Australian Government | Australian Institute of Marine Science

NORTH WEST SHOALS TO SHORE RESEARCH PROGRAM

November 2020




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

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

In this edition:

The NWSSRP has been a three-year, $20 million study of the North West Shelf.

We provide a summary of the findings and expected publication dates for the program of 11 separate studies within four main themes that were conducted by a multidisciplinary team of scientists, technical staff and industry experts.

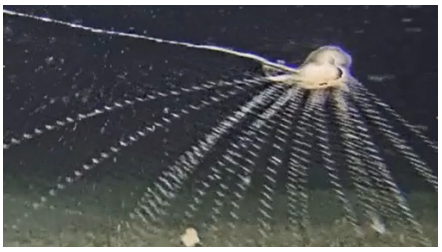
What we found

Marine Noise and Monitoring Impacts

Anthropgenic noise is increasing rapidly in marine environments and is recognised as a pollutant of global importance. The marine noise study investigated the effect of sounds caused by seismic surveys on benthic fishes and pearl oysters.

Seabed Habitats and Biodiversity

The Ancient Coastline Key Ecological Feature (KEF) at 125 metres was found to harbour some surprising marine life. Effective management of activities in the area can now benefit from a better understanding of its habitats and diversity.



Threatened and iconic species

Australia's North West is home to some of our most iconic marine animals. To manage potential threats, we studied the distribution and movement behaviour of marine turtles and pygmy blue whales; where they go, how long they spend there and the key areas they use during breeding, migration and feeding.

Understanding the North West's isolated coral reef atolls

AIMS long-term record of the isolated reef atolls of Australia's North West Shelf is an important dataset for a unique region.

In this study we combined the latest technological innovations to fill in the gaps in knowledge and create reliable maps of important seabed communities.

The Impact of Seismic Sound on Fish and Pearl Oysters

Theme 1: Marine Noise and Monitoring Impacts

Theme Leader Dr Mark Meekan

Developing research from Australian waters and elsewhere suggests that marine noise pollution, including seismic surveys and vessel operations, can have impacts on the physiology and biology of marine invertebrates and fishes. This study has been the first dedicated experiment investigating the impacts of a full-sized airgun array, operated in a real-world format, on a tropical demersal fish assemblage and on pearl oysters.

The study into the potential response of demersal fishes to different regimes of exposure to a seismic source has now been completed.

Measures including relative abundance, distribution, movement and community composition were assessed using Baited Remote Underwater Video Stations, passive acoustics and acoustic telemetry. The final results are undergoing peer review and are expected to be published by the end of 2020.

The potential responses of pearl oysters to different regimes of exposure to a seismic source has been assessed by comparing measurements of physiology, immunology and genetics indicative of a stress response.

The analyses of samples to evaluate the effect of a seismic survey on pearl oyster health is complete and the assessment of the effect of seismic surveys on pearl production capacity is expected to be released in a peer reviewed journal by mid-2021.

Mapping the Ancient Coastline

Theme 2: Seabed Habitats and Biodiversity

Theme Leader Dr Karen Miller

Theme 2 of the North West Shoals to Shore Research Program set out to provide improved knowledge of seabed habitats and biodiversity associated with the Ancient Coastline Key Ecological Feature (AC125) as well as pearl oyster habitats offshore from Eighty Mile Beach.

In total, we collected multibeam sonar data from 11,935km of the sea floor, gathered imagery across 600km of the seabed, counted fishes from 202hrs of BRUVS video, took 158 sediment samples and genotyped 715 pearl oysters.

This massive effort has allowed us to determine the diversity of benthos and fishes that exist on the AC125, and show that it is dominated by sandy substrates, with hard substrates supporting diverse epibenthic communities only patchily distributed across the feature.

Benthic and fish communities are most diverse in areas shallower than the designated KEF, although the AC125 captures a representative sub-set of lower-mesophotic biota from the region.

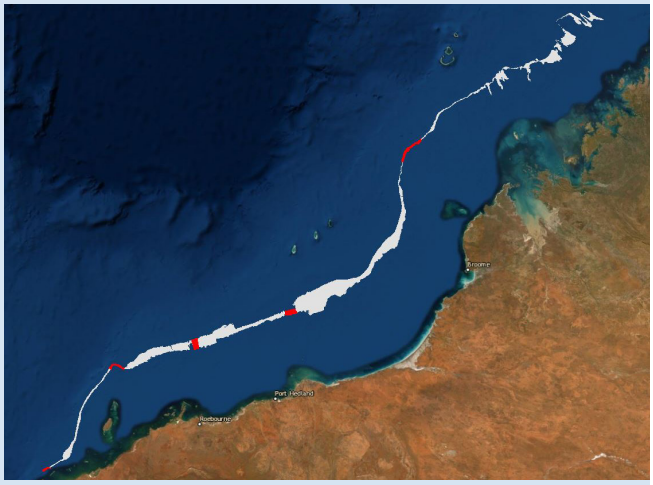
We also made some exciting new discoveries, including new records of benthic siphonophores on the North West Shelf, mystery puffer-fish nests and new depth records for five fish species, including the endangered zebra shark.

We were able to show that pearl oysters rarely exist at depths >50m offshore from Eighty Mile Beach, and that they prefer to live in flat sandy habitats with other filter feeding species.

Our genetic data showed that the oysters comprise a single genetic stock, but that subtle genetic structure shows that they are not completely intermixed, likely reflecting some variation in dispersal patterns and recruitment processes across the region and among years.

Overall, this study has provided new information that will inform management of important seabed diversity, as well as contribute to sustainable management of the pearl oyster fishery.

Importantly it has filled major knowledge gaps on benthic biodiversity in the region enabling a transition from precautionary management to regulatory decisions based on data.



Above: The study sites along the Ancient Coastline Key Ecological Feature indicated in red.

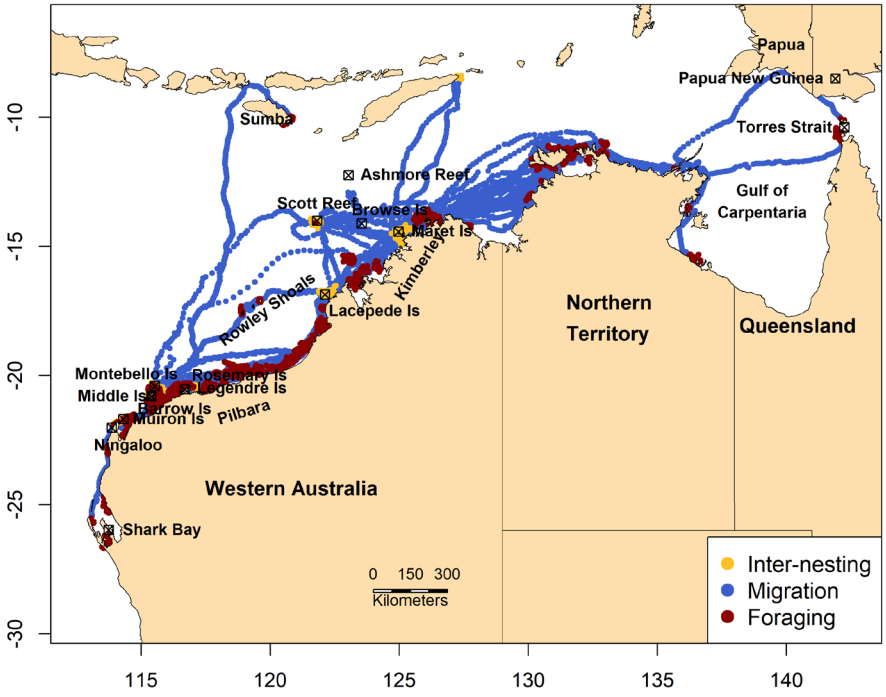
Identifying Important Areas for Pygmy Blue Whales and Marine Turtles

Theme 3: Protected and Iconic species movement, distribution and threats

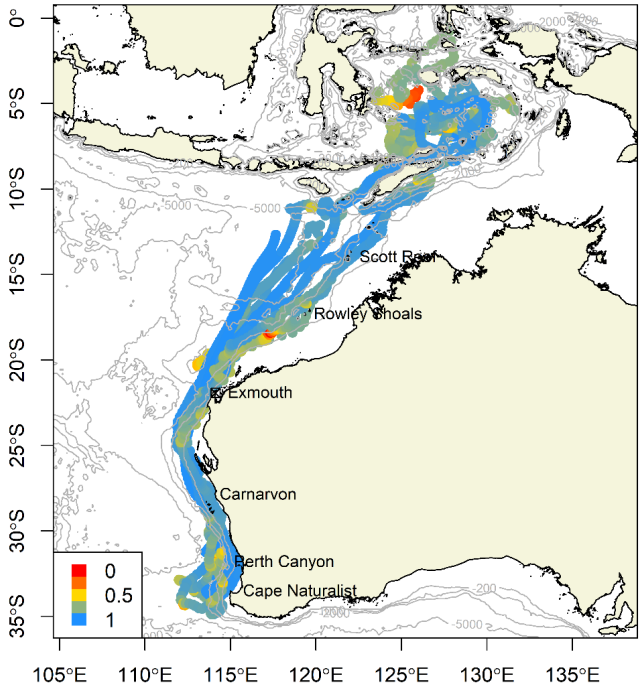
Theme Leader Dr Michele Thums and Dr Luciana Ferreira

On Australia's North West Shelf, many listed threatened, migratory, marine species co-occur with expanding industrial development. Assessing potential impact relies on accurate data on species movement and distribution, but this information is limited and this uncertainty has implications for management. This project theme aimed to resolve this problem for a number of target species of conservation concern; green and hawksbill turtles and pygmy blue whales using satellite telemetry and passive acoustics.

The spatial extent of the turtle inter-nesting areas for 16 rookeries were in most cases more than adequately encompassed by existing spatial protection. Turtle foraging areas were widely dispersed along the coast with 35% (greens) and 23% (hawksbills) occurring within Marine Protected Areas, but low overlap with designated Biologically Important Areas (BIAs).



Above: Satellite tracks from 96 female green and 42 female hawksbill turtles colour coded by behaviour: inter-nesting (yellow), migration(blue) and foraging (red).



Pygmy blue whales used waters off the continental shelf, with median depths of ~1000 metres supporting a reduction in the currently designated distribution extent on the shelf. We found support for the foraging BIA off Exmouth with an expansion to the northwest. Whales documented in the Scott Reef area (3 out of 11) spent less time there than at Ningaloo, however it was part of the core area of use.

High overlap between potential industry pressures and species distributions occurred between Ningaloo reef and just north of Barrow Island, to the 1000 metre contour for whales and in coastal waters (< 50 m) between Barrow Island and Broome, and offshore Kimberley (< 100 m) for post-nesting turtles.

Our research has quantified important areas for these species useful for refining the current distribution and BIAs and has provided an estimate of exposure to industry threats to assist decision making.

Above: Pygmy blue whale tracks colour coded by behaviour with cooler colours indicating migration and warmer colours indicating foraging (in Australia) and likely foraging, breeding and resting in Indonesia. Satellite tag deployments were done off Exmouth for this study and we also included deployments from the Perth Canyon (Double et al. 2014) and the Bonney Coast, SA by L. Moller and colleagues.

Tolerance of a Remote North West Reef

Theme 4: Spatial Dynamics of Isolated Coral Reef Atolls

Theme Leader Dr James Gilmour

The Rowley Shoals is a group of three atoll-like coral reefs on the North West Shelf. The reefs are among the most remote and pristine marine areas in the world but a combination of natural disturbances and climate change are putting this healthy reef system at risk.

Our research investigated new approaches to monitoring coral reefs, the processes underlying recovery following disturbances at the reefs, and the capacity of corals to adapt to changing conditions.

Emerging Monitoring Techniques

Reef images collected by satellites, multibeam sonar, drones and SCUBA divers were combined to map the distribution of coral reef habitats across the reef system.

The sites surveyed by divers for over 20 years were re-surveyed using new technologies, including 3D reconstructions of coral communities, image capture using remote tow-camera systems, and eDNA to assess coral distribution and diversity.

The tow-camera system provided a rapid method for assessing benthic communities in habitats with limited slope and structural complexity but did not provide comparable estimates of coral diversity in the dominant reef slope habitats.

The eDNA in seawater at monitoring sites provided comparable estimates of coral diversity and was more likely to identify rare and cryptic species but did not provide comparable estimates of coral abundance.

The latest advances in Artificial Intelligence (AI) were applied to auto-classify coral images collected using different methods. This AI process identified many coral genera and growth forms with high accuracy, leaving only a small proportion to be classified by trained observers.

Impact and Recovery of Reefs

Some 20% of corals on the Rowley Shoals bleached in 2020. However, long-term monitoring data revealed that coral communities have maintained a high cover and diversity over the past two decades. With bleaching expected to increase in the coming decades, we explored whether parts of the reef might escape the worst heat stress or whether corals have adapted to future conditions.

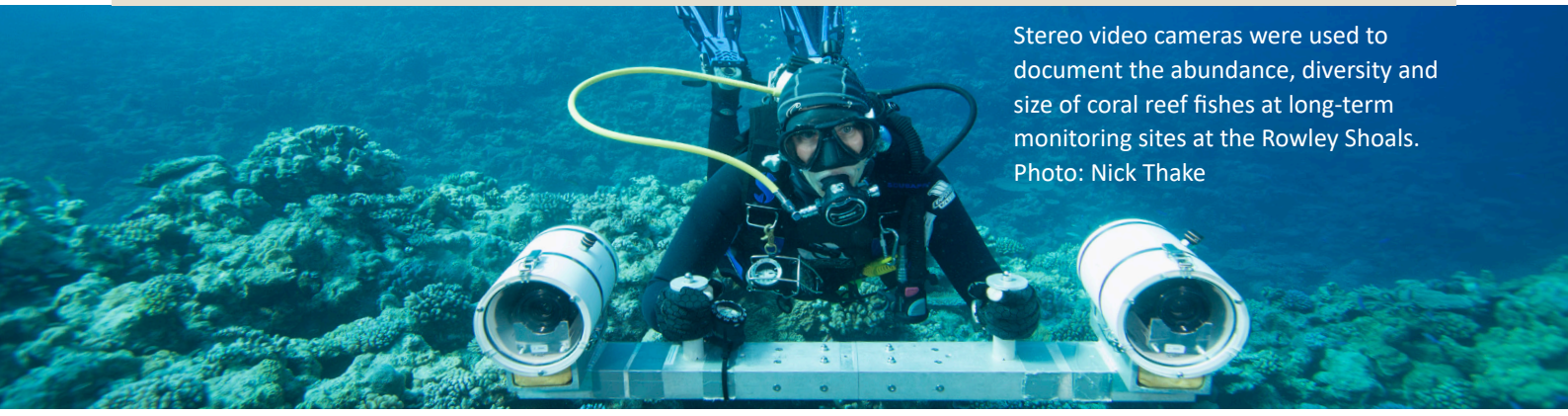
Hydrodynamic models and genomic methods established that spawning corals dispersed among habitats and atolls, whereas brooding corals rarely dispersed beyond their local habitat, potentially limiting their recovery from severe local impacts.

Heat stress experiments revealed that corals from the warm lagoon habitat had a higher heat tolerance than those from the adjacent slope at each reef, and we are exploring the genetic architecture underlying that tolerance.

Baited remote underwater video systems (BRUVS) revealed high abundances of regionally fished species compared to other WA reefs and confirmed that populations of predatory fishes and sharks have remained stable over time.

Using a combination of acoustic telemetry data, network analysis and habitat modelling, we also found that at each reef some predatory fish move mostly between the lagoon and nearby forereef, whereas reef sharks move over greater distances along the forereef and among the reefs.

The research highlights the significance of the Rowley Shoals as a relatively healthy reef system, and as benchmark for the condition of coral reefs both locally and globally. The results will be published in scientific journals.



Stereo video cameras were used to document the abundance, diversity and size of coral reef fishes at long-term monitoring sites at the Rowley Shoals. Photo: Nick Thake

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

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