Australian Government
Australian Institute of Marine Science

NORTH WEST SHOALS TO SHORE RESEARCH PROGRAM

April 2020




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

Welcome to the quarterly newsletter from the North West Shoals to Shore Research Program (NWSSRP). Produced by the Australian Institute of Marine Science (AIMS).

In this edition:

The May 2020 symposium has been postponed until further notice but we can still bring you a preview of the presentations to come later this year under the four key areas of research:

- Marine Noise and Monitoring
- Seabed Habitats and Biodiversity
- Threatened Species
- Understand the Isolated Coral Atolls of the North West Shelf

What's happening?

Coral eDNA proves its worth as a monitoring technique

eDNA could provide an alternative to diver-based surveys. (Photo: Nick Thake)

Environmental DNA (eDNA) extracted from seawater samples is showing great promise for the future of coral reef monitoring programs, according to researchers who have been trialling new techniques at the highly diverse Rowley Shoals atolls in northwestern Australia.

PhD candidate Laurence Dugal has been working with the North West Shoals to Shore Research Program to test the effectiveness of survey information using eDNA from seawater.

Surveys generally rely on expensive and time-intensive diver-based assessments of coral health and diversity, however next-generation sequencing makes use of genetic material contained in environmental samples to simultaneously detect a range of target species in a more rapid and efficient way.

"Using two coral-specific molecular markers and a reference database including 70 local coral species, we successfully identified 42 species from 56 one-litre seawater samples," Laurence said. "Also, there was considerable overlap in genetic richness between the results of the eDNA and visual survey data, and the diversity detected with eDNA was significantly improved when we integrated information from a database of locally-collected species."

The findings showcase the potential of eDNA metabarcoding for coral reef monitoring and the importance of improved reference databases for better results in studies.

Marine heatwave events and extensive coral bleaching has highlighted the urgent need to document biodiversity on reefs in their current state in order to detect any changes in community structure and diversity.

Abstracts

Understanding the distribution, important areas and threats for pygmy blue whales on the North West Shelf

The pygmy blue whale (*Balaenoptera musculus brevicauda*) is currently listed as an endangered species under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act). They are thought to migrate along the shelf edge from Australian feeding grounds to Indonesian breeding grounds with known foraging grounds in the Perth canyon and potential foraging grounds off Exmouth and Scott Reef. This species is particularly difficult to survey using conventional visual methods, because they occur at low density, a long way from shore and over vast spatial scales. However blue whales, like many cetaceans make sounds that can be used to indicate their presence. Here we used both new and existing datasets, including from passive acoustic surveys and animal borne satellite telemetry to model and map the distribution and important areas for pygmy blue whales on the North West Shelf.

Presenter
Dr Michele Thums is a quantitative ecologist 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.

Informing turtle conservation on the North West Shelf through the synthesis of multiple satellite tracking datasets

Marine turtle populations are declining globally. Australia supports some of the largest rookeries of marine turtles in the Indo-Pacific. Here we compiled existing satellite tracking data for adult, female green turtles (n = 76) and hawksbill turtles (n = 23) from Western Australia and used it to pinpoint nesting areas in the region not sampled. We filled these gaps with targeted new deployments of satellite tags (20 for each species) and used the combined data to determine the distribution and important areas for each species.

Our results showed a predominance for coastal post-nesting movements to neritic foraging grounds, with green turtles exhibiting wider post-nesting distribution. We also identified some local residency to the nesting site for individuals from both species. We showed the use of a common migratory corridor in shallow, coastal waters, also used by other migratory marine megafauna. We found high spatial overlap among turtles at their nesting sites but only low spatial overlap during post-nesting movements, especially on the foraging grounds. Our analysis suggests that more samples are needed to robustly delineate the foraging distribution, particularly for green turtles.

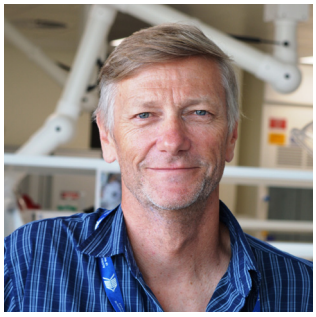
Presenter
Dr Luciana Ferreira is a postdoctoral scientist working on the spatial and movement ecology of marine megafauna and the application of ecological and statistical models to describe movement and distribution of species.

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 is a fish biologist with a research focus on the ecology of larval reef fishes and elasmobranchs.

Measurement of sound, particle motion and ground motion

Most fishes detect sound via mechanosensors (otoliths and associated structures) in their ears. As these act as acoustic accelerometers fishes are most likely to react to the acoustic particle motion component of the air-gun signal, compared to marine mammals that respond to the acoustic pressure. In contrast, invertebrates sitting on the seabed likely respond to the ground motion. The threshold for response may be a function of exposure levels from individual signals, the accumulation of energy from multiple shots, or simply the duration of exposure or number of shots the animal experiences.

To validate initial propagation models the AIMS team conducted >50 deployments totalling >100 sensor datasets to measure acoustic pressure, particle velocity and ground motion, at the fish and pearl oyster sites, before, during and after exposure. This included long-term monitoring of the local soundscapes from six months prior to nearly a year after the exposure. Those deployed during the exposure collected nearly 70,000 recordings of individual seismic shots fired at various ranges and azimuths from the air-gun array across the two experimental sites. The measured recordings were then used to validate the Curtin University propagation model and produce estimates for each of the ten most appropriate acoustic metrics for each shot fired (≈20,000 shots across both experiments) as they would be received at various ranges and azimuths (totalling >1,000,000 estimates for each metric) across the two experimental areas. These then provided the estimate of exposure levels at each of 179 (144 fish and 35 pearl oyster) 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 with a focus on underwater acoustics.

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 stereo 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 particular a focus on six commercially important species, including red emperor.

The telemetry component included the capture (using traps), tagging with acoustic transmitters and release of 387 red emperor (*Lutjanus sebae*) within the two arrays, approximately half the fish in each. Each array comprised 38 acoustic receivers, each separated by 900 m, in a hexagon format that covered ≈32 km^2. The receivers provided near-continuous data on tag locations, and hence movement of fish in the area, until removal in December 2018.

Presenter
Dr Conrad Speed is a marine ecologist with interests in the behavioural ecology, population biology, and trophic role of marine predators.

Distribution and connectivity of fish and sharks at remote coral reefs

Fish assemblages were sampled 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 meso-predators compared to surrounding isolated reefs. Acoustic tracking data for grey reef shark, silvertip shark and red bass at Scott Reef and Rowley Shoals were also used to map networks and quantify movement and connectivity for these species within and among these reef systems. Our results highlight the importance of these rare and unique isolated reefs as an ecologically meaningful baseline and for understanding habitat connectivity of meso- and top-order predators in coral reefs ecosystems.

Presenter
Matt Birt is a fish ecologist specialising in the use of stereo-video techniques to explore research questions in fish ecology.

Genetic connectivity in *Pinctada maxima*

Cutting-edge genome sequencing techniques were used to examine the population genetic structure of the silver lip pearl oyster (***Pinctada maxima***) off Eighty Mile Beach in northwest Australia. Results provide novel insight into fine-scale patterns of dispersal and recruitment among different depths and fishing grounds in the last wild-capture pearl oyster fishery in the world.

Presenter
Dr Luke Thomas has a background in molecular ecology and population genetics and is currently working with the UWA Oceans Institute and the Australian Institute of Marine Science.

Biodiversity across the Ancient Coastline Key Ecological Feature, and distributions and habitat associations of pearl oysters off Eighty Mile beach.

Towed video imagery of the benthos and Baited Remote Underwater Video were used to quantify patterns of biodiversity associated with focussed study areas within the Ancient Coastline Key Ecological Feature. This talk will outline patterns of benthic and fish biodiversity, along with ecological processes that help shape those communities. Project results will also be presented on pearl oyster distributions and abundances across different depths off Eighty Mile Beach.

Presenter
Dr Stephen Whalan is a Benthic Ecologist at the Australian Institute of Marine Science with expertise aligned to the population ecology of benthic marine communities and a strong motivation to provide ecological data that informs conservation and management practices.

Predictive modelling of benthic habitats of the Ancient Coastline KEF and pearl oyster habitats offshore from 80 Mile Beach

The spatial distribution of major benthic habitat types across Ancient Coastline Key Ecological Feature (ACKEF) have been predictively modelled using high resolution bathymetry data, built from multi-beam sonar surveys, coupled with in situ observations of benthic habitats across five ACKEF study areas. These models were then combined with observations of fish from BRUVs to predict the spatial distribution of fish abundance in the same study areas. A related study used depth and backscatter data to identify patterns in the distribution and abundance of pearl oysters in the deeper waters offshore from Eighty Mile Beach.

Presenter
A spatial-ecological data scientist at the Australian Institute of Marine Science, **Dr Marji Puotinen** 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.

POSTPONED

NORTH WEST SHOALS TO SHORE RESEARCH PROGRAM

SYMPOSIUM

The 2020 symposium has been postponed. We hope to present to you the completion of this three-year program of work later this year.

For more information on the full program visit: www.aims.gov.au/nw-shoals-to-shore

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