National Environmental Research Program

MARINE BIODIVERSITY *hub*

Research HIGHLIGHTS 2013

A national research collaboration delivering marine biodiversity knowledge to the Australian Government

Introduction

The National Environmental Research Program (NERP) Marine Biodiversity Hub conducts applied research to support evidence-based decision making for managing our oceans.

It is a partnership between Australia's Department of the Environment and seven research providers — the University of Tasmania, CSIRO, Geoscience Australia, the Australian Institute of Marine Science, Museum Victoria, Charles Darwin University and the University of Western Australia.

To deliver the best research outcomes to the Department, the Marine Hub also calls on the expertise of staff from Australia's Integrated Marine Observing System, the Australian Fisheries Management Authority and the Australian Petroleum Production and Exploration Association, as well as researchers and managers from most Australian states and territories.

We recognise that our research needs to be strategic, building on the best available information and practice, and directly relevant to the Commonwealth's Environment Portfolio. Increasingly, our research is designed and delivered in partnership with portfolio managers.

In compiling this document of research highlights from 2013, we set ourselves a challenge. How do our research outputs designed in 2011, fit the needs of the new Department of the Environment strategy, "A Plan for a Cleaner Environment"?

A school of one-spot pullers on a colourful Lord Howe Island Reef.
(Image: Rick Stuart-Smith, Reef Life Survey)

Some projects map across very easily: the design of an integrated monitoring program for the Great Barrier Reef meets a clear need of the Reef 2050 Plan; our research on developing more efficient assessment and monitoring strategies for threatened species aims to improve the coordination, targeting and effectiveness of species recovery plans; and our work on identifying the scientific and social values of the marine environment supports a balanced approach to Marine Protected Areas.

Other projects, while not designed to meet the new objectives, directly contribute to them nevertheless. For example, our efforts to improve access to, and derive maximum information from, existing data will directly assist in achieving the Government's goal

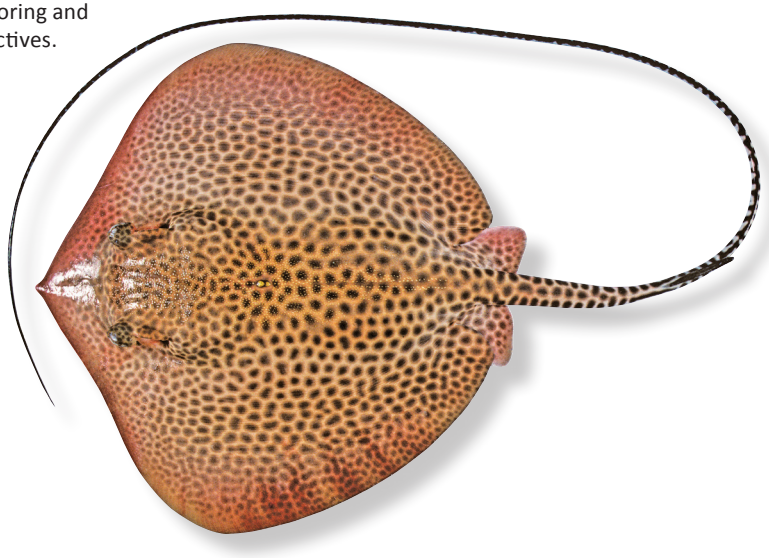
of simplifying environmental assessments. Likewise, our focus on developing uniform standards for the collection and analysis of new data. Indeed, the need for the National Marine Monitoring Blueprint that we are developing with the Department will only increase given the greater requirement for oversight and auditing of environmental assessment programs to be managed by external agencies.

Generally, we were pleased with the consistency between our research directions and the Department's new strategic direction. The Plan for a Cleaner Environment is requiring us to revisit the value and application of all our research, and adjust the way in which we package and deliver our research outputs to best serve the Portfolio and Australia in general.

In addition to the Marine Hub's high level of national collaboration, we are also leaders in global partnerships, with links to the Reef Life Survey, the CITES Elasmobranch Group and the COSMOS global biogeography project. With the Government, we apply our expertise to support Australian Aid regionally, UN working groups, IUCN and the Convention on Biological Diversity globally.

But even this is not enough. It is a sad observation from the search for the missing Malaysian airliner MH730, that Australia's deep-sea survey capability is very limited. In practical terms, we are restricted to depths shallower than 200 m for the precise and non-destructive approaches desirable for long-term monitoring. This is disturbing given that more than three-quarters of the Commonwealth Marine Reserve (CMR) network is deeper than 200 m. With the only blue-water research vessel dedicated to scientific research, it is unclear where the capacity to monitor Australia's vast offshore estate will come from.

The Marine Hub has been asked to develop a white paper on the capacity needs for marine biodiversity. The paper will form part of a national review and strategy for Australian marine research and monitoring. In combination with the National Marine Monitoring Blueprint, the paper will define the needs, infrastructure and capabilities required to support the Environment Portfolio's monitoring and assessment objectives.



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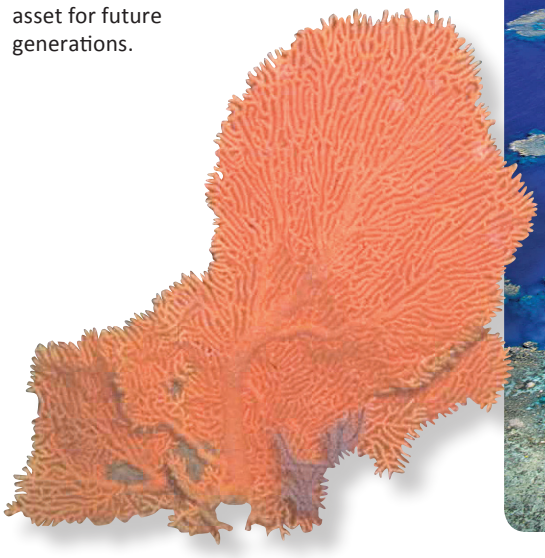
Protecting the Great Barrier Reef, supporting the Reef 2050 Plan

Protecting and improving the health of Australia's unique and diverse Great Barrier Reef has been identified as a priority in the Australian Government's Cleaner Environment Plan. In 2013, a NERP Marine Biodiversity Hub-led team of managers and researchers developed a framework to integrate monitoring efforts across the Great Barrier Reef World Heritage Area (GBRWHA).

The framework will ensure that research and monitoring investments meet management needs, and will use existing data sets to provide an understanding of long-term trends in the Reef's health. The new approach will provide managers with the evidence they need to respond to environmental change and safeguard Australia's greatest natural asset for future generations.



Meeting management priorities

The Great Barrier Reef is the world's most extensive coral reef system and is recognised as a World Heritage site. While it still has some of the richest biological diversity on Earth, a 2012 analysis revealed that the average amount of living coral cover fell by half between 1985 and 2012 (De'ath 2012). The Australian Government's Reef 2050 Plan provides a 'long-term strategic approach to address key threats to the Great Barrier Reef'. The Great Barrier Reef World Heritage Area Integrated Monitoring Framework is a key element of the Plan.

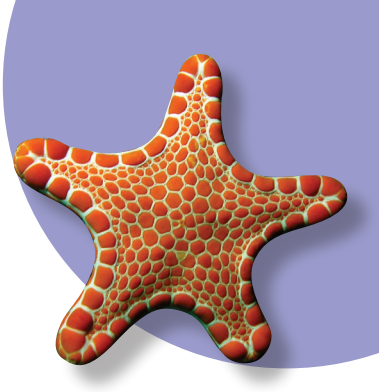
The Framework was a response to the urgent need to align research and monitoring efforts with management – a cornerstone of adaptive management. It will assist in achieving the objectives of the Reef 2050 Plan by:

- identifying management priorities
- outlining preferred governance arrangements for integrated monitoring
- identifying gaps to be filled for data collection, management, analysis and reporting
- identifying existing management and monitoring initiatives that will support integrated monitoring

The result – the framework provides a blueprint for a cost-effective approach to understanding how the reef is responding to various pressures and the effectiveness of management interventions.

The Reef 2050 Plan identifies improving coastal habitat and water quality along the Reef as a management priority. The Integrated Monitoring Framework will help address this by providing a blueprint to improve monitoring in a way that allows researchers and managers to better understand cause-and-effect relationships, for example the effects of nutrient runoff on seagrass beds and coral reefs.

The new, integrated approach will also make it easier to track the effects of the Crown of Thorns starfish and climate change on coral reefs, and to monitor and assess the effects of management interventions. (Image: GBRMPA)



A model for cost-effective monitoring

Integrating efforts to survey the Reef's health makes cost-effective use of available monitoring resources. It is expected to help inform how we oversee the ongoing health of other areas within Australia's Exclusive Economic Zone, including the Commonwealth's estate of offshore marine reserves.

The GBRWHA Integrated Monitoring Framework was a partnership between three NERP Hubs (Marine Biodiversity, Tropical Ecosystems and Environmental Decisions) and the Great Barrier Reef Marine Park Authority (GBRMPA). It drew on the experience and knowledge of GBRMPA and the Australian Institute of Marine Science.

Reference: De'ath G *et al.* (2012) *The 27-year decline of coral cover on the Great Barrier Reef and its causes*. Proceedings of the National Academy of Sciences

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High cover coral (far north Great Barrier Reef).
(Image: Eric G. Matson, AIMS)

More effective approaches to threatened-species recovery

The NERP Marine Biodiversity Hub is assisting the Australian Government to protect Australia's unique marine biodiversity by developing coordinated, targeted and more effective approaches to threatened species recovery planning.

The Marine Hub's partners have developed new cost-effective ways of determining abundance and population trends for threatened river and estuary sharks and rays in the Top End. In 2013, they extended this approach to better understand white shark populations off Eastern Australia, an emerging government priority.

Below: CDU's Peter Kyne rescues juvenile largetooth sawfish from a waterhole near the Daly River. (Image: Amos Malak Malak Ranger Group)

Right: CSIRO's Richard Pillans with a northern river shark, a species whose numbers appear healthy in some rivers. (Image: CSIRO)

A coordinated effort delivers for Top End sharks and rays

The Northern Territory river systems are one of the world's last strongholds for several shark and ray species, including the largetooth sawfish (a ray), the speartooth shark and the northern river shark.

Collaboration between Marine Hub partners (CSIRO and Charles Darwin University), Northern Territory Fisheries, traditional owners, Indigenous ranger groups, cattle station proprietors and volunteers has improved the knowledge base for these Top End species.

As part of the coordinated effort, 165 individual sharks and rays were fitted with acoustic tags that provided information on movement, migrations, habitat use and survivorship.

The result – scientists, managers and the local community now have a better understanding of the populations and habitat use of Top End sharks and rays, and the factors influencing their survival. Some species appear less abundant than previously thought, while others were found in rivers outside their known range. New infrastructure developments relating to water use may be particularly relevant to these species. The information will help guide decisions about conservation, wildlife trade regulation and management.

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Targeting white sharks

In 2013, as part of a NERP Emerging Priorities project, Marine Hub partners joined forces with researchers and managers from the New South Wales and Victorian governments, as well as scientists from the University of Technology Sydney and the Integrated Marine Observing System, to estimate the abundance of white sharks off Australia's East Coast. The study focused on white shark aggregations at Corner Inlet, south-east of Melbourne, and at Port Stephens in the Hunter region of New South Wales.

The research applied acoustic tagging and genetic fingerprinting approaches developed to estimate the population size and mortality rates of Top End sharks and rays. Already, genetic samples have been taken from 168 white sharks. In addition, the scientists used aerial surveys, which may provide a repeatable, low cost, high-frequency option for monitoring the East Coast white shark population.

Above right: CSIRO researchers, supported by NSW Department of Primary Industries (DPI) staff, surgically implant an acoustic tag in a juvenile white shark. (Image: David Harasti, NSW DPI)

Right: A tagged juvenile white shark is released from the in-water tagging cradle. (Image: David Harasti, NSW DPI)

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Multi-species conservation – a cost-effective approach

A focus of Marine Hub research is the development of cost-effective approaches to protecting species. In 2013, Marine Hub scientists developed landscape (seascape) approaches for species management whereby the needs and threats to multiple species are considered simultaneously.

The goal was to develop more cost-effective approaches that not only protect threatened species, but also keep a watch on, and help protect, species at risk of declining to the point where they could be proposed for listing. One study included 50 species of temperate sharks and rays. With the assistance of Australian shark experts, Marine Hub researchers used historic ranges to identify key areas of importance for particular life-history stages. The multi-species approach efficiently determined priority areas for managing human use and monitoring the population status of sharks and rays.

As part of the coordinated research effort, Australia's shark and ray experts produced maps showing where various species are found around the nation, and highlighting the areas of greatest importance for their survival.

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Efficient environmental assessments

Simplifying the process of environmental assessments is a goal of the Australian Government's Cleaner Environment Plan. To achieve this, governments, industry and wider society require easy access to relevant, high-quality environmental information.

In 2013, the NERP Marine Biodiversity Hub's partners collated and improved access to existing environmental data, and used their collective expertise to mine the pooled information for valuable new insights.

Significantly, standards were developed to ensure greater uniformity in the way data is collected, analysed and managed in future. This will enable information from different sources to be combined, and/or compared, leading to a more comprehensive understanding of marine systems.

Better access – collating data for more general use

The Marine Hub has developed a national data catalogue summarising existing information about the Key Ecological Features of Australia's oceans (identified by the Australian Government as being important to ecosystem health) and the nation's Commonwealth Marine Reserves. The catalogue will provide a valuable resource for informing environmental assessments.

In addition, the Marine Hub has improved access to data on the pressures that may impact these Key Ecological Features and the Exclusive Economic Zone in general. With these data in hand, areas can be identified where the cumulative impacts from several pressures may be affecting the environment.

Collectively, these achievements will ensure that the benefits of past investments in marine data collection are maximised to assist government, industry and society in the environmental assessment process.

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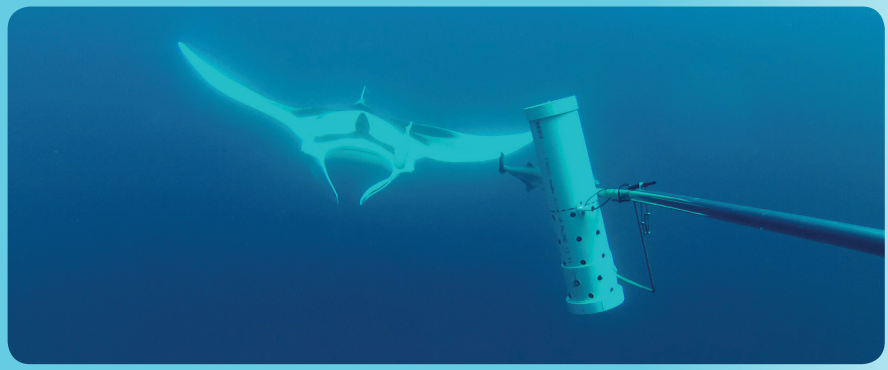
A better understanding of the North West Shelf



During a three-week survey of the Oceanic Shoals Commonwealth Marine Reserve, a poorly known region of the Timor Sea north of Australia, more than 500 square kilometres were efficiently surveyed using multibeam sonar.

On the same voyage, 65 kilometres of video footage shed light on the marine environment and its life forms, while baited cameras assessed fish populations. Ocean drifters mapped surface currents and whale and dolphin activity was recorded. The findings have been combined with recent data sets for shoals closer to the northern and western shelf margins, enabling a regional scale overview of the area and the prediction of biodiversity patterns. The datasets and models will support marine bioregional monitoring and management and will help guide decisions about acreage release for offshore oil and gas development and the industry's subsequent monitoring and management.

The survey benefited from the combined expertise of researchers from the Marine Hub, the Australian Institute of Marine Science (AIMS), Geoscience Australia, the University of Western Australia, and the Museum and Art Gallery of the Northern Territory. It was conducted aboard the AIMS research vessel, *Solander.*

Top: An albino manta ray slowly approaches the baited cameras. Above left: An inquisitive bottlenose dolphin (*T. Truncatus*) approaches the research vessel RV *Solander*. Above right: Killer whale calf porpoising through the waves. Far left: A shoal of leatherjackets (*Aluterus monoceros*) concentrates around the camera unit. (Images: Tom Letessier, Jessica Meeuwig, Phil Bouchet, Centre for Marine Futures, Oceans Institute, University of Western Australia)

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Efficient environmental assessments *(cont.)*

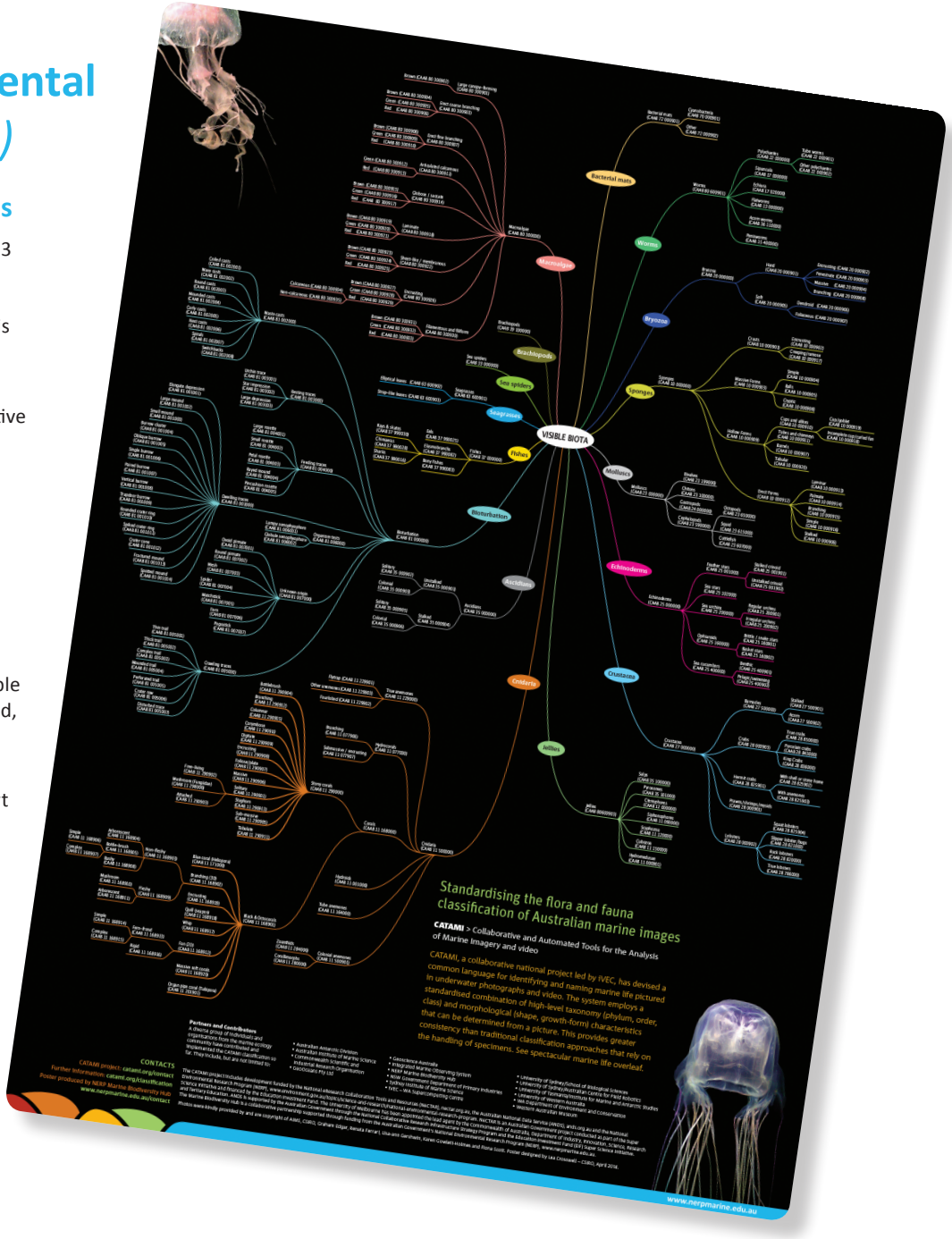
Data standards for assessments

A computer-aided project launched in 2013 to process and store visual underwater data from around Australia will, for the first time, enable continental-scale analysis of marine ecosystems, leading to more efficient environmental assessments.

The project, known as CATAMI (Collaborative and Automated Tools for the Analysis of Marine Imagery and video), saw Marine Hub partners collaborate with host universities and State departments to develop and test standards for classifying Australian underwater marine imagery.

The published CATAMI data standard is an important means for generating the necessary consistency in the way image data is processed. Significantly, it will enable datasets to be combined, and/or compared, providing insights into marine ecosystems at scales not previously possible.

Applications include monitoring to support marine bioregional plans, managing the Commonwealth's network of marine reserves, and industry monitoring with a view to regional management.



Poster image: Putting names to a sea of faces – standardising the flora and fauna classification of Australian marine images, CATAMI project.

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A deeper understanding of biodiversity

Marine Hub scientists have identified 890 shrimp and crab-like species (decapods) in surveys of the deep waters off Western Australia – more than 260 are likely to be new to science. Ongoing updates to scientific knowledge on the diversity and distribution of Australia's marine biota are part of continuous improvement in how we see and classify our marine environment. This helps validate and update the classification of bioregions and depth strata that are used to inform Commonwealth Marine Reserve (CMR) zoning and management, and improves the information available for environmental impact assessments. Main image: Pebble crab (*Randallia eburnea*) discovered off Western Australia.

(Images: Karen Gowlett Holmes, CSIRO)

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Protecting marine environments

Assessing our oceans on the basis of scientific, economic and social evidence is vital for achieving a balanced approach to Marine Protected Areas, according to the Australian Government's Cleaner Environment Plan.

In 2013, the Marine Hub's partners investigated priority places and conservation values of Australia's oceans, establishing the evidence base needed to make decisions to protect the marine environment.

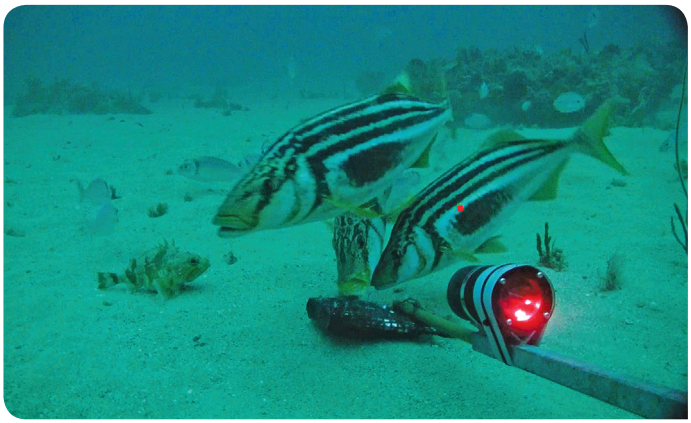
This new evidence will assist government and industry to balance ocean use with the protection of the marine environment.

Places of priority

Evidence for protection

The Marine Hub's partners have improved knowledge of marine life in two important Commonwealth Marine Reserves (CMRs): the Oceanic Shoals and Flinders.

Analyses conducted in 2013 have significantly improved our understanding of the biodiversity of reefs and open sediment habitats in these priority places. This evidence base will allow managers to target monitoring efforts, detect any changes in the marine reserves, and adapt their management decisions accordingly.



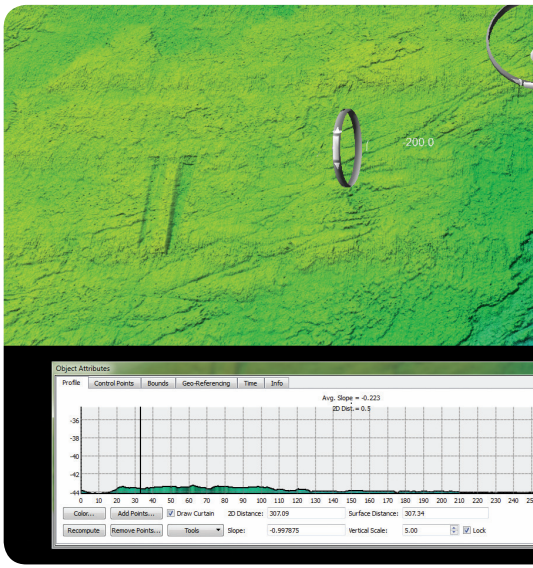
A still image taken from baited remote underwater video (depth 160 m) to illustrate the potential for stripey trumpeter to be a key indicator species within the Flinders CMR. (Image: University of Tasmania)

Mapping the way forward

Advances in acoustics research are leading to enormous benefits in marine bioregional planning, monitoring and management.

Through the Marine Hub, scientists from Geoscience Australia, the University of Tasmania and CSIRO, are mapping the ocean's floor at much greater detail than previously possible. Attention is being paid to ensuring national and international consistency in the collection and interpretation of acoustics data.

The end result will be one map of the seabeds around the continent that will reveal the



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location and structure of canyons and slopes and offer clues about associated biodiversity. A national map is essential for understanding and managing the riches our oceans have to offer economically, biologically and socially. It is an essential step to balancing these, sometimes competing, values.

Recently, the Marine Hub's researchers have produced new swath maps of the Flinders, Freycinet and Oceanic Shoals Commonwealth Marine Reserves and the high conservation-value waters surrounding the Abrolhos and Solitary Islands. The maps provide baseline information for monitoring these reserves and priority places for conservation.

Conservation values

Identifying biodiversity 'hotspots'

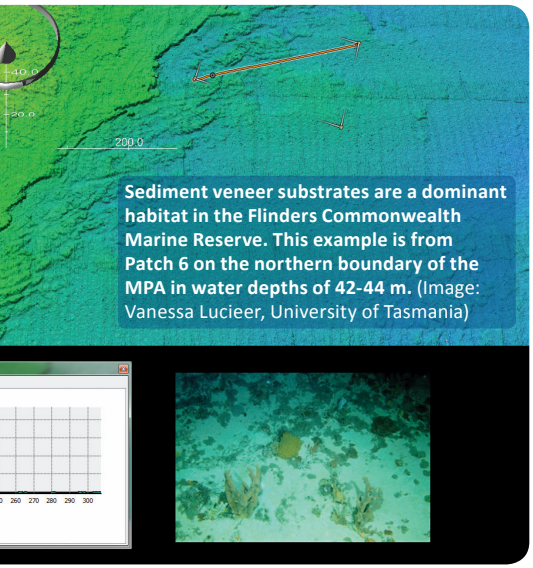
In 2013, Marine Hub partners worked together to analyse Reef Life Survey data, improving our understanding of biological diversity.

This novel global analysis of reef fish developed a new tool for measuring biodiversity based on species function and abundance rather than species-richness. It reported new 'hotspots' of functional biodiversity in some temperate regions, including south-western Australia and the Galapagos Islands, where species counts are only moderate.

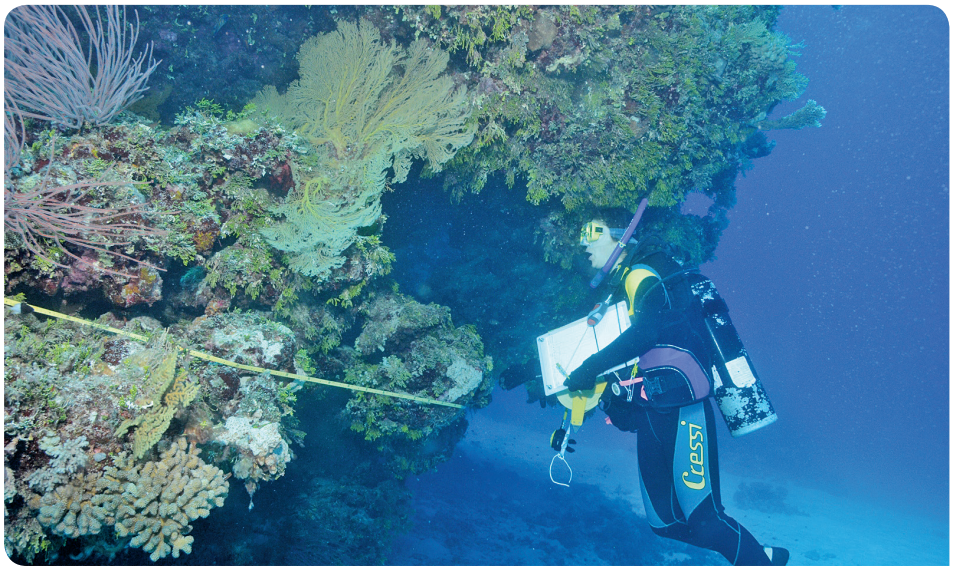
The survey has produced the best dataset of its kind in the world, extremely cost effectively.

The international research team included Marine Hub scientists and more than 150 trained SCUBA divers working for the non-profit organisation Reef Life Survey.

Reef Life Survey volunteer diver counting invertebrates in the Coral Sea at Holmes Reef. (Image: Graham Edgar, University of Tasmania)



Sediment veneer substrates are a dominant habitat in the Flinders Commonwealth Marine Reserve. This example is from Patch 6 on the northern boundary of the MPA in water depths of 42-44 m. (Image: Vanessa Lucieer, University of Tasmania)



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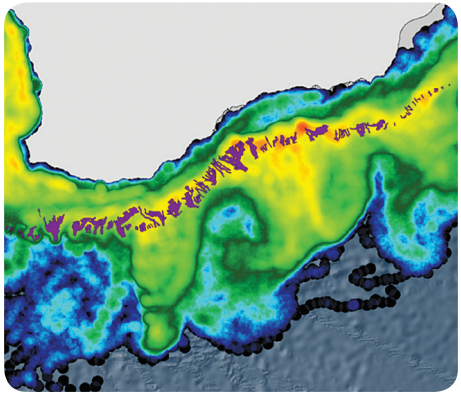
Protecting marine environments *(cont.)*

Deep understanding – the high biodiversity and productivity of marine canyons

Marine Hub partners completed a national assessment of submarine canyons in 2013. These seafloor features are recognised for their conservation value and many are protected in Commonwealth Marine Reserves because of their association with high biodiversity and enhanced productivity. Several Australian fisheries rely on the continued health of canyon ecosystems.

The canyon classification identified 713 canyons on the Australian continental margin, a third of which are protected by the Commonwealth Marine Reserve network. The research shows the uniqueness of particular canyons in local, regional and national contexts. It provides the evidence for physical and biological variation among canyons, important information for conserving biodiversity and for the sustainable use of resources.

Top right: Connectivity map for submarine canyons in the Albany Group, southwest Australia. The image shows the modelled distribution of larvae over a three month period, with clear concentrations of larval settlement in and near canyons and dispersal pathways into the Southern Ocean. (Image: Geoscience Australia)



Above: High resolution bathymetric image of Kalgan Canyon, one of the Albany Group of submarine canyons offshore southwest Australia. This is an example of a shelf-incised canyon that connects the continental shelf to the deeper ocean. (Image: Geoscience Australia)

Accounting for public views on the environment

Marine Hub-led research in Western Australia has demonstrated the importance of incorporating social evidence into the development and management of marine parks. It also revealed the need for different user groups and interested parties to share an understanding of an area's biodiversity values if conservation goals are to be met.

The research used non-market valuation to estimate peoples' environmental values. Specifically, the study measured how much individuals would be willing to pay for hypothetical, costed policy options that would protect biodiversity at Ningaloo and Ngari Capes marine parks.

The study used survey-based techniques to determine how much the West Australian community would be willing to pay to protect marine biodiversity, including turtle populations in the Ningaloo Marine Park. (Image: Chloe Sykes)

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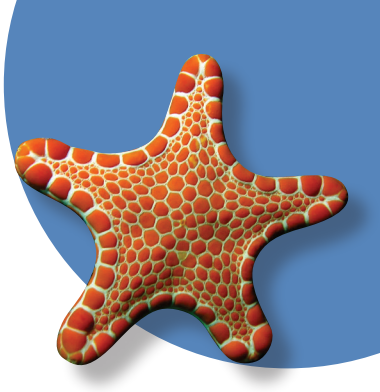

The study found that for Ningaloo Reef, members of the general community held similar environmental values to experts. However, for Ngari Capes, community members valued iconic species such as whales highly, whereas experts placed more importance on functional attributes of ecosystems such as seagrass. This may reflect a better public awareness of the importance of corals to the Ningaloo Reef ecosystem than the role of seagrass in the lesser known Ngari Capes Marine Park.

The approach provides a way to help policy and decision-makers gain a broader understanding of the views of the community, rather than just those of vocal stakeholders, with regard to the use and protection of our marine environment.

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A blueprint for monitoring our oceans

In 2012, the Marine Hub made significant progress toward developing a blueprint for monitoring marine ecosystems within Commonwealth waters. In 2013, the Hub progressed this further by focusing its research effort on developing nationally consistent approaches to monitoring benthic (seabed) habitats. This included:

- collating existing data on Commonwealth Marine Reserves and Key Ecological Features,
- developing and applying scientifically robust sampling designs and national monitoring standards, and
- applying novel methods to the analysis of monitoring data.

The results of this research will be synthesised in the blueprint in 2014.

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Further information

Links to all research reports, scientific publications and datasets are available through the NERP Marine Biodiversity Hub website. Data are published on the Australia Ocean Data Network and the Atlas of Living Australia as they become available.

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The NERP Marine Biodiversity Hub is supported through funding from the Australian Government's National Environmental Research Program, administered by the Department of the Environment. Our goal is to support marine stakeholders in evidence-based decision making for marine biodiversity management. Stakeholders include the Department of the Environment, the Australian Fisheries Management Authority (AFMA), the Australian Petroleum Production and Exploration Association (APPEA) and the Integrated Marine Observing System (IMOS). June 2014

Cover images: Rick Stuart-Smith, Reef Life Survey