National Environmental Science Program
Marine Biodiversity Hub
ANNUAL PROGRESS REPORT 4
1 January 2018 – 31 December 2018

Final Submission to the
Department of the Environment and Energy (DoEE)
– 13 May 2019

Hub Name (full activity title): NESP Marine Biodiversity Hub

Host organisation: University of Tasmania

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Other consortium partners/subcontractors/research organisations:

Partners

CSIRO

AIMS

Geoscience Australia

University of Western Australia

Charles Darwin University

New South Wales, DPI

New South Wales, OEH

Museum Victoria

Integrated Marine Observing System

Main Subcontractors (2018)

Clean Ocean Foundation

James Cook University

WA Museum

University of Melbourne

Curtin University

Murdoch University

Western Australian Department of Primary Industries and Regional Development

North Australian Indigenous Land and Sea Management Alliance (NAILSMA)

Tasmanian Department of Primary Industries, Parks, Water and Environment

Sea Mammal Research Unit, University of St Andrews

Claire Charlton Environmental Consulting

Macquarie University

Hub Leader Certification

As Hub Leader, I certify that I have taken adequate steps to reasonably assure myself that:

- each required report component is attached;
- the contents of each component of the report is complete and accurate in all material respects;
- funds have been used for the purpose for which they were provided and all funding conditions have been met, Recipient and Other Contributions have been received, and appropriate oversight has been maintained of Hub projects, their progress, performance and budgets during the reporting period;
- all relevant risks to project delivery have been notified to the Department in this and previous reports and that appropriate steps are being taken to manage those risks;
- the Hub and its sub-contractors have current workers compensation and public liability insurances, as required under the Funding Agreement; and
- any carryover of project funds has been allocated to projects in the next reporting period or financial year in accordance with the approved Research Plan or funds identified for refund to the Department.

Signed:

Hub Leader Name: Prof. Nicholas Bax

Date: May 14, 2019

Hub Steering Committee Chair Certification:

As steering committee chair, I certify that any issues of concern or matters raised during steering committee meetings where the draft progress report was discussed have been adequately resolved, amended or incorporated into the final report submitted to the department.

Signed:

Hub Steering Committee Chair Name: Peter Cochrane

Date: May 13, 2019

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Letter from the Hub Leader

2018 saw an increase in the rate of delivery of products to the Department. An early delivery was the first estimate of population size and trend for the white shark populations on the east and west coasts, generating considerable media interest and providing a sound basis for the Department to respond to many conflicting proposals on the control and protection of this species. The new and intensive genetic approach – close kin genetics – used for this estimate provided the first statistically valid population estimate for this species worldwide. Its development for rare and threatened species started with the freshwater sawfish in 2012 (insufficient animals could be caught to provide a valid estimate), switched to speartooth shark in 2014 and was extended to grey nurse shark in 2015. Population estimates for all species are now with the Department.

Of course there are many species of sharks and rays in Australia and not all can have the resources expended for a quantitative population estimate. Hub researchers worked closely with the Department in 2018 to develop a comprehensive shark action plan, building on a previous national assessment. The plan indicated that 38 of the 328 shark species in Australia were threatened and in need of protection although the status of a further 30 was uncertain due to lack of data. This is one of the lowest proportions of threatened sharks and rays globally and assisted the Department in developing a process to prioritise action on the threatened species.

It may already be too late to restore populations of the critically endangered handfish populations in their once natural environment, although trials are underway to improve the quantity and quality of artificial spawning habitat. Working with industry, a captive rearing population of the spotted handfish was established in 2018, which successfully produced the first captive-born generation. Meanwhile an emergency response was put into action to remove an egg mass from the red handfish, of which only about 100 fish survive worldwide, in an attempt to establish a captive rearing population for this species. Much more work needs to be done in closing the life-cycle for these two species, but the essential first steps have been taken through a collaboration of researchers, managers and industry, supported by the Hub.

There are insufficient resources to work to recover all listed marine species in Australia, so the Hub has been working with the Department on two initiatives to support these other species. The first stage of an integrated management project was completed in Northern Australia with the aim of managing the landscape which supports many species, and following a national evaluation and prioritisation exercise, including responsibilities under the EPBC Act, restoration activities were started for the listed giant kelp community off Tasmanian and seagrass in the Shark Bay World Heritage Area, two keystone species that support many other vulnerable species.

A major impetus of the Hub has been to help access and promote the many diverse Australian marine data collection initiatives so that they support, at little additional cost to the taxpayer, the ongoing information needs of marine managers in the Department and beyond. An important approach has been promote standardisation of data collection and sharing for the many marine environmental surveys occurring every year in Australian waters. The Hub worked with the National Marine Science Committee to hold the first Marine Baselines and Monitoring Group that is identifying the opportunities for national coordination of marine environmental data collection so that Australia will be able to profit in the future from sustained time series data, the lack of which is regularly identified in State of Environment reports. Hub researchers led over 65 researchers from 30 institutions to develop and publish Standard Operating Procedures for major data collection platforms and collaborated with national infrastructure initiatives to ensure that some of the major data streams used for Marine Park and SOE reporting will come under national archiving and FAIR data initiatives. Global interest in these approaches have led to their inclusion in the Ocean Best Practices repository and current prioritisation for inclusion in the global ocean observing system. Earlier data syntheses by the Hub have now been picked up through major national initiatives supporting improved data accessibility for managers including SeaMap Australia, AusSeabed and the Parks Australia Science Atlas.

Collating and improving access to existing data, while setting the standards for future data collection is very useful but going to sea to collect new information is considerably more fun, and given the paucity of knowledge of what the new Australian Marine Parks contain, equally useful. Marine surveys in the Beagle and Hunter Marine Parks provided a good opportunity to test and refine these national approaches while the year ended with a 27-day voyage to the southern seamounts in and adjacent to the Huon and Tasman Fracture Marine Parks developed collaboratively with Parks Australia, CSIRO and NIWA (New Zealand) and including students and early career researchers from universities and museums around Australia. The presence of Parks Australia on board throughout the voyage allowed an almost unprecedented level of engagement between managers and early career researchers that will provide ongoing benefit for the future baseline and monitoring of Australian Marine Parks. The survey itself generated a larger set of data on coldwater corals on deep-water coral reefs than exists anywhere else in the world, that together with similar, although less intensive, surveys 10 and 20 years ago will result in new understandings of how these vulnerable coldwater coral communities and structured through depth and their potential for recovery from physical disturbances including fishing.

It is a rare privilege these days to receive six-years dedicated funding for a body of research such as marine biodiversity. The value of this approach is witnessed by our increasing engagement with departmental officers as we now have the information and resources to ensure that the data collected by scientists is prepared and delivered in a form that is useful to managers in the Department and beyond. This extended engagement between researchers and the Department has enabled Australia's marine research organisations to build their scientific capacity and this manifests as increasing expert advice to the Department. Hub researchers support departmental officers in preparing for and representing their scientific priorities in national fora including the National Marine Science Committee, and the review into allocation of ship-time for the Marine National Facility. Hub researchers support, and in some cases represent the government (as scientific experts with DoEE and DFAT) at international negotiations including the Convention for Biological Diversity, the UN dialogue on developing a new implementing agreement for managing biodiversity beyond national jurisdiction, the UN Convention on Migratory Species, and the Convention on International Trade of Endangered Species. Hub research is now being used in studies funded by the Australian Government (ARC, DFAT), the German Government, and the Fisheries and Agriculture Organisation of the United Nations to develop new bioregional and bathymetry maps for the Indian, South Pacific and Antarctic oceans, and support environmental reporting through the State of Environment Report and the World Ocean Assessment.

In the last two years of the Hub, our researchers are working with the Department and stakeholders to identify and develop synthesis projects that will further focus and deliver our research and the combined expertise of the research collaborations that we have developed into products that are of immediate and of long-term value to the Department and marine stakeholders in general.

Research

Progress towards outcomes

2018 was a very productive year for the NESP Marine Biodiversity Hub. Executive focus areas were managing program level risks, refining monitoring and evaluation arrangements, completing the third progress report, implementing Research Plan Version 4 (2018), developing Research Plan Version 5 (2019) and identifying synthesis projects between themes and potentially between Hubs to maximise the value of our shared research and expertise to the Department.

The Steering Committee met twice in person, to review the third progress report and review and subsequently endorse the 2019 research plan. The Steering Committee also met by phone to provide early input to the 2019 research plan. The Research Partners Committee, Research Users and Research Leadership Team met to discuss research progress, identify strategic opportunities and user concerns which informed the 2019 research plan.

All three research themes made substantial progress on agreed milestones for the reporting period noting delays with some project milestones that have been discussed with the department (see Attachment A). Implementation of RPV4 coincided with a number of significant highlights in 2018. The more important of these include: establishing national standards to collect and analyse marine biodiversity data, applying the new standards in several Australian Marine Park (AMP) surveys (i.e. Tasman Fracture, Huon, Hunter, Beagle and Boags AMPs); demonstrating the success of novel genetic techniques to provide new population estimates for three species of threatened sharks (i.e. white, grey nurse and northern river shark); releasing the first national snapshot of wastewater discharges from Australia's sewage outfalls; successful initiation of captive breeding of critically endangered spotted handfish and initial capture and maintenance of critically endangered red handfish; and completing the scoping phase of a seascapes approach to threatened and migratory marine species in northern Australia. The Hub was also recognised for its outstanding efforts in science communication, including the voyage to Tasmanian seamounts and in communicating the new estimate of eastern Australia's white shark population.

Research Plan Version 5 (RPV5) was developed and submitted to DoEE in November and approved in December 2018. Numerous multi-stakeholder workshops were used to engage key stakeholders. The workshops were well attended by research partners, research users including the Department and the Hub's committee members. RPV5 included five new research projects; two projects focus on advancing capacity in coastal habitat restoration (i.e. seagrass and giant kelp habitats); advancing standardised approaches to assessing the state of coral and rocky reefs; establishing social and economic benchmarks for AMPs; and identification of nearshore habitats for juvenile white shark in south Australia. Eight existing projects were refined or extended to enhance research impact.

The NESP Marine Biodiversity Hub website has been updated to reflect research progress. The website serves as both a summary of what we do, and as importantly is a searchable repository of all the documents and products that we have developed though the CERF, NERP and NESP Hubs. Communication to a broader audience is being developed through targeted communication campaigns and social media, including short videos and images. The Hub also launched its quarterly newsletter *The Striped Trumpeter* as a new mechanism to inform our stakeholders and research-users about our research highlights and new outputs. This followed requests from the Research Users group. The Hub continues to work closely with the Australian Ocean Data Network to ensure its data are discoverable and accessible.

The Hub has identified eight impact stories to highlight research achievements (see section below).

Research projects

Attachment A lists the projects funded under the Marine Biodiversity Hub and provides information on the project status, information on outputs and links to products for all projects (where available). Exceptions to the NESP Data Management and Accessibility Guidelines are also noted here.

There is one instance where research outputs did not meet the guidelines:

1. White shark data has been classified as restricted due to risks of targeting a threatened species listed under the EPBC Act. This has been discussed with relevant Departmental officers (this was noted in the 2017 progress report).

Performance against milestones

Performance against Funding Agreement Milestones

All milestones for the period and to date have been met as per Funding Agreement Milestones 1-21.

Performance against the Research Plan milestones

Information on project progress and performance is provided in Attachment A. We are pleased to be able to provide precise quantitative information for most performance metrics, reflecting our detailed tracking of performance and delivery against what are intentionally ambitious milestones and targets.

Measuring success

The National Environmental Science Program (NESP) is a long-term commitment to support environmental and climate research. The key objective of the NESP is to improve our understanding of Australia's environment through collaborative research that delivers accessible results and informs decision making. The focus of NESP is on practical and applied research that informs on-ground action and that will yield measurable improvements to the environment.

The Program builds on its predecessors - the National Environmental Research Program and the Australian Climate Change Science Program – in securing for decision makers the best available information to support understanding, managing and conserving Australia's environment.

The NESP is delivered through multi-disciplinary research Hubs or consortia, hosted by Australian research institutions.

The NESP seeks to achieve its objective by supporting research that:

- is practical and applied and informs on-ground action
- addresses the needs of the Australian Government and other stakeholders by supporting and informing evidence-based policy and improving management of the Australian environment
- is innovative and internationally recognised
- enhances Australia's environmental research capacity
- is collaborative and builds critical mass by drawing on multiple disciplines, research institutions and organisations to address challenging research questions
- produces meaningful results accessible to government, industry and the community
- includes synthesis and analysis of existing knowledge
- builds relationships between scientists and policy-makers to encourage collaborative problem solving on environmental issues.

NESP end-users will be a broad range of stakeholders whose decisions may impact on the environment, and include the Australian Government, state governments, industry, business, community groups and Indigenous land managers (or Indigenous Communities).

The intended outcomes of the NESP are:

- Enhanced understanding of, and capacity to manage and conserve Australia's environment.
- Improved climate and weather information for Australia through a greater understanding of the drivers of Australia's climate.
- Timely research that is used by policy and decision-makers to answer questions and provide solutions to problems.
- Research outcomes that are communicated clearly to end-users and the general public, and stored in a manner that is discoverable and accessible.

Table A: Quantitative performance measures

Key Performance Indicator	Hub Result for 12-month Period (numerical only)	Explanation (if any)
1. Percent of projects (active or completed in the reporting period) for which there is a research-user actively engaged in the project?	100%	
2. Percent of projects approved under RPV5 in which research-users were actively involved in project design?	100%	
3. Number of research outputs provided to end users **on time**[1] and as identified in the Research Plan	59	21 manuscripts 42 reports 11 metadata records
4. Proportion of research outputs provided to end users **on time** and as identified in the Research Plan	80%	Delivery of all milestones (activity and outputs milestones) is at 80%. The Hub's Steering Committee has recognised that, given the complexity and challenges associated with some delivery of some milestones, minor delays in delivery of milestones and outputs are to be expected.
5. Number of instances of where the hub has used NESP-generated information from another NESP hub.	1	The Hub has worked closely with ES&CC scientists to understand climate change effects in the Shark Bay World Heritage Area, this information was used to develop the seagrass restoration (funded in RPV6 as project E6).
6. Number of peer reviewed NESP-funded publications during the reporting period	21 journal articles 42 scientific reports	
7. Number of NESP research citations in other researchers' publications during the reporting period	57 citations	Citations on journal articles published in 2018 only
8. Number of researchers, including PhD and Post-Doc positions engaged as a result of NESP (total, Full-time equivalent) during the reporting period	34	The total NESP funded and In-kind funded FTE reported by other entities, less any FTE attributable to Admin staff, plus the UTAS Research Staff and students paid from the NESP funds.
9. Number of data sets provided to the Hub, or made publicly available, by third parties for the purposes of informing NESP research	48	
10. Percentage of data sets made publically available under open licence by the Hub	99%	White shark data has been classified as restricted due to risks of targeting a threatened species listed under the EPBC Act

[1] On time – delivered on the date the outputs were expected to be delivered

Key Performance Indicator	Hub Result for 12-month Period (numerical only)	Explanation (if any)
11. Percentage of NESP research outputs (including publications, data and metadata) that are discoverable and accessible in accordance with NESP data accessibility requirements and the funding agreement.	99%	There is one instance where research outputs do not meet the guidelines (note this predates the 2018 reporting period): 1. White shark data has been classified as restricted due to risks of exploitation for a threatened species listed under the EPBC Act
12. Number and FTE of Indigenous people employed in a project (separate into full and part time positions).	0	The Hub has did not directly employ Indigenous people in 2018 but did in 2016 and will in 2019
13. Number of Indigenous researchers/graduates/post-graduate/PhD/Post Doc Positions in projects.	0	The Hub does not ask its researchers to identify as Indigenous
14. Number of Indigenous people trained in the use of environmental management tools and techniques.	4 people	
15. The number of management tools for Indigenous waters and land that benefitted from NESP research and outcomes (including but not limited to Plans of Management for IPAs, Co/Joint managed parks, Marine Park Plans of Management, Conservation Agreements).	1	
16. Number and type of communication products that have been used to communicate research with Indigenous people.	2 products	
17. Number of research, knowledge sharing and communication events held with Indigenous communities.	4 events	This includes a national workshop bringing together marine scientists and Indigenous people that the Hub has convened and supported for 3 years.
18. Number of public events, conference presentations, jointly authored/published papers with Indigenous participants/contributors.	1 events	
19. Number of Indigenous communities and organisations engaged to develop, refine or inform NESP research	19+ entities	2018 was a transition year for the Hub with Indigenous engagement and participation where some existing partnerships were winding down while other new partnerships were forming. In 2018 the Hub engaged with 15 new Indigenous communities/organisations/liaison officers to develop new research opportunities and/or promote respectful engagement and participation in marine research. + denotes the many Indigenous communities attending and contributing to the AMSA Indigenous workshop

NESP impact stories

NESP impact stories are provided at Attachment B. These stories showcase the contribution of NESP funded research to the environment, the economy, society, culture, public policy, quality of life, beyond contributions to academia.

Eight impact stories are provided for 2018:

1. A closer look at the status of sea snakes in Australia
2. Captive breeding and habitat conservation of Red Handfish
3. Assessing the status of Australia's sharks, skates and rays
4. First national snapshot brings the opportunity for a seachange in wastewater management
5. Putting evidence in the hands of the managers to improve decision making
6. Building understanding about the national importance of restoring coastal habitats (E5) – and how this has led to two new restoration projects
7. Evidence for the recovery of Grey Nurse Shark
8. Building understanding and capacity for protecting deep-sea corals

Hub level risk management

All risks identified in the Hub risk management plan are being actively managed.

The following risks have been identified in the Hub risk management plan since the approval of RPV5:

Added risks	Consequence	Likelihood	Rating	Response	Treatments
Risk 12 restated and refined treatment Ineffective engagement with key stakeholders reduces research impact	Moderate	Possible	Medium	Reduce	Increase Hub Executive focus on knowledge brokering on priority engagements including projects A12, D2, D6, E1, E4, E3, Indigenous engagement and engagement with Parks Australia
New risk added 16. Breach of requirements for privacy, confidentiality or to protect intellectual property	Moderate	Possible	Medium	Reduce	The Hub Executive will undertake a survey of partner agency Indigenous cultural competence processes and mechanisms with the view to understanding partners existing arrangements and identifying opportunities to reduce risk. The results of the survey will be shard and discussed with Hub's Partners Committee.

The Hub has updated a number of risks in its risk register over the course of 2018 to reflect changes to risk ratings and risk treatments, for example: risk associated with loss of key staff; and failure of Hubs to provide financial acquittal and audit certificates.

Marine Biodiversity Hub Research Plan Version 5 - Attachment A

Project Number/ID	Project Name/Title	Project Summary	Project Leader	Lead Organisation	Approved Funding Research Plan Versions 1-5 (This should match the NESP funding, other cash-contribution, and other in-kind contribution listed in RPVS Attachment C)			Start Date	Completion Date	Status (Use dropdown)	Outcomes
					NESP Funding* $	Total Other Contributions* $	Total Budget* $				Project Outcomes (Has the project achieved, or are you moving towards achieving, the outcomes identified in the Research Plan? Describe how the research findings have been/will be used to inform decision-making and on-ground action. Use tangible and specific examples where possible. I.e. rather than saying research will inform policy, include the name of the policy/policies. E.g. Research results have been used by Program X to inform Strategy X)
A1	Northern Australian hotspots for the recovery of threatened euryhaline species	Euryhaline elasmobranchs represent over half of the EPBC-listed threatened sharks and rays, with northern Australia of national importance for this threatened species community. Critical information gaps remain, limiting the implementation of Recovery Plan objectives. This project will fill many data gaps through the application of acoustic telemetry, traditional and advanced molecular research (population genetics and close-kin mark-recapture), life history studies and Indigenous knowledge and education. The focus is to improve management and facilitate recovery of these threatened species, through three research themes: 1) monitoring and understanding euryhaline species; 2) Indigenous partnerships for management of euryhaline species; and 3) knowledge for the reassessment of river shark status.	Peter Kyne	Charles Darwin University	846,509	858,631	**1,705,140**	01.07.15	31.07.18	Ongoing	The project has significantly improved shared understanding about the status and habitat use of large-tooth sawfish and river sharks in Northern Territory rivers. This new understanding delivers on actions in the existing EPBC Act Recovery Plan for Sawfish and River sharks and provides evidence to inform referrals and assessments under the EPBC Act and NT environmental legislation. The project has also build capacity of Indigenous ranger groups to monitor and recover largetooth sawfish in Northern Australia rivers and rescued 40 juveniles from drying flood plains to increase juvenile survival.
A2	Quantification of National Ship Strike Risk	See Project C5	David Peel	CSIRO	0	0	**0**	01.07.15	31.06.18	Completed	see project C5
A3	A national assessment of population status of white sharks	White sharks are listed as Vulnerable under the EPBC Act and the subject of a national recovery plan, yet there is still no effective way to assess their population status and thus no way of determining the efficacy of conservation actions. Recent debate due to various human-shark interactions has highlighted the need for further information. This project will provide a national assessment of population size and status in order to establish the efficacy of existing recovery actions and provide a scientifically sound and rational basis from which to develop policies that balance conservation objectives and public safety.	Barry Bruce	CSIRO	764,000	783,000	**1,547,000**	01.07.15	28.02.18	Completed	The project has significantly improved shared understanding about the status (provision of population estimates for the eastern and western populations in Australia) and habitat use of white sharks in Australia. This new shared understanding provides evidence to inform decision making about the status of this vulnerable/migratory species listed under EPBC Act and referrals and assessments under the EPBC Act. It also provides scientific evidence to inform decisions to manage human-shark interactions in multiple state jurisdictions in southern Australia.
A4	The Status of Human-Shark Interactions and Initiatives to Mitigate Risk in Australia	Considerable political, public and media attention have recently been focussed on human-shark interactions, specifically surrounding shark attack and ways to mitigate this risk. Finding the most appropriate policy balance between conservation of sharks, maximising public safety and understanding the broader social and economic ramifications/drivers for doing so is a continuing challenge for Government. To deliver this need the project has reviewed the status of human-shark interactions in Australia, provided a synthesis of current initiatives to reduce risk, reviewed recent international efforts to address these issues and identified knowledge gaps to provide an informed base to determine the most appropriate future research and policy support.	Barry Bruce	CSIRO	50,000	50,000	**100,000**	01.06.15	15.12.15	Completed	The project has improved shared understanding among government agencies, researchers and politicians about the status of 3 species of sharks involved in human-shark interactions and initiatives to mitigate risk in Australia. The report collates existing information to provides managers and other stakeholders with evidence to inform decision making about a species that interacts with humans - a vulnerable/migratory species listed under EPBC Act.
A5	Defining Connectivity of Australia's hammerhead sharks	Hammerhead sharks are the focus of conservation management through recent listing on CITES and CMS. The clear data gap for DOE and GBRMPA is connectivity of populations across national and international jurisdictions. This project applies genetic and satellite telemetry to examine the movement and connectivity of hammerhead sharks. This will help refine use of CMRs and the GBRMP, and define BIAs where possible. These data will be assimilated with current research to provide a more comprehensive understanding of the status of hammerhead shark populations to inform species listing and assist management and conservation policies at national and international levels.	Michelle Heupel	Australian Institute of Marine Science (AIMS)	742,852	767,344	**1,510,196**	01.07.15	31.12.19	Ongoing	The project is designed to improved shared understanding about the connectivity of populations of hammerhead sharks in Australian waters. This new understanding delivers on actions about status of CITES/CMS listed species and conservation dependent species listed under EPBC Act. The project has also build understanding and capacity of Indigenous ranger groups for monitoring sharks.

Project Number/ID	Project Name/Title	Project Summary	Project Leader	Lead Organisation	Approved Funding Research Plan Versions 1-5 (This should match the NESP funding, other cash-contribution, and other in-kind contribution listed in RPV5 Attachment C)			Start Date	Completion Date	Status (Use dropdown)	Outcomes
					NESP Funding* $	Total Other Contributions* $	Total Budget* $				Project Outcomes (Has the project achieved, or are you moving towards achieving, the outcomes identified in the Research Plan? Describe how the research findings have been/will be used to inform decision-making and on-ground action. Use tangible and specific examples where possible. I.e. rather than saying research will inform policy, include the name of the policy/policies. E.g. Research results have been used by Program X to inform Strategy X)
A6	Prioritisation of research and management needs for Australian elasmobranch species	NERP successfully demonstrated new ways to get the raw ingredients for evidence-based management of previously intractable species: abundance, survival, connectivity. But there is still a need to explore/demonstrate how management can use these tools (e.g. adaptive control of bycatch, or deciding if more monitoring is needed), and which species are suitable. This project comprised (i) a workshop to re-assess Australian shark and ray species in terms of degree-of-concern, state-of-knowledge-for-management, and feasibility-of-filling-knowledge-gaps; and (ii) a desk study exemplifying one pathway to management use. In 2016, we have worked with DoEE to prioritise species for research and explore more management pathways.	Michelle Heupel	Australian Institute of Marine Science (AIMS)	88,493	88,493	**176,986**	01.05.15	31.12.15	Completed	The project has generated a shared understanding among shark researchers, and participating policy makers, about priorities for Australia's shark and rays species that require further research, many of which are listed under CITES, CMS and threatened under the EPBC. Shared understanding will extend to a broader group of stakeholders in the second half of 2018. The project outcomes also provide a key input to project A11 - the Shark Action Plan.
A7	Monitoring population dynamics of 'Western' right whales off southern Australia	Continuation (since 1993) of annual aerial surveys, to include counts and identification photographs, of Southern Right Whales between Cape Leeuwin (WA) and Ceduna (SA), where wintering animals come close to the coast – adult females to calve, at approximately three-year intervals, other adults and juveniles less regularly. The area is the main wintering ground of a major 'western' subpopulation of 'Australian' right whales, differing in number and extent of recovery (from 19th century hunting) from an 'eastern' subpopulation which so far shows little if any recovery. Counts allow estimation of population trend and current numbers; identification photographs allow estimation of life history parameters.	John Bannister	The Western Australian Museum	240,000	30,000	**270,000**	15.08.15	31/03/21	Ongoing	The project, continuing to 2021, has provided shared understanding among researchers, policy makers and other stakeholders on an annual basis about the status and trends of southern right whales in southern Australia to inform decision making about recovery efforts for and endangered/migratory species listed under EPBC Act. Understanding about status and trends of southern right whales is also shared through reporting mechanisms with the International Whaling Commission.
A8	Exploring the status of Western Australia's sea snakes	All sea snakes are listed marine species under the EPBC Act and three Australian endemic species are listed as Critically Endangered or Endangered, and as such are a national conservation priority. This project examines sea snake abundance and diversity from broad-scale and targeted surveys at reef and coastal sites to update Conservation Advices, refine status within CMRs and inform policies of DoEE, DPaW, PA and others. This research will improve our understanding of population status to guide on-ground conservation to reduce population declines.	Michelle Heupel	Australian Institute of Marine Science (AIMS)	453,015	477,429	**930,444**	01.02.16	31.12.19	Ongoing	The project, continuing until the end of 2019, collated existing information to generate a shared understanding among researchers, policy makers and other stakeholders about the status of sea snakes in NW Australia, species listed under EPBC Act as either threatened or a marine species. Researchers have also used existing information to predict the distributions of seasnakes in NW Australia and collected new information to improve the evidence base about distribution of seasnakes in NNW Australia, this information will be used to inform decisions making for EPBC referrals and assessments and to manage Australian Marine Parks and those in State waters.
A9	Grey Nurse Shark Ck-MR Population Estimate - East Coast	A review of the 2002 National Recovery Plan for Grey Nurse Shark (DEWHA 2009) concluded it was not possible to determine if the east coast population had shown any signs of recovery (DoE 2014). Action 1.1 of the new recovery plan (DoE 2014) is to resurvey Grey Nurse Shark populations to assess population trends and dynamics. This project will resample the east coast population and use genetic SNP data to inform close kin-mark recapture analysis to estimate population size and trend, and provide guidance on future monitoring strategies for the east coast population of Grey Nurse Shark.	Russell Bradford	CSIRO	115,000	115,000	**230,000**	01.01.16	20.06.18	Completed	The project will provide a population estimate to generate a new shared understanding about the status of grey nurse sharks in eastern Australia. This new understanding delivers on actions in the existing EPBC Act Recovery Plan for grey nurse shark and provides evidence to inform referrals and assessments under the EPBC Act and equivalent threatened species legislation in state government jurisdictions
A10	Conservation of spotted handfish and their habitat	Spotted handfish are critically endangered and in accordance with the signed recovery plan we will conserve them through various direct conservation actions guided by research. This includes replanting of the degraded plastic artificial spawning habitats (ASH) with a re-designed array of ceramic units, assessment of taut eco-friendly moorings in critical spotted handfish habitat, genetic and capture mark recapture studies, a population viability analysis (PVA) and performance assessment of management actions. We will also continue our captive breeding project with industry and engagement with the broader community through talks, outreach and publications and re-establishment of the handfish recovery team.	Tim Lynch	CSIRO - Oceans & Atmosphere	543,743	1,290,328	**1,834,071**	01.03.16	31.12.20	Ongoing	The project has significantly improved shared understanding about the population status and trends of spotted handfish in Tasmanian estuaries. This new understanding delivers on actions in the existing EPBC Act Recovery Plan for spotted handfish and provides evidence to inform referrals and assessments under the EPBC Act and State government environmental legislation. The project is also testing the effectiveness of practical approaches to recover the population of spotted handfish, including use of artificial spawning habitat and eco-moorings. The project also includes a captive breeding component, involving a broad range of stakeholders and industry partners, and efforts to date have been very successful.
A11	Shark action plan	Conservation of elasmobranch species (sharks and rays) is an increasing priority globally, including Australia, as evidence of overexploitation of some species becomes apparent. Common issues and threats among elasmobranch species may improve management if considered holistically. This project will produce a Shark Action Plan assessing requirements for improved management including a summary of current status across the taxa, guidelines for reducing impacts and improving management, and identification of key knowledge gaps	Michelle Heupel	Australian Institute of Marine Science (AIMS)	235,092	360,883	**595,975**	10.01.17	31.12.18	Ongoing	The project, continuing until the end of 2018, will generate the key scientific elements of a conservation plan for Australia's sharks and rays.

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A12	Australia's Northern Seascape: assessing status of threatened and migratory marine species	Northern Australia has a relatively untouched natural environment and is the current focus of substantial economic development, which has the potential to impact biodiversity and cultural values. The Northern Seascapes Project Phase 2 will map the distributions of several *EPBC* -listed threatened and migratory marine species at a broad-scale, and develop and trial a cost-effective rapid assessment approach ('SeaBlitzes') to gather finer-scale spatial data on priority marine species of the northern seascape, including the critical habitats they depend on. SeaBlitzes will survey selected hotspots determined through scoping undertaken in Phase 1 of the Northern Seascapes Project (to be delivered end 2017). The data and knowledge generated by the rapid assessments will establish baselines, and grow the information base for decision-making on proposed activities under Commonwealth and Territory environmental regulations. This approach will deliver on actions in threatened species Recovery Plans, Sea Country Plans, and management plans for protected areas (e.g. Indigenous Protected Areas and Marine Reserves), and will develop capacity for continued data collection through a community-based participatory approach.	Peter Kyne	Charles Darwin University	1,377,105	1,417,105	**2,794,210**	1.01.17	31.12.20	Ongoing	The project, with delivery of the scoping report for phase 1 and follow-up workshop with stakeholders, will generate new shared understanding about existing information on EPBC listed threatened and migratory marine species and potential for interaction with human activities/pressures in the North Marine Region. The scoping report from phase one will provide the basis to prioritise locations (i.e. Seablitze locations) for the collection of new data on multiple species. Early outputs from Phase one have generated new shared understanding about Indigenous interests in threatened and migratory marine species Northern Australia and also changes to intertidal habitats in northern Australia over a 30 year time frame. The project is designed to improve understanding about status of threatened and migratory marine species in northern Australia to inform decision making about referral and assessments under the EPBC Act and recovery of listed species
A13	Estimation of population abundance and mixing of 'Southern' right whales in the Australian and New Zealand regions	This project will provide, for the first time, an abundance estimate of the total Australian population of southern right whales. It will also investigate the movement and connectedness of whales that utilise breeding areas on the eastern, southern and western coasts of Australia. Information on the population abundance and movements of southern right whales provided by this project will allow the Australian government to better evaluate progress made against the Conservation Management Plan for the species and ensure conservation efforts for the species are effectively coordinated at the regional level.	Karen Evans	CSIRO	200,758	113,044	**313,802**	1.04.18	30.03.20	Ongoing	The project, continuing until March 2020, will provide a new shared understanding about the to to the abundance of southern right whales in Australia and connectivity with the populations found in the New Zealand region. This new understanding will be used to inform decision making for implementing and reviewing the conservation managment plan under the EPBC Act.
A14	Identification of near-shore habitats of juvenile white sharks in Southwestern Australia	There is credible evidence that juvenile white sharks are present in a relatively restricted region between the head of the Great Australia Bight (GAB) and Ceduna, which encompasses the boundaries of State and Commonwealth managed marine parks and reserves, some of which are accessed via Indigenous Protected Areas. This pilot project is to undertake visual surveys (using Unmanned Aerial Vehicle – UAV) for juvenile white sharks during spring and summer. The on-land surveillance approach outlined in this proposed pilot project will inform decision makers on the efficacy of supporting subsequent on-water activity to capture and electronically tag juvenile white sharks to assess habitat use in the Great Australian Bight Marine Park (Commonwealth waters) and Far West Coast Marine Park (State waters).	Russell Bradford	CSIRO	50,000				01.03.20	Ongoing	The project, continuing until March 2020, will provide evidence to support reports of a junvenile aggregation area for white sharks in South Australia. These insights are important for understand opportunities to improve our understanding of western populations of white shark and connectivity with the eastern popuation. Understanding population dynamcis and connectivity is critical for assessing the effectiveness of conservation measures for species listed as threatened under the EPBC Act.
B1	Road testing decision support tools via case study applications	This project will deploy tools from economics and decision science to identify sound investments within constrained budgets for: 1. Ecological monitoring of Commonwealth Marine Reserves 2. Management actions for threatened and migratory species or threatened communities, and 3. Restoration of saltmarsh and shellfish habitats.	Terry Walshe	Australian Institute of Marine Science (AIMS)	557,840	547,340	**1,105,180**	01.07.15	30/11/18	Ongoing	The project, continuing until November 2018, is designed to improved shared understanding about the use of decision support tools in Parks Australia and other interested stakeholders. This new understanding will be used to improve decision making processes by improving efficiency of process, transparency in decision making and increased effectiveness in use of resources.
B2	Analysis and elicitation to support State of the Environment reporting for the full spectrum of data availability	The availability and quality of observation data that may be used to support State of the Environment reporting lies on a spectrum from: (i) high quality (e.g. Reef Life Survey, Long term reef monitoring programme, Temperate Reef Monitoring programme, state-based MPA monitoring programmes); (ii) moderate quality (e.g. continuous plankton recorder, occasional by catch surveys); (iii) low quality (anecdotal information) to (iv) expert beliefs but no empirical observations.	Simon Barry	University of Tasmania, CSIRO	62,942	63,640	**126,582**	01.07.15	30.06.17	Completed	
B3	Enhancing access to relevant marine information – developing a service for searching, aggregating and filtering collections of linked open marine data	This project aims to improve the searchability and delivery of sources of linked open data, and to provide the ability to forward collections of discovered data to web services for subsequent processing through the development of a linked open data search tool. The work will improve access to existing data collections , and facilitate the development of new applications by acting as an aggregator of links to streams of marine data. The work will benefit managers (i.e. Department of the Environment staff) by providing fast and simple access to a wide range of marine information products, and offering a means of quickly synthesising and aggregating multiple sources of information	Johnathan Kool	Geoscience Australia	91,750	106,000	**197,750**	01.07.15	31.12.16	Completed	The project provided proof of concept for a novel approach to searching, aggregating and filtering collections of linked open marine data informing decision making to enhance access to marine data. The developed concept was shared with DoEE and other stakeholders and opportunities for applying the concept where discussed and are being considered.
B4	Underpinning the repair & conservation of Australia's threatened coastal-marine habitats – phase II.	The objective of this research is to support the scaling-up of repair efforts for two threatened nearshore marine ecological communities, shellfish reefs and salt marshes. Both habitats harbour significant marine biodiversity and play a critical role in supporting healthy estuarine and nearshore systems. The research synthesis will be used to guide the development of more effective policy on coastal-marine repair, improve community education on the importance of habitats to estuary health and develop a detailed business case to support investment in marine repair activities for private industry stakeholders.	Colin Creighton Dr Ian McLeod Dr Chris Gillies	James Cook University	520,000	616,569	**1,136,569**	01.07.15	30.06.2018	Completed	The project has generated a shared understanding among researchers, policy makers and stakeholders about the ecological, social and economic importance of shellfish reefs in Australia and how to recover these imperilled habitats to ensure we can once again benefit from them. New information on the benefits of shellfish reefs has been used to inform the development of business cases and proposals to restore shellfish reefs in Australia. Resources were also used to build connections between various restoration efforts operating in different parts of Australia and included convening events like the Inaugural Australian Coastal Restoration Symposium and a workshop of Indigenous communities with an interest to shellfish reef restoration. Collectively the project has provided the evidence base and network to support a national approach to shellfish reef restoration in Australia.

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C1	Improving our understanding of pressures on the marine environment	The marine environment in Australia is impacted by a wide range of different pressures. This project aims to assist DoE, and other research users, to improve understanding of the potential impacts of anthropogenic disturbance to marine conservation values by providing up-to-date data and analyses on the spatial distribution of pressures and trends. The research is designed to inform decision making under the EPBC Act (acceptability of proposed activities, evaluation of effectiveness of mitigation measures) on NMES (including Key Ecological Features), implementation of multiple strategies in four Marine Bioregional Plans management of Commonwealth Marine Reserves and State of the Environment reporting.	Piers Dunstan	CSIRO	551,278	551,278	**1,102,556**	01.07.15	30.08.19	Ongoing	The project has developed a shared understanding about status and trends of human pressures in Australia's marine environment. Information was used to inform a broad range of human pressures indicators in the 2016 State of the Environment - Marine Chapter. Collectively the project provides policy makers and stakeholders with an understanding about options for assessing risks to the environment from human pressure, the importance of understanding how perception of 'values' influences and shapes assessment of risks and options for assessing risks. The project provides a platform for understanding how to approach assessment of human risks to the marine environment and will inform implementation of projects A12 and E1.
C2	Continental-scale tracking of threats to shallow Australian reef ecosystems	The project will integrate Australia's largest, most detailed datasets of shallow-water tropical and temperate marine biodiversity, and assess how pollution, fishing, rising sea temperatures and introduced species are impacting associated natural values. An initial outcome will be the identification of state-of-the-environment indicators for inclusion in the 2016 State of the Environment report, with subsequent activities aimed at contributing additional data products needed for other NESP projects, Parks Australia, and the Essential Environmental Measures initiative. The project will also describe a national shallow-water baseline of biodiversity in Commonwealth Marine Reserves for assessment of change through the long term.	Graham Edgar	University of Tasmania	807,147	1,759,030	**2,566,177**	01.07.15	31.12.17	Completed	The project has generated a shared understanding among researchers, policy makers and other stakeholders about the effects of human activities/pressures on biodiversity of shallow-water shallow reefs in Australia. Information was used to inform status and trends of reefs in the 2016 State of the Environment - Marine Chapter and to inform management of Australian Marine Parks and identification of essential environmental measures for DoEE. The project informs understanding about the thermal limits shallow-water marine species informing risk assessment for conservation of marine biodiversity. It also provides data evidence-based insights about ecological indicators for shallow reef systems in Australia's marine environment.
C3	Change detection and monitoring of key marine and coastal environments – application of the Australian Geoscience Data Cube	This project aims to leverage the extensive time-series of earth observation image data in the Australian Geoscience Data Cube (AGDC) by developing change detection algorithms to analyse key environmental parameters in the coastal and marine zone. Spatial information produced by this project can inform management decisions, and assist in evaluating management action outcomes, by providing a quantifiable measure of historical change and ongoing monitoring and change detection capabilities. Phase 1 of this project aimed to demonstrate the capability of using the AGDC through the development of an inter-tidal zone change detection algorithm and data set, with a view to developing and implementing an expanded range of stakeholder targeted algorithms to inform decision making processes in Phase 2.	Stephen Sagar	Geoscience Australia	56,500	72,400	**128,900**	01.05.15	01.12.16	Completed	The project provides stakeholders with a proof of concept for use of satellite data to monitoring coastal change informing decisions for coastal management and State or the Environment reporting. The concept demonstrated here has since been used in project A12 to demonstrate status and trends on intertidal habitat change in northern Australia.
C4	The National Outfall Database project (Clean Ocean Foundation)	NOD addresses the need of government and community to understand the impacts on health and the ocean environment that occur from sewerage outfalls around Australia. The project will be delivered over a three year time frame and will provide: 1) A publically accessible national outfall database and reports. 2) A ranking of the outfalls (and sewerage treatment systems) according to health and impact criteria with peer review of the ranking system and resulting ranking outcomes. 3) Comparison of geographical regions in sewerage volume and pollution impact. 4) Mapping of the database. 5)Community engagement in conduct of this research and consumption of the outcomes.	John Gemmill	Clean Ocean Foundation	400,000	400,000	**800,000**	01.07.15	30.06.19	Ongoing	The project, continuing to June 2019, has generated a shared understanding about the volume and content of sewage outfalls to the marine environment in Australia. This information will be used to objectively rate Australia's sewage outfalls and provide evidence to inform government decisions about investments to improvement to sewage treatment facilities. The project team is also working with citizen scientists to promote participation in data collection that will inform decision making about management of sewage systems and notification of bypass events.
C5	Quantification of risk from shipping to large marine fauna across Australia	Given the substantial and ongoing increases in coastal and port development along the Australian coastline, and an associated increase in recreational and commercial shipping, there is an increasing potential for adverse interactions with marine species. Two risks associated with these activities for large marine fauna are ship collisions (particularly relevant for marine mammals, turtles and whale sharks) and the impact of chronic ocean noise (across a wide range of species). This project aims to provide directed and robust science (species- and area-specific) to inform management and administrative decision-making by the Department of Environment in its application of the EPBC Act.	David Peel	CSIRO	367,000	392,000	**759,000**	01.07.15	30.06.18	Completed	The project has generated a shared understanding among researchers, policy makers and stakeholders about the risks of vessel strike to targeted threatened and migratory marine species at a national-scale. This new understanding delivers on actions in the existing EPBC Act Recovery Plans for turtles, dugong and whales and provides evidence to inform referrals and assessments under the EPBC Act and State and Territory environmental legislation. The project has also informed the review of the Australian Government's National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna 2017 and discussions at the International Whaling Commission. The project demonstrated proof of concept for a national-scale shipping noise map, currently being progressed by project E2, to inform decision making about avoidance and mitigation of potential biodiversity impacts from shipping noise.

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D1	National Data Collation, Synthesis and Visualisation to Support Sustainable Use, Management and Monitoring of Marine Assets	Effective management of marine assets requires an understanding of ecosystems and the processes that influence patterns of biodiversity. Through collaboration and synthesis of existing data this project will improve access to, and usability of, marine data to better inform management and improve public understanding of biodiversity in the marine estate. End-users and stakeholders will benefit from improved regional and national descriptions of biodiversity assets for the Commonwealth marine estate, including Commonwealth Marine Reserve network and other high-priority marine areas. In turn, this will inform prioritisation of future investments in monitoring marine ecosystems and State of the Environment reporting.	Karen Miller	Australian Institute of Marine Science (AIMS)	1,595,900	1,653,812	**3,249,712**	01.07.15	31.12.18	Ongoing	The project has generated a shared understanding among researchers, policy makers, AMP managers and other stakeholders about what we know about marine biodiversity in Australia's north and north-west marine regions. This new understanding targeted Australian Marine Parks and key ecological features to provide clarity about what we know and the information gaps. This new understanding will used to inform decisions on referrals and assessments under EPBC Act and also in AMP management, for example to prioritise future investments in targeted information collection for marine parks. Collated information has been synthesised to form targeted information products that communicate the values of marine parks meeting the specific needs of Parks Australia and its stakeholders
D2	Standard Operating Procedures (SOP) for survey design, condition assessment and trend detection	Understanding of the status and trends of indicators in Australia's marine environment requires standardised monitoring. This project will develop Standard Operating Procedures (SOP) in the planning, collection, analysis, and reporting of monitoring data. In particular, the project will: 1) provide guidance on what kind of monitoring is required (and where and when), 2) provide a simple yet powerful survey design tool, 3) provide two worked SOP examples (one benthic and one pelagic), 4) develop field manuals for some high priority sampling platforms (e.g. underwater video) with prioritisation stemming from a comparative analysis, and 5) assess approaches for monitoring pelagic ecosystems.	Scott Foster	CSIRO	837,712	889,256	**1,726,968**	01.07.15	15.1.2020	Ongoing	This project has developed national standards for the collection and management of biodiversity data on Australia's continental shelf. National standards for data collection are a critical requirement for regional and national reporting on status and trends of marine biodiversity. The project team is promoting and extending use of the national standards for surveys conducted by the Marine Biodiversity Hub and also by others operating outside the Hub. The extension and use of national standards will user in a new phase of environmental reporting, where anecdotal evidence in reports is progressively replaced by data. Extension to the project in 2019 provided additional resources to significantly enhance the delivery of fit-for-purpose marine biodiversity data products to decision makers.
D3	Implementing monitoring of AMPS and the status of marine biodiversity assets on the continental shelf	New [RPv3] - There is a significant need to support Parks Australia in the establishment of a baseline inventory and monitoring program for CMR networks, and ensure it is integrated within a broader national monitoring framework. This project will provide the science support for program development, and a prioritisation framework for implementation. By facilitating national approaches, including a standards-based approach to collecting new marine data, project outcomes will include key steps to assist Parks Australia to implement and initiate a CMR monitoring program, new knowledge to inform CMR management, a national integrated framework for SOE reporting, and collaboration between State-based and Commonwealth-based programs.	Neville Barrett	University of Tasmania	4,779,464	4,897,964	**9,677,428**	01.01.17	31.12.20	Ongoing	The project has generated a shared understanding among researchers, policy makers, AMP managers and other stakeholders about what we know about shelf reefs on Australia's continental shelf. This new understanding informs the management of Australian Marine Parks and decision making on referrals and assessments under the EPBC Act where proposed activities may interact with shelf reefs (e.g. offshore petroleum development). Collated information has been synthesised in a comprehensive report for managers of Australian Marine Parks to provide an information base for communicating conservation values are prioritising investments in the collection of new information in marine parks. Extensions to the project in 2018 shifted the focus of the project to collecting new marine biodiversity data in prioritised areas, in particular to inform decision making for management of Australian Marine Parks.
D4	Expanding our spatial knowledge of marine biodiversity to support future best-practice reviews	This project will fill data gaps and evaluate methods relevant to the ongoing spatial management of seafloor biota across the Australian marine domain. The objective is to prepare Australian, State and Territory governments for future best-practice reviews of Australia's marine bioregionalisation that can be used to improve marine spatial planning and management initiatives (e.g. marine bioregional plan and marine protected area reviews, environmental impact and natural heritage assessments). The project will incorporate results from field trips to unexplored offshore areas of Australia's marine domain and communicate biodiversity values of the CMR network to the Australian public.	Tim O'Hara	Museum Victoria	770,000	1,638,774	**2,408,774**	01.07.17	31.12.20	Ongoing	The project, continuing to mid 2018, is developing shared understanding among researchers about new approaches to bioregionalisation in the ocean. This new understanding will inform future versions of IMCRA - a fundamental spatial layer than underpins marine bioregional planning and marine reserve planning and review in Australia. The project generated shared understanding about marine biodiversity in the deep eastern abyss off Australia's east coast developing a new model for communicating insights from marine science surveys with the managers, stakeholders and the public. The survey will provide AMP managers with new insights about benthic biodiversity for 7 deep water marine parks and compare the findings to deep water environments in the Great Australian Bight.

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D5	A standardised national assessment of the state of coral and rocky reef biodiversity	This project will involve integration of a national suite of reef biota Underwater Visual Census (UVC) monitoring datasets (Reef Life Survey, UTas, AIMS, Parks Victoria, SA DEWNR) to provide a comprehensive update to the state of Australian Reefs report for the next national State of the Environment Report. Maps and indicator trends will show changes in the health of rocky and coral reefs nationally from 2005 to 2020. The update will include addition of a new index which summarises the population trajectories for 600-1000 reef species nationally. Individual species trajectories will provide the only threat status information for the majority of these species, assisting future listing of previously unassessed species if significant declines are detected.	Rick Stuart-Smith	University of Tasmania	199,233			01.01.2019	31.12.2020	Ongoing	This project, extending to the end of 2020, is designed to develop a standardised approach to assessing status and trends of marine biodiversity on coral and rocky reefs around Australia. Central to its objective is establishment of documented procedures and outputs to enable assessments to be systematically repeated over time to inform for state of the environment and other environmental reporting initiatives. The project will collate an unprecedented array of data and established a new database to inform the future reporting.
D6	Socioeconomic benchmarks	Social and economic values are key drivers for marine science and marine policy but are too rarely integrated with marine biodiversity monitoring programs. In close consultation with PA we will review existing metrics used to survey social and economic values associated with marine parks. This review will include consulting with national and international expertise and actively consulting with State and other Commonwealth agencies, some of whom are currently conducting reviews or have existing frameworks for surveying social and economic values (e.g. GBRMPA, NSW DPI and Vic Parks). In collaboration with national partners and PA we will organise a national methods workshops to discuss and refine metrics and methods to quantify social and economic benchmarks for State and Australian Marine Parks (AMPs) and produce an SOP relevant to AMPs taking into consideration the	Tim Langlois	University of Western Australia	150,000			10.01.2019	31.12.2020	Ongoing	This project, extending to the end of 2020, is designed to establish a clear pathway forward for establishing social and economic metrics for measuring the costs and benefits of Australian Marine Parks. The pathway forward will include the identification of targeted metrics, a costed plan for establishing a benchmark and demonstrate the procedures for collecting, analysing and reporting on an agreed set of metrics for Parks Australia.
E1	Guidelines for analysis of cumulative impacts and risks to the Great Barrier Reef	Existing guidance and standards for assessing impacts and risk (e.g. ISO 31000) are specified at a high-level allowing for considerable variation in approach, cost and outcomes from assessments and no guidance on direct or cumulative impacts. We will develop a national standard to support analysis of impacts and risks to the environmental, social and economic values required by the EPBC Act. The standard will be compatible with and support the process outlined in the Significant Impact guidelines for MNES and for Australian Marine Parks (AMP), including the means to calculate the impact and risk of upstream, downstream, facilitated and indirect impacts that will be presented in clear tabular and	Piers Dunstan	CSIRO	350,000	411,000	**761,000**	01.01.2018	31.12.2018	Ongoing	This project, extending to the end of 2018, will develop practical guidance for advancing the analysis of cumulative impacts and risk for the GBRWHA. The Guidance will provide directions about how to undertake analysis and point users to important existing information sources and tools for use in analysis. The guidance will be developed in a way that allows for use on other environments in Australia.
E2	Characterising anthropogenic underwater noise to improve understanding and management of acoustic impacts to marine wildlife	Shipping noise is a marine pollutant that contributes significantly to the marine soundscape and is a stressor of marine animals, particularly marine mammals. In Australia, the characterisation and actual impacts of shipping noise on species behaviour are not clearly understood and information is needed. This research will provide quantitative spatial and temporal maps of vessel noise exposure and impacts to MNES. The outputs will provide key information to marine regulators and management agencies such as DoEE, AMSA and GBRMPA, and their counterparts in state and territory governments, to help them meet responsibilities and obligations under international and national law and policy to minimise the impacts of the shipping noise on MNES.	David Peel	CSIRO	401,855	401,855	**803,710**	01.01.2018	31.12.2019	Ongoing	This project, extending until the end of 2019, will advance our capacity to understand the relative contribution and distribution of different sources of noise in the marine environment. The focus is on better understanding the potential effects of anthropogenic noise on marine wildlife, particularly wildlife listed as threatened or migratory under the EPBC Act. It will also provide insights to options for mitigating the potential effects of anthropogenic noise on marine wildlife.
E4	Recreational fishing in Commonwealth waters	Australia's recreational fishing sector is moving further offshore in pursuit of fishing opportunities, which places them in areas managed by the Australian Government. Most recreational fisheries research is state based and at two case study sites - Hunter Australian Marine Park (AMP) and the Ningaloo AMP - this data will be assessed for its usefulness to quantify offshore fishing. New data will also be collected will also be collected using creel, socio-economic and remote sensing techniques to better understand fisher's effort, harvest and motivations. As well, the response by fish communities to harvest and the fishery to climate change will be assessed at larger scales. As recreational fishers are key stakeholders in marine management and regulation, a better understanding of their values is required to effectively inform administration of the EPBC Act (e.g. effects of Matters of National	Tim Lynch	CSIRO	253,883	253,883	**507,766**	01.01.2018	31.12.2019	Ongoing	This project, extending until the end of 2019, is designed to provide greater insights to how recreational fishers are using Australian Marine Parks. Research predominantly focuses on recreational fishing in AMPs in Western Australia and NSW. Insights from the project will provide an improved understanding among researchers, AMP managers and state marine reserve and fisheries managers. The research findings will be used to inform decision making for sustainable use of resources in AMPs.
E5	The role of restoration in conserving MNES	Restoration of marine ecosystems offers the prospect of effective conservation in the face of chronic degradation and climate change. But techniques for restoration are generally in their infancy. In 2018 this project will review the capacity for recent advances in restoration of • giant kelp forests, • coral reefs, • seagrass communities, • saltmarsh communities, and • shellfish communities, to reduce conservation risks associated with matters of national environmental significance (MNES) listed under the Cth EPBC Act. In subsequent years we will trial and extend restoration techniques in the more promising habitats and develop a restoration decision	Ian McLeod	James Cook University (JCU)	221,750	236,750	**458,500**	01.01.2018	31.12.2020	Ongoing	This project, extending until the end of 2020, was designed to promote and develop a shared understanding about the national importance of coastal habitat restoration and how it relates to the EPBC Act. It will also provide advice on the relative cost-effectiveness of coastal restoration given their are a range of habitat types that can be targeted. The first year of the project instigated two new research projects designed to advance capacity for restoration of seagrass and giant kelp habitats - both these habitats support matters of national environmental significance under the EPBC Act.

Project Number/ID	Project Name/Title	Project Summary	Project Leader	Lead Organisation	Approved Funding Research Plan Versions 1-5 (This should match the NESP funding, other cash-contribution, and other in-kind contribution listed in RPVS Attachment C)			Start Date	Completion Date	Status (Use dropdown)	Outcomes
					NESP Funding* $	Total Other Contributions* $	Total Budget* $				Project Outcomes (Has the project achieved, or are you moving towards achieving, the outcomes identified in the Research Plan? Describe how the research findings have been/will be used to inform decision-making and on-ground action. Use tangible and specific examples where possible. I.e. rather than saying research will inform policy, include the name of the policy/policies. E.g. Research results have been used by Program X to inform Strategy X)
E6	Assisting restoration of ecosystem engineers through seed-based and shoot-based programs in the Shark Bay WHS	This project will develop community-based seeding and shoot planting restoration practices in the Shark Bay World Heritage Site (WHS). The goal is to scale up the existing restoration research to practice and assist recovery of the dominant seagrasses, Amphibolis Antarctica and Posidonia australis following the 2011 marine heat wave. The Shark Bay WHS is unique globally for its natural values, including stromatolites, extensive seagrass meadow that have constructed sills and banks over 1,000s of years resulting in restricted exchange with the ocean, unique and abundant marine megafauna including 1/8th of the worlds population of dugongs, large populations of sharks and turtles, and one of the longest studied populations of dolphins in the world. The inshore waters of the WHS provides connectivity to the deeper waters of the adjacent Commonwealth Shark Bay Marine Park. Shark Bay seagrasses have recently been devastated by the marine heatwave of 2010-2011 and these events are predicted to increase in frequency and intensity with global warming. The loss of 23% of seagrass cover in the bay (860 km2) had a flow on effect to mega herbivores, fish, tourism and the commercial aquaculture and fisheries industries	Gary Kendrick	University of Western Australia	200,000	216,282	**416,282**	30.1.2019	30.01.2021	Ongoing	This project , extending until early 2020, was designed to advance our understanding and capacity for restoring seagrass habitats in Australia. The project focuses on restoration of seagrass habitat in Shark Bay World Heritage Area. The project seeks to restore seagrass habitat that was significantly degraded from the effects of a recent heatwave. The project will establish a collaborative capacity for seagrass restoration in Shark Bay including the partnership and training of the Malgana Indigenous Rangers. Shark Bay seagrass communities are an outstanding universal value of the world heritage area and they are critical to the survival of EPBC listed threatened and migratory species, such as dugong and turtles.
E7	Assessing the feasibility of restoring giant kelp beds in eastern Tasmania	The proposed research will extend on externally funded work commencing in 2018 to select for thermally tolerant and low-nutrient-tolerant giant kelp (Macrocystis pyrifera) genotypes, and which will examine effects of acclimation of selected genotypes by pre-exposure to warm, nutrient poor conditions. The project will outplant pre-exposed selected genotypes of giant kelp as micro-sporophytes in experiment providing / not providing an added source of nutrient. The work is designed to assess the feasibility of this approach as a means to develop minimum patch sizes for giant kelp that can be self-replacing and self-expanding.	Craig Johnson	University of Tasmania	150,000	446,884	**596,884**	01.01.2019	31.12.2020	Ongoing	This project, extending until the end of 2020, was designed to advance our understanding and capacity for restoring giant kelp habitat in temperate Australia. The project will develop understanding about the feasibility of restoring diminishing populations of giant kelp with genotypes that have been selected for their tolerance to warm, nutrient poor conditions. Giant kelp is an EPBC listed threatened community and restoration research is identified as a priority in DoEE's approved conservation advice.
TOTAL PROJECT					**19,030,821**	**21,905,974**	**40,537,562**				
#	On Track: The timeframes and milestones for the project are being met. Delayed: The timeframes and milestones for the project are not being met.										
*	If you are collaborating with another Hub please only include your Hubs portion.										
**	Significant: includes changes ≥10% of total project costs, changes in scope that impact on the outputs, milestones delayed by more than 3 months, changes to final delivery dates, and changes to the Project Leader or Lead Organisation. Minor: includes changes <10% of total project costs, delays in milestones of less than 3 months, and changes to project team (other than project leader).										

Project Number/ID	Project Name/Title	Project Summary	Outputs	
			Outputs (List outputs described in the project plan as well as any additional outputs the project delivered. Insert extra rows as needed)	**Link to output** (Provide hyperlinks to outputs/products where available)
A1	Northern Australian hotspots for the recovery of threatened euryhaline species	Euryhaline elasmobranchs represent over half of the EPBC-listed threatened sharks and rays, with northern Australia of national importance for this threatened species community. Critical information gaps remain, limiting the implementation of Recovery Plan objectives. This project will fill many data gaps through the application of acoustic telemetry, traditional and advanced molecular research (population genetics and close-kin mark-recapture), life history studies and Indigenous knowledge and education. The focus is to improve management and facilitate recovery of these threatened species, through three research themes: 1) monitoring and understanding euryhaline species; 2) Indigenous partnerships for management of euryhaline species; and 3) knowledge for the reassessment of river shark status.	Troubled waters: Threats and extinction risk of the sharks, rays and chimaeras of the Arabian Sea and adjacent waters	https://www.nespmarine.edu.au/document/troubled-waters-threats-and-extinction-risk-sharks-rays-and-chimaeras-arabian-sea-and
			Concise report on CKMR population estimate for G.garricki	
			Manuscript on movement and habitat use G.garricki	
			Manuscript on population structure of G.garricki	
			A rare contemporary record of the Critically Endangered Ganges Shark, Glyphis gangeticus	https://www.nespmarine.edu.au/document/rare-contemporary-record-critically-endangered-ganges-shark-glyphis-gangeticus
			Species Overview: Largetooth Sawfish Pristis pristis - Report	https://www.nespmarine.edu.au/document/species-overview-largetooth-sawfish-pristis-pristis
			Recreational fishing impacts on threatened river sharks: A potential conservation issue - Journal Article	https://www.nespmarine.edu.au/document/recreational-fishing-impacts-threatened-river-sharks-potential-conservation-issue
			Description of the egg cases of Dentiraja polyommata (Rajiformes: Rajidae) and Asymbolus pallidus (Carcharhiniformes: Scyliorhinidae) from Queensland, Australia - Journal Article	https://www.nespmarine.edu.au/document/description-egg-cases-dentiraja-polyommata-rajiformes-rajidae-and-asymbolus-pallidus
			Sawfishes in Papua New Guinea: a preliminary investigation into their status and level of exploitation - Journal Article	https://www.nespmarine.edu.au/document/sawfishes-papua-new-guinea-preliminary-investigation-their-status-and-level-exploitation
			Inferring contemporary and historical genetic connectivity from juveniles - Journal Article	https://www.nespmarine.edu.au/document/inferring-contemporary-and-historical-genetic-connectivity-juveniles
			Reproductive parameters of rhinobatid and urolophid batoids taken as bycatch in the Queensland (Australia) East Coast Otter Trawl Fishery - Journal Article	https://www.nespmarine.edu.au/document/reproductive-parameters-rhinobatid-and-urolophid-batoids-taken-bycatch-queensland-australia
			Urogymnus acanthobothrium sp. nov., a new euryhaline whipray (Myliobatiformes: Dasyatidae) from Australia and Papua New Guinea - Journal Article	https://www.nespmarine.edu.au/document/urogymnus-acanthobothrium-sp-nov-new-euryhaline-whipray-myliobatiformes-dasyatidae

Project Number/ID	Project Name/Title	Project Summary	Outputs	
			Outputs (List outputs described in the project plan as well as any additional outputs the project delivered. Insert extra rows as needed)	**Link to output** (Provide hyperlinks to outputs/products where available)
			A new species of wedgefish, Rhynchobatus cooki (Rhinopristiformes, Rhinidae), from the Western Pacific - Journal Article	https://www.nespmarine.edu.au/document/new-species-wedgefish-rhynchobatus-cooki-rhinopristiformes-rhinidae-western-pacific
			Malak Malak Sawfish Patrol and Relocation Protocol	https://www.nespmarine.edu.au/document/malak-malak-sawfish-patrol-relocation-protocol
			Genetic sequencing of threatened euryhaline species	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=f7d3a11e-bd2b-4d8d-af3d-d2fc3a058339
			Acoustic telemetry tracking data	http://metadata.imas.utas.edu.au/geonetwork/srv/eng/metadata.show?uuid=8e9746ed-20f8-4c1b-9437-1fa0d5e53264
			Euryhaline elasmobranch fishing database (including images)	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=a0cf8cc5-67cd-49bb-bcaa-dedf21ed3287
			Euryhaline Elasmobranchs community communications outputs	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=2b1ebdbb-e6c5-4673-b230-d7d2b5eba819
			Every Sawfish Counts - Sawfish Rescue, Daly River, September 2017	https://www.youtube.com/watch?v=fKkvHRptWww
			Every Sawfish Counts - Sawfish Rescue, Daly River, September 2017	https://www.youtube.com/watch?v=fKkvHRptWww&t=10s
			Save a Sawfish (Kriol	https://www.youtube.com/watch?v=u22S1zVwiLE&t=5s
			Save a Sawfish (English Angelina Joshua)	https://www.youtube.com/watch?v=dESDV9A7gFs
			Tyemirerriny: looking after Daly River Sawfish	https://www.youtube.com/watch?v=o5oN7xu1mI0&t=10s
			Sawfish territory - Malak Malak rangers	https://www.youtube.com/watch?v=QxRgjRqtth0

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			Outputs (List outputs described in the project plan as well as any additional outputs the project delivered. Insert extra rows as needed)	**Link to output** (Provide hyperlinks to outputs/products where available)
A2	Quantification of National Ship Strike Risk	See Project C5	See project C5	
A3	A national assessment of population status of white sharks	White sharks are listed as Vulnerable under the EPBC Act and the subject of a national recovery plan, yet there is still no effective way to assess their population status and thus no way of determining the efficacy of conservation actions. Recent debate due to various human-shark interactions has highlighted the need for further information. This project will provide a national assessment of population size and status in order to establish the efficacy of existing recovery actions and provide a scientifically sound and rational basis from which to develop policies that balance conservation objectives and public safety.	Genetic relatedness reveals total population size of white sharks in eastern Australia and New Zealand - Journal Article	https://www.nespmarine.edu.au/document/genetic-relatedness-reveals-total-population-size-white-sharks-eastern-australia-and-new
			Assessing the size of Australia's white shark populations - Fact sheets	https://www.nespmarine.edu.au/document/assessing-size-australias-white-shark-populations
			A national assessment of the status of white sharks - Report	https://www.nespmarine.edu.au/document/national-assessment-status-white-sharks
			Broad-scale coastal movements of white sharks off Western Australia described by passive acoustic telemetry data - Journal Article	https://www.nespmarine.edu.au/document/broad-scale-coastal-movements-white-sharks-western-australia-described-passive-acoustic
			Juvenile white sharks Carcharodon carcharias utilise estuarine environments in south-eastern Australia - Journal Article	https://www.nespmarine.edu.au/document/juvenile-white-sharks-carcharodon-carcharias-utilise-estuarine-environments-south-eastern
			Use of stereo baited remote underwater video systems to estimate the presence and size of white sharks (Carcharodon carcharias) - Journal Article	https://www.nespmarine.edu.au/document/use-stereo-baited-remote-underwater-video-systems-estimate-presence-and-size-white-sharks
			Towards a national population assessment for white sharks - Fact sheet	https://www.nespmarine.edu.au/document/towards-national-population-assessment-white-sharks-fact-sheet
			White shark acoustic tracking movement data 2015, 2016, 2017	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=d4cfbedf-6a0f-44ef-b736-08974c14bbcc
			Sequence IDs for archived white shark genetics data	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=de2cb27d-ae90-476d-b609-3fd1a2f52871

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A4	The Status of Human-Shark Interactions and Initiatives to Mitigate Risk in Australia	Considerable political, public and media attention have recently been focussed on human-shark interactions, specifically surrounding shark attack and ways to mitigate this risk. Finding the most appropriate policy balance between conservation of sharks, maximising public safety and understanding the broader social and economic ramifications/drivers for doing so is a continuing challenge for Government. To deliver this need the project has reviewed the status of human-shark interactions in Australia, provided a synthesis of current initiatives to reduce risk, reviewed recent international efforts to address these issues and identified knowledge gaps to provide an informed base to determine the most appropriate future research and policy support.	The status of human-shark interactions and initiatives to mitigate risk in Australian waters	https://www.nespmarine.edu.au/document/status-human-shark-interactions-and-initiatives-mitigate-risk-australian-waters
A5	Defining Connectivity of Australia's hammerhead sharks	Hammerhead sharks are the focus of conservation management through recent listing on CITES and CMS. The clear data gap for DOE and GBRMPA is connectivity of populations across national and international jurisdictions. This project applies genetic and satellite telemetry to examine the movement and connectivity of hammerhead sharks. This will help refine use of CMRs and the GBRMP, and define BIAs where possible. These data will be assimilated with current research to provide a more comprehensive understanding of the status of hammerhead shark populations to inform species listing and assist management and conservation policies at national and international levels.	Northern Australia Hammerhead Shark Tagging Program - Fact Sheet (Update January 2019)	https://www.nespmarine.edu.au/document/northern-australia-hammerhead-shark-tagging-program-fact-sheet-update-january-2019
			Indigenous knowledge and cultural values of hammerhead sharks in Northern Australia	https://www.nespmarine.edu.au/document/indigenous-knowledge-and-cultural-values-hammerhead-sharks-northern-australia
			Crossing lines: a multidisciplinary framework for assessing connectivity of hammerhead sharks across jurisdictional boundaries - Journal Article	https://www.nespmarine.edu.au/document/crossing-lines-multidisciplinary-framework-assessing-connectivity-hammerhead-sharks-across
			Northern Australia Hammerhead Shark Tagging Program - Fact Sheet	https://www.nespmarine.edu.au/document/northern-australia-hammerhead-shark-tagging-program-fact-sheet
			Exploring the status of Australia's hammerhead sharks - Report	https://www.nespmarine.edu.au/document/exploring-status-australia%E2%80%99s-hammerhead-sharks
			Defining the connectivity of Australia's hammerhead sharks - Fact Sheet	https://www.nespmarine.edu.au/document/defining-connectivity-australia%E2%80%99s-hammerhead-sharks-fact-sheet
			Hammerhead connectivity metadata from tagged sharks	https://catalogue.aodn.org.au/geonetwork/srv/en/metadata.show?uuid=0b1796db-6686-4577-95fe-770e1e8ffb46

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			Outputs (List outputs described in the project plan as well as any additional outputs the project delivered. Insert extra rows as needed)	**Link to output** (Provide hyperlinks to outputs/products where available)
			Hammerhead connectivity movement kmz files (for mapping)	https://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=9a767302-742f-447c-a060-a23d9f12197c
			mtDNA haplotypes, microsatellite, SNP genotypes and population connectivity analysis (GenPop, Structure etc) - great hammerhead and winghead sharks	
			mtDNA haplotypes, microsatellite, SNP genotypes and population connectivity analysis (GenPop, Structure etc) - scalloped hammerhead sharks	
			Analysis of parasite communities on hammerhead sharks	
			Analysis of parasite communities on hammerhead sharks	
A6	Prioritisation of research and management needs for Australian elasmobranch species	NERP successfully demonstrated new ways to get the raw ingredients for evidence-based management of previously intractable species: abundance, survival, connectivity. But there is still a need to explore/demonstrate how management can use these tools (e.g. adaptive control of bycatch, or deciding if more monitoring is needed), and which species are suitable. This project comprised (i) a workshop to re-assess Australian shark and ray species in terms of degree-of-concern, state-of-knowledge-for-management, and feasibility-of-filling-knowledge-gaps; and (ii) a desk study exemplifying one pathway to management use. In 2016, we have worked with DoEE to prioritise species for research and explore more management pathways.	Close-Kin Mark-Recapture - Journal Article	https://www.nespmarine.edu.au/document/close-kin-mark-recapture
			Prioritisation of research and management needs for Australian elasmobranch species - Final Report	https://www.nespmarine.edu.au/system/files/FINAL%20Heupel%20A6%20report%20Prioritisation%20of%20research%20and%20management%20needs%20of%20Aust%20elasmobranch%20species_mh.pdf
A7	Monitoring population dynamics of 'Western' right whales off southern Australia	Continuation (since 1993) of annual aerial surveys, to include counts and identification photographs, of Southern Right Whales between Cape Leeuwin (WA) and Ceduna (SA), where wintering animals come close to the coast – adult females to calve, at approximately three-year intervals, other adults and juveniles less regularly. The area is the main wintering ground of a major 'western' subpopulation of 'Australian' right whales, differing in number and extent of recovery (from 19th century hunting)	Monitoring Population Dynamics of "Western" Right Whales off Southern Australia 2018-2021 - Progress Report on activities for 2018	https://www.nespmarine.edu.au/document/monitoring-population-dynamics-%E2%80%98western%E2%80%99-right-whales-southern-australia-2018-2021-progress
			Monitoring population dynamics of Western right whales - Final Report on activities for 2017	https://www.nespmarine.edu.au/document/monitoring-population-dynamics-%E2%80%98western%E2%80%99-right-whales-southern-australia-final-report-0

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			Outputs (List outputs described in the project plan as well as any additional outputs the project delivered. Insert extra rows as needed)	**Link to output** (Provide hyperlinks to outputs/products where available)
		from an 'eastern' subpopulation which so far shows little if any recovery. Counts allow estimation of population trend and current numbers; identification photographs allow estimation of life history parameters.	Monitoring population dynamics of Western right whales - Progress Report on activities for 2017	https://www.nespmarine.edu.au/document/monitoring-population-dynamics-western-right-whales-progress-report-activities-2017
			Monitoring Population Dynamics of "Western" Right Whales off Southern Australia - final report on activities March 2017 - Report	https://www.nespmarine.edu.au/document/monitoring-population-dynamics-%E2%80%98western%E2%80%99-right-whales-southern-australia-final-report
			Monitoring population dynamics of Western right whales - Progress report on activities for 2016 - Report	https://www.nespmarine.edu.au/document/monitoring-population-dynamics-western-right-whales-progress-report-activities-2016
			Population trend in right whales off southern Australia 1993-2015 - International Whaling Commission June 2016 - Report	https://www.nespmarine.edu.au/document/population-trend-right-whales-southern-australia-1993-2015-international-whaling-commission
			Monitoring population dynamics of Western right whales - Final report on activities 30 March 2016 - Report	https://www.nespmarine.edu.au/document/monitoring-population-dynamics-western-right-whales-final-report-activities-30-march-2016
			Monitoring Population Dynamics of "Western" Right Whales off Southern Australia Milestone Report - Report	https://www.nespmarine.edu.au/document/monitoring-population-dynamics-%E2%80%98western%E2%80%99-right-whales-southern-australia-milestone-report
			Aerial survey monitors right whales off southern Australia - Fact Sheet	https://www.nespmarine.edu.au/document/aerial-survey-monitors-right-whales-southern-australia-fact-sheet
			2015 Aerial survey data of southern right whales (Eubalaena australis) off southern Australia	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=0c8cf643-8111-4872-9ece-7672c2ef460b
			2016 Aerial survey data of southern right whales (Eubalaena australis) off southern Australia	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=881d2cde-26af-44e9-b695-6c3b458fafc2
A8	Exploring the status of Western Australia's sea snakes	All sea snakes are listed marine species under the EPBC Act and three Australian endemic species are listed as Critically Endangered or Endangered, and as such are a national conservation priority. This project examines sea snake abundance and diversity from broad-scale and targeted surveys at reef and coastal sites to update Conservation Advices, refine status within CMRs and inform policies of DoEE, DPaW, PA and others. This research will improve our understanding of population status to guide on-ground conservation to reduce population declines.	Future directions in the research and management of marine snakes	https://www.nespmarine.edu.au/document/future-directions-research-and-management-marine-snakes
			Report on surveys and analyses of data	
			Spatial and temporal patterns in sea snake populations on the North West Shelf - Progress Report	https://www.nespmarine.edu.au/document/spatial-and-temporal-patterns-sea-snake-populations-north-west-shelf-progress-report

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			Exploring the status of Western Australia's sea snakes - Report	https://www.nespmarine.edu.au/document/exploring-status-western-australia%E2%80%99s-sea-snakes
			Spatial distribution map of sea snake species occurrence	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=8114ec84-7907-4ad8-8453-e0b255dc2bd7
A9	Grey Nurse Shark Ck-MR Population Estimate - East Coast	A review of the 2002 National Recovery Plan for Grey Nurse Shark (DEWHA 2009) concluded it was not possible to determine if the east coast population had shown any signs of recovery (DoE 2014). Action 1.1 of the new recovery plan (DoE 2014) is to resurvey Grey Nurse Shark populations to assess population trends and dynamics. This project will resample the east coast population and use genetic SNP data to inform close kin-mark recapture analysis to estimate population size and trend, and provide guidance on future monitoring strategies for the east coast population of Grey Nurse Shark.	Sizing up Australia's eastern Grey Nurse Shark population	https://www.nespmarine.edu.au/document/sizing-australia%E2%80%99s-eastern-grey-nurse-shark-population
			A close-kin mark-recapture estimate of the population size and trend of east coast grey nurse shark	https://www.nespmarine.edu.au/document/close-kin-mark-recapture-estimate-population-size-and-trend-east-coast-grey-nurse-shark
			Grey Nurse Shark Tissue Sample Collection	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=fc5edda0-cd1e-462e-a610-d45106111db4
A10	Conservation of spotted handfish and their habitat	Spotted handfish are critically endangered and in accordance with the signed recovery plan we will conserve them through various direct conservation actions guided by research. This includes replanting of the degraded plastic artificial spawning habitats (ASH) with a re-designed array of ceramic units, assessment of taut eco-friendly moorings in critical spotted handfish habitat, genetic and capture mark recapture studies, a population viability analysis (PVA) and performance assessment of management actions. We will also continue our captive breeding project with industry and engagement with the broader community through talks, outreach and publications and re-establishment of the handfish recovery team.	Conservation of handfish and their habitats – annual report (milestone 4, 2018)	
			Procedures and methods for establishment of captive breeding populations of spotted handfish	https://www.nespmarine.edu.au/document/procedures-and-methods-establishment-captive-breeding-populations-spotted-handfish
			Local densities and habitat preference of the critically endangered spotted handfish (Brachionichthys hirsutus): Large scale field trial of GPS parameterised underwater visual census and	https://www.nespmarine.edu.au/document/local-densities-and-habitat-preference-critically-endangered-spotted-handfish
			Conserving Critically Endangered spotted handfish - Fact Sheet	https://www.nespmarine.edu.au/document/conserving-critically-endangered-spotted-handfish-fact-sheet
			Monitoring of Spotted Handfish (Brachionichthys hirsutus) populations and on ground conservation actions - Report	https://www.nespmarine.edu.au/document/monitoring-spotted-handfish-brachionichthys-hirsutus-populations-and-ground-conservation
			Density estimates of Spotted Handfish (Brachionichthys hirsutus) - GPS Underwater Visual Census. 2015-2016	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=b0c79329-a480-4762-a943-a902a74fc13e

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			Outputs (List outputs described in the project plan as well as any additional outputs the project delivered. Insert extra rows as needed)	**Link to output** (Provide hyperlinks to outputs/products where available)
			Spotted Handfish (Brachionichthys hirsutus) - GPS Underwater Visual Census - 2017 resurveys of baseline sites	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=51702b57-d4e4-4477-b199-b3485675f66c
A11	Shark action plan	Conservation of elasmobranch species (sharks and rays) is an increasing priority globally, including Australia, as evidence of overexploitation of some species becomes apparent. Common issues and threats among elasmobranch species may improve management if considered holistically. This project will produce a Shark Action Plan assessing requirements for improved management including a summary of current status across the taxa, guidelines for reducing impacts and improving	Shark Action Plan Policy Report - milestone 11, RPv3 2017	
			Shark Action Plan species assessments report	
A12	Australia's Northern Seascape: assessing status of threatened and migratory marine species	Northern Australia has a relatively untouched natural environment and is the current focus of substantial economic development, which has the potential to impact biodiversity and cultural values. The Northern Seascapes Project Phase 2 will map the distributions of several *EPBC* -listed threatened and migratory marine species at a broad-scale, and develop and trial a cost-effective rapid assessment approach ('SeaBlitzes') to gather finer-scale spatial data on priority marine species of the northern seascape, including the critical habitats they depend on. SeaBlitzes will survey selected hotspots determined through scoping undertaken in Phase 1 of the Northern Seascapes Project (to be delivered end 2017). The data and knowledge generated by the rapid assessments will establish baselines, and grow the information base for decision-making on proposed activities under Commonwealth and Territory environmental regulations. This approach will deliver on actions in threatened species Recovery Plans, Sea Country Plans, and management plans for protected areas (e.g. Indigenous Protected Areas and Marine Reserves), and will develop capacity for continued data collection through a community-based participatory approach.	Lost before found: A new species of whaler shark Carcharhinus obsolerus from the Western Central Pacific known only from historic records	https://www.nespmarine.edu.au/document/lost-found-new-species-whaler-shark-carcharhinus-obsolerus-western-central-pacific-known
			The phylogenomic position of the Critically Endangered Largetooth Sawfish Pristis pristis (Rhinopristiformes, Pristidae), inferred from the complete mitochondrial genome	https://www.nespmarine.edu.au/document/phylogenomic-position-critically-endangered-largetooth-sawfish-pristis-pristis
			Scoping a seascape approach to managing and recovering northern Australian threatened and migratory marine species	https://www.nespmarine.edu.au/document/scoping-seascape-approach-managing-and-recovering-northern-australian-threatened-and
			Desktop review of Indigenous research and management priorities for threatened and migratory species	https://www.nespmarine.edu.au/document/desktop-review-indigenous-research-and-management-priorities-threatened-and-migratory
			Characterising northern estuaries using the Digital Earth Australia	https://www.nespmarine.edu.au/document/characterising-northern-estuaries-using-digital-earth-australia
			Northern Australia threatened species	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=47042e1d-8940-4186-8644-e6f5402574f4
			Northern Australia pressures mapping	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=ecb15d97-8deb-454e-bca8-0db634d9e29a
			Northern Australia changes in key coastal habitats	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=1ab541b2-01ce-4062-8b1d-8b5d24f7d346

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A13	Estimation of population abundance and mixing of 'Southern' right whales in the Australian and New Zealand regions	This project will provide, for the first time, an abundance estimate of the total Australian population of southern right whales. It will also investigate the movement and connectedness of whales that utilise breeding areas on the eastern, southern and western coasts of Australia. Information on the population abundance and movements of southern right whales provided by this project will allow the Australian government to better evaluate progress made against the Conservation Management Plan for the species and ensure conservation efforts for the species are effectively coordinated at the regional level.		
A14	Identification of near-shore habitats of juvenile white sharks in Southwestern Australia	There is credible evidence that juvenile white sharks are present in a relatively restricted region between the head of the Great Australia Bight (GAB) and Ceduna, which encompasses the boundaries of State and Commonwealth managed marine parks and reserves, some of which are accessed via Indigenous Protected Areas. This pilot project is to undertake visual surveys (using Unmanned Aerial Vehicle – UAV) for juvenile white sharks during spring and summer. The on-land surveillance approach outlined in this proposed pilot project will inform decision makers on the efficacy of supporting subsequent on-water activity to capture and electronically tag juvenile white sharks to assess habitat use in the Great Australian Bight Marine Park (Commonwealth waters) and Far West Coast Marine Park (State waters).		

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B1	Road testing decision support tools via case study applications	This project will deploy tools from economics and decision science to identify sound investments within constrained budgets for: 1. Ecological monitoring of Commonwealth Marine Reserves 2. Management actions for threatened and migratory species or threatened communities, and 3. Restoration of saltmarsh and shellfish habitats. The three case studies involve coherent integration of ecological understanding, social and organisational value judgements, and economic analysis.	Benefit-cost analysis of the Windara shellfish reef restoration project	https://www.nespmarine.edu.au/document/benefit-cost-analysis-windara-shellfish-reef-restoration-project
			Benefit-cost analysis for marine habitat restoration: a framework for estimating the viability of shellfish reef repair projects	https://www.nespmarine.edu.au/document/benefit-cost-analysis-marine-habitat-restoration-framework-estimating-viability-shellfish
			Review of decision support tools and their potential application in the management of Australian Marine Parks	
			An assessment of alternative management interventions for treatment of Tropical Fire Ants on Ashmore Reef - Report	https://www.nespmarine.edu.au/document/assessment-alternative-management-interventions-treatment-tropical-fire-ants-ashmore-reef-0
B2	Analysis and elicitation to support State of the Environment reporting for the full spectrum of data availability	The availability and quality of observation data that may be used to support State of the Environment reporting lies on a spectrum from: (i) high quality (e.g. Reef Life Survey, Long term reef monitoring programme, Temperate Reef Monitoring programme, state-based MPA monitoring programmes); (ii) moderate quality (e.g. continuous plankton recorder, occasional by catch surveys); (iii) low quality (anecdotal information) to (iv) expert beliefs but no empirical observations. The project has been completed, and provided direct input to the marine chapter of the 2016 State of the Environment report, by providing expert assessment of environmental status indicators defined for the 2011 State of the Environment report.		
B3	Enhancing access to relevant marine information – developing a service for searching, aggregating and filtering collections of linked open marine data	This project aims to improve the searchability and delivery of sources of linked open data, and to provide the ability to forward collections of discovered data to web services for subsequent processing through the development of a linked open data search tool. The work will improve access to existing data collections , and facilitate the development of new applications by acting as an aggregator of links to streams of marine data. The work will benefit managers (i.e. Department of the Environment staff) by providing fast and simple access to a wide range of marine information products, and offering a means of quickly synthesizing and aggregating multiple sources of information.	Enhancing access to relevant marine information - developing a service for searching, aggregating and filtering collections of linked open marine data - final report - Report	https://www.nespmarine.edu.au/document/enhancing-access-relevant-marine-information-%E2%80%93-developing-service-searching-aggregating-and
			Enhancing access to relevant marine information: Developing a service for searching, aggregating and filtering collections of linked open marine data - Scoping study - Report	https://www.nespmarine.edu.au/document/enhancing-access-relevant-marine-information-developing-service-searching-aggregating-and
B4	Underpinning the repair & conservation of Australia's threatened coastal-marine habitats – phase II.	The objective of this research is to support the scaling-up of repair efforts for two threatened nearshore marine ecological communities, shellfish reefs and salt marshes. Both habitats harbour significant marine	Expanding fish productivity in Tasmanian saltmarsh wetlands through tidal reconnection and habitat repair	https://www.nespmarine.edu.au/document/expanding-fish-productivity-tasmanian-saltmarsh-wetlands-through-tidal-reconnection-and

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		biodiversity and play a critical role in supporting healthy estuarine and nearshore systems. The research synthesis will be used to guide the development of more effective policy on coastal-marine repair, improve community education on the importance of habitats to estuary health and develop a detailed business case to support investment in marine repair activities for private industry stakeholders.	Seven pearls of wisdom: advice from Traditional Owners to improve engagement of local Indigenous people in shellfish ecosystem restoration	https://www.nespmarine.edu.au/document/seven-pearls-wisdom-advice-traditional-owners-improve-engagement-local-indigenous-people
			Australian shellfish ecosystems: Past distribution, current status and future direction	https://www.nespmarine.edu.au/document/australian-shellfish-ecosystems-past-distribution-current-status-and-future-direction
			Underpinning the repair and conservation of Australia's threatened coastal-marine habitats: Shellfish restoration research - Mid-project update - Report	https://www.nespmarine.edu.au/document/underpinning-repair-and-conservation-australia%E2%80%99s-threatened-coastal-marine-habitats
			Repairing and conserving Australia's saltmarshes and seascapes - Report	https://www.nespmarine.edu.au/document/repairing-and-conserving-australia%E2%80%99s-saltmarshes-and-seascapes
			Sustainable management of Australia's coastal seascapes: a case for collecting and communicating quantitative evidence to inform decision-making - Journal Article	https://www.nespmarine.edu.au/document/sustainable-management-australia%E2%80%99s-coastal-seascapes-case-collecting-and-communicating
			Shellfish reef habitats: a synopsis to underpin the repair and conservation of Australia's environmental, social and economically important bays and estuaries - Report	https://www.nespmarine.edu.au/document/shellfish-reef-habitats-synopsis-underpin-repair-and-conservation-australias-environmental
			Australia's saltmarshes: a synopsis to underpin the repair and conservation of Australia's environmentally, socially and economically important bays and estuaries - Report	https://www.nespmarine.edu.au/document/australias-saltmarshes-synopsis-underpin-repair-and-conservation-australias-environmentally
			Fostering the repair of Australia's saltmarshes and shellfish reefs - Fact Sheet	https://www.nespmarine.edu.au/document/fostering-repair-australia%E2%80%99s-saltmarshes-and-shellfish-reefs-fact-sheet
			Symposium report: Inaugural Australian Coastal Restoration Symposium	https://www.nespmarine.edu.au/document/symposium-report-inaugural-australian-coastal-restoration-symposium
			Restoring Angasi oyster reefs: What is the endpoint ecosystem we are aiming for and how do we get there?	https://www.nespmarine.edu.au/document/restoring-angasi-oyster-reefs-what-endpoint-ecosystem-we-are-aiming-and-how-do-we-get-there
			Australian shellfish reef images	http://catalogue.aodn.org.au/geonetwork/srv/en/metadata.show?uuid=2ddd5dbc-cc54-4777-aa14-56c461d180f0
			Shellfish reef locations	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=8677fd3f-c640-460c-b5a9-34177884a076
			Biodiversity supported by shellfish reefs	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=5acb935b-c8da-4b2e-af38-63ac1da126be

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			Saltmarsh prawn and fish species composition and production data	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=a15a9349-e357-4e0a-a8c0-8e6fcb306279
			Shellfish water filtration data	https://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=13682e14-1d4d-46d5-839d-8c40a3713ce6
			Restoring Shellfish Reefs (Ocean breef)	https://www.youtube.com/watch?v=nI-CzovK5pA

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C1	Improving our understanding of pressures on the marine environment	The marine environment in Australia is impacted by a wide range of different pressures. This project aims to assist DoE, and other research users, to improve understanding of the potential impacts of anthropogenic disturbance to marine conservation values by providing up-to-date data and analyses on the spatial distribution of pressures and trends. The research is designed to inform decision making under the EPBC Act (acceptability of proposed activities, evaluation of effectiveness of mitigation measures) on NMES (including Key Ecological Features), implementation of multiple strategies in four Marine Bioregional Plans management of Commonwealth Marine Reserves and State of the Environment reporting.	Options for assessing risks to environmental values in Matters of National Environmental Significance and Commonwealth Marine Reserves – report to be uploaded to website	https://www.nespmarine.edu.au/document/options-assessing-cumulative-impact-and-risk-environmental-values-matters-national
			Essential ocean variables for global sustained observations of biodiversity and ecosystem changes	https://www.nespmarine.edu.au/document/essential-ocean-variables-global-sustained-observations-biodiversity-and-ecosystem-changes
			Rethinking Approaches to Valuation in Marine Systems – report to be uploaded to website	https://www.nespmarine.edu.au/document/rethinking-approaches-valuation-marine-systems
			Towards a value based approach to cumulative risk and impact analysis - Fact sheet	https://www.nespmarine.edu.au/document/towards-value-based-approach-cumulative-risk-and-impact-analysis
			Changes in pressures on the Marine Environment over three decades	https://www.nespmarine.edu.au/document/changes-pressures-marine-environment-over-three-decades
			Australian Ship Reporting System and Automatic Identification System - Shipping Summaries - 1999-2015	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=b8135966-33c6-4a1c-bcbc-d797c2a1155f
			Cyclone Summaries 1900-2015	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=9fb32adf-f8e8-4b38-8e23-1c6e847b6a91
			Maritime Cables	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=b8824a13-8e0b-4172-9678-dabccdedeeb7
			Petroleum and Gas Production Facilities, Australia 2016	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=2eddbe26-0276-4468-a210-0c00ada8bf39
			Petroleum pipelines	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=19d8f59a-b918-442f-8e2c-d80125600868
			Petroleum Titles, Australia 2016	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=836b1a1d-19d8-4f66-b12f-88e4ce9ba19c
			Plastic Pollution in the World's Oceans (2007-2013)	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=DA83B0E3-2B75-48A2-8FDD-874EDD9DBDBF

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			Pollution Events Summary, Australia 1970-2015 (AMSA)	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=2ff40822-a773-4788-aedd-232639142cde
			Population Density, Australia 2011 (ABS)	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=c8b09cef-c645-48aa-8658-22ece782365f
			Seismic Surveys, Australia (2015)	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=17249677-2be0-43a0-a9b5-da01e0be3fa7
			Summaries of AFMA log book data on effort distribution for Commonwealth fisheries in the Australian Exclusive Economic Zone	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=aa53a4df-7fe6-46d1-93b7-2d3732f4883e
			Twenty years of high-resolution sea surface temperature imagery around Australia: inter-annual and annual variability	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=b8f48127-495e-42e6-8d53-db3c56ee3a7f
			State fisheries data	
C2	Continental-scale tracking of threats to shallow Australian reef ecosystems	The project will integrate Australia's largest, most detailed datasets of shallow-water tropical and temperate marine biodiversity, and assess how pollution, fishing, rising sea temperatures and introduced species are impacting associated natural values. An initial outcome will be the identification of state-of-the-environment indicators for inclusion in the 2016 State of the Environment report, with subsequent activities aimed at contributing additional data products needed for other NESP projects, Parks Australia, and the Essential Environmental Measures initiative. The project will also describe a national shallow-water baseline of biodiversity in Commonwealth Marine Reserves for assessment of change through the long term.	Moving beyond trophic groups: evaluating fishing-induced changes to temperate reef food webs	https://www.nespmarine.edu.au/document/moving-beyond-trophic-groups-evaluating-fishing-induced-changes-temperate-reef-food-webs
			Continental-scale tracking of threats to shallow Australian reef ecosystems - Indicator report	https://www.nespmarine.edu.au/document/continental-scale-tracking-threats-shallow-australian-reef-ecosystems-indicator-report
			Thermal limits to the geographic distributions of shallow-water marine species - Journal Article	https://www.nespmarine.edu.au/document/thermal-limits-geographic-distributions-shallow-water-marine-species
			Abundance and local-scale processes contribute to multi-phyla gradients in global marine diversity - Journal Article	https://www.nespmarine.edu.au/document/abundance-and-local-scale-processes-contribute-multi-phyla-gradients-global-marine
			Translating local benthic community structure to national biogenic reef habitat types - Journal Article	https://www.nespmarine.edu.au/document/translating-local-benthic-community-structure-national-biogenic-reef-habitat-types
			Ubiquity of microplastics in coastal seafloor sediments - Journal Article	https://www.nespmarine.edu.au/document/ubiquity-microplastics-coastal-seafloor-sediments

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			Colours of the Coral Sea - Poster	https://www.nespmarine.edu.au/document/colours-coral-sea
			Assessing national biodiversity trends for rocky and coral reefs through the Integration of citizen science and scientific monitoring programs - Journal Article	https://www.nespmarine.edu.au/document/assessing-national-biodiversity-trends-rocky-and-coral-reefs-through-integration-citizen
			Biodiversity enhances reef fish biomass and resistance to climate change - Journal Article	https://www.nespmarine.edu.au/document/biodiversity-enhances-reef-fish-biomass-and-resistance-climate-change
			Bright spots among the world's coral reefs - Journal Article	https://www.nespmarine.edu.au/document/bright-spots-among-world%E2%80%99s-coral-reefs
			Thermal biases and vulnerability to warming in the world's marine fauna	https://www.nespmarine.edu.au/document/thermal-biases-and-vulnerability-warming-worlds-marine-fauna
			Pollution markers at ecological monitoring sites	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=11075fdf-e53e-4d8c-8999-0b239a742243
			Integration of marine biodiversity datasets and derived indicators	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=084e90fe-ef03-4b41-8991-832116db2ffb
C3	Change detection and monitoring of key marine and coastal environments – application of the Australian Geoscience Data Cube	This project aims to leverage the extensive time-series of earth observation image data in the Australian Geoscience Data Cube (AGDC) by developing change detection algorithms to analyse key environmental parameters in the coastal and marine zone. Spatial information produced by this project can inform management decisions, and assist in evaluating management action outcomes, by providing a quantifiable measure of historical change and ongoing monitoring and change detection capabilities. Phase 1 of this project aimed to demonstrate the capability of using the AGDC through the development of an inter-tidal zone change detection algorithm and data set, with a view to developing and implementing an expanded range of stakeholder targeted algorithms to inform decision making processes in Phase 2.	Coastal change detection tools utilising 28 years of Earth Observation data in the Australian Geoscience Data Cube (AGDC) - Report	https://www.nespmarine.edu.au/document/coastal-change-detection-tools-utilising-28-years-earth-observation-data-australian
			AGDC Time Series Video - Murray Mouth and Lower Lakes	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=a0bf5d29-0986-443a-a9e2-a9d7523c9a3c
			AGDC Time Series Video - Southern Moreton Island	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=90f1121e-b973-46d4-9a51-5f750d954319
			AGDC Time Series Video - Southern Stradbroke Island	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=67fef6b1-1540-445f-a995-71abcefeb99b

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C4	The National Outfall Database project (Clean Ocean Foundation)	NOD addresses the need of government and community to understand the impacts on health and the ocean environment that occur from sewerage outfalls around Australia. The project will be delivered over a three year time frame and will provide: 1) A publically accessible national outfall database and reports. 2) A ranking of the outfalls (and sewerage treatment systems) according to health and impact criteria with peer review of the ranking system and resulting ranking outcomes. 3) Comparison of geographical regions in sewerage volume and pollution impact. 4) Mapping of the database. 5)Community engagement in conduct of this research and consumption of the outcomes.	National Outfall Database - Community Report for August 2018	https://www.nespmarine.edu.au/document/national-outfall-database-community-report-august-2018
			2017 Data Analysis Report	
			Warriewood Monitoring Summary - Report	https://www.nespmarine.edu.au/document/warriewood-monitoring-summary
			National Outfall Database https://www.nod.org.au/	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=21448123-0170-4aff-9b56-2b6aa21c73ed
C5	Quantification of risk from shipping to large marine fauna across Australia	Given the substantial and ongoing increases in coastal and port development along the Australian coastline, and an associated increase in recreational and commercial shipping, there is an increasing potential for adverse interactions with marine species. Two risks associated with these activities for large marine fauna are ship collisions (particularly relevant for marine mammals, turtles and whale sharks) and the impact of chronic ocean noise (across a wide range of species). This project aims to provide directed and robust science (species- and area-specific) to inform management and administrative decision-making by the Department of Environment in its application of the EPBC Act.	Quantification of risk from shipping to large marine fauna across Australia: Final Report, Milestone 3.5, RPv3 2017	https://www.nespmarine.edu.au/document/quantification-risk-shipping-large-marine-fauna-across-australia-final-report
			Avoiding the collision course	https://www.nespmarine.edu.au/document/avoiding-collision-course
			Report from workshop on characterising underwater shipping noise in Australia - Report	https://www.nespmarine.edu.au/document/report-workshop-characterising-underwater-shipping-noise-australia
			Historical Data on Australian Whale Vessel Strikes - International Whaling Commission June 2016 - Report	https://www.nespmarine.edu.au/document/historical-data-australian-whale-vessel-strikes-international-whaling-commission-june-2016
			Scoping of potential species for ship strike risk analysis - Report	https://www.nespmarine.edu.au/document/scoping-potential-species-ship-strike-risk-analysis
			Historical Australian vessel strike data	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=78cfb62c-e8ec-4437-9113-1e1fdc523f95
			Distribution map for Western Australian Humpback whale Migration	https://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=40e7e293-e5e2-4d46-9611-c2db22182b24

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			Relative vessel strike risk for Southern Right Whales	https://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=40e7e293-e5e2-4d46-9611-c2db22182b24
			Relative vessel strike risk for Eastern Australian Humpback whales	https://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=40e7e293-e5e2-4d46-9611-c2db22182b24
			Relative vessel strike risk for Western Australian Humpback whales	https://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=40e7e293-e5e2-4d46-9611-c2db22182b24
			Relative vessel strike risk for Green Turtles	https://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=40e7e293-e5e2-4d46-9611-c2db22182b24

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D1	National Data Collation, Synthesis and Visualisation to Support Sustainable Use, Management and Monitoring of Marine Assets	Effective management of marine assets requires an understanding of ecosystems and the processes that influence patterns of biodiversity. Through collaboration and synthesis of existing data this project will improve access to, and usability of, marine data to better inform management and improve public understanding of biodiversity in the marine estate. End-users and stakeholders will benefit from improved regional and national descriptions of biodiversity assets for the Commonwealth marine estate, including Commonwealth Marine Reserve network and other high-priority marine areas. In turn, this will inform prioritisation of future investments in monitoring marine ecosystems and State of the Environment reporting.	Eco-narrative of Bonaparte Gulf Marine - Milestone 17, RPv4 2018	https://www.nespmarine.edu.au/system/files/Galaiduk_Nichol%20An%20eco-narrative%20of%20Joseph%20Bonaparte%20Gulf%20Marin
			Eco-narrative of Kimberley Marine Park - Milestone 17, RPv4 2018	
			An eco-narrative of Geographe Marine Park - South-west marine region	https://www.nespmarine.edu.au/document/eco-narrative-geographe-marine-park-south-west-marine-region
			An eco-narrative of Gifford Marine Park - Temperate East marine region	https://www.nespmarine.edu.au/document/eco-narrative-gifford-marine-park-temperate-east-marine-region
			An eco-narrative of Perth Canyon Marine Park - South-west marine region	https://www.nespmarine.edu.au/document/eco-narrative-perth-canyon-marine-park-south-west-marine-region
			Origin of high density seabed pockmark fields and their use in inferring bottom currents	https://www.nespmarine.edu.au/document/origin-high-density-seabed-pockmark-fields-and-their-use-inferring-bottom-currents
			Transferring biodiversity models for conservation: Opportunities and challenges	https://www.nespmarine.edu.au/document/transferring-biodiversity-models-conservation-opportunities-and-challenges
			Ecosystem Understanding to Support Sustainable Use, Management and Monitoring of Marine Assets in the North and North-West Regions: Final Report 2016 - Report	https://www.nespmarine.edu.au/document/ecosystem-understanding-support-sustainable-use-management-and-monitoring-marine-assets-0
			Environmental predictors of foraging and transit behaviour in flatback turtles (Natator depressus) - Journal Article	https://www.nespmarine.edu.au/document/environmental-predictors-foraging-and-transit-behaviour-flatback-turtles-natator-depressus
			Palaeoshorelines on the Australian continental shelf: morphology, sea-level relationship and applications to environmental management and archaeology - Journal	https://www.nespmarine.edu.au/document/palaeoshorelines-australian-continental-shelf-morphology-sea-level-relationship-and
			Ecosystem understanding to support sustainable use, management and monitoring of marine assets in the North and North-west regions - Stakeholder workshop report April	https://www.nespmarine.edu.au/document/ecosystem-understanding-support-sustainable-use-management-and-monitoring-marine-assets
			Developing a toolbox of predictive models for the monitoring and management of KEFs and CMRs in the North and North-west regions - Scientific Workshop Report -	https://www.nespmarine.edu.au/document/developing-toolbox-predictive-models-monitoring-and-management-kefs-and-cmrs-north-and
			Sea Around Us Project - Relative pelagic fish abundance inferred from commercial catch data, Western Australia (1997-2006)	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=16501b1f-4b29-4b52-82d1-2e5c4d536acc
			Sea Around Us Project - Relative demersal fish abundance inferred from commercial catch data, northwestern Australia (1997-2006)	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=e90f84bd-a1c8-4943-ac6a-dbfee0cc313e
			Juvenile shark occurrence inferred from baited remote underwater video surveys Northwest Australia (2003-2013)	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=5af57072-c4c2-4a5a-bc72-62486dc6d73e

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			Oceanic Shoals Commonwealth Marine Reserve - Pelagic baited camera surveys (stereo-BRUVS)	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=ef452136-c42c-4f0a-98b3-f38a000a3752
			Oceanic Shoals Commonwealth Marine Reserve - Opportunistic visual surveys of marine megafauna	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=99208235-d68e-4039-bf77-362549a7aa48
			Oceanic Shoals Commonwealth Marine Reserve - Predicted pelagic diversity	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=99208235-d68e-4039-bf77-362549a7aa48
			Chlorophyll-a and ocean productivity	http://northwestatlas.org/node/27500
			Sea Surface Temperature (SST)	http://northwestatlas.org/node/27499
			Petroleum leases and offshore titles near the Oceanic Shoals as of 2016	http://northwestatlas.org/node/1651
			Biologically important areas (BIAs)	http://northwestatlas.org/node/27496
			Species richness	http://northwestatlas.org/node/27495
			RAMSAR wetlands	http://northwestatlas.org/node/27494
			World Heritage Areas	http://northwestatlas.org/node/27492
			IMCRA provincial bioregions	http://northwestatlas.org/node/27490
			IMCRA mesoscale bioregions	http://northwestatlas.org/node/27489
			Key Ecological Features	http://northwestatlas.org/node/27488
			Bathomes	http://northwestatlas.org/node/27486

Project Number/ID	Project Name/Title	Project Summary	Outputs	
			Outputs (List outputs described in the project plan as well as any additional outputs the project delivered. Insert extra rows as needed)	**Link to output** (Provide hyperlinks to outputs/products where available)
			Oceanic Shoals/Wessel Islands Sponge species ids	
			Oceanic Shoals Polychaete species ids	http://www.ga.gov.au/metadata-gateway/metadata/record/102241
			Interactive map gallery 'What research has been done in the North and NorthWest regions to document megafauna, benthos, demersal and pelagic fish and megafauna?'	http://northwestatlas.org/nwa/map/gallery
			Interactive map gallery 'Benthic habitat model outputs for the Oceanic Shoals CMR'	http://northwestatlas.org/node/1710
			Most likely benthic class habitat model for the Oceanic Shoals CMR	http://northwestatlas.org/node/1710
			Combined benthic class habitat model for the Oceanic Shoals CMR	http://northwestatlas.org/node/5449#indeterminant
			Hard coral probability habitat model for the Oceanic Shoals CMR	http://northwestatlas.org/node/5449#hard coral
			Soft coral probability habitat model for the Oceanic Shoals CMR	http://northwestatlas.org/node/5449#soft coral
			Filterer probability habitat model for the Oceanic Shoals CMR	http://northwestatlas.org/node/5449#filterer
			Gorgonian probability habitat model for the Oceanic Shoals CMR	http://northwestatlas.org/node/5449#gorgonians
			Alcyon probability habitat model for the Oceanic Shoals CMR	http://northwestatlas.org/node/5449#alcyon
			Whips probability habitat model for the Oceanic Shoals CMR	http://northwestatlas.org/node/5449#whips
			Sponge coral probability habitat model for the Oceanic Shoals CMR	http://northwestatlas.org/node/5449#sponge
			Burrowers probability habitat model for the Oceanic Shoals CMR	http://northwestatlas.org/node/5449#burrowers

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			Outputs (List outputs described in the project plan as well as any additional outputs the project delivered. Insert extra rows as needed)	**Link to output** (Provide hyperlinks to outputs/products where available)
			Macroalgae probability habitat model for the Oceanic Shoals CMR	http://northwestatlas.org/node/5449#macro-algae
			Seagrass probability habitat model for the Oceanic Shoals CMR	http://northwestatlas.org/node/5449#seagrass
			Halimeda probability habitat model for the Oceanic Shoals CMR	http://northwestatlas.org/node/5449#halimeda
			The 25%, 50%, 75% and 95% kernel utilisation distribution of telemetry data from 11 flatback sea turtles from the Lacepede Islands for each of the main turtle phases of	http://northwestatlas.org/node/27491
			Count of research effort across the N and NW regions: high resolution bathymetry; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1684 http://northwestatlas.org/node/1689
			Count of research effort across the N and NW regions: all bathymetry; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1685, http://northwestatlas.org/node/1688
			Count of research effort across the N and NW regions: oceanic data; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1686, http://northwestatlas.org/node/1687
			Count of research effort across the N and NW regions: hard corals; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1674, http://northwestatlas.org/node/1690
			Count of research effort across the N and NW regions: soft corals; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1682, http://northwestatlas.org/node/1691
			Count of research effort across the N and NW regions: sponges; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1683, http://northwestatlas.org/node/1692
			Count of research effort across the N and NW regions: brittle stars; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1671, http://northwestatlas.org/node/1693
			Count of research effort across the N and NW regions: marine mammals; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1675, http://northwestatlas.org/node/1696
			Count of research effort across the N and NW regions: polychaetes; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1679, http://northwestatlas.org/node/1694
			Count of research effort across the N and NW regions: molluscs; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1676, http://northwestatlas.org/node/1695
			Count of research effort across the N and NW regions: seabirds; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1681, http://northwestatlas.org/node/1698

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			Outputs (List outputs described in the project plan as well as any additional outputs the project delivered. Insert extra rows as needed)	**Link to output** (Provide hyperlinks to outputs/products where available)
			Count of research effort across the N and NW regions: sea turtles; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1680, http://northwestatlas.org/node/1697
			Count of research effort across the N and NW regions: demersal sharks and rays; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1673, http://northwestatlas.org/node/1700
			Count of research effort across the N and NW regions: pelagic sharks and rays; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1678, http://northwestatlas.org/node/1701
			Count of research effort across the N and NW regions: demersal fish; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1699, http://northwestatlas.org/node/1672
			Count of research effort across the N and NW regions: pelagic fish; by (1) CMR, and (2) KEF	http://northwestatlas.org/node/1677, http://northwestatlas.org/node/1702
			Bathymetry of Bremer Commonwealth Marine Reserve	https://www.youtube.com/watch?v=AgbuMT2QIRg
D2	Standard Operating Procedures (SOP) for survey design, condition assessment and trend detection	Understanding of the status and trends of indicators in Australia's marine environment requires standardised monitoring. This project will develop Standard Operating Procedures (SOP) in the planning, collection, analysis, and reporting of monitoring data. In particular, the project will: 1) provide guidance on what kind of monitoring is required (and where and when), 2) provide a simple yet powerful survey design tool, 3) provide two worked SOP examples (one benthic and one pelagic), 4) develop field manuals for some high priority sampling platforms (e.g. underwater video) with prioritisation stemming from a comparative analysis, and 5) assess approaches for monitoring pelagic ecosystems.	Scoping of new field manuals for marine sampling in Australian waters - Milestone 29, RPv4 2018	https://www.nespmarine.edu.au/document/scoping-new-field-manuals-marine-sampling-australian-waters
			Workshop report on data discoverability and accessibility	
			Scoping report on potetnial applications of satellite imagery (e.g. Digital Earth Australia) to marine monitoring if Commonwealth waters	
			Version 2 of Standard Operating Procedures for collecting mairne biodiversity data	
			An Introduction to MBHdesign - a tutorial for R-package. Milestone 30, RPv4 2018	
			Advancing marine biological observations and data requirements of the complementary essential ocean variables (EOVs) and essential biodiversity variables (EBVs) frameworks	https://www.nespmarine.edu.au/document/advancing-marine-biological-observations-and-data-requirements-complementary-essential
			Linking capacity development to GOOS monitoring networks to achieve sustained ocean observation	https://www.nespmarine.edu.au/document/linking-capacity-development-goos-monitoring-networks-achieve-sustained-ocean-observation

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			Outputs (List outputs described in the project plan as well as any additional outputs the project delivered. Insert extra rows as needed)	**Link to output** (Provide hyperlinks to outputs/products where available)
			Comparative assessment of seafloor sampling platforms	https://www.nespmarine.edu.au/document/comparative-assessment-seafloor-sampling-platforms
			Comparative assessment of pelagic sampling methods used in marine monitoring	https://www.nespmarine.edu.au/document/comparative-assessment-pelagic-sampling-methods-used-marine-monitoring
			Poster - Gear Up: Field manuals for marine sampling	https://www.nespmarine.edu.au/document/gear-field-manuals-marine-sampling
			Field manuals for marine sampling to monitor Australian waters - Report	https://www.nespmarine.edu.au/document/field-manuals-marine-sampling-monitor-australian-waters
			Flyer - Field manuals for marine sampling to monitor Australian waters - Fact sheets	https://www.nespmarine.edu.au/document/flyer-field-manuals-marine-sampling-monitor-australian-waters
			Spatially balanced designs that incorporate legacy sites - Journal Article	https://www.nespmarine.edu.au/document/spatially-balanced-designs-incorporate-legacy-sites
			Scoping report: Comparative assessment of benthic sampling platforms - Report	https://www.nespmarine.edu.au/document/scoping-report-comparative-assessment-benthic-sampling-platforms
			Scoping report: Comparative assessment of pelagic sampling platforms - Report	https://www.nespmarine.edu.au/document/scoping-report-comparative-assessment-pelagic-sampling-platforms
D3	Implementing monitoring of AMPS and the status of marine biodiversity assets on the continental shelf	New [RPv3] - There is a significant need to support Parks Australia in the establishment of a baseline inventory and monitoring program for CMR networks, and ensure it is integrated within a broader national monitoring framework. This project will provide the science support for program development, and a prioritisation framework for implementation. By facilitating national approaches, including a standards-based approach to collecting new marine data, project outcomes will include key steps to assist Parks Australia to implement and initiate a CMR monitoring program, new knowledge to inform CMR management, a national integrated framework for SOE reporting, and collaboration between State-based and Commonwealth-based programs.	Fish assemblages on reefs in the Hunter Marine Park and adjacent waters	https://www.nespmarine.edu.au/document/fish-assemblages-reefs-hunter-marine-park-and-adjacent-waters
			Spatial properties of sessile benthic organisms and the design of repeat visual survey transects	https://www.nespmarine.edu.au/document/spatial-properties-sessile-benthic-organisms-and-design-repeat-visual-survey-transects
			Trialling suitable indicator metrics of change for baited remote underwater video station datasets - progress report	https://www.nespmarine.edu.au/document/trialling-suitable-indicator-metrics-change-baited-remote-underwater-video-station-datasets
			Theme D Project showcase and future research prioritisation workshop report - Report	https://www.nespmarine.edu.au/document/theme-d-project-showcase-and-future-research-prioritisation-workshop-report

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			Outputs (List outputs described in the project plan as well as any additional outputs the project delivered. Insert extra rows as needed)	**Link to output** (Provide hyperlinks to outputs/products where available)
			ARMADA: A marine data aggregator and visualisation tool to support management of Australia's Commonwealth Marine Area - Report	https://www.nespmarine.edu.au/document/armada-marine-data-aggregator-and-visualisation-tool-support-management-australia%E2%80%99s
			Sensitivity of fine-scale species distribution models to locational uncertainty in occurrence data across multiple sample sizes - Journal Article	https://www.nespmarine.edu.au/document/sensitivity-fine-scale-species-distribution-models-locational-uncertainty-occurrence-data
			Changes in deep reef benthic community composition across a latitudinal and environmental gradient in temperate Eastern Australia - Journal Article	https://www.nespmarine.edu.au/document/changes-deep-reef-benthic-community-composition-across-latitudinal-and-environmental
			Collation of existing shelf reef mapping data and gap identification - Phase 1 Final Report Shelf reef key ecological features - Report	https://www.nespmarine.edu.au/document/collation-existing-shelf-reef-mapping-data-and-gap-identification-phase-1-final-report
			Identification and collation of Australia's shelf mapping datasets and development of a national geomorphological classification scheme for reef systems - Phase 1 Workshop Report - Report	https://www.nespmarine.edu.au/document/identification-and-collation-australia%E2%80%99s-shelf-mapping-datasets-and-development-national
			Mapping shelf rocky reef habitats in the Hunter Commonwealth Marine Reserve - Report	https://www.nespmarine.edu.au/document/mapping-shelf-rocky-reef-habitats-hunter-commonwealth-marine-reserve
			Geomorphological classification of reefs: draft framework for an Australian standard - Report	https://www.nespmarine.edu.au/document/geomorphological-classification-reefs-draft-framework-australian-standard
			Spatial scale and geographic context in benthic habitat mapping: review and future directions - Journal Article	https://www.nespmarine.edu.au/document/spatial-scale-and-geographic-context-benthic-habitat-mapping-review-and-future-directions
			Biological and habitat feature descriptions for the continental shelves of Australia’s temperate-water marine parks- including collation of existing mapping in all AMPs	https://www.nespmarine.edu.au/document/biological-and-habitat-feature-descriptions-continental-shelves-australia%E2%80%99s-temperate-water
			Workshop report from the inaugural National MPA Science/Management Network meeting	https://www.nespmarine.edu.au/document/workshop-report-inaugural-national-mpa-sciencemanagement-network-meeting-0
			Workshop report from the National BRUV Forum – Perth, 18-19 July 2017	https://www.nespmarine.edu.au/document/workshop-report-national-bruv-forum-%E2%80%93-perth-18-19-july-2017
			Reefs on the Australian Continental Shelf	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=2ffb37a5-5c58-4ea9-a47d-5d526be31346

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			Outputs (List outputs described in the project plan as well as any additional outputs the project delivered. Insert extra rows as needed)	**Link to output** (Provide hyperlinks to outputs/products where available)
			Hydrographic Survey of the Boags Commonwealth Marine Reserve in Southwestern Bass Strait	http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=fd47612a-fb21-4459-9e3a-adf66ed8ca59
			First look at deep rocky reefs in Beagle Commonwealth Marine Reserve	https://www.youtube.com/watch?v=i2JCGR2SEAc&t=15s
			Discovering black corals in Freycinet Commonwealth Marine Reserve	https://www.youtube.com/watch?v=kgKgNgx4UP4&t=83s
			Oceans of the Unknown Exhibition - mapping the oceans	https://www.youtube.com/watch?v=vzYATX64Lng
			RV Investigator Voyage - Blogging the Seamounts voyage	https://www.nespmarine.edu.au/seamounts/landing-page
			RV Investigator Voyage - Videos from the Seamounts voyage (23 Nov - 19 Dec 2018)	https://www.youtube.com/user/NERPMarineHub/feed
D4	Expanding our spatial knowledge of marine biodiversity to support future best-practice reviews	This project will fill data gaps and evaluate methods relevant to the ongoing spatial management of seafloor biota across the Australian marine domain. The objective is to prepare Australian, State and Territory governments for future best-practice reviews of Australia's marine bioregionalisation that can be used to improve marine spatial planning and management initiatives (e.g. marine bioregional plan and marine protected area reviews, environmental impact and natural heritage assessments). The project will incorporate results from field trips to unexplored offshore areas of Australia's marine domain and communicate biodiversity values of the CMR network to the Australian public.	Contrasting processes drive ophiuroid phylodiversity across shallow and deep seafloors	https://www.nespmarine.edu.au/document/contrasting-processes-drive-ophiuroid-phylodiversity-across-shallow-and-deep-seafloors
			Report on deep-sea biological communities of the east coast AMP network	
			Report comparing endemnicity and species richness between east coast AMPs and Great Australina Bight communities	
			Report summaring project, available methods for future meso-scale bioregionalisations and opportunities to incorporate new data sources, and variation between taxonomic groups	
			Polychaetes from Australia's Eastern Abyss	https://www.nespmarine.edu.au/document/polychaetes-australia%E2%80%99s-eastern-abyss
			Towards an IMCRA 5	https://www.nespmarine.edu.au/document/towards-imcra-5

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			Outputs (List outputs described in the project plan as well as any additional outputs the project delivered. Insert extra rows as needed)	**Link to output** (Provide hyperlinks to outputs/products where available)
			RV Investigator voyage - Blogging the Abyss (15 May - 16 June 2017)	https://www.nespmarine.edu.au/abyss-landing-page
			RV Investigator Voyage - Videos from the Abyss voyage (15 May - 16 June 2017)	https://www.youtube.com/user/NERPMarineHub/feed
D5	A standardised national assessment of the state of coral and rocky reef biodiversity	This project will involve integration of a national suite of reef biota Underwater Visual Census (UVC) monitoring datasets (Reef Life Survey, UTas, AIMS, Parks Victoria, SA DEWNR) to provide a comprehensive update to the state of Australian Reefs report for the next national State of the Environment Report. Maps and indicator trends will show changes in the health of rocky and coral reefs nationally from 2005 to 2020. The update will include addition of a new index which summarises the population trajectories for 600-1000 reef species nationally. Individual species trajectories will provide the only threat status information for the majority of these species, assisting future listing of previously unassessed species if significant declines are detected.		
D6	Socioeconomic benchmarks	Social and economic values are key drivers for marine science and marine policy but are too rarely integrated with marine biodiversity monitoring programs. In close consultation with PA we will review existing metrics used to survey social and economic values associated with marine parks. This review will include consulting with national and international expertise and actively consulting with State and other Commonwealth agencies, some of whom are currently conducting reviews or have existing frameworks for surveying social and economic values (e.g GBRMPA, NSW DPI and Vic Parks). In collaboration with national partners and PA we will organise a national methods workshops to discuss and refine metrics and methods to quantify social and economic benchmarks for State and Australian Marine Parks (AMPs) and produce an SOP relevant to AMPs taking into consideration the DoEE's environmental accounting processes and PA's Monitoring, Evaluation, Reporting and Improvement (MERI) framework.		

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			Outputs (List outputs described in the project plan as well as any additional outputs the project delivered. Insert extra rows as needed)	**Link to output** (Provide hyperlinks to outputs/products where available)
E1	Guidelines for analysis of cumulative impacts and risks to the Great Barrier Reef	Existing guidance and standards for assessing impacts and risk (e.g. ISO 31000) are specified at a high-level allowing for considerable variation in approach, cost and outcomes from assessments and no guidance on direct or cumulative impacts. We will develop a national standard to support analysis of impacts and risks to the environmental, social and economic values required by the EPBC Act. The standard will be compatible with and support the process outlined in the Significant Impact guidelines for MNES and for Australian Marine Parks (AMP), including the means to calculate the impact and risk of upstream, downstream, facilitated and indirect impacts that will be presented in clear tabular and graphic formats, including maps as appropriate.	Ecosystem restructuring along the Great Barrier Reef following mass coral bleaching	https://www.nespmarine.edu.au/document/ecosystem-restructuring-along-great-barrier-reef-following-mass-coral-bleaching
			Final report - guidance for analysis of cumulative impacts and risk for GBRWHA	
			Plain English summary - guidance for analysis of cumulative impacts and risk for GBRWHA	
			A new wave of marine evidence-based management: emerging challenges and solutions to transform monitoring, evaluating, and reporting	https://www.nespmarine.edu.au/document/new-wave-marine-evidence-based-management-emerging-challenges-and-solutions-transform
E2	Characterising anthropogenic underwater noise to improve understanding and management of acoustic impacts to marine wildlife	Shipping noise is a marine pollutant that contributes significantly to the marine soundscape and is a stressor of marine animals, particularly marine mammals. In Australia, the characterisation and actual impacts of shipping noise on species behaviour are not clearly understood and information is needed. This research will provide quantitative spatial and temporal maps of vessel noise exposure and impacts to MNES. The outputs will provide key information to marine regulators and management agencies such as DoEE, AMSA and GBRMPA, and their counterparts in state and territory governments, to help them meet responsibilities and obligations under international and national law and policy to minimise the impacts of the shipping noise on MNES.	Database of ship source spectra for predominant large vessels	
			Finescale shipping nosie map map for a smaller area (e.g. GBR) to demonstrate improved methods/data	
			Paper on improve methods of ambient noise estimation	
			Short report summarising the results of the initial investigation into incorporating other sound sources and cumulative mapping and a roadmap to accomplish aims in year 2 of project	
E4	Recreational fishing in Commonwealth waters	Australia's recreational fishing sector is moving further offshore in pursuit of fishing opportunities, which places them in areas managed by the Australian Government. Most recreational fisheries research is state based and at two case study sites - Hunter Australian Marine Park (AMP) and the Ningaloo AMP - this data will be assessed for its usefulness to quantify offshore fishing. New data will also be collected will also be collected using creel, socio-economic and remote sensing techniques to better understand fisher's effort, harvest and motivations. As well, the response by fish communities to harvest and the fishery to climate change will be assessed at larger scales. As recreational fishers are key stakeholders in marine management and regulation, a better understanding of their values is required to effectively inform administration of the EPBC Act (e.g. effects of Matters of National Environmental Significance), use of Australian Marine Parks and Commonwealth managed commercial fisheries.	Recreational fishing in Commonwealth waters - Milestone Report, milestone 6 RPv4 2018	Submitted for director approval
			State-based aggregated recreational fishing data (WA and NSW)	

Project Number/ID	Project Name/Title	Project Summary	Outputs	
			Outputs (List outputs described in the project plan as well as any additional outputs the project delivered. Insert extra rows as needed)	**Link to output** (Provide hyperlinks to outputs/products where available)
E5	The role of restoration in conserving MNES	Restoration of marine ecosystems offers the prospect of effective conservation in the face of chronic degradation and climate change. But techniques for restoration are generally in their infancy. In 2018 this project will review the capacity for recent advances in restoration of • giant kelp forests, • coral reefs, • seagrass communities, • saltmarsh communities, and • shellfish communities, to reduce conservation risks associated with matters of national environmental significance (MNES) listed under the Cth EPBC Act. In subsequent years we will trial and extend restoration techniques in the more promising habitats and develop a restoration decision framework to guide future investments.	The role of restoration in conserving matters of national environmental significance in marine and coastal environments	https://www.nespmarine.edu.au/document/role-restoration-conserving-matters-national-environmental-significance-marine-and-coastal
			Report on cost-effectiveness of alternative restoration projects	
E6	Assisting restoration of ecosystem engineers through seed-based and shoot-based programs in the Shark Bay WHS	This project will develop community-based seeding and shoot planting restoration practices in the Shark Bay World Heritage Site (WHS). The goal is to scale up the existing restoration research to practice and assist recovery of the dominant seagrasses, Amphibolis antarctica and Posidonia australis following the 2011 marine heat wave. The Shark Bay WHS is unique globally for its natural values, including stromatolites, extensive seagrass meadow that have constructed sills and banks over 1,000s of years resulting in restricted exchange with the ocean, unique and abundant marine megafauna including 1/8th of the worlds population of dugongs, large populations of sharks and turtles, and one of the longest studied populations of dolphins in the world. The inshore waters of the WHS provides connectivity to the deeper waters of the adjacent Commonwealth Shark Bay Marine Park. Shark Bay seagrasses have recently been devastated by the marine heatwave of 2010-2011 and these events are predicted to increase in frequency and intensity with global warming. The loss of 23% of seagrass cover in the bay (860 km2) had a		

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E7	Assessing the feasibility of restoring giant kelp beds in eastern Tasmania	The proposed research will extend on externally funded work commencing in 2018 to select for thermally tolerant and low-nutrient-tolerant giant kelp (Macrocystis pyrifera) genotypes, and which will examine effects of acclimation of selected genotypes by pre-exposure to warm, nutrient poor conditions. The project will outplant pre-exposed selected genotypes of giant kelp as micro-sporophytes in experiment providing / not providing an added source of nutrient. The work is designed to assess the feasibility of this approach as a means to develop minimum patch sizes for giant kelp that can be self-replacing and self-expanding.		

MBH 2018 Annual Progress Report – Attachment B

Compiled Impact Stories

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NESP Impact Story 1

Hub
Marine Biodiversity

Title
A closer look at the status of sea snakes in Australia

Project number
Project A8: Exploring the status of Western Australian sea snakes

Short version
The Marine Biodiversity Hub is assessing the status of sea snakes across tropical Australia with a focus on the west coast following population declines that include the presumed extinction of three species at Ashmore Reef Marine Park. We are working with state fisheries departments in Western Australia, the Northern Territory and Queensland, and with Anindilyakwa Land and Sea Rangers in the Marine Indigenous Protected Area around Groote Eylandt. The new knowledge is being used by state and territory governments to guide fisheries bycatch strategies; by the Department of the Environment and Energy (DoEE) to assess conservation listings under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act); and by Parks Australia to build the inventory of natural values and baselines for monitoring in Australian Marine Parks.

Narrative

THE CONTEXT/PROBLEM
Western Australia has a diversity of sea snake species, and the highest number of threatened sea snakes in the world. Sea snakes have been a conservation priority due to population declines at Ashmore Reef Marine Park, including the presumed local extinction of three species: the Critically Endangered Short-nosed sea snake (*Aipysurus apraefrontalis)* and Leaf-scaled sea snake, (*Aipysurus foliosquama)*, and the Endangered Dusky sea snake (*Aipysurus fuscus*).

The subsequent discovery of populations of the two Critically Endangered species more than 800 kilometres south of their previously known range highlights the lack of knowledge for these species and more generally this group. Poor species-level information can cause inappropriate assignment of conservation status, and hamper risk-assessments and regional policies regulating human activities, including at Ashmore Marine Park.

Accurate information on the spatial and temporal distribution of protected species is critical to understanding the threats they face. *For example, it is crucial to understanding the overlap and potential impact of interactions with fisheries.*

THE RESEARCH IMPACT

This project is collating existing data, collecting targeted data, and visualising predicted fine-scale distributions and habitat association patterns for sea snakes inside and outside fishing grounds. Using these methods, new populations have been identified for two of the three species previously presumed extinct.

The new knowledge is reducing uncertainty relating to species conservation status and threatening processes. It underpins state and territory government fisheries bycatch strategies, and guides conservation assessments by the Department of the Environment and Energy (DoEE) for species listed as Critically Endangered *under the Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

For Parks Australia, the knowledge is adding to the inventory of natural values and baselines for monitoring in Australian marine parks, in particular sea snake assemblages at Ashmore Reef and Cartier Island marine parks.

Nationally consistent methods and manager-friendly visualisation tools are proving of great value to management agencies. For example, predictive modelling is showing fisheries managers where protected and threatened sea snake species interact with trawl fishing grounds.

HOW THE IMPACT WAS ACHIEVED

Hub research has improved access to existing scattered information on sea snakes, increased the available information through targeted sampling based on predictive habitat models, and collected samples for future research on stock structure and connectivity.

At the request of Parks Australia, existing occurrence data for sea snake species in Western Australia was updated by collating previous survey data for the North West Marine Region. In addition, Hub researchers conducted intensive field surveys to update records and collect tissue samples across coastal Western Australia, from Exmouth Gulf and Murion Islands, to Bassett-Smith shoal in the Northern Kimberley.

Updated occurrence data were subsequently used in predictive spatial models to understand the potential distribution and geographic ranges for this group. The models have identified habitat associations for conservation priority sea snake species, and highlighted potential new locations. Preliminary field validation of these models has uncovered a new locality for the Endangered Dusky sea snake at Heywood Shoal.

Fisheries agencies in Western Australia, the Northern Territory and Queensland are helping researchers understand interactions between sea snakes and demersal trawl fisheries across the different sectors. Data on commercial bycatch are being compiled to understand the assemblage of sea snake species

interacting with fisheries. We are also working closely with the Anindilyakwa Land and Sea Rangers to undertake surveys of sea snakes within the Marine Indigenous Protected Area (IPA) around Groote Eylandt. As an area closed to trawl fishing, surveys within the IPA will help understand whether protected areas adjacent to heavily fished grounds provide refuge for sea snake species regularly caught as bycatch in the fishery. Knowledge from Sea Rangers is being used to inform where researchers collect data, they are also building their capacity to deploy scientific methods to collect data to inform understanding about the status of sea snakes and other marine species of interest.

SUPPORTING INFORMATION

'Accurate information on the spatial and temporal distribution of protected species is critical to understanding the processes that threaten them. In a fisheries context, it is crucial to determine the spatial extent of species such as sea snakes so as to understand the overlap and potential impact that fisheries interactions have on their populations. **Through predictive modelling, this project has provided fine scale distributions and habitat association patterns for protected and threatened sea snake species inside and outside of highly productive trawl fishing grounds**.'

- Dr Mathew Hourston, Research Scientist, Department of Primary Industries and Regional Development, Bycatch and Harvest Strategies, Science and Resource Assessments Division, Perth, Western Australia, Australia

'Parks Australia values research that contributes to improving knowledge of Australian Marine Parks. Our priority is building an inventory of our park values and establishing baselines that allow us to monitor trends over time. **Research that contributes to our understanding of natural values, such as sea snake assemblages at Ashmore Reef and Cartier Island Marine Parks, is useful.** Also, research that applies nationally consistent methods and delivers manager-friendly visualisation tools is of great value to management agencies'.

- Parks Australia

Research outputs

Udyawer, V., P. Barnes, X. Bonnet, F. Brischoux, J. M. Crowe-Riddell, B. D'Anastasi, B. G. Fry, A. Gillett, C. Goiran, M. L. Guinea, H. Heatwole, M. R. Heupel, M. Hourston, M. Kangas, A. Kendrick, I. Koefoed, H. B. Lillywhite, A. S. Lobo, V. Lukoschek, R. McAuley, C. Nitschke, A. R. Rasmussen, K. L. Sanders, C. Sheehy, R. Shine, R. Somaweera, S. S. Sweet, and H. K. Voris. (2018). Future directions in the research and management of marine snakes. Frontiers in Marine Science **5(399)**. doi:10.3389/fmars.2018.00399

Nitschke, C. R., M. Hourston, V. Udyawer, and K. L. Sanders. (2018). Rates of population differentiation and speciation are decoupled in sea snakes. Biology Letters **14(10)**. doi:10.1098/rsbl.2018.0563

Udyawer, V., and M. Heupel. (2017). Spatial and temporal patterns in sea snake populations on the North West Shelf, Progress Report for NESP MBH Project A8,. National Environmental Science Programme, Canberra, Australia. https://www.nespmarine.edu.au/document/spatial-and-temporal-patterns-sea-snake-populations-north-west-shelf-progress-report

Udyawer, V., R. Somaweera, C. R. Nitschke, B. D'Anastasi, K. Sanders, B. Webber, M. Hourston, M. Heupel. (In prep). Prioritising search effort to locate previously unknown populations of rare sea snakes. Conservation Biology.

Attributions

Australian Institute of Marine Science:
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The Royal Danish Academy of Fine Arts, Schools of Architecture, Design and Conservation:
Arne R. Rasmussen

The University of Sydney:
Richard Shine

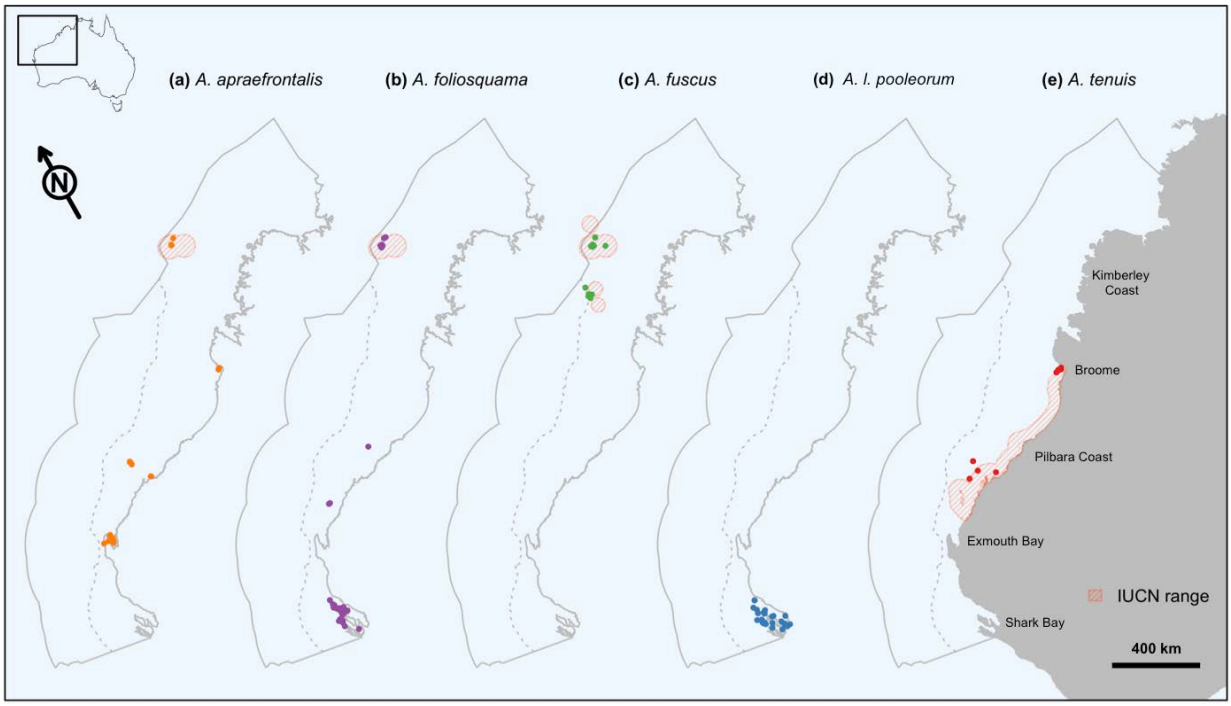
University of California, Santa Barbara:
Samuel Sweet

Field Museum of Natural History, Chicago:
Harold K Voris

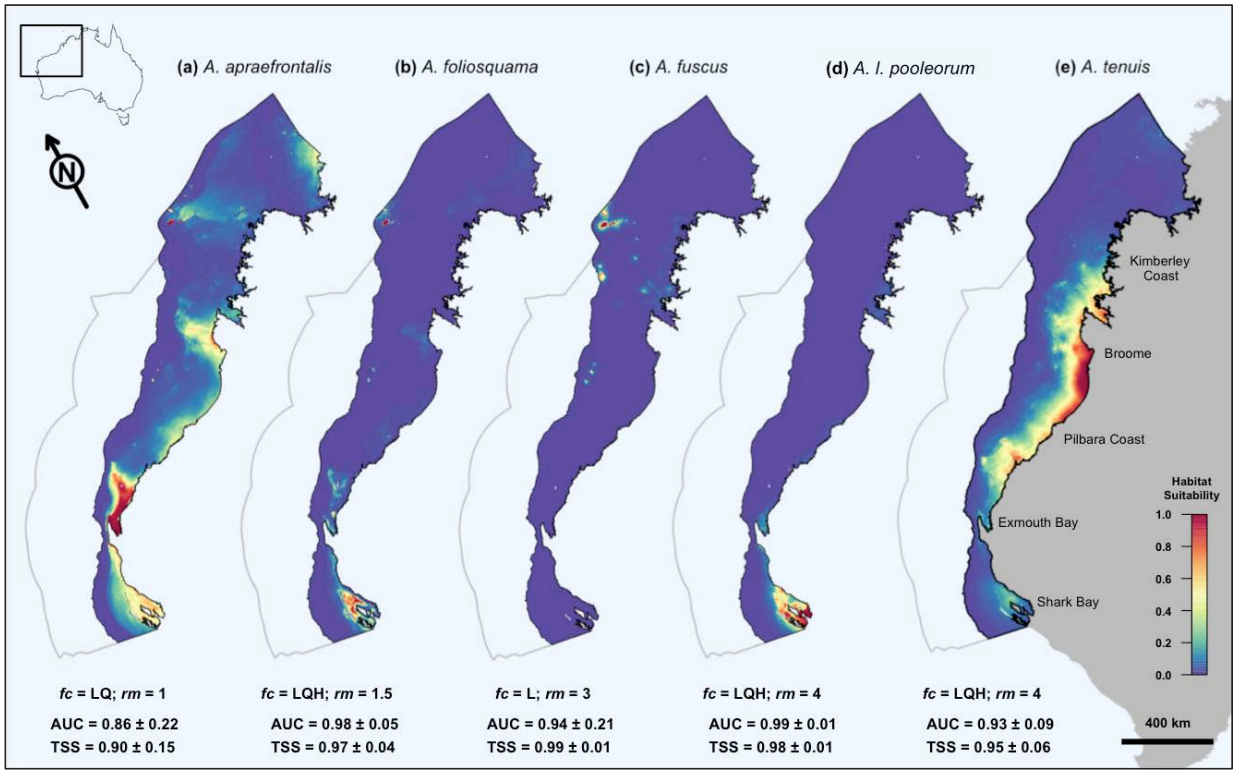
Nature Conservation Foundation, India:
Aaron S. Lobo

Scalable and interactive version of the model outputs:

https://vinayudyawer.github.io/SeaSnake-NicheModels/ModelMap.html



The currently recognised distribution of five endemic sea snakes in WA (red hatched polygons), with the additional data compiled by the NESP A8 project.



The predicted suitable habitats for those species modelled on the new data compiled by the A8 project.

Vinay Udyawer and Charlotte Nitchke processing a sea snake during snorkel surveys around the Murion Islands. Surveys collected species and habitat association data and a small tissue sample from any sea snakes encountered during a timed snorkel transect. Image: Vinay Udyawer

Sea snake bycatch from one night's research trawl sampling within Exmouth Gulf. This night we sampled five individuals from three species, including the Critically Endangered Short-nosed sea snake (*Aipysurus apraefrontalis*). All individuals were released in healthy condition after measurements and a small tissue sample was collected from them. Image: Vinay Udyawer

A Dusky sea snake (*Aipysurus fuscus*) captured at Heywood Shoal, a location from where this species has not previously been recorded. Image: Chris Dowling.

NESP Impact Story 2

Hub
Marine Biodiversity

Title
Captive breeding and habitat conservation of Red Handfish

Project number
Project A10: Conservation of handfish and their habitat

Short version
A Red Handfish egg mass and its adult guardian has been collected from the wild and hatched in captivity, significantly boosting the known population size of this Critically Endangered species. The National Handfish Recovery Team supported the high-risk plan based on systems, knowledge and partnerships developed during the Spotted Handfish captive rearing program. These factors were critical to the project's resounding success.

Narrative

CONTEXT/PROBLEM
The Red Handfish (*Thymichthys politus*), arguably the rarest known fish in the world, is near extinction. Previously locally common around the South East Tasmanian coastline, it is now known only from two 50-metre patches of rocky reef in Norfolk Bay, Tasmania. One site has an estimated 100 individuals and the other has an estimated 5–10 individuals.

Critical interventions are needed when species reach these dangerously low abundance levels, but mistakes can hasten a species' demise.

THE RESEARCH IMPACT
This project removed one Red Handfish egg mass and its attendant female adult and hatched the eggs in captivity at CSIRO Hobart. Seventeen of the juvenile Red Handfish are now held at Seahorse World.

This achievement is potentially an important step towards boosting the population size of the Red Handfish. Juveniles can be 'head-started' by being reared in the aquarium beyond the highest stage of natural mortality (the first year of life) and released to 're-seed' wild populations, and eggs can be collected each year to build up captive breeding stocks as an insurance population.

This work lays the foundation for potential future activities including population assessment, ecological studies, protective zoning, and further captive breeding and reintroduction to the wild. As part of the 'head-starting' approach, work was also undertaken to rehabilitate Red Handfish habitat. A team of seven divers funded by University of Tasmania (UTAS) removed 3000 urchins from a 100 m x 10 m area of shallow reef (3–5 m depths) at the most heavily degraded site.

How the impact was achieved

The collection and captive hatching and rearing of Red Handfish was an emergency response involving CSIRO, UTAS, and government and commercial partners, working closely with the NHRT. The rapid response was possible because of the systems, expertise, and partnerships developed in 2017 during the successful captive rearing program for the Critically Endangered Spotted Handfish. The Marine Biodiversity Hub provided funding for both projects.

In September 2018, the imminent threat to the Red Handfish due to severe habitat degradation prompted an extraordinary meeting of the NHRT and an 'emergency intervention' plan was developed.

In agreeing to the intervention, the NHRT, together with Commonwealth and state government advisors, noted that the effort to hatch and rear a single clutch of Red Handfish from an extracted egg mass was highly risky, especially for a species with so few remaining individuals. Based on the experience of the same collaborators for the Spotted Handfish (*Brachionichthys hirsutus*), however, the risks had been reduced.

Furthermore, the required expertise, resources and facilities were still in place and could be quickly made operational. The chances of finding another red handfish egg mass. The NHRT knew there was no certainty that divers would find another Red Handfish egg mass this year or in the future.

The captive rearing process

The adult female Red Handfish and egg mass were collected in November 2018 and transferred to CSIRO according to collection protocols developed for the Spotted Handfish.

The Spotted Handfish holding facility at CSIRO Hobart was adapted to meet the different requirements, such as water chemistry, and habitat features and diet.

Transfer to aquaculture facility

In December 2108, 17 juveniles were transferred to a newly commissioned facility at Seahorse World, Beauty Point, Tasmania, using transport procedures developed for the Spotted Handfish. To the relief of all who felt the weighty responsibility of keeping the Red Handfish alive, the intervention has so far been a success.

Supporting evidence

'**The cooperation between researchers from different institutions, government agencies, and other key stakeholders (including private businesses) to absorb new information on threats to the red handfish, identify the necessary actions to mitigate these threats, the resources required and the options to obtain them, and to work cooperatively to build a**

business case over a very short time-frame, is unprecedented in my experience in managing threatened species.

The initial results speak for themselves, and it is no exaggeration to say that this cooperative effort has probably prevented the imminent extinction of this species - at least for the time being.

The key lessons that have been learnt are: the importance of cooperation between experts and Government; the value of being able to work flexibly and pragmatically; and the critical importance of having a financial reserve available to fund emergency intervention activities.'

– *Andrew Crane, Manager, Policy and Conservation Advice Branch, Natural and Cultural Heritage Division, Department of Primary Industries, Parks, Water and Environment, Tasmania*

'**Is there a more urgent marine conservation need than handfish? Probably not. So the rapid response and collaboration of all involved in handfish conservation has been important and great to see. Plenty more to be done but things are looking a lot more positive than they were a short while ago with captive breeding and habitat protection under way.'**

– *Professor Caleb Gardner, Institute for Marine and Antarctic Studies*

The red handfish is listed as Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A recent escalation of threats to this species, coupled with the availability of new population and habitat information, prompted emergency interventions to be identified by the Handfish Recovery Team**. The NESP Marine Biodiversity Hub have played a crucial role in coordinating prompt and appropriate cooperation between researchers and government agencies, and implementing on-ground actions that may well contribute to the prevention of the extinction of this species. The cooperative and innovative approach of the Marine Biodiversity Hub should be applauded in this instance and the Department would like to congratulate the coordinators of this project for an exceptional effort in coordinating urgent conservation efforts.**

– *Lesley Gidding-Reeve, Director, Marine and Freshwater Species Conservation, DOEE*

'Of all the exciting projects I have been privileged to undertake as an aquaculturist at Seahorse World, working on the Handfish Recovery Program is the single most satisfying endeavour of my career to date. The Spotted Handfish juveniles are now 15 months old and every day I am learning something new about them.

To be asked in December to help raise the small number of Red Handfish babies hatched out at CSIRO labs, and to care for their mum, completely tops off this experience. We are honoured to partner with CSIRO, IMAS and the Marine Biodiversity Hub in this critical conservation venture, and we

hope that our efforts will contribute to eventually ensure that the Red Handfish is ultimately saved from extinction.'

– *Rachelle Hawkins, Director, Seahorse World*

This Red Handfish and her egg mass were successfully transferred to the CSIRO holding facility. Seventeen juveniles are now in captivity at Seahorse World.

Image: Rick Stuart-Smith, UTAS

Attributions

Dr Tim Lynch, CSIRO and NESP Marine Biodiversity Hub: Project leader
Kim Lee Chang, CSIRO Australian National Algal Collection: set up brine shrimp facility and managed purchase of captive rearing facility for Seahorse World
Tim Fountain, CSIRO: adapted captive rearing facility
Stephanie Faber, CSIRO: intern from the Netherlands provided aquarium care

Tyson Bessel PhD candidate: research to cover captive rearing, feeding, population assessment, animal morphometrics (distinguishing male and female) and eDNA methods for more effectively for unknown populations.
UTAS dive team: Dr Rick Stuart-Smith, Toni Cooper, Carolina Garcia, Louise De Beuzeville, Martin Puchert, Ondine Pontier and Nelson Roberts
Rochelle Hawkins: Director, Seahorse World: provided advice on fish care and leading the care of the juvenile Red Handfish
The National Handfish Recovery Team includes representatives from the Department of the Environment and Energy (Commonwealth), the Department of Primary Industries, Parks, Water and Environment (Tasmania), CSIRO, the Derwent Estuary Program, and the Institute for Marine and Antarctic Studies at the University of Tasmania.

Additional information

While Spotted Handfish like open areas of sand, Red Handfish are reef species and prefer to be wedged in place, with one foot on a protective structure. Reef, rocks and other animals were added to the tank, which was conditioned to provide the right biological environment and water chemistry. It was a nerve-wracking time, with 'mum' not eating her amphipods until her home was satisfactory.

A special 'food factory' was built from scratch to produce the correct microalgae to grow a supply of artemia (brine shrimp) for the Red Handfish hatchling's daily feeds. This called on the expertise of the Australian National Algal Collection.

Potential future research

The following are potential avenues of future research being considered for the Red Handfish.

- A PhD student has been engaged and is likely to conduct eDNA surveys to seek unknown populations (from sampling seawater), and a whole-population survey.
- Working with the Tasmanian state government to establish protection zones within Red Handfish habitats.
- Removal of urchins and 'head-starting' animals from captivity into the Primrose Sands site, where the existing population is thought to have been lost (due to the spread of urchins).
- Another round of eggs could potentially be removed this year to 'head-start' in captivity and then return to the wild, thereby increasing genetic diversity at the depleted site.
- Investigating the triggers for spawning in captivity while concurrently considering genetic and biosecurity considerations for a re-stocking program, should captive breeding prove successful.
- Exploring non-invasive techniques to obtain samples suitable for population genetics studies.

NESP Impact Story 3

Hub
Marine Biodiversity

Title
Assessing the status of Australia's sharks, skates and rays

Project number
Project A11: Shark Action Report

Short version
The Shark Action Report provides a national perspective of the status of 328 shark, skate and ray species in Australia relative to conservation and management policies of the Northern Territory, Queensland and Australian governments. The Department of the Environment and Energy (DoEE) is using this fundamental knowledge to identify at-risk species and ensure the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) is as up to date as possible in protecting threatened sharks, skates and rays. Their task has been made easier as only 12% of assessed species were identified as threatened: one of the lowest threat rates for regional or national level assessments for these species.

Narrative

CONTEXT/PROBLEM
Sharks, skates and rays have life history characteristics that render their populations susceptible to human activities and climate variability. With increasing numbers of threatened and exploited species exposed to human and natural threats, a national approach was needed to understand their population status, the extent of threats and existing protection measures and to identify management solutions. This information facilitates up-to-date listings under the EPBC Act, and guides effective conservation and management by DoEE and fishery managers.

THE RESEARCH IMPACT
This assessment by the Marine Biodiversity Hub provides a new big-picture perspective of the overall status of shark, skate and ray species in Australian waters relative to current conservation and management policies. It identifies species of conservation concern, and knowledge gaps that may affect our ability to adequately understand population status and efficacy of management.

Recommendations compiled for application to management are guiding the conservation and protection of these species by managers in the Northern Territory, Queensland and the Australian governments.

For example, the knowledge is being used by the DoEE to define at-risk species that require further attention, to reveal species that may require future protection, and those that are abundant and of no immediate conservation concern. It is fundamental to ensuring the EPBC Act is as up to date as possible in protecting threatened sharks, skates and rays.

HOW THE IMPACT WAS ACHIEVED

National Action Plans for Australian mammals and birds have supported DoEE, state and territory governments in prioritising and managing threatened species and the decision was made by DoEE and Hub scientists to develop a National Action Plan for Chondrichthyans to provide similar gains in efficiency and effectiveness.

The project team used the assessment process for the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species to assess the status of 328 chondrichthyan species. Status assessments were completed for 328 chondrichthyan species to identify those needing additional conservation action.

The following information contributes to a shared understanding of their national status.

- The majority of assessed Australian shark and ray species were determined not to be in a threatened category and were assessed as Near Threatened (9.8%) or Least Concern (69.4%). A further 9.2% are currently Data Deficient (insufficient information to assess their status). Thus 11.6% of assessed species fell within a threatened category. This is one of the lowest threat rates when compared to other regional or national level assessments for these species.
- Three of five species assessed as Critically Endangered are currently protected under the EPBC Act.
- Eleven of 16 species assessed as Endangered are currently protected under the EPBC Act.
- Five of 17 species assessed as Vulnerable are currently listed under the EPBC Act.
- The main threat to Australian chondrichthyan species is commercial fishing pressure through targeted harvest or bycatch mortality.

Results of this project provide summary information on the potential threats to species in Australian waters, as well as individual species assessments.

Project outputs include advice on how to approach assessment of the status of Australian chondrichthyans relative to international convention listings such as the Convention on Conservation of Migratory Species.

Assessments of species status, based on IUCN Red List of Threatened Species categories and criteria will be compiled into a book for management and conservation agencies.

Supporting evidence

'**IUCN Species assessments provide a much needed global window into the underwater world. It would be difficult to put national conservation efforts into a global context without the global perspective Red List assessments provide.**'

– *Nick Dulvy, Co-Chair of the IUCN Shark Specialist Group*

'The production of national-scale action plans has significant benefits for defining the status of Australian animal populations. These assessments provide important status information that is used to define at-risk species that require further attention, reveal species that may require future protection and those that are abundant and of no immediate conservation concern. **This project is fundamental to ensuring the EPBC Act is as up to date as possible in protecting threatened sharks and rays.**'

– *Lesley Gidding-Reeve, Director, Marine and Freshwater Species Conservation, DOEE*

A juvenile Largetooth Sawfish in a drying waterhole. Image: Peter Kyne.

A Great Hammerhead shark tagged with a miniPAT tag. Image: Andrew Chin

The Mumburarr Whipray, a new species, of whipray from northern Australia. Credit: Peter Kyne

Research outputs

Outputs of this project are in final stages and will be made available via the Marine Biodiversity Hub website in the near future.

Attributions

Michelle Heupel, Australian Institute of Marine Science

William White, CSIRO

Peter Kyne, Charles Darwin University Research Institute for the Environment and Livelihoods

Colin Simpfendorfer, James Cook University Centre for Sustainable Tropical Fisheries and Aquaculture

NESP Impact Story 4

Hub

Marine Biodiversity Hub

Title

First national snapshot brings the opportunity for a seachange in wastewater management

Project number

Project C4: National Outfall database

Short version

This project built a collaborative information sharing network among governments, water authorities, researchers and communities. It is the first attempt in Australia's history to provide all these stakeholders with ready access to high quality coastal wastewater data, consolidated at a national level. The resulting National Outfall Database produced by Clean Ocean Foundation and the Marine Biodiversity Hub provides a transparent, national evidence base for considering risks and investments in sewage infrastructure and wastewater recycling. For example, the 2016 national snapshot of wastewater discharges to Australia's coastal environment identified $1 billion of economic benefit if only 20% of the discharges were recycled by upgrading treatment facilities.

Narrative

THE CONTEXT/PROBLEM

Much of the wastewater generated by Australia's increasing coastal population is released to the marine environment. Data on Australia's wastewater treatment facilities and outfalls, however, has been inaccessible and unconsolidated, making it very difficult to predict their impacts, and the lost opportunities associated with wastewater treatment. Coastal communities were unable to understand the potential effects of wastewater on the environment and water users.

THE RESEARCH IMPACT

The National Outfall Database (NOD) produced by Clean Ocean Foundation and the Marine Biodiversity Hub is the first attempt in Australia's history to provide all stakeholders with ready access to nationally-consolidated high quality coastal wastewater data. Now accessible on a public website, it includes 2015 and 2016 datasets covering treatment types and volumes, monthly flow rates and the composition of water discharged (nutrients and other pollutants) for 181 ocean, river and estuary outfalls.

Analyses of the 2016 dataset reveals the total wastewater discharge to Australia's oceans was 1350 gigalitres: equivalent to 2.7 Sydney harbours. The potential value of this water would have been more than more than $1 billion, had as little as

20% been recycled. Wastewater discharge per person ranged from more than 50,000 litres in Western Australia to more than 150,000 litres in New South Wales.

Governments, water authorities, local councils, researchers and the public now have a transparent evidence base to guide discussion and decision making about risks and investments in sewerage infrastructure, wastewater recycling, and standardised national reporting.

The database provided the basis of a groundbreaking economic report co-authored by Dr Boyd Blackwell of AquaEquis Consulting and John Gemmill of Clean Ocean Foundation: *Coastal Outfall System Upgrades in Australia: Benefits, Costs, and Improved Transparency.*

This report provides a preliminary cost-benefit analysis of upgrading Australia's 181 coastal outfalls to a tertiary level to produce Class A recycled water for non-drinking purposes, providing opportunities for increased water reuse and reduced disposal to the ocean. It estimates net benefits of $22 billion to $52 billion, with upgrade costs of $7 billion to $10 billion: evidence that these upgrades are economically desirable, even without the added environmental, health and social benefits.

HOW THE IMPACT WAS ACHIEVED

Collaboration between the Marine Biodiversity Hub and Clean Ocean Foundation demonstrated both ministerial and public interest in wastewater data, and encouraged the participation of water treatment authorities.

Agreements and relationships were established to systematically collate and make public existing wastewater data from relevant state water authorities in all six states and the Northern Territory. Negotiations with state governments and water authorities (and some local councils) included developing standards for reporting. Previously, many discharging authorities only had to display their license conditions, rather than what they were discharging. The resulting data was collated and analysed by Clean Ocean Foundation and UTAS researchers. All data providers were invited to verify displayed data before public release.

Each outfall page on the NOD website includes information such as location, licence number and flow limit per day, and tables and trend charts for 32 indicators of water quality parameters. A clickable outfall map enables users to select a location and drill down to more specific links to key publications, data and resources.

Clean Ocean Foundation also initiated a network of recreational water users interested in helping to understand their water quality issues and become a part of the solutions. Sydney and Gold Coast coastal groups developed 'citizen science' protocols for water-quality monitoring and other communities were assisted to find information about local outfalls and make contact with like-minded coastal groups.

SUPPORTING MATERIAL

Testimonials

'Undertaking economic and policy analysis of wastewater system upgrades and reuse at national and state levels, would have been impossible without the National Outfall Database. We would still have no idea of how much water is being 'wasted' in Australia from wastewater being disposed of into our coastal waters. **Without this essential scientific information, it is impossible to analyse how to best address the negative impacts of wastewater outfalls for our coastal and marine communities**.'

– *Boyd Blackwell, AquaEquis Consulting*

'**I regard the 'National Outfall Database' as a highly significant and groundbreaking contribution to account for Australia's collective waste impacts on our surrounding oceans.** This database offers a true Australia-wide perspective and it contains detailed, helpful and confronting information. I expect that this will trigger action to reduce our discharge of harmful wastes to the marine environment. I congratulate all people that have participated in this ambitious and important project. I do hope that this can be replicated with a similar data base for Australia's inland river and stream outfalls.'

– *Dr Ian Wright, Senior Lecturer in Environmental Science, University of Western Sydney*

'Issues with masses of 'nurdles' [tiny microplastics] and cotton buds washing up on Warrnambool beaches have generated concerns and prompted beach clean-ups and awareness-raising activities by our community. **The National Outfall Database has been an invaluable information source for us: allowing us to locate other ocean outfalls around Australia as a step towards making contact with other similarly affected communities. It has saved us an enormous amount of work.'**

– *Colleen Hughson, Coordinator, Beach Patrol 3280 (Warrnambool, Victoria)*

Research outputs

National Outfall Database website

https://www.outfalls.info/

Coastal Outfall System Upgrades in Australia: Benefits, Costs, and Improved Transparency – Final Report

https://www.cleanocean.org/2019-upgrading-australias-outfalls.html

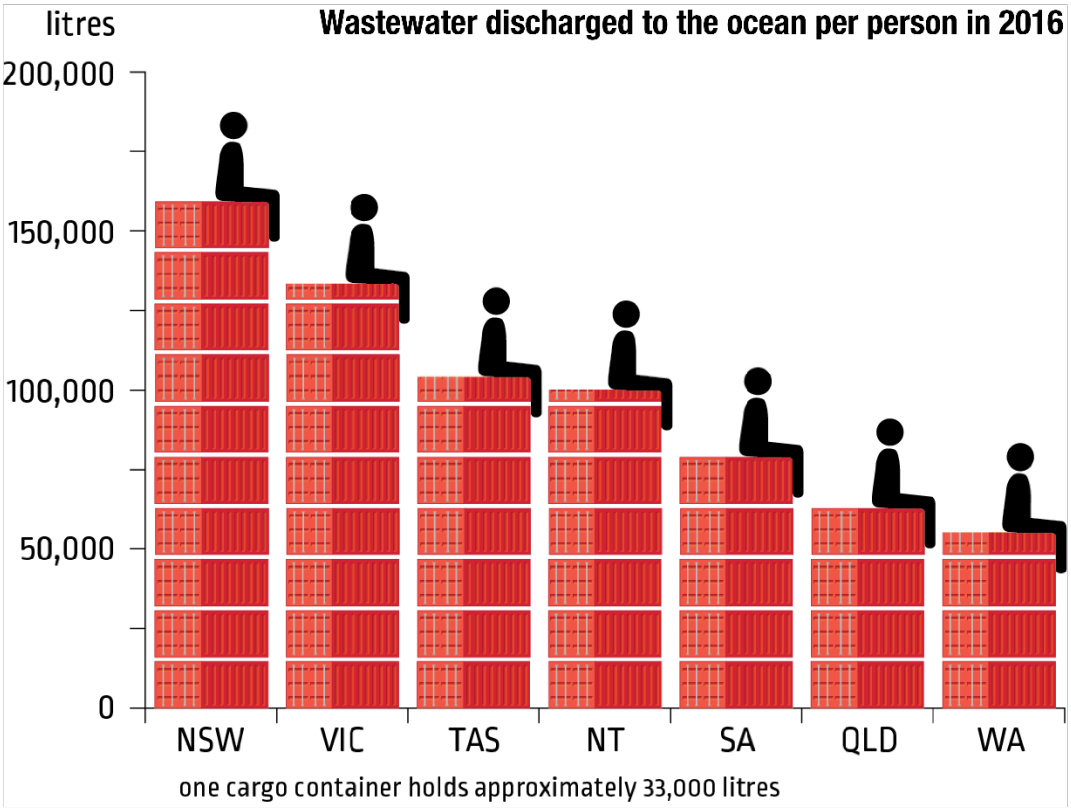
Publications and resources

https://www.outfalls.info/about/publications

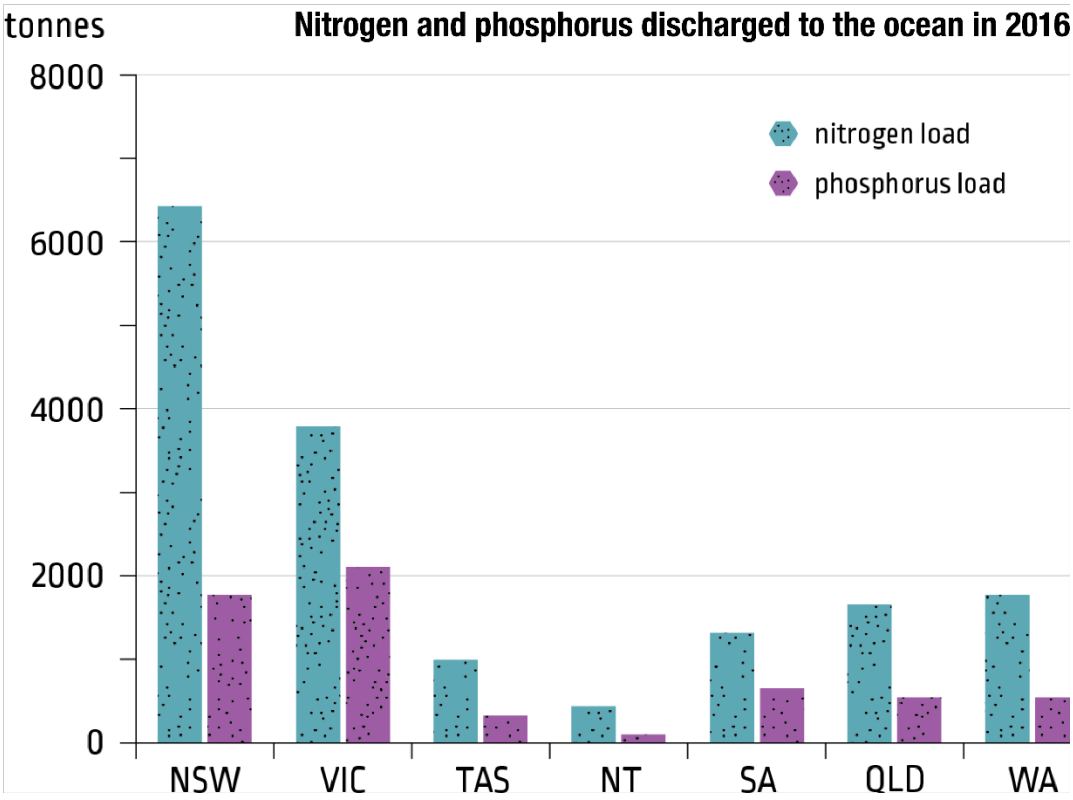
Community report: First national snapshot of wastewater discharged to Australia's oceans

https://www.nespmarine.edu.au/news/first-national-snapshot-wastewater-discharged-australias-oceans

Surfer scientists the next wave in ocean outfall monitoring
https://www.nespmarine.edu.au/news/surfer-scientists-next-wave-ocean-outfall-monitoring



Wastewater discharged to the ocean per person in 2016.



Nitrogen and phosphorus discharged to the ocean in 2016.

The National Outfall Database features a clickable map that users can use to locate details about their area of interest.

John Gemmill of Clean Ocean Foundation (right) and Brendan Donohoe of Surfrider Northern Beaches. The practical surfboard and beach-based toolkit they developed makes use of a backpack, ice and Eski. Image: Clean Ocean Foundation

Attributions

University of Tasmania

- Dr Andy Fischer, Data Modelling and Analysis
- Qurratu Ayunin Rohmana, Senior Researcher

Dr Boyd Blackwell – AquaEquis Consulting
Dr John Cumming – Infotech Research
John Gemmill – NOD Team Leader

NESP Impact Story 5

Hub
Marine Biodiversity

Title
Putting evidence in the hands of the managers to improve decision making

Project number(s)
Data management (a cross project impact story)

Short version
The Marine Biodiversity Hub has forged enduring collaborations between researchers, research-users and managers of national science infrastructure to aggregate and link data (from the Hub and broader research community). Australian marine park managers are key beneficiaries of the Hub's work and use it to raise awareness and understanding of park values, assess pressures and improve decisions and outcomes. This information is now considered *critical for informing marine park management decisions*. The Hub's success in improving data aggregation, access and uptake at national scales has stimulated efforts to improve data access across the broader marine research community.

Narrative

CONTEXT/PROBLEM
Marine managers need timely scientific evidence as the basis for decisions and recommendations about environmental protection, conservation and sustainable use. It must be at their fingertips: searchable, accessible and 'fit-for-purpose'. This requires moving beyond historical approaches in which data are generated and shared within research communities.

THE RESEARCH IMPACT
The Hub is a key national provider of marine biodiversity and human activity data and working closely with marine managers has identified the data tools and delivery mechanisms that can immediately improve their day to day management activities. We have used this knowledge to promote the adoption of standards and effective information delivery more broadly in the Australian marine science community.

The Hub helped to develop several national online data stores and access portals that aggregate data (from the Hub and broader research community) and facilitate the flow of information from scientists to marine managers. This has been underpinned by extensive collaboration with managers of national science infrastructure (such as the Australian Ocean Data Network and the Integrated Marine Observing System) and the adoption of national and international standards (OGC Web Services, metadata standards, vocabularies).

This new level of data delivery to managers, combined with the Hub's ongoing engagement with research providers and users, supports effective monitoring and management of Australia's marine environment.

Managers at Parks Australia use Hub data to raise awareness and understanding of park values, identify information gaps and research needs, assess the potential impacts of pressures and make management decisions. Internal access to key data, via departmental platforms *is critical for informing marine park management decisions*.

The Hub has set new benchmarks and standards for collecting, managing and accessing marine biodiversity data by working with national collaborators. These are the cornerstone to developing national-scale data layers and connecting distributed information systems. As a result, initiatives such as Seamap Australia, AusSeabed, Global Archive and the Australian Marine Parks Science Atlas are already providing governments and their stakeholders with fit-for-purpose marine biodiversity data.

HOW THE IMPACT WAS ACHIEVED

The Hub has set clear data sharing standards for all projects receiving funding from NESP. All collected data needs to be available through Australia's national marine data repository, the Australian Ocean Data Network (AODN), and all attempts must be made to make previously collected data open through the same process. We have initiated collaborations with research users, participated in national discussions regarding data discoverability and supported strategic initiatives aligned with national objectives such as the National Marine Baselines and Monitoring Group and AODN. We have worked with marine managers, policy makers and data managers to understand opportunities and constraints, and built on opportunities and investments presented by research users including Parks Australia and the Department of the Environment and Energy (DoEE).

For example, through consultation with the DoEE Environmental Resources Information Network (ERIN) and others, we identified that access to spatial data could be streamlined through the use of OCG Web Services (international standards for sharing spatial data) to achieve interoperability with Wylie (a new internal DoEE map viewer designed to provide policy staff with immediate access to more than 80 relevant digital marine maps), Australian Marine Parks (AMP) Science Atlas, Seamap Australia, and other online tools. Spatial visualisation of relevant data is key to policy staff being able to use evidence for timely decision making on investment of resources, environmental assessments and review of programs and plans.

(See details of online data delivery tools in 'Additional information' section below)

SUPPORTING EVIDENCE

Testimonials

"**At Parks Australia, Australian Marine Park managers use NESP [Marine Biodiversity Hub] data to inform management and prioritise future research needs.** Supporting researchers to consistently share data and data records via national platforms allows us to easily access past and present science which is

invaluable when identifying research gaps. Internal access to key data, via Departmental platforms, provides managers with a great resource for understanding marine park values and assessing the potential impacts of pressures – this information is critical for informing marine park management decisions."
– David Logan, Senior Marine Parks Officer (Parks Australia)

The Australian Ocean Data network (AODN) is very pleased about the recent achievements of the collaboration with the NESP Marine Biodiversity Hub to increase the number of dataset collections made available on the AODN Portal. A significant number of data collected by the NESP Marine Biodiversity Hub has been made more FAIR (Findable, Accessible, Interoperable, Re-Usable) through the development of this collaboration.

The data and the associated metadata now available in the AODN Portal increases Findable and Accessible data.

A major step forward is the use of OGC web services in order to make the data more Interoperable and Re-Usable than previously.

Future work will be on adopting and adapting appropriate standards for data access, format and content to improve all aspects of the FAIR principles.

– *Sebastien Mancini - Director, AODN*

Research outputs

Provide titles and links to key outputs from the research described in the previous section (noting that the Marine Hub is not the only contributor to the first two of these).

https://seamapaustralia.org

https://atlas.parksaustralia.gov.au

https://www.nespmarine.edu.au/hub-imagery/search

Attributions

The Hub's data delivery is led by Emma Flukes under the guidance of Paul Hedge and Nic Bax. Success comes from the contributions of many national infrastructure initiatives and the collaborations of researchers and data managers of the Hub partners.

Additional information

Australian Ocean Data Network
The Hub has taken steps to ensure all its research data outputs are well described and accessible through AODN, which holds some 50 Marine Hub data collections, including a significant body of internationally relevant biological data. The Hub has

worked with AODN to help improve data cataloguing, and delivery to marine managers, decision-makers and researchers. The Hub is now the second largest contributor of data to AODN and the largest contributor of marine biodiversity data.

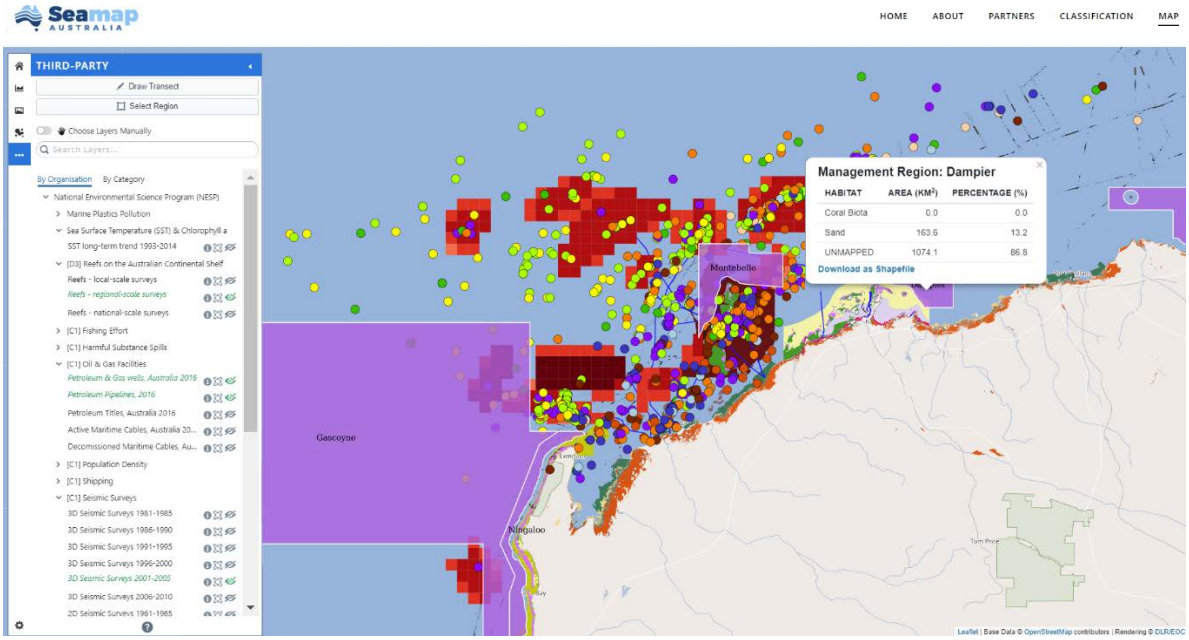
Seamap Australia

Hub research was integral to the inception of Seamap Australia, an interactive spatial tool to support assessments and reporting by Government and industry.

Seamap Australia (Version 1) built on national seabed habitat mapping projects initiated by the Marine Biodiversity Hub, such as the collation of spatial data on benthic reef habitats on the continental shelf. Importantly the Hub's earlier projects led to the successful application for national data infrastructure funds that provided the capacity to build Seamap Australia.

Consultation with Parks Australia (PA) highlighted the potential for Seamap Australia to greatly enhance the efficiency of management decisions by linking data repositories such as AusSeabed, GlobalArchive, the National Reef Monitoring Network and the Atlas of Living Australia. Seamap Australia now provides Australian Marine Park managers a rapid visual summary of known research conducted in a particular area, including bathymetry mapping, habitat imagery, benthic habitat mapping, and species distributions, which managers find *invaluable when identifying research gaps*.

The Hub Data Manager continues to work with PA to refine features of Seamap Australia and increase the tool's usefulness to AMP managers.

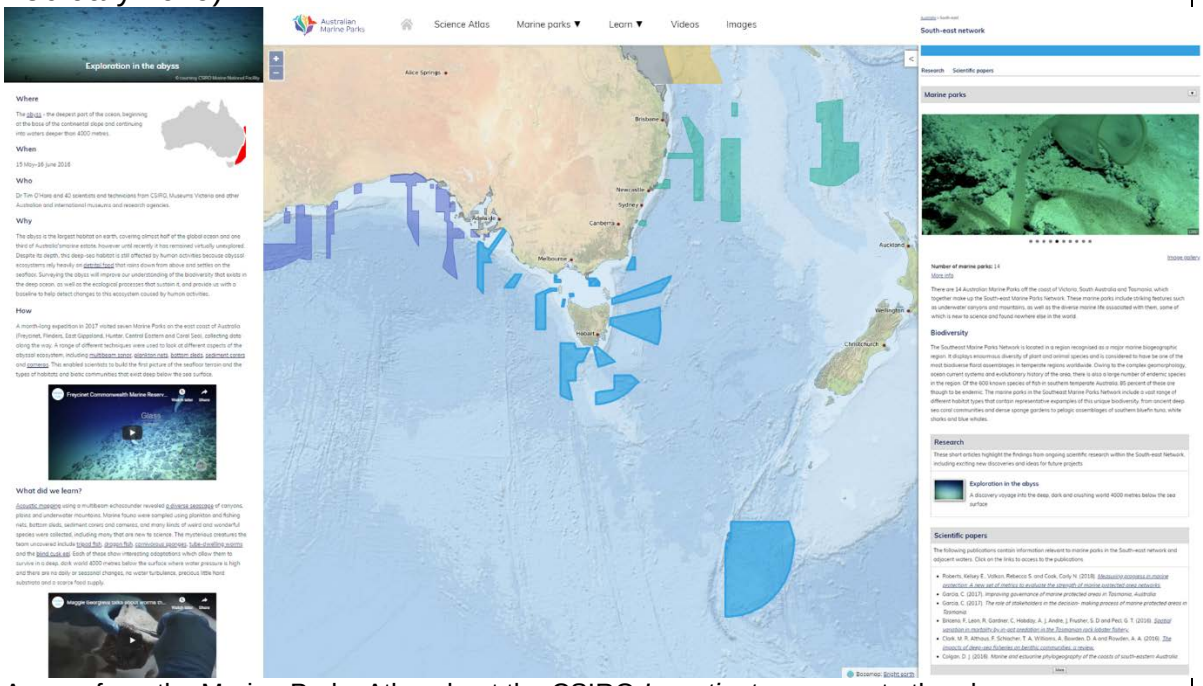


A page from Seamap Australia showing habitats in the Dampier management region.

Australian Marine Parks Science Atlas

The Hub has worked closely with Parks Australia and the Australian Institute of Marine Science (a Hub partner) to provide comprehensive scientific content for the Australian Marine Parks Science Atlas – a new development. This critical tool to support decision-making in park management is an extension of earlier Hub data

deliverables. The content of the Atlas draws heavily on the Hub's research outputs, including images, figures, maps and 'eco-narratives' which summarise research findings in AMPs. They communicate key information for managers, in a standardised, convenient format for easy integration with the Atlas. The new Marine Parks Atlas has already been visited by more than 1360 users (as at 20 February 2019)



A page from the Marine Parks Atlas about the CSIRO *Investigator* voyage to the abyss.

Hub website – image catalogue

The Marine Biodiversity Hub website provides open and free access to a large selection of images, figures and videos related to Hub research.

NESP Impact Story 6

Hub

Marine Biodiversity Hub

Title

Building understanding about the national importance of restoring coastal habitats – and how this has led to two new restoration projects

Project number(s)

Project E5: The role of restoration for the management of matters of national environmental significance in marine and coastal environments

Short version

This project developed the national critical mass and information base that is accelerating coastal ecosystem restoration around the country. It is leading to the mainstreaming of habitat restoration as a management tool, including for Matters of National Significance under the EPBC Act. Together with the Tropical Water Quality Hub and The Nature Conservancy, the project established a national network of stakeholders that is providing the foundation for successful, collaborative research and on-ground action involving councils, government departments, natural resource managers, non-government organisations, consultants, Traditional Owners, recreational fishers, community groups and government research organisations. The Hub's national information base is already resulting in investments in habitat restoration including shellfish restoration trials between industry and Traditional Owners at Moreton Bay, giant kelp restoration trials in Tasmania, and seagrass restoration with the Traditional Owners in the Shark Bay World Heritage Area.

Narrative

THE CONTEXT

Australia's states and territories have primary responsibility for coastal waters, and may be assisted by the federal government in certain circumstances specified in the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EPBC Act focusses on nine matters of national environmental significance (MNES), including World Heritage Areas and Ramsar wetlands, threatened and endangered species and habitats, and migratory species.

The management of MNES in coastal areas generally has focused on implementing protected areas and sector-based management of remaining pressures. But now, active restoration is seen internationally as key to achieving conservation and environmental management goals.

Healthy coastal ecosystems support our way of life, providing critical social and environmental benefits. They support marine industries, including commercial and recreational fishing, real estate, recreation, and tourism, and protect our shores and marine life from climate extremes.

In some areas of Australia, restoration of coastal habitats is scaling-up rapidly, and national leadership and coordination are needed to seize opportunities for strategic implementation and knowledge sharing.

RESEARCH IMPACT

This project built a critical mass of support and scientific evidence on the national importance and potential benefits of restoring coastal ecosystems, specifically seagrass meadows, kelp forests, shellfish reefs and saltmarsh wetlands. Working with DoEE, Hub researchers identified how restoration supports existing MNES, enabling the mainstreaming of this rapidly developing area of biodiversity management under the EPBC Act.

We established a national network of stakeholders that provides the foundation for successful, collaborative research and on-ground action among researchers, practitioners, policymakers, government agencies, managers and funding organisations.

Our review of historical and recent large-scale loss in marine and coastal habitats highlights emphasises where restoration can reverse those declines. For example, coastal wetland restoration in New South Wales has restored hundreds of hectares of habitat through reinstating hydrological flows and projects are planned to scale up to thousands of hectares.

We show that active restoration can complement existing management actions to manage coastal habitats, often the same habitats that threatened and migratory marine species rely on for survival.

Research priorities identified by this project are being addressed in new collaborations to investigate the feasibility of restoring giant kelp in Tasmania and with Indigenous groups to restore seagrass in the Shark Bay World Heritage Site.

Networking and new shared understanding has led to industry investment and collaboration, such as successful collaborative shellfish restoration trials between recreational fishing organisation Ozfish the Quandamooka Traditional Owners of Moreton Bay.

HOW THE IMPACT WAS ACHIEVED

This project reviewed the status of four ecologically critical coastal habitats in Australia – seagrass meadows, kelp forests, shellfish reefs, and coastal saltmarsh wetlands – and evaluated (1) Commonwealth responsibility under the EPBC Act and (2) the capacity of restoration to improve management of associated MNES. We shared the findings with key stakeholder groups and expert workshops, and explored the role of the Australian Government in leading and coordinating restoration efforts.

The Hub collaborated with the Tropical Water Quality Hub and The Nature Conservancy to fund a ‘Networks Coordinator’ and develop websites and social media for five restoration networks, ensuring ongoing coordination of marine restoration in Australia.

A multi-stakeholder workshop held at the DoEE in Canberra in June 2018 was titled: ‘Marine and Coastal Habitat Restoration: How active restoration can help preserve matters of national environmental significance’. It had more than 55 attendees including 30 from academia, non-government organisations, natural resource management groups and restoration practitioners and 25 from DoEE and other national agencies.

Photos of a healthy (left) and degraded (right) giant kelp forest. Photo credit: Adam Obaza (left), Matthew Doggett (right)

Societies of practice such as the Australian Coastal Restoration Network are key to sharing knowledge about good practice and have been supported through this project. Photo by Patch Clapp.

Testimonials

Several coastal and marine habitats are listed as Threatened Ecological Communities under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). The Giant Kelp Marine Forests of South East Australia ecological community, the *Posidonia australis* seagrass meadows of the Manning-Hawkesbury ecoregion ecological community and the Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community are listed as Endangered and the Subtropical and Temperate Coastal Saltmarsh ecological community is listed as Vulnerable. These communities have been listed as threatened under the EPBC Act because the natural composition and function of the ecological communities has significantly declined across their full range. This has occurred for a number of reasons including: coastal development, climate change, pollution, invasive species and other anthropogenic pressures. **This project contributes to our knowledge and understanding of these ecological communities. It is a great example of the collaborative nature of the Marine Biodiversity Hub, utilising expertise and data from many partners, the results of which are contributing to stakeholder conservation management efforts for these communities.**

– Lesley Gidding-Reeve, Director, Marine and Freshwater Species Conservation, DOEE

The creation of the Australian Coastal Restoration Network is an essential tool for connecting practitioners in both research and management and improving our collective actions. We were very pleased with the expanding networks facilitated by the Marine and Coastal Habitat Restoration workshop. For OzFish, the workshop led to co-investment in seagrass restoration in Cockburn Sound with the University of Western Australia in collaboration with NESP funding, and kelp restoration trials in Tasmania with the University of Tasmania (also NESP funded now). Your relationship with the Quandamooka of Moreton Bay led to our successful collaboration with them on shellfish restoration trials. All OzFish Board members, contractors and chapter presidents have been provided with a copy of your report, **'The role of restoration in conserving matters of national environmental significance in marine and coastal environments', an extremely useful background about the feasibility of restoration in Australia.**

- Craig Copeland, *Chief Executive Officer, OzFish Unlimited,* craigcopeland@ozfish.org.au

'**The Project E5 workshop and subsequent report were crucial in facilitating one of the first collaborations of Australia kelp researchers to crystallise the primary themes & knowledge-gaps in the restoration of Australian kelp forests.** The workshop and Ian's encouragement were also critical in us adapting our chapter from the E5 report into a standalone review publication on kelp forest restoration in Australia. All of which provided a platform to develop the new Project E7, which is looking specifically at restoration of endangered giant kelp forests in Tasmania. Stemming directly from the second day of the workshop in Canberra, and using the skills and expertise of Jemma Purandare and Ian, a Kelp Restoration Network is also currently under development. We hope this will act as a hub for researchers and practitioners, but also as a tool to increase engagement of restoration research with industry, traditional owners, policy-makers, and the general public – all of which are crucial stakeholders in the use of restoration as a tool for habitat conservation and management in Australia.'

- *Dr Cayne Layton, University of Tasmania*

'Healthy coastal habitats are important for the food security and livelihoods of many of the developing countries, which Australia assists through foreign aid programme. Attending the marine and coastal habitat restoration workshop in Canberra provided valuable background to assist in scoping the feasibility of restoration activities and how this can complement existing management actions. The main project report will be a useful source of information for evaluation of future projects.'

- *Heidi Prislan, Assistant Director, Environment Unit, Sustainability and Climate Change Branch, Department of Foreign Affairs and Trade*

Research outputs

Provide titles and links to key outputs from the research described in the previous section.

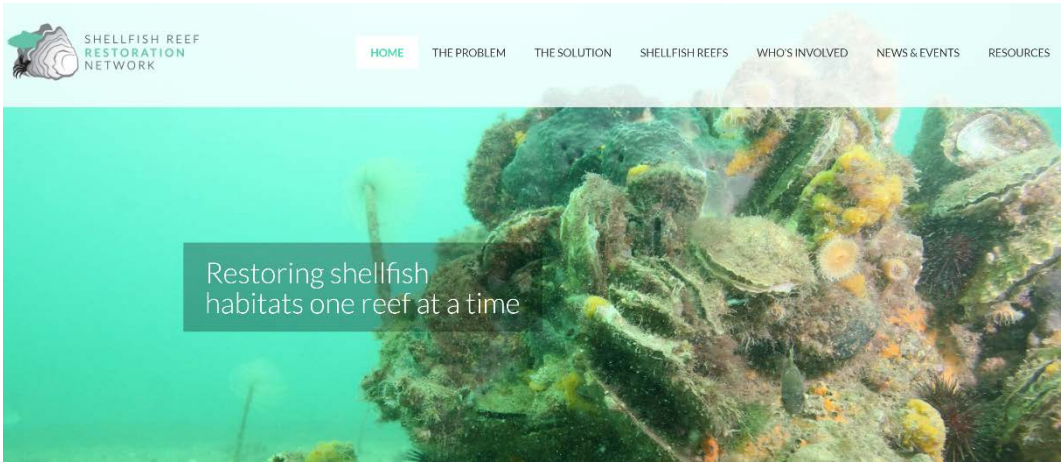
- McLeod I.M., Bostrom-Einarsson, L., Johnson, C.R., Kendrick, G., Layton, C., Rogers, A., Statton, J. (2018) The role of restoration in conserving matters of national environmental significance in marine and coastal environments. NESP MBH Report https://www.dropbox.com/s/4r2gydlervjm8i9/McLeod%20et%20al%202018%20The%20role%20of%20restoration%20in%20conserving%20MNES%20in%20marine%20and%20coastal%20environments.pdf?dl=0

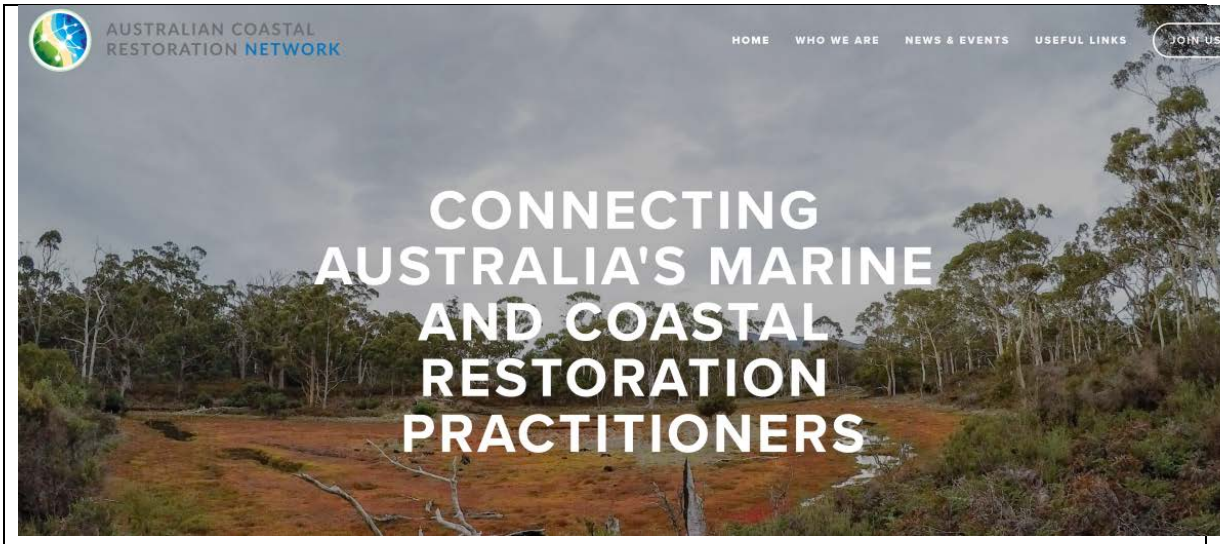
- Layton C, Coleman MA, Marzinelli EM, Steinberg PD, Swearer SE, Vergés A, Wernberg T, Johnson CR (in prep.), Kelp forest restoration in Australia. Ecological Management and Restoration

- Sherman C.D.H., Sinclair, E.A., Statton, J. Waycott, M., McLeod, I.M., Kendrick, G.A. (In internal review) Breakthroughs in seagrass restoration using seeds-based approached. To be submitted as a commentary piece to the journal Ecological Management and Restoration

- Australian Coastal Restoration Network website https://www.acrn.org.au/

- Australian Shellfish Restoration Network website https://www.shellfishrestoration.org.au/





Attributions

- Dr Ian McLeod led the overall project and the shellfish and saltmarsh aspects of the review
- Dr John Statton and Prof. Gary Kendrick led the seagrass restoration research
- Dr Cayne Layton and Prof. Craig Johnson led the kelp restoration research
- Dr Abbie Rogers and Prof. Michael Burton led the economic analysis and assisted with shaping cost benefit analysis discussions during workshops
- Dr Chris Gillies from The Nature Conservancy provided the opening keynote to the main workshop in Canberra
- Jemma Purandare has supported the Australian Coastal Restoration Network, the Shellfish Restoration Network, the Seagrass Restoration Network, the Mangrove and Saltmarsh Network and the Kelp Restoration Network through secretariat services, website and social media support.
- Kylie Kulper and Madison Watt from DoEE

NESP Impact Story 7

Hub: Marine Biodiversity

Title: Evidence for the recovery of Grey Nurse Shark

Project number(s)

Project A9: A close-kin mark-recapture estimate of the population size and trend of east coast grey nurse shark.

Short version

A close-kin mark-recapture approach developed in this project provides the most rigorous estimate of adult population size and trend to date for Australia's Critically Endangered Grey Nurse Shark. The estimates strengthen the evidence base for policy development by the NSW Department of Primary Industries Fisheries (DPIF) and the Department of the Environment and Energy (DoEE), including continued listing of the species under the NSW Fisheries Management Act 1994 and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Evidence of a modest population increase also provides *hope* to the conservation community that this species will continue to exist in the wild.

Narrative

CONTEXT/PROBLEM

The Grey Nurse Shark is listed as two separate populations under Australia's EPBC Act. The east coast population is Critically Endangered due to serious declines in numbers, and the west coast population is Vulnerable.

The Australian Government has focussed on understanding whether current protection and management measures are enabling recovery of the species, especially the east coast population. In addition, New South Wales and Queensland governments enforce stringent protection and management measures, particularly at key aggregation sites. Some sectors, such as recreational fishers, would like to see these measures relaxed.

Reliable measures of population size and trend are needed to guide and evaluate national and state-based management. The accuracy of past methods, however, has been limited by tag loss and tag reporting rates, and a restricted geographic range of sampling effort. This has in turn reduced agreement on current status and what needs to be done.

THE RESEARCH IMPACT

The new estimate of adult population size for Australia's eastern population of Grey Nurse Shark is between 1,686 and 2,167, with an annual rate of increase of between 3.4 per cent and 4.5 per cent.

This new knowledge has reduced stakeholder uncertainty about the listing status for this species under the Fisheries Management Act 1994 and the EPBC Act, and provides a stronger evidence base for policy development and conservation management by the DoEE, and the NSW DPIF.

The very modest recovery – following historical Commonwealth and state measures implemented since the species was protected – highlights the need to maintain existing management and protection, especially at key east coast aggregation sites. Further work on the level of risk experienced by the recovering population is required before making any management changes.

Samples collected for this project have been deposited with the Australian Museum's Centre for Wildlife Genomics, creating a lasting archive for future research. Field data, including sample locations, have been deposited in the Atlas of Living Australia through MERIT (https://fieldcapture.ala.org.au).

How the impact was achieved

The project built on data collections and novel analysis of genomic data developed in sustained research partnerships between the Marine Biodiversity Hub, CSIRO and the Australian and state governments, with support from the Threatened Species Commissioner (through the Queensland Department of Natural Resource Management – now Queensland Department of Environment and Science).

In-kind support for collecting tissue samples from live sharks was provided by NSW DPI and the University of Queensland. Additional samples came from the NSW DPI shark control program archive. A total of 514 tissue samples was sourced, and the mitochondrial DNA from 374 of these sharks was of sufficient quality for analysis.

Adult population size and trend for the eastern population was estimated using close-kin mark-recapture, an approach that combines advanced genetics and statistical modelling. The technique was developed by CSIRO to estimate Southern Bluefin Tuna populations, and refined in studies Hub-supported studies for other species under pressure such as northern river sharks and white sharks.

The benefit of the approach is that it allows the use of samples from dead animals, and circumvents problems such as tag loss and tag reporting rates. It also ensures a broad geographic spread of sampling effort, as was the case in this study, which found close-kin matches covering the whole range of the species. It has revolutionised our ability to derive robust population estimates for sharks and other data-poor species, and is being applied worldwide.

Recommendations for future research are listed in the 'additional information' section below.

Supporting evidence

The close-kin mark-recapture technique developed and utilised by members of the NESP Marine Biodiversity Hub has been instrumental in providing us with the most rigorous population estimate to date for this important population. **This has been a brilliant example of the collaborative nature of the Marine Biodiversity Hub,**

utilising expertise and samples from both Queensland and NSW, and results from this work will contribute significantly to conservation management efforts for this species.'

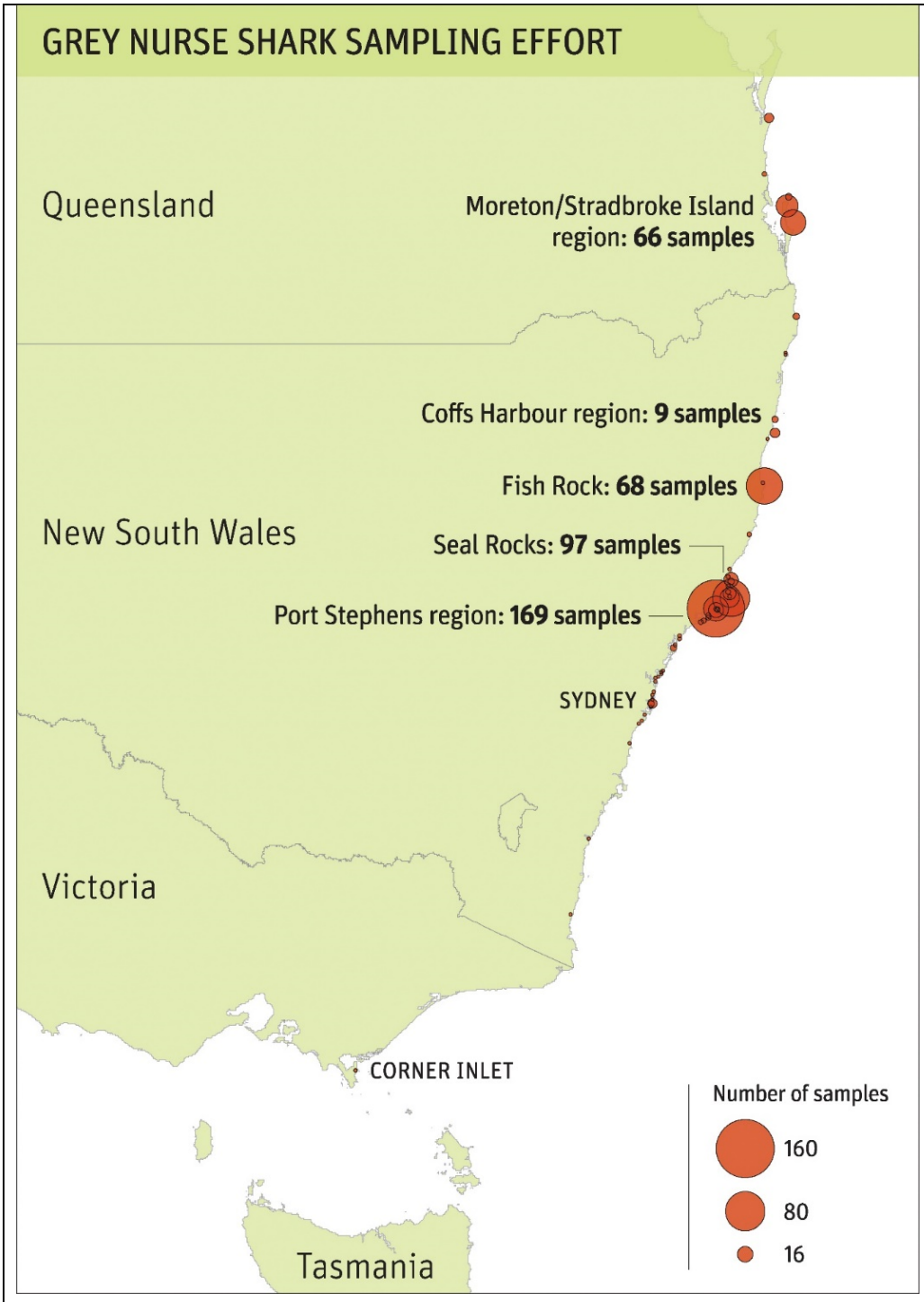
– *Lesley Gidding-Reeve, Director, Marine and Freshwater Species Conservation, DOEE*

My team manages threatened species of fish in NSW including Grey Nurse Shark. We are therefore the consumers of Grey Nurse Shark research as it allows us to formulate evidence-based policy, which is pivotal for political and community support of management actions for the recovery of this critically endangered species. Research like this: reduces uncertainty with respect to population status and trends and thereby listing status under the Fisheries Management Act 1994 and the Environment Protection and Biodiversity Conservation Act 1999; provides scientific data and analysis on spatial and temporal patterns of Grey Nurse Shark distribution and abundance in eastern Australia; and assesses the strengths of relationships to environmental drivers, all of which could contribute to a better understanding of the species and therefore improved management in NSW.

– *Dr Trevor Daly, Senior Fisheries Manager, Threatened Species Aquatic Environment, NSW Department of Primary Industries Fisheries*

This latest research by Russell Bradford *et al.* shows that the east coast population of grey nurse sharks is stable and even growing. I am very pleased to see this and it is excellent research. The estimated population is almost five times the initial estimates of 300 to 500 by Nick Otway and upon which the first Grey Nurse Recovery Plan was based in 2004. This plan eliminated the public aquarium industry from collecting grey nurse sharks for display, even though it was only about one shark a year in total between all the aquariums. **These upgraded numbers give me hope firstly for the species survival in the wild, as well as the possibility of removal of the moratorium that the public aquariums face when the Recovery Plan is reviewed later this year.**

– *Dr Rob Jones, 'The Aquarium Vet'*


GREY NURSE SHARK SAMPLING EFFORT
Queensland
Moreton/Stradbroke Island region: 66 samples
Coffs Harbour region: 9 samples
Fish Rock: 68 samples
New South Wales
Seal Rocks: 97 samples
Port Stephens region: 169 samples
SYDNEY
Victoria
CORNER INLET
Tasmania
Number of samples
160
80
16

Grey Nurse Shark. Image: David Harasti, NSW DPI

Research outputs

- Report: A close-kin mark-recapture estimate of the population size and trend of east coast grey nurse shark, https://www.nespmarine.edu.au/document/close-kin-mark-recapture-estimate-population-size-and-trend-east-coast-grey-nurse-shark
- Fact sheet: Sizing up Australia's eastern Grey Nurse Shark population, https://www.nespmarine.edu.au/document/sizing-australia%E2%80%99s-eastern-grey-nurse-shark-population

Attributions

CSIRO

- Russell Bradford: (PI)
- Robin Thompson and Mark Bravington (data analyses – CKMR)
- Rasanthi Gunasekera, Pierre Feutry, Peter Grewe (genetics)
- Richard Hillary, Toby Patterson (advice and guidance)

New South Wales Department of Primary Industries

- David Harasti, Nicholas Otway, Roger Laird, Brett Louden, Peter Gibson, Joel Williams, Tom Davies (sample collection teams)

University of Queensland

- Deborah Foote (sample collection)

Queensland Parks and Wildlife Service

- Carley Kilpatrick (sample collection)

Menzies Institute for Medical Research, University of Tasmania

- James Marthick (genetics)

Alaska Department of Fish and Game

- Dr Kenneth Goldman (age-at-length)

Marine Biodiversity Hub

Nic Bax, Paul Hedge (support and guidance)

Department of the Environment and Energy, Australian Government

Lesley Gidding-Reeve (support, guidance, and most important of all, patience)

Additional information

Recommendations in the project report provide a foundation for future research and monitoring. They suggest using vertebrae and epigenetics to develop accurate Australian growth estimates, and continuing regular tissue sampling and visual imaging of live animals. Surveys should be conducted from the New South Wales/Victorian border to Wilsons Promontory to confirm potential reoccurrence in southern waters, and at aggregation sites at and near Exmouth, WA (using baited remote underwater video). Assembly of a genome for Grey Nurse Shark would help to identify half-sibling pairs.

NESP Impact Story 8

Hub

Marine Biodiversity

Title

Building understanding and capacity for protecting deep-sea corals

Project number(s)

Project D3: Implementing monitoring of AMPs and the status of marine biodiversity assets on the continental shelf

Short version

The Seamount Corals Survey deployed new monitoring technologies, extended baseline knowledge, and extended the ecological understanding required to manage and conserve deep-sea coral communities in Australia and around the world. More than 40 scientists, from the Marine Biodiversity Hub and Australian and New Zealand agencies, joined Parks Australia managers on the Marine National Facility voyage to survey Australia's largest aggregation of deep-sea corals. Parks Australia provided essential support in gaining the shiptime, and engaged enthusiastically in survey design, field research and communication, forging a shared understanding of marine park monitoring and management. An intensive communication campaign contributed to building public support for Australia's marine protected areas.

Narrative

THE PROBLEM/CONTEXT

Internationally significant deep coral-reef communities exist on seamounts in the Tasman Fracture and Huon marine parks off southern Tasmania. The coral communities are highly diverse, but vulnerable to human disturbance, particularly bottom trawling, and some were damaged before being protected from fishing. Their distribution and ecology, the extent of damage, and whether there has been any recovery since fishing ceased in some areas 10 or more years ago, however, was little known. Investigating these questions on the Tasmanian seamounts has international significance as deep-sea corals are under pressure worldwide and this is only area of fished deep-sea coral that has been surveyed over a period of 20 years (this was the third survey).

THE RESEARCH IMPACT

The Seamount Corals Survey addressed three of Australia's largest marine challenges: marine park conservation and management; the need for measureable and robust methods for ecological monitoring, including to establish baselines; and the need to communicate the importance of the Australian Marine Park network to decision-makers and the public.

Improved understanding of biodiversity values is a key outcome identified in all Australian marine park management plans. The survey is improving understanding of the biodiversity values in the South-east Australian Marine Parks Network, specifically the distribution and biodiversity of deep-sea coral reefs. An example is

the discovery of previously unknown coral reefs on rocky areas adjacent to seamounts, and on 'knoll-like' features at the continental shelf edge.

By applying new technologies and gathering baseline knowledge required to detect recovery in seamount communities, the survey is also improving our understanding of the effectiveness of marine park management interventions to improve biodiversity values.

The collaborative approach to survey planning and implementation was a step change in science/policy partnership approach to complex biodiversity surveys, fostering shared understanding of management requirements and the technical challenges and rigours of the research. Improvements in capacity to predict deep-sea coral distributions are needed to guide Australian Government contributions to national and international negotiations. These include: under UNCLOS to improve biodiversity management beyond national jurisdiction; development of deep-sea EIAs under the International Seabed Authority; and conservation of deep-sea corals through the Convention on Biological Diversity.

Public communication about the survey raised awareness of the biodiversity values of marine parks of the South-east Marine Park Network.

How the impact was achieved

The 27-day Seamount Corals Survey 2018 was led by CSIRO and designed with Parks Australia to provide data on the status and trends of deep-water coral communities in the South-east Marine Parks Network. It drew together scientists from Australian and New Zealand research agencies.

Parks Australia managers articulated specific management and communication needs and the national benefits and helped with the survey design and the approach to communicating research activities and findings at sea.

Researchers and park managers worked side by side at sea to map and sample coral communities on 45 seamounts in and out of marine parks. New technologies were used for the first time to sample rocky habitats between the seamounts that support deep-sea corals.

The sampling included 147 one to two-kilometre-long seabed camera transects to depths of 2000 metres) collected by a high-tech camera system 'flown' two metres above the seafloor. Some 60,000 stereo images and 300 hours of video were collected for analysis.

Biological samples were collected for identification, and many new species were found. Multibeam acoustic data were collected in areas not previously mapped in high-resolution.

Supporting evidence

Planning and joining the Seamounts voyage to our Australian Marine Parks gave Parks Australia staff, researchers, support staff and communication experts the chance to learn from each other and build strong trusted partnerships. Being directly involved in doing the science was fantastic and working side-by-side with the researchers allowed us to participate in the successes and challenges such a

complicated project brings – the mutual trust and dedication shown by the team was inspiring. Coming together to raise awareness of the research and the marine parks worked very well – there are significant overlaps in our key messages and through a well-coordinated communication effort, we were able to reach a big audience and provide compelling stories that bring to life the interconnections between science and management.

– Jason Mundy, Assistant Secretary Marine Protected Areas Branch, Parks Australia

Testimonials to come:

Joseph Appiott, CBD

Tia Stevens (DoEE) international biodiversity

Jihyun Lee, ISA

Someone at DFAT (BBNJ)

Research outputs

We have commenced the program of data analysis to provide the international peer-reviewed papers that will test and substantiate our initial observations.

Communication outputs:

'Blogging the seamounts': daily blogs and research updates while at sea: https://www.nespmarine.edu.au/seamounts/landing-page

Sections of the voyage, including imagery from the underwater camera, were live-streamed to more than 5000 viewers.

Social media videos while at sea:

- Gliding albatross, our constant companions https://www.youtube.com/watch?v=uplWzTod6e8
- Tasmanian Seamounts: Australia's other coral reefs https://www.youtube.com/watch?v=f5QtCtZ5oZI
- Deep feelings: brittlestars and corals https://www.youtube.com/watch?v=bzOzdY7tpe0
- It's tough getting fish along to the BRUVS party https://www.youtube.com/watch?v=6K6sBlZKaRE

More than 255 media items (TV, radio, print and online) about the voyage were tracked by iSentia with an audience reach of more than one million people.

Article in *The Conversation*: 'Exploring Australia's 'other reefs' south of Tasmania': https://theconversation.com/exploring-australias-other-reefs-south-of-tasmania-108986

Economist Movie – Release June 21, 2019 www.films.economist.com

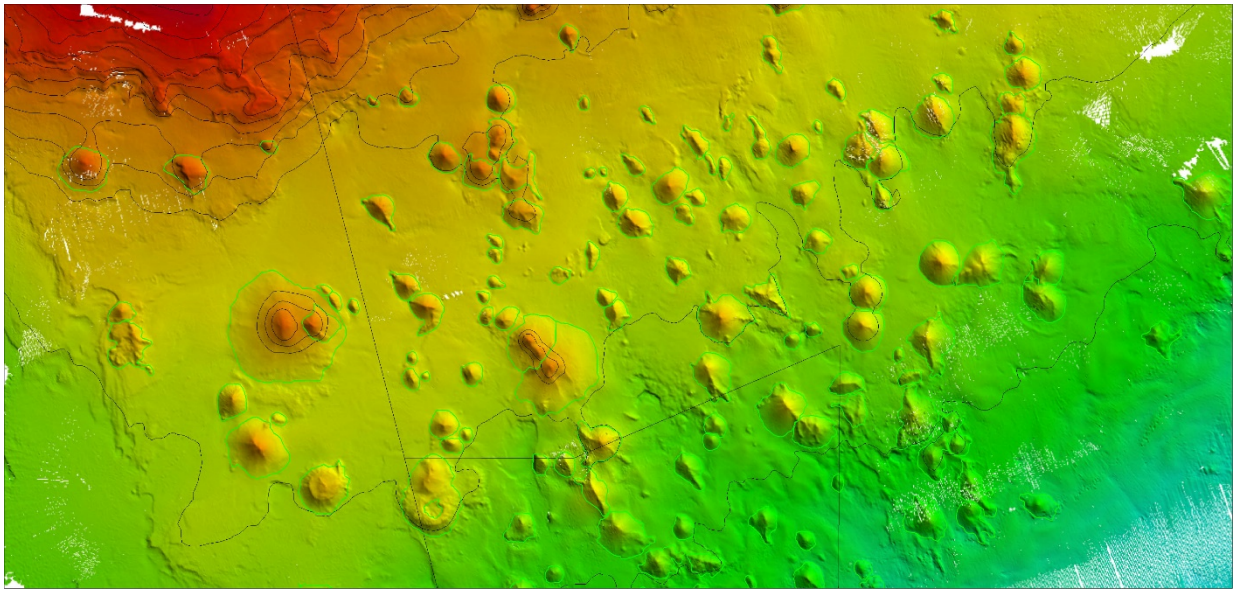
Pre-recorded contribution of an interview with Nic Bax to the 14th Conference of Parties to the CBD Sustainable Ocean Initiative Day

Five-minute movies being developed in collaboration with Parks Australia

Faunal images from survey are being prepared for a major communication event in 2019/20 (dates to be advised).

Attributions

Dr Alan Williams (CSIRO) Voyage Leader and Principal Investigator
Prof Nic Bax (UTAS/CSIRO) Co-Principal Investigator
Dr Malcolm Clark (NIWA) Co-Prinicipal Investigator
Prof Thomas Schlacher (USQ) Co-Principal Investigator
Mr Jason Mundy (Parks Australia)



Bathymetry chart showing seamounts. Image: CSIRO

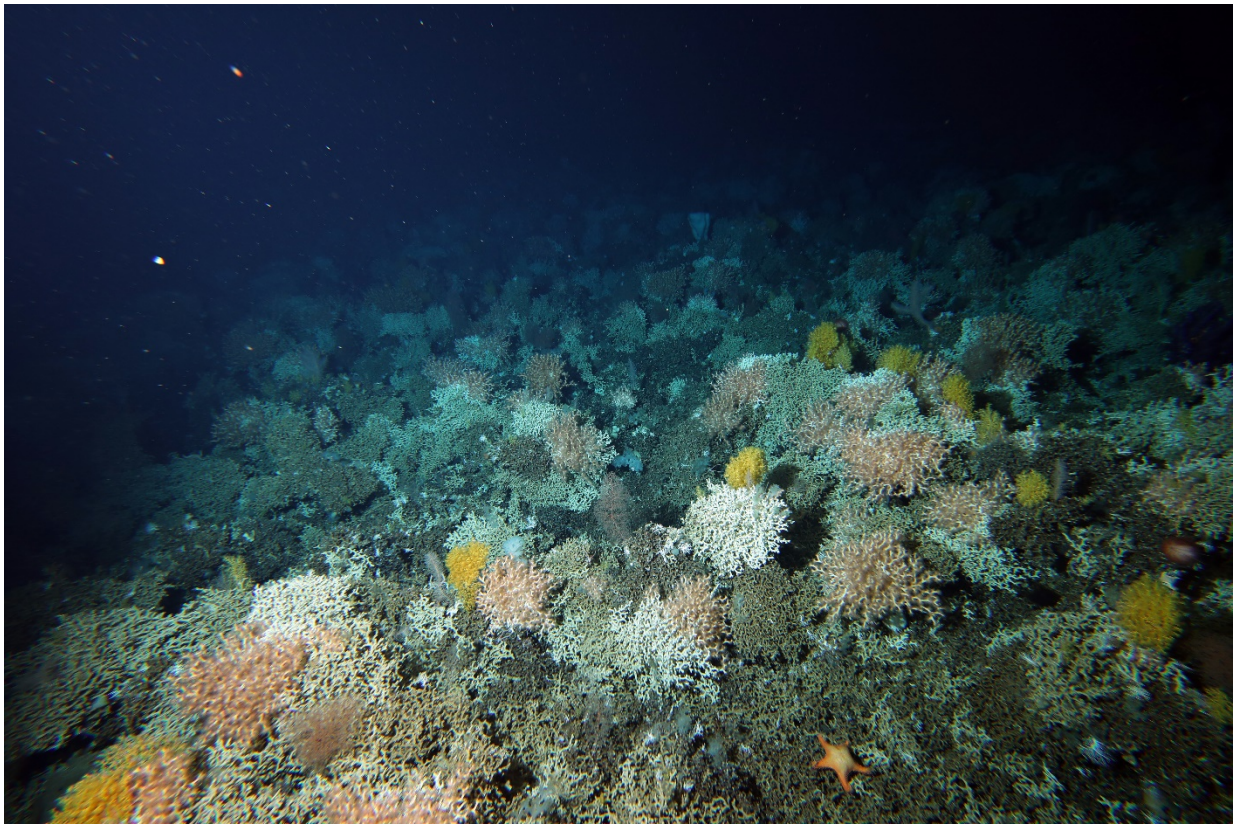
Jason Mundy of Parks Australia with a baby blobfish.

Dave Logan (right) with Marine Biodiversity Hub director and a principal investigator on the voyage, Nic Bax. Image: CSIRO

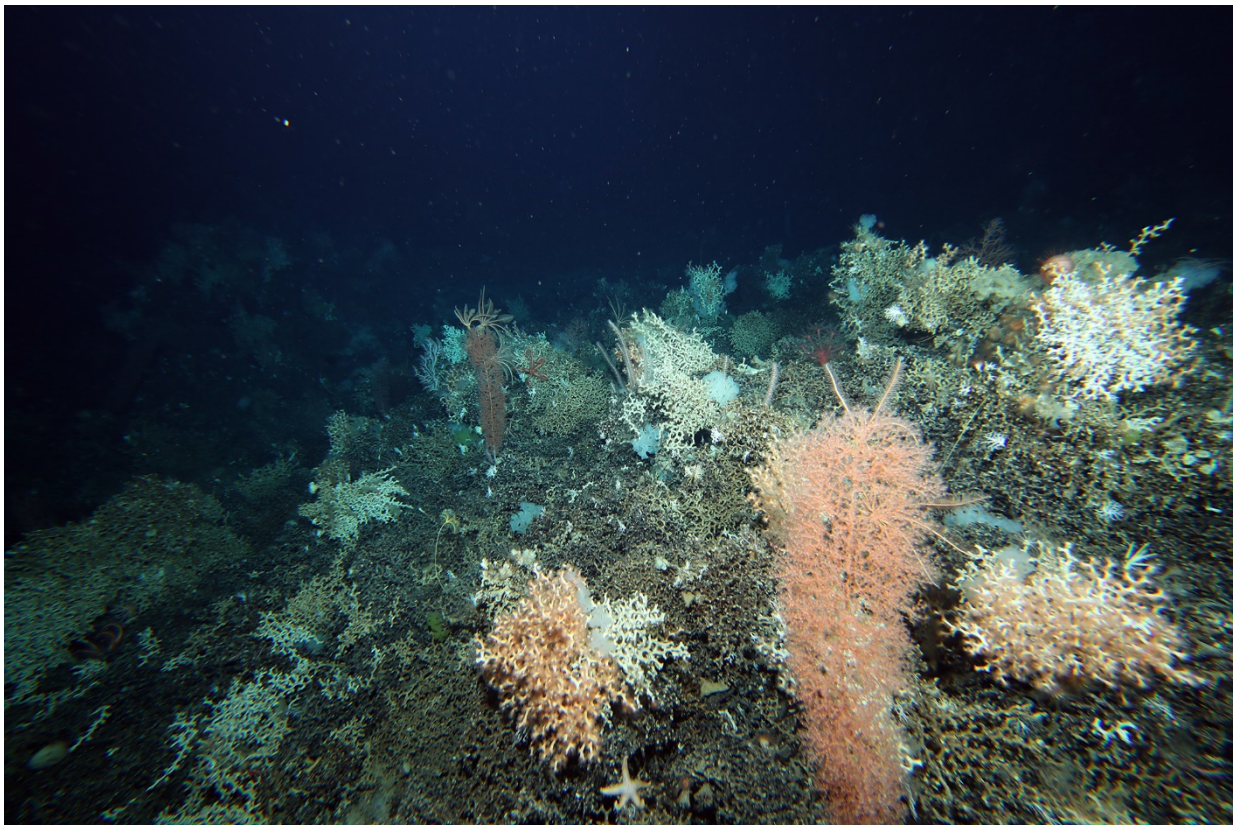
The deep-tow camera system on the CSIRO wharf at Hobart. This high-tech system is the main sampling tool being used to survey the distribution and condition of deep-sea coral communities. Image: CSIRO

Nick Mortimer and Karl Forcey CSIRO piloting the deep-tow camera. Image: CSIRO

Cath Samson and Cassie Layton of Parks Australia join the voyage at CSIRO Hobart. Image: Parks Australia/CSIRO



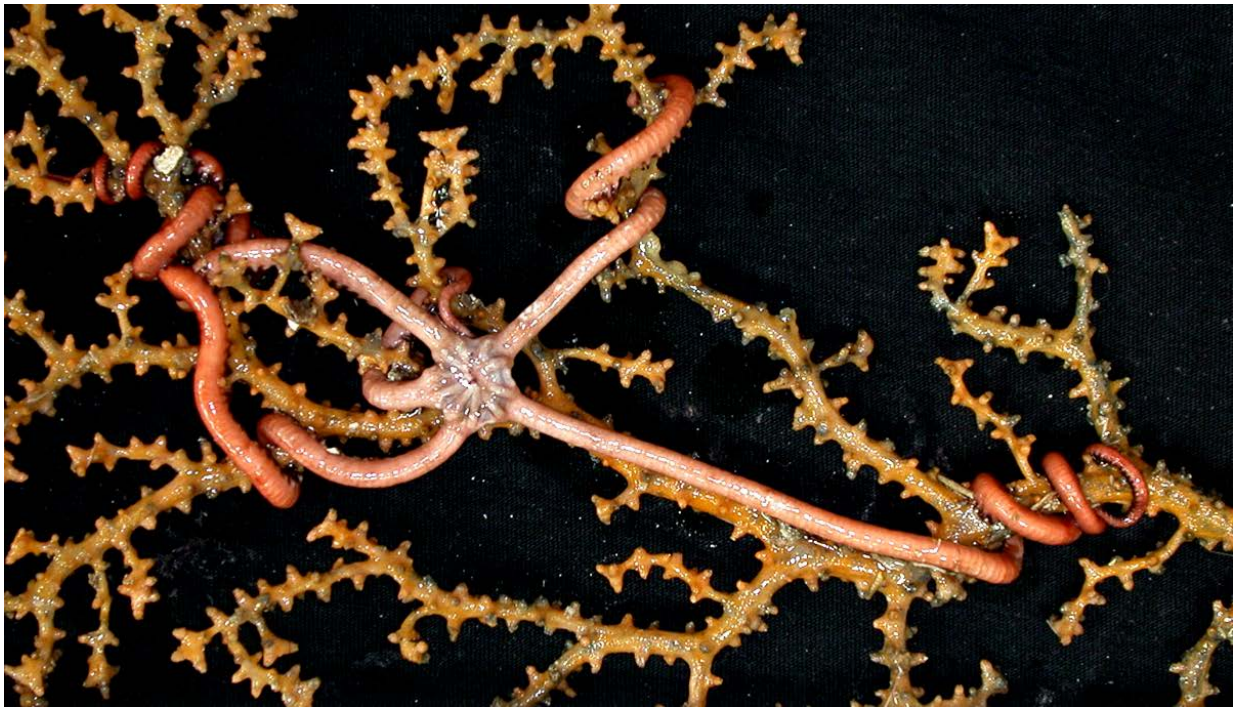
Solenosmilia coral reef with unidentified solitary yellow corals. Image: CSIRO



Bottlebrush gold corals (Chrysogorgia) on *Solenosmilia* reef. Image CSIRO

A scrum of biologists sorts treasures from the deep. Image: CSIRO

A Eunicidae polychaete worm on *Solenosmilia* coral. Images: Laetitia Gunton/CSIRO



The brittle star *Ophiocreas sibogae i*s almost always found clinging to a deep-sea coral, (*Paramuricea* sp.) By climbing on the coral, the brittle star gets a better access to drifting particles on which it feeds. Image: Karen Gowlett-Holmes, CSIRO

Alan Williams watches Candice Untied and Kylie bring in samples collected from the net. Image Thomas Schlacher/CSIRO

Candice Untiedt with her haul of beautiful gold bottlebrush corals (Chrysogorgia), the biggest haul of gold corals any of the biologists had ever seen. Image: CSIRO