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NORTH WEST SHOALS TO SHORE RESEARCH PROGRAM SYMPOSIUM

September 23-24, 2020




Informing the sustainable development of Australia's North West marine estate

Abstracts - Wednesday 23 September

Theme 4: Understanding the isolated coral atolls of the North West Shelf: The past, present and future of Rowley Shoals.

Coral communities

Western Australia has some of the world's best managed and healthiest coral reefs, but a combination of natural disturbances and climate change are now degrading even our reefs. We contrast the dynamics of adjacent reefs systems over more than two decades, highlighting the roles of local environment, background disturbances, coral life histories, and particularly heat stress and bleaching, in structuring their coral communities.

Presenter
Dr James Gilmour (Theme Leader) is a coral ecologist at AIMS, exploring complementary data to understand the dynamics of coral reefs and to better manage their future condition.

Mapping coral reef habitats using 3D rugosity metrics

We demonstrate the use of 3D rugosity metrics analysed at different scales to quantify some of the unique habitats of the Rowley Shoals, such as extensive reef flats and lagoon complexes.

Presenter
Dr Ben Radford is a spatial and ecological modeler at AIMS, specialising in remote sensing data to map and monitor reefs.

eDNA for coral monitoring

We combined traditional visual surveys with seawater eDNA assessments and found considerable overlap in coral diversity. The eDNA approach generated species-level resolution using a custom DNA reference database, for an enhanced overview of the local coral diversity and abundance.

Presenter
Laurence Dugal is a joint PhD student with AIMS and UWA, specialising in eDNA metabarcoding technologies to characterize marine biodiversity..

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Helping to better understand WA's marine environment.

A quantitative assessment of tow-cameras for coral monitoring

We compared a towed-camera approach to repeated surveys of shallow water coral reef benthic assemblages on fixed transects, relative to the benchmark data obtained from diver photo-transects.

Presenter
Dr Anna Cresswell is a quantitative marine ecologist at AIMS, studying the temporal dynamics of coral populations and communities.

Autoclassification of coral communities

We demonstrate the latest advances in AI (Artificial Intelligence) for automating coral classification from benthic imagery generated from established methods, and the possibilities for automation at different spatial scales.

Presenter
Mat Wyatt is a data scientist at AIMS, specialising in computer vision techniques for identification of marine species.

Shark and predatory fish communities

We sampled fish assemblages using baited remote underwater video systems (BRUVS) at the Rowley Shoals. The results show distinct fish assemblages across the different reef zones, stability through time and relatively high abundances of regionally fished species compared to surrounding isolated reefs.

Presenter
Matt Birt Birt is a fish ecologist at AIMS, specialising in the use of stereovideo techniques to explore research questions in fish ecology.

Movement and connectivity of marine predators

Movement of marine predators can connect different habitats and create links that are key for ecosystem function. We used a combination of acoustic telemetry data, network analysis and habitat modelling to quantify movement patterns and habitat use of three coral reef predators. Movements of predatory fish resulted in local-scale connectivity between the lagoon and nearby forereef, whereas reef shark connectivity operated at larger scales with movements along the forereef linking distant areas..

Presenter
Dr Luciana Ferreira is a postdoctoral scientist at AIMS working on the spatial and movement ecology of marine megafauna and the application of ecological and statistical models to describe movement and distribution of species.

Mechanisms of coral resilience

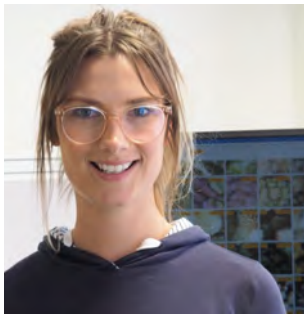
Understanding where the next generation of young corals comes from, and their capacity to adapt to changing conditions, underlies the future of the Rowley Shoals. In this study, we used genomic methods to explore patterns of larval connectivity among communities at the Rowley Shoals, for corals with spawning and brooding modes of reproduction. We also tested whether background environmental variation among sites conveyed greater resistance to heat stress and coral bleaching,and discuss the implications of our results for the future resilience and adaptation of coral reefs to climate change.

Presenter
Dr Luke Thomas is a joint postdoctoral scientist with AIMS and UWA, specialising in molecular ecology and population genetics.

Dr Jim Underwood is an AIMS postdoctoral fellow whose research focuses on understanding the eco-evolutionary interplay between genetic diversity and resilience of coral reefs.

Coral bleaching 2020

Coral communities at the Rowley Shoals experienced unusually high sea surface temperatures and coral bleaching in 2020. Degree heating week values predicted coral bleaching for Imperieuse Reef (4.11 °C-weeks), however, coral bleaching of varying severity was recorded across all three reefs. Most communities surveyed experienced approximately 1-30% coral bleaching and up to 60% of bleaching was observed at some sites.



Presenter
Nicole Ryan is a benthic ecologist at AIMS, monitoring of long-term changes of benthic communities of the reefs and shoals of north Western Australia.

Hydrodynamic connectivity of corals

Physical processes that control the exchange of water masses within different parts of the reef, and with the surrounding deep ocean, play an important role in regulating the distribution of water and material (heat, larvae, nutrients, sediment) within reef systems. This study integrates in situ field measurements (current, water levels, waves and temperature) and numerical ocean modelling across the relevant spatial and temporal scales to better understand how ocean-driven processes shape the reef environment and the dispersal of coral larvae.

Presenter
Camille Grimaldi is a joint PhD student between UWA and AIMS, working on the oceanographic drivers of coral reef connectivity on coral reef atolls.

Theme 3: Protected and iconic species movements and threats

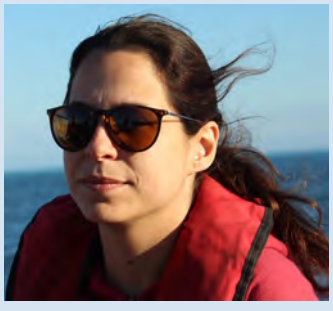
Quantifying movement, distribution and important areas of pygmy blue whales on the North West Shelf.

The pygmy blue whale (*Balaenoptera musculus brevicauda*) is a listed Endangered species under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999. The distribution of the species on the North West Shelf (NWS) and designation of Biologically Important Areas (BIA) for these whales is based on limited information. This has implications for conservation management and thus, more data and quantitative analysis on the residency, movement and migration pathways of the species is urgently required. Here, we compiled passive acoustic monitoring data (46 instruments from 2006 to 2017) and satellite telemetry data (12 deployments from 2009 to 2020) across the NWS to quantify the spatial distributions of pygmy blue whales on the NWS. These data were used to identify hotspots of pygmy blue whales on the NWS and provide quantitative data to assist with refining current distribution maps and BIAs that can assist with mitigating impacts of industrial development and other pressures in the region.

Presenter
Dr Michele Thums (Theme Leader) is a quantitative ecologist at AIMS with a research focus on understanding the natural and anthropogenic drivers of animal movement and distribution and producing applied outcomes relevent to threatened species management and conservation.

Multiple satellite tracking datasets inform marine turtle conservation on the North West Shelf.

Australia supports some of the largest rookeries of marine turtles in the Indo-Pacific, but there is little published data on the spatial use of Australian sub populations. Here we compiled existing satellite tracking data for adult, female green (n = 96) and hawksbill turtles (n = 42) from Western Australia and used it to determine the distribution and important areas for each species. In addition, we compiled spatial data on human activities on the North West Shelf and calculated the overlap of species distributions with these activities. The spatial extent of the inter-nesting areas was largely encompassed by existing spatial protection during the breeding season, and in some cases reduction in size of these protected areas could be considered. We identified 13 core foraging areas with 35% (greens) and 23% (hawksbills) occurring within Marine Protected Areas, but low overlap with recognised Biologically Important Areas. We have provided the first quantification of the areas used for inter-nesting, foraging, and migration for these species that can be used to inform marine spatial planning and assist decision making.



Presenter
Dr Luciana Ferreira is a postdoctoral scientist at AIMS working on the spatial and movement ecology of marine megafauna and the application of ecological and statistical models to describe movement and distribution of species.

Abstracts - Thursday 24 September

Theme 2: Seabed habitats and biodiversity

Characterising the Ancient Coastline Key Ecological Feature: Fish and benthic communities

The ancient coastline at 125 m depth (AC125) is defined as a Key Ecological Feature based on the expectation it comprises hard substrate that supports high species diversity. Our exploration of five study Areas along the AC125 showed a dominance of soft sediment habitats with sparse to no epibenthic biota, possibly due to burial of the original coastline. We identified important but patchy aggregations of epibenthic communities, but most areas of hard substrate that supported epibenthic communities were found in waters shallower than the AC125. The fish of the AC125 and adjacent habitats sampled are representative of mesophotic fish communities of the region. Highest fish species richness was shallower than the AC125 associated with areas that featured benthic biota and pockets of complex substrate. Drivers of fish abundance varied by species. We also observed several species of fishery and conservation importance associated with the AC125 and adjacent habitats, as well as extending the known depth distributions of several fish species.

Presenter
Dr Marji Puotinen is a spatial-ecological data scientist at AIMS, aims to get maximum value from field data through robust sample design and modelling approaches that 'fill in the blanks' between the in-situ observations.

Presenter
Dr Leanne Currey-Randall is a fish ecologist at AIMS who uses multiple techniques to understand the drivers of diversity, abundance, community structure and movement patterns of fishes (teleosts and elasmobranchs).

Pearl Oyster habitats and distributions in the 80 Mile Beach region

The silver-lipped pearl oyster, *Pinctada maxima*, is an important Western Australian fishery with wild-caught animals used for the culture of pearls. Oysters are harvested by divers to ~35m depth, although anecdotal evidence suggests oysters extend beyond diving depths. We used image-based and acoustic methods to determine the distribution and habitat-associations of *P. maxima* off Eighty Mile Beach, including data from 862 km2 of multibeam survey and 119 towed video transects to 134 m depth. *P. maxima* occurred from 28-76m with ~90% of oysters found shallower than 38m. Most oysters (>98%) occurred in sandy habitats with neighbouring benthic communities of filter feeders. There was no evidence that extensive populations extend into deep water.

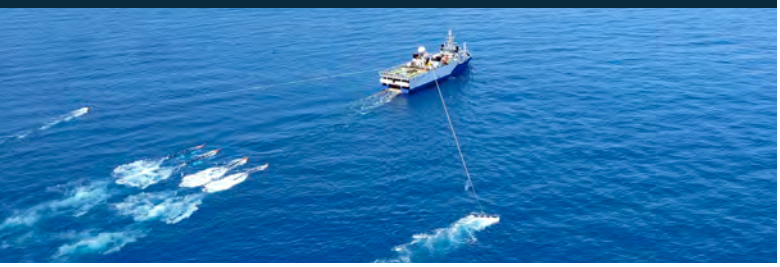
Presenter
Dr Karen Miller, AIMS (Theme Leader) is a benthic ecologist whose research focusses on understanding the patterns and processes that drive the distribution of marine invertebrate biodiversity in our oceans.

Genetic connectivity of the pearl oyster *Pinctada maxima*

Offshore populations of the pearl oyster *Pinctada maxima* are thought to represent broodstock that replenish the nearshore fishery in the Eighty Mile Beach region of Western Australia. We used a genotyping by sequencing approach to explore genetic connectivity among inshore shallow (8-15 metres depth) and offshore deep (~35 metres depth) populations of *P. maxima* near Eighty-Mile Beach, in order to infer patterns of larval dispersal and recruitment. We sampled 715 individuals from 33 sites using a spatially replicated, hierarchical design including two depths, up to five locations within each depth, and up to five replicate sites within each location (separated by 1-5km). Our results, based on 3,852 single nucleotide polymorphisms, indicated high-levels of dispersal and connectivity among inshore and offshore fishing grounds. Genetic structure likely reflects changes in dispersal patterns from year to year, but where successive dispersal and recruitment events over generations and in a dynamic environment act to largely homogenize the population.

Presenter
Dr Luke Thomas is a joint postdoctoral scientist with AIMS and UWA, specialising in molecular ecology and population genetics.

Theme 1: Marine seismic noise - measurement and impacts



Design and implementation of a real-world experiment to investigate the effect of marine seismic survey on fish and pearl oysters

In 2018, the Australian Institute of Marine Science (AIMS), in collaboration with its partners conducted two experiments to investigate the effect on demersal fishes and pearl oysters (*Pinctada maxima*) of exposure to a 3D seismic survey. These experiments were conducted off the northern Western Australian coast at one site ≈90km off Point Samson (fish) and another ≈40 km west of Broome (pearl oysters). The fish experiment was conducted within a fishery management area closed to commercial fishing. Locations within this area with suitable and similar fish habitat sites were selected to provide differing levels of exposure (including control sites) for monitoring fish abundance and behaviour. Approximately 400 red emperor (*Lutjanus sebae*) were captured and tagged with assistance of local commercial fishers and the Department of Primary Industries and Regional Development to measure movements in response to the seismic survey. The pearl oyster experiment involved the collection, deployment, retrieval and assessment (using scientific and commercial measures) and deployment of more than 10,000 oysters at various distances and therefore exposure levels from the seismic sail lines.

Presenter
Dr Mark Meekan (Theme Leader) is a fish biologist at AIMS with a research focus on the ecology of larval reef fishes and elasmobranchs.

Measurement of sound, particle motion and ground motion

To assess the acoustic exposure levels experienced by demersal fishes and pearl oysters from air-gun array 'shots' fired during the seismic sail lines operated during the two experiments, we conducted >50 deployments of pressure, particle velocity and ground motion sensors. This produced >100 datasets, including long-term observations of the soundscapes and biological sounds. Sensors deployed during the exposure period collected ≈70,000 recordings of individual seismic shots at various ranges and azimuths from the air-gun array, across the two experimental sites. These measures were used to validate previous Curtin University models of propagation losses at each experimental area. Interpolating across range and azimuth provided an estimate of individual shots (totalling >1,000,000 estimates for each of ten acoustic metrics) and cumulative exposure levels at each of 179 (144 fish and 35 pearl oyster) biological sampling sites. This presentation will highlight some of the findings and limitations of the passive acoustic monitoring datasets from the fish and pearl oyster experimental sites. The recordings even managed to capture a passing cyclone and the responses of the fish choruses to this extreme weather event.

Presenter
Dr Miles Parsons is a research scientist at AIMS with a focus on underwater acoustics.

Dr Robert McCauley is an Associate Professor at Curtin University. He has researched impacts of seismic survey air gun sources on animals from plankton to whales.

The effect of marine seismic surveys on the movement, abundance and community structure of demersal fish assemblages on the North West Shelf

During the fish seismic exposure experiment, demersal fishes were observed in five sampling surveys over a six-month period (three surveys before and two after exposure), using Baited Remote Underwater Videos Systems (BRUVS). In addition, two acoustic telemetry arrays (one each in the high exposure and vessel control zones), tracked the movements of acoustically tagged red emperor (*Lutjanus sebae*), to observe any displacement of the fish, as a result of the seismic survey. During each sampling survey, BRUVS were deployed at 144 locations (629 deployments in total) at various distances from the seismic sail lines. Relative abundance, fish length and behavioural measures were recorded for each species. This provided quantitative data on abundance, community structure and behaviour of the demersal fish assemblage in the area before and after the seismic survey with a focus on six commercially important species, including red emperor.

Presenter
Dr Conrad Speed is a marine ecologist with interests in the behavioural ecology, population biology, and trophic role of marine predators currently working as a postdoctoral scientist with AIMS.