AIMS @ JCU

Student Seminar Day 2013
Tuesday, 15th October at Reef HQ

9:00 am	**Opening address**	**Libby Evans-Illidge**
9:15 am	Digestive physiology in the smallest vertebrates: rapid growth masks the postprandial metabolic response in a larval coral reef fish	Ian McLeod
9:30 am	The inflation response of pufferfishes in a warming world	Georgia McGee
9:45 am	Comparisons between two butterflyfish hybrid groups at Christmas Island, within the Indian and Pacific Ocean suture zone	Stefano Montanari
10:00 am	Effects of nitrogen history on nitrate and ammonium uptake and cell division in the microalga *Chlorella* sp.	Martino Malerba
10:15 am	Insights into population dynamics of the intertidal *Carteriospongia foliascens* in central Great Barrier Reef	Muhammad Abdul Wahab
10:30 am	**Morning tea, view posters and photographs**	
11:00 am	The soft coral guide to bacterial manipulation	Marnie Freckelton
11:15 am	The response of the coral holobiont to pathogenic bacteria under elevated seawater temperatures	Jeroen van de Water
11:30 am	Assessing the impacts of sedimentation and turbidity on coral disease prevalence: insights from coral reefs exposed to offshore dredging	Joe Pollock
11:45 am	Effects of turbidity and sedimentation on the survival of *Pocillopora damicornis* recruits	Adriana Humanes
12 midday	Spatial variation in background mortality of dominant coral taxa along Australia's Great Barrier Reef	Chiara Pisapia
12:15 pm	Crown-of-thorns starfish predation and physical injuries promote brown band disease on corals	Sefano Katz
12:30 pm	**Lunch with poster session and view/vote on photographs**	
2:00 pm	Contrasting movements and patterns of habitat use in reef-associated sharks: implications for management and conservation	Mario Espinoza
2:15 pm	Habitat selection patterns of the Australian sharpnose shark *Rhizoprionodon taylori* in a nearshore environment	Samantha Munroe
2:30 pm	The utility of Network Analysis in studying aquatic animal movements: an example from two nearshore shark species	Elodie Lédée
2:45 pm	Crossing latitudes - long distance tracking of an apex predator	Luciana Ferreira
3:00 pm	**Afternoon tea**	
3:30 pm	Using data-logging acoustic receivers to study dugong movements in coastal environments: A comparison with satellite tracking	Daniel Zeh
3:45 pm	Stay or stray: Examination of reef-based movement of redthroat emperor	Leanne Currey
4:00 pm	The movement and space use of true sea snakes in coastal habitats	Vinay Udyawer
4:15 pm	Do coral reef communities undergo "mesopredator release" when sharks are overexploited?	Shanta Barley
4:30 pm to 5:00 pm+	**Judges deliberation and presentation of awards and prizes; drinks and nibbles provided**	

9.15am

Digestive physiology in the smallest vertebrates: rapid growth masks the postprandial metabolic response in a larval coral reef fish

Ian M. McLeod[a,b,c] and Timothy D. Clark[b, c]

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Climate change is predicted to increase ocean temperatures and alter plankton communities that are food for many marine fish larvae, although the broad consequences remain speculative. For the first time, we tested the effect of increased temperature on the growth, metabolism, and digestion of a larval coral reef fish, *Amphiprion percula*. Firstly, we measured the length and weight of 364 larvae across fine temporal scales at typical current temperature (28.5°C) and a temperature likely to be more common by the end of the century (31.5°C). Secondly, we determined routine metabolic rate ($\dot{M}O_{2routine}$) and the postprandial metabolic response at 28.5°C and 31.5°C using intermittent-flow respirometry. Larvae fed voraciously, and growth rates were rapid and temperature-independent in the 24 hours following satiation feeding; body length and weight increasing by 10% and 26%, respectively. While $\dot{M}O_{2routine}$ and peak $\dot{M}O_2$ during digestion were 55% and 28% higher at 31.5°C, the elevated temperature had no significant effect on specific dynamic action (SDA) (0.52 ± 0.046 J), digestion duration (6.35 ± 0.38 hours), or the percent of total meal energy used for digestion (SDA coefficient; 6.598 ± 0.651%). The exceptional growth in the larvae (26% body mass day-1) masked the SDA response, requiring back-calculation to disentangle the effects of weight gain and SDA.

9.30am

The Inflation Response of Pufferfishes in a Warming World

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Coral reef ecosystems are changing as a result of global warming and there are serious concerns over the impact of increasing ocean temperatures on the ecology of coral reef fishes. The metabolic processes which provide energy for the daily activities of coral reef fishes are likely to be affected by the warming climate, which may negatively impact on the ability of these fishes to properly execute behaviours necessary to their survival such as predator defence. The ability to elicit an effective predator defence can literally mean the difference between life and death on coral reefs, however little is currently known about the physiological costs of predator defence strategies utilised by reef fishes. Pufferfishes are an iconic group of reef fish with an extreme strategy for predator defence. In order to avoid being eaten, 'puffers' inflate themselves to several times their normal size by rapidly gulping large volumes of water into their stomach. The extreme nature of this defence suggests that it is a physiologically demanding activity to perform and as such, may suffer a decline in efficiency as a result of warming seas. The overarching aim of this project was to identify the metabolic costs of the inflation predator defence strategy of a single pufferfish species (*Canthigaster valentini*) and to gain an insight into how a warming environment may influence the capacity and efficiency of this extraordinary anti-predator response.

9.45am

Comparisons between two butterflyfish hybrid groups at Christmas Island, within the Indian and Pacific Ocean suture zone

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

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Christmas Island, in the eastern Indian Ocean, is located at the overlap of the Indian and Pacific Ocean marine provinces, and is a major hotspot for hybridisation. Here we compare and contrast the causes and consequences of hybridisation in two species groups of *Chaetodon* butterflyfishes with different divergence times: *Chaetodon guttatissimus* × *Chaetodon punctatofasciatus* and *Chaetodon trifasciatus* × *Chaetodon lunulatus*. For both species groups, habitat and dietary overlap between parent species facilitate high levels of heterospecific encounters. Further, low abundance of potential mates promotes heterospecific pair formation and the breakdown of assortative mating. Despite similarities in ecological conditions, the genetic consequences of hybridisation differ between the species groups. Hybridisation in *C. guttatissimus* × *C. punctatofasciatus* shows bidirectional maternal contributions and relatively high levels of introgression, both inside and outside the hybrid zone. *Chaetodon trifasciatus* × *C. lunulatus* in turn, exhibits unidirectional mitochondrial inheritance and no introgression. Further, our results indicate that *C. guttatissimus* × *C. punctatofasciatus* may reduce local species diversity through intermixing of hybrid and parental genotypes, whereas *C. trifasciatus* × *C. lunulatus* may generate sufficient genotypic novelty for the hybrids to remain distinct from the parents, thus increasing overall genetic diversity. These findings are consistent with hybridisation theory and show that the outcomes of hybridisation in reef fish are affected by the genetic distance between the hybridising parental species.

10.00am

Effects of nitrogen history on nitrate and ammonium uptake and cell division in the microalga *Chlorella* sp.

Martino E. Malerba[a,b,c], Sean R. Connolly[c,d], Kirsten Heimann[c,e]

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The rate at which single phytoplankton cells take up and assimilate inorganic nitrogen is a major driver of productivity in natural aquatic systems. Current nutrient models assume that nitrate and ammonium uptake rates are solely dependent on extracellular nitrogen concentrations. Observed dynamics, however, cannot be adequately explained based on these assumptions, suggesting that other factors play an important role. This study investigated how nutrient starvation history interacts with nitrate and ammonium uptake of a species and its rate of cell division. Obtained uptake data suggested that dynamics are more complex than previously thought. Without nitrogen starvation, nitrate and ammonium assimilation rates were similar; but when nitrate and ammonium were supplied simultaneously, nitrate uptake was initially repressed. *Chlorella* sp. starved of nitrogen for 6 to 17 days showed a 10-fold decline in nitrate uptake rate for the first 24 hours following resupply, while no delay in uptake was observed for ammonium. In contrast, the "starvation effect" on nitrate uptake was not observed when 17-day starved cultures were refertilized with ammonium before nitrate provision. These results quantify important dynamics in nitrogen uptakes rates and the influence of starvation length and the form of inorganic nitrogen used for refertilization. These new findings may help to resolve the importance of nitrogen status on phytoplankton dynamics, especially regarding algal bloom formation and longevity.

10.15am

Insights into population dynamics of the intertidal *Carteriospongia foliascens* in central Great Barrier Reef

Muhammad Azmi Abdul-Wahab[a,b,c], Rocky de Nys[b], Nicole Webster[c] and Steve Whalan[d]

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Sponges are important structural and functional components of benthic habitats. Despite the significant ecological roles that sponges play in diverse aquatic environments, information fundamental to their management and conservation is surprisingly scarce. The physical environment plays a significant role in shaping populations of marine species, however, fundamental biological and ecological processes including growth, reproduction, larval behaviours and survival are critical to population maintenance and are key contributors to the establishment of population demography. Here, we will focus on *Carteriospongia foliascens*, a foliose dictyoceratid sponge (Thorectidae, Phyllosponginae) that occurs on the intertidal coastal reef flats of the Palm Islands group in the central Great Barrier Reef (GBR). Intertidal populations of *C. foliascens* within the Palm Islands group are abundant and conspicuous, with a distribution that is constrained to a narrow shallow depth range (intertidal reef flat). These sponge populations were monitored using fixed quadrats for two years unveiling patterns of reproduction, growth, survival and recruitment. Manipulative laboratory based experiments were also undertaken to establish larval settlement behaviours. We will discuss how these processes may have contributed to the distribution of this species and propose why intertidal populations of *C. foliascens* face a great risk of local extinction in the face of climatic and environmental changes.

11.00am

The Soft Coral Guide to Bacterial Manipulation

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Coral disease is a real and significant threat to biodiversity, however, in many instances the causes remain unknown. All corals are covered in a microbial community that varies between species and location. This community plays an important role in the health and resilience of the coral host and can be observed to change from a 'healthy' community to a 'diseased' community. Unfortunately, the mechanisms that drive changes in these communities are also not well understood.

Many bacterial populations use a mechanism known as Quorum Sensing to regulate gene expression across populations and mediate interactions with other species or the environment. Quorum Sensing regulates the formation of biofilms and virulence and for this reason, has been suggested as a route for host organisms, such as coral, to interact with their microbial symbionts.

In my PhD, I have isolated and identified compounds in soft corals capable of mediating Quorum Sensing. The structural properties of these compounds appears to regulate whether induction or inhibition of Quorum Sensing occurs, an effect that varies between bacterial species with flow on effects to the types of bacteria that can thrive in their presence. These compounds could represent a mechanism of interaction between host and microbial community and provide soft corals with the capability of manipulating its bacterial community. Knowledge of these types of interactions could help us to not only to comprehend the mechanisms regulating healthy and diseased microbial communities, but lead to a better understanding of disease and disease susceptibility in the coral reef environment.

11.15am

The response of the coral holobiont to pathogenic bacteria under elevated seawater temperatures

Jeroen A.J.M. van de Water[a,b,c], Maryam Chaib De Mares[b,c], Groves Dixon[d], Madeleine J.H. van Oppen[a,c], David G. Bourne[c], Mikhail V. Matz[d] and Bette L. Willis[a,b]

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Ocean warming has played a major role in the rising incidence of coral diseases, potentially because of shifts in coral-associated bacterial communities and increases in virulence of pathogenic bacteria. Corals possess a suite of immune mechanisms to defend themselves against microbes, although how pathogen-induced responses of the coral holobiont are affected by elevated seawater temperatures, is unknown. Using a holistic approach, we investigated the responses of the holobiont of the heat-tolerant scleractinian coral *Montipora aequituberculata* (including coral, *Symbiodinium* and coral-associated bacterial communities) challenged by the bacterium *Vibrio coralliilyticus*, a causative agent of some white syndromes, and a coral commensal bacterium (*Oceanospirillales* sp.), under ambient (27°C) and elevated seawater temperatures (29.5°C, 32°C) over a 22-day period. No signs of bleaching were visible in any treatment; however PAM fluorometry demonstrated that the photochemical capacity of the coral holobiont was significantly reduced by Day 22 in the 32°C treatment, and further reduced in *V. coralliilyticus*-challenged corals when compared to *Oceanospirillales* and control treatments. Activity of the prophenoloxidase system, a major component of invertebrate immune responses, was significantly reduced in corals challenged by *V. coralliilyticus* at 32°C. In contrast, no differences in photochemical capacity or phenoloxidase expression were detected between control and *Oceanospirillales*-challenged corals. Results of ongoing RNA-Seq analyses of the full transcriptomic response of both the coral host and *Symbiodinium*, in combination with 16S rDNA 454 pyrosequencing, will also be discussed and will provide further insights into the interactive effects of elevated seawater temperatures and bacterial challenges on the coral holobiont.

11.30am

Assessing the impacts of sedimentation and turbidity on coral disease prevalence: insights from coral reefs exposed to offshore dredging

F. Joseph Pollock[a,b,c], Joleah B. Lamb[b,c], Stuart N. Field[d,e], Scott F. Heron[f,g], Britta Schaffelke[a], George Shedrawi[d], David G. Bourne[a] and Bette L. Willis[b]

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In recent decades, coral reef ecosystems have declined to the extent that reefs are now threatened globally. While many water quality parameters have been proposed to contribute to reef declines, little evidence exists conclusively linking specific water quality parameters with increased disease prevalence *in situ*. Here we report evidence from *in situ* coral health surveys confirming that elevated sedimentation and turbidity significantly increase the prevalence of white syndromes (WS), a devastating group of globally important coral diseases. Coral health surveys were conducted along a dredging-associated sediment plume gradient to assess the relationship between sedimentation, turbidity and coral health. Reefs exposed to the highest number of days under the sediment plume (296 to 347 days) had two-fold higher levels of disease, largely driven by a 2.5-fold increase in WS, and a six-fold increase in other signs of compromised coral health relative to reefs with little or no plume exposure (0 to 9 days). Multivariate modelling and ordination incorporating sediment exposure level, coral community composition and cover, predation and multiple thermal stress indices provided further confirmation that sediment plume exposure level was the main driver of elevated disease and other compromised coral health indicators. This study provides the first empirical evidence linking sedimentation and turbidity with elevated coral disease prevalence *in situ*. Our results help to explain observed increases in global coral disease prevalence in recent decades and suggest that minimizing sedimentation and turbidity associated with coastal development will provide an important management tool for controlling coral disease epizootics.

11.45am

Effects of turbidity and sedimentation on the survival of *Pocillopora damicornis* recruits

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

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Coral reefs around the world are facing increasing pressure from terrestrial runoff and eutrophication. Inshore reefs are not only affected by nutrient-enriched terrestrial runoff during the monsoonal wet season, but throughout the year, due to the retention and resuspension of fine sediments from the shallow seafloor. Laboratory experiments were conducted to investigate the effects of fine suspended sediments on the survival of early coral recruits of *Pocillopora damicornis*. The effect of experimental addition of total suspended sediment (TSS) at 30 and 100 mg/l on the survivorship and growth of recruits was evaluated over 31 days. Both elevated sediment treatments had a negative impact on survival, but 30 mg/l was as lethal as 100 mg/l. Thirty mg/l corresponds to only 3 mg sediment deposition cm^{-2} day^{-1} and is often encountered at inshore reefs, while 100 mg/l is close to the highest TSS reported for inshore coral reefs. Recruits were significantly smaller at elevated TSS, suggesting that energy was expended to the removal of sediment particles, decreasing the energy available for coral growth. A second experiment evaluated the effects of a short-term (48 hours) burial under a thin (2,5 mm) layer of fine particles (<63 μm) enriched with different levels of organic carbon on the survival of *P. damicornis* recruits. The results demonstrated that their rates of mortality increased with both the organic enrichment and with the time of exposure. Moreover, enriched sediments reduced survivorship days after the end of the exposure period.

12.00midday

Spatial variation in background mortality of dominant coral taxa along Australia's Great Barrier Reef

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Even in the absence of major disturbances (e.g. cyclones, bleaching), corals are consistently subject to high levels of background injury (partial mortality) that undermines individual fitness and resilience of coral colonies. In locations with disproportionate rates of partial mortality, corals may be less able to cope with the increasing incidence of acute disturbances associated with climate change. This study quantified background partial mortality based on instantaneous measures of observable injuries in four common coral species along the Great Barrier Reef in Australia: long-lived massive *Porites*, encrusting *Montipora*, fast-growing *Acropora hyacinthus* and *Pocillopora damicornis*. A total of 2276 adult colonies were surveyed among 27 sites, nine reefs and three latitudinal sectors along 1000km^2 on the Great Barrier Reef. Percentage of background partial mortality was surprisingly very high (between 5% and 21%) and its incidence varied at both small and large spatial scales, being two-times higher in the central and in the southern sectors, than in the northern in all four coral species. Coral taxa differed significantly in the magnitude of background partial mortality, which was highest in massive *Porites*, and differences between taxa were consistent among latitudes. Spatial differences in the incidence of background partial mortality have significant ramifications for coral capacity to cope with increasing acute disturbances, such as climate-induced coral bleaching. These data are important for understanding coral responses to increasing stressors, and in particular for predicting their capacity to recover between subsequent disturbances.

12.15pm

Crown-of-thorns starfish predation and physical injuries promote brown band disease on corals

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Brown band (BrB) disease manifests on corals as a ciliate-dominated lesion that typically progresses rapidly, causing extensive mortality. Currently, it is still unclear if the dominant ciliate *Porpostoma guamense* causes BrB pathogenicity as a primary pathogen or as an opportunistic pathogen taking advantage of compromised coral tissue or depressed host resistance. In this study, manipulative aquarium-based experiments investigated the role of *P. guamense* as pathogens of the coral *Acropora hyacinthus* when healthy, preyed on by *Acanthaster planci* (crown-of-thorns starfish; COTS) or physically injured. Progression rates of BrB lesions originating from COTS scars were up to 4.6 ± 0.3 cm/day, and ~70% of total coral tissue area was lost 4 days after ciliate inoculation. Similarly, BrB lesions developed rapidly on physically injured corals, and ~38% of coral tissue area was lost 60 h after inoculation. A choice experiment demonstrated that ciliates are strongly attracted to physically injured corals, with over 55% of inoculated ciliates migrating to injured corals and forming a distinct lesion. No BrB lesions were observed on healthy corals following experimental inoculations, and ciliates did not migrate to healthy corals during choice experiments. Our results indicate that ciliates characteristic of BrB disease are opportunistic pathogens that rapidly migrate to and colonise compromised coral tissue, leading to rapid coral mortality, particularly following predation or injury. Predicted increases in tropical storms, cyclones and COTS outbreaks are likely to increase the incidence of coral injury in the near future, promoting BrB disease and further contributing to declines in coral cover.

2.00pm

Contrasting movements and patterns of habitat use in reef-associated sharks: implications for management and conservation

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Recent studies have reported large declines of reef-associated sharks. This has raised concern as some species are thought to play an important role in the stability and functioning of marine communities. Marine protected areas (MPAs) have become a widely use tool in conservation; however, MPAs are often designed with little prior knowledge of a species' spatial ecology, this is particularly true for large predatory fish that may spend a significant amount of time outside reserve boundaries. Here, we examined the movements and habitat use of grey reef sharks (*Carcharhinus amblyrhynchos*) and bull sharks (*C. leucas*) along the central Great Barrier Reef (GBR). Forty grey reef sharks and twenty-seven bull sharks were tagged with acoustic transmitters and monitored using an array of 56 listening stations. Grey reef sharks spent most of their time on a single reef and exhibited low inter-reef movement. Site fidelity index (days detected / days monitored) for grey reef sharks ranged from 0.04-0.98, with females having on average (±SD) higher site fidelity (0.55±0.17) than males (0.31±0.21). Bull sharks were highly mobile (up to 2200 km) and used a wide range of habitats; however, some individuals spent up to 30% of their time within the study site. This study showed that current MPAs in the GBR provide some protection for grey reef sharks, but have limited conservation value for less site attached sharks. A better understanding of how reef-associated sharks move and use specific habitats will be critical to develop conservation strategies to protect local populations.

2.15pm

Habitat selection patterns of the Australian sharpnose shark *Rhizoprionodon taylori* in a nearshore environment

Samantha E.M. Munroe[a], Colin Simpfendorfer[b] and Michelle Heupel[b,c]

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The goal of this study was to identify important habitats and the degree of habitat specialisation of a locally abundant shark species. Forty Australian sharpnose sharks *Rhizoprionodon taylori* were monitored between 2011-2013 in Cleveland Bay using passive acoustic telemetry. Habitat selectivity and specialisation were assessed across five benthic habitat types (outer bay, seagrass, reef, sandy inshore and intertidal mudflats) using Strauss's linear index of selectivity and a modified Freeman-Tukey statistic, respectively. *Rhizoprionodon taylori* were present for short to moderate periods of time, ranging from 1 -140 days (mean 18.4). Mean individual niche breadth was high (0.78). *Rhizoprionodon taylori* selected for seagrass habitats (mean 0.24) and sandy habitat (mean 0.11). Seagrass selection decreased with increased rainfall while sandy habitat selection simultaneously increased. *Rhizoprionodon taylori* are demersal predators and may have selected for seagrass habitat because it has a greater abundance of demersal prey. However, seagrass habitat is adjacent to river outlets and likely experiences declines in salinity with increased rainfall. *Rhizoprionodon taylori* may have moved into sandy habitat to avoid lower salinities. Results indicate *R. taylori* are not specialised, however, selection for seagrass and use of sandy areas as refuge suggest these are important

2.30pm

The utility of Network Analysis in studying aquatic animal movements: an example from two nearshore shark species

Elodie J.I. Lédée[a], Colin Simpfendorfer[a], Michelle Heupel[a,b] and Andrew Tobin[a]

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Understanding how marine species use their environment has become increasingly important in managing and conserving species. Passive acoustic telemetry allows long-term monitoring of the marine animal behaviour and movement via a network of moored listening stations that record the presence of tagged animals. Traditional spatial statistics (e.g. home range) are used to investigate the data. However, these methods provide an incomplete picture of animal movement because the data is manipulated to estimate animal location prior to analysis. Network Analysis is an alternative approach that does not manipulate the data and treats listening stations as network nodes and analyses movement based on flows between nodes. To investigate the utility of Network Analysis in analysing tracking data, the data on sharks' movement was analysed. Results were compared to those from kernel-based home range analysis and showed that both methods provide similar results for identifying core use but were different for general activity use. Both species have similar numbers of path within their core use and general activity areas; including nine common to both species. Average path length showed both species were efficient in moving within their networks. Network Analysis provides new and useful interpretation of tracking data not provided by traditional approaches.

2.45pm

Crossing latitudes – long-distance tracking of an apex predator

Luciana C. Ferreira[a,b], Michele Thums[a,c], Mark Meekan[a] and Jessica Meeuwig[b,d]

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A 222cm female tiger shark was tagged with a SPOT tag on August 2008 off Ningaloo, WA. Initially, the shark moved around the area of the Rowley Shoals and Kimberley region. In January 2008 the shark travelled to waters off Perth and Jurien Bay, arriving off Albany on April-May 2009. It then returned to the area around the Monte Bello Islands from September 2009, returning to Perth on January 2010, as it did in the previous year. The shark had 3 distinct home range cores with 50% Kernel, one around the Monte Bello Islands, another near the Kimberley and a small area off Jurien. A total of 25% of locations were recorded within seven Commonwealth Marine Reserves. The shark showed different patterns of temperature occupancy in each region. Off the north coast (10°-24°S), temperature range experienced by the shark was much greater than when the shark visited south coast (>35°S). Analysis of the vertical profiles of water temperature for each region indicated that the shark was diving up to 380m around tropical latitudes, but staying as close to the surface possible and not descending below 100m in temperate latitudes. This suggests that tiger sharks forage over a wide vertical range in the tropics, but adapt their vertical movements to the water temperature profile at each latitude so that they forage at the surface in cool temperate waters. These results support the existence of large home ranges and movements (>1000kms) as a key feature of the ecology of this species.

3.30pm

Using data-logging acoustic receivers to study dugong movements in coastal environments: A comparison with satellite tracking

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An array of 28 acoustic receivers was installed over an area of 252 km^2 in Moreton Bay near Brisbane and used to compare the potential of automated acoustic tracking and ARGOS/GPS tracking to inform dugong spatial management, especially in the vicinity of ports. We fitted 10 dugongs with acoustic and ARGOS/GPS transmitters in 2012 and 11 dugongs in 2013. Individual dugongs were tracked from 6 to 90 days. Acoustic detections closely matched the extent of occurrence and core areas of habitat use indicated by the ARGOS/GPS tags when the dugongs were within the range of the acoustic array, providing proof of the concept. Acoustic technology potentially has the following significant advantages over ARGOS/GPS technologies for studying dugong habitat use in port environments: (1) the acoustic transmitters are much less expensive allowing at least a five-fold increase in sample size for the same outlay; (2) individual dugongs can potentially be tracked for much longer using the acoustic technology; (3) the absence of a tether should greatly reduce animal welfare issues and (4) the potential to track fast swimming animals should be improved. Composite home ranges calculated from merged 0.95 and 0.50 home range data from all individuals indicated that the dugongs were active in an area nearly four times the designated Go Slow Zone on the eastern banks of the Moreton Bay Marine Park suggesting that protected areas may need review.

3.45pm

Stay or stray: Examination of reef-based movement of redthroat emperor

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Redthroat emperor (*Lethrinus miniatus*) is an important species to commercial and recreational fisheries of the Great Barrier Reef, yet little is known about its movement patterns. Previous research has yielded limited results where the few recaptured fish were caught soon after release near the release location. However, two individuals travelled over 200km across deep water. Based on these conflicting results it is unclear whether long distance movements are typical for this species. Utilising an acoustic telemetry network at three reefs, this research provides the first description of long-term movements of redthroat emperor around Heron Island Reef on the southern Great Barrier Reef. Sixty adult individuals (300-500 mm fork length) were fitted with V13 transmitters over three deployments, and monitored within the network of acoustic receivers between April 2011 and January 2013. Duration of detections varied for tagged individuals throughout the listening period, from 1-332 days. No inter-reef movements were detected and movements were variable among individuals. The majority of fish displayed high site fidelity, with small home ranges. Transmitter pressure sensors indicated vertical movement in the water column varied among individuals, utilising depths up to 25 m. No single pattern in depth use was observed with vertical movement patterns differing with time of day and month. This study offers new insights into the ecology of this important species, and will provide a better understanding of movement patterns for management, including the benefit of marine protected areas.

4.00pm

The movement and space use of true sea snakes in coastal habitats

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True sea snakes are air breathing, marine reptiles that inhabit coral reef and coastal areas, and are most commonly encountered as bycatch in trawl fisheries around the Great Barrier Reef. This talk will present preliminary data looking at the spatial ecology of coastal sea snakes and discuss possible implications this might have on their susceptibility to trawl fishing practices. The movement of two species of coastal sea snakes (*Lapemis curtus* and *Hydrophis elegans*) were recorded using passive acoustic telemetry within Cleveland Bay. Animals were implanted with depth sensing acoustic tags for medium to long term monitoring within the bay. The data was used to investigate 2 and 3 dimensional space use in snakes between day and night periods. The current data suggests a significant difference in the use of water column between day and night, however, fine scale data of surface swimming and diving patterns are required to assess the diel activity patterns of snakes in coastal areas.

4.15pm

Do coral reef communities undergo "mesopredator release" when sharks are overexploited?

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It is widely claimed that sharks play a critical role in stabilizing coral reef communities and that their removal will trigger significant trophic cascades that ultimately destroy the reef itself. But empirical evidence to support these claims remains elusive, making it difficult to anticipate how coral reef communities will respond to the depletion of shark numbers. My research will conclusively test the proposal that the loss of sharks causes "mesopredator release" on coral reefs, boosting the density, biomass and growth rate of mesopredators, the typical prey of sharks, thereby modifying their feeding behavior, and by implication, their reproductive success. I will compare the trophic structures of two reef complexes in the Timor Sea, one pristine and the other a long-term hunting ground of shark fishers, noting that such paired locations are incredibly rare globally. My focal species are mesopredators that have been shown to be more abundant at Scott Reef than at Rowley Shoals, in addition to a range of herbivores and omnivores. My project will implement a new stable isotope technique being developed by Simon Thorrold at Woods Hole Oceanographic Institute that has the potential to revolutionize our understanding of food webs. In addition, I will use otolith growth ring analysis, diver operated video systems (DOVS), stereo baited remote underwater video (BRUVS) and gut content analysis.

Poster

Gene expression analysis of the coral response to high CO_2 and salinity stress

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Coral diseases pose a major and increasing threat to coral reefs. One major obstacle to addressing this problem is our inadequate understanding of the coral immune system/response. Anecdotally, diseases have a greater impact on corals that are already under stress, but, until recently, there has been little empirical support for this hypothesis. Although almost nothing is known about the effects of elevated pCO_2 on coral immunity, in both mammals and *Drosophila hypercapnia* is known to suppress the immune response and decrease an organism's resistance to disease.

In addition to high pCO_2 disturbances, the coral holobiont has to face other environmental challenges that can alter this coral-bacteria association. One of these is the production of the metabolite dimethylsulfoniopropionate (DMSP) by the coral holobiont. DMSP concentration has been shown to increase with climate stressors such as salinity in marine diatoms and appears to be involved in symbiotic cnidarians osmoregulation. However, the mechanisms of DMSP production by the coral holobiont are still unknown. To investigate the changes in DMSP production we exposed the corals to hyper and hypo-salinity, finding a significant increase of DMSP under these conditions.

In this study we used transcriptomic and qPCR analysis to understand the effects of high pCO_2 conditions on the coral immune system and the coral DMSP production pathway. Results of these analyses will be presented, and their broader implications discussed.

Poster

Coral Reefs of Today: Sponge Reefs of the Future

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Ocean acidification (OA) and elevated seawater temperature are predicted to cause a significant worldwide decline in coral cover and may result in extinction of some coral species by the end of this century. While the effects of climate change on corals have been intensely investigated, the impact of global warming and OA on sponges is still poorly understood. However, it has been reported that some symbiont-containing sponges may be more resistant to bleaching events than corals. A 'sponge-takeover', which occurred 200 MYA and lasted over two million years, provides some additional evidence that sponges may be more resilient to stressors than corals and might be able to replace them as the dominant reef fauna. For instance, a sponge-takeover is currently being observed in many parts of the Caribbean. We hypothesise that coral reefs of today will become sponge reefs in the future, as sponges and corals respond differently to changing ocean chemistry and environmental conditions. With our research we aim to understand how sponges cope with elevated temperature and increased pCO_2. Furthermore, we want to investigate whether they show mechanisms to adapt to these environmental changes and how sponge dominance may influence overall reef functioning. We will conduct controlled laboratory and field experiments with adult sponges as well as with larvae and juveniles to study the molecular and physiological responses of four ecologically important reef species to increased temperature and pCO_2. Finally, we will construct models, which will enable us to simulate different future scenarios considering sponges as the dominant fauna on today's coral reefs.

Poster

Coal Pollution in the Marine Environment: a risk to the Great Barrier Reef?

Kathryn Berry[a,b,c], Mia Hoogenboom[a], Jon Brodie[c], Kathryn Burns[a,c], Diane Brinkman[b] and Andrew Negri[b]

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Australia currently exports more coal by sea than any other nation and a series of port developments and expansions are proposed/planned along the Queensland coast that will facilitate further increases in this activity. Over 90% of Australian coal is exported through ports situated adjacent to the Great Barrier Reef World Heritage Area (GBRWHA) and unknown quantities of coal dust enter the marine environment during pre-shipment storage and ship loading procedures. Very little research has been conducted on the behaviour of coal in seawater and the potential effects of coal on tropical marine biota. Such information is essential to improve the assessment of potential environmental impacts of coal shipment through the GBRWHA. Research is currently being conducted at the Australian Institute of Marine Science and James Cook University to identify the ecological implications of coal pollution in the Queensland marine environment, particularly focusing on coral reefs, and to define its potential toxicity and/or physical impacts on certain reef-building coral species. This project will consist of environmental monitoring at inshore reef environments located in the vicinity of coal ports as well as river mouths of catchments that contain coal mines. Laboratory experiments will examine the biological responses of marine biota (corals and seagrass) to coal dust in order to better understand the risks associated with accidental dust release and major coal spills. This information will provide coal industry and regulators with scientifically rigorous information to improve impact assessments, risk modelling and management of coal in the GBRWHA.

Poster

Characterizing bacteriophages for BBD: potential for phage therapy?

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The prevalence of black band disease (BBD) is increasing in coral populations on the Great Barrier Reef as seawater temperatures rise with climate change and in response to increasing anthropogenic impacts, such as those with elevated nutrients. Our understanding of coral diseases is limited, making it difficult to develop appropriate strategies for the management of coral diseases. Viruses are the least studied member of coral reef communities, despite their ubiquitous abundance and likely contributions to both coral health and disease. We show that distinct T4-like bacteriophage communities occur in association with two different stages in the development of BBD, i.e. in a transitional stage between cyanobacterial patches and black band disease, and in fully developed black band lesions. The bacteriophages associated with transitional and BBD lesions may simply reflect the bacterial composition specific to the respective disease stages, or they may play a role in either the onset or mitigation of BBD, for instance through lysis of probiotic or pathogenic bacteria, respectively. Characterisation of BBD phages could further provide a foundation for the development of phage therapy - the treatment of a bacterial disease with pathogen-specific bacteriophages, a possibility we will explore in future research.

Poster

Hypoxia tolerance is conserved across genetically distinct sub-populations of an iconic, tropical Australian teleost (*Lates calcarifer*)

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Tropical coastal systems are particularly prone to periods of environmental hypoxia, which can result from organismal respiration as well as thermal stratification, and may be further exacerbated by anthropogenic disturbances. In this study we used five genetically distinct sub-populations of Australian barramundi (*Lates calcarifer*) to examine the extent of intraspecific variability in hypoxia tolerance. Fish were maintained at two temperatures (26°C or 36°C), representing the seasonal thermal range for this species across its tropical distribution in Australia. All fish maintained a constant oxygen consumption rate ($\dot{M}O_2$) as air saturation of the water decreased from 100% down to a critical oxygen saturation ($[O_2]$crit) of 15.44 ± 3.20% (mean ± SD) and 21.07 ± 3.92% at 26°C and 36°C, respectively. Mean $[O_2]$crit, used as a performance measure of hypoxia tolerance, did not differ between sub-populations. No differences were found for resting $\dot{M}O_2$ between sub-populations at 26°C, however modest differences were detected between two sub-populations at 36°C (3.36 ± 0.62 and 2.83 ± 0.27 mg $O_2 kg^{-1} min^{-1}$ for Gladstone and Broome sub-populations, respectively). Resting $\dot{M}O_2$ was lower for sub-populations at 26°C (1.46 ± 0.26 mg $O_2 kg^{-1} min^{-1}$) than at 36°C (3.10 ± 0.43 mg $O_2 kg^{-1} min^{-1}$) with a temperature coefficient (Q10) of 2.12 ± 0.30. We conclude that both hypoxia tolerance and resting $\dot{M}O_2$ are conserved across the distribution of barramundi in Australia, which reflects the capacity of this species to cope in environments with large fluctuations in both temperature and dissolved oxygen.

Poster

Lagged effects and widespread distribution gradients of coral disease following a severe tropical cyclone

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Tropical cyclones are the most severe form of mechanical disturbance to reef corals. Wounding and injuries to corals have been shown to increase disease susceptibility, potentially leading to additional coral mortality than from breakage alone. Although cyclone severity is predicted to increase as global mean sea temperatures rise, the relationship between coral damage and disease following a major storm event has not been examined. In February 2011, immediately following one of the most severe tropical cyclones to cross the Great Barrier Reef, we quantified coral damage and disease prevalence along a latitudinal gradient spanning 700 km. Our findings, which derive from a total of 140,870 coral colonies surveyed across 66 semi-permanent transects, revealed that coral damage gradually attenuated with increasing distance from the cyclone path (second order polynomial, $R^2 = 0.83$), although mean disease levels remained relatively low along the entire latitudinal gradient (>1%). Interestingly, during follow-up surveys 6 months later, coral disease prevalence was strongly correlated with levels of damage recorded immediately following the cyclone event ($r = 0.76$). In addition, sites located within zones sustaining destructive wind speeds (125 - 280 km hr^{-1}), exhibited a 4-fold increase in mean overall coral disease prevalence (5.1%) compared to sites enduring only gale force winds (>125 km hr^{-1}; prevalence = 1.5%). One year following the cyclone event, mean disease prevalence at sites located within destructive wind speed zones returned to levels recorded in February 2011, however a significant loss of coral cover was determined at the majority of sites, implicating disease as the driver. These results serve to predict the potential widespread and lagged effects of increasing cyclone intensities on coral health.

Poster

Digestive physiology in the smallest vertebrates: rapid growth masks the postprandial metabolic response in a larval coral reef fish

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Climate change is predicted to increase ocean temperatures and alter plankton communities that are food for many marine fish larvae, although the broad consequences remain speculative. For the first time, we tested the effect of increased temperature on the growth, metabolism, and digestion of a larval coral reef fish, *Amphiprion percula*. Firstly, we measured the length and weight of 364 larvae across fine temporal scales at typical current temperature (28.5°C) and a temperature likely to be more common by the end of the century (31.5°C). Secondly, we determined routine metabolic rate ($\dot{M}O_{2routine}$) and the postprandial metabolic response at 28.5°C and 31.5°C using intermittent-flow respirometry. Larvae fed voraciously, and growth rates were rapid and temperature-independent in the 24 hours following satiation feeding; body length and weight increasing by 10% and 26%, respectively. While $\dot{M}O_{2routine}$ and peak $\dot{M}O_2$ during digestion were 55% and 28% higher at 31.5°C, the elevated temperature had no significant effect on specific dynamic action (SDA) (0.52 ± 0.046 J), digestion duration (6.35 ± 0.38 hours), or the percent of total meal energy used for digestion (SDA coefficient; 6.598 ± 0.651%). The exceptional growth in the larvae (26% body mass day-1) masked the SDA response, requiring back-calculation to disentangle the effects of weight gain and SDA.

Poster

Chromera- a coral symbiont or a parasite?

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Coral reefs were considered as the product of a mutualistic relationship between the corals and algae of the genus *Symbiodinium*. However, recent research has demonstrated that corals lives in close associations with large, diverse and specific populations of other microorganisms collectively referred to as the coral holobiont. *Symbiodinium* belongs to a group of protists called alveolates and recently it has been established that a number of other related alveolates are also intimately associated with corals including: the newly discovered algal species *Chromera*. Currently, there is a great deal of interest in *Chromera* because it is thought to be the missing link between the photosynthetic dinoflagellates and the non-photosynthetic apicomplexans. Interestingly, all the members of the Apicomplexa are, so far, identified as parasitic organisms. Although the literature implies that *Chromera* is a coral symbiont, this hypothesis has not been rigorously tested; its close relationship to apicomplexans suggests that it might be a facultative parasite. The research project aims to establish the nature of the relationship between *Chromera* and corals by investigating its impact on coral fitness using molecular-based approaches. Gene expression levels will be compared in *A. digitifera* larvae exposed to *Chromera* with larvae exposed to a compatible *Symbiodinium* strain (as a positive control), using the Illumina RNAseq technology. Stress and immune challenges have distinct transcriptomic signatures, as does the normal *Symbiodinium* infection process. Hence analysis of the transcriptomic impact of *Chromera* infection should shed some light on the nature of the association of this organism with coral.

Poster

Reef fish hybridization: lessons learnt from butterflyfishes (genus Chaetodon)

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

Poster

Dredging during coral spawning off the Western Australian coastline: will there be any impacts?

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Dredging off the Western Australian coastline is set to increase owing to a surge in oil and gas exploration. The potential impacts of dredging-related suspended solids, sedimentation and light attenuation on the synchronous mass spawning of corals is not well understood. I aim to determine dose:response thresholds across a range of early life history stages and identify the mechanisms causing any deleterious effects. Experiments will be conducted at the National Sea Simulator where water quality parameters can be controlled with precision. For fertilisation experiments, up to eight suspended sediment concentrations will be used to determine impacts of sediment type, mineralogy, particle size and sperm concentration on fertilisation success. Cause:effect pathways pinpointing the underlying mechanisms for fertilisation failure in the presence of sediments will be examined using light and electron microscopy. Larval development and settlement experiments will be conducted by manipulating sedimentation and light in addition to suspended solids. Results from this project will inform risk assessments for dredging and improve environmental and economic outcomes for regulators and the resource sector.

Poster

Diving into the deep-end: Investigating Queensland's tropical deep reef fish

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Little is known about Queensland's tropical fish that occur at depths 50-700m. These fishes are commercially valuable in many locations making these multiple-species assemblages susceptible to overexploitation. Increasing demand, market prices, and popularity have caused fishermen across the Indian and Pacific Oceans to gear up and target these species. My project will investigate the deep-reef assemblage off the Queensland shelf, the biodiversity and demography of the fishes below 100m, which is regarded as a virgin fishery. As the economic viability of shallower fishery species is slowing, more local fishermen are tempted to fish deeper. In Queensland, there is a unique opportunity to sample before extensive fishing pressure. By looking at key demographic and ecological characteristics such as growth, reproductive seasonality, and fish-habitat associations, we can demonstrate if these change with increasing fishing pressure. Fishery-independent surveys using Structured Line Fishing and Baited Remote Underwater Video Stations (BRUVS) will be employed. Samples from research fishing will be used in addition to donated samples provided from commercial and recreational fishermen. BRUVS are a fishery-independent method used to gather information when the selectivity of fishing gear is a concern. The use of BRUVS helps to overcome the challenges of studying species at depths not available for SCUBA, and can collect information on species assemblage, size and somatic estimates of individuals, along with preliminary habitat information. Future aspects of this project will incorporate genetic and otolith studies. Fisheries information can be augmented by advances in otolith and genomic analyses, improving stock assessment capabilities, and providing more detailed information of the assemblage.

Poster

Increased turbidity enhances negative impacts of ocean acidification on marine calcifying organisms of the Great Barrier Reef

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Due to global change and riverine runoff, many marine organisms have to cope with global and local stressors simultaneously. The present study evaluates the individual and combined influence of ocean acidification, OA and increased turbidity on two calcifying coral reef key species, the scleractinian coral *Acropora millepora*, and the green algae *Halimeda opuntia*. In a manipulative laboratory experiment, both organisms were exposed to combinations of pCO_2 (437 and 1092 µatm) and photosynthetically available radiation, PAR (35 and 150 µM x m^{-2} s^{-1}). Results show that corals and algae respond differently to changed environmental conditions. While growth rates of corals were susceptible to changed pCO_2 and changed light conditions, algae were only impacted by changed light regimes, however not by pCO_2. Light calcification rates of both organisms showed no effect of pCO_2. However, dark calcification rates revealed the deleterious impact of OA by dissolving the skeleton of both, coral and algae. Yet, due to higher light calcification rates, the algae was still capable to maintain positive net calcification rates under all conditions, while corals showed net dissolution in the high pCO_2/ low light treatment. We therefore suggest a taxa specific response to altered environmental conditions with corals being more impacted under future OA and turbid conditions than calcifying algae. This will lead to further shifts in community structures with less primary framework builders and more algae dominated inshore reefs at the Great Barrier Reef.