b], MR Heupel[a,c]

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The coral trout complex (*Plectropomus spp.*) consists of at least seven different species, three of which have economic significance in the recreational and commercial reef fisheries of the Great Barrier Reef. Management regulations are biased toward the more abundant and better studied *P. leopardus*, despite some species (e.g., *P. laevis*) being listed as vulnerable on the IUCN Red List. The goal of this study was to improve understanding of space use and foraging behaviour of sympatric coral trout at both inshore (*P. leopardus/P. maculatus*) and midshelf reefs (*P. leopardus/P. laevis*) using passive acoustic telemetry and dietary indicators (stable isotope analysis). Fifty-eight acoustic receivers were deployed at three reefs to track the movements of 156 tagged coral trout. Muscle tissue and blood components were sampled from the three species at four reefs for stable isotope analysis (δ13C and δ15N). Preliminary results show that movement and foraging data are complementary and demonstrate similar behavioural patterns. *Plectropomus laevis* used a horizontal area ~3 times the size that *P. leopardus* exploited, and foraged in the benthic habitat to a greater extent. At inshore reefs, foraging patterns of *P. maculatus* and *P. leopardus* were similar, however *P. maculatus* spent more time in deeper water and its horizontal distribution was restricted to a smaller area compared to *P. leopardus*. This apparent niche separation has significant implications for the efficacy of management in the Great Barrier Reef and highlights the need for species-specific data and regulatory initiatives.

10.00am

Quick Fix GPS technology highlights risk to marine animals moving between protected areas

Daniel R. Zeh[a,b],Michelle R. Heupel[a,b], Mark Hamann[b], Colin J Limpus[c], Helene Marsh[a,b]

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Incidental capture in fishing gear is the most serious threat to the survival of many species of marine mammal. Fisheries closures developed to protect marine mammals have tended to concentrate on areas of high marine mammal density. Movement corridors have generally been less protected because they are often unknown and difficult to detect. Seagrass meadows in Moreton and Hervey Bays in southeast Queensland support significant populations of dugongs. Pedigree analysis based on genetic and ancillary biological data indicates that there is substantial movement of dugongs between these bays, which are separated open surf coasts where dugongs are occasionally caught in inshore shark nets set for bather protection. This bycatch suggests that the dugong movement corridor between Moreton and Hervey Bays is close to the coast, a hypothesis not confirmed by nearly 30 years of dugong satellite tracking using PTT technology. Twenty-nine dugongs were captured in seagrass habitats on the Eastern Banks of Moreton Bay in 2012-2014 and fitted with Quick Fix GPS and acoustic transmitters. One animal was captured and tracked twice. Four dugongs were tracked moving from Moreton Bay to Hervey Bay covering distances of 278 – 338 km over 5 – 9 days; one dugong made the return journey. Three of the four animals travelled along and very close to the coast; the track of the fourth animal is uncertain. These results suggest dugong would benefit from netting closures that extend beyond seagrass meadows.

11.00am

The transcriptomic response of the coral *Acropora millepora* under hypo-saline stress

C. Aguilar[a,b], J.B. Raina[c], S. Fôret[d], D. Hayward[d], C. A. Motti[e], B. Lapeyre[f], D. G. Bourne[e] and D. J. Miller[a,b]

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Coral reefs can experience salinity changes during intense tropical storms that result in heavy rainfall and periodic coastal freshwater runoff into the reef environment. Precipitation events affect parts of the Great Barrier Reef every summer, leading to salinity induced coral bleaching and mortality in extreme events; however to date, little is known about the actual effects of this hypo-osmotic stress on corals at the physiological level. *Acropora millepora* adults and juveniles (devoid of *Symbiodinium*) subjected to an acute low salinity stress exposure (25PSU and 28PSU respectively) were used to characterise the transcriptomic responses of the corals to hypo-osmotic stress. After 1h of stress, coral homologues to the genes involved in betaines catabolisms, a metabolic pathway for breaking down organic osmolytes, were up-regulated. While up-regulation of heat shock proteins was observed and is a common response to different environmental stressors in *Acropora sp*, the up-regulation of genes involved in ion and amino acids transport were specific to salinity stress. Our analysis suggests a switch from disruption of protein homeostasis after the acute (1 h) exposure, to an activation of protein degradation after a prolonged (24 h) exposure to hypo-saline conditions. These results highlight the impact that hypo-osmotic stress has on *A. millepora* metabolism, and provides important insights for understanding the mechanisms of coral response to environmental stress. Given the predicted increase in extreme weather events on the GBR under future climate change scenarios, corals are likely to be exposed to increased short term hypo-salinity shocks, and therefore understanding their underlying mechanisms to deal with these events is important.

11.15am

Host transcriptome analysis during onset and establishment of coral-algal symbiosis

Amin R Mohamed[a,b,d,f] , Vivian Cumbo[b], Chuya Shinzato[g], Cheong Chen[h], David Bourne[c], Bette Willis[b,e], Mark Ragan[h], Nori Satoh[g], David J Miller[b,d]

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The mutualistic relationship between reef-building corals and intracellular photosynthetic dinoflagellates of the genus *Symbiodinium* provides the foundation of the coral reef ecosystem. Disruption of this relationship leads to coral bleaching which is occurring on a large scale and poses a real threat to the survival of coral reefs. In spite of the great ecological significance of this partnership to coral reefs, little is currently known about the molecular mechanisms involved in the establishment and maintenance of the symbiosis. A number of studies have investigated host gene expression during the establishment of coral-algal symbiosis, but these have failed to detect host symbiosis-related signals. To better understand the early events occurring during the establishment of symbiosis, infection experiments were conducted during spawning in Sesoko Island, Okinawa, Japan in June 2013 using *Acropora digitifera* larvae and a competent strain of symbionts, *Symbiodinium sp*. clade B. Next generation sequencing (Illumina RNAseq) was used for the first time to follow coral transcriptome-wide gene expression after exposure to competent *Symbiodinium* at 4-, 12-, 48- h post infection. These experiments allowed the detection of transient transcriptomic signals in the coral during the initial infection period. The data imply that the establishment of symbiosis involves cross talk between the partners; an active response is required on the part of the host in order to recognize appropriate partners but at the same time the symbionts appear to suppress some host responses, including immunity.

11.30am

Inshore coral health of the Great Barrier Reef

MM Rocker[a,b,c], BL Willis[a,c], KE Fabricius[d], LK Bay[d]

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Physiological mechanisms and functions of corals can be used individually or together as indicators of overall coral health and resilience. This study explores how corals respond physiologically to gradients in water quality in two inshore catchments of the Great Barrier Reef (GBR). The demography and physiological condition (colony growth, mortality, symbiont and skeletal density, total lipids, and ash-free dry weight) of *Acropora tenuis* colonies were monitored over a two-year period. Twenty tagged colonies were followed at three reefs within two water quality catchments in the central Great Barrier Reef. Coral health and physiology were examined in the context of variation in environmental and ecological water quality parameters among sites and seasons. Our study highlights that poor inshore water quality does not necessarily reduce coral condition, given the high growth rates and lipid investments of corals at the most turbid settings nearest the river compared to the clearer setting further from the river, as well as the positive correlation between growth and symbiont densities. Dissolved organic and inorganic nutrients were influential environmental drivers of coral condition within the Burdekin and Whitsundays catchments. These results elucidate the relationship between influential environmental parameters and physiological coral responses used to define coral health. Relationships between environmental conditions and coral health provide critical information to inform and facilitate management decisions to protect and sustain inshore reefs.

11.45am

Eutrophication and climate change compromise the fate of early life history stages of *Acropora tenuis*

Adriana Humanes[a,b], Bette Willis[a], Katharina Fabricius[b], Andrew Negri[b]

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[b]*Australian Institute of Marine Science, Townsville, 4180, Queensland, Australia*

Inshore coral reefs are subjected to increasing pressures of organic nutrient runoff from coastal activities and seawater temperature increase as a result of climate change. More information is needed on the effects of water quality and heating on early life history stages of hard corals, critical demographic stages in the recovery and replenishment of coral populations. Here we conducted a series of experiments to test the combined effects of nutrient enrichment and temperature on *Acropora tenuis* early life history stages. Fertilization, larvae survivorship and settlement were significantly reduced by increases in temperature while embryo abnormalities increased when temperature and nutrients co-occurred. Recruits grew more rapidly under high temperature treatments but mortality also increased. Gamete and larval stages were more affected to water quality and temperature stress than recruits. Our results suggest that nutrient enrichment together with elevated temperatures acting on every stage of reproduction and embryonic/larval development could result in a critical failure of supply-side-related recruitment for this species.

12.00midday

The point count transect method for estimates of species richness and diversity of reef-building corals

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

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Coral reefs present specific challenges for data collection, with issues surrounding logistical restrictions (e.g., time and site accessibility) particularly evident when working at depth. As such, efficiency is paramount and sampling methodology should be chosen to reflect this. Most abundance estimates rely on point intercept (PIT) or line intercept transects (LIT) as introduced in the early 1970s. However, these methods are often inappropriate for research questions focusing on rare events or incidental species, as well as incurring significant logistical constraints. Here we outline an alternative method for surveying reef-building corals; the point count transect (PCT) adapted from a well-established technique in terrestrial ecology (e.g., avian surveys).

We test the use and viability of the PCT in coral reefs, and compare its performance next to the established 10 m LIT methodology. Species accumulation was faster for the PCT, and estimated species richness significantly higher at a standardized sample size (LIT: 52.83, PCT: 100.99, at 468 individuals). The difference was even greater when compared at a standardized sampling effort (LIT: 42.85, PCT: 100.3, at 189 minutes). Analysis of the SADs revealed that the increased species count in the PCT was generated by species with an occurrence frequency of < 7.

We conclude that PCT is more efficient than the LIT at capturing species richness for a given unit of sampling effort, and produces data suitable for modern statistical analysis (such as rarefaction, and meta-community analysis), allowing greater insight into fundamental ecological questions such as species richness gradients.

1.30pm

Understanding the impacts of dredging on sponges

Brian Strehlow[a,b,c,d,e], Mari Carmen Pineda[d,e], Peta Clode[b,c], Alan Duckworth[d,e], Gary Kendrick[a,d], Michael Renton[a], Nicole Webster[d,e]

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[d]*Western Australian Marine Science Institution, Perth, 6009, Western Australia, Australia*
[e]*Australian Institute of Marine Science, Townsville, 4180, Queensland, and Perth, 6009, Western Australia, Australia*

Dredging operations generate three central abiotic stressors for marine organisms. Elevated total suspended solids (TSS) can cause light attenuation and result in high sediment deposition. These stressors can impact ecologically important filter feeders, including sponges. Experimental exposures using six abundant and broadly distributed sponge species revealed that stress responses are species specific. Most sponge species exhibited sublethal responses to the three stressors, although *Carteriospongia foliascens* exhibited high mortality under both elevated TSS and low light, making it a promising bioindicator for dredging related pressures.

Determining sublethal stress in sponges is extremely challenging, hence we are developing novel sensitive approaches to characterise the stress response. These methods comprise: 1) micro-computed tomography (microCT) scanning to visualise and quantify sediment management strategies in 3-dimensions; and 2) thermistor flowmeters to measure changes in sponge pumping (i.e. filtering) rates. Three dimensional x-ray analysis of *Stylissa flabelliformis* exposed to elevated TSS revealed both active and passive mechanisms for moving sediment within their tissues. Assessment of pumping rates in *Cliona orientalis* exposed to elevated TSS using a custom-designed 1.5 mm diameter thermistor revealed that short term exposure results in a 40±10% decrease in pumping rate within one hour, followed by complete cessation of pumping after two hours.

The long term effects and energetic costs of coping with dredging related pressures will be determined in future experiments. This research provides an improved understanding of sponge responses to dredge-related pressures and will contribute to more effective management of dredging operations in the future.

1.45pm

Climate change and tropical sponges: The effect of elevated pCO_2 and seawater temperature

Holly Bennett[a,b], James Bell[a], Simon Davy[a], Nicole Webster[b]

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[b]*Australian Institute of Marine Science*

Sponges are important structural and functional components of coral reef ecosystems. Despite their ecological importance, little is known about how sponges respond to predicted climate change scenarios. Here we examined the physiological responses of four abundant Great Barrier Reef sponge species, the phototrophic *Carteriospongia foliascens* and *Cymbastella concentrica* and the heterotrophic *Stylissa sp*. and *Rhopaleoides odorabile* which were exposed to nine pCO_2 and temperature treatments (pCO_2 400, 800 and 1200 ppm X 28.5, 30 and 31.5°C). Experiments were terminated when lethal effects were observed hence experimental durations were 2, 3, 8 and 12 weeks for *C. foliascens*, *R. odorabile*, *Stylissa sp*. and *C. concentrica*, respectively. Mortality, necrosis and bleaching were highest in the 31.5°C treatments for all species. Respiration rates were ~1.3 times greater at 31.5°C compared with 28.5°C and 30°C. Net photosynthesis decreased 5 to 30 fold at 31.5°C for *C. foliascens* and *C. concentrica* respectively, compared with photosynthetic rates of sponges exposed to 28.5°C and 30°C. Respiration rates in *C. concentrica* were 0.7 times lower at 1200ppm, than 400ppm. Reduced oxygen consumption during periods of elevated carbon dioxide has been observed in other marine invertebrates due to changes in intra and/or extracellular pH. These results demonstrate that elevated temperatures, as a result of climate change, will have adverse effects for coral reef sponges. Further to this, whilst increasing pCO_2 is not directly lethal to sponges, their inability to regulate extracellular pH suggests pH dependent cellular processes i.e. protein synthesis may be impacted, ultimately effecting long-term sponge success.

2.00pm

Quantifying the effect of seagrass productivity on growth and survival of foraminifera *Marginopora vertebralis*

Victoria Hrebien[a], Catherine Collier[a], Yan Ow[a], and Sven Uthicke[b]

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Large benthic foraminifera (LBF), like most marine calcifiers, are vulnerable to ocean acidification (OA). Some species, such as *Marginopora vertebralis*, live predominantly within seagrass meadows or on algae as epiphytes. This study hypothesized that seagrass habitats provide refuge from OA as the photosynthetic uptake of dissolved inorganic carbon (DIC) of seagrass can increase pH and carbonate saturation. Short-term incubations (≤ 24 hours) under controlled laboratory conditions were conducted to investigate productivity and calcification responses of *M. vertebralis*. Over a range of pCO_2 (476 µatm to 1781 µatm), calcification significantly decreased with increased pCO_2 during the light. In the dark, foraminifera decalcified significantly with increased pCO_2. Incubations were repeated at 476 µatm and 1175 µatm with and without seagrass present. Surprisingly, calcification and productivity of foraminifera decreased by at least 10% in the presence of seagrass. In a 5-week experiment, *M. vertebralis* growth, survival, photochemistry, and chlorophyll a content were investigated for four habitat treatments (glass tank, sand only, seagrass and sand, and artificial grass and sand). *M. vertebralis* growth was 5% greater, while mortality was significantly reduced by at least 5% within seagrass treatments. Furthermore, foraminifera within seagrass treatments displayed higher photosynthetic yield (6%; PAM fluorometry) and higher chlorophyll content (16%). This study demonstrated that while there may be negative physiological effects of living within seagrass due to lower rates of calcification and photosynthesis, there is a habitat benefit. To further investigate, morcosensors were sued to document the pH and O_2 microenvironment of foraminifera both on seagrasses and neutral surfaces.

2.15pm

Can butterflyfish and Drupella snail transmit coral diseases?

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Infectious diseases are powerful natural forces that can severely reduce biodiversity and catalyse extinctions. Managing diseases in nature requires understanding how pathogens survive and are transmitted in their host population, thus the identification and control of disease vectors is critical, whether the pathogens are formally known or not. In this study, laboratory experiments were used to confirm if corallivores, specifically the butterflyfish *Chaetodon plebeius* and the snail *Drupella sp*., had the potential to spread black band (BBD) and brown band (BrB) diseases, two common coral diseases on the Great Barrier Reef. Chaetodontids were never found to transmit either disease, even when fishes fed directly on both infected and healthy nubbins for extended periods of time. In contrast, *Drupella sp*. directly transmitted BrB to healthy corals in 40% of cases when the snail was fed infected tissue. In treatments where snails were exposed to BrB, but subsequently kept in a holding tank for either 12 or 24h (delayed transmission), transmission was observed in 12% of cases. However, *Drupella* was unable to transmit BBD either in direct or delayed transmission treatments. This study highlights the different potential of reef fish and invertebrates to act as coral disease vectors and contributes to clarifying the aetiology and transmission patterns of coral diseases on coral reefs.

Speed Talk

The importance of ecological and behavioural data in studies of hybridisation among marine fishes

Stefano R. Montanari[a, b], Jean-Paul A. Hobbs[c], Morgan S. Pratchett[d], Lynne van Herwerden[b,e]

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[c]*The Oceans Institute and School of Plant Biology, University of Western Australia, Crawley, WA 6009, Australia*
[d]*ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, QLD 4811, Australia*
[e]*College of Marine and Environmental Sciences, James Cook University, Townsville, QLD 4811, Australia*

Hybridisation is widespread and has substantial evolutionary and adaptive relevance. We summarise the current knowledge of hybridisation in marine fishes, with a focus on ecology and behaviour. Rarity of parental species, niche overlap and assortative mating breakdown have a role in initiating hybridisation. Modern literature on fish hybridisation has a strong genetic focus, containing little or no quantitative ecological and behavioural information. Future studies should gather ecological and behavioural data from hybrid zones, teasing out processes relevant to overcoming pre-zygotic barriers. This will provide insights into the maintenance of reproductive isolation and the process of speciation in the marine environment.

Speed Talk

Coral mucus: an effective indicator of dredge related stress

Pia Bessell-Browne[a,b,c,d], Peta Clode[a], Alan Duckworth[b,d], Rebecca Fisher[c,d], Ross Jones[c,d], Andrew Negri[b,d]

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[b]*Australian Institute of Marine Science, Townsville, QLD, 4810, Australia*
[c]*Australian Institute of Marine Science, The University of Western Australia, Nedlands, WA 6009, Australia*
[d]*West Australian Marine Science Institute, Perth, Western Australia, Australia*

The impacts of sediments on coral reefs are under increasing scrutiny, with increased coastal development. Numerous dredging operations have facilitated this development and can generate large quantities of suspended sediments that can affect nearby coral populations. In order to appropriately manage the impacts of dredging related stressors on ecosystems, effective indicators of stress need to be developed. This talk describes a forensic analysis of coral health near a large dredging project in northwest Western Australia, which was undertaken to identify indicators of sediment-related stress. A promising indicator is that the number of mucus tunics produced by *Porites* colonies is linked with distance from dredging and represents an early warning of partial colony mortality.

Speed Talk

Understanding drivers of hypoxia tolerance in a tropical estuarine fish

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

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Hypoxia is increasing in freshwater and estuarine systems globally, yet we know little about the ability for tropical fish to acclimate to this changing environment. This study investigated the acclimation potential of two geographically-separated populations of barramundi (*Lates calcarifer*) to fluctuating oxygen availability. Hypoxia tolerance improved similarly in both populations and was driven primarily by physiological plasticity, rather than inherent variability between populations.

Speed Talk

Diversity and function of viruses in marine sponges

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Viruses are ubiquitous biological entities that play significant roles in regulating biological processes in marine environments. Despite their abundance, we have limited knowledge about how viruses interact with marine hosts, particularly with sponges which are ecologically important components of benthic environments. Sponges harbor dense communities of symbiotic microorganisms and the high diversity/complexity of symbionts make sponges an ideal model for studying host-virus interactions. This study aims to describe the viral diversity and function in the most representative sponge species from the Australian East Coast and the Red Sea, investigating how sponge-viral dynamics vary spatially and amongst different sponge species.

Speed Talk

Bioeroding sponges: victors or victims of a changing environment?

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Bioeroding sponges such as *Cliona* spp. bore through live and dead coral surfaces thereby affecting the balance between reef accretion and reef erosion. Increasing temperatures, nutrient levels, and ocean acidification are predicted to be deleterious to corals and other calcifying organisms whilst being beneficial to bioeroding sponges. To accurately model the trajectory of future reef growth, it is necessary to experimentally determine how these stressors affect bioeroding sponges and their competitive interactions with corals.

Speed Talk

How coal affects water quality: a coral's perspective

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Growth in seaborne coal trade has been accompanied by increased shipping accidents, resulting in physical damage to marine ecosystems. Additionally, extreme groundings can result in the release of up to 100,000 tons of coal into coastal waters. Once in the marine environment, coal particles can be found at the sea surface, throughout the water column and within bottom sediments, thus posing a potential threat to a range of marine organisms. In 180 seconds I will address the main features of coal that cause adverse biological effects and how coal contamination may impact a coral that can't swim away from it.

AIMS@JCU Alumni Keynote

Corals in a perturbed world: adapt, acclimatize or re-assemble

Gergely Torda

Climate change poses two main challenges for reef building corals: an increment in the frequency and severity of tropical storms; and ever increasing water temperatures. In contrast to the alarming rates of coral loss experienced worldwide, an increasing body of evidence shows that corals in fact have potential for adapting to these stressors. First, I will show that the diversity of life histories among scleractinians makes their assemblages resilient to cyclone damage through reconfiguration. I will highlight the importance of connectivity in the recovery process, and present a novel method to assess connectivity of coral populations. And second, I will discuss how the complex biology of the coral holobiont equips these keystone organisms with the potential for transgenerational acclimatization and adaptation to cope with predicted levels of ocean warming.

Poster

Coal contamination: a potential threat for early development stages of corals

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Successful fertilisation of gametes, larval dispersal and connectivity are important for the persistence of marine invertebrate populations, and these early life history stages are known to be sensitive to marine pollution. Coal dust is a contaminant of emerging interest that can be found both within bottom sediments, in the water column and at the ocean surface. It therefore has the potential to impact survival and settlement of marine invertebrates, including reef corals, since both gametes and larvae remain planktonic during the first week(s) of development. In order to assess this potential risk, gametes, newly fertilized embryos (3h and 12h), and larvae (4d) of the coral *Acropora tenuis* were exposed to a range of suspended coal exposure scenarios (0-800 mg l^{-1}). The effects of coal dust on fertilisation, survivorship and settlement were quantified. We found significant inhibition in fertilisation (by 40-100%) at coal concentrations ≥ 100 mg coal l^{-1}. Survivorship decreased with increasing concentration and exposure duration, with 12h old embryos exhibiting the highest mortality (32%). Larvae survivorship and settlement were only significantly affected in the highest concentration (800 mg l^{-1}). Our results demonstrate that younger development stages are more sensitive to coal exposure; however, embryos that survive coal exposure and develop into larvae may not be significantly affected and are likely to settle and metamorphose into corals. Critical early life history stages of corals are able to withstand moderate levels of coal contamination; however, some processes can be inhibited above the thresholds reported here.

Poster

Bluespine Unicornfish (*Naso unicornis*) are both natural control agents and mobile vectors for invasive algae in a Hawaiian Marine Reserve.

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In the quest to demonstrate efficacy of Marine Reserves, it has been hypothesized that protecting herbivorous fishes within these reserves will in turn help these areas to resist algal overgrowth of corals. However, empirical studies lack in demonstrating the validity of several key, mechanistic assumptions undergirding this concept including that herbivorous fishes are resident in significant numbers within Marine Reserve boundaries, that they routinely consume the invasive algae of concern at significant levels, and that they do not act as significant mobile vectors for the invasive algae. A 46-year-old Marine Reserve (Hawaii Marine Laboratory Refuge, 21°27′35″N, 157°48′15″W) in waters off Oahu provided a natural experiment to examine these issues with the herbaceous bluespine unicornfish (*Naso unicornis*) and the invasive rhodophyte, *Gracilaria salicornia*. Five unicornfish were captured, implanted with a small acoustic transmitter, and tracked continuously using acoustic telemetry from June-August 2013 to define home ranges of individuals. Habitat composition, invasive algal cover, and grazing activities were determined for primary areas of use of tagged individuals. The results indicated that unicornfish were resident within the Marine Reserve where they consumed *G. salicornia*, but that grazing intensity was not uniform across reef habitats because most unicornfish used the reef crest more intensively than the reef flats. We also showed that unicornfish egested viable fragments of *G. salicornia* that resumed vegetative growth after several weeks which is statistically supported by chlorophyll fluorescence measurements of a pulse amplitude modulation fluorometer. We conclude that *N. unicornis* may act as both a natural control agent and a mobile vector for invasive alien algae.

Poster

How a coral pathogen fights off viral infections

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Half of the known bacteria are equipped with an 'acquired' immune system that prevents infection of 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, so called "clustered regularly interspaced short palindromic repeats" (CRISPRs). We demonstrate that one of the main pathogens of the coral black band disease, a cyanobacterium, is equipped with such a CRISPR immune system. The analysis of the CRISPR templates allows us to track previous virus infections and to obtain insights into the interaction between viruses and the pathogenic cyanobacterium. We hypothesize that the black band mat is a hot spot for virus infections and that cyanobacteria are in a constant arms race with their targeting viruses. This poster explains the cyanobacterial CRISPR immune system and the signatures of its past viral infections. Viruses may play an overlooked role in the progression of black band disease.

Poster

Ingestion of micro-plastic particles per sea turtles : method development

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This research project led to the development of a method to extract and quantify micro-plastics from organic field collected samples. Ocean contamination by plastic is an emerging global issue. Once ingested, plastic debris can cause partial obstruction of the digestive tract and reduce the feeding stimulus. Death caused by marine debris ingestion has been recorded in numerous species, including turtles. Micro-plastics can also accumulate toxic chemicals from sea water, increasing their toxicity to wildlife. Although plastic debris ingestion by sea turtles has been widely recorded and documented, one of the key barriers to studying the micro-plastic load of sea turtles is the lack of consistent methods to extract and quantify the micro-plastic particles from biological samples. An efficient protocol is presented for the extraction and quantification of a range of micro-plastics from sea turtles ingesta. Micro-plastics made from polyethylene, polystyrene, polypropylene and PVC, from 100 µm to 5 mm can be analyzed using this method, which can help to obtain a more comprehensive understanding of the presence of micro-plastics in marine organisms.

Poster

Giant trevally movement patterns and importance of environmental drivers

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Effective conservation of large predators requires a broad understanding of their ecology. *Caranx ignobilis* is a large marine predator well represented in coral reef environments, yet they are poorly studied. Acoustic monitoring was used to track movements of 20 *C. ignobilis* in the central Great Barrier Reef from 2012 to 2014. Using a linear modelling approach, biological and environmental effects on space use, presence and depth use were investigated to define any response to environmental changes. *Caranx ignobilis* typically remained at their capture reef with 98.8% of detections recorded at these locations. Individuals were recorded at study reefs for periods from 9 to 335 days with mean residency index of 0.53. Environmental drivers were correlated with *C. ignobilis* daily presence and hourly depth use, but had little influence on monthly space use. There was little or no effect of fish size on space use, presence and depth use. By improving the current understanding of large teleost movement patterns among coral reefs, this study reveals that site attachment may be present and environmental parameters play a role in observed movement patterns related to depth and presence. These data provide useful information for management plans development, particularly in relation to reserve design.

Poster

Nitrate–nitrite dynamics and phytoplankton growth: Formulation and experimental evaluation of a dynamic model

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A multi-nutrient quota model was modified to describe the coupled dynamics of nitrate and nitrite utilization for four phytoplankton species, *Picochlorum atomus* (Butcher; Chlorophyta), *Nannochloropsis oculata* (Droop; Ochrophyta), *Isochrysis sp*. (Haptophyta), and *Pyrocystis lunula* (Schütt; Dinophyta). Although rarely considered in nutrient-limited phytoplankton models, nitrite can be an important nitrogen source, as it can be either released due to incomplete reduction of nitrate, or taken up to supplement low nitrogen availability. The model accurately characterizes the dynamics of nitrite uptake and excretion, nitrate uptake and assimilation efficiency, and population growth for the study species in batch culture, despite the fact that the species display a range of qualitatively different nutrient utilization patterns. The good performance of the model suggests that per-capita secretion and re-assimilation of nitrite, together with changes to the per capita internal nitrogen supply, can be inferred from daily observations of medium nitrate and nitrite utilization and population growth. The model also reproduces qualitative characteristics of nitrite dynamics that have been observed in previous empirical studies, such as a rise in per-capita nitrite secretion when culture medium nitrate concentrations and intracellular nitrogen levels are high. Our model therefore provides a new framework for evaluating the potential broader trophic consequences of the effects of nitrite uptake and release on the dynamics of phytoplankton populations.

Poster

Electron microscopy provides insights into the nano scale world of marine sponges

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Viruses are ubiquitous biological entities that play significant roles in regulating biological processes in marine environments. Despite their abundance, we have limited knowledge about how viruses interact with marine hosts, particularly with sponges which are ecologically important components of benthic environments. Sponges harbor dense and diverse communities of symbiotic microorganisms and this high complexity makes the sponge holobiont an ideal model for studying host-virus interactions. We used Transmission Electron Microscopy (TEM) to survey the diversity and morphology of virus-like particles associated with 17 species of marine sponge. Individuals were collected from the Great Barrier Reef at Orpheus Island, Australia (18°35'34"S, 146°28'53"E) and in the Red Sea, at Anna's Reef, Saudi Arabia (22°13'95"N, 39°01'81"E). Sponge-viruses were visualised using two different preparation procedures: i) purification of viruses from the sponge tissue using Cesium Chloride density gradients and ii) preparation of thin tissue sections from fixed sponges. TEM grids were examined on a Titan Cubed TEM at the King Abdullah University of Science and Technology. Distinct icosahedral VLP structures were observed in individuals from the species *Amphimedon queenslandica*, *Stylissa carteri*, *Xestospongia testudinaria*, *Carteriospongia foliascens*, *Hyrtius erectus*, *Auletta sp*. and *Mycale sp*.. Histological preparations revealed the presence of VLPs in both eukaryotic and prokaryotic cells and structures closely resembling archaeal Bicaudaviriidae viruses were observed in *S.carteri* purified in CsCl gradients. This study revealed a wide diversity of viral morphologies associated with marine sponges, consistent with the high diversity of potential hosts within the sponge holobiont.

Poster

Move-over parrotfish: Coral embryos make next-gen mucous cocoons in response to suspended sediment

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Disturbed sediment produced from dredging activities and other turbidity-generating events are a concern for catchment and marine managers. Understanding the impact of suspended sediment on the early life histories of coral, which underpin recruitment, is fundamental to proper management of tropical coastlines. Coral embryos of *Acropora tenuis* and *A. millepora* were subject to suspended sediment to assess concentration-response relationships. Embryos exposed to suspended sediment for a 12 h period often formed protective cocoons. Scanning electron microscope imagery indicated the cocoon was predominantly composed of mucus and incorporated sediment particles. Cocoon formation was first observed when 3 h old embryos were subject to elevated suspended sediment and cocoon formation rates peaked with 6 h old embryos. Few cocoons were observed once embryos became larval (ciliated) at 36 h age. Cocoons were observed as low as ~30 mg L^{-1} and inshore siliciclastic sediment caused greater cocoon formation than offshore carbonate sediment. Six hours after being transferred into sediment-free seawater, embryos began escaping from the cocoons and most had escaped after 24 h, coinciding with the development of cilia. Escaped larvae were induced to settle and there were no significant differences in settlement between those that had escaped cocoons and larvae not exposed to suspended sediment. This study is the first to document this potential protective adaption of coral embryos to elevated suspended sediment.

Poster

Diving into the deep-end: Baited Remote Underwater Video Stations (BRUVS) to study deep-reef fish in the Great Barrier Reef, Australia

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Underwater video has great utility to study harder to sample areas such as deeper reefs. Baited Remote Underwater Video Stations (BRUVS) and multi-beam bathymetry were used to investigate deep-reef fish communities off the continental slope in the Great Barrier Reef, Australia. BRUVS were deployed between 50-300m in three depth categories (Deep-Shallow, Deep-Mid and Deep-Deep), and fish species richness and diversity were recorded using Australian Institute of Marine Science (AIMS) software. There were significant differences in fish assemblages across depths, with different dominant families and groups of species characterising each category. For the particular reefs studied, multi-beam habitat derivatives such as depth, rugosity and slope were correlated with higher species diversity and greater abundance. Longer deployments than typical shallow-water BRUVS deployments were required to maximize fish sampled below 200m. This study resulted in novel records for fish species recorded elsewhere in the Indo-Pacific at similar depths 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.

Poster

Community assembly, portfolio effects, and diversity-stability relationships of coral reef fishes

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Understanding what determines the relative abundance of species within communities, and the relationship between diversity and stability are two central goals of community ecology. Importantly, the drivers of 'commonness and rarity' may also affect diversity-stability relationships through different portfolio effects. Clarifying causal pathways between drivers of relative abundance and portfolio effects will provide clues for resolving the diversity-stability relationship. This project aims to develop an analytical framework to delineate the drivers of relative species abundance and quantify how these drivers influence portfolio effects and diversity-stability relationships. Data of reef fish meta-communities on the Great Barrier Reef will be analysed based on the framework.

Image courtesy of
Dr Ian McLeod

http://aims.jcu.edu.au