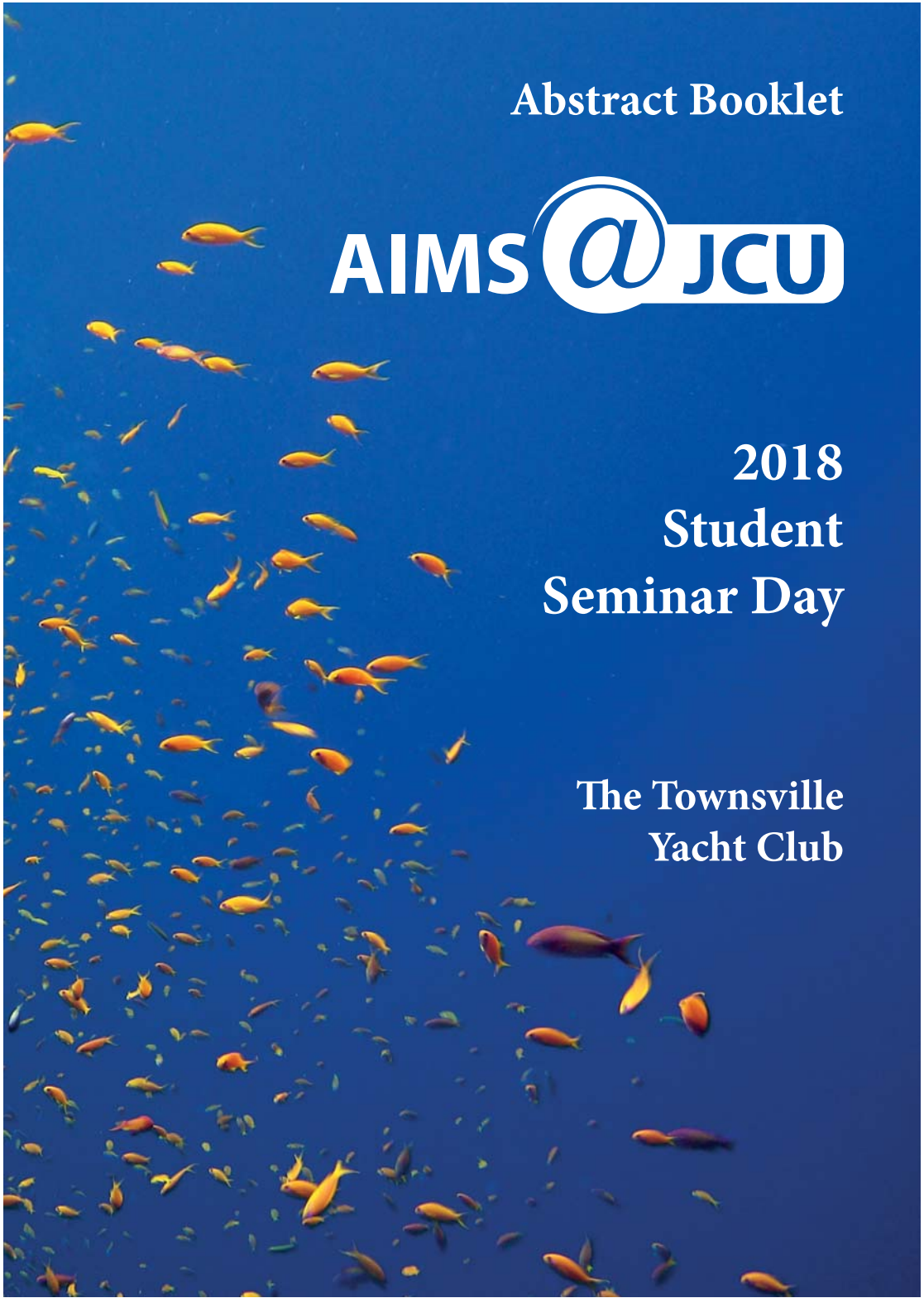

Abstract Booklet

AIMS@JCU

2018 Student Seminar Day

The Townsville Yacht Club

AIMS@JCU

Student Seminar Day 2018
Friday, 14th September

Time	Title	Presenter
9:00 am	**Opening address, AIMS@JCU Research Director**	**Libby Evans-Illidge**
	Session 1: Understanding mobile predators	
9:20 am	Stationary video transect reveals differences in habitat use and movement pattern between two stingray species	Shiori Kanno
9:35 am	Batoid nurseries: definition, use and importance	Ana Paula Barbosa Martins
9:50 am	When sharks are away, rays will play: consequences of top predator removal on coral reef ecosystems	Samantha Sherman
10:05 am	Dietary interactions determined from fatty acid profiles of sympatric coral reef mesopredators	Stacy Bierwagen
10:20 am	Illuminating the secret lives of sea snakes with tail scales	Blanche D'Anastasi
10:35 am	**Morning Tea**	
	Session 2: Understanding change on the reef	
11:05 am	Larval connectivity and retention patterns differed between different ENSO years along the Great Barrier Reef	Rodrigo Gurdek
11:20 am	Optimizing the functional groups in ecosystem models: Case study of the Great Barrier Reef	Vanessa Haller
11:35 am	Long-term acclimatisation of the cosmopolitan deep-water coral *Desmophyllum dianthus* thriving in low seawater Ph	Christopher Brunner
11:50 am	Acquired tolerance of reef-building corals to future climates	Jose Montalvo
12:05 pm	**AIMS@JCU Alumni Keynote**	**Dr. Sam Munroe**
12:35 pm	**Lunch with poster session and view/vote on photographs**	
	Session 3: Reef monitoring and management	
1:45 pm	A model for deriving benthic irradiance in the Great Barrier Reef lagoon using MODIS satellite imagery	Marites Canto
2:00 pm	Coral Reef Microbiomes: Establishing baselines for microbial based monitoring	Bettina Glasl
2:15 pm	The COTS Dashboard: Leveraging Business Intelligence to promote effective COTS control on the Great Barrier Reef	Sam Matthews
2:30 pm	The weakest link– Cumulative effects of heavy fuel oil and UV radiation across multiple life stages of coral	Mikaela Nordborg
2:45 pm	**Speed talks**	
4:00 pm	**Closing remarks**	**Prof. Helene Marsh**
4:15 pm-6:00 pm	**Judges deliberation; presentation of awards and prizes; End of day function with drinks and canapés provided**	

JAMES COOK UNIVERSITY AUSTRALIA

Australian Government

Australian Institute of Marine Science

9:20 am

Stationary video transect reveals differences in habitat use and movement pattern between two stingray species

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Mangroves are highly productive habitats offering abundant food resources and physical refuge against predators to elasmobranch species, particularly, juveniles. However, habitat use and behavioural pattern of stingrays are poorly understood within mangrove habitats and the direct utilisation of mangroves remains unclear. Stationary video transects were used to investigate fine-spatial scale use of mangroves by juveniles of two stingray species – mangrove whiprays *Urogymnus granulatus* and cowtail stingrays *Pastinachus ater* – in a mangrove-fringed intertidal area at Pioneer Bay, Orpheus Island, Australia. Transects compared abundance, residence time and behaviour of stingrays among three different habitats (inside-mangrove, mangrove-edge and sandflat) between summer (February) and winter (August). The abundance of *U. granulatus* was not significantly different between seasons, while *P. ater* was significantly more abundant in summer than in winter, suggesting a seasonal habitat shift by *P. ater*. *Urogymnus granulatus* exhibited tide-associated movement, where they occupied mangroves during flooding tide and moved to sandflats at ebb tide. As *U. granulatus* were frequently observed feeding and refuging among the root structures, they likely gain feeding opportunities and predator avoidance from occupying mangrove habitats. *Pastinachus ater* predominantly occurred on sandflats regardless of tidal height, confirming the possible importance of sandflats for feeding by this species. Juveniles of these two co-occurring stingrays consistently utilised a mangrove-fringed nearshore bay, highlighting that this may be critical habitat for early life stages, and that loss of mangroves may have significant negative effects on populations.

9:35 am

Batoid nurseries: definition, use and importance

Ana P.B. Martins[a,b,c], Michelle Heupel[b], Andrew Chin[a,b] & Colin Simpendorfer[a]

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[c]*CAPES Foundation, Ministry of Education of Brazil, Brasilia – DF 70040-020, Brazil*

Nursery areas are crucial for many elasmobranchs, providing benefits that increase fitness and survival. Shark nurseries are well studied and our knowledge of their function and importance has expanded over the past decades. However, little attention has been given to batoid nurseries, with studies covering less than 6% of the 663 described species. Threats of extinction faced by batoids reinforce the importance of defining these critical habitats. This review synthesises current knowledge of batoid nurseries to provide a better understanding of their ecological roles and importance. Historically, different criteria have been used to define viviparous and oviparous batoid nurseries, causing confusion that could lead to failure of conservation and management strategies by under- or over-estimating the importance of areas and delaying effective action. We suggest the criteria used to identify shark nurseries be applied to batoids, standardizing this nursery definition for all elasmobranchs, but also advocate for a second set of criteria that identifies egg case nurseries. Regarding ecological aspects, batoids are thought to play three main roles in nurseries: energetic links, bioturbators and mesopredators. Biotic and abiotic features affect abundance and distribution of batoids within nurseries and likely play a key role in their habitat use. However, analysis of batoid ecological roles in nursery areas is limited by the lack of research on their early life history stages. Thus, identification of areas that support sensitive life stages and an improved understanding of early life history are crucial for the efficient management and conservation of batoid species and their nurseries.

9:50 am

When sharks are away, rays will play: consequences of top predator removal on coral reef ecosystems

Samantha Sherman[a,b,c], Michelle R. Heupel[c], Andrew Chin[a,c] & Colin A. Simpfendorfer[a]

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Many elasmobranch populations are decreasing globally due to overfishing, however the ecosystem effects of these decreases are poorly understood. Southeast Asia has the highest level of elasmobranch catch globally, while the Western Pacific, in coastal areas, has a relatively low level of elasmobranch catch. However, both of these regions are relatively understudied relative to elasmobranch abundance. The aims of this study were to investigate the ecological consequences of removal of sharks from coral reef ecosystems, including changes in community composition and species behaviour. Baited Remote Underwater Video Systems (BRUVS) were deployed at 20 sites across six countries to determine elasmobranch presence, relative abundance, and behaviour. Batoids were significantly more abundant at Southeast Asian sites, while sharks were present in higher abundances in the Western Pacific. As batoids can be major diet components for some sharks, differences in relative abundance of sharks and batoids between the two regions was quantified to look for evidence of mesopredator release, or alternatively, if differences resulted from variations in batoid behaviour under different levels of predator abundance. Preliminary results showed that when shark abundance was low, batoids spent significantly more time in view and repeatedly visited the same BRUVS, suggesting bolder behavior in the absence of sharks. These results suggest that removing top predators from coral reef systems will not only affect abundance of lower trophic species, but also prey behaviour. Understanding the consequences of predator removal on coral reefs is important for the future for fisheries, tourism, and overall ecosystem health.

10:05 am

Dietary interactions determined from fatty acid profiles of sympatric coral reef mesopredators

Stacy L Bierwagen[a,b], Heidi Pethybridge[c], Michelle R Heupel[d], Andrew Chin[a,d] & Colin A Simpfendorfer[a]

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Functional redundancy among coral reef sharks and large predatory fishes is generally believed to be high, but is difficult to quantify in natural systems. The assumption of dietary overlap among predators raise questions about the ecological influence of reef sharks, and about energy flow among high order mesopredators in coral reef ecosystems. Fatty acids (FA) can give additional insights into the trophic ecology of complex ecosystems as many are uniquely associated to specific food sources and are transferred up the food chain. FA analysis is rarely used in coral reef studies, and to our knowledge have never been applied to diet study of reef sharks on the Great Barrier Reef. We used fatty acid profiles of the dorsal muscle and plasma of several mesopredators to give unique insights into the trophic structure and functioning of the Great Barrier Reef ecosystems. Multivariate analysis identified significant dietary overlap between the two shark species (*Triaenodon obesus* and *Carcharhinus amblyrhynchos*) but clear niche separation between sharks and fishes (*Lethrinus miniatus*, *Plectropomus leopardus* and *L.laticaudis*). All mesopredators sampled exhibited high proportions of polyunsaturated fatty acids (PUFA, ie DHA & ARA) (28.62-50.43) linking each species sampled to carnivory, but the differences of specific PUFAs and mono-unsaturated FAs suggest distinctive dietary sources. We found distinct differences in diet from commonly used basal trophic biomarkers between fish and sharks. The two shark species shared dietary overlap, but niche space in *T. obesus* was smaller than that of *C. amblyrhynchos*. These results demonstrate that finer scale inter-specific differences in diet exist between mesopredators in coral reef ecosystems, which could increase the potential for cascading top-down effects if one of these species were removed from the ecosystem.

10:20 am

Illuminating the secret life of Shark Bay sea snakes with tail scales and DNA

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[c]*ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, Queensland, 4811*
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[e]*Dpt. of Environment & Agriculture, Curtin University, Perth, Western Australia, 6102*
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True sea snakes (Elapidae: Hydrophiinae) have declined in at least four marine reserves in Australia and New Caledonia, with an inexplicable, virtual extinction at their most biodiverse location, Ashmore Reef. Whilst the need to conserve sea snakes is clearly recognisable, vast knowledge gaps around biology, ecology, connectivity and ranges limits capacity to determine how to conserve them. *Aipysurus laevis pooleorum*, the Shark Bay sea snake, is one of the least known sea snake taxa. It was originally described as a subspecies of *Aipysurus laevis*, based on colour, size and scale morphology (Smith, 1974) from waters between Shark Bay and Perth, Western Australia. Its taxonomic status is unclear due to an absence of molecular data and habitat use is poorly defined due to data deficiency. Conservation concerns for this taxon were raised in 2010 when an unprecedented heatwave caused catastrophic habitat loss throughout Shark Bay. Here we define the taxonomic status and genetic connectivity of the Shark Bay sea snake for the first time using combined morphometric, mitochondrial DNA and Single Nucleotide Polymorphism analyses. We describe the range of habitats used based on field observations from boat and manta-tow snorkel surveys. Conservation recommendations are made based on our findings.

11.05 am

Larval connectivity and retention patterns differed between different ENSO years along the Great Barrier Reef

Rodrigo Gurdek[a], Jessica Benthuysen[b] & Lynne van Herwerden[c]

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Larval transport represents a key phase in the life cycle of coral reef organisms by enhancing the persistence of populations and connectivity networks. Interannual larval connectivity and retention levels, including the influence of El Niño-Southern Oscillation (ENSO) events, has been documented across the Pacific Ocean. However, interannual connectivity changes in the Great Barrier Reef (GBR), remain uncertain. In this study, year-to-year larval connectivity and retention estimates along the whole GBR are presented for the first time. Larval dispersal of the model reef-associated fish, *Lutjanus carponotatus*, was modelled from 2010 to 2017, during different ENSO events. The eReefs hydrodynamic model and particle tracking techniques were used to simulate the dispersal of larvae released from 28 inner and outer GBR locations. A large-scale, multidirectional larval connectivity was observed along the GBR, mainly in central and northern sectors. Larval connectivity between the GBR and Papua New Guinea coastal waters was registered in the 2014 El Niño alert event. During the extreme 2010 La Niña event, larvae mostly exhibited a northward dispersal, although a predominant southward transport existed during the rest of the years. Larval retention was the lowest in the 2010 La Niña year, with values increasing during El Niño and neutral events. Across-shelf larval connectivity between the main inshore island groups and the outer reef was detected in all years. Identifying the larval connectivity and retention tendencies under different years, and ENSO events, emphasises the importance of considering multiannual periods when studying connectivity of GBR populations with pelagic larval dispersal phases.

11.20 am

Optimizing the functional groups in ecosystem models: Case study of the Great Barrier Reef

Vanessa Haller[a,b,c] & Elena Rovenskaya[c]

[a]*School of Mathematical Sciences, Queensland University of Technology, Australia*
[b]*AIMS@JCU, Australian Institute of Marine Science, Australia*
[c]*Advanced System Analysis, International Institute of Applied System Analysis (IIASA), Austria*

Ecosystems around the world are faced with multiple and interacting threats. These interactions can only be detected with a full system analysis. The nodes within this model could be at species or functional group level. This could mean a network size from 700 to 20 nodes. This study aims to find the optimal number of nodes as well as the uncertainties that are introduced through exaggerated grouping. This study uses a network of a coral reef from the Great Barrier Reef and is based on data originating from an honours thesis (Tudman, 2001) and the online database FishBase. The model incorporates 197 nodes at species level and eight nodes at a functional group level; mostly invertebrates, plankton and plants. The models at different resolutions (combining fish species) are investigated by simulating the network over time after a threat (reduction of the biomass in one node) has been introduced and comparing the resulting dynamics to the full model. The dynamics resulting from a system moving from the original steady state to the post-threat steady state differ between the full and the reduced system. This difference or error is then used to estimate and investigate the structural uncertainty of lower resolutions.

11:35 am

Long-term acclimatisation of the cosmopolitan deep-water coral *Desmophyllum dianthus* thriving in low seawater pH

Christopher A. Brunner[a], Jürgen Laudien[a], Carin Jantzen[a,b], Vreni Häussermann[c,d] & Günter Försterra[c,d]

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[b]*SECORE International, Inc., 4673 Northwest Parkway Hilliard, Ohio, 43026, USA*
Institute of Marine Science
[c]*Huinay Scientific Field Station, Casilla 462, Puerto Montt, Chile*
[d]*Pontificia Universidad Católica de Valparaíso, Facultad de Recursos Naturales, Escuela de Ciencias del Mar, Avda. Brazil 2950, Valparaíso, Chile*

Corals growing in deep waters, such as the azooxanthellate coral *Desmophyllum dianthus*, are expected to be the first to experience the effects of ocean acidification, since the aragonite saturation horizon progressively shifts towards shallower depths. In the fjord Comau (Chilean Patagonia), this coral thrives along a natural pH gradient. An eleven-months in situ cross-transplantation experiment at the centre and mouth of the fjord (pH = 7.76 ± 0.09 and 7.94 ± 0.11, respectively) was conducted to estimate the acclimatisation potential of *D. dianthus* towards acidifying oceans. Transplantation of *D. dianthus* specimens to more favourable (higher) pH values resulted in significantly elevated calcification rates (Tukey-Kramer test, $p = 0.009$). A transplantation to unfavourable (lower) pH conditions, resulted in almost the same growth rates as controls. In mean, a calcification rate of 0.37 ± 0.17 kg m^{-2} $year^{-1}$ with a dry mass increase of 0.05 ± 0.02 % day^{-1} was observed using the buoyant-weight technique, which corresponds with most rates reported elsewhere. This demonstrates a high acclimatisation potential of *D. dianthus* for the life in acidifying oceans. However, the combination of different environmental factors, such as rising temperatures, or hypoxia following mass die-off events of phytoplankton blooms may create an overwhelming pressure, ultimately impacting this important ecosystem engineer and therewith also organisms depending on the created habitat.

11:50 am

Acquired tolerance of reef-building corals to future climates

Jose Montalvo-Proano[a,b,c], Madeleine van Oppen[b,d], Philip Munday[c], Nicole Webster[b,e], Manuel Aranda[f] & Line K Bay[b]

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[d]*University of Melbourne, Melbourne VIC*
[e]*University of Queensland, Brisbane QLD*
[f]*King Abdullah University of Science and Technology, Thuwal Saudi Arabia*

Genetic adaptation is often assumed to be too slow to be relevant to the pace of current environmental change, but short-term experiments have revealed that corals can respond adaptively to environmental stressors through non-genetic processes within their life span (i.e., acclimation). Acquired tolerance by genetic, epigenetic and symbiont-driven mechanisms is a potentially important acclimation pathway for corals to overcome rapid environmental change predicted for this century, however, the drivers and mechanisms of this process are currently not well understood. For example, the development of acquired tolerance to future environmental conditions may be confined to specific developmental stages and may carry a metabolic cost resulting in trade offs between growth and survival. To test these hypotheses, larvae and juveniles of the coral Acropora loripes were grown and maintained under three projected scenarios of temperature and pCO_2 from the stage of gamete fertilization. Acute heat tolerance of larvae, juvenile growth and survival, and the establishment of symbiosis were examined. The acute stress experiments revealed that coral larvae rapidly acquire tolerance, with individuals reared under the most extreme condition surviving longer and in higher numbers than larvae reared under control conditions. A similar pattern was found for juvenile growth and survival. Further analyses will examine symbiotic associations, gene expression and DNA methylation profiles to investigate the molecular mechanisms underpinning acquired tolerance. These results highlight substantial capacity for the acquisition of tolerance in the early life stages of this coral species, and are relevant for understanding coral resilience in a warming future.

1:45 pm

A model for deriving benthic irradiance in the Great Barrier Reef lagoon using MODIS satellite imagery

Marites Canto[a,b,c], Lachlan McKinna[d,a], Katharina Fabricius[b,a], Barbara Robson[b,a] & Yvette Everingham[a]

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[d]*Go2Q Pty Ltd, Sunshine Coast, QLD Australia*

We developed a new ocean color model to derive benthic photosynthetically active radiation (bPAR) for waters of the World Heritage-listed Great Barrier Reef Marine Park (GBRMP), Australia. For coral reefs and other marine environments, the underwater light field is critical to ecosystem health. However, for the GBRMP, bPAR is still poorly understood as data currently do not exist at relevant spatial and temporal scales. We addressed this challenge by using satellite-derived bPAR from MODIS-Aqua imagery. Using the Beer-Lambert law, the downwelling solar irradiance $E_s(\lambda)$ was propagated to the sea-floor and spectrally integrated to derive instantaneous bPAR. Satellite-derived bPAR were then validated against concurrent *in situ* data recorded at several depths in four optically diverse test sites within the GBR. Satellite-*in situ* matchups showed significant model performance with regression metrics of $r^2 = 0.60 – 0.78$, slope = 0.98 – 1.22 and intercept = -0.28 – 0.06. We further demonstrate the model in the central GBRMP, revealing patterns of strong inter- and intra-annual variability. Our model will allow us to assess changes in bPAR in response to external drivers, and its effects on benthic primary productivity as well as enable improved future assessment of the suitability of benthic habitats within the GBR based on light availability. Concurrent work is also underway evaluating bPAR as a potential GBRMP water quality metric.

2:00 pm

Coral Reef Microbiomes: Establishing baselines for microbial based monitoring

Bettina Glasl[a,b,c], David G. Bourne[a,b,c], Pedro R. Frade[d], Torsten Thomas[e], Britta Schaffelke[a,] & Nicole S. Webster[a,c,f]

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Coral reefs are becoming increasingly threatened by local and global pressures. The development of effective monitoring tools is therefore of utmost importance for the protection and persistence of coral reefs. Although the fundamental contribution of microbes to the stability and functioning of coral reefs is widely recognised, their potential value for ecosystem diagnostics remains unexplored. An absence of microbial baselines for coral reefs has hindered our ability to detect shifts in the microbial community that could be informative of environmental anomalies. This study established the first comprehensive microbial reference dataset for selected inshore Great Barrier Reef sites and assessed their potential utility in environmental monitoring. A microbial census, including multiple coral reef niches (i.e. seawater, sediment, corals, sponges and macroalgae) assessed at high temporal resolution, was acquired by sequencing the 16S rRNA gene of 381 samples over the course of 16 months. Furthermore, temporal, spatial and intra-niche stabilities of microbiomes with varying lifestyles (e.g. free-living, host-tissue associated and host-biofilm associated) were compared to select optimal microbial traits for microbial monitoring approaches. Fine-scale effects of environmental fluctuations on the compositional variability/stability of free-living, host-tissue and host-biofilm associated microbiomes were assessed and correlated to environmental water quality parameters. Indicator value analysis and machine learning approaches were successfully used to identify microbial indicator taxa as well as to predict coral reef ecosystem health. Our study provides the first framework for integration of microbial based monitoring approaches in coral reef monitoring initiatives.

2:15 pm

The COTS Dashboard: Leveraging Business Intelligence to promote effective COTS control on the Great Barrier Reef

Samuel Matthews[a,b,c] & Mary Bonin[c]

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[b]*ARC Centre of Excellence for Coral Reef Studies, Sir George Fisher Research Building, Douglas QLD 4814, Australia*
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Outbreaks of COTS have been responsible for 40% of the decline of coral cover on the Great Barrier Reef (GBR) over the last 30 years and controlling them provides the only current solution to directly preserve coral cover on the GBR. In the context of recent mass bleaching on the GBR there has been an increased commitment to preserving coral cover and consequently the COTS Control Program is undergoing a three-fold increase in its operational fleet. The expansion of this program will provide unprecedented amounts of ecological data for the GBR (up to 7,000 surveys per annum across >700 reefs) and a unique opportunity to leverage these data using newly developed Business Intelligence (BI) software. Working closely with the Great Barrier Reef Marine Park Authority (GBRMPA), we have developed a data visualisation and analytical tool to increase the efficiency and efficacy of COTS Control Program. Built in Microsoft Power BI, “The COTS Dashboard” provides an interactive and user-friendly interface to synthesise data from a variety of disparate data streams and survey methodologies to provide easy to interpret visualisations to assess the status of the individual reefs and the progress of conservation interventions. The COTS Dashboard also reports on Key Performance Indicators for the control program such as the reduction in COTS numbers, delivery of surveillance and monitoring data and the program’s effectiveness in reducing coral cover loss. Importantly, as the COTS Control Program expands, the COTS dashboard provides a scalable platform to synthesize these new data in near-real time, promoting effective data driven decision-making on the GBR.

2:30 pm

The weakest link– Cumulative effects of heavy fuel oil and UV radiation across multiple life stages of coral

Mikaela Nordborg[a,b,c], Diane Brinkman[b] & Andrew Negri[a,b]

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Petroleum hydrocarbon oils can severely impact marine ecosystems, especially in regions frequently receiving high amounts of ultraviolet radiation (UVR), such as tropical coral reefs. UVR can more than double the toxicity of dissolved petroleum hydrocarbons and contributes to preventing critical life stage transitions at very low concentrations. While some information on the sensitivity of several life stages of coral to petroleum hydrocarbons are available, differences in methodology, pollutant, species and life stage studied prevents direct assessments of relative hazards. Additionally, only a handful of previous studies have included UVR co-exposure despite its influence on toxicity and prevalence on shallow-water reefs. Here we present a unique comparison of the effects of heavy fuel oil (HFO) on key life stages of the coral *Acropora millepora*, and highlight the importance of UVR as a co-factor when studying petroleum toxicity to tropical coral reef organisms. The toxicity of HFO was tested through chronic exposures of each life stage in the presence and absence of UVR. The sensitivity of life stages varied substantially with impacts observed for multiple life stages at concentrations lower than or similar to those previously reported from the field following accidental spills. HFO exposure in the presence of UVR could both prevent or delay the natural recovery of reefs following mortality events and exert additional pressure on juvenile and adult coral populations. Further, this study confirms that UVR, when ecologically relevant, should be included in experimental designs and risk assessments to ensure the potential impacts of petroleum hydrocarbons are not underestimated.

2:45 pm Speed Talk

Cumulative impacts of sediment deposition and climate change on up to three-months old coral recruits

Christopher A. Brunner[a,b,c], Andrew P. Negri[b], Mia Hoogenboom[c], Sven Uthicke[b] & Gerard Ricardovr[b]

[a]*AIMS@JCU*
[b]*Australian Institute of Marine Science*
[c]*James Cook University, ARC Centre of Excellence for Coral Reef Studies*

Changing climate and sediment runoff are grave threats for the survival of recently settled coral recruits due to their limited defence mechanisms and small size. In this study, the cumulative effects of periodical sediment deposition (environmentally relevant concentrations) and two climate scenarios (predicted for the middle and end of this century) were tested on up to three-months old *Acropora millepora* recruits. Mortality greater than 90% was observed at sedimentation with 80 mg/cm², with greatest effect in the climate resembling the year 2100 (29.5°C, 980 ppm). This demonstrates that in the future elevated sedimentation may seriously impact the recruitment of corals.

2:50 pm Speed Talk

Coastal Acidification in the Benthic Boundary Layer

Stephanie diPerna[a,b,c] & Michael Bode[a,c]

[a]*ARC Centre of Excellence for Coral Reef Studies, James Cook University, Australia*
[b]*AIMS@JCU, Australian Institute of Marine Science, Australia*
[c]*School of Mathematical Sciences, Queensland University of Technology, Australia*

Coastal acidification is the combination of ocean and biologically-driven acidification in coastal environments. Water chemistry parameters fluctuate due to biological processes, such as photosynthesis and respiration. Fluctuations are potentially most pronounced in the benthic boundary layer on coral reefs, driven by the metabolism of common reef organisms (e.g. coral and algae). It is unclear how these highly fluctuating coastal microenvironments will react to local stressors and climate change, as factors such as light, organic materials and temperature may influence biologically-mediated acidification. Therefore our understanding of coastal acidification impacts on inshore reefs has implications for effective coastal management.

2:55 pm Speed Talk

Superadditivity and subadditivity dynamics are not inherent to threat type

Vanessa Haller[a,b,c] & Michael Bode[a,c]

[a]*ARC Centre of Excellence for Coral Reef Studies, James Cook University, Australia*
[b]*AIMS@JCU, Australian Institute of Marine Science, Australia*
[c]*School of Mathematical Sciences, Queensland University of Technology, Australia*

Species and ecosystems usually face more than one threat which can accumulate nonlinearly: either subadditive or superadditive. These additivity dynamics are commonly attributed to the nature of the threatening processes, but this assumption has led to conflicting empirical observations. Using a modelling approach, our results reveal that threats do not always display consistent additive behavior, even in simple systems. Instead, their additivity depends on the intensity and parameter impacted by each threat. More generally, our results suggest that cumulative impact theory should focus on the intensity of threats, and should be cautious about attributing additive dynamics to particular threat combinations.

3:00 pm Speed Talk

Presence, abundance and impacts of microplastics on the Great Barrier Reef

Marina Santana[a,b], Frederieke Kroon[a]; Lynne van Herwerden[b], Cherie Motti[a] & George Vamvounis[b]

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An estimated 51 trillion microplastics contaminate oceans. Yet, their ecological impacts remain unidentified. This project examines potential ecological risks of microplastic contamination on coral reef ecosystems through combined field surveys and laboratory experiments. Specifically, it investigates: (i) microplastic presence and abundance in coral reef habitats (surface, water column, sediment); (ii) microplastic intake by wild coral reef organisms (filter deposit and plankton feeders); (iii) microplastic intake dynamics (selection, retention, depuration); and (iv) ultimate effects (growth, reproduction, mortality) of microplastic intake in representative species. Overall, the results will support an ecological risk assessment for the main microplastics on the Great Barrier Reef.

3:05 pm Speed Talk

Quantifying the Toxic Effects of Diuron and Alternative Herbicides on *Symbiodinium*

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Herbicide contamination has been of recent concern due to increased agricultural practices adjacent to the Great Barrier Reef. Off-site transport of many herbicides leads to deleterious effects for marine species including seagrasses, corals and microalgae. Coral endosymbionts, *Symbiodinium*, experience decreased growth rates and photosynthetic outputs due to elevated diuron concentrations, amongst other herbicides. Quantifying the toxic effects of both PS-II and alternative herbicides can help ameliorate national water quality guidelines. We strive to obtain ecologically relevant endpoints for herbicidal effects on *Symbiodinium*; thereby adding species sensitivity distributions for common herbicides present on the Great Barrier Reef.

3:10 pm Speed Talk

Enhancing Settlement Across Coral Species: Evidence for Ecologically Plausible Biological and Chemical Settlement Inducers

Taylor Whitman[a,b], Carly Randall[a], Andrew Negri[a] & David G. Bourne[a,b]

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Coral reproductive strategies are affecting larval survival, dispersal, and settlement across similar reef zones. Furthermore, environmental factors of hydrodynamic flow, and ecological effects of community composition and predation are also determining success during these stages. Though species-specific settlement cues have been identified for acariciid and acroporid corals, an inability to settle several other ecologically important species has posed a great threat for reef restoration. By examining the plausibility of the proposed physical, biological, and chemical cues, we attempt to elucidate the research steps needed for identifying a universal settlement inducer *in vitro* that influences successful reef restoration in the future.

3:30 pm Speed Talk

Nature or Nurture: Are coral microbiomes influenced by parents or the environment?

Hannah Epstein[a,b,c], Greg Torda[a,b], Philip Munday[a] & Madeleine van Oppen[b,d]

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The establishment of coral bacterial communities in offspring is fundamental to coral fitness, but its drivers are largely unknown. Here, we examined the influence of parents and the environment on the bacterial communities of *Pocillopora damicornis* offspring using a field-based reciprocal transplant experiment. Coral planulae were released and settled *in-situ* from parents from two adjacent reef habitats, after which they were reciprocally transplanted and sampled after one week. Using 16S rRNA metabarcoding, bacterial communities in offspring were found to vary according to parental and planulation habitats, suggesting both parents and the environment exerted influence on their bacterial community composition.

3:35 pm Speed Talk

Beneficial microbes to reef species under a changing climate

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

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[c]*Australian Institute of Marine Science, Townsville, QLD, Australia*
[d]*Australian Centre for Ecogenomics, University of Queensland, St Lucia, QLD, Australia*

As microbes play a key role in host health by providing essential nutrients to their host, microbial changes can have detrimental or beneficial effects on host fitness. Changes in microbes can rapidly occur under environmental stressors, but whether new beneficial functions might contribute to acclimatisation of reef species to climate change is largely unexplored. My project aims to define the key microbial metabolic pathways that contribute to host health and assess variation in microbial function in reef species under future climate. By determining whether beneficial microbes are transmitted between generations, we will characterize the contribution of microbes to the resilience of coral reefs.

3:40 pm Speed Talk

Coevolution and the search for symbionts in marine invertebrates

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Marine invertebrates often host highly diverse microbial communities, making it difficult to distinguish between functionally important microbial symbionts, commensals and transient environmental microbes. However, researchers can start to tease apart the myriad of microbial interactions by applying lessons learnt from host-microbial coevolution in model organisms. Congruent phylogenies of host and microbe is a common feature of symbiosis and coevolution, yet this has not been demonstrated in invertebrates hosting high microbial diversity. Detection of congruent host / microbial phylogeny would indicate a stable symbiotic partnership that can be investigated further to establish the functional basis of symbiosis.

3:45 pm Speed Talk

Viral Accessory Genes Contribute to Environmental Acclimatisation in Coral Reef Sponges

Cecília Pascelli[a,b,c], Patrick Laffy[c], Thomas Rattei[d], Timothy Ravasi[e] & Nicole Webster[a,c,f]

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[f]*Australian Centre for Ecogenomics, University of Queensland, Australia*

Viruses are ubiquitous entities that regulate diverse biological processes in marine ecosystems. They are important components of marine sponges and play roles structuring their associated microbial community and regulating metabolic functions within the sponge holobiont. Sequencing of the sponge metavirome revealed the presence of accessory metabolic genes that potentially confer host resistance to marine pollutants including heavy metals, plastics and herbicides. The functional potential of the viral community varied significantly between sponge species and sites, largely suggesting a viral mediated acclimatisation of the sponge holobiont to local environmental conditions.

3:50 pm Speed Talk

Machine learning algorithms for time-series and their application to restoration, prediction and quality control of oceanographic data

Vinicius Santino Alves[a]

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Australia's collaborative, nationwide Integrated Marine Observing System program deploys a moored array of instruments to monitor the physical, chemical and biological variables of the oceans and coastal marine environment. The data helps us understand the ocean's role in controlling the functioning and health of coastal ecosystems.

This research aims to develop a machine learning framework to process time-series data generated by this network. The intent is to automate a quality control process that currently demands a human-in-the-loop to recognise non-trivial sensor failures. Furthermore, the architecture will allow data enrichment by filling gaps in the data, providing forecasting and highlighting outliers.

3:55 pm Speed Talk

Let there be (UV) light

Mikaela Nordborg[a,b,c] & Andrew Negri[a,b]

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In environmental science a high emphasis is placed on ensuring experimental conditions are appropriate for the test subject. However, for tropical marine species found one prevalent environmental factor is almost never considered unless it is the stressor under study: ultraviolet light (UV). UV exposure is frequently extreme in Australia, both above and below the surface, and UV has been demonstrated to affect the toxicity of pollutants and resilience to temperature. To ensure our results are ecologically relevant UV light should be included in future experimental designs whenever our tests subjects are likely to experience high UV in their natural habitat.

Poster

Experimental inoculations show that environmental bacteria and host factors affect bacterial community composition in coral recruits

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Coral-associated microorganisms are essential for maintaining the health of the holobiont by participating in nutrient cycling and protecting the host from pathogens. Under stressful conditions, disruption of the coral prokaryotic microbiome is linked to increased susceptibility to diseases and mortality. Inoculation of corals with beneficial microbes could confer enhanced stress tolerance and help corals thrive under climate change. Here, we explored the feasibility of coral microbiome manipulation by repeatedly inoculating coral recruits with a bacterial cocktail generated in the laboratory. By co-culturing the two coral species *Acropora tenuis* and *Platygyra daedalea*, we also investigated the effect of host species on the acquired microbiome. The repeated inoculation of coral recruits had a strong effect on microbiome community composition. Metabarcoding using the 16S rRNA gene revealed that the seven bacterial strains administered through the cocktails were enriched in the inoculated recruits compared to their control counterparts. Moreover, significant differences between inoculated and control recruits were solely driven by the strains present in the inocula. Then, despite being reared in the same environment, *A. tenuis* and *P. daedalea* established different bacterial communities, both in terms of taxonomic composition and diversity indices. Results from our co-culture experiment thus confirm that coral host factors as well as the environmental bacterial pool play a role in shaping bacterial community composition. While the long-term stability of taxa included in the bacterial inocula remains to be assessed, we provide proof-of-concept for the feasibility of coral microbiome manipulation as a first step towards developing probiotics for coral reef restoration.

Poster

The Effects of CO_2 Variability on the Sensitivity of Coral Reef Fish to Ocean Acidification

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Elevated CO_2 levels associated with ocean acidification (OA) have been shown to consistently alter behavioural responses in coral reef fish. Additionally, elevated CO_2 has also been shown to impact survival and growth. However, all studies to-date have used stable pCO_2 treatments, not considering the substantial diel pCO_2 fluctuations that occur on shallow reef habitats. Here, we reared juvenile damselfish, *Acanthochromis polyacanthus*, and clownfish, *Amphiprion percula*, under a series of stable (500 and 1000 µatm) and diel fluctuating CO_2 treatments (1000 ± 300 and 1000 ± 500 µatm) before assessing their survival, growth and behavioral performance. As expected, lateralization of *A. polyacanthus* was significantly reduced by exposure to 1000 µatm CO_2. However, juveniles reared under both diel fluctuating CO_2 treatments exhibited restoration of lateralization comparable to fish reared under control conditions. Predator cue response of *Am. percula* was also negatively impacted by exposure to 1000 µatm CO_2. However, juveniles reared under both 1000 ± 300 and 1000 ± 500 µatm CO_2 demonstrated partial restoration of antipredator behavior. The survival and growth of both *A. polyacanthus* and *Am. percula* were not significantly affected by CO_2 treatment. Overall, we show that diel CO_2 fluctuations can reduce the severity of behavioural impairments caused by ocean acidification. Thus, out study highlights the critical importance of using ecologically relevant CO_2 levels when investigating the impacts of OA on coral reef fish.

Poster

Nutrient availability and metabolism underpin the stability of coral-Symbiodiniaceae symbioses

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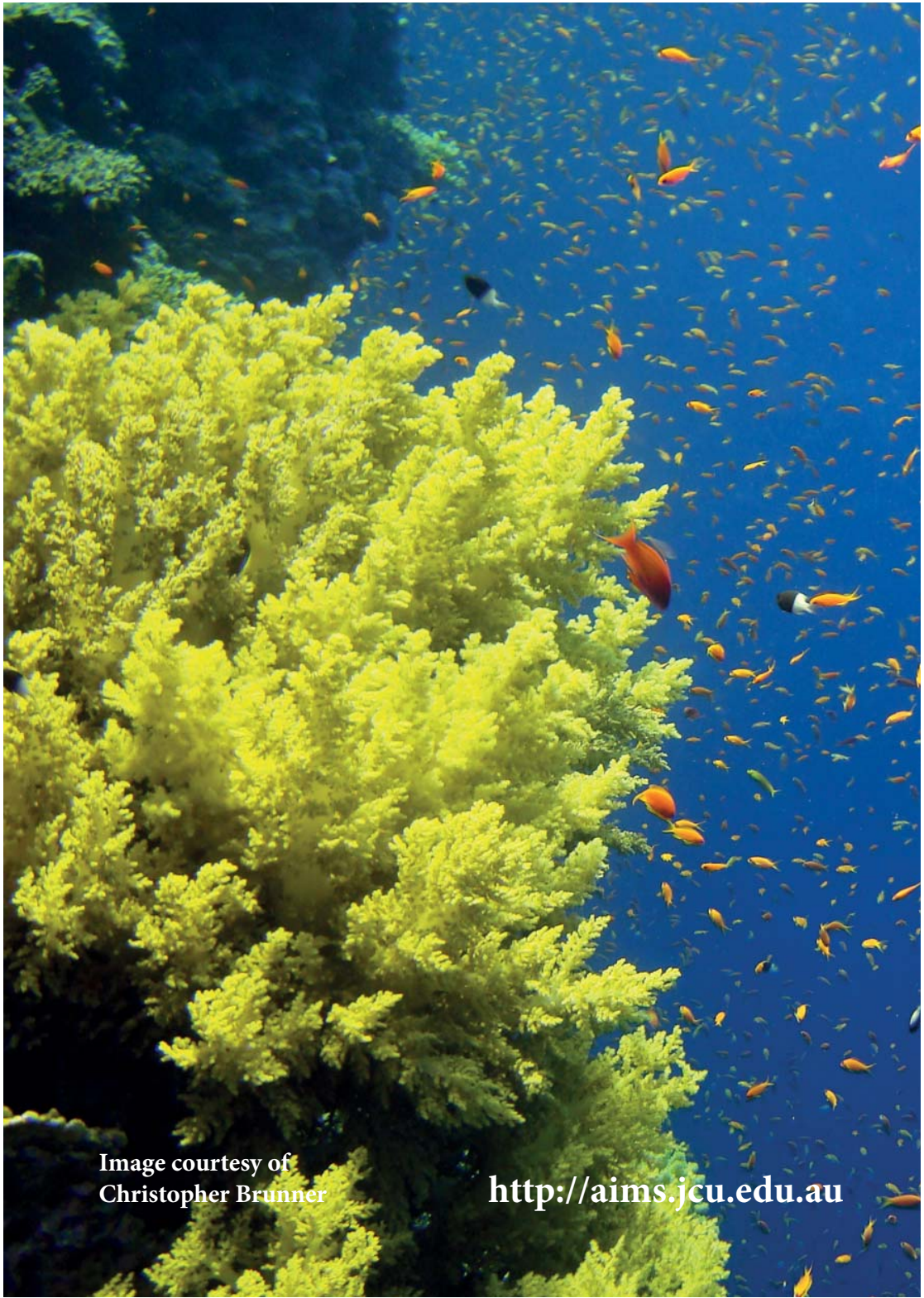
Coral reefs ecosystems are under severe decline worldwide due to a combination of anthropogenic global and regional stressors, such as ocean warming and nutrient perturbation. The symbiosis between corals and their intracellular algal symbionts of the family Symbiodiniaceae form the base of reef ecosystems through their tight nutrient cycling in oligotrophic waters. The stability of this symbiosis is under threat due to rising seawater temperatures, which result in coral bleaching (the loss of Symbiodiniaceae) and are contemporarily understood through well-characterised photo-oxidative stress pathways. In contrast, the impacts of nutrient perturbation on coral holobionts, while well-studied, are much more equivocal. However, recent studies have revealed that the forms and ratios of available nutrients on coral reefs determine the photosynthetic and energetic health of corals, with consequences for their thermal tolerance. Here we discuss and synthesise the impacts of nutrient availability on coral health and thermal tolerance. We argue that the inorganic nutrient metabolism of coral hosts and Symbiodiniaceae underpins the environmental stress tolerance of coral reefs, and therefore a much deeper understanding of coral reef nutrient biology is required to elucidate the fate of coral reef ecosystems.



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