Ningaloo Outlook

A BHP-CSIRO Research Partnership
Year 4 – Progress Report

Ningaloo Outlook is a five-year strategic marine research partnership between BHP and CSIRO, which has completed its fourth year. Since 2015 the team has tagged iconic marine wildlife to better understand their movement patterns, developed maps of deep seafloor habitat, and used innovative approaches to understand shallow reefs.

Ningaloo Reef is the longest fringing coral reef in the world, extending more than 300 kilometres. The reef provides a diverse array of habitats, from the shallow lagoons to deeper offshore habitats, and is home to many species.

Outcomes

- Status assessments of the reef's core ecological values.
- New knowledge and better understanding of Ningaloo Reef to inform conservation and management.
- Community engagement to build capacity and understanding.
- Training opportunities for the next generation of scientists to become world-class researchers.
- Knowledge transfer.

An update – progress made in Year 4 – what are we finding?

Ningaloo Outlook consists of three distinct themes; deep reefs, shallow reefs, and megafauna. Activities commenced in 2015 and run until 2020.

The research team have embarked upon numerous field trips to Ningaloo, developed maps and tracked fauna, and led community engagement activities in Exmouth and Perth.

The team has been assessing how computers can do some of the data crunching to develop habitat maps for the deeper areas of the reef, and has successfully recorded two complete round-trip journeys of female turtles from Ningaloo to their nesting beaches on offshore islands.

As part of the partnership, we've also been ensuring our three Ningaloo Outlook PhD scholars have access to the best training available, with one of our scholars (Joe Turner) submitting his PhD in early 2019 and now gainfully employed in habitat mapping in the UK!

Shallow reef survey at Ningaloo (CSIRO, photographer Dan Orr).

Deep reefs

Research on Ningaloo's deep reefs continues to shed new light on the complex range of habitats where diver access is limited or not possible.

During year 4, data collected in previous years using multi-beam, video and Autonomous Underwater Vehicles (AUVs) has been analysed.

The focus of efforts has been on developing analytical methods, specifically habitat modelling and assessing machine learning tools and their accuracy.

Six species distribution models (SDMs) were compared to assess their accuracy for predicting the fauna and flora on the seafloor, investigating the effect of "grain size" (spatial scale at which data are collected or aggregated).

The accuracy of models at each grain size differed between taxa. For corals the highest accuracies were found at 10 m resolution, while for macroalgae and sponges the highest accuracies were at 250 m. BIOMOD2 — an ensemble method that utilises machine learning — was the top performing method.

Selection of grain size is crucial when modelling the distribution of species to obtain the most ecologically relevant results.
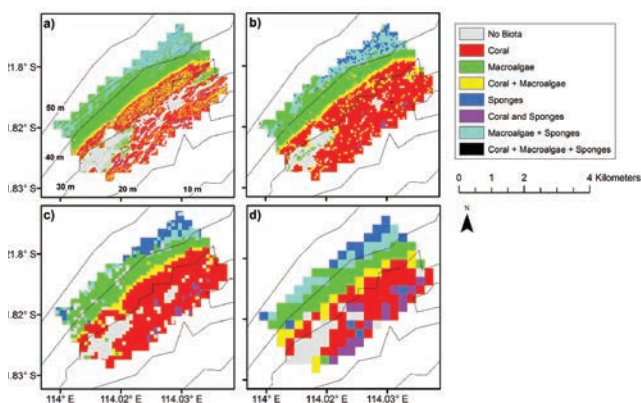

Figure 1. Ensemble model results combined for biota in the Helby Banks area for the following grain sizes: a) 10 m, b) 50 m, c) 100 m, and d) 250 m.

Shallow reefs

The shallow reef theme continues to incorporate innovative approaches into their research to understand how shallow reefs function and how they vary in space and time.

In May 2018 the shallow reefs research team completed surveys at 72 locations (Figure 1) assessing the abundance of fish and biota on the seafloor, and fish behaviour associated with patterns of human use. These surveys occurred across northern Ningaloo, between Osprey (south) and Jurabi (north).
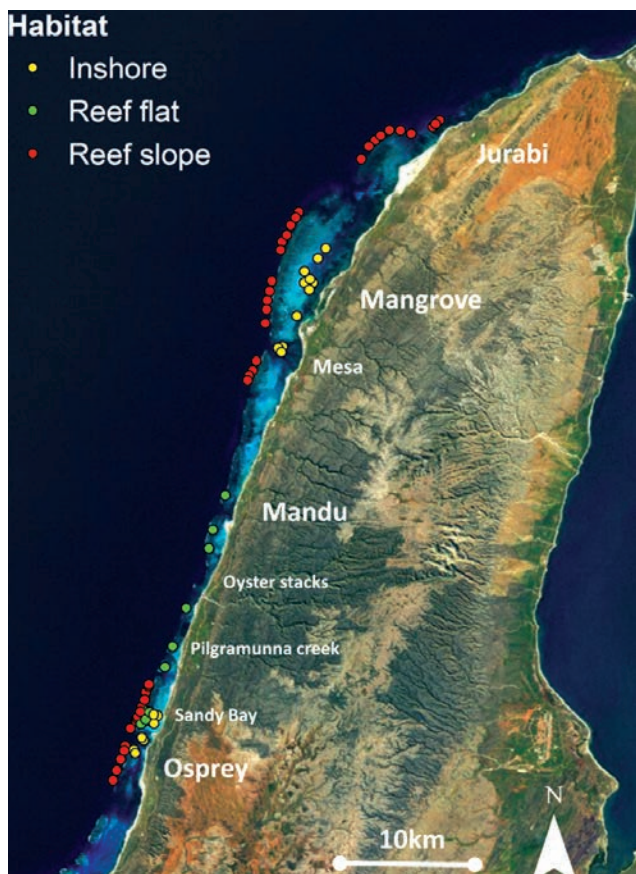

Figure 2. Location of the 72 sites between Osprey and Jurabi surveyed for fish, sharks, benthos and large debris in 2018.

The data collected extends one of the longest continuous datasets on the abundance of fish and corals for northern Ningaloo (the CSIRO team has surveyed several areas since 2006), furthering our understanding of these important ecosystems.

In year 4, surveys revealed small increases in mean percent hard coral cover across reef slope and inshore habitats. These increases in coral cover corresponded with increases in coral reef health, and are likely to reflect coral communities recovering from disturbances prior to 2015.
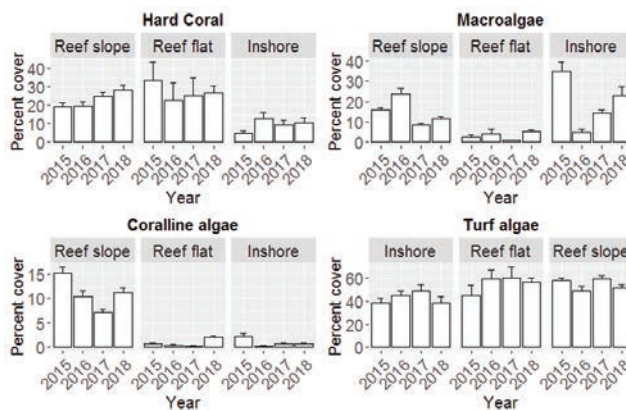

Figure 3. Mean percentage cover of four types of biota on reef slope, reef flat and inshore habitats surveyed during 2015 – 2018.

In year 4 underwater visual surveys of reef fish revealed variable but differing fish assemblages between habitats. Surgeonfish (Acanthuridae), butterflyfish (Chaetodontidae) and emperors (Lethrinidae) were the most abundant fish observed on the reef slope, while parrotfish (Scaridae), damselfishes (Pomacentridae) and drummer (Kyphosidae) were the most abundant on the reef flat and inshore. Herbivores were the dominant functional group across all habitats.

Marine debris surveys at eight locations between Osprey Bay and Lighthouse Bay confirmed that northern Ningaloo continues to contain a very low density of in-water debris. Heavily-used areas, such as Oyster Stacks, appeared to have a similar amounts and types of debris to areas that are less heavily used, with the notable exception of Tantabiddi which had more debris than other locations. Most debris appeared to be less than 2 years old, suggesting it is likely to have been discarded recently, probably near where it was found.

Tagging turtles and sharks

Turtles, whale sharks and reef sharks are iconic species that capture the attention of the community, both locally and more broadly. These species are also listed as important ecological assets of Ningaloo Coast World Heritage Area.

During the fourth year of the project three field expeditions (May/June 2018; October 2018; January 2019) were undertaken to study the ecology of green turtles (*Chelonia mydas*), whale sharks (*Rhincodon typus*), and the ecology of coastal and reef sharks.

During the project, 200 green turtles have been captured and measured, with flipper tags attached to all individuals. Of the 200 turtles, 60 have had acoustic tags attached, and 35 have had satellite tags attached.

In addition, 50 whale sharks (*R. typus*) have been tagged with acoustic and/or satellite tags, and 42 reef sharks have been tagged with acoustic tags.

The tracks of all satellite-tagged animals can be viewed in near real-time here: www.seaturtle.org/tracking.

Ultrasound has proved useful for identifying pre-nesting female turtles. Of three turtles found to have developing egg follicles, each left the vicinity of Ningaloo. One nested at 80 Mile Beach (~800 km away), the second at Trimouille Island (~250 km) and the third at Barrow Island (~200 km). We have followed the Trimouille and Barrow turtles back from nesting to the original capture location, providing rare examples of a complete round-trip nesting journey of a sea turtle.

Ten satellite tags were deployed on whale sharks in 2018 with a focus on large male and female sharks. Size and sex ratios of whale sharks at Ningaloo are uneven, and only one female larger than 9 m total length was observed and tagged. Also, in 2018, another towed satellite tag was recovered with assistance from the Department of Biodiversity Conservation and Attraction (DBCA) Rangers. This was attached to 'Suzie', a 7 m female. Suzie's track showed movement from Ningaloo to Ashmore Reef, back to Ningaloo and then north to Rowley Shoals, before moving back to Ningaloo and between Ningaloo and Dirk Hartog Island.

Three towed satellite tags attached whale sharks for 160, 211 and 300 days have now been recovered. Data from these tags provides a unique insight into both the vertical and horizontal movements and are being used to interpret behaviour during periods of residence and migration. Satellite tagging has revealed that males and females use very similar areas and no difference in migration pathways between small and large males. Tissue samples, photo identification and accurate length information have been collected from over 160 individual whale sharks — information which will be used to investigate population dynamics of this species within the Indian Ocean.

We now have three complete datasets from recovered tags which are providing a unique insight into the behavior of whale sharks that visit Ningaloo. The data demonstrate significant differences between animals as well very different diving behavior of the same individual in different places.
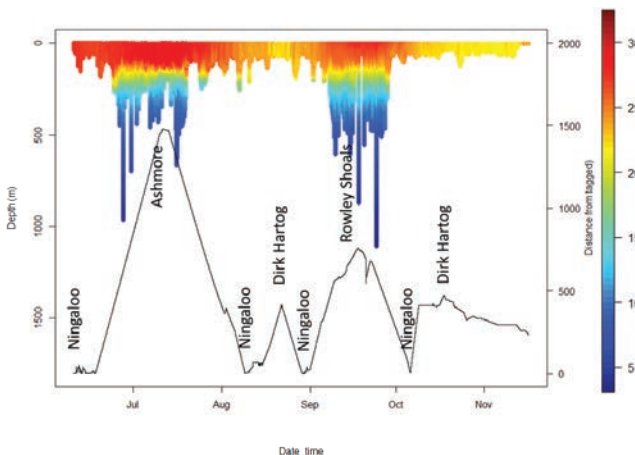

Figure 4. Depth (m), temperature (colour coded in degrees celcius) and distance from tagging location during a 173-day, 6334-km track of a 7 m female whale shark named "Suzie".

Community Engagement

Community participation is a key part of the Ningaloo Outlook Project and the team has continued to engage with Exmouth District High School and with community volunteers. BHP staff have participated in the annual green turtle tagging field trip to Ningaloo for several years.

The team also participates in local events, including the annual Whale Shark Festival, where you can find the team building 'creations' with the festival-goers. The team has also been busy during the year providing research updates at local events including 'The Professors and Pints' event at the Whalebone Brewing Company and the Central Regional TAFE.
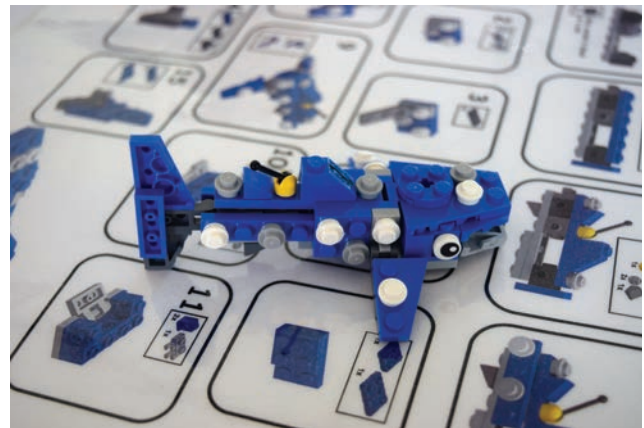
'Build your own' whale shark. The 2018 outreach activity at the Whale Shark Festival in Exmouth (CSIRO).

Training our future scientists

A core element of the Ningaloo Outlook partnership is training opportunities for future scientists. This is in part being achieved through three PhD scholars (Anna Cresswell, Joe Turner and Jessica Stubbs), all based at the University of Western Australia (UWA). All of our scholars have participated in field activities at Ningaloo and presented their research at relevant national conferences, further enhancing their network of contacts in their respective fields.

All of the scholars were also active participants at community events including educational science outreach activities run for students at Exmouth District High School and attendance at the annual Exmouth Whale Shark Festival.

We are now pleased to announce that Joe Turner, is the first of the three scholars to submit his PhD thesis into UWA in early February 2019!

"We thought it was really interesting how scientists research the reef with an AUV, collect the data, check the health of the system and discover new things."
- Chelsea Davies Yr12 (2018 School Captain)

PhD Scholar Joe Turner showing Exmouth District High School students how habitats are classified to generate habitat maps as part of the projects STEM outreach activities (CSIRO).

Did you know?

Science generated from the Ningaloo Outlook research partnership is informing future management decisions on the Ningaloo reef area. This is being achieved through the provision of new knowledge about the reef and its inhabitants, the development of monitoring techniques, and the availability of data for input into key environmental baselines.

The team works to ensure that they provide the information they generate to a wide range of users, including government departments, industry, schools and interested members of the public.

Like to know more and keep-up-to-date?

Visit our webpages:

https://research.csiro.au/ningaloo/

Or email:

- CSIRO Team: Ningaloo.outlook@csiro.au
- BHP: bhpetexternalaffairs@bhp.com