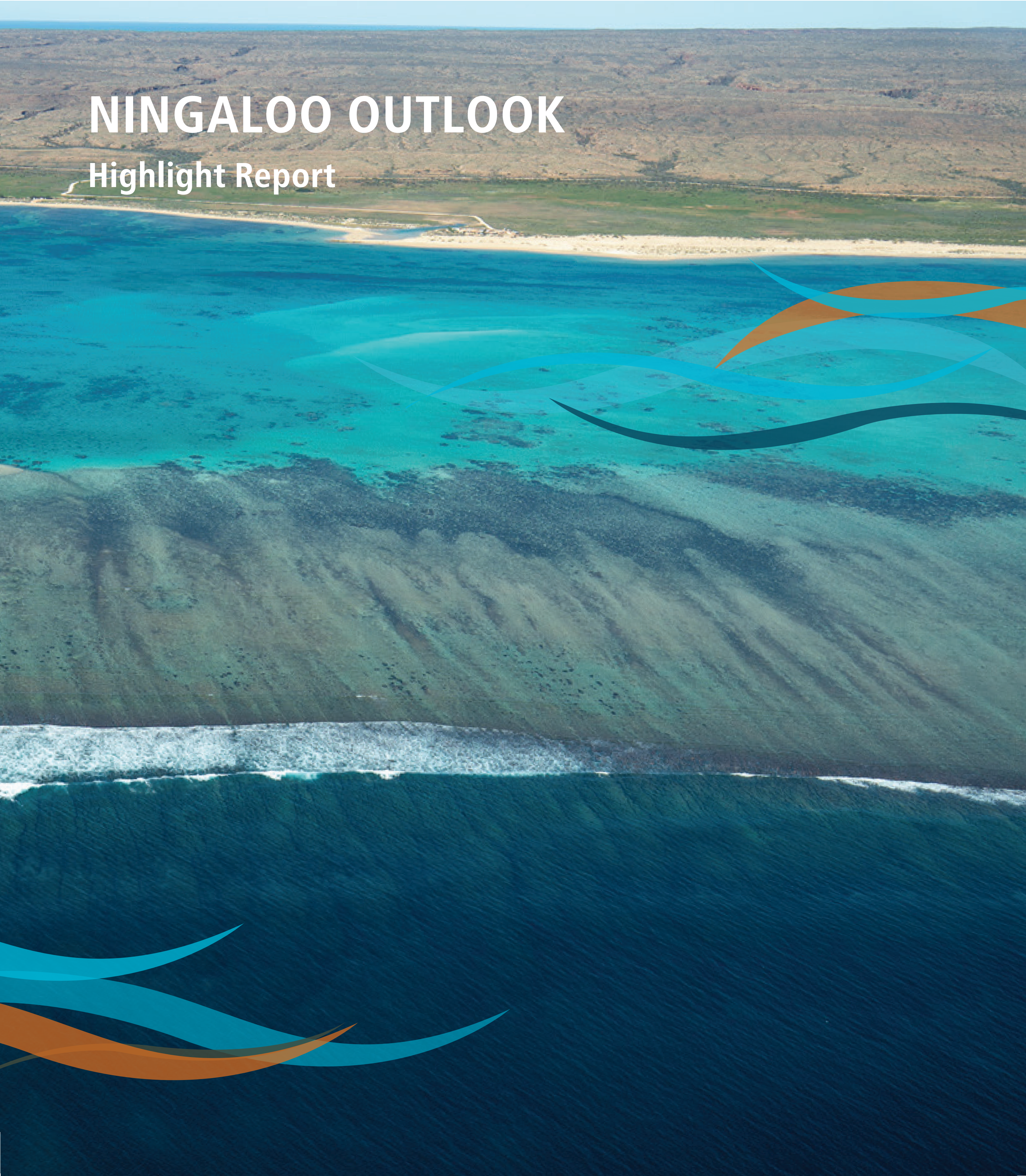
NINGALOO OUTLOOK

Highlight Report



Ningaloo Outlook has provided vital information on the trends and condition of the region's natural assets, as well as insights into the movements of megafauna to and from Ningaloo.

INTRODUCTION

The Ningaloo coast hosts one of the world's longest fringing coral reef systems, along with globally-significant abundances of large megafauna. Its uniqueness led to inscription on the World Heritage list, and attracts hundreds of thousands of tourists, who bring tens of millions of dollars of revenue to the region each year. But Ningaloo's ecosystems, and their ability to support the tourism industry, are being challenged by multiple pressures, like global climate change and ever-increasing human use. Successful navigation through these challenges relies on sound science to identify the pressures, understand the changes they create and help find the ways that we can mitigate them.

Ningaloo Outlook was a five-year partnership between CSIRO and BHP involving an investment of $5.4M to implement a program of research which aimed to increase the understanding of Ningaloo's reef ecosystems and their iconic inhabitants. Ningaloo Outlook also supported a PhD scholarship program and involved active participation by BHP staff, and the community of Exmouth, including students and teachers from the local school.

The research included 29 expeditions involving dozens of researchers, who took a myriad of measurements and deployed a wide range of instruments from autonomous underwater vehicles (AUV) to satellite tags. Surveys of deep reefs, where diving is difficult, used AUV and towed video, while divers swam along more than 45 km of the more accessible shallow reefs. Researchers tagged over 300 individual turtles, whale sharks and coastal sharks using technologies ranging from simple metal tags to more complex acoustic and satellite tags. More than 1000 members of the public, including school children, participated in the research and education. Many more were engaged through public presentations and web-based information.

Ningaloo Outlook has provided vital information on the trends and condition of the region's natural assets, as well as insights into the movements of megafauna to and from Ningaloo. This information has been, and will continue to be, provided to government and industry, as well as the broader community, who together will make critical decisions that affect Ningaloo in the future.

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Photo by Nick Thake

DEEP REEFS
highlights

The deep reefs of Ningaloo are home to an abundant and diverse filter-feeding community, but little is known about them. Information on the abundance and taxonomic composition of these deep habitats, along with knowledge of the ecological processes that sustain them, are needed to facilitate the development of long-term management strategies for these unique ecosystems.

Did you know?

Reef-building corals at Ningaloo rarely grow deeper than 30 metres.

Deep reef ecosystems (known as 'mesophotic' ecosystems because of the low amount of light that reaches the seafloor in deeper water) are extremely difficult to survey using conventional diver-based methods because of the risks to divers. But we still need to survey these ecosystems so that we can understand long-term trends in the abundance of the plants and animals that live there, and the role that human activities play. Ningaloo Outlook researchers circumvented the problem by using a range of methods, and in doing so made several new discoveries.

Among these discoveries, using the *Starbug-X* Autonomous Underwater Vehicle (or AUV) (Figure 1), the team discovered a community of more than 12 million mushroom-shaped corals in water depths of around 40 metres. The corals, called *Cycloseris distorta*, were so dense they were equivalent to half of Australia's entire population standing shoulder to shoulder on Bondi Beach (Figure 2).

Although these mushroom corals have been reported in other parts of the world, including the Great Barrier Reef and the Galapagos Islands, this appears to be the largest aggregation ever discovered. Like most corals, mushroom corals get their energy from the sun through single-celled algae that live within the corals and photosynthesise. This means that they can't survive in water that is too deep, otherwise not enough light would reach them. But if they were too shallow they might be susceptible to rough sea conditions, especially at Ningaloo Reef where tropical storms are common. So it seems that this community of mushroom corals has found the perfect 'Goldilocks Zone' to prosper, not too deep, not too shallow, but just right.

Figure 1: Starbug-X on a mission collecting video imagery of reef habitat.

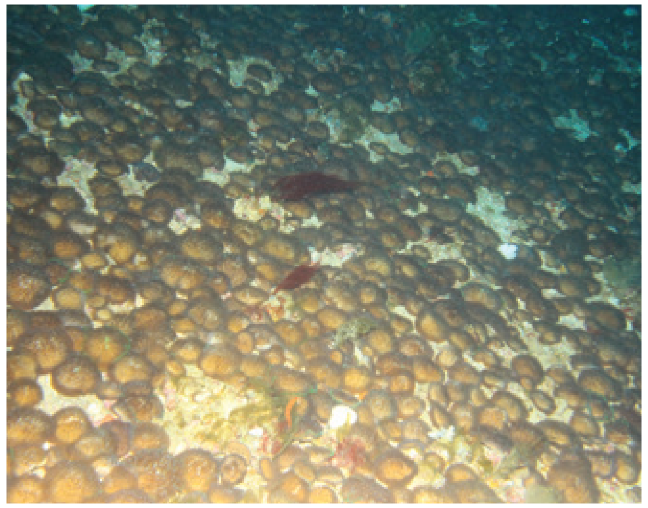


Figure 2: A field of *Cycloseris distorta* discovered in 2017. The bed discovered was 2.7 km long and an average of 90 m wide, with a density between 51 – 100 coral per m^2.

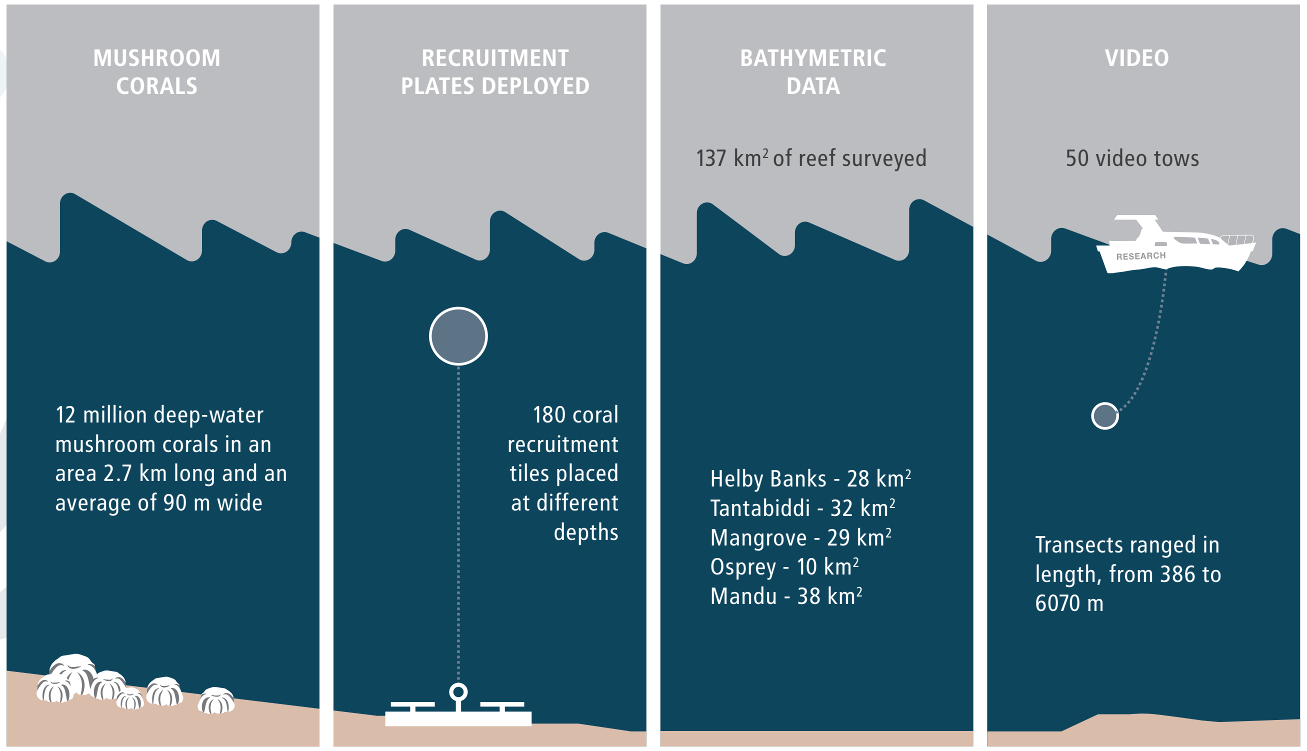
Did you know?

The deeper areas of Ningaloo support filter feeding communities like sponge gardens which provide important habitats for fish and other fauna.

The Goldilocks Zone was discovered during surveys the team did each year to map the biota of the seafloor, and figure out whether it changed from year to year. The team found that the main part of Ningaloo Reef (where reef-building hard corals are dominant) extends to depths of around 35 metres, but reef-building corals rare or absent at depths greater than 25-30 metres. At depths of around 35-70 metres, the team found few hard corals; the biota at these depths were mostly sponges and octocorals (a group which includes soft corals and sea pens). Extensive beds of shell gravel and nodules made of coralline algae, interspersed with a few solitary corals, occur at the deeper depths. Comparing surveys done in different years, the team found that the abundance and composition of the biota was quite consistent, changing little during the project. This is the first time repeated surveys of these ecosystems have been conducted at Ningaloo over an extended period, and so provides valuable new information.

To better understand patterns through time, we need to know about the rates at which the animals and plants "recruit" — meaning the addition of new individuals to a population. Scientist don't yet know very much about patterns of recruitment in mesophotic reefs. So, the research team deployed terracotta tiles at a range of different depths – we know from previous studies that coral larvae readily attach onto these tiles, and grow into juveniles (i.e. "recruit") if conditions are conducive. When the tiles were retrieved after 90 days, the most juvenile corals were found on tiles retrieved from a depth of 25 metres, and the fewest from 40 metres. Interestingly in shallow water, corals were mostly found underneath tiles, while at the deepest site they were mostly found on the tile's upper surface.

NINGALOO OUTLOOK DEEP REEFS



The deep reefs at Ningaloo were surveyed in 2016, 2017 and 2019. The types of species and their abundance in these areas over this period changed very little. The data collected is helping improve our understanding of these important habitats.

SHALLOW REEFS
highlights

Ningaloo is one of the world's longest fringing reefs and is one of the few World Heritage listed coral reefs projected to avoid severe bleaching more than twice per decade by 2040. Research in Ningaloo Outlook sought to extend existing assessments of corals, fish and debris close to shore and to provide new information on understudied locations further offshore.

Did you know?

In May 2015 cyclone Quang generated waves greater than 17 m high only 30 km to the west of Ningaloo Reef. These waves generated predicted wave heights at Ningaloo higher than 9 m with water speeds above 5.8 metres per second, which are some of the fastest ever predicted for a coral reef.

Ningaloo's shallow reefs (Figure 3) host more than 200 species of corals and 500 species of fishes. Ningaloo is one of the few World Heritage-listed coral reefs that are predicted to avoid severe bleaching more than twice per decade by 2040 — due in part to the reef's close proximity to cooler, deeper water and currents which bring that water to the reef. Despite this, Ningaloo's coral reefs are being challenged by increasing sea temperatures (which can cause corals to bleach and ultimately die), as well as more frequent and severe weather events, and ever-increasing human use. Decisions about actions that might alleviate some of these pressures need information about changes in the condition of the reef's animals and plants.

To generate this information divers from the Ningaloo Outlook team swam along more than 45 km of reef to survey corals, fish and debris (rubbish) (Figure 4). These surveys extended one of the longest continuous ecological datasets for an Australian coral reef, dating back to 2007. Drawing on the 13 year span the data encompassed, the team found that after a long-term decline since the first survey, the amount of hard coral (measured as percentage of reef surface covered by living coral) increased on the reef slope after 2015 — despite two cyclones and one extreme marine heatwave (Figure 5).

To better understand the mechanisms underlying this increase in coral, the team measured the rates of growth and survival of three different types of corals: flat-shaped corals (from the genus *Acropora*), bushy-shaped corals (*Stylophora* and *Seriatopora*) and round-shaped corals (*Platygyra*). They did this by combining several different techniques, from measurements of individually-tagged corals to innovative structure-from-motion technology, which uses overlapping photos to generate large three-dimensional images. The team found that the flat corals grew outwards by almost 3 centimetres each year, while the bushy corals grew around 3.5 centimetres and the round corals grew by less than a centimetre (Figure 6). Smaller corals tended to grow faster than larger corals and all corals tended to grow faster in places where waves were smaller. More than 80% of corals survived each year, though this varied between the three groups (Figure 6). The team concluded that the increase in coral abundance since 2015 is probably due mainly to growth of existing corals.

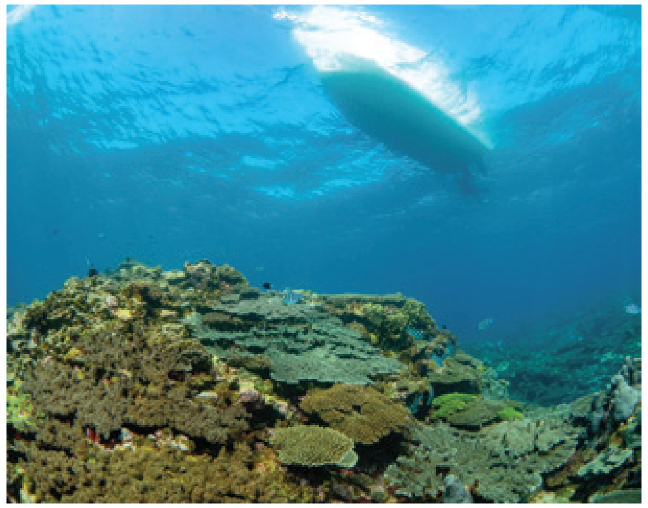


Figure 3: Image of reef slope coral assemblage at Osprey Reef, Ningaloo.

Figure 4: Divers conducting coral and fish surveys on the reef slope at Ningaloo Reef.

Did you know?

Parrotfish and sea urchins are estimated to consume over 90% of calcium carbonate eroded by animals on the reef slope.

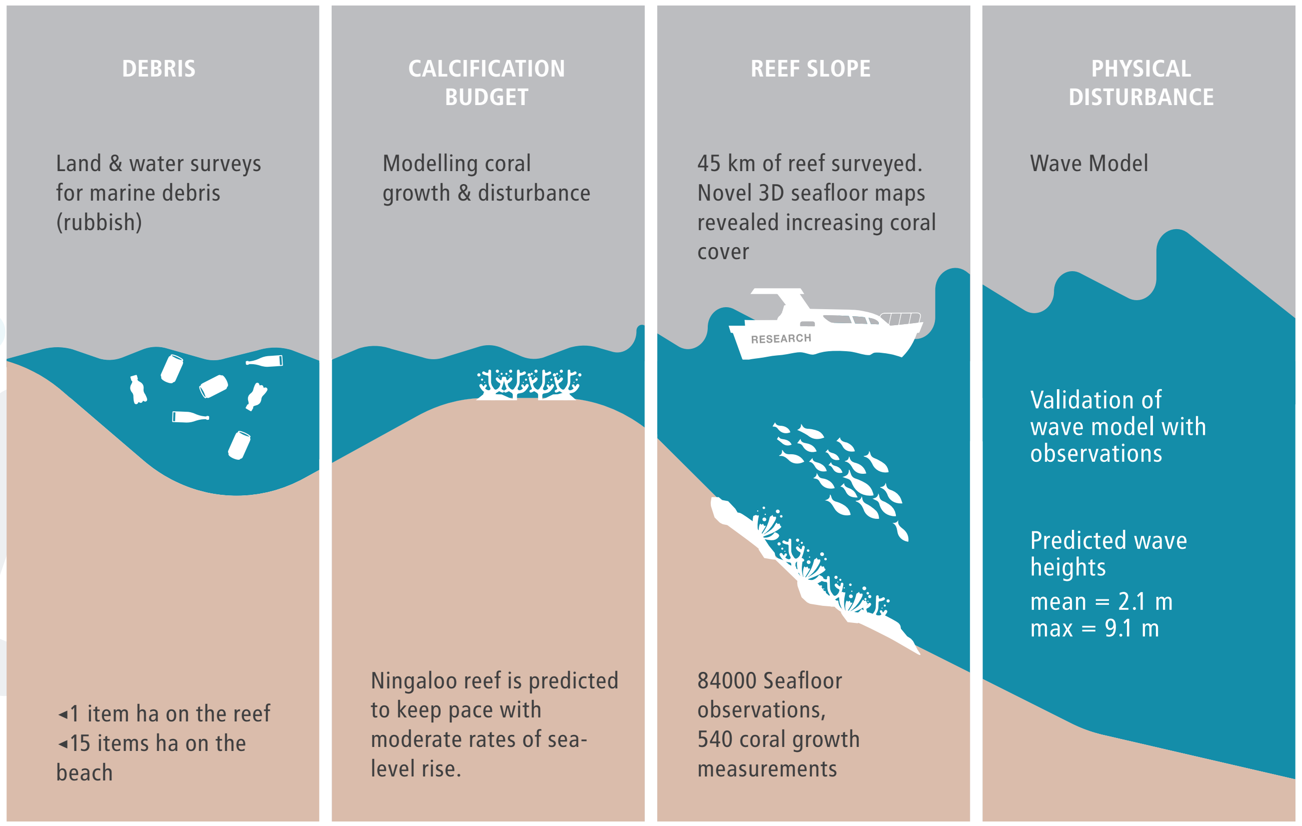
The other main potential reason that coral abundance might increase is through recruitment of new corals. The same tiles used in the study of how coral recruitment changes between shallow and deep water were used to generate insights into this; they revealed that the rates at which juvenile corals appear is not sufficient to account for the increase. Juvenile corals on the tiles tended to occur on top of encrusting red algae, which is consistent with other studies that have shown that these algae exude chemicals which seem to attract the coral larvae.

The team also surveyed the amount of debris on the beaches and reefs. This is a worldwide problem because debris can injure or kill marine animals by suffocating, starving or poisoning them. The team found relatively little debris, with less than 1 item per hectare found on the reef and less than 15 items per hectare found on Ningaloo's beaches.

The largest amount of debris was found near the main boat launching facility at Tantabiddi. Most items appeared to originate from fishing and boating activities, and included things such as fishing line, plastic lures, anchor rope, metal and nylon net. Most appeared to have been there for less than two years. Overall, the amount of debris the team found was much lower than similar coral reef ecosystems elsewhere in the world.

The team concluded that shallow reefs of northern Ningaloo were in good overall condition. Conditions since 2015 have remained favourable for growth of hard corals with no notable impacts from heatwaves or storms and little mortality from coral predators or coral.

NINGALOO OUTLOOK SHALLOW REEFS



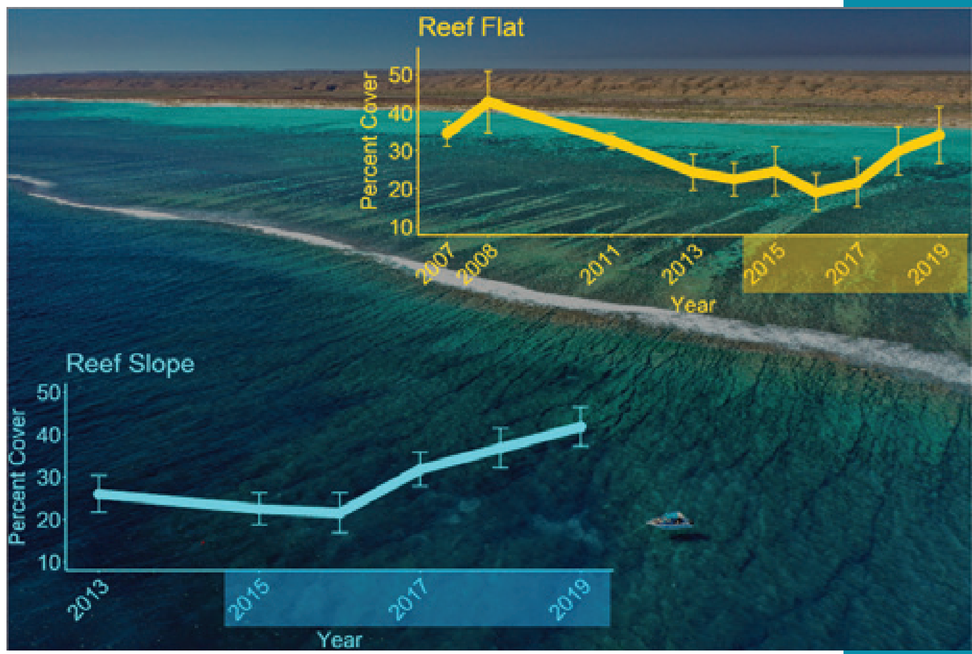


Figure 5: Percent coral cover (mean +/-se) at northern Ningaloo between 2015 and 2019.

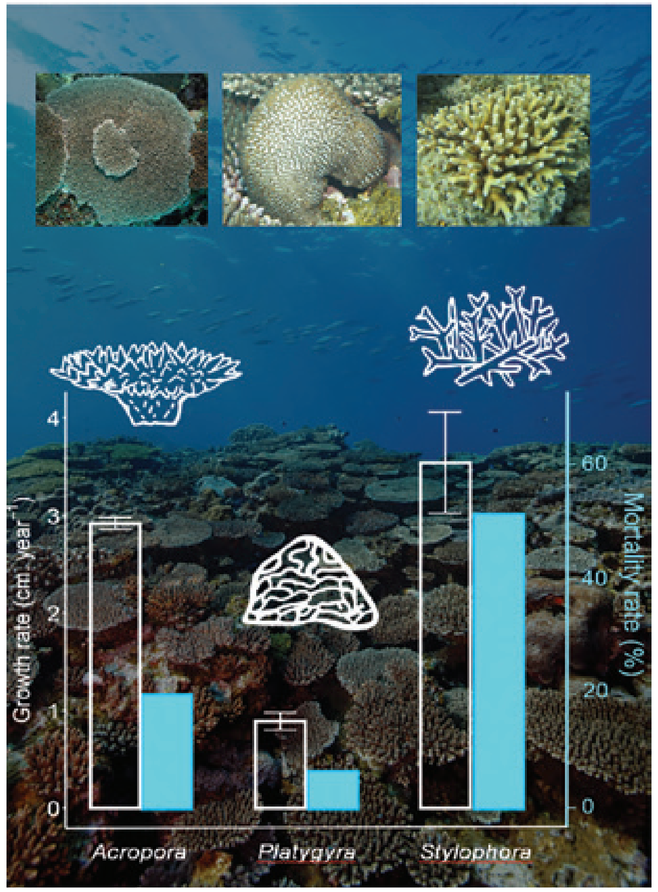


Figure 6: Mean growth (white bars) and death rates (blue bars) of common corals with different growth forms at Ningaloo: flat *(Acropora)*, round (*Platygyra*) and bushy corals (*Stylophora/Seriatopora*).

Did you know?

Sea levels are predicted to rise by between 0.4 m and 0.7 m in the Indian Ocean by 2100, with potential negative impacts on the reef and adjacent coastal areas. Our research currently suggests Ningaloo's reefs are capable of keeping pace with this sea-level rise.

TRACKING AND TAGGING

TURTLE TAGGING FACTS

- 34 Satellite Tags → 48000 Locations
- 800 Biological Samples
- 211 Flipper Tags → 12 Recaptures
- 60 Acoustic Tags

WHALE SHARK TAGGING FACTS

- 46 Tagged since 2015 → Acoustic Tags; Satellite Tags → 6884 Locations
- 270 Biological Samples

COASTAL SHARK TAGGING FACTS

- 48 Acoustic Tags → 72 acoustic receivers downloaded → over 1000000 detections of tagged sharks
- 84 Biological Samples

SHARK highlights

Growth rates measured from the same whale shark individuals 1 year apart during this study show a large degree of variability. The fastest growth rates (~ 74 centimetres per year) were recorded in a 6.47 metre male whereas the slowest growth rate was only 6.3 centimetres per year in a 6.17 metre male.

Did you know?

Whale sharks give birth to live young with one female recorded having more than 300 embryos.

The whale shark (*Rhincodon typus*) is unique. It is the largest fish in the world, growing up to 16 metres long, or more. Whale sharks are distributed throughout tropical and warm temperate seas, with aggregations of these ocean wanderers gathering at Ningaloo from March to August each year. Globally their populations are declining, with capture in targeted fisheries and ship strike the major causes.

To understand where they go after visiting Ningaloo, the team tagged 40 whale sharks (males and females between 3.7 and 9.0 metres long) with satellite tags. Some of these transmitted information for almost a year, conveying information about their whereabouts until they returned to Ningaloo the following year. The information showed that whale sharks tagged at Ningaloo stayed in the eastern Indian Ocean, Arafura and Timor Seas (Figure 7). Some moved as far as Christmas Island, Indonesia, Timor Leste and the Gulf of Carpentaria, but most remained within 300-400 kilometres of Ningaloo. Some individuals moved southwards as far as Perth during summer months. Each individual had its own unique pattern of movement, suggesting that they have developed their own strategy of finding sufficient food resources, including swimming thousands of kilometres in different directions. Some animals swam continuously at speeds of 2-4 kilometres per hour in one direction for up to four weeks to reach an area where they then spent several months before moving elsewhere.

These long-distance movements in a single direction suggest that whale sharks are moving to these areas based on prior experience or an inherited ability to find sporadic and ephemeral patches of food.

Four satellite tags were recovered after detaching from whale sharks that had undertaken long distance movements before returning. Normally researchers get only a tiny fraction of the data that satellite tags collect, so recovery of tags and the data they store in them is like hitting the data jackpot! Researchers were able to reconstruct movement from GPS locations with diving behaviour from depth recorded every 10 seconds (Figure 8). Diving behaviour and swimming speed depended on whether they were travelling to feeding grounds (fast) or at feeding grounds (slow), and was different between day and night (deeper at night). The speed at which they moved up or down was much faster at night. Whale sharks that travelled from Ningaloo to offshore areas such as Ashmore Reef and Indonesia dove to depths beyond 1700 metres, where water temperature was as low as 3.5°C and there is no light (Figure 8). Most of these deep dives are fast, with the animal swimming down at 0.4 metres per second and then back up the surface at similar speeds. During sustained long-distance swimming whale sharks mostly remained close to the surface, with a few slow dives; however when they spent weeks or longer in a single area they dove more often and faster, presumably searching for food and feeding.

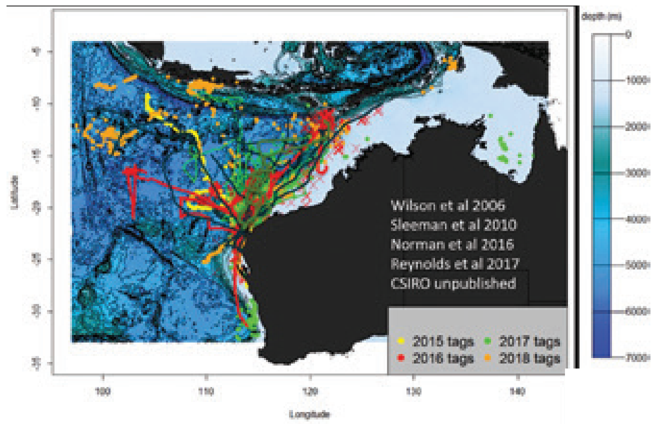


Figure 7: Map showing satellite locations of whale sharks tagged by CSIRO between 2015 and 2018 (points and crosses) as well tracks of whale sharks in published research to date.

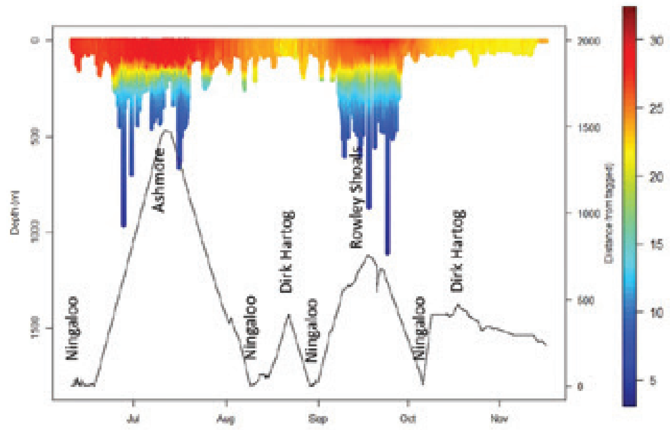


Figure 8: Depth, temperature and distance from tagging location of a 7 m female whale shark tracked with a satellite tag for seven months. Depth is shown on left Y-axis and distance from tag location on right hand Y-axis. Temperature at depth is shown in colour coded bars.

Did you know?

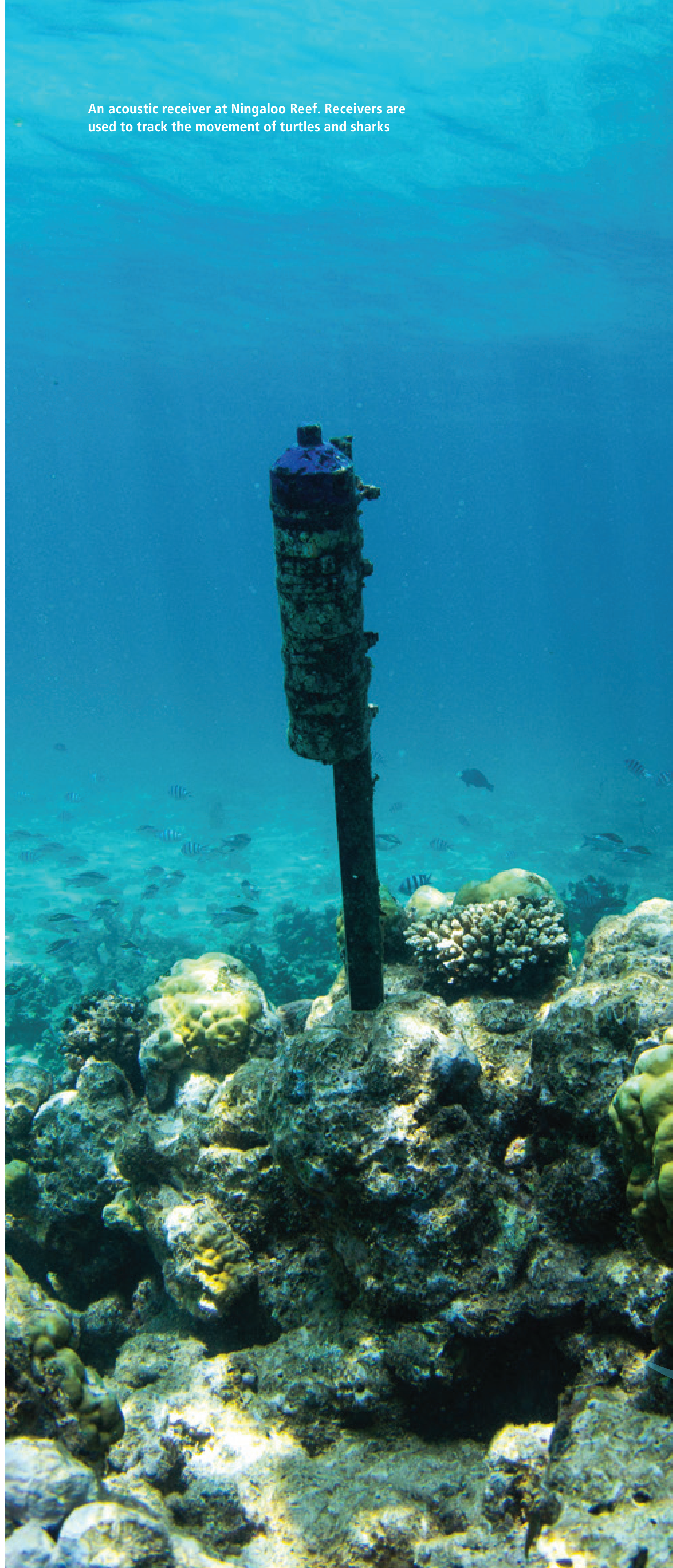
Lemon sharks tagged at Mangrove Bay undertake seasonal migrations along the Ningaloo coast before returning to within a few hundred metres of their home range.

The team also studied movement of multiple species of coastal and reef sharks, using surgically implanted acoustic tags. Movements by these sharks were then detected by receivers that detect the acoustic signals emitted by the tags, with an array of receivers at Mangrove Bay, and others at Tantabiddi to the north and Coral Bay to the south. Some individuals were followed in this way for up to 1900 days, providing some of the longest continuous data for sharks anywhere in the world.

Of the four species of sharks for which the team tagged enough individuals to generate robust data, grey reef sharks had the smallest average home range of 3.5 km^2, while blacktip reef sharks had a home range 4.3 km^2, and lemon and tiger sharks had larger home ranges of 9.9 km^2 and 13.4 km^2, respectively. Grey reef sharks tended to stay in the vicinity of reef passes (both inside and outside the reef), reef slope, or near patch reefs and flat rocky areas inside the reef. Blacktip reef sharks tended to spend more time within Mangrove Bay, near reef passes, or over low rocky areas near the shore or near reef passes. They tended not to move into water deeper than 20 metres. Lemon sharks also spent a high proportion of time within Mangrove Bay and low rocky areas, and didn't travel into deeper water. Tiger sharks roamed around most habitats, including sand patches and patch reefs and low rocky areas within the lagoon (Figure 9).

Some adult female lemon sharks moved repeatedly to Point Cloates (75 kilometres away) and Coral Bay (135 kilometres away) around mating season in October and November, suggesting that lemon sharks migrate long distances along the coast to mate and give birth. However, not all resident animals moved away from Mangrove Bay, and the team observed some females with fresh mating scars, as well as newly-born lemon sharks within Mangrove Bay, indicating that Mangrove Bay is an important mating and nursery area for lemon sharks.

Figure 9: Tagging a 4 m tiger shark at Ningaloo. Large sharks are tagged in a purpose built sling alongside the research vessel.



An acoustic receiver at Ningaloo Reef. Receivers are used to track the movement of turtles and sharks

Did you know?

Whale sharks dive to depths of more than 1.7 km and swim down and back up at similar speeds.

During the winter months, adult lemon sharks in the Ningaloo lagoon shift their home range about 1 km further west than in summer. This results in the sharks being in water that is 2-5 °C warmer. This fine-scale change in habitat use is thought to be a form of behavioural thermoregulation that improves fitness and growth.

TURTLE highlights

The green turtles that inhabit Ningaloo are part of a broader population that is distributed across north-western Australia, and which is one of the most abundant populations in the world. Research in Ningaloo Outlook sought to understand how far these turtles roam, and what food they rely on.

Photo by Violeta Brosig, Blue Media Exmouth

The green turtles which inhabit Ningaloo are part of a population which is distributed around north-western Australia, and which is one of the largest in the world. Many live in the lagoons within the reef, or nest on the beaches during summer. The Ningaloo Outlook team sought to find out whether these turtles stayed at Ningaloo or roamed more widely.

The team used a combination of different types of tags. Thirty-four green turtles were tagged with satellite tags (13 of these were nesting females captured while on the beach, the remaining 21 were captured in the water), and 60 with acoustic tags. Turtles captured in the water in known feeding areas tended to remain very close to where they were tagged (Figure 10), typically moving just a few kilometres at most. Juvenile turtles tended to stay within Mangrove Bay, with average home range of around 1 km^2. Adult turtles spent more time further out in the lagoon, and had larger home ranges (4 km^2), but the only occasions in which they travelled very far were to mate or nest.

To detect females that were likely to nest in the upcoming season, large female turtles were captured in the water, and a portable ultrasound machine was used to assess whether vitellogenic (yolk-forming) follicles were present (Figure 12). The team detected these yolk-forming follicles in three females, and successfully tracked two of them for their entire nesting migration, from feeding grounds to nesting beaches and back (Figure 13) — this has rarely been done for any species of turtle anywhere in the world. Both turtles nested more than 200 kilometres from where they were tagged, then returned (in one case the last transmission after 283 days was a mere 400 metres from where she was first captured). The third travelled more than 800 kilometres, to Eighty Mile Beach, but the tag stopped transmitting before she returned to Ningaloo.

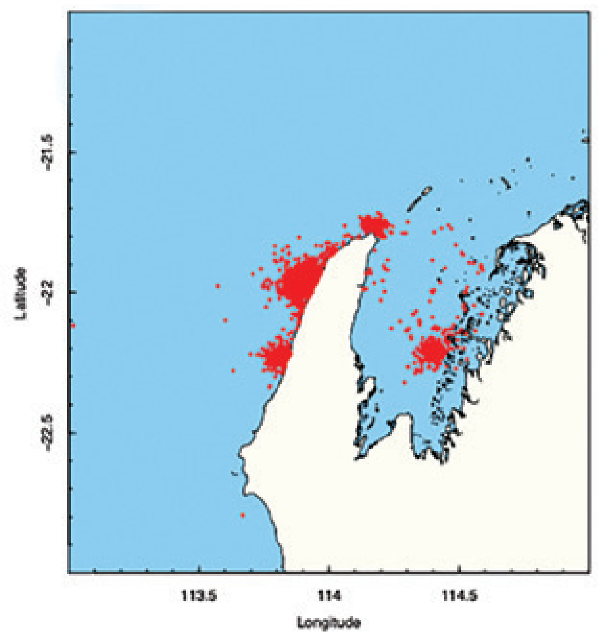


Figure 10: Locations received from satellite transmitters attached to green turtles captured from feeding grounds at Mangrove Bay and Sandy Bay.

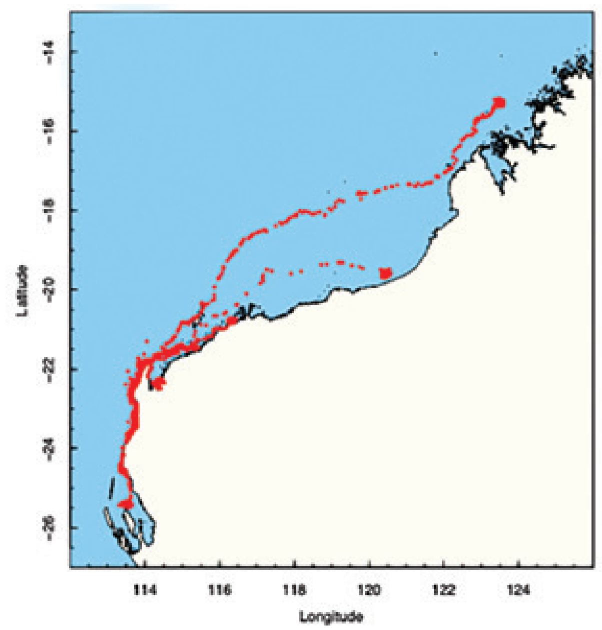


Figure 11: Locations received from satellite transmitters attached nesting female green turtles, who were then tracked back to their feeding grounds.

Did you know?

Female green turtles can migrate up to thousands of kilometres from their feeding grounds to nest.

In contrast to the turtles captured in the water, nesting females tagged after laying eggs on the beach at Ningaloo moved much further, in one case more than 1200 km to the Kimberley (Figure 11). They ranged widely, moving between Shark Bay and the Kimberley; half left the Ningaloo World Heritage Area entirely. The study revealed the wide extent of movements by green turtles, with those from Ningaloo nesting in the Pilbara, and those nesting at Ningaloo arriving from far afield.

The team also set out to study what the turtles were eating. The team decided to investigate whether they could develop a non-invasive method of collecting specimens for turtles, using nail clippings instead of the usual method of taking skin biopsies or blood samples. By comparing the chemical signatures in skin, blood and nail clippings they found that using nail clippings as a non-invasive way of studying turtle's diet worked extremely well. Using these data, they found that a turtle's diet varied according to its size (and therefore age), with a pattern consistent with a change to a seagrass-dominated diet after arrival of juveniles from their oceanic habitats, followed by a movement into the lagoon and reef to feed on seaweed and jellyfish.

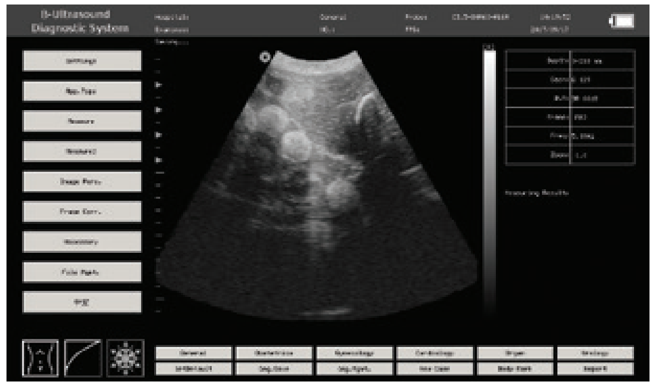


Figure 12: Image of vitellogenic (yolk-forming) follicles detected using a portable field ultrasound.

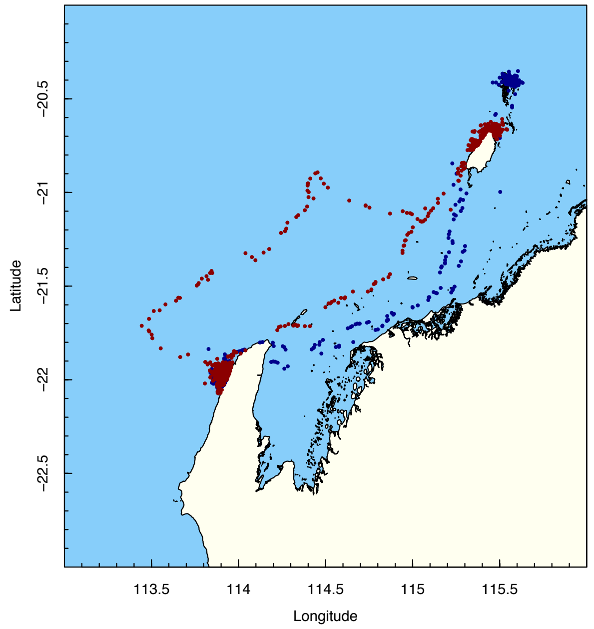


Figure 13: Locations received from satellite transmitters attached to two green turtle females for which vitellogenic follicles were detected through ultrasound. Each individual is shown in a different colour.

Figure 14: Dr Suzie Starfish using art and science to help Year 1 students from Exmouth District School learn about turtle research.

COMMUNITY OUTREACH highlights

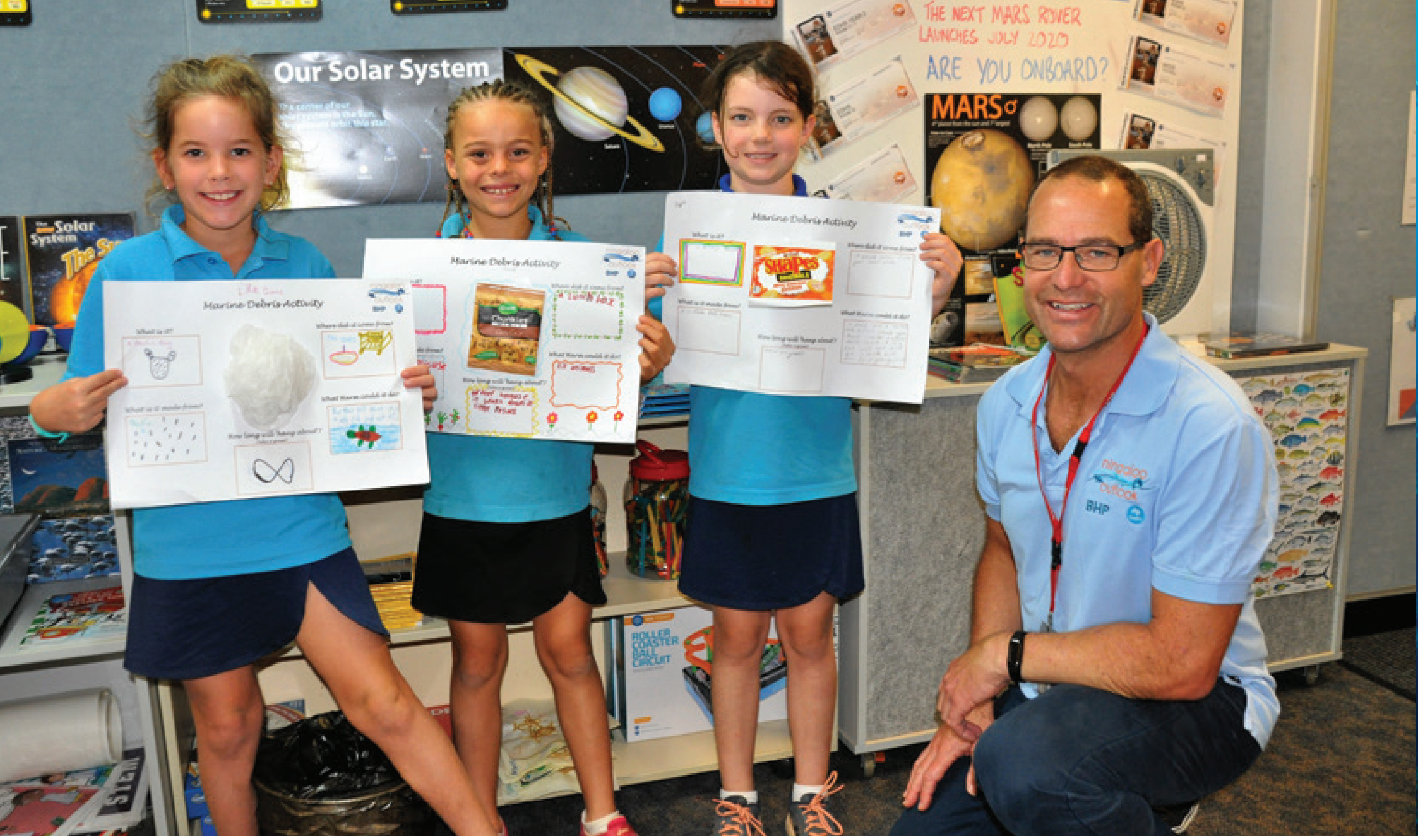
Photo by Violeta Brosig, Blue Media Exmouth

During Ningaloo Outlook over 1000 school students participated in science activities led by the team, who also gave more than 40 public presentations, attended community events like the annual Ningaloo Whale Shark Festival and presented their research findings at more than 35 national and international conferences.

Building scientific capacity and understanding of Ningaloo's ecosystems within the broader Exmouth community was central to Ningaloo Outlook. The team worked closely with local schools, the general public, and other organisations, to conduct and communicate the findings of their research.

Outstanding participation by local community members and school students proved critical to the team's turtle research. More than 30 volunteers helped with tagging — many returning several times. Some tagging sessions during the nesting season went for 12 hours (from sunset to sunrise), testing the stamina of some hardy volunteers! The research also incorporated yearly visits by Year 9 students, with more than 150 students joining the research team for science classes on the beach over the course of the program. Students looked after, measured and tagged turtles while learning about the physics underpinning satellite tags, the chemistry underlying the methods the researchers use to study diet, and the biology of turtles. Students, teachers and researchers alike all gained much from these experiences.

Engagement with local volunteer groups continued through initiatives such as the Reef Check program, where Ningaloo Outlook researchers assisted in training 25 reef check volunteers, who continue to participate in monitoring of sensitive inshore coral habitats.



The team established strong collaborations with teachers at the Exmouth District School, and together they developed 'science, technology, engineering and mathematics (STEM)' activities that integrated the real-world research activities the team's professional scientists do in their work into the school curriculum. The team brought their research into the classrooms to educate primary school students in Years 3, 4 and 5 about the effects of debris on marine ecosystems, linking lessons to key elements of the primary curriculum. As part of the class activity, students each brought in a piece of debris that they collected from the beach near their home, and investigated what the object was, where it might have originated, and whether it might pose a problem to marine life. Together they then used the conversations discuss the "Three R's" (reduce, reuse, recycle) and how students can play an active role in their own lives to reduce the amount of rubbish that ends up in the ocean.

Students from Year 7 to 10 studying digital information technology built their own OpenROV (Remotely Operated Vehicle) at school, before testing it in the local public swimming pool. The pool tests involved printing a life-sized replica of the reef and laying it on the bottom of the pool, for students to survey remotely from above — just like the research team does. Student learnt engineering principals on how to assemble the ROV, and how to use it to generate three-dimensional images using "structure from motion" principles that apply the laws of physics, reinforcing that engineering and technical skills are also integral in marine research.

STEM activities expanded to include art and became "STEAM" when Dr Suzie Starfish visited younger primary school students with her art-meets-science activities engaging the minds of students whilst providing important creative and critical thinking skills (Figure 14). From shark art to turtle storytelling students were taken through a variety of visual learning techniques to illustrate the importance of the marine environment for marine animals and people. The interactive approach demonstrated how science and technology is used in the protection and management of the Ningaloo Marine Park.

Partnerships with the University of Western Australia helped build scientific capacity with the team guiding three PhD candidates through to successful completion of their research projects. Working closely with Ningaloo Outlook researchers and university supervisors, the PhD candidates developed and honed skills in planning and conducting research, as well as presenting it to a variety of different audiences.

The engagement extended into the partners' own organisations. BHP staff participated in tagging (and naming!) turtles, and Ningaloo Outlook researchers visited the BHP offices in Perth each year to tell staff about what they had found, providing an opportunity to discuss the work together.

Presenting results to scientific peers is an important part of validating research: the team certainly did not shirk this responsibility, giving more than 45 presentations to audiences at scientific gatherings of all kinds all over Australia, and even overseas.

WRAP UP

During Ningaloo Outlook, CSIRO and BHP sought to increase knowledge of the iconic Ningaloo Reef and its inhabitants, and to share this knowledge with decision makers that are responsible for its conservation and sustainable use. Participation by the local community, and education and training of youth, were a central part of this. Training also included the BHP PhD Scholarship Scheme, providing opportunities for three students to complete doctoral studies while embedded in the project.

The result was a comprehensive and integrated research program which included distinct research Themes (Deep Reefs, Shallow Reefs, Turtles and Sharks). The research generated millions of data records that were synthesised to provide new knowledge about aspects as diverse as the composition of the poorly-known deepwater biota, to the journeys of wandering whale sharks and green turtles. Surveys of shallow reefs were integrated with existing data to provide unique time series that demonstrated the dynamics of these complex habitats over more than a decade.

To generate these new insights, the research team mounted dozens of expeditions, employing innovation and adaptability to address challenging questions. The team focused on providing their insights to the people who stand to benefit most — the decision-makers and the community of Exmouth, and above all, the youth who will be the stewards of this magnificent place in the coming decades. Each of us — researchers, industry, community and resource managers — have a role to play in wisely caring for Ningaloo through managing its use, so that we can shield it from damage. Ningaloo Outlook is a contribution to this endeavour.

Photo by Violeta Brosig,
Blue Media Exmouth

FOR MORE INFORMATION

Ningaloo.outlook@csiro.au

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

Images taken by the CSIRO team: Richard Pillans, Anna Cresswell, Sue Pillans, Mat Vanderklift, Dan Orr, Russ Babcock, Jo Myers, Nick Mortimer