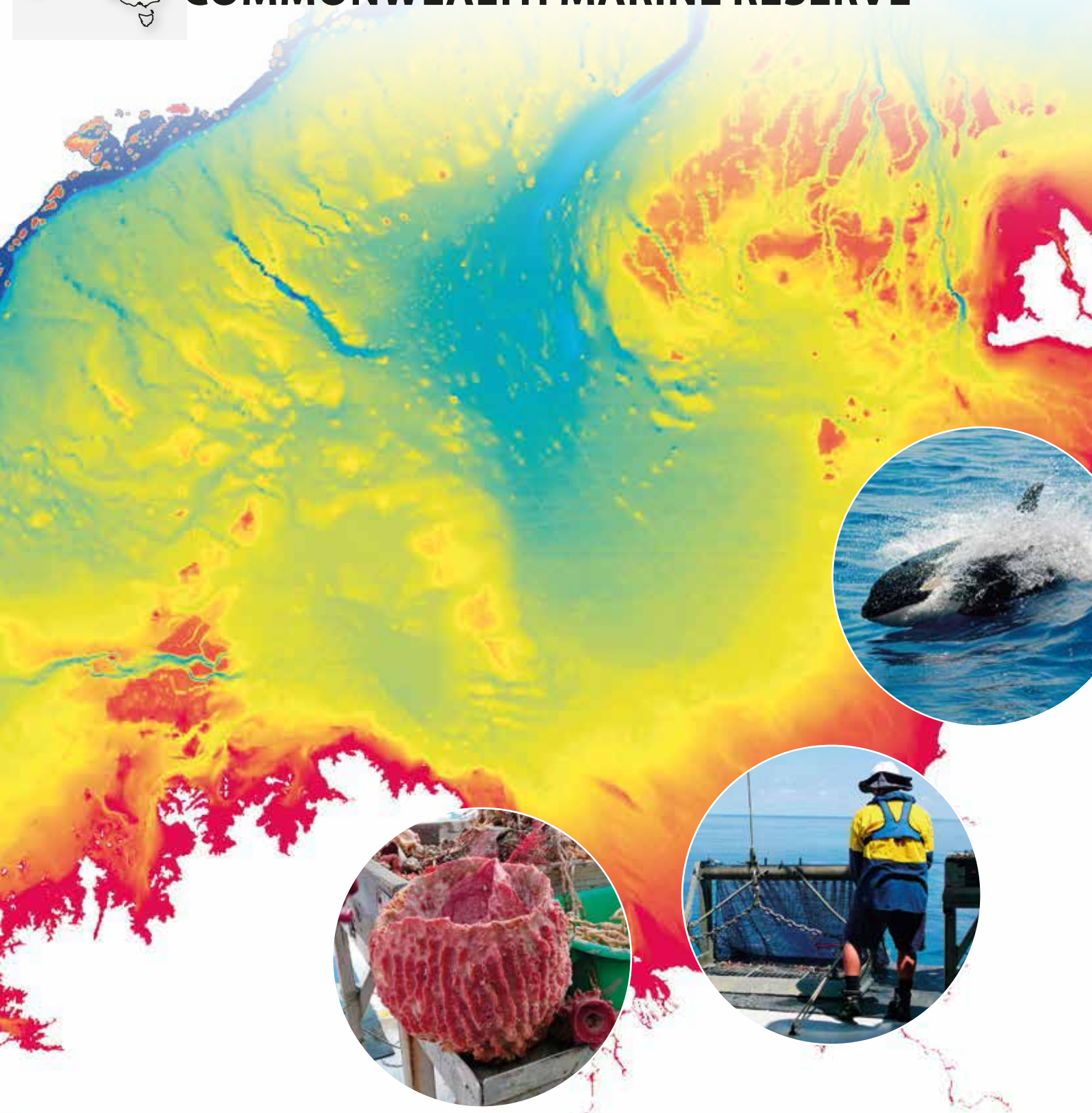
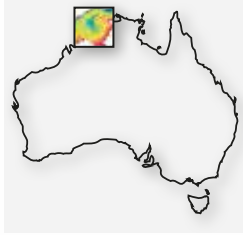


Exploring the

OCEANIC SHOALS

COMMONWEALTH MARINE RESERVE



National Environmental
Research Program

MARINE BIODIVERSITY *hub*

Voyage of discovery

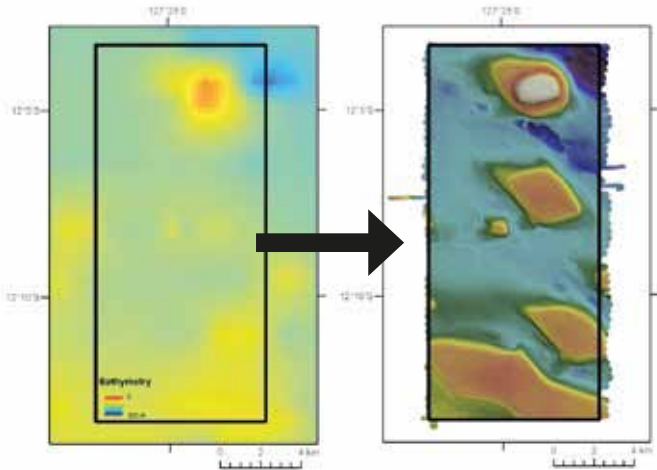
Commonwealth marine reserves (CMR) are areas recognised as having high conservation value. In 2012, a voyage of discovery set out for the western part of the Oceanic Shoals Commonwealth Marine Reserve, a poorly known part of Australia's north-west continental shelf. The voyage aimed to improve understanding of the habitats, gather benthic biological samples and observe fish communities. The information gathered builds on information from two previous voyages (2009, 2010). This 25 day voyage of the RV Solander, undertaken by the Marine Biodiversity Hub under the National Environmental Research Program (NERP), produced high resolution seabed maps of the previously unvisited carbonate banks and pinnacles in the western part of the CMR.

The Oceanic Shoals CMR was proclaimed in 2012, and contains components of three Key Ecological Features (KEF) which are defined in the North and North-west marine bioregional plans (Commonwealth of Australia, 2012a, b). KEFs are part of the marine environment considered regionally important for biodiversity or ecosystem function and integrity. The three Key Ecological Features are:

- the carbonate banks and terraces of the Van Diemen Rise (North Marine Region);
- the carbonate banks and terraces of the Sahul Shelf (North-west Marine Region), and;
- the pinnacles of the Bonaparte Basin (North and North-west Marine Regions).

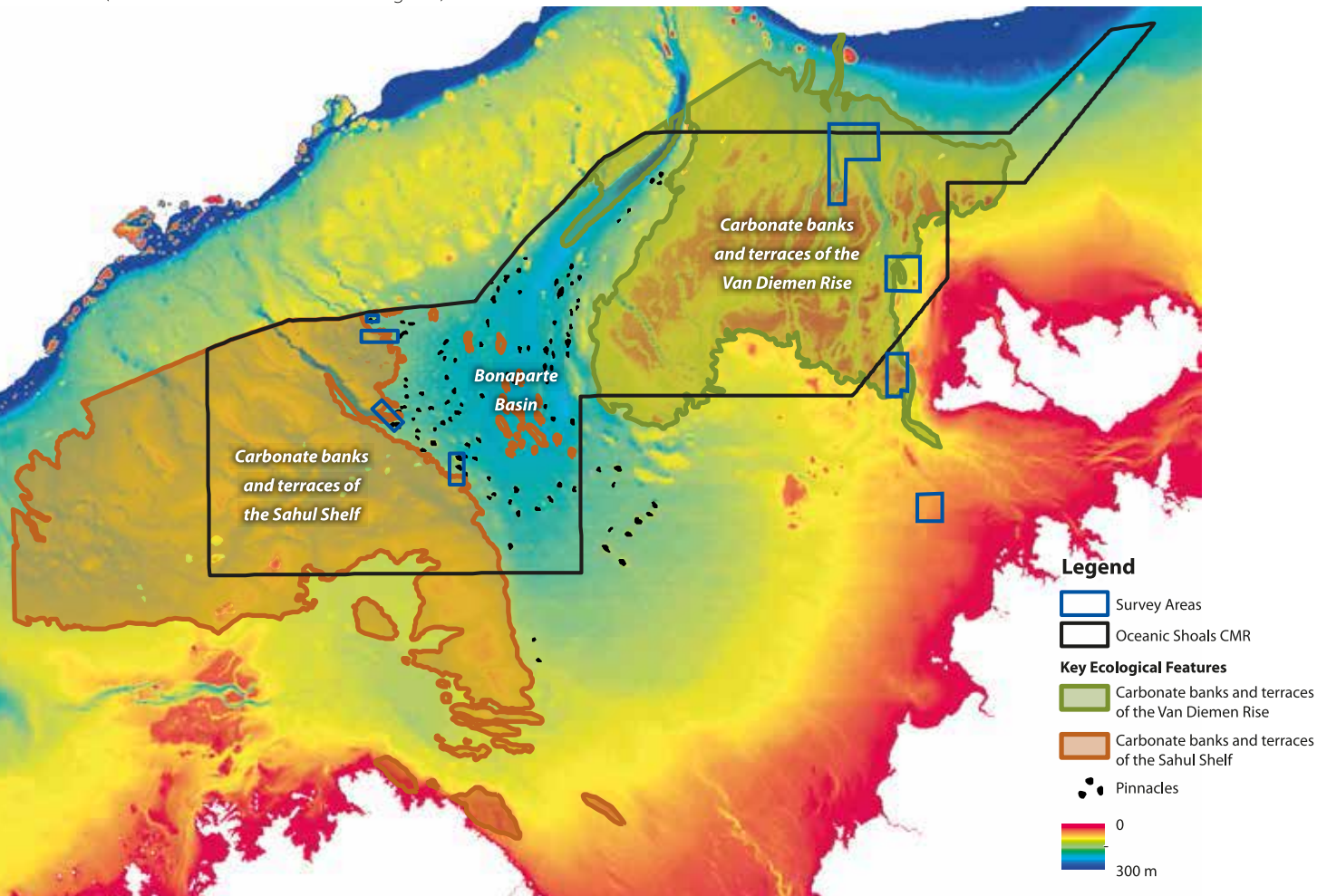
Coming into focus:

Left: bathymetry map before the 2012 survey with a spatial resolution of 250 m. Right: same area mapped by this project at a spatial resolution of 2 m. High resolution sonar mapping revealed 41 new banks and pinnacles covering an area of 152 km², an increase of 33% from 105 km² of the previous survey.



Study areas:

Carbonate banks, terraces and pinnacles (see legend) in relation to the Oceanic Shoals Commonwealth Marine Reserve (black outline). Survey areas for 2009, 2010 and 2012 voyages are also shown (blue boxes). The Oceanic Shoals CMR covers an area of approximately 72,000 km² and is designated as a Multiple Use Zone (IUCN VI).





Sub-bottom profiler



Towed underwater camera



Pelagic camera

The expedition used a multi-beam sonar, sub-bottom profiler, pelagic cameras, baited video stations, sediment grabs, box cores, benthic sleds, and conductivity, temperature and depth instruments (CTD). The baited mid-water stereo video rigs identified 38 species of sharks and fishes, establishing a baseline for the mid-water assemblage that can be used in the future.

Mapping the present, seeing the past

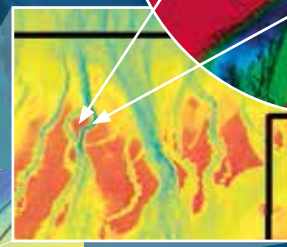
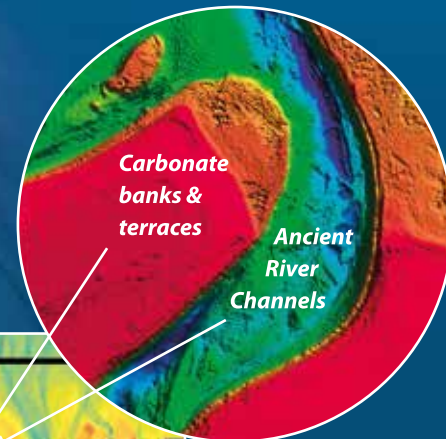
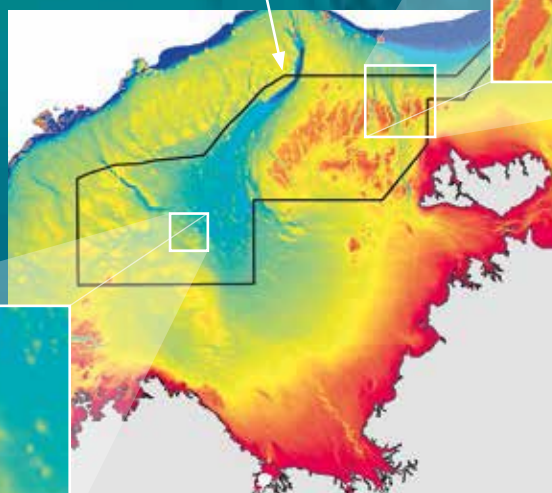
The seafloor of the Sahul Shelf shows ancient river channels and terraces formed when the continental shelf was exposed during the low sea levels of the last ice age. At that time, an extensive landscape of limestone ranges bounded the 35,000 km² Malita inland sea (now Bonaparte Basin, see Study areas graphic under Voyage of Discovery). Today these same features form a vast mosaic of submerged terraces, banks and pinnacles separated by deeply incised canyons which this study explores in detail for the first time.

Rising steeply from water depths of about 80 m some banks and pinnacles emerge to within 30 m of the water surface where light dependent organisms can thrive. Previous work detected rich sponge and soft coral communities in the region. This study addresses the character and continuity of the largely unexplored seafloor communities inhabiting the banks and pinnacles of the western part of the Oceanic Shoals CMR.

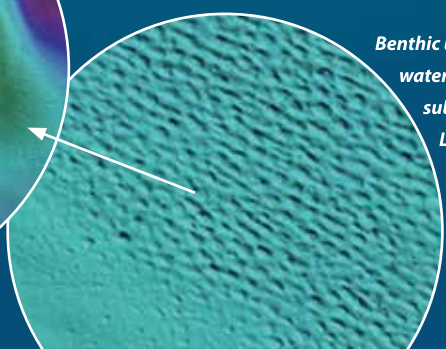
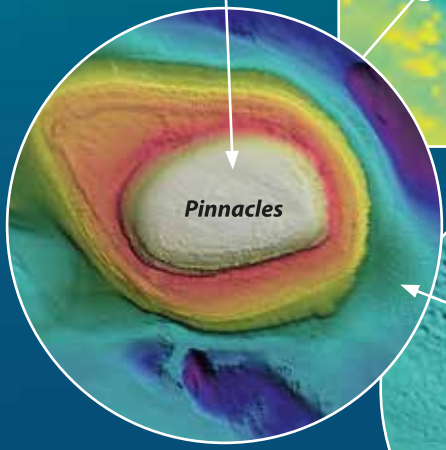
Pinnacles that rise to within 45 m water depth support more biodiversity, including hard corals.



Oceanic Shoals CMR



The carbonate banks, terraces and pinnacles of the outer Sahul shelf were built by repeated episodes of reef growth during high sea level (interglacial) phases of the last 2 million years. These same features were then shaped by erosion and weathering during the low sea level of a following ice age. Today, tidal currents play an important role by shaping and scouring the seabed around these hard ground features.



Benthic biodiversity on banks and pinnacles decreases with water depth and across the transition from the hard substrate of banks to soft sediment plains.

Left - evidence of fluid escape causing pockmarks (up to 5 m wide, 1 m deep).

Understanding Key Ecological Features

Key Ecological Features (KEFs) are elements of the Commonwealth marine environment that are considered to be of regional importance for either the region's biodiversity or ecosystem function and integrity.

Qualitative Modelling:

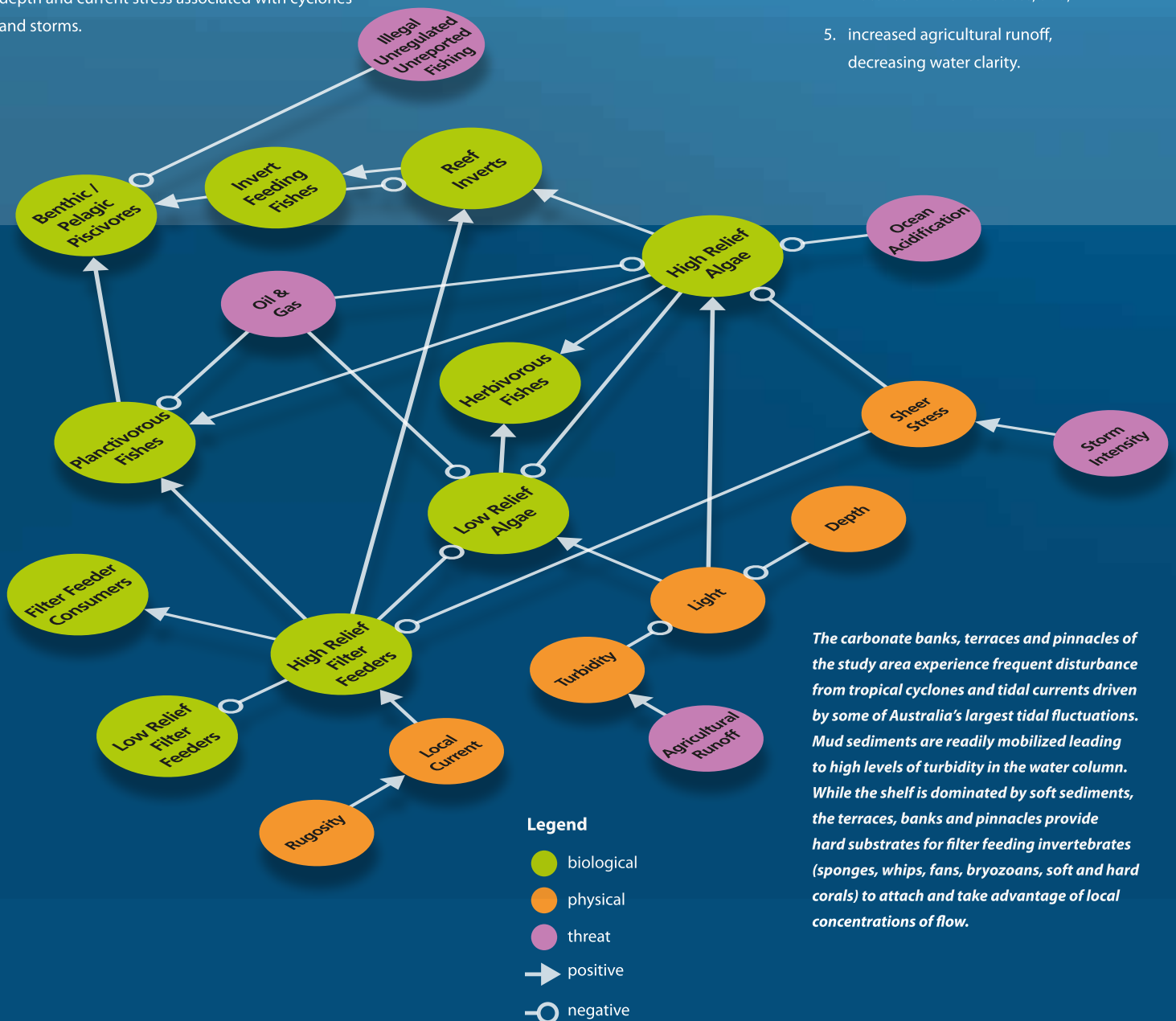
A qualitative model was developed to identify ecological indicators most likely to be useful for management. The graphic (below) summarises the dynamics of the carbonate banks, terraces and pinnacles that are key features of this area.

No fundamental differences were found between the communities of organisms associated with terraces, banks or pinnacles. However, there were differences in how organisms were positioned relative to physical factors such as water clarity and depth and current stress associated with cyclones and storms.

Invertebrates attached to the seafloor support mobile populations of fishes and other invertebrates through a web of predator-prey interactions and habitat-effects such as providing refuge from strong currents. The predator-prey relationships are not limited to the seafloor community. For example, invertebrate and plankton eating fishes are consumed by both benthic and pelagic predatory fish species demonstrating a connection between the benthic and pelagic ecosystems.

Five plausible threats were identified that may impact the functioning of these Key Ecological Features over the next 50 years:

1. oil and gas spills, impacting algae and planktivorous fishes;
2. illegal fishing, impacting benthic and pelagic piscivores;
3. ocean acidification impacting high relief algae;
4. increased storm intensity increasing water column shear stress, and;
5. increased agricultural runoff, decreasing water clarity.



The carbonate banks, terraces and pinnacles of the study area experience frequent disturbance from tropical cyclones and tidal currents driven by some of Australia's largest tidal fluctuations. Mud sediments are readily mobilized leading to high levels of turbidity in the water column. While the shelf is dominated by soft sediments, the terraces, banks and pinnacles provide hard substrates for filter feeding invertebrates (sponges, whips, fans, bryozoans, soft and hard corals) to attach and take advantage of local concentrations of flow.

In Brief:

- 57 species are first-time observations for the Sahul Shelf and Northern Territory;
- seven are first-time records for Australia;
- 13 are new for the Indo-Pacific region;
- four species of hard coral found in the Oceanic Shoals CMR are IUCN-listed as *Vulnerable* or *Near Threatened*;
- one species is *Endangered*.



“ This study confirms the Key Ecological Features of the Oceanic Shoals CMR as biodiversity hotspots. ”

A newly discovered species of sea spider.

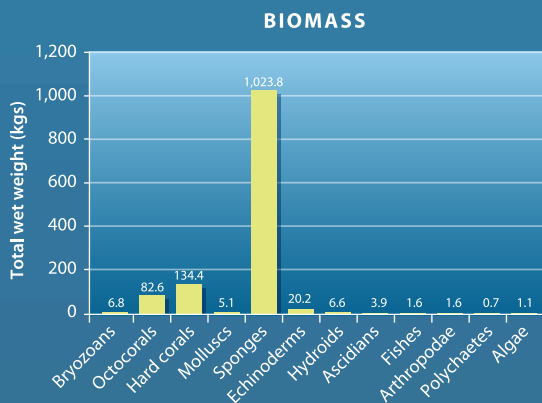


Benthic Biodiversity

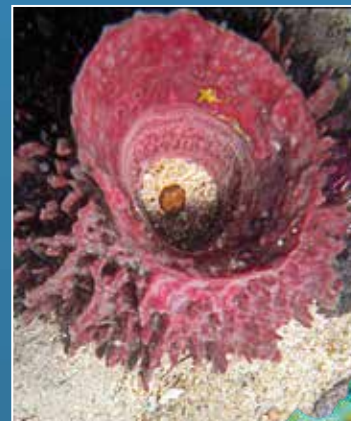
This study confirms the Key Ecological Features of the Oceanic Shoals CMR as biodiversity hotspots. Previous reports of rich sponge and octocoral communities are confirmed and their distribution is shown to extend throughout the western part of the Oceanic Shoals CMR.

A hotspot for sponges:

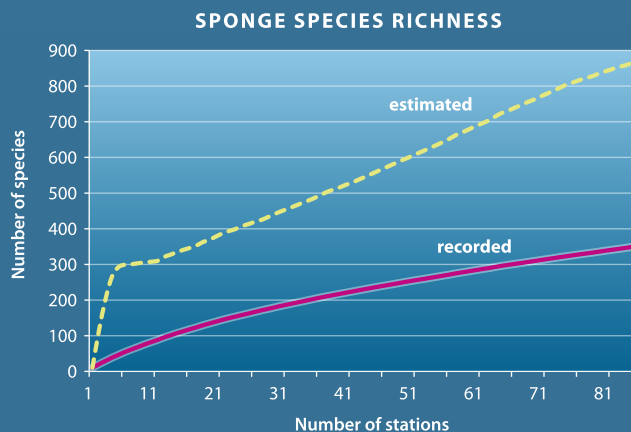
The banks in the Oceanic Shoals CMR are biodiversity hotspots for sponges, with more species and different communities than the surrounding seafloor.



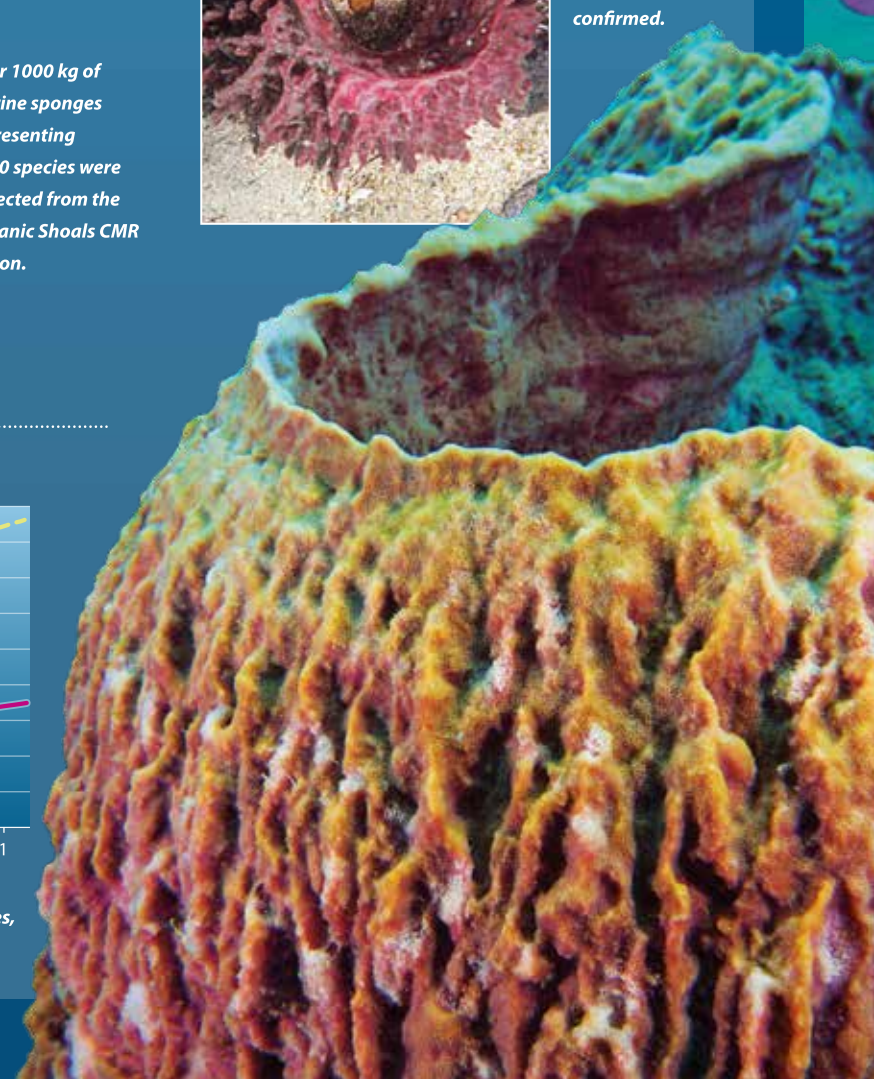
Over 1000 kg of marine sponges representing ~350 species were collected from the Oceanic Shoals CMR region.




29 sponge species collected are new to science, with as many as 100 potential new species yet to be confirmed.



Modelling indicates there may be as many as 900 sponge species, almost twice the number estimated for the Ningaloo CMR.





“ High resolution sonar mapping revealed 41 new banks and pinnacles covering an area of 152 km², an increase of 33% from 105 km² of the previous survey. ”

Further reading:

Commonwealth of Australia. 2012a. Marine bioregional plan for the North Marine Region. Department of Sustainability, Environment, Water, Population and Communities. Canberra, 191 pp. www.environment.gov.au/topics/marine/marine-bioregional-plans/north

Commonwealth of Australia. 2012b. Marine bioregional plan for the North-west Marine Region. Department of Sustainability, Environment, Water, Population and Communities. Canberra, 260 pp. www.environment.gov.au/topics/marine/marine-bioregional-plans/north-west

Nichol, S.L., Howard, F.J.F., Kool, J., Stowar, M., Bouchet, P., Radke, L., Siwabessy, J., Przeslawski, R., Picard, K., Alvarez de Glasby, B., Colquhoun, J., Letessier, T., Heyward, A., 2013. *Oceanic Shoals Commonwealth Marine Reserve (Timor Sea) Biodiversity Survey: GA0339/SOL5650 Post-Survey Report*. Record 2013/038. Geoscience Australia, Canberra. www.ga.gov.au/corporate_data/76658/Rec2013_038.pdf

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Project Partners:

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