Table of Contents

[Project A1 – Northern australian hotspots for the recovery of threatened euryhaline species 1](#_Toc467170196)

[Project A3 – A national assessment of population status of white sharks 14](#_Toc467170197)

[Project A4 - The status of human-shark interactions and initiatives to mitigate risk in Australia 29](#_Toc467170198)

[Project A5 – Defining connectivity of australia’s hammerhead sharks 35](#_Toc467170199)

[Project A6 – Prioritisation of research and management needs for Australian elasmobranch species 47](#_Toc467170200)

[Project A7 – Monitoring population dynamics of ‘western’ right whales off southern Australia 52](#_Toc467170201)

[Project A8 – Exploring the status of australia’s sea snakes 60](#_Toc467170202)

[Project A9 – Grey nurse shark ck-mr population estimate – east coast 71](#_Toc467170203)

[Project A10 – Monitoring and conservation of spotted handfish 79](#_Toc467170204)

[Project A11 – Shark action plan 100](#_Toc467170205)

[Project A12 – Scoping a seascape approach to managing and recovering northern Australian threatened and migratory marine species 109](#_Toc467170206)

[Project B1 – Road testing decision support tools via case study applications 116](#_Toc467170207)

[Project B2 - Analysis and elicitation to support State of the Environment reporting for the full spectrum of data availability 125](#_Toc467170208)

[Project B3 – Enhancing access to relevant marine information – developing a service for searching, aggregating and filtering collections of linked open marine data 130](#_Toc467170209)

[Project B4 – Underpinning the repair and conservation of australia’s threatened coastal habitats – phase 2 138](#_Toc467170210)

[Project C1 – Improving our understanding of pressures on the marine environment 152](#_Toc467170211)

[Project C2 – Continental scale tracking of threats to shallow Australian reef ecosystems 164](#_Toc467170212)

[Project C3 - Change detection and monitoring of key marine and coastal environments – application of the Australian Geoscience Data Cube 181](#_Toc467170213)

[Project C4 – The National Outfall database project (Clean Ocean Foundation) 187](#_Toc467170214)

[Project C5 – Quantification of risk from shipping to large marine fauna across Australia 197](#_Toc467170215)

[Project D1 – National data collation, synthesis and visualisation to support sustainable use, management and monitoring of marine assets 212](#_Toc467170216)

[Project D2 – Standard Operating Procedures (SOP) for survey design, condition assessment and trend detection 229](#_Toc467170217)

[Project D3 – Preparing for and implementing monitoring of CMRs and the status of marine biodiversity assets on the continental shelf 243](#_Toc467170218)

[Project D4 – Expanding our spatial knowledge of marine biodiversity to support future best-practice reviews 260](#_Toc467170219)

[Emerging Priority Marine Plastics project - Assessing effectiveness of waste management in reducing the levels of plastics entering Australia's marine environment 268](#_Toc467170220)

# Project A1 – Northern australian hotspots for the recovery of threatened euryhaline species

Project length – 30 Months

Project start date – 01/07/2015

Project end date – 31/12/2017

Project approval date - xx/xx/xxxx (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - Submitted for re-approval

Project Leader – Peter Kyne (2017 FTE – 20%)

Lead Research Organisation – Charles Darwin University

Project leader contact details: - [peter.kyne@cdu.edu.au](mailto:peter.kyne@cdu.edu.au), phone: 0477 306 344

### Project Funding

|  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | TOTAL |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NESP funding | 349,000 | 403,581 | 93,928 | x | x | x | x | 846,509 |
| Cash co-con | 30,800 | 29,800 | 18,786 | x | x | x | x | 79,386 |
| In-kind co-con | 318,200 | 373,781 | 75,142 | x | x | x | x | 767,123 |
| TOTAL | 698,000 | 807,162 | 187,856 | x | x | x | x | 1,693,018 |

*2017 funding for CDU only*

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

Euryhaline species represent over half of the EPBC-listed threatened elasmobranchs, with northern Australia of national importance for this threatened species community. Critical information gaps remain, limiting Recovery Plan objective implementation. This project will fill many data gaps through 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.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

This proposal extends the project by an additional six months in order to maintain and download a reduced acoustic receiver array in the estuaries of 5 NT rivers. The objective is to monitor large Speartooth Sharks tagged under RPV1 and RPV2 to examine female philopatry. This is essential knowledge for the interpretation of close-kin mark-recapture population estimates and connectivity results.

Additionally, CSIRO are over-committed in terms of capacity in undertaking molecular analysis and demographic modelling for close-kin mark-recapture and population structure, and as a result a number of milestone delivery dates have been altered (see table under heading ‘Project milestones’)

The changes made between RPV2 and RPV3 (i.e. this document) are:

* Project length: changed to 30 months
* Project end date: changed to 31/12/2017
* 2017 Project funding: Increased NESP funding by $26,844; increased CDU cash contribution; increased CDU in-kind contribution to match.
* Increased NESP funding is for: Peter Kyne 0.1 FTE for 6 month period Jul-Dec 2017 ($8,844) and operating (field work and equipment; $18,000)
* Milestone delivery date changes as outlined in table under heading ‘Project milestones’ (5 milestones; remainder unchanged)
* Additional download field trips 6 & 7 (reduced estuarine acoustic receiver array) added to Appendix I
* UTAS PhD candidate Florriaan Devloo-Delva undertaking the project ‘From rivers to ocean basins - quantifying sex-specific connectivity in elasmobranchs’ added to the researcher list along with field sampling to acquire shark tissue samples (milestone added)

### Problem Statements

#### Problem

Description of the specific problem

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. New information demonstrates the value of northern estuaries and rivers to sustaining these data-poor species, and advancing technologies are allowing the discovery of data essential to the management and, ultimately, recovery of these species.

#### How Research Addresses Problem

What solution will this research provide?

This project will provide new knowledge on the status, distribution and management of species based on the application and development of an array of technologies and partnerships, with the aim of improving status and a re-evaluation of the EPBC listing of key species. The three project themes will each utilise a diverse array of methodologies, drawing on a broad collaborative approach. Indigenous partnerships will bring to the project unique knowledge on species and their habitats.

This research will provide the Department of the Environment and Energy with a vastly improved understanding of the status of several threatened species to inform and direct management and recovery decisions.

This project has a short-term focus with the bulk of activity in 2015 and 2016, concluding with the retrieval of the extensive acoustic receiver array deployed under NERP ($110,000 value) in early 2017, which will then be available for future NESP projects (2017-2020). Indigenous partnerships developed in this project will potentially form the basis of longer-term NESP projects.

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

This project aligns with the following Departmental research priorities:

* Determine and trial practical and repeatable methods for monitoring the status and trends of key coastal and marine species and environments to underpin management of Commonwealth Marine Reserves.
* Improve our knowledge of key marine species and ecosystems to underpin their management and protection.
* Identify key opportunities to collaborate and build Indigenous participation and knowledge into the management and protection of marine species.

This project is addressing the following EPBC Recovery Plan for Sawfish and River Shark objectives:

* Improve the information base to allow the development of a quantitative framework to assess the recovery of, and inform management options for, sawfish and river shark species.
* Develop research programs to assist conservation of sawfish and river shark species.
* Improve community understanding and awareness in relation to sawfish and river shark conservation and management.
* Reduce and, where possible, eliminate adverse impacts of Indigenous fishing on sawfish and river shark species.

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

This project comprises three themes with the following research components:

Theme 1: Monitoring and understanding euryhaline species

* Continue annual monitoring of euryhaline elasmobranchs currently tagged (212 individuals) in NT rivers for mortality estimates, movement patterns and critical habitat determination (regular downloading of 55 acoustic receivers (see Appendix I for tentative download schedule), plus tagging of 30 neonate *G. glyphis* in 2015 for mortality estimates)
* Host a small-scale working group on prioritising recovery-directed research on threatened euryhaline elasmobranchs, and for considering ‘stopping-rules’ for investment in threatened euryhaline elasmobranchs
* Investigate the optimal design of acoustic receiver arrays to measure long term movement and mortality of euryhaline elasmobranchs in NT, QLD and WA rivers
* Develop statistical methods for estimating annual juvenile mortality accounting for movement and uneven coverage of acoustic arrays (due to the periodic loss of receivers)
* Initiate a tagging program on large sub-adult *Glyphis glyphis* (1.5m +) to investigate adult distribution, reproductive philopatry & mortality (Adelaide River) (basis for future NESP proposal to investigate migratory corridors and critical habitat use of large marine species including river sharks)
* Determine the age of *Glyphis glyphis* for demographic models and potentially testing DNA ageing, using existing specimens and collection of 10 medium to larger-sized animals from the Adelaide River
* Synthesize and report on habitat use (including critical habitat), long-term movements and biologically important areas for euryhaline elasmobranchs (synthesising all NESP phase 1 and NERP research)

Theme 2: Indigenous partnerships for management of euryhaline species

* Develop partnerships to assess Indigenous cultural use and knowledge of sawfish, and develop a sawfish education package for communities (commence in 2-3 communities with scope to expand)
* Develop protocols and methodologies for implementing annual Malak Malak (NT) sawfish survey (billabong fishing survey and relocation of trapped animals to main channel; I-Tracker application development; deploy small-scale acoustic receiver array for monitoring effectiveness of relocation program) (annual survey and monitoring to form the basis of future 2017-2021 NESP funding proposal if successful in 2015-2016)
* Develop data collection, mapping and monitoring tools to support the above in collaboration with NAILSMA and utilising I-Tracker tools as appropriate

Theme 3: Knowledge for the reassessment of river shark status

* Undertake field collection of *Glyphis garricki* tissue samples in unsurveyed NT habitat (primarily large rivers including Daly and Victoria Rivers) and WA distribution (Cambridge Gulf, King Sound) in partnership with Indigenous Ranger Groups
* Examine population structure of *Glyphis garricki* (using existing and newly collected tissue samples)
* Establish lower bound population size estimate (close-kin mark-recapture) for *Glyphis garricki*
* Using data gained from the above research, undertake an updated assessment of the status of river sharks based on extent of occurrence, area of occupancy, population structure and population size calculations (synthesising all NESP phase 1and NERP research)

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

This project links to other Hub projects on management of marine species, namely the project on White Shark status which shares some methodological approaches, and the project on prioritisation of research and management needs for threatened elasmobranch species. This project links to the Threatened Species Recovery Hub and the Northern Australia Environmental Resources Hub, with an additional link to the Threatened Species Commissioner.

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

This research expands on methodologies developed under NERP Marine Biodiversity Hub project 2.4 ‘Supporting Management of Listed and Rare Species’. That project was a proof of concept for close-kin mark-recapture as a tool to estimate population status in rare, poorly-known and difficult to sample marine species. The trial focal species for that project was *Glyphis glyphis*. The project also delivered additional research on three other threatened species, but these were not the prime focus of the close-kin mark-capture study.

Tools developed under the NERP project can now be extended to monitor other species through an existing NERP-funded acoustic receiver array, to apply the close-kin mark-recapture method to additional species (namely in this proposal, the Endangered *Glyphis garricki*) and to reassess the EPBC status of key species with this new information.

This project leverages off the extensive acoustic receiver array deployed under NERP in the Northern Territory.

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

* Improved knowledge of key marine species to underpin their management and protection
* Practical and repeatable monitoring of threatened euryhaline species
* Enhanced Indigenous participation in the management and protection of marine species
* Status determination for threatened river sharks
* Indigenous community education to improve the status and management of threatened euryhaline species
* Indigenous Ranger Group training in threatened species surveying and management

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

* This project will monitor and refine the status of key threatened species, leading to a reassessment of EPBC status with an evaluation of the appropriateness of down-listing key species
* The establishment of a long-term sawfish patrol on Malak Malak country in the Daly River region (with the possibility to expand this program elsewhere) will see any juvenile sawfish which have been stranded in drying waterholes be relocated to the main river, with the practical outcome of increased survivorship (relocated animals will be tagged to monitor survivorship and evaluate the program long-term) and increased capacity for monitoring
* The rolling out of an Indigenous education program on the status of key species (initial focus on sawfish, with extension to other species) will aim to decrease mortality of threatened species (through increased safe release following capture)

#### Value

What value does the project demonstrate for the environment and how can this be measured?

Euryhaline elasmobranchs represent over half of the EPBC-listed threatened sharks and rays, and are subject to a multi-species Recovery Plan. This project will directly address several Recovery Plan objectives (listed above), and the project outcomes will be measured against meeting those objectives. The project will also lead to the reassessment of EPBC-status of key species (river sharks) which will demonstrate improvements in understanding since the first EPBC-listings (this may also lead to the demonstration of improved status). The project will aim to improve sustainability of threatened species through Indigenous education and stakeholder engagement with the commercial fishing industry.

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

* Updated assessment for river shark status
* Manuscripts on ecology and status relevant to the management of threatened euryhaline species
* Manuscripts on optimal design of acoustic receiver arrays and statistical methods for estimating mortality
* Threatened marine species education package for Indigenous communities
* Media releases around key field and engagement activities, such as the first threatened marine species survey of the western Northern Territory coastline
* Data and information outputs of this project will include distribution, extent of occurrence and area of occupancy estimates for key marine species, Indigenous knowledge on key species distribution and occurrence, mortality and survivorship data on key species, the first data on river shark age determination (an essential component of understanding demography), molecular data on population structure and population connectivity of key species, and lower population size estimate for *Glyphis garricki*. Data will be housed on appropriate explorable databases and made fully available to DoEE
* Refining the identification of biologically important areas (BIAs) within the NT and WA for threatened euryhaline elasmobranchs (using published BIA protocols)

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

Theme 1: Monitoring and understanding euryhaline species

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1: Engagement with research end-users and stakeholders | Due 01 December 2015 |  |
| Milestone 2: Annual monitoring of tagged euryhaline elasmobranchs | Due 01 August 2016 |  |
| Milestone 3: Neonate river shark tagging for mortality estimates | Due 01 August 2016 |  |
| Milestone 4: Large river shark tagging for adult occurrence delineation and philopatry | Due 31 December 2016 | Changed from 01 Aug 16 (RPV2) to 31 Dec 16 (RPV3) |
| Milestone 5: Statistical methods for estimating annual juvenile mortality | Due 01 August 2016 |  |
| Milestone 6: Optimal design of receiver arrays | Due 01 December 2016 |  |
| Milestone 7: River shark ageing for demography | Due 01 December 2016 |  |
| Milestone 8: Working group on euryhaline elasmobranch species | Due 01 December 2016 |  |
| Milestone 9: Annual monitoring of tagged euryhaline elasmobranchs | Due 01 August 2017 |  |
| Milestone 10: Retrieval of acoustic receiver array (thereafter for future NESP projects) | Due 01 August 2017 |  |
| Milestone 11: Synthesize and report on habitat use, biologically important areas and long-term movements of euryhaline elasmobranchs | Due 01 August 2017 |  |
| Milestone 12: All project outputs and data will be made publically and freely accessible and available on the internet (see section Data and Information Management) | Due 01 August 2017 |  |
| Milestone 13: Field sampling for PhD project ‘From rivers to ocean basins - quantifying sex-specific connectivity in elasmobranchs’ | Due 31 December 2017 |  |

Theme 2: Indigenous partnerships for management of euryhaline species

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1: Engagement with research end-users and stakeholders | Due 01 December 2015 |  |
| Milestone 2: Protocols for annual Daly River Indigenous sawfish survey | Due 01 December 2015 |  |
| Milestone 3: I-Tracker tool development for Daly River Indigenous sawfish survey and relocation | Due 01 December 2015 |  |
| Milestone 4: Daly River Indigenous sawfish survey and relocation | Due 01 December 2015 |  |
| Milestone 5: Develop Indigenous partnerships for sawfish knowledge assessment | Due 01 August 2016 |  |
| Milestone 6: Develop sawfish education package for Indigenous communities | Due 01 August 2016 |  |
| Milestone 7: Indigenous workshops for sawfish knowledge assessment | Due 01 August 2016 |  |
| Milestone 8: Daly River Indigenous sawfish survey and relocation | Due 01 December 2016 |  |
| Milestone 9: All project outputs and data will be made publically and freely accessible and available on the internet (see section Data and Information Management) | Due 01 December 2016 |  |

Theme 3: Knowledge for the reassessment of river shark status

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1: Engagement with research end-users and stakeholders | Due 01 December 2015 |  |
| Milestone 2: WA sampling | Due 01 August 2016 |  |
| Milestone 3: Western NT marine survey | Due 01 August 2016 |  |
| Milestone 4: *Glyphis garricki* population structure | Due 31 December 2016 | Changed from 01 Aug 16 (RPV2) to 31 Dec 16 (RPV3) |
| Milestone 5: *Glyphis garricki* lower bound population size | Due 01 August 2017 | Changed from 01 Dec 16 (RPV2) to 01 Aug 17 (RPV3) |
| Milestone 6: River shark status assessment | Due 01 December 2017 | Changed from 01 Dec 16 (RPV2) to 01 Dec 17 (RPV3) |
| Milestone 7: All project outputs and data will be made publically and freely accessible and available on the internet (see section Data and Information Management) | Due 31 December 2017 | Changed from 01 Dec 16 (RPV2) to 31 Dec 17 (RPV3) |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| Peter Kyne (0.2 FTE) \*only FTE for 2017 | Charles Darwin University | Project leader/Field ecology/telemetry/Indigenous partnerships |
| Christy Davies | NAILSMA | Indigenous partnerships |
| Pierre Feutry | CSIRO | Molecular research |
| Richard Pillans | CSIRO | Field ecology/telemetry |
| Toby Patterson | CSIRO | Mortality & movement models |
| Mark Bravington | CSIRO | Population assessment & modelling |
| Grant Johnson | NT Fisheries | Field ecology |
| David Morgan | Murdoch University | WA field ecology |
| Jeff Whitty | Murdoch University | WA field ecology |
| Michelle Heupel | AIMS | Life history/field ecology |
| Florian Devloo-Delva | UTAS | PhD candidate |

Note: 2015 is 1 July to 31 December; 2016 is 1 January to 31 December; 2017 is 1 January to 30 June (project length: 24 months)

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
|  |  |  |
|  |  |  |

Research End Users and Key Stakeholders **–** Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| Department of the Environment and Energy | Lesley Gidding-Reeve, Debbie Rudd |  |
| Department of the Environment and Energy | Gregory Andrews |  |
| Department of the Environment and Energy | Parks Australia (Kakadu National Park) |  |
| Department of the Environment and Energy | SPRAT, Kasia Gabrs |  |
| Malak Malak Ranger Group | Rob Lindsay, Traditional Owners |  |
| Additional Indigenous ranger groups | TBD through consultation and engagement |  |
| Indigenous land councils | Northern Land Council; others TBD |  |
| NT Fisheries | Thor Saunders |  |
| WA Fisheries |  |  |
| WA Parks and Wildlife |  |  |
| NT Seafood Council | Lyn Lambeth |  |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| Department of the Environment and Energy | Lesley Gidding-Reeve, Ashley Leedman |  |
| Department of the Environment and Energy | Gregory Andrews |  |
| Department of the Environment and Energy | Parks Australia (Kakadu National Park) |  |
| Department of the Environment and Energy | SPRAT, Kasia Gabrs |  |
| Malak Malak Ranger Group | Rob Lindsay, Traditional Owners |  |
| Additional Indigenous ranger groups | TBD through consultation and engagement |  |
| Indigenous land councils | Northern Land Council; others TBD |  |
| NT Fisheries | Thor Saunders |  |
| WA Fisheries |  |  |
| WA Parks and Wildlife |  |  |
| NT Seafood Council | Lyn Lambeth |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

Knowledge brokering and communications will be a core component of the project, and will be considered in the framework of the Hub’s Knowledge Brokering and Communications Strategy. Communications tools will include newsletter articles, short films, media releases and media packages and website contributions, amongst other tools. The development of Indigenous education tools will be accompanied by communication activities to promote this widely. This will include Indigenous specific knowledge brokering through the partnership with NAILSMA and Indigenous communities.

As this project has a substantial number of milestones, the outcomes and outputs of these will be regularly reported to DoEE, by maintaining frequent contact with the Wildlife, Heritage and Marine Division. Any activities in Kakadu National Park are reported to Parks Australia upon their completion (for example within a day of the completion of a field trip), a practice which was successfully implemented during NERP. All activities will be regularly reported to the Threatened Species Commissioner.

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

This project will collate species movement and population datasets and Indigenous knowledge and produce reports that include species distribution maps (see milestones). Data and information will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. Species distribution datasets will be stored in a long-term secure storage, metadata will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal <http://portal.aodn.org.au/aodn/>

Project data management includes the specific recognition of the need to manage any sensitive data in consultation and agreement with Indigenous groups and organisations.

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website <http://www.nespmarine.edu.au>. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

Contact person

Name: Peter Kyne

Email Address: peter.kyne@cdu.edu.au

Phone Number: 0477 306 344

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

Project funding will be used for salaries, to purchase acoustic tags for telemetry, maintain acoustic receiver arrays, undertake field sampling and surveys, engage and employ Indigenous Ranger Groups and communities, develop Indigenous data recording and education tools, host workshops, and sequence DNA for molecular analyses.

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

Northern Australian marine, estuarine and riverine systems, particularly in the Northern Territory and Kimberley, Western Australia.

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

Key components of this project will be undertaken in partnership with Indigenous organisations, communities and Ranger Groups (i.e. this is a Category 1 project for Indigenous engagement and participation). Ranger Groups will be partnered to undertake field work, and a central theme of the project is the development of key Indigenous partnerships to enhance the management and protection of marine species. The North Australian Indigenous Land and Sea Management Alliance (NAILSMA) is a core project partner, and will use its extensive knowledge and relationships across northern Australia to lead key project components including assessing cultural use and developing Indigenous data-recording and education tools. Indigenous Land Councils will be consulted during the development of research to evaluate engagement and partnership opportunities. The Malak Malak rangers (NT) and Dambimangari rangers (WA), amongst other ranger groups will be undertaking project field components. A long-term vision is the adaptive management of threatened sawfishes on country by the Malak Malak Ranger Group. Indigenous participants will have opportunities to co-author research outputs, attend workshops and be acknowledged in all research outcomes.

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

This project focuses on EPBC-listed threatened euryhaline elasmobranchs of northern Australia, encompassing acoustic telemetry, molecular research and Indigenous knowledge.

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

Non-threatened marine fauna; geographic regions outside of northern Australia.

### Risks

List all significant risks to the success of the project

Extreme monsoonal weather conditions have the potential to constrain field research and the remote location of Indigenous communities may constrain ability to work in these areas during the wet season.

NERP demonstrated the functionality of molecular approaches underlying the use of close-kin mark-recapture to estimate population status, and any initial risks around the development of this novel methodology have been nullified. As this project focuses on rare and threatened marine species, a central risk is the possibility of not being able to locate these species in the field, particularly in areas which have never been surveyed before. There was a risk around not being granted approval from relevant authorities to lethally sample a small number of *Glyphis glyphis* for essential ageing, but all approvals have now been received.

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

Threatened species, marine conservation, population status, recovery planning, close-kin mark-recapture

**Appendix I. Tentative NT acoustic receiver array download schedule 2015-2017**

|  |  |  |  |
| --- | --- | --- | --- |
|  | South Alligator | Adelaide | Other Alligators\* |
| Download 1 | Jun-15 | Jun-15 | May-15 |
| Download 2 | Feb-16 | Feb-16 | May-16 |
| Download 3 | Jun-16 | Jun-16 |  |
| Download 4 | Sep-16 | Sep-16 |  |
| Download 5 | Dec-16 | Dec-16 |  |
| Retrieval^# | May-17 | May-17 | May-17 |
| Download 6^ | Jun-17 | Jun-17 | Jun-17 |
| Download 7^ | Dec-17 | Dec-17 | Dec-17 |

\*Wildman, West Alligator, East Alligator

^Estuarine receivers to remain in place to monitor large Speartooth Shark

#Retrieval may occur earlier for a variety of reasons, such as: sufficient data has been collected to answer research questions, all tagged fish have left the array area, tag batteries have expired etc.

**Appendix II. Tentative sampling field work schedule (excluding NT acoustic receiver array downloads – see Appendix I)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Field activity** | **Date** | **Location** | **Partners** |
| Wildman River sampling | Sep 15 | Wildman River | CDU, NT Fisheries |
| WA shark sampling | Oct 15 | King Sound | Murdoch, CDU |
| Daly River shark sampling | Oct 15 | Daly River | CDU, Malak Malak, NT Fisheries |
| Western NT survey | Nov 15 | Western NT | CDU, NT Fisheries |
| Floodplain sawfish survey | Nov 15 | Daly River | CDU, Malak Malak, NAILSMA |
| *Glyphis glyphis* juvenile & sub-adult tagging | Nov 15 | Adelaide River | CDU, NT Fisheries |
| *Glyphis glyphis* sampling for ageing | Nov 15 | Adelaide River | CDU, NT Fisheries |
| WA shark sampling | Dec 15 | Ord River | Murdoch, CDU |
| Floodplain sawfish survey | Oct 16 | Daly River | CDU, Malak Malak, NAILSMA |

# Project A3 – A national assessment of population status of white sharks

Project length – 2.5 years

Project start date – 01/07/2015

Project end date – 30/12/2017

Project approval date - xx/xx/xxxx (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - Submitted for re-approvalSubmitted for re-approval

Project Leader – Barry Bruce (FTE – 25%)

Lead Research Organisation – CSIRO Oceans & Atmosphere

Project leader contact details: - [Barry.Bruce@csiro.au](mailto:Barry.Bruce@csiro.au), 03 62325413

### Project Funding

|  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | TOTAL |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NESP funding | 197,000 | 275,000 | 292,000 | x | x | x | x | 764,000 |
| Cash co-con |  |  |  | x | x | x | x |  |
| In-kind co-con | 197,000 | 275,000 | 311,000 | x | x | x | x | 783,000 |
| TOTAL | 394,000 | 550,000 | 603,000x | x | x | x | x | 1,547,000 |

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

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.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

Recommend changing the delivery of Milestone 8 ‘*Test the development of the ‘cousins’ approach of CK-MR for estimating population trends - extension of statistical kin-finding methods to incorporate genomic data (from half sibs to half cousins)*’ from June 2016 to December 2016. This is due to delays in completing the genome assembly. The assembly is required before the statistical analyses can be completed.

The addition of full-scale BRUV deployments and analysis (Milestone 3) following on from successful trials of the technology.

### Problem Statements

#### Problem

Description of the specific problem

The white shark (*Carcharodon carcharias*) is listed as vulnerable and migratory under the EPBC Act and has been protected in Australian waters since the late 1990s. A review of the 2002 Recovery Plan, in 2008, concluded that although progress had been made on a number of listed actions, there was still no effective way to estimate population size or trends and thus no effective way of determining if current recovery plan actions were having any beneficial effect. Recent public and political debate in NSW, Western Australia and South Australia due to a series of shark attacks attributed to the species as well as claims of increasing interaction frequency, highlight the need to assess population status and trends in white sharks. This information is required to establish the efficacy of combined recovery actions, use such data to design effective and defendable recovery and population rebuilding strategies and provide a scientifically sound and rational basis from which to develop policies that balance conservation objectives and public safety. This project will build on the significant advances made under NERP by providing National population estimates for the species, advance the knowledge on movement patterns and key areas of habitat use (hotspots) as well as develop strategies for the future monitoring of the species. The novel genetic and integrated modelling tools developed and trialled nationally on white sharks have links to other project initiatives under NERP and NESP and, combined, serve as a testing ground for these new techniques to assess the condition and trend of Australia’s threatened species populations for which conventional data provide an inadequate base to do so. Importantly, combined with other NESP project initiatives (e.g. project A6 and A1) this project will contribute as a case study to identify how much information (and hence investment) is required to provide an adequate level of policy advice regarding the status of threatened marine species.

#### How Research Addresses Problem

What solution will this research provide?

NESP research on white sharks will focus on refining the initial population estimates for eastern Australia using data streams established under NERP and will provide first estimates of adult population size for white sharks west of Bass Strait. Estimating population size is a key deliverable, however, the information required for assessing the efficacy of Recovery Plan actions and underpinning policies that balance the species conservation with public safety also require an assessment of population trend and the ability to robustly assess the impact of any proposed mitigation policies or additional sources of impact. NESP project work will also provide scientifically robust tools and assessment procedures to measure and monitor trends as well as providing improved knowledge of the species’ movement patterns and habitat use.

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

This project aligns with the following research priorities:

* Identifying hot spots and management strategies for top order marine predators, including research to identify effective non-lethal measures to manage human-shark interactions.
* Improve our knowledge of key marine species and ecosystems to underpin their better management and protection.
* Better understanding, measuring and reporting on the condition and trend of threatened species (links with Threatened Species Recovery Hub).

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

During NERP, we showed that new genetic technologies could be used to find half-sibling pairs in white sharks, which can be used to estimate current adult abundance via Close-Kin Mark-Recapture (CK-MR) analyses. Data continue to support the two population model for Australian white sharks with populations separated east and west by Bass Strait. We established on-going data streams to monitor shark movements and survival via internal tagging with long-life (5-10 year duration) acoustic tags matched with strategic deployments of acoustic receivers in nursery areas. These receiver deployments complement national scale receiver arrays managed by IMOS and collaborating institutions. These data streams are still providing data on sharks tagged up to six years ago. We continue to collate genetic samples from various research programs from both eastern and western white shark populations. These data and sampling streams were specifically designed to provide the required data for refining east-coast population estimates and for developing methods to estimate population trend. Refining eastern population estimates and applying the knowledge and techniques developed to the achieve estimates of the western population will be the focus of NESP research. This research will establish a national scale population assessment for white sharks in Australia. As part of this research, new CK-MR tools will be trialled that have the potential to estimate population trend from existing genetic samples. This latter development, if effective, holds promise for more rapid and effective assessments of the population status of Australia’s threatened species populations for which conventional data provide an inadequate base to do so.

During 2015 to 2017, NESP research within this portfolio will focus on:

* Consolidating existing data and refining east-coast population estimates using on-going data streams established through 2012-2014, thereby ensuring these streams will provide a useful base for future monitoring
* Trialling strategies for monitoring juvenile abundance and age/growth validation
* Assembling and analyse movement pattern data for sharks west of Bass Strait based on historical and current electronic tagging of white sharks
* Coordinating sample collection and undertaking assays of archived tissue to establish requirements for making population estimates for the western white shark population
* Estimating population size for Australian white sharks west of Bass Strait
* Establishing and test tools for estimating population trend from existing samples

This will be achieved by:

1. Improving, monitoring and reviewing data streams established during under NERP (2015+2016)

Acoustic tagging of juvenile white sharks in eastern Australia provide on-going data streams for monitoring nursery area use, survival rates and ontogenetic changes in movement patterns and overall habitat occupancy. These data streams will be incorporated into a revised estimate of population size for white sharks in eastern Australia and update tools for similar estimates for white sharks west of Bass Strait. Recent additional tagging of juvenile white sharks by NSW DPI will complement and add to estimates of survival for juvenile white sharks in eastern Australia. All acoustic data will be archived in the IMOS/AATAMS database.

Estimating and monitoring juvenile abundance in nursery areas holds promise for future monitoring strategies for this species, particularly in eastern Australia. Aerial surveys provided some data during NERP but remain an expensive option. Baited underwater videos (BRUVs) have become a standard tool for surveys and monitoring. BRUVs were trialled in the Port Stephens area (in collaboration with NSW DPI) in 2014-15 to test their utility for assessing abundance and monitoring tagged juvenile white sharks (Harasti et al., submitted). This will also complement BRUV deployments in the adjacent Hunter Commonwealth Marine Reserve as a means of assessing this reserve’s potential for contributing to the conservation outcomes for the species. The Port Stephens area is ideally suited to the use of BRUVs due to the geographically discrete nature of the nursery area and existing knowledge of the percentage time spent by juvenile white sharks in highly localised zones near to shore as well as the propensity of tagged sharks to annually revisit these specific areas. Limited BRUV trials in 2014 met with immediate success in sighting juvenile white sharks and including close proximity passes suitable for individual identification and length estimation. BRUV deployments will be targeted in these nearshore-beach zones of the Port Stephens nursery area where acoustic tagging, satellite tracking and vessel-based surveys during NERP identified high contact rates with both tagged and untagged sharks. BRUV surveys are aimed to provide information on:

* Age/growth validation estimation

Age validation in white sharks, even in juveniles, is still unresolved: radio-carbon dating suggests slower growth and older sharks at length than unvalidated vertebral band-pair counts. This info is important for overall growth models and estimates of how white shark populations can handle additional mortality and how long it will take populations to ‘recover’. It is also important to some calculations in Close-kin estimates of population size. In addition, it will become a key piece of info as we go forward with the monitoring of acoustic tagged sharks.

* Estimates of relative/absolute abundance

Acoustic tagging and monitoring is beginning to show that sharks are more common off certain beaches than others. However, the acoustic monitoring does not by itself give an indication of how many sharks are present. BRUV work may just do this in either a relative sense or, when matched as a mark-recapture tool, as an absolute estimate.

2. Estimate adult population size via CK-MR analyses of SA/WA tissue samples (2015-2017)

Approximately 200 tissue samples from white sharks west of Bass Strait have already been archived for CK-MR analyses for this project. These samples will be assayed in 2015 and will provide the basis for establishing what samples are required to estimate population size and status for the western population in 2016-2017. This will provide guidance on the number of samples required to achieve an identified level of certainty and will be used to establish the 2016-17 research plan.

3. Close kin mark recapture – development of the ‘cousins’ approach (trial 2015 – test 2016-2017)

Current CK-MR techniques provide for identifying sharks that share one parent (half-sibling pairs) or both parents (full sibling pairs). The number of half-sibling pairs detected in the population has a direct relationship to the census (true) population size of adults that produced the population. Initial estimates for the number of adult white sharks on the east coast have been made under NERP. However, these analyses do not provide for estimates of population trend. NESP research will build on defining demographic parameters through the data streams established under NERP and via assimilating these data streams into an integrated model of the population that can be used to estimate trends and responses to pressures. However, with the same samples already in hand, it may be possible to estimate census population size and over previous generations thereby providing a clear understanding of population trend. The next level of complexity for CK-MR is to identify first cousins (H1CPs), animals that share one ‘grandparent’. This would provide a population estimate for the previous generation to compare with the half-sibling pair estimate of the current generation– giving a population trend without the need to wait for future data to roll in. To identify H1CPs larger components of the white shark genome needs to be compared between individuals. Pre-analysis checks of all of the species currently being assessed by under NERP-NESP by CK-MR reveal that white sharks are the best candidate species to trial this technique, which, if successful, may revolutionize the way assessments and management decisions are taken on data-poor listed species. This component will assemble the data necessary (genome assembly) for cousin-finding on white sharks in 2015, and assess the viability of the technique in 2016.

4. Integrated population modelling and developing an ongoing strategy for monitoring (2016-2017)

Development of an integrated, spatially-structured, population model for white sharks is fundamental to both assessing stock status and for the development of a robust ongoing monitoring strategy. The various research components either completed under NERP or proposed under NESP, will dramatically reduce the uncertainty in a variety of the parameters required for modelling the population ('census size' estimates of mature population size, survival rates, movements and spatial dynamics). This part of our project will integrate all data streams to allow for the determination of national population status (arguably the key management uncertainty). Developing a population model that can adequately simulate various monitoring programs will be vital to deciding on what is a cost-effective integrated monitoring program that can achieve the relevant management objectives.

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

This project addresses issues not covered by other current NESP projects. However, it develops and applies similar techniques (CKMR and population assessment tools) to those used by:

* 'A1: Northern Australian hotspots for the recovery threatened euryhaline species'.

In conjunction with A1, this project provides information highly relevant to:

* 'A6: Prioritisation of research and management needs for Australian elasmobranch species'  
  specifically with respect to providing a detailed case study from which to assess what level of information is required to adequately inform policy decisions.

It has broad links to and or will have complementary input to:

* A5: Establishing the status of Australia's hammerhead sharks.

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

This project builds on white shark research undertaken under NERP as part of a scheduled extension of the portfolio of work to complete a national assessment of white shark population status. NERP research focussed on developing the information base and trialling tools for assessing population size in white sharks. NERP research focussed on the eastern population of white sharks (recognising that Australia has two white shark populations, separated east and west by Bass Strait). Research completed as part of the NERP (or currently underway as part of Emerging National Priorities funding in 2015) has successfully applied close kin mark-recapture to identify juvenile white sharks that share one or both parents, provided the first estimates of adult population size for eastern Australia, improved information on movement patterns and trialled aerial surveys for identifying the location of nursery areas and estimating juvenile abundance. Acoustic tags now deployed in sharks are providing an on-going data stream which, when combined with movement models, will provide the first estimates of juvenile survival that can be used to improve population assessment models. Initial research on the western population of white shark, as part of the same NERP portfolio, investigated the locations of nursery areas in South Australia and Western Australia and archived tissue samples for CK-MR analyses from white sharks through collaborative partnerships with WA Fisheries, Flinders University, and SARDI. This has built the information and sample base to apply the techniques developed in eastern Australia so as to achieve population estimates for the west and thus complete the national-scale analysis of population status.

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

This project is phase two of the initiative commenced under the NERP, at Ministerial and Departmental request, to provide a national assessment of white populations. The project will, through its completion, advance efforts to halt the decline of marine biodiversity through: supporting the recovery of a threatened species, the white shark (*Carcharodon carcharias*) by meeting the requirements of the primary goal of the National Recovery Plan to assess population size and status.

The project will provide information on the status of white sharks in the context of marine matters of national environmental significance and fulfil obligations under the National Plan of Action (Sharks).

The project will contribute to:

* Priorities identified in the department’s Operational and Strategic Plans by advancing efforts to halt the decline of marine biodiversity.
* Responses regarding the management of human-shark interactions (a subject that has become a significant issue of public interest) by providing the scientific basis for informed, rational and effective policy decisions surrounding the species.
* Inform efficient and effective biodiversity data, information and knowledge systems, through its collaborative approach and integration of existing expertise and data.
* The ability to establish well-informed conservation management strategies for white sharks (and other threatened species) in Australian waters via innovative technologies and analytical techniques.
* State and Commonwealth Government policies directed at managing shark-human interactions (where they relate to white sharks) are based on robust and defensible scientific data on shark population status, habitat use, movements and behaviour – balancing conservation values and public safety.

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

The project will provide information from which on-going listing under the EPBC Act can be assessed, decisions (e.g. referred actions) on issues regarding human-shark interactions can be based on robust and defensible scientific data on white shark populations. This project will ensure that State and Commonwealth Government policies directed at managing shark-human interactions (where they relate to white sharks) are based on robust and defensible scientific data on shark population status, habitat use, movements and behaviour – balancing conservation values and public safety.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

White sharks are a listed threatened species and have been the subject of recovery plan actions since 2002. This project provides the first assessment of the efficacy of recovery plan actions by providing an assessment of population size and status – this highest priority action within the plan.

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

Scientific tools to refine and integrate CK-MR, electronic tagging distribution and species demographic data for population assessments of a key threatened species at a national scale (combining knowledge developed under this project combined with similar techniques being applied under NESP to euryhaline sharks and planned for grey nurse sharks).

Draft and final reports providing:

* national estimates of (census) population size and trend for white sharks in Australian waters (western and eastern populations respectively) are established that fulfil the highest priority actions of the National Recovery Plan.
* An updated estimate of juvenile white shark survival and abundance for input into integrated national population assessment models in order to refine population estimates
* Spatial data information that identifies movement corridors, hotspots, biologically important areas and contributes to management strategies for top-order marine predators.
* National-level information on habitat use, behaviour and spatial dynamics of white sharks at various scales used to provide the scientific underpinning for government decisions and policies as well as provide for more informed public debate

New scientific genetic and statistical tools trialled for the estimation of historical population trend from contemporary tissue samples for key species for which other methods of population assessment are unreliable or unavailable.

.

.

The project will provide peer-reviewed additions to the scientific literature that will add to the science-support for the development and implementation of policies to support the ecologically sustainable management of Australia’s marine environment.

Where possible/practical the project will provide face-to-face presentations of results to end-users and stakeholders as well as a research summary for managers that describes project outcomes. Communication products will be developed to promote the project and the research findings, including NESP Chirp articles and social media.

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1: Incorporate established 2015 data streams into refined population estimates for white sharks in eastern Australia and evaluate the efficacy of these data streams for future monitoring. | Due October-December 2015 | Data from 2015 has been incorporated into revised estimates of population size for eastern Australia & New Zealand – complete  Data/sampling from sharks captured 2015 NSW/Qld shark control program sampling complete  Data secured from IMOS database |
| Milestone 2: Trial BRUV approach for evaluating juvenile white shark abundance and for monitoring tagged sharks to improve estimates of demographic parameters in the Port Stephens nursery area. | Due October 2015-March 2016 | Trial completed by D. Harasti & K. Lee (NSW DPI). Trials recorded 34 sightings of 22 individual juvenile white sharks ranging in size from 1.58 to 2.22 m, with up to eight sighted on a single survey day. A manuscript is currently under internal review: Harasti, D., Lee, K. A., Laird, R. Bradford, R. & Bruce, B. (in review). Use of baited remote underwater video systems (BRUVs) to estimate relative abundance and size of juvenile white sharks, *Carcharodon carcharias*. |
| Milestone 3: Deploy BRUVs in the Port Stephens region during 2016-17; analyse data. | Due June 2017-August 2017 |  |
| Milestone 4: Run initial assays and analyses on archived western population tissue sets to assess requirements for estimating population size | Due October-December 2015 | Initial assays have been completed – DNA has been extracted and processed from 200 samples. Samples are mainly from larger juveniles and sub-adult sharks (both sexes) as well as reasonable numbers of adult males but with relatively few adult females sampled (as opposed to primarily small juveniles sampled in eastern Australia). Despite aerial and on-water surveys to locate nursery areas west of Bass Strait that would be suitable for sampling, none have been found with juveniles widely spread. This means that a slightly different path will be followed for estimating population size in the west. We will be exploring alternative kinship comparisons based on Father-Offspring pairs given the abundance of adult males in the samples available, in addition to half-sibling analyses to estimate the number of adults in the population as the next step. |
| Milestone 5: Test the development of the ‘cousins’ approach of CK-MR for estimating population trends. Initial assembly of the white shark genome from new PacBio and existing Illumina sequences | Due December 2015 | Sequencing data are in hand. We will be assembling a white shark genome via a group in Belgium (contract under development). This genome assembly will also be combined with another recent assembly (that used a different technique) to see if we can improve on each other’s assembly. This will set the groundwork for the application of the ‘Cousins’ approach in 2016-17. |
| Milestone 6: Archive acoustic tag data into IMOS/AATAMS database; Project progress report | Due December 2015 | ‘Protected Data’ status for white shark tag codes has been finalised. All metadata records for individual white shark tags deployed under CSIRO projects have been uploaded into the IMOS/ATF database. Database now has over 200,000 raw detections of white sharks under protected data status. |
| Milestone 7: Coordinate collection and central archiving of white shark tissue samples from western population; analyse samples in plate batches (plates of 94 samples each) as they become available; Tag juvenile and adult sharks in South Australian and Western Australian waters for movement pattern analysis, tissue sampling and for estimating survival rates. | Due January 2016- June 2017 | Samples continue to be archived; further sample collection via collaborator agencies ongoing (NSW DPI, WA Fisheries, Flinders Uni, SARDI); DNA has now been extracted from 429 white sharks (201 from eastern Australia + 228 from west of Bass Strait; 397 of these have been sequenced. Further samples are expected within the next few months and we anticipate we will be able to sequence another full plate (94 sharks) by then end of the year; PSAT tag data from adult male and female sharks tagged at the Neptune Islands have shown extensive offshore movements (females – as far south as Macquarie Island) as well as extensive use of shelf –edge and slope waters. |
| Milestone 8: Test the development of the ‘cousins’ approach of CK-MR for estimating population trends - extension of statistical kin-finding methods to incorporate genomic data (from half sibs to half cousins) | Due June 2016  **Recommend change to December 2016** | We have collaborated with Gavin Naylor’s lab (Charleston USA) to attempt a combined genome assembly based on our PacBIO data and his lab’s Illumina data on white sharks, however the combined assembly did provide an improved dataset – we are thus proceeding with an assembly based on our PacBIO data. This has provided significant progress and direction but has slowed the completion of this milestone. |
| Milestone 9: Archive 2016 acoustic tag data into IMOS/AATAMS database; Project progress report | Due December 2016 | Upload of data is progressing; next data downloads from receivers specifically deployed for the project anticipated in early September 2016 (SE Victoria) and early November 2016 (Port Stephens region). |
| Milestone 10: Progress report | Due April 2017 |  |
| Milestone 11: Finalise development of ‘cousins’ approach – assess results and applicability for estimating population trend; apply technique to archived east coast samples. | Due June 2017 |  |
| Milestone 12: Archive 2017 acoustic tag data into IMOS/AATAMS database | Due December 2017 |  |
| Milestone 13: Finalise development of ‘cousins’ approach – assess results and applicability for estimating population trend; apply technique to archived west coast samples; Incorporate established 2016-17 data streams into refined population estimates for white sharks in eastern and western Australia. Provide national assessment of population size and trend and finalise strategies for future monitoring. | Due December 2017 |  |
| Milestone 14:Draft report describing research findings and future options | Due 31 October 2017 |  |
| Milestone 15: Engage with research users to discuss research findings and outcomes of project (including population assessments, habitat use and spatial dynamics); | Due November 2017 |  |
| Milestone16: Final report describing research findings and future options | Due December 2017 |  |
| Milestone 17: Project outputs and data will be made publically and freely accessible and available on the internet | Due December 2017 |  |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| Barry Bruce | CSIRO | Project leader |
| Russell Bradford | CSIRO | Sample and field coordination; data analysis |
| Peter Grewe | CSIRO | Genetic analysis |
| Mark Bravington | CSIRO | Statistical analysis |
| Richard Hillary | CSIRO | Population modelling |
| Rasanthi Gunasekera | CSIRO | Genetics technical support |
| Toby Patterson | CSIRO | Movement dynamics |
| David Harasti (0.20 FTE) | NSW DPI | NSW DPI coordinator; field logistics; data analysis |
| Kate Lee | NSW DPI | Data analysis |
| Brett Louden (0.10 FTE) | NSW DPI | Field logistics; data analysis |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
| Joe Smith | Foundation for X | e.g. Cash, Undertake X management activity on which research will be based |
|  |  |  |

Research End Users and Key Stakeholders **–** Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| Department of the Environment and Energy: Marine and Freshwater Species Conservation Section: Wildlife, Heritage and Marine Division | Ashley Leedman/Lesley Giddings  Threatened Species Commissioner |  |
| Department of the Environment and Energy - Threatened Species Commissioner | Gregory Andrews |  |
| Parks Australia | Amanda Parr |  |
| Queensland Government |  |  |
| NSW Government (specifically NSW DPI) | Vic Peddemors |  |
| Victorian Government | TBA |  |
| South Australian Government (specifically PIRSA and DENR) | Barry Hayden |  |
| Western Australian Government (specifically WA Department of Fisheries; WA EPA, Department of Premier & Cabinet) | TBA |  |
| Department of the Environment and Energy - ERIN | Carolyn Armstrong |  |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| NSW DPI | Natalie Moltschaniwskyj |  |
| WA Department of Fisheries | TBA |  |
| PIRSA | TBA |  |
| AFMA | TBA |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

Knowledge brokering and communication strategies were well established during our activities under NERP and will be continued under NESP, in accordance with the Hub’s Knowledge Brokering and Communications Strategy. The primary end user of the information is the Marine and Freshwater Species Conservation Section: Wildlife, Heritage and Marine Division of DoEE, although various Commonwealth and State Government agencies maintain significant interest in the outcomes of the project. Apart from the regular and required monthly reporting of project activities, we will maintain both direct formal (information sessions/seminars within the Department in Canberra) and informal contact with the Department (ad-hoc requests for information and advice via phone and email on request). Specific to these engagements will be a regular review of progress and outputs to ensure alignment with DoEE needs. Information sessions/seminars will be held with other key end users/stakeholders including the NSW Government (via seminars at NSW DPI), the South Australia Government (via seminars at SARDI Aquatic Sciences) and the WA Government (via seminars at WA Department of Fisheries). We recognise that this project also has significant public interest. Public seminars were undertaken during NERP to continue to educate and inform the public on the project. These have included open-access public seminars in central NSW (central and mid-north coast, Sydney) and Victoria (Melbourne). These will be continued during NESP and opportunities will be explored to present similar public seminars in other States.

The pathway to adoption for the outputs of the project remain by fulfilling the highest priority needs of the national recovery plan for the species thereby providing the science-support base for informing the policies regarding conservation actions. This project also aligns with the National Plan of Action (Sharks).

Information from this project will also be communicated via media responses/engagement where appropriate and publications in the scientific literature.

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

This project will collate species movement and distribution datasets, genetic datasets and produce reports that include species distribution maps (see milestones). Data and information will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. Species distribution datasets will be stored in a long-term secure storage, metadata will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal <http://portal.aodn.org.au/aodn/>

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website <http://www.nespmarine.edu.au>. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

The primary contact point for data and information management contact for this project is the project leader (see details in front page).

Contact person

Name: Barry Bruce

Email Address: barry.bruce@csiro.au

Phone Number: 03 6232 5413

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

Funding is required for contribution to salaries of staff, field work in strategic areas, data analyses, the development of molecular and statistical analyses and extension of results.

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon. Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

Areas of southern and central Qld, central NSW, SE Victoria, South Australia and Western Australia.

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

The project is mostly focused on laboratory analyses of samples collected by collaborators and data analyses and is therefore considered a category three project for Indigenous engagement. Our approach to engagement will primarily involve provision of updates to the DoEE Indigenous Advisory Group the Fisheries Research and Development Corporation Indigenous Reference Group. These groups will also be asked for advice on opportunities to enhance Indigenous engagement in this project. The project team will also make contact with relevant indigenous groups within the specific geographic areas where we either have (under NERP) or will under NESP be undertaking on-ground field work such as central NSW, SE Victoria and coastal areas of SA and southern WA, to determine if there is interest in sharing relevant knowledge and interests related to this research. This contact will be in the form of identifying the nature of work we are undertaking, the reasons for such work and seeking input from such groups as to their level of interest in this work.

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

This project will:

* refine current estimates of white shark population size for eastern Australia; provide first estimates of population size for the population west of Bass Strait and trial analyses to assess population trends
* assess movement patterns for sharks in both eastern and western populations, identifying the distribution of temporal hotspots, biologically important areas and migratory corridors
* identify national scale strategies/requirements for future monitoring of these populations

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

This project will identify future monitoring strategies/requirements but will not implement them.

### Risks

List all significant risks to the success of the project

Much of the ground-work for this project was established and tested under NERP. The main risks are in obtaining sufficient samples for CK-MR analyses. However, this risk has been minimised by establishing collaborative tissue sampling and exchange programs with WA Fisheries, NSW DPI, SARDI, Flinders University and researchers working with QLD DPI. A significant tissue base exists and continues to grow.

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

Conservation status, population size and trend, close-kin mark-recapture, marine predator, shark, threatened species, movement dynamics.

# Project A4 - The status of human-shark interactions and initiatives to mitigate risk in Australia

*Project length* - six months

*Project start date* – 1/06/2015

*Project end date* – 15/12/2015\*

Project status - Completed

\*Note that this project will provide guidance on appropriate areas of NESP investment and project delivery for 2016-2018 in order to meet the stated high priority objective “to identify effective non-lethal measures to manage human-shark interactions”. Funding for research areas potentially stemming from this project, should they be identified, have not been indicated in years past 2015. This project will provide planning guidance for such projects.

*Project Leader* – Barry Bruce (FTE – 15%)

*Lead Research Organisation* – CSIRO Oceans & Atmosphere

*Total NESP funding* - $50,000

*Total Recipient and Other Contributions (co-contributions)* - $50,000

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* | *2021* |
| *NESP funding* | *$50,000* |  |  | *x* | *x* | *x* | *x* |
| *Cash co-con* |  |  |  | *x* | *x* | *x* | *x* |
| *In-kind co-con* | *$50,000* |  |  | *x* | *x* | *x* | *x* |

**Project Summary**

Considerable political, public and media attention has 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. This project will review the status of human-shark interactions in Australia, provide a synthesis of current initiatives to reduce risk, review recent international efforts to address these issues and identify knowledge gaps to provide an informed base for determining the most appropriate future research and policy support.

**Problem Statements**

*Problem*

Considerable political, public and media attention has recently been focussed on the interactions between sharks and humans in the marine environment and specifically surrounding shark attack and ways to mitigate this risk. This debate has initiated a considerable investment at the State Government level in new tools, techniques and publicly accessible information that supplement existing strategies in an attempt to mitigate risks of shark-human interaction. Similar issues exist in other areas of the world where a diverse range of risk mitigation strategies have been implemented and technologies developed with varying degrees of success. Finding the most appropriate policy balance between conservation of sharks in the marine environment, maximising public safety and understanding the broader social and economic ramifications/drivers for doing so is a continuing challenge for Government. Despite the numerous developments in this space and specifically within Australia, there is no current synthesis of available information on research, technological development, investment and policy initiatives in this area as well as a clear articulation of the information gaps that require addressing to best support and inform policy and public debate. While there is considerable opportunity for NESP-funded projects to add value in this area, doing so would best be served by first providing a clear understanding of current research and development in this area, current policy initiatives and a clear articulation of unresolved issues and information gaps.

*How Research Addresses Problem*

This project will provide a background paper on the status of human-shark interactions in Australia, identify current national projects and initiatives in this space (including available information on public perception) review recent international efforts to address these issues and identify knowledge gaps in order to provide an informed base for determining the most appropriate directions for future research that best supports the development of effective Federal and State Government policy initiatives.

*Alignment with NESP Research Priorities*

This project specifically addresses the articulated high priority objective:

• Identifying hot spots and management strategies for top order marine predators, including research to identify effective non-lethal measures to manage human-shark interactions.

**Research**

*Description of research*

A focus group will initially draft a background paper on the status of human shark interactions in Australia, identify current national and international projects and initiatives in this space in order to provide an informed base for determining the most appropriate national direction for research and policy support. This project will ensure alignment between NESP activities in this space and Departmental and policy requirements. It will ensure that research is nationally coordinated and reduce the prospect of duplication of effort

Specifically the background paper will:

* Provide a synthesis of the current state of knowledge of shark-human interactions in Australia, focussing specifically on species such as white sharks, bull sharks and tiger sharks
* Identify what initiatives are currently underway nationally to address human-shark interactions including the status of current research as well as current management and policy initiatives.
* Identify technological developments within Australia and internationally in this space
* Identify lessons and experiences from these initiatives
* Identify issues and knowledge gaps
* Provide guidance to the Department regarding further investment that is cognisant of State Government initiatives and requirements and ensure a coordinated national knowledge base for addressing these issues.

*Links with other projects and hubs*

This project addresses issues not covered by other current NESP projects. However, it has broad links to:

A3: A national population assessment for white sharks

A5: Establishing the status of Australia's hammerhead sharks

A6: Prioritisation of research and management needs for Australian elasmobranch species

Outcomes of this project may also be relevant to the Threatened Species NESP Hub due to the listed status of white sharks.

*Related research*

The project will provide a national synthesis on initiatives and available information in the area of human-shark interactions and risk-minimisation strategies. This information has not previously been collated.

**Expected Outcomes**

*Outcomes*

This project will inform the Department and Minister of the current status of human shark interactions in Australia and the current portfolio of initiatives underway to mitigate risk. This information will provide a nationally integrated view of actions and provide the basis for determining appropriate investment strategies and policy direction at a national level that is cognisant of State initiatives and investment as well as informed by international developments.

The specific outcomes of this project will be:

A clearly articulated and collective understanding of current initiatives in the management of human-shark interactions (nationally and internationally).

The alignment of potential NESP investment in this space to Departmental and policy requirements in context with State Government initiatives.

*Specific management or policy outcomes*

Interactions between humans and sharks have created considerable political, public and media debate and pressure on Government to provide or assess risk mitigation strategies. Responses to these interactions have had ramifications under the EPBC Act when listed species are impacted (e.g. white sharks) including adjudicating on referred actions and mitigation measures. A clearly articulated and collective understanding of current information, initiatives and knowledge gaps in this area will provide an immediate guide for policy makers and the basis for which to guide further investment in this area.

*Value*

More effective conservation, management and mitigation strategies related to large predators and their interactions with humans will lead to better management of the marine environment and resources which will benefit the marine environment as a whole.

**Planned Outputs**

The project will develop a background document that:

* Provides a synthesis of the current state of knowledge of shark-human interactions in Australia, focussing specifically on species such as white sharks, bull sharks and tiger sharks
* Identifies what initiatives are currently underway nationally to address human-shark interactions including the status of current research as well as current management and policy initiatives.
* Identifies technological developments within Australia and internationally in this space
* Identifies lessons and experiences from these initiatives
* Identifies issues and knowledge gaps
* Provides guidance to the Department regarding further investment that is cognisant of State Government initiatives and requirements and ensure a coordinated national knowledge base for addressing these issues.

**Delivery of Project**

*Project leader’s track-record*

Barry Bruce has an extensive track record in areas of shark research, project delivery and specifically in leading projects that review information at State and national scales.

*Delivery on time and within budget*

This research will be based on existing data/information which will help ensure success in a timely fashion. The main costs involved are salary time to conduct data synthesis and travel funds to bring the focus group together. The time allocated for these tasks is appropriate and as such we anticipate that the project will be completed within budget.

**Project Milestones**

|  |  |
| --- | --- |
| **Milestones** | **Due date** |
| Establish focus group and draft scoping/background document | September 2015 |
| Focus group meeting with relevant DoE/MO staff | September –October 2015 |
| Complete scoping document (as final report) summarising issues and potential areas of research to address DoE/MO requirements | December 2015 |

**Researchers and Staff** (including early career researchers/PhDs – if names not yet known, list position/role)

|  |  |  |
| --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE** |
| Barry Bruce (CSIRO) | Project leader | 0.15 |
| Michelle Heupel (AIMS) |  | 0.1 |
|  |  |  |

**Partner contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| CSIRO | $34,500 |  | $34,500 |
| AIMS | $15,500 |  | $15,500 |
| It is anticipated that variety of researchers from various agencies will contribute information. A focus group will be established and travel funds form part of the requested budget to allow for meetings of the focus group during the course of the project |  |  |  |

**Other contributions** – only list contributors who are not already identified as Partners

|  |  |  |  |
| --- | --- | --- | --- |
| **Organisation/name** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| It is anticipated that variety of researchers from various agencies will contribute information. |  |  |  |
|  |  |  |  |

**Research End Users and Key Stakeholders –** Identify at least one section or programme within DoE who will be an end user for this project, as well as any end users external to the department.

|  |  |
| --- | --- |
| **Research End Users (section/programme/organisation)** | **Name/s (optional)** |
| Department of the Environment: Marine and Freshwater Species Conservation Section: Wildlife, Heritage and Marine Division  Office of the Minister Department of the Environment | Ashley Leedman/Lesley Giddings  Threatened Species Commissioner |
| **Key Stakeholders (organisation/programme)** |  |
| Queensland Government  NSW Government (specifically NSW DPI)  Victorian Government  South Australian Government(specifically PIRSA and DENR)  Western Australian Government (specifically WA Department of Fisheries; WA EPA, Department of Premier & Cabinet) |  |

**Knowledge Brokering and communication**

A key requirement of the project is to synthesize available information by communicating with researchers and management agencies currently involved in relevant initiatives. Both Bruce and Heupel have extensive backgrounds in liaison with other researchers as well as State and Commonwealth agencies (including the Department of the Environment) on a range of shark issues. Knowledge brokering and communication strategies have been well established during these activities and that experience will provide guidance in this NESP project. Apart from the regular and required monthly reporting of project activities, this project will provide direct formal communication with the Department in Canberra through an information/briefing session and, via the Department, to the Minister's office. We will regularly review progress and outputs to ensure alignment with DoE/Ministerial needs.

**Expenditure Summary**

Funding is required for contribution to salaries of staff and travel costs associated with meetings of the focus group.

**Location of Research**

There is no groundwork associated with this project. The project leader is based in Hobart; input will be canvassed across State, University and Commonwealth-based researchers

**Indigenous Consultation and Engagement**

The extent to which project actions, outputs and outcomes are of specific significance to Indigenous communities and groups is, from the outset, unclear. However, we recognise that this does not indicate that such significance does not exist. We will seek guidance from Hub and NESP leadership as to the most appropriate strategy to consider Indigenous engagement. However, in the first instance, we recommend that an Indigenous consultation and engagement strategy be considered more broadly for this project (and ay future investment in this space) as part of project A6: 'Prioritisation of research and management needs for Australian elasmobranch species'.

**Inclusions (in scope)**

This project provides a synthesis of existing information on national information, projects and initiatives in mitigating human-shark interactions in Australian waters and a review of strategies initiated internationally. The objective is to provide a clearly articulated and collective understanding of current initiatives in the management of human-shark interactions (nationally and internationally) and ensure alignment of potential NESP investment in this space with Departmental and policy requirements in context with State Government initiatives.

**Exclusions (out of scope)**

This project will not conduct new research in this area

**Risks**

No significant risks are anticipated

**Project Keywords**

Human-shark interactions, risk mitigation approaches,

# 

# Project A5 – Defining connectivity of australia’s hammerhead sharks

Project length – 3.5

Project start date – 01/07/2015

Project end date – 31/12/2018

Project approval date - 8/1/2016(if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - In progress

Project Leader – Michelle Heupel (FTE – 20%)

Lead Research Organisation – Australian Institute of Marine Science

Project leader contact details: - [m.heupel@aims.gov.au](mailto:m.heupel@aims.gov.au); 07-4753 4205

### Project Funding

|  | 2015 | 2016 | 2017 | 2018 | TOTAL |
| --- | --- | --- | --- | --- | --- |
| NESP funding | $103,601 | AIMS $29,466  CSIRO $24,704  JCU $27,580  Satellite tags $72,500  Field work $70,000  Travel $7,500  Genetics $8,475  $240,225 | AIMS $30,036  CSIRO $25,443  JCU $28,407  Satellite tags $72,500  Field work $70,000  Travel $4,000  Genetics $9,725  $240,111 | AIMS $30,617  CSIRO $26,203  JCU $29,260  Travel $8,000  Genetics $11,075  $104,455 | 688,392 |
| Cash co-con | x | x | x | x |  |
| In-kind co-con | $118,080 | AIMS $37,031  CSIRO $33,179  JCU $14,695  NT Fisheries $39,400  WA Fisheries $80,000  $204,305 | AIMS $37,772  CSIRO $35,168  JCU $15,135  NT Fisheries $40,132  WA Fisheries $80,000  $208,207 | AIMS $38,527  CSIRO $37,278  JCU $15,590  NT Fisheries $40,886  WA Fisheries $40,000  $172,281 | 702,873 |
| TOTAL | 221681 | 444,350 | 448,318 | 276,736 | 1,391,265 |

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

Hammerhead sharks are the focus of conservation management through recent listing on CITES and CMS. The clear data gap for DoEE 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 determine 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.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

A change has been made to the type of satellite tag deployed during this project. The original plan was to use mark-recapture satellite tags, but due to a combination of the devalued Australian Dollar and limited data provided by these tags we will use SPOT and MiniPAT tags instead. While we will deploy fewer tags (compared to the mark-recapture tags), they provide greater amounts of information. It is acknowledged that catching individuals will be a challenge, but the project addresses this by working with partners who reliably capture hammerhead sharks (WA and NT Fisheries) to deploy transmitters. The project team will also work in Qld to deploy tags in that region. An additional change is the inclusion of the winghead shark (*Eusphyra blochii*) to genetic analyses. This species is not well known, but is distributed in the tropics alongside the other two target species. Failure to understand the dynamics of this species may create a policy loophole due to the inability to identify *E. blochii* from other hammerhead or shark carcasses once the large winged head has been removed. Genetic analyses of all three species (scalloped; *Sphyrna lewini*, great; *S. mokarran*, winghead; *E. blochii*) will also include outlier samples from a variety of Pacific and Indian Ocean locations where possible. These changes will enhance and increase the outputs of this project.

### Problem Statements

#### Problem

Description of the specific problem

Linkages between Australia, Papua New Guinea and Indonesia where high fishing and mortality occurs need to be fully defined to ensure adequate state and national management plans are developed. There is currently fragmentary knowledge of stock structure and resolving this will have important implications for management and conservation actions. These data are integral to non-detriment findings for CITES, management of the Great Barrier Reef Marine Park, species assessments for EPBC listing, WTO assessment of Australian fisheries, and State and Territory fisheries management plans. Two tropical hammerhead species (scalloped, great) are being considered for EPBC listing highlighting the potentially threatened status of these populations and the imminent need for accurate data on population connectivity.

#### How Research Addresses Problem

What solution will this research provide?

This project will use a collaborative and multi-pronged approach to understand the connectivity of hammerhead shark populations within Australia and with neighbouring countries. Due to the tropical distribution of the two hammerhead species (e.g., QLD, NT, WA, Indonesia, Papua New Guinea) this project will be focussed in northern Australia. Knowledge gaps related to population connectivity will be investigated using two main approaches. The first is detailed genetic sampling and analysis of individuals from northern Australia, Papua New Guinea, Indonesia and other Pacific regions. This will allow analysis of stock structuring on genetic time scales to be determined. In addition, mark-recapture satellite tags and traditional tagging will be used to define the extent of movement of individuals over time frames of months to years to further define connectivity based on movement. Satellite data will be used to help determine whether hammerhead sharks are present in the GBRMP or CMRs and if any BIAs can be identified as defined using the BIA protocol (<http://www.environment.gov.au/marine/publications/bias-protocol>). Sampling in Torres Strait will also be conducted to see whether this little understood region plays a role in population connectivity or as a population sink. In conjunction, research into the cultural significance and value of hammerhead sharks in the Torres Strait and along the Queensland coast will be explored to better define the biocultural significance of these species. Where culturally and ethically appropriate, Traditional Indigenous Knowledge may be incorporated into the project to help refine any areas of importance for the species. Genetic, tagging and Indigenous information will be coupled with data collected in 2015 NESP research to further define the status of hammerhead shark populations in northern Australia. To address CITES NDF requirements DoEE sources fishery data to ensure harvest and trade is sustainable. The data (e.g., catch composition, CPUE) that are provided to DoEE, along with those extracted from 2014 reviews of fisheries (Koopman and Knuckey 2014, Simpfendorfer 2014), will be integrated with: 1) results of the 2015 NESP data synthesis project to compile available catch and distribution data for hammerhead sharks in Australian waters, and 2) movement and genetic data produced during this project to further refine our understanding of the status of hammerhead shark populations in Australia and provide advice for future versions of the NDF and management of hammerhead sharks under (anticipated) Conservation Dependent listing under the EPBC Act. This multidisciplinary approach will significantly advance the current state of knowledge and provide guidance for future research and management requirements for these species.

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

This project will provide direct guidance relative to several Departmental research priorities under NESP including:

* Improve our knowledge of key marine species and ecosystems to underpin their management and protection
* Improve the management of marine and coastal biodiversity by evaluating and quantifying the results of management interventions
* Identify past and current pressures on the marine environment, and understand their impact to better target policy and management actions

This project will also help inform species assessment for administration under the EPBC Act relative to species listing, WTO assessment, and obligations under CITES and CMS. In addition, results of this research are important to species protection within the GBRMP and policies related to state and Commonwealth fisheries.

### Research

Detailed description of research being conducted, including description of methods

This project consists of three main components and a synthesis exercise. The research components include:

* Genetic analysis of hammerhead and winghead shark population structures and connectivity based on samples collected from *S. lewini,* *S. mokarran* and *E. blochii* from Qld, NT, WA, Indonesia, Papua New Guinea, Hawaii and other Pacific Islands (Pacific Island samples are being utilised for broader linkage and comparative analyses). Genetic analysis per species (mtDNA gene sequencing (e.g. Control Region, ND2, ND4), microsatellite loci and Single Nucleotide Polymorphisms (SNPs) will be used) will examine population connectivity, gene flow and genetic stock structure on both evolutionary and contemporary time scales.
* Use of external ID and satellite transmitters (PSAT and SPOT tags) to define the scales of movement of hammerhead sharks to define population connectivity on shorter temporal scales. The PSAT tags can be programmed to release from the shark at a set time period (months in this case) and indicate the location of the individual at that time and send archived data via satellite. PSATtags record detailed depth, temperature and light data that can be used to estimate animal positions through time. SPOT tags send location information every time the tag breaks the water surface to produce semi-continuous tracks. These tags provide a more reliable mark-recapture approach than conventional identification tags and will produce movement data on more demographically relevant time scales.
* Exploration of the cultural value, traditional use and Indigenous knowledge of hammerhead shark populations. This work will form part of Karin Gerhardt’s PhD research into traditional knowledge transfer in Indigenous communities. Part of this work will focus on the Torres Strait where hammerhead sharks are known to be an iconic totem species.

Data from the 2015 desktop study will be incorporated with genetic, movement and traditional knowledge results to refine conceptual models of hammerhead stock structures in the Australian region. These data will be used to inform species assessments, the National Plan of Action for sharks, CITES non-detriment finding and other national and international policy documents. Outputs from the 2015 synthesis project will be made available via the Hub web site.

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

Outcomes of this project will have relevance to the Tropical Water Quality and Threatened Species Hubs.

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

This project will leverage data collected under NERP Tropical Ecosystems Hub project 6.2 and build on data synthesised in the 2015 NESP project “Exploring the status of Australia’s hammerhead sharks”. This project will also draw information from recent work carried out under the Fisheries Research and Development Corporation “Australian Shark Report card” project. Microsatellite and SNP loci development and screening in winghead sharks will leverage data from a CSIRO:BioPlatforms Australia Fish DNA dataset project (<http://www.bioplatforms.com/dna-barcoding/>) with additional sampling and genetic analyses for hammerhead species leveraging data from a current CSIRO:ACIAR:NFA project ‘Sustainable management of the shark resources of Papua New Guinea: socioeconomic and biological characteristics of the fishery (<http://aciar.gov.au/project/fis/2012/102>) and a current CSIRO:University of Tasmania:QMS PhD project (Madeline Green - Population connectivity of sharks in the western South Pacific).

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

* Assessment of genetic connectivity of hammerhead and winghead shark populations in northern Australia (QLD, NT, WA) and neighbouring countries (Indonesia, Papua New Guinea).
* Improved understanding of scales of movement of hammerhead sharks based on satellite and mark-recapture analysis methods including use of protected regions such as the GBRMP, Coral Sea CMR, North CMR Network and North-west CMR Network where possible.
* Revised conceptual models of hammerhead shark stock structure for use by stakeholders (DoEE, GBRMPA, State and Territory agencies, commercial and recreational fishing bodies).
* Contribute information to Traditional Owner knowledge base on hammerhead sharks based on project results.
* Improved status assessment of hammerhead shark populations based on genetic, movement and stock structure results.

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

Analysis of genetic and movement scale connectivity of hammerhead and winghead sharks in northern Australia, Papua New Guinea and Indonesia. This information will be directly relevant to revision of the CITES non-detriment finding, EPBC listing and assessment of these species, reporting under CITES and CMS, and WTO assessments of Australian fisheries. Outcomes are also relevant to State and Territory fishery management agencies who may need to consider joint management arrangements or policy changes. These data are likely to be used in species assessment and subsequent management and policy decisions, and will be delivered within timeframes relevant to Departmental advice on CITES and EPBC actions.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

This project will establish the connectivity of hammerhead and winghead sharks in Australian waters to those of neighbouring countries, most specifically Indonesia and Papua New Guinea. Results of this research will be directly applicable to the CITES non-detriment finding, species listing advice to the Minister relative to pending EPBC nominations and WTO assessments of Australian fisheries. In addition, the acquired knowledge will be crucial to management of the GBRMP and relevant State, Territory and Commonwealth fisheries.

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

Outputs of the project will include:

* A report outlining the results of genetic and movement analysis of hammerhead shark populations in northern Australia, Indonesia and Papua New Guinea including identification of BIAs (aggregation sites) and use of CMRs where possible; revised conceptual models of stock structure and species status assessments; and a summary of Indigenous knowledge and traditional use of hammerhead sharks.
* Presentation of results to key stakeholders and end users.
* Policy Brief (Research Summary for Managers) that describes project outcomes.
* Manuscripts for scientific journals outlining the results of project components (eg, genetics, movement, Indigenous use and knowledge transfer).
* Presentation of recommendations at scientific conferences.
* Communication of findings to the broader community via social media.

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1: Complete satellite and tagging deployment plan based on findings of the 2015 NESP project. Order satellite tags. Coordinate with project partners to begin tag deployment. | Due 30 March 2016 | A project Team meeting was held in Hobart in May to agree on the satellite tagging plan. Review of studies and discussion with research teams in the Central Pacific and Caribbean on hammerhead tagging protocols and techniques. Tags were ordered and received in early August. |
| Milestone 2: Acquire available genetic samples for hammerhead studies, identify areas lacking samples and formulate a plan for obtaining samples from those areas. | Due 30 June 2016 | A project Team meeting was held in Hobart in May to discuss available samples and identify prospects for additional samples which were subsequently sought. Compilation of samples is still underway based on identification of additional sample sources and via collection through project field efforts. Planned deadline for scalloped hammerhead samples is Dec 2016 and great hammerhead and winghead sharks by June 2017.  The scalloped hammerhead samples are primarily from Madeline Green’s UTas:CSIRO:ACIAR PhD research. |
| Milestone 3: Meeting with research end-users eg DoEE and GBRMPA to inform on progress and plans. | Due June 2016 | Staff from GBRMPA and DoEE have been briefed on project progress to date as well as outcomes from the 2015 study. |
| Milestone 4: Satellite tag deployment begun. | Due 30 August 2016 | Satellite tag deployments have begun in WA with one tag already deployed. Trips for additional deployments are currently being scheduled. |
| Milestone 5: Traditional Owner groups engaged (data sharing agreements in place) and Indigenous knowledge research underway. | Due 15 September 2016 | Discussions with Indigenous groups are underway. Letters of agreement have not yet been secured, but groups have been identified who are willing to participate. |
| Milestone 6: Present results to date to DoEE and TSSC at their Nov meeting (if suitable) to inform on progress relevant to the NDF and species listing requirements. Present updated results to additional end-users via individual meetings. | Due November 2016 | Presentation to DoEE and TSSC can be completed, but the Nov meeting is a reduced session and clashes with the NESP workshop. As such a formal presentation is best delayed to the March TSSC meeting. Direct updates to GBRMPA and DoEE staff will be delivered. |
| Milestone 7: Progress report on genetic sample acquisition and processing; satellite tag deployments and Indigenous knowledge research. | Due 1 December 2016 | These tasks are on track for delivery in December. |
| Year 2 |  |  |
| Milestone 7: Continued deployment of satellite tags and processing of genetic samples. | Due 28 February 2017 |  |
| Milestone 8: Analysis of acquired satellite tag movement and genetic data and summary provided to end-users. | Due 31 May 2017 |  |
| Milestone 9: Provide a briefing to DoEE and TSSC on project findings and outcomes to date to inform listing advice to the Minister and 2017-18 review of the NDF. | Due June 2017 |  |
| Milestone 10: Continued interviews and data collection with Traditional Owners engaged in the project. | Due 1 October 2017 |  |
| Milestone 11: Report on genetic analyses and satellite tag deployments; briefing to managers, stakeholders and end-users. | Due 1 December 2017 |  |
| Year 3 |  |  |
| Milestone 12: Finalise satellite tag data analysis to define movement connectivity. Advise end-users and resource managers on use of areas. | Due 30 June 2018 |  |
| Milestone 13: Complete analysis of Indigenous knowledge and biocultural significance of hammerhead sharks. | Due 30 August 2018 |  |
| Milestone 14: Revise stock structure estimates based on genetic and movement data. | Due 31 September 2018 |  |
| Milestone 15: Final report on hammerhead shark population connectivity completed including revised stock structure estimates; presentation of results to managers and stakeholders. | Due 1 December 2018 |  |
| Milestone 16: All project outputs and data will be made publically and freely accessible and available on the internet. | Due 1 December 2018 |  |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| Michelle Heupel (0.2 FTE) | Australian Institute of Marine Science | Project leader, responsible for compiling report |
| Andrew Chin (0.2 FTE) | Australian Institute of Marine Science and James Cook University | Data analyst, data collection, assimilation and analysis |
| Will White (0.05 FTE) | CSIRO | Data advisor relative to Indonesian fishing and genetics |
| Sharon Appleyard (0.15 FTE) | CSIRO | Genetic sample analysis |
| Colin Simpfendorfer (0.0.5 FTE from JCU) | James Cook University | Population modeller, fisheries advisor |
| Karin Gerhardt (0.4 FTE: JCU scholarship) | James Cook University | PhD student – Indigenous knowledge of hammerhead sharks and their biocultural significance |
| Grant Johnson (0.2 FTE from NT Fisheries) | NT Fisheries | Status of hammerheads in NT |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
| Matias Braccini | WA Fisheries | Satellite tag deployment |
|  |  |  |

Research End Users and Key Stakeholders **–**

Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| Department of the Environment and Energy | Ivan Lawler, Daniel Rothenfluh |  |
| Great Barrier Reef Marine Park Authority | David Wachenfeld |  |
| NGO groups (e.g. WWF, HSI) | Jim Higgs (WWF), Alexia Wellbelove (HSI), Glenn Sant (TRAFFIC) |  |
| Torres Strait Regional Authority |  |  |
| Parks Australia | Amanda Parr |  |
| SPRAT |  |  |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| New South Wales Fisheries | Vic Pedemmors |  |
| Queensland Fisheries | Ian Jacobsen |  |
| Northern Territory Fisheries | Thor Saunders, Grant Johnson |  |
| Western Australian Fisheries |  |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

Recent engagement with DoEE and GBRMPA has indicated hammerhead sharks are a research priority with population connectivity being a primary data gap and area of concern. States and Territories also have concerns around these species in relation to active fisheries (eg, Qld, NT) or population status (ie, scalloped hammerheads are listed as Endangered in NSW). This project builds upon discussions with stakeholders to fill identified knowledge gaps and refine research needs for these species. Communication with DoEE, GBRMPA and other stakeholders and partners will be crucial to the success of this research. As such regular briefings and discussions will be completed in addition to: reports, publications, newsletters, social media and web-based information outlets (eg, AIMS web page) as appropriate. The pathway to impact of this research will include direct consultation and engagement with stakeholders and end users through phone or face to face meetings several times per year. Project progress will be discussed with stakeholders and end-users to discuss the scope of outputs and help identify future research, management and policy priorities relevant to management of hammerhead populations. Activities will be aligned with and coordinated through the Hub’s Knowledge Brokering and Communication Strategy.

A series of joint meetings with stakeholders has already begun and a schedule of future meetings at key times related to project milestones and policy decision points has already been developed. These meetings will be used to review project progress and evaluate the approaches applied relevant to meeting end user needs.

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

This project will collect species distribution and movement datasets, genetic data, Indigenous knowledge and produce outputs that include species distribution maps (see milestones). Data and information will be managed in accordance with the data management framework for the NESP Marine Biodiversity Hub. Species distribution datasets will be stored in a long-term secure storage, metadata will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal <http://portal.aodn.org.au/aodn/>

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website <http://www.nespmarine.edu.au>. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

The primary contact point for data and information management contact for this project is the project leader (see details in front page).

Name: Michelle Heupel

Email Address: m.heupel@aims.gov.au

Phone Number: 07 4753 4205

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

Expenditure will include salary for participation of key researchers (Heupel, Chin, White, Appleyard), to purchase satellite tags and subsequent field costs for tag deployment, provide funds for genetic sample processing and analysis, support travel to Indigenous communities for data collection and provide travel funds to meet with relevant agencies and present outcomes.

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

This research will be conducted throughout northern Australia (Qld, NT, WA) and include linkages and effort into Papua New Guinea and Indonesia where possible.

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

Sharks have varying levels of biocultural significance to Traditional Owner groups in Queensland and the Torres Straits, but what value hammerhead sharks have to each of the groups is not very well understood by Western society. The main region in Australia where hammerhead sharks are a known totem species is the Torres Strait Islands. The Traditional Indigenous Knowledge of the shark is captured in dance, song, art, and technical ‘stories’. Engagement with Traditional Owner groups in the Torres Strait and particularly the eastern coastline of northern Queensland would be a fundamental step in research on hammerhead species. Many Traditional Owner groups in Queensland and the Torres Strait have established their own protocols for working with researchers. This project will respect each group’s protocol and ensure that all ethics approvals and data sharing agreements are in place before work begins. This includes working with TSRA’s buddy system for knowledge brokering and community interaction.

This project will include focused research to understand the biocultural values of hammerhead sharks to different Traditional Owner groups and look to collaborate with groups to better understand what traditional ecological data may be available for these species (Category 1 engagement). Traditional Ecological Knowledge (TEK) on species can contribute to place-based, fine scale, spatial and temporal information. This information can then assist in development of management techniques or governance frameworks that recognize and incorporate Indigenous people’s rights and interests. Working with Traditional Owners and incorporating their TEK can provide important avenues for discussion and build dialogue between scientists and communities in which they work. It can also help ground the research in the realities of ‘local’ communities throughout the research process. It is well recognized in literature that incorporating TEK in fisheries management can complement western science and management knowledge by providing long-term baselines for stock assessments, local knowledge of species ecology and behaviour, habitat conditions and trends, as well as customary management systems. Recognition (and inclusion) of cultural knowledge in science and management is fundamental for Indigenous communities to have significant roles in decision making affecting environmental management in sea country estates.

This research will be conducted via supporting the PhD research of Karin Gerhardt which focuses on traditional knowledge transfer in Indigenous communities. The intent of this portion of the project is to better understand historical perceptions of hammerhead presence and abundance as well as define biocultural significance. Inclusion of Traditional Owners outside Torres Strait will require contact and engagement. Karin has established relationships in several regions that can facilitate engagement if appropriate. Engagement of Indigenous communities will be conducted in accordance with the Hub Engagement and Participation Strategy, will meet ethical standards and respect and acknowledge the relevance and importance of Indigenous knowledge of these species.

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

This project addresses connectivity issues, data gaps and requirements of hammerhead shark populations in northern Australia, Papua New Guinea and Indonesia as described above.

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

The project focuses exclusively on hammerhead sharks in northern Australia and as such excludes similar issues for other shark species, including the smooth hammerhead which is distributed in southern Australia.

### Risks

List all significant risks to the success of the project

This project will be based on an extensive desktop study completed in 2015 which will direct sampling and reduce risk of misplaced effort. Genetic samples have been obtained from multiple areas from previous research efforts which are available for use in this project. The genetic methods are established and well developed. The combination of already established knowledge and collected samples will work to ensure this project is successful.

Until we start working with Traditional Owners the sensitivity of the cultural information is not understood. Data sharing agreements will need to be developed with individual Traditional Owner groups interested in participating in the research. The level of detailed information available for the publically available reports may be limited by the groups.

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

Hammerhead shark, fisheries, conservation, management, connectivity, biocultural

# Project A6 – Prioritisation of research and management needs for Australian elasmobranch species

*Project length* – 8 Months

*Project start date* – 1/5/2015

*Project end date* – 31/12/2015

*Project current status - Completed*

*Project Leader* – Michelle Heupel, AIMS

*Lead Research Organisation* – AIMS

*Total NESP funding* - $88,493

*Total Recipient and Other Contributions (co-contributions)* - $88,493

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* | *2021* |
| *NESP funding* | *$88,493* | *TBA depending on review end 2015* | *x* | *x* | *x* | *x* | *x* |
| *Cash co-con* |  | *“* | *x* | *x* | *x* | *x* | *x* |
| *In-kind co-con* | *$88,493* | *“* | *x* | *x* | *x* | *x* | *x* |

**Project Summary**

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 comprises (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 will work with DoE to prioritize species for research and explore more management pathways.

**Problem Statements**

*Problem*

Unlike many vulnerable marine species, elasmobranchs are targeted and exploited and lack the protections afforded to other species such as designation as Matters of National Environmental Significance. For many marine species, especially sharks and rays, there are significant knowledge gaps which make it hard to develop appropriate management. How to apply available tools (including new methods like close-kin mark-recapture, and acoustic tagging) to improve management and assessment of threatened species requires exploration. In addition to defining how best to address knowledge and data gaps, an indication of which species are in greatest need of analysis and assessment to establish suitable management approaches is critical.

*How Research Addresses Problem*

This project will take two approaches to examine issues of data deficiency and methodological approaches to resolve these gaps using elasmobranch species as a case study. First, a workshop will gather experts to review Australian elasmobranch status and priority species for management. Second, a simultaneous desktop study will develop a process using close-kin mark-recapture to efficiently monitor and review a current management scenario (including triggers for deciding when it is safe to stop). Workshop and desktop analysis outcomes will be used as a basis for additional research and interaction with DoE over a variety of management, monitoring, and research options for threatened elasmobranchs and other vulnerable marine taxa (e.g. turtles, marine mammals, sea snakes) commencing in 2016.

*Alignment with NESP Research Priorities*

This work aligns with the Hub’s subtitle, “Maximising the efficiency of managing Australia’s, marine environment”. We have developed tools that will help us do that better; now we need to work out how best to use those tools, and on what. Assessment of the status of elasmobranchs and applicability of these methods are crucial to improving management efficacy.

This project will also help inform species assessment for administration under the EPBC Act and will guide management and conservation of threatened marine species within Australia.

**Research**

*Description of research*

This research comprises two components a national workshop and a related desktop study that will be one of the sources of information for the workshop.

The workshop will involve senior shark researchers, DoE staff, and other management parties (eg AFMA). The workshop will integrate existing data, explore existing and emerging methods for defining the status of elasmobranchs and produce a report outlining priority species, priority knowledge gaps and available tools/approaches to resolve those gaps.

The desktop study will produce a paper that includes statistical modelling to demonstrate one pathway to use new tools: whether genetic monitoring of bycatch or culling can predict long-term impacts (or lack of) before damage is done. Broad management and data concerns surrounding these species will be a focus of these efforts.

*Links with other projects and hubs*

Approaches refined in this project will be applicable to species beyond elasmobranchs and as such will help inform topics and species of interest to both the Tropical Water Quality and Threatened Species Hubs.

*Related research*

Builds on decades of elasmobranch work around Australia, and specifically on NERP Theme 4 projects on close-kin mark-recapture/acoustic-tagging (euryhaline elasmobranchs, white sharks) NERP TE Hub projects 6.1 and 6.2. This work differs because pre-NERP work didn’t have the new tools, while NERP was focused on tool development (esp. genetics) and data collection. The new project is about how generally to use the results, and clarifying which species/populations might now be worth tackling. The workshop will leverage existing data, expertise of participants, outputs of FRDC funded research and species assessments completed via the IUCN Shark Specialist Group. Synthesis of this information has not been done previously.

**Expected Outcomes**

*Outcomes*

National Workshop

* Summary of the state of knowledge and current gaps relative to threatened and data deficient elasmobranchs in Australia.
* Identification of research priorities to refine the status of threatened and data deficient elasmobranchs and evaluation of available techniques to fulfil these needs.
* A list of elasmobranch species that are considered threatened based on IUCN and FRDC Shark Report Card project assessments.

Desktop Study

* Case study on how new methods can be applied to management issues

*Specific management or policy outcomes*

Better ability to prioritise amongst potentially threatened elasmobranchs and to plan efficient research and monitoring approaches (including stopping rules). This is critical to informing EPBC Recovery Plans and Conservation Advice.

Providing the basis for a decision science approach to enhancing threatened marine species protection and recovery planning.

The desktop study will provide more flexible options for management (specifically elasmobranchs, but also other TEPS in the future) that can be adaptive and scalable.

*Value*

Outcomes of this project will help develop effective research strategies to produce the best value results for helping define species status, develop effective conservation management, assist in species listing and recovery planning where required and provide additional management options . This will include prioritisation of which species and approaches produce the best results relative to cost.

**Planned Outputs**

Outputs of the project will include:

* A report outlining workshop findings, recommendations relative to data gaps and effective research approaches to address these gaps.
* A paper demonstrating how management can use new methods to examine adaptive monitoring of bycatch to assess impact
* Presentation of results to key stakeholders and end users

**Delivery of Project**

*Project leader’s track-record*

Project PIs have a long track record of successful research results and delivery in previous NERP Hubs. Dr Heupel has demonstrated this through on time reporting and production of over 15 journal publications from NERP research. NERP projects met all milestones on time and within budget. Dr Bravington has led the development and application of close-kin methods, both within NERP (white sharks, speartooth sharks) and externally (southern bluefin tuna).

*Delivery on time and within budget*

This project is designed to be the first stage of a multi-year research effort. As such the workshop and desktop study are designed to be completed prior to the end of 2015 to direct and inform research plans for 2016 and beyond. Staged project planning allows tasks to be completed within prescribed timeframes and allocated budget.

**Project Milestones**

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers.

|  |  |
| --- | --- |
| **Milestones** | **Due date** |
| Workshop report | 1 November 2015 |
| Paper submitted | 15 December 2015 |

**Researchers and Staff** (including early career researchers/PhDs – if names not yet known, list position/role)

|  |  |  |
| --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE** |
| Michelle Heupel – Australian Institute of Marine Science | Workshop coordinator | 0.2 |
| Mark Bravington – CSIRO | PI Desktop study | 0.2 |

**Partner contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| AIMS | $57,792 |  | $57,792 |
| CSIRO | $30,701 |  | $30,701 |

**Other contributions** – only list contributors who are not already identified as Partners

|  |  |  |  |
| --- | --- | --- | --- |
| **Organisation/name** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| Numerous |  |  | See AIMS |
|  |  |  |  |

**Research End Users and Key Stakeholders –** Identify at least one section or programme within DoE who will be an end user for this project, as well as any end users external to the department.

|  |  |
| --- | --- |
| **Research End Users (section/programme/organisation)** | **Name/s (optional)** |
| Department of the Environment |  |
| Department of Agriculture |  |
| Australian Fisheries Management Authority |  |
| Great Barrier Reef Marine Park Authority |  |
| NGO groups (e.g. WWF, HSI) |  |
| **Key Stakeholders (organisation/programme)** |  |
| New South Wales Fisheries |  |
| Queensland Fisheries |  |
| Northern Territory Fisheries |  |
| Western Australian Fisheries |  |
| South Australian Fisheries |  |
| Victorian Fisheries |  |
| Tasmanian Fisheries |  |

**Knowledge Brokering and communication**

Research end-users will be included in the workshop and policy case applied here to ensure engagement and knowledge transfer. A workshop report and paper will be compiled including recommendations regarding methodological approaches, research priorities and critical data needs for threatened and data deficient elasmobranchs to be shared with the science community as well as end-users. Presentations of these findings will be completed for key end users coupled with meetings to discuss results and future directions to meet end-user and stakeholder needs. Communication will also be completed through press releases, social media and web-based information outlets (eg, AIMS web page) as appropriate. Activities will be aligned with and coordinated through the Hub’s Knowledge Brokering and Communication Strategy.

**Expenditure Summary**

NESP funds will be used to support travel, accommodation and workshop hosting costs as well as salary for report/paper writing. Workshop costs specifically include salary time for Dr Heupel to coordinate the workshop, prepare workshop documents (IUCN, EPBC, State listings, FRDC Shark Report card, ABARES, etc.) and compile workshop outputs/report ($30,892). Remaining costs ($26,900) will be used to cover flights, accommodation, venue hire, etc for up to 20 workshop participants. Matching funds comprise matching salary costs for Dr Heupel ($30,892) and an (under)estimate of the time of the 20 participants at the workshop. Case study costs ($30,701) consist of salary for Dr Bravington to complete the in depth analysis required to assess the potential applications of CKMR to management and policy priorities and one trip to Canberra to present results. Timing of expenditures will be dictated by the timing of the workshop based on availability of participants.

**Location of Research**

The location of this workshop is yet to be determined but will be based on the location of participants to reduce costs and travel requirements. PIs are based in Townsville and Hobart, but outcomes are expected to be national in scope.

**Indigenous Consultation and Engagement**

The timeframes and scope of this project limit the opportunity to involve or engage Indigenous communities. Part of the scope of this project will consider how to engage effectively engage Indigenous communities. Effective engagement can be seen in studies of euryhaline elasmobranchs and other iconic species such as dugong and turtles, future engagement will build upon the contacts, and approaches employed for these species. Future work will apply the Hub’s Indigenous Engagement and Participation Strategy to consultation on relevant species as identified from this exercise.

**Inclusions (in scope)**

This project addresses methodological approaches, data gaps and requirements of species assessment and management as described above.

**Exclusions (out of scope)**

The 2015 project focuses exclusively on elasmobranch species and as such excludes similar issues for other marine fauna. Efforts in 2016 and beyond will include these species as applicable.

**Risks**

There are no significant risks associated with this project

**Project Keywords**

Elasmobranch, close kin mark recapture, conservation, prioritisation, management

# Project A7 – Monitoring population dynamics of ‘western’ right whales off southern Australia

Project length – 3 Years

Project start date – 15/08/2015

Project end date – 30/03/2018

Project approval date - xx/xx/xxxx (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - In progress

Project Leader – John Bannister (FTE – 30%)

Lead Research Organisation – The Western Australian Museum

Project leader contact details: - [bannisj@bigpond.com](mailto:bannisj@bigpond.com); 08-9212 3800

### Project Funding

|  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | TOTAL |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NESP funding | 40,000 | 40,000 | 40,000 | x | x | x | x | 120,000 |
| Cash co-con | x | x | x | x | x | x | x |  |
| In-kind co-con | 5,000 | 5,000 | 5,000 | x | x | x | x | 15,000 |
| TOTAL | 45,000 | 45,000 | 45,000 | x | x | x | x | 135,000 |

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

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 shows little if any recovery. Counts allow estimation of population trend and current numbers; identification photographs allow estimation of life history parameters.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

### Problem Statements

#### Problem

Description of the specific problem

Southern right whales were reduced almost to extinction by 19th Century whaling, throughout the southern hemisphere but including off Australia. There have been signs of recovery since the 1950s, but particularly since the mid-1970s given cessation of whaling on this species. The short-term question (a) is at what rate has the population been recovering, and to what current numbers; in the long-term (b) the aim would be to relate any such recovery, or alterations in it, to environmental changes on the (Antarctic) feeding grounds.

#### How Research Addresses Problem

What solution will this research provide?

* From annual counts: estimates of numbers and hence trend in population growth since 1993.
* From identified animals: estimates of life history parameters, and any changes in them, e.g. conception rates, that can be related to availability of food (amphipods, krill) on southern feeding grounds, south of 40°S.

This project serves to implement a very high priority action in the Australian Government’s *Conservation Management Plan for Southern Right Whale (2011-21)* – Action Area B1: Measuring and monitoring population recovery; continue to obtain and refine population abundance and trends for the western sub-population.

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

* Improve our knowledge of key marine species and ecosystems to underpin their better management and protection.
* Determine and trial practical and repeatable methods for monitoring the status and trends of key coastal and marine species and environments,  and possibly:
  + Improve the management of marine and coastal biodiversity by evaluating and quantifying the results of management interventions

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

Objectives:

* continue collection of the dataset, i.e. counts and photographs, of southern right whales, from the southern coast between C Leeuwin WA and Ceduna SA, as in each year since 1993.
* continue ‘matching’ photographs of head callosities obtained on the flights using a computer-assisted system against those (some 2000 individuals) in the existing identification catalogue.
* continue databasing existing information on sightings, linked to animals already identified.

Methods:

As in previous years (see for example Bannister, 2014a, b) one flight will be undertaken from a high wing, single engine aircraft (Cessna 172) based on Albany WA. Each flight has recently lasted *ca* 39 hours, over four-five flying days. The plane is crewed by a pilot/observer and photographer/observer, flying at *ca* 100 knots and searching within *ca* 1 n mile of the coast at *ca* 1500 feet, descending to 500 or 700 feet (the minimum permissible height in WA and SA respectively) for photography. When whales are sighted, a count is made and individuals are circled for photography; the GPS sighting position is recorded, as latitude and longitude. For photographic identification, clear images of the head callosity pattern are required although body marks such as ‘birthmarks’ (‘white’ or ‘grey’ dorsal blazes) are photographed when present. A small proportion of animals occurs as ‘white’ (partial albino) calves, with characteristic dark spotting, the body colour turning to grey as the animal matures: the body pattern in such animals is also photographed.

The same aircraft and photographer/observer will be available as on all flights since 1998. The same pilot/observer will be available as in 1998-2004 and 2006-2014. As usual the flight will be close to the coast, searching an area *ca* 1 n mile (*ca* 1.8 km) wide seawards of the coast where right whales, particularly cows with newborn calves, are to be found. The flight will take place between C Leeuwin WA and Ceduna SA, over a distance of some 900 miles (*ca* 1700 km). ‘Legs’ of up to 4.5 hours duration are flown between fuelling points (towns or coastal settlements). An additional leg along the west coast between Augusta and Perth will be included, as in past years, to cover the small number of animals to be found on that part of the coast each winter. Each flight along the south coast usually consists of four legs, each being covered twice, once ‘outward’ and once ‘inward’. A further leg, between Albany and Cape Leeuwin, WA, and the one along the west coast between C Leeuwin and Perth, are, for logistical reasons, generally covered only once. Flying only takes place in ‘good’ or better conditions, i.e. in wind speeds of no more than 15 knots, usually following a high pressure weather system from Albany eastwards along the coast towards the Great Australian Bight. Depending on the weather conditions, and for comparability with previous years, a window of 30 days between 15 August and 15 September is allowed, but the survey should ideally take place towards the end of August when peak numbers can be expected.

As in previous years, direct counts will be obtained of animals observed within the search area. Counts are usually made by the observer but confirmed with the pilot as possible. Photographs (using a Canon EOS 5D digital camera, with 100-400mm lens) will be obtained by the photographer/observer of as many animals as possible but with emphasis on cows with calves, images being assessed on a laptop after each leg. The search area includes virtually all the area to which ‘western’ right whales resort in winter/spring, close to the coast, in particular for the females to give birth. Most animals, particularly cows accompanied by their calves of the year, are easily observed in the relatively clear waters on the south coast, and no corrections are made for the probability of sighting (g(0)), which is assumed to be 1. In the coastal shallow waters, over the sandy bottom where cows with calves, in particular, are to be found, all animals present, including those under water, can usually be seen. This makes for a relatively simple sighting protocol, readily repeatable over the years.

For the aerial survey, as in previous years, the maximum count on the flight will be compared with results since 1993 to obtain estimates of a) increase rate and b) current population size. Increase rate, both instantaneous and as an annual percentage is obtained by regression analysis for the total count as well as for cows accompanied by calves of the year (cow/calf pairs), of counts (log normal) against year.

Population size is currently obtained using a simple model based on the numbers of cow/calf pairs sighted. Given the relative paucity of animals that visit the remainder of the southern Australian coast, the ‘western’ population recorded between C Leeuwin and Ceduna is considered to represent the majority of the ‘Australian’ population. The model assumes that each reproductive female is recorded on the coast only once in three years, that the sex ratio is unity, that there are at least as many immature animals as adults.

Photographs from the flights will be added to the ‘WA’ catalogue for computer-assisted comparison (‘matching’ - using a system developed by Hiby and Lovell, 2001) with those already available from WA and elsewhere, including the Antarctic. Sightings information will be added to the existing database which relates detailed sightings information to individuals already identified photographically, and allows tabulation of individual sighting histories.

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

Information obtained will be used in revising (as necessary) BIAs, and deriving local (ie State) management plans.

The project provides information for comparison with similar results being obtained for the ‘eastern’ Australian subpopulation through a project also previously funded by AMMC (Mandy Watson and Ian Westhorpe, Assessment of Numbers and Distribution of Southern Right Whales in South-east Australia), as well as for other Southern Hemisphere populations e.g. off South Africa and Argentina.

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

The project continues a series of annual surveys in the same area and using the same methodology on the same sub-population since 1993.

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

Expected outcomes will be:

* Updated population trend, 1993-2016 and on
* Updated population size, 2016 and on
* Updated sightings database
* Updated photo-catalogue
* Information to be used towards providing a level of protection for such threatened species that migrate through the SW CMR.

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

The information obtained from these surveys has been, and will continue to be, used a) at State Level, in Mammal Action Plan Listings, b) Nationally, in National Recovery Plans, and c) Internationally, at the annual meetings of Scientific Committee of the International Whaling Commission, to provide a better understanding of the current status of the population and identify regions/specific localities of importance.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

In the long-term the project should provide data important in determining the effect of environmental change, particularly on the feeding grounds, on biological processes such as conception rate, as already demonstrated for animals in the southwest Atlantic/Antarctic (e.g. in Leaper et al 2006).

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

Data and analyses (obtained as described in Methods, above), i.e.

* Counts of animals (by class – cows accompanied by calves, other animals, by position (GPS) and time.
* Head and (where appropriate) body photographs, by position and time.
* Information on Biologically Important Areas for Southern Right Whales in the area surveyed.
* ‘Progress’ and ‘Final’ reports, annually.
* Report annually to the Scientific Committee of the International Whaling Commission.
* Public information through press releases and on the Museum website.

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1: undertake aerial survey | Due 15 August -15 September 2016 |  |
| Milestone 2: analyse count data | Due 30 October 2016 |  |
| Milestone 3: select identification photos from aerial survey | Due 15 November 2016 |  |
| Milestone 4: provide Progress Report on 2015 activities | Due 30 December 2016 |  |
| Milestone 5: incorporate sightings data in the sightings database | Due 30 January 2017 |  |
| Milestone 6: provide Final Report on 2015 activities | Due 30 March 2017 |  |
| Milestone 7: All project outputs and data will be made publically and freely accessible and available on the internet | Due 30 March 2017 |  |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| John Bannister | WA Museum (Hon Associate) | Project Leader/Manager |
| Jenny Schmidt | Great Southern Aviation | Pilot |
| Andrew Halsall | A.H. Photography | Observer/photographer |
| Prof Phil Hammond | St Andrews University | Statistical advice |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
|  | WA Museum | In kind provision of admin services |
|  |  |  |

Research End Users and Key Stakeholders **–** Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| Migratory Species Section/Wildlife Heritage and Marine Division/Commonwealth Department of Environment | Deb Callister |  |
| Marine Science Program/WA Department of Parks and Wildlife | Holly Raudino |  |
| DoEEParks Australia | Frances Murray |  |
| DoEE ERIN | Carolyn Armstrong |  |
| DoEE Australian Antarctic Division | Mike Double |  |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| International Whaling Commission/Scientific Committee/Head of Science | Greg Donovan |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

This project is essentially a continuation of an operational monitoring program that was running well before NESP, its approach to engagement while funded by NESP will be consistent with the Hub’s Knowledge Brokering and Communication Strategy. The project team (including the Research Theme Leaders and the Hub’s Knowledge Broker) will maintain continued engagement and communications with key stakeholders to ensure they are informed of progress and monitoring results. The monitoring results will be primarily communicated with a Final Report to the funding agency, with results conveyed to WA Dept of Parks and Wildlife, AAD, Commonwealth Department of the Environment and Energy, Scientific Committee of the International Whaling Commission. Opportunities to promote the research and its finding will be investigated, including through newsletter articles, the NESP Chirp newsletter and social media.

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

This project will collate species distribution and movement datasets and produce reports maps (see milestones). Data and information will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. Species distribution datasets will be stored in a long-term secure storage, metadata will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal <http://portal.aodn.org.au/aodn/>

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website <http://www.nespmarine.edu.au>. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

The primary contact point for data and information management contact for this project is the project leader (see details in front page).

Contact person

Name: John Bannister

Email Address: bannisj@bigpond.com

Phone Number: (08) 9295-4361

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

Aerial survey: $19000

Photography: $3300

Data extraction/analysis/databasing/report writing: $17700

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

WA Museum

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

This project is a mature operational monitoring program with very limited opportunity for participation in surveys (i.e. surveys are conducted in light aircraft with few berths). In this context this project is considered to be a category three project for Indigenous engagement. Our approach to engagement will primarily involve provision of updates to the DoEE Indigenous Advisory Group and the Fisheries Research and Development Corporation Indigenous Reference Group. These groups will also be asked for advice on opportunities to enhance Indigenous engagement in this project. The project team will also explore opportunities to share and integrate knowledge with Natural Resources Alinytjara Wilurara who have demonstrated a strong interest and commitment to monitoring Southern Right Whales at the Head of the Bight in South Australia.

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

Survey results – counts, population trend, numbers

Updated Databases – sightings, identified individuals

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

### Risks

List all significant risks to the success of the project

The major significant risk is inclement weather during the allocated 4-week period (15 August-15 September, chosen as the period during which maximum whale numbers occur). In the past the allocated period has provided sufficient flexibility, although numbers could be expected to drop off rapidly after 30 September.

A less significant risk is breakdown in the computer–assisted matching program, which is sensitive to incorrect data entry. In the past this has caused annoying delay, but has been overcome in due course.

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

Right whale population trends, numbers

# Project A8 – Exploring the status of australia’s sea snakes

Project length – 4 years

Project start date – 01/02/2016

Project end date – 31/12/2019

Project approval date - 8/1/2016 (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - Submitted for re-approval

Project Leader – Michelle Heupel (FTE – 0.05%)

Lead Research Organisation – Australian Institute of Marine Science

Project leader contact details: - [m.heupel@aims.gov.au](mailto:m.heupel@aims.gov.au); 07-4753 4205

### Project Funding

|  | 2016 | 2017 | 2018 | 2019 | TOTAL\* |
| --- | --- | --- | --- | --- | --- |
| NESP funding | $52,169 | AIMS $58,633  Travel $5,000  $63,633 | AIMS $61,841  Travel $5,000  Field work $100,000  $166,841 | AIMS $65,372  Travel $5,000  Field work $100,000  $170,372 | 453,015 |
| Cash co-con | x | x | x | x | x |
| In-kind co-con | $52,169 | AIMS $72,771  CDU $14,267  WA Fisheries $50,000  $137,038 | AIMS $76,942  CDU $14,552  WA Fisheries $50,000  $141,494 | AIMS $81,532  CDU $15,196  WA Fisheries $50,000  $146,728 | 477,429 |
| TOTAL | $104,338 | $200,671 | $308,335 | $317,100 | 930,444 |

\**total of 2017-2019 request; 2016 already awarded*.

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

All sea snakes are listed marine species under the EPBC Act and three Australian endemic species are listed as Critically Endangered or Endangered. Recent inexplicable declines of sea snakes highlight a lack of ecological information in Australia which hampers management. 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.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

Not applicable, this is an extension of a desktop analyses to assimilate and understand current data from the Northwest Shelf. The 2017 project describes a directed plan to produce the information required to update Conservation Advices and use of NW CMRs.

### Problem Statements

#### Problem

Description of the specific problem

Reported declines in sea snake abundance in Western Australia have increased concern about the status of sea snake species in this region. The NW was once a global hotspot for sea snake abundance including the three endemic species that are listed as Endangered or Critically Endangered (*Aipysurus apraefrontalis*, *A. foliosquama* and *A. fuscus*). The extent and underlying causes of sea snake declines are still unknown, which hinders assessments of population status and development of management and recovery plans. Sea snakes are a key management issue in the north within and beyond CMRs and relative to EPBC species listing. There is currently limited knowledge about the distribution and range of sea snake species in the region in addition to a lack of understanding of population status. Data are needed to define the status of these species to assist with EPBC listing status and up to date species distribution (area of occurrence) maps are required for Conservation Advices for these species. Sea snakes can be vulnerable to capture in some fisheries and are also used for their skin and flesh in some countries. Their interactions with Australian trawl fisheries are not well defined which also requires investigation. The causes of observed population declines have not been defined, indicating a need for research and exploration of the status of these species. An improved understanding of the distribution and status of sea snake populations within Australian waters is needed to fully define any required conservation action.

#### How Research Addresses Problem

What solution will this research provide?

There is a need to better understand the threatening processes sea snakes encounter to identify effective options for management and recovery plans. We will work collaboratively to synthesise data on sea snake populations to refine species distributions, interactions with fisheries, ecosystem roles and habitat requirements to inform policy and management of sea snakes and NW CMRs. Directed surveys coupled with exploration of movement and habitat requirements and interactions with fisheries will improve our understanding of the status of these species.

This project will integrate field surveys, trawl interaction data and existing data to define the range, distribution and area of occurrence of key sea snake species, especially in the northwest marine region. Data will be used to examine relative abundance between habitats and identify any habitat association or preferences to help refine the status of these listed species. Recent data (e.g. D’Anastasi et al. 2016; Biological Conservation) have indicated that the distribution of sea snakes listed as Endangered or Critically Endangered (i.e. *Aipysurus apraefrontalis*, *A. foliosquama* and *A. fuscus*), may be broader than previously thought. This would change their current status under the EPBC and requires further exploration to define the extent of their distribution and abundance. Sea snakes are known to be bio-indicators of broader ecosystem health in other regions (e.g. New Caledonia). This analysis will explore signs of continued or concomitant decline in other species to reveal whether broader impacts are occurring where sea snakes serve as an indicator species. Survey and fishery data collected in this project will be compared with available historic data to: (a) identify if the recorded declines are still occurring, and (b) if these declines are more or less widespread than previously recorded (both spatially and in other species). The data will also be used to assess potential causes for declines including sea snake-fisheries interactions, increasing seasonal water temperatures and habitat loss. This approach will provide a significant advance on the current state of knowledge and provide guidance for future research and management requirements for these species. Project outcomes will include exploration of data gaps and potential expansion of genetic stock structure analysis as well as confirmation of species identification and distribution.

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

This project will provide direct guidance relative to several Departmental research priorities under NESP including:

* Improve our knowledge of key marine species and ecosystems to underpin their management and protection.
* Improve the management of marine and coastal biodiversity by evaluating and quantifying the results of management interventions.
* Identify past and current pressures on the marine environment, and understand their impact to better target policy and management actions.

This project will also help inform species assessment for administration under the EPBC Act and Recovery Plans and Conservation Advices for sea snake species.

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

This project consists of several components culminating in a synthetic analysis of sea snake populations. The research components include:

* Analysis of historic and present species abundance. Baited remote underwater video surveys (BRUVS) have been conducted at Ashmore and Carter reefs in previous years (e.g. 2004). Repeat BRUV surveys completed in 2016 provide an opportunity to compare sea snake sightings in historic and present data. Use of BRUVS data also provides the opportunity to examine habitats where sea snakes are prevalent (e.g. habitat preference) and if any other changes are apparent in the data indicating broader system decline (e.g. decreased mesopredator abundance, changes in habitat quality). Collected data will be examined in the context of habitat type and health to explore reasons for occurrence and/or decline of sea snake populations and whether these species act as bio-indicators of habitat decline in the NW.
* Surveys to refine species distribution. Historic data indicate high dependence of Critically Endangered sea snakes on remote atolls (e.g. Ashmore, Carter reefs), but several of these species have recently been reported from Shark Bay, Exmouth Gulf and Ningaloo Reef, WA (D’Anastasi et al. 2016; Biological Conservation). Surveying habitats between these locations is required to determine if these species are distributed between these two locations and whether they may be abundant in un- or under-sampled locations (e.g. Lacepede Islands, Kimberley coast). Occurrence data will be used to construct species-specific distribution maps and identify habitats and sites with high sea snake abundances. Combining existing data (BRUVS, RLS, etc) with surveys will refine species distribution and abundance.
* Investigation of fishery interactions. Data on trawl fishery captures are compiled by State, Territory and Commonwealth fisheries which will be used to examine the species encountered and encounter rate of threatened sea snake species. Where possible, presence and movement of individuals will be examined via GPS and/or acoustic tracking to define the habitat requirements of these species, help define their ecological role in coastal and reef habitats and explore interactions with trawl fisheries in the region.
* Exploration of opportunistic data in the north. Research opportunities are expanding across northern Australia and BRUVS sampling and dedicated field work is often part of these efforts. This project will integrate new BRUVS data and conduct opportunistic surveys where possible, particularly in key regions such as Groote Eylandt where Indigenous ranger groups have expressed interest in understanding sea snake populations. This will provide opportunities for Indigenous engagement as well as expansion of project scope beyond the NW Shelf.
* Tissue sampling. Tissue samples will be collected from individuals captured in surveys and from fishery interactions where possible. Tissue samples can be used to confirm species identification via genetic analyses and could also be used in stable isotope analyses to help define the ecological role and trophic niche of sea snakes, providing evidence about their prey requirements. Tissue samples will be collected and stored to facilitate analysis by/with collaborators (e.g. Kate Sanders, University of Adelaide).

Data from the 2016 desktop study will be incorporated with newly collected data to further refine the status of threatened sea snake species in the Australian region. These data will be used to inform EPBC species assessments, Recovery Plans, Conservation Advices, CMR monitoring, fishery management and other relevant national and international policy documents.

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

The project team will liaise with Threatened Species Hub and Tropical Water Quality Hub members to understand their interests and potential applications of sea snake data.

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

This project will build on data synthesised in the 2016 NESP project “Exploring the status of Western Australia’s sea snakes”. In addition the project will leverage data collected previously by the Australian Institute of Marine Science, contributed to public data repositories such as the Reef Life Survey and fishery interaction data related to capture of these species in trawl fisheries. Additional data will be sourced where possible for inclusion in this analysis including environmental data.

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

* Updated sea snake species abundance, area of occupancy and extent of occurrence in the NW shelf based on new data
* Improved understanding of the distribution and status of threatened sea snakes, including within NW shelf CMRs
* Examination of whether sea snakes act as bio-indicators for declines in wider reef ecosystem health in NW shelf habitats
* Improved understanding of the ecological role of sea snakes to refine management and conservation efforts

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

Little is known about the distribution, biology and ecology of Australian sea snake populations in the remote NW Shelf, which directly hampers our capacity to manage their populations despite evidence of declines. Results of this project will be directly relevant to EPBC species listing, updating Conservation Advices and recovery planning for these species and improve understanding and management of NW CMRs. Outcomes are also relevant to state fishery and resource management agencies. For example, MSC qualification of prawn trawl fisheries requires information on interactions with threatened species such as sea snakes.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

This project will refine the status of sea snakes in the north, northwest and beyond to provide updated information for species assessment, Conservation Advices and CMR management. The project will provide guidance for what additional knowledge is required to effectively manage and protect their populations within Australian waters. Results of this research will help define species status, assist in EPBC species listing and recovery planning where required, and guide effective conservation and fisheries management.

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

Outputs of the project will include:

* Revised species-specific distribution (e.g. area of occurrence) maps for updating Conservation Advices
* Analysis of interaction with human activities (e.g. trawl fisheries, port developments and mining activities) and providing potential management and mitigation options
* Assessment of space use, habitat requirements and ecological role of Critically Endangered sea snakes and their role as bio-indicators
* Presentation of results to key stakeholders and end users
* Manuscripts for scientific journals outlining the results of project components
* Presentation of recommendations at scientific conferences.
* Communication of findings to the broader community via social media.

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1: Connect with project partners and discuss data assimilation, engage with key stakeholder and end-users relative to project plans and available data | Due 15 April 2016 | Meetings have been held with DoEE staff to ensure project goals meet management needs. Meetings have also been held with key partners (e.g. WA Fisheries) to confirm plans and data sharing. |
| Milestone 2: Collate available data (AIMS, WA Fisheries, CDU, JCU, etc) | Due 30 May 2016 | Data acquisition is currently underway with several data sets already acquired (e.g. BRUVS, RLS, spatial mapping layers, etc) and preliminary analyses underway. |
| Milestone 3: Continue data analysis and development species distribution maps and relative abundance indices. | Due 31 August 2016 | Analysis is underway and continued analyses indicate this milestone is on target. |
| Milestone 4: Provide an update on project progress to key stakeholders and end-users to help refine final analyses and reporting. | Due 31 October 2016 |  |
| Milestone 5: Produce a report compiling the data gathered, knowledge gaps, and species status. Report will include recommendations for data additional collection and ongoing research efforts. | Due 1 December 2016 |  |
| Milestone 6: All project outputs and data\* will be made publically and freely accessible and available on the internet | Due 1 December 2016 |  |
| Year 2 |  |  |
| Milestone 7: Develop survey plan, liaise with partners, end-users and potential collaborators. | 30 March 2017 |  |
| Milestone 8: Conduct video analysis from Ashmore Reef (CMR) repeated BRUV sampling | 30 June 2017 |  |
| Milestone 9: Compile additional survey and sightings data for Endangered and Critically Endangered species. Begin analysis of BRUV data comparisons | 15 November 2017 |  |
| Milestone 10: Progress report on field survey data, BRUV analysis and species mapping. | 1 December 2017 |  |
| Year 3 |  |  |
| Milestone 11: Produce updated species distribution (area of occurrence) maps to DoEE for Conservation Advice update | 28 February 2018 |  |
| Milestone 12: Provide a briefing to DoEE and TSSC on project findings and outcomes to date to inform listing advice | 31 May 2018 |  |
| Milestone 13: Continue field surveys and tissue sample collection, begin compiling fishery interaction data | 30 June 2018 |  |
| Milestone 14: Engage in sampling or survey work in northern Australia (beyond WA) | 31 October 2018 |  |
| Milestone 15: Report on surveys and analyses; briefing to managers, stakeholders and end-users. | 1 December 2018 |  |
| Year 4 |  |  |
| Milestone 16: Finalise survey work, compile survey data for analysis | 30 April 2019 |  |
| Milestone 17: Finalise trawl interaction analysis and produce report or publication on interactions with human activities and possible mitigation | 30 August 2019 |  |
| Milestone 18: Revise species distribution and status based on survey and fishery data including assessment of the ecological role of sea snakes and their potential role as bio-indicators | 31 September 2019 |  |
| Milestone 19: Final report on; presentation of results to managers and stakeholders | 1 December 2019 |  |
| Milestone 20: All project outputs and data\* will be made publically and freely accessible and available on the internet | 1 December 2019 |  |

\**Due to existing confidentiality agreements fisheries data cannot be made publicly available*

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| Michelle Heupel (0.05 FTE) | Australian Institute of Marine Science | Project leader, responsible for research planning and reporting |
| Vinay Udyawer (0.5 FTE) | Australian Institute of Marine Science | Data assimilation and analysis, management of field work |
| Hamish Campbell (0.1 FTE from CDU) | Charles Darwin University | Assist with data analysis and interpretation |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
| Rory McAuley, Dan Gaughan | WA Fisheries | Access to fisheries vessels to conduct survey work, equipment use and collect samples, access to trawl interaction data; valued at $50k/yr |

Research End Users and Key Stakeholders **–** Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| Department of the Environment and Energy | Katrina Daniels |  |
| Parks Australia | Amanda Parr |  |
| Western Australian Fisheries | Rory. McAuley, Dan Gaughan |  |
| DPaW, WA |  |  |
| NGO groups (e.g. WWF, HSI) |  |  |
| DoEE ERIN | Carolyn Armstrong |  |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| Northern Territory Fisheries | Grant Johnson |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

Recent engagement with DoEE species listing section and PA has indicated sea snakes as a research priority in the north and northwest. This project builds upon those discussions to fill identified knowledge gaps for these species. States and Territories also have concerns around these species in relation to trawl fisheries (eg, WA) or population status. Communication with DoEE and other stakeholders and partners will be crucial to the success of this research. The pathway to impact of this research will be via several mechanisms including direct consultation and engagement with stakeholders and end users through phone or face to face meetings several times per year. Project progress will be discussed with stakeholders and end-users (Commonwealth, WA, NT, QLD) to discuss the scope of outputs and help identify future research, management and policy priorities to maintain sea snake populations. In addition to regular discussions, reports, publications, newsletters, social media and web-based information outlets (eg, AIMS web page) will be employed to disseminate research outcomes and outputs as appropriate. Presentations of preliminary findings will be completed for key end users in conjunction with discussions about the current and future directions of sea snake research. Activities will be aligned with and coordinated through the Hub’s Knowledge Brokering and Communication Strategy.

Knowledge brokering and communication contact

Name: Michelle Heupel

Email Address: m.heupel@aims.gov.au

Phone Number: 07 4753 4205

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

This project will collect species distribution and movement data and produce reports that include up to date species distribution maps (see milestones). Data and information will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. Species distribution datasets will be stored in a long-term secure storage, metadata will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal <http://portal.aodn.org.au/aodn/>

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website <http://www.nespmarine.edu.au>. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

The primary contact point for data and information management contact for this project is the project leader (see details in front page).

Contact person

Name: Michelle Heupel

Email Address: m.heupel@aims.gov.au

Phone Number: 07 4753 4205

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

Expenditure will include salary for participation of key researchers, funds to conduct field surveys and data collection and travel funds to meet with relevant agencies and present outcomes.

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

This research will be conducted throughout northern Australia including work in the NW (including coastal, shelf and reef sites), Northern Territory and QLD. The majority of the focus will be in WA where species declines are most pronounced.

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

Sea snakes have varying levels of significance and use in Indigenous communities, but it is unknown how important sea snakes are, especially in remote regions of northwest Australia (e.g. offshore reefs). Therefore engagement with Indigenous communities is an important step in research on these species. During the course of this project consultation with Indigenous groups will be conducted to define their interest in these species and their significance to communities (Category 2 engagement). For example, recent discussions have suggested high interest in sea snake populations by Indigenous communities near Groote Eylandt, NT. Engagement with the local sea ranger group will be pursued and sampling in this region will be conducted where possible. Contact with relevant communities can be facilitated through existing AIMS and CDU relationships. Research processes and outcomes will involve communities and be shared with communities depending on the level of interest defined. Engagement of Indigenous communities will be conducted in accordance with the Hub Engagement and Participation Strategy, will meet ethical standards and respect and acknowledge the relevance and importance of Indigenous knowledge of these species.

Indigenous engagement contact

Name: Michelle Heupel

Email Address: m.heupel@aims.gov.au

Phone Number: 07 4753 4205

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

This project addresses data gaps and requirements of sea snake populations as described above.

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

The project focuses exclusively on sea snakes in northern Australia and as such excludes similar issues for species in other regions.

### Risks

List all significant risks to the success of the project

This project will be based on a desktop study completed in 2016 which will help direct sampling and reduce risk of misplaced effort. Information requests from DoEE will also play a role in focusing research efforts to ensure required data are collected. Access to existing data has already been secured for the 2016 work and the project partners already have required field gear. Access to sites and vessels will require planning and negotiation but are not expected to be problematic. Engagement with partners and end users is based on long-standing relationships and continual updates. Based on the above the project is well placed to deliver on time and within budget.

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

Sea snake, NW Marine region, conservation, management

# Project A9 – Grey nurse shark ck-mr population estimate – east coast

Project length – 1 Year

Project start date – 01/01/2016

Project end date – 30/06/2017

Project approval date - xx/xx/xxxx (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - In progressIn progress

Project Leader – Russell Bradford (FTE – 0.16%)

Lead Research Organisation – CSIRO Oceans & Atmosphere

Project leader contact details: - [Russ.Bradford@csiro.au](mailto:Russ.Bradford@csiro.au); 03 6232 5077

### Project Funding

|  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | TOTAL |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NESP funding | x | 95,564 | 19,436 | x | x | x | x | 115,000 |
| Cash co-con | x | x | x | x | x | x | x |  |
| In-kind co-con | x | 95,564 | 19,436 | x | x | x | x | 115,000 |
| TOTAL | x | 191,128 | 38,872 | x | x | x | x | 230,000 |

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

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 signs of recovery (DoE 2014). Action 1.1 of the new recovery plan (DoE 2014) is to resurvey GNS 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.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

No changes to the research output have been made. However, the original schedule of milestones should be amended as outlined under Project Milestones below.

### Problem Statements

#### Problem

Description of the specific problem

The grey nurse shark, *Carcharias taurus*, is distributed throughout the tropical and temperate waters of the North and South Atlantic, Indian, and western Pacific Oceans (Last and Stevens 2009). In Australia, *C. Taurus* is distributed throughout the entire region except for Tasmania, and is rare in waters of the Northern Territory (Last and Stevens 2009). Two populations of *C. Taurus* are recognised in Australia: one along the east coast of Australia from the central Queensland coast to at least the NSW/Victorian boarder (DoE 2014); the other along the west coast from Steep Point (~ 700 km north of Perth) to the South Australian border in the Great Australian Bight (Chidlow et al. 2005).

Globally, the grey nurse shark was designated in 1996 as “endangered” on the IUCN Red List of Threatened Species; this designation was elevated to “vulnerable” in 2000 (Pollard and Smith 2009). In Australia, protection was first afforded in 1984 when the NSW government protected the species in response to a precipitous decline in the population. The Queensland government followed suit in 1997 with full protection for the species. The Federal government also provided national protection in 1997, listing the grey nurse shark as vulnerable under the *Endangered Species Protection Act 1992* and the subsequent *Environment Protection and Biodiversity Conservation Act 1999* in 2000 (DoE 2014). The following year (2001) saw the separation into an eastern and western population with the eastern population being listed as critically endangered and the western population as vulnerable.

In 2002 a national recovery plan (EA 2002) was published detailing a pathway to recovery for the species. Although the recovery plan encompassed both the eastern and western populations, the focus was placed on the eastern population due to the greater concern over the population’s status. Progress towards achieving the objectives of the recovery plan were reviewed in 2014 and a new recovery plan published (DoE 2014). An overarching objective of the 2014 revised recovery plan was to improve the population status such that the species may be removed from the threatened species list of the EPBC Act (DoE 2014). The 2014 recovery plan consists of 10 main objectives, the first of which is to monitor and resurvey the population to assess population trends.

#### How Research Addresses Problem

What solution will this research provide?

This project aims to address the primary objective of the 2014 recovery plan (“Develop and apply quantitative monitoring of the population status (distribution and abundance) and potential recovery of the grey nurse shark in Australian waters. “) through the application of close kin-mark recapture (CK-MR) techniques to provide a robust contemporary estimate of population size and trend. The CK-MR approach has proven successful for several species of conservation concern.

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

This project aligns with the following research priorities:

* Determine and trial practical and repeatable methods for monitoring the status and trends of key coastal and marine species and environments to underpin management of Commonwealth Marine Reserves.
* Improve our knowledge of key marine species and ecosystems to underpin their better management and protection.
* Better understanding, measuring and reporting on the condition and trend of threatened species (links with Threatened Species Recovery Hub).

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

This project (part 3) will complete the collection of tissue samples from grey nurse shark (GNS) that was initiated under projects funded by the Department of the Environment and Energy (part 1) and the Threatened Species Commissioner (part 2). Samples are collected from free-swimming GNS by SCUBA using a purpose-built biopsy needle. The samples will be used to develop a suite of SNPs, which will in turn be used as input in a CK-MR model framework.

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

This project addresses issues not covered by other current NESP projects. However, it develops and applies similar techniques (CK-MR and population assessment tools) to those used by:

* A1: Northern Australian hotspots for the recovery threatened euryhaline species'.
* A3: A National assessment of population status of white sharks’

In conjunction with A1 and A3, this project provides information highly relevant to:

* A6: Prioritisation of research and management needs for Australian elasmobranch species'

It has broad links to and or will have complementary input to:

* A5: Establishing the status of Australia's hammerhead sharks

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

This project builds on grey nurse shark research undertaken by the CSIRO Oceans & Atmosphere Flagship, funded through the Australian Government’s Department of the Environment and Energy. The previous work was aimed at obtaining grey nurse shark samples for genetic analysis.

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

The project will provide information on the status of grey nurse shark in the context of marine matters of national environmental significance and fulfil obligations under the National Plan of Action (Sharks).

The project will contribute to:

* Priorities identified in the department’s Operational and Strategic Plans by advancing efforts to halt the decline of marine biodiversity.
* Inform efficient and effective biodiversity data, information and knowledge systems, through its collaborative approach and integration of existing expertise and data.
* The ability to establish well-informed conservation management strategies for grey nurse shark (and other threatened species) in Australian waters via innovative technologies and analytical techniques.

The project will also contribute to:

* Objective 1 of the grey nurse recovery plan: “Develop and apply quantitative monitoring of the population status (distribution and abundance) and potential recovery of the grey nurse shark in Australian waters.”
* Objective 9 of the grey nurse recovery plan: “Continue to develop and implement research programs to support the conservation of the grey nurse shark.”

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

The project will provide information from which on-going listing under the EPBC Act can be assessed based on robust and defensible scientific data on grey nurse shark populations. This project will ensure that State and Commonwealth Government policies are based on robust and defensible scientific data on shark population status.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

This project will directly address the primary objective of the 2014 Grey Nurse Shark Recovery Plan. The project output will be used to inform management of the east coast population of the grey nurse shark, and provide some direction for further research on the west coast population of grey nurse shark. There may be additional value to CMR managers depending on the outcomes of genetic analyses.

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

Scientific tools to refine and integrate CK-MR and species demographic data for population assessments of a key threatened species at a national scale (combining knowledge developed under this project combined with similar techniques being applied under NESP to euryhaline sharks and white sharks).

A draft and final report providing an estimate of (census) population size and trend for the eastern Australian population of grey nurse shark will be developed to fulfil the highest priority actions of the National Recovery Plan.

The project will provide peer-reviewed additions to the scientific literature that will add to the science-support for the development and implementation of policies to support the ecologically sustainable management of Australia’s marine environment.

Focused communication products to promote the research and its finding, including NESP Chirp article and social media posts.

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1: Payment on signing of the contract – 25% of cost | Due On signing | Awaiting signing |
| Milestone 2: Final collection of samples – 25% of cost | Due 28 February 2017 | Milestone delayed from RPV2 due to issues with collecting samples. |
| Milestone 3: Complete SNP analyses | Due 30 May 2017 | Milestone delayed from RPV2 due to issues with collecting samples |
| Milestone 4: Draft project report providing population estimate for GNS east population | Due 15 July 2017 | Milestone delayed from RPV2 due to issues with collecting samples**.** |
| Milestone 5 – Engage with DoEE to discuss draft report and future direction | Due 15 August 2017 |  |
| Milestone 6: Final project report providing population estimate for GNS east population | Due 1 October 2017 |  |
| Milestone 7: Payment on acceptance of final report - 50% | Due 25 October 2017 |  |
| Milestone 8: All project outputs and data will be made publically and freely accessible and available on the internet | Due 25 October 2017 | **.** |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| Russell Bradford | CSIRO | Project leader |
| Mark Bravington | CSIRO |  |
| Richard Hillary | CSIRO |  |
| Pierre Feutry | CSIRO |  |
| Barry Bruce | CSIRO |  |
| Rasanthi Gunasekera | CSIRO |  |
| David Harasti | NSW DPI |  |
| Technical Staff | NSW DPI |  |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
| Joe Smith | Foundation for X | e.g. Cash, Undertake X management activity on which research will be based |

Research End Users and Key Stakeholders **–** Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| Department of the Environment and Energy: Marine and Freshwater Species Conservation Section: Wildlife, Heritage and Marine Division | Ashley Leedman/Lesley Giddings |  |
| Department of the Environment and Energy – Office of the Threatened Species Commissioner | Gregory Andrews |  |
| NSW Government  (specifically NSW DPI) | Natalie Moltschaniwskyj, Bob Creese, Alan Jordan, David Harasti |  |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| NSW DPI | Natalie Moltschaniwskyj |  |
| WA Department of Fisheries | TBA |  |
| Grey Nurse Shark Watch Group | Carley Bansemer - Kilpatrick |  |
| Grey Nurse Stakeholders Group | Sue Sargeant |  |
| Queensland NRM | Sarah Brown |  |
| University of Queensland | Debra Boden, Mike Bennett |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

The approach to research-user and stakeholder engagement in this project will be consistent with the Hub’s Knowledge Brokering and Communication Strategy. The primary end user of the information is the Marine and Freshwater Species Conservation Section: Wildlife, Heritage and Marine Division of DOEE, although various Commonwealth and State Government agencies maintain significant interest in the outcomes of the project. The pathway to impact for this project will include regular and required reporting of project activities, and both direct formal (information sessions/seminars within the Department in Canberra) and informal contact with the Department (ad-hoc requests for information and advice via phone and email on request). Specific to these engagements will be a regular review of progress and discussion about the form and content of outputs to ensure alignment with DOEE needs. Information sessions/seminars will be held with other key end users/stakeholders including the NSW Government (via seminars at NSW DPI). We recognise that this project also has significant public interest; opportunities will be explored to present public seminars at key venues.

The pathway to adoption for the outputs of the project remain by fulfilling the highest priority needs of the national recovery plan for the species thereby providing the science-support base for informing the policies regarding conservation actions. This project also aligns with the National Plan of Action (Sharks).

Information from this project will also be communicated via media responses/engagement where appropriate and publications in the scientific literature.

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

This project will collate species distribution, movement and genetic datasets and produce reports that include species distribution maps (see milestones). Data and information will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. Species distribution datasets will be stored in a long-term secure storage, metadata will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal <http://portal.aodn.org.au/aodn/>

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website <http://www.nespmarine.edu.au>. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

The primary contact point for data and information management contact for this project is the project leader (see details in front page).

Contact person:

Name: Russell Bradford

Email Address: Russ.Bradford@csiro.au

Phone Number: 0412 623 228

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

Funding is required for contribution to salaries of staff, field work in strategic areas, data analyses, and development of molecular and statistical analyses and extension of results.

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

Areas of southern and central Qld and NSW.

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

This project is primarily a desktop study including a small field component and is considered a category 3 project for Indigenous engagement. . Our approach to engagement will primarily involve provision of updates to the DoEE Indigenous Advisory Group the Fisheries Research and Development Corporation Indigenous Reference Group. These groups will also be asked for advice on opportunities to enhance Indigenous engagement in this project. The project team will also make contact with relevant indigenous groups within the specific geographic areas where we be undertaking on-ground field work. This contact will be in the form of identifying the nature of work we are undertaking, the reasons for such work and seeking input from such groups as to their level of interest in this work.

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

This project will refine estimates of grey nurse shark population size for eastern Australia and provide a trend. The project will identify national scale strategies/requirements for future monitoring of this population.

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

This project will identify future monitoring strategies/requirements but will not implement them.

### Risks

List all significant risks to the success of the project

Much of the ground-work for the analysis of data to be generated for this project has been established and tested under NERP (euryhaline shark and white shark projects (A1 and A3, respectively). The majority of the required tissue samples were collected under two projects funded directly through the Federal Department of the Environment and Energy. Additional samples are to be collected in partnership with NSW DPI.

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

Conservation status, close kin mark recapture, shark, threatened species

# Project A10 – Monitoring and conservation of spotted handfish

Project length – 1 year with an option to extend to 2021

Project start date – 1/1/2017

Project end date – 30/12/2017 or 30/12/2021

Project approval date - xx/xx/xxxx (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - Submitted for re-approval

Project Leader – Tim Lynch (FTE – 25%)

Lead Research Organisation – CSIRO

Project leader contact details: - tim.lynch@csiro.au, 03 6232 5239, 0416 089 749

### Project Funding

|  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | TOTAL |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NESP funding | x | *$40,000* | *$40,000* | x | x | x | x | 80,000 |
| Cash co-con | x | *$30,000* | *$40,000* | x | x | x | x | 70,000 |
| In-kind co-con | x | *$57,550* | *$150,957* | x | x | x | x | 208,507 |
| TOTAL | x | ***$127,550*** | ***230,957*** | x | x | x | x | 358,507 |

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

Spotted handfish are critically endangered. To conserve them we will continue a scientifically robust monitoring program to track performance of recovery plan actions across all known sub-populations (Actions 4a, 4b, 4d and 4e).

Monitoring is the crucial for future placement of artificial spawning habitat (ASH) (1c and 1d) and to determine minimum population size for captive breeding brood-stock (3b-c).

On-ground conservation work will include implementing/monitoring eco-friendly moorings in critical handfish habitat (2c), collection of 'ambassador fish' to commence the captive breeding project with industry (3b-c) and engagement with the broader community through talks, outreach and publications (6a).

### Summary of changes since previous Research Plan

* Capture of brood stock for ‘ambassador fish’ and to pilot a captive breeding program
* PhD and/or honours projects to monitor implementation of eco-moorings and interactions with native/endangered species and introduced marine pests as well as investigations of handfish capture-mark-recapture and movements

### Problem Statements

#### Problem

Description of the specific problem

Spotted handfish (alongside Red and Ziebell’s handfish) are critically endangered. Conservation of the species is governed by a recently signed Recovery Plan between the Tasmanian state and Commonwealth governments. Threats, objectives, strategies and actions to recover the species are both budgeted and outlined in the plan.

Conservation of endangered species is somewhat of a “wicked problem” as there are too many species to effectively conserve with available resources. Recovery also requires co-ordination between research, management and policy experts, industry and other stakeholders who often have differing focuses. This can result in various non-productive outcomes. These include:

* Switching between multiple species over time and never fully recovering any
* Spreading resources too thinly to be effective
* A feedback loop of continuous research (the uncertainty loop) before implementing actions
* A feedback loop of consultation/governance/reporting (the planning loop) before implementing actions
* Non-specific decision points to commence, continue or abandon recovery efforts
* Lack of performance assessment of recovery actions
* Lack of communication and documentation of research and actions

Efficient placement of resources requires a framework within which pragmatic decisions can be made at points along a recovery trajectory. Spotted handfish have a long history of conservation effort and provide an ideal model to articulate a framework for effective marine conservation. To undertake recovery of the species within this framework we propose work for 2017 with an option to continue the project through 2018-2021.

Once widespread across South and Eastern Tasmania, spotted handfish were one of the species collected in 1802 by François Péron, as part of Nicolas Baudin’s French scientific expeditions to Van Diemen’s Land (Last and Gledhill 2009 and Medlock pers. comm.). Until the late 20th Century spotted handfish where described as ‘common’ (Last et al., 1983), and so abundant in the Derwent Estuary that they were collected for practical demonstrations by the zoology department of the University of Tasmania (Last pers. comm.). However, following declines first noticed in the 1980s (Barrett et al., 1996) they are now listed as Critically Endangered on the Environmental Protection and Biodiversity Conservation Act (EPBC). Extensive surveys across the historic distribution of spotted handfish have been undertaken (Barrett et al., 1996; Green et al., 2012; Green unpublished data) but only 10 small sites are now recognised to contain extant sub-populations.

Investigations of once common and but now rare species must always be conducted with the caveat that what is being observed is a remnant. Individuals may not be in the densities, habitats or locations that would have best describe the virgin stock but rather are now distributed in response to current threats and historic processes. Hence, species can be persisting in the periphery of their historic geographic ranges (Channell and Lomolino, 2000). An example of this may be the spotted handfish populations of Battery Point and Sandy Bay. Both populations are towards the points of a large bay that now hosts a dense array of several hundred swing moorings as well as extensive foreshore urbanisation. It is within this bay that handfish were once historically collected for UTAS practical demonstrations but human modifications have degraded what would once have been ideal spotted handfish habitat.

Unlike many marine species, spotted handfish directly recruit onto the benthos at the point of spawning. Following sexual maturity being reached after 2-3 years, females provide parental care of egg masses of between 60-100 eggs (Bruce *et al*., 1997). This reproductive strategy is unusual within the species community assemblage of sub-tidal soft-bottom taxa, which generally have the highest proportion of larva that persist for long periods as plankton in the water column (>30 days) (Levin, 2006) and hence have the potential for wide dispersal. However, direct recruitment can be very successful for exploitation of favourable habitats which are spatially restricted (Strathmann *et al*., 2002). This strategy of relatively small numbers of eggs which avoid a pelagic stage, combined with a restricted range and sedentary benthic lifestyle make handfish populations potentially vulnerable to disturbance and displacement. Fortunately this makes handfish a highly suitable candidate for captive breeding and the fish have been successful held and bred in captivity in the past (Green *et al*., 1999). However, no captive population currently exists.

Adult handfish are poor dispersers, preferring to walk rather than swim (Last *et al*., 2007). In the past, with large robust populations, emigration and connectivity between handfish sub-populations could have occurred over time through the small (<150m) movement’s adult animals make over multiple months and slightly larger (<500m) seasonal movements that the normally solitary fish undertake to form breeding aggregations (Bruce *et al*., 1997; Lynch *et al*., 2015; Moriarty, 2012; Lynch and Wong 2015). However, as a poor adult disperser that also lacks a planktonic phase and are closely associated with particular shallow soft sediment habitat, the species may be vulnerable to habitat degradation and fragmentation (Crook *et al.,* 2015). A lack of connectivity would place the species at an increased risk of local sub-population extinction, similar to a documented collapse at Primrose Sands in 2005 (Green, 2007).

In 2015 and 2016 CSIRO and UTAS undertook a monitoring project (Wong, 2015) across all known sub-population sites. In addition, the work also determined handfish micro-habitat preferences and consolidated all previous survey data into time-series (Green *et al.,* 2013; Wong 2015; Lynch and Wong 2015; Lynch *et al*., 2016). Most sub-populations are in medium to low densities and one of these, which has been tracked at multiple points through time, displayed a linear decline from 50 fish per hectare in 2005 to only 5 fish by 2015 and again in 2016.

With our 2016 work we now have established minimum replication (n<3) to establish trends. Preliminary data analysis suggest little differences in densities between sites over the last 2 years and encourages us to conclude that we are developing a suitable baseline to measure performance assessment of management actions. Two exceptions to this were Bellerive and Tranmere where more fish were sighted in 2016. At Bellerive we think this could be related to recovery of the micro-habitat following heavy engineering in 2014/15 and at Tranmere, we suspect this may be related to a pie-crust and Nth Pacific sea-stars infestation in 2015 which has since abated. For performance assessment via a scientifically robust Before, After, Control, Impact (BACI) approach, a time-series dataset across multiple sites and years is required.

While care must be taken with interpretation of time-series data, the lack of any meta-population trends does not support the hypothesis that the meta-population is well connected via dispersal. A dire scenario for the conservation of spotted handfish is that sub-populations are now fragmented and isolated from one another, which increases the risk of major effects on sub-populations from stochastic or non-predictable impacts. If this is occurring it may mean individual sub-populations are at an increased risk of localised extinction. Possible examples of this are the documented collapse at Primrose Sands in between 1999 and 2005 (Green 2007) and the linear decline at Ralphs Bay.

An alternative hypothesis is that fish are well connected and are migrating between sites/subpopulations or to undiscovered sites, perhaps in response to inter-annual changes in local environmental conditions such as food or micro-habitat availability within their relatively dynamic shallow soft sediment habitat. An intermediate hypothesis could be that fish are connected between sites in close proximately within regions.

The generally solitary nature of the species may also mean that spotted handfish are able to persist in low densities. However, this solitary behaviour changes during mating with seasonal breeding aggregations (Lynch and Wong 2015). In many species that form breeding aggregations there are behavioural cues for mating that are only triggered when critical densities of animals come together. Known as the Allee effect, negative rates of population growth or depensation can occur once a critically low density is reached (Stoner and Ray-Culp, 2000). With what is known of spotted handfish behavioural ecology they may be susceptible to the Allee effect and at some sites population trajectories may result in densities that are too low for successful mating. For instance, over recent years there appears to be limited recruitment across most of the meta-population, with few juvenile animals observed (Green *et al*., 2012, Lynch *et al*., 2015; Wong, 2015). This result again should be viewed with caution as the species is somewhat cryptic and with effective camouflage is difficult to observe; hence smaller individuals will be increasingly difficult to spot. However, from the location of observed juveniles and their known direct recruitment, it is unlikely there is ontogenetic separation in habitat use.

Another key result from the 2015 pilot study was the discovery of a strong preference by spotted handfish for micro-habitat complexity (Wong 2015). This not only provides a possible explanation for the species patchy distribution and direct recruitment, but also offers a potential mechanisms to explain the species decline (Lynch *et al*., 2016). For instance, historic dredge fisheries across the species range would not only have captured fish as by-catch (Bruce *et al*., 1997) but would also have destroyed microhabitat complexity. In the present, traditional swing mooring chains, which are now at maximum density in the Derwent (MAST pers comms), destroy habitat complexity. Swath mapping has shown that in dense mooring fields a high percentage of habitat is scraped away, with chain swings interconnecting. Predation by north Pacific sea stars of habitat complexity forming species such as bi-values and the three dimensional spawning substrates used by handfish – such as stalked ascidians - is also ongoing.

#### How Research Addresses Problem

What solution will this research provide?

Research plan 2017

This project builds on our previous work to provide a pathway to recovery of the species through tangible on-ground actions. In particular the proposal is to undertake the next set of annual surveys to develop a time-series to assess population trends and also make a collection of brood stock for an ‘ambassador fish’ program to raise awareness and commence the captive breeding program and to pilot a captive breeding program.

For a scientifically robust monitoring program to track conservation trajectories of spotted handfish, repeated, standardised survey of multiple replicate sub-populations are required (Recovery Plan Actions 4a, 4b, 4d and 4e). To not repeat this survey prior to the breeding season in September 2017 would make it difficult to track either sub-population or meta-population trends or to adequately plan or access recovery plan actions in the future. For performance assessment via a scientifically robust Before, After, Control, Impact (BACI) approach, a time-series dataset across multiple sites is required. The 2015 & 2016 surveys established a baseline at 9 sites as the initial temporal (Before) control, while also providing guidance on power requirements for detecting various scenarios in the future.

Fish have spot patterns that allow for individual identification with a high (100%) level of confidence for adult (>70mm) fish (Moriarty 2012). In 2014 we trailed this approach through direct visual comparison at Battery Point across 38 fish of which three were recaptures (Lynch *et al*., 2015). An initial trail of an automatic pattern recognition software, I3S, was successful in 2016 and we will use photographic capture-mark-recapture on our data base of *Brachionichthys hirsutus,* images. All photographs and metadata has been entered into a file structured database and rules for data basing developed. An Access database has been constructed to store data and will soon receive all data that is currently stored in an excel database. We will do this transfer following I3S analysis so as to provide individual identification IDs for each fish. With this database and tool we wish to ask three questions: 1) how many recaptures are there within sites, 2) how many recaptures between sites, 3) based on capture-mark-recapture estimates, what is the minimum population size?

As only one high density sub-population of spotted handfish is now known to exist (Wong, 2015), planning for the capture of brood stock and re-establishment of captive breeding (Bruce *et al*., 1997) would be prudent at this stage. Establishment of a captive bred populations is a priority for both State and Federal governments. Surveys will provide critical stock assessment guidance for brood-stock capture based on our photographic capture-mark-recapture study.

The State Government, who are the owners off all spotted handfish, have outlined that sustainable take, hygiene and socio-economic considerations are key considerations for this stage of the project. Our industry partners for captive husbandry and breeding are the Zoos and Aquarium Association and their affiliate Seahorse Australia Pty Ltd, which is the parent company of Seahorse World and the Southern Ocean Aquarium. A significant and growing part of their business is the tourists who come to Seahorse World to see not only seahorses both also other iconic creatures of Southern Australia, e.g. seadragons, giant crabs, cowfish, cuttlefish and more. More than 42,000 tourists visit annually from all over the world to take a guided tour. Situated on Inspection Head Wharf on the River Tamar in northern Tasmania, Seahorse World are well located to display ‘ambassador’ Spotted Handfish and provide both public outreach and the captive breeding pilot program. The production side of their business allows for live food cultures on a daily basis, trained scientists on staff and sophisticated filtration for optimal water quality. Seahorse World also have meeting rooms where seminars and educational forums can be held. As a Tasmanian based aquaculture facility Seahorse World also significantly reduces quarantine hygiene risks for release of any captive bred fish back into the wild. A Memorandum of Understanding (MoU) has been developed to govern the captive breeding of fish between the Government of Tasmania, CSIRO and ZAA.

Replacement of traditional swing moorings with ‘eco-moorings’ to minimise habitat damage is a key recovery plan action for habitat conservation. With our Derwent Estuary Program (DEP), Royal Hobart Yacht Club and Derwent Sailing Squadron partners we have received an additional $10,000 from NRM South for eco-moorings which are planned to be deployed in November 2016 – January 2017. Interactions with moorings and north pacific sea stars and other introduced marine pests are also an areas of interest. Deployment of eco-moorings in late 2016 and early 2017 would give time for assessment prior to deployment, providing temporal control for statistics of recovery of the benthos. This work looks to be scientifically novel – most previous work seems to be on fish farm impacts, which are biological (feed/waste fall) and involve rotation of cages or trawling which is intermittent. In contrast chain moorings have mechanical impacts and are ongoing and fixed into place. The limited research that has been done on the impacts of swing moorings has mostly focussed on seagrass, not soft sediment communities – though recently some fish assemble work has being undertaken by UNSW.

These deployments will allow for an experimental approach for a potential PhD project between CSIRO, UNSW and NSW OEH looking at macro-benthic community recovery following replacement of swing moorings with eco-moorings. The PhD has a wider focus across the impacts of swing moorings on bio-diversity and interactions with introduced pests and will have study sites in both the Derwent estuary and Sydney Harbour. Identifying areas with impacts that affect spotted handfish is an important component in understanding both their conservation and other bio-diversity. We will build on our habitat model (Wong 2015) by integrating data from both the CSIRO’s and OEH shallow water multi-beam echosounder (MBES) databases. The MBES’s produces highly detailed bathymetric data of features such as depressions and relief and corresponding backscatter maps to determine geomorphology and identify contrasts in seafloor sediment. Mapping will provide a method of understanding preferred handfish habitat and allow the monitoring of site specific impacts, such as mechanical disturbance via moorings. An improved habitat model will also increase understanding of the relative impacts of threats within high quality habitat, breeding habitat and non-breeding habitat.

Besides work with the aquarium industry, liaison with other identified stakeholders will also occur across the entire project with an emphasis on habitat conservation. This will include discussion with relevant councils, mitigation of yacht mooring impacts with MAST and mooring owners and citizen scientist initiatives for control of introduced marine pests and planting of ASH.

**PhD and/or honours projects**

Two PhD and/or honours projects are in development. The first through UNSW in partnership with NSW OEH will focus on threats, such as moorings, while the second through UTAS will continue to develop conservation biology questions around the handfish and coastal species in general. Both projects will have wider application to both anthropogenic impacts in estuaries and conservation of coastal marine species.

The University of NSW PhD would focus on the impacts of swing moorings on soft sediment communities in both Tasmania and NSW. This project aims to study the response of the coastal benthic community after the removal of physical disturbance from mooring scrapes and anchor chains. Work would include:

* Analysis of CSIRO and OEH backscatter swath mapping of swing mooring impacts
* Identify the short term re-colonisation and long term succession of the benthic community after disturbance has ceased using genetic based analysis (e.g. meta-fingerprinting) and underwater visual census.
* Provide benthic community population data following deployment of eco-friendly moorings
* Using manipulative studies to identify the establishment of invasive species following mooring disturbance and cleaning and its impact on native community succession
* Investigate the effect localised alteration and fragmentation of habitat - resulting from physical disturbance caused by moorings - over a regional scale

A second PhD or honours project would be in collaboration with the University of Tasmania and would focus more on the spotted handfish movements and recovery as a model for conservation of other species:

Capture mark recapture modelling of handfish movements and populations

Effectiveness of artificial spawning habitat and captive breeding programs to increase population densities of the spotted handfish at sites

Experimental control of the Northern Pacific Sea Star (*A. amurensis*) and flathead (*Platycepheluys* spp) and impacts on the spotted handfish *Brachionichthys hirsutus*

Microhabitat & species distribution for the spotted handfish *(Brachionichthys hirsutus)*, red handfish (*Thymichthys politus*) and, if possible, Ziebell’s handfish (*Brachiopsilus ziebelli*) based on descriptions from historical data and interviews

Egg survival and parental care, particularly in response to predators such as *A. amurensis* assessed via time-series videography

**Research Plan 2018-2021**

Recovery plan actions include deployment of ASH, replacement of swing moorings, site specific suppression of predators and release of captive bred animals. All of these actions are proposed between 2018-2021 and require monitoring to understand their impact on species recovery. As the research progresses these actions will be integrated into the BACI design mentioned previously with sites maintained as controls, and other sites receiving ‘on-ground’ actions as treatments (impacts).

To conserve spotted handfish various management actions are outlined in the species recovery plan (Commonwealth of Australia 2015). One recovery plan action that has been implemented previously is the planting of Artificial Spawning Habitat (ASH). Fish have been shown to use ASH for breeding (Green *et al*., 2012) and lack of spawning substrate is a key limiting factor for the species. During the 2015 pilot study at one site (Battery Point) ASH was deployed based on GPS plots of fish observations.

Recovery actions will include design and manufacture of ASH, to replace and enhance the ageing arrays that are currently in place. 1000 ASH will be planted at each of seven sites, with each array GPS plotted and maintained across the course of the study. At four of these sites predator removal trials will also be conducted. Three sites will be left as controls with no management actions. These actions will commence after the 2017 breeding season and continue each year, so BACI ‘impact’ treatments would commence in the 2018 breeding season (with the exception of Battery Point which as the proof of concept site is in advance of other replicates). This will allow for four years of temporal controls for all sites. Once animals are available for re-stocking they will be released at sites which have been prepared for re-introduction.

Replications of the survey through 2018- 2021 will then follow, in conjunction with project risk assessment (i.e. success of habitat conservation and predator removal trails). If recovery actions prove to be successful they will be extended to the control sites.

Harmonising conservation research and management practises (Hogg *et al*., 2015) will require close liaison across project partners with an emphasis on closing the ‘research–implementation gap’ and adaptive management. A second key outcome of this project is therefore to develop a timeline and design to implement and access recovery plan actions based on a sequential treatments approach. Besides performance assessment other parts of this timeline may include genetic research for population estimation and connectivity determination, a stock recruitment model, an age and growth model and captive breeding.

CSIRO has a collection of 241 fin clips of handfish taken across a number of years, which are stored in ultra low -80°C freezers. Besides three whole animal specimens, previous fin clips samples were taken between 2006-2008 and include: Battery Point (9), Howrah (18), Sandy Bay (15), Mary-Anne Bay (15), Opossum Bay (20), Ralphs Bay (58) and Tranmere (106). As these clips have been taken over a number of years (2006-2008) they could also provide insights through temporal analyses in changes in genetic diversity.

The first phase of the genetic work has commenced with material sourced for the development of co-dominant polymorphic nuclear markers. The minimum requires 50-75mg of tissue from 3 individuals has been sourced from preserved whole animals held at CSIRO. Once markers are developed, DNA from a preliminary/baseline panel of spotted handfish from across the various sampling sites will be tested and screened for these markers. The markers and their polymorphic information content are then assessed *in silico* for their utility in determining the effective population size of handfish.

With Dr Sharron Appleyard from CSIRO we prose that preliminary investigations into the level of genetic connectivity and the degree of gene flow between the baseline samples will be undertaken in 2017/18 financial year. Assuming the markers are informative, we would propose a second phase of work that would be population level analyses.

Another application of the developed markers would be to assess brood stock that are collected for the captive breeding program – for instance by screening for genetic diversity of sires and dams. Development of this method may also have applications to other handfish that are rare and endangered.

Finally the release of captive bred handfish is proposed for some time after 2018-19. The State Government, have outlined that habitat suitability and preparation and threat mitigation are key considerations for this stage of the project. Consideration will also be given during this phase of the project to re-connection of sub-populations.

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

The proposed work aligns strongly with current NESP marine biodiversity research priorities, specifically

***Maximising the efficacy of managing Australia’s marine environment***

* Improve the management of marine and coastal biodiversity by evaluating and quantifying the results of management interventions.
* Identify key social and economic values of the marine environment to build better stakeholder support and engagement in the management of marine and coastal environments.

***Improving our understanding of the marine environment including biophysical, economic and social aspects***

* Determine and trial practical and repeatable methods for monitoring the status and trends of key coastal and marine species and environments.

The 2017 surveys are required to maximise the efficacy of managing Australia’s marine environment by evaluating and quantifying the results of management interventions. Repeating the surveys conducted in 2015 and 2016 will establish practical and repeatable methods for monitoring the status and trends of spotted handfish into the future in response to management interventions. This year will establish monitoring as operational with no further development of methodology required.

Our collection of brood stock for the ambassador fish program and a pilot study of captive husbandry and breeding, which is funded in-kind from industry, identifies key social and economic value of the marine environment. Our ambassador fish will build better stakeholder support and engagement in the management of marine and coastal environments.

The proposed work relating to mitigating the impacts of traditional swing moorings directly relates to identifying key social and economic values of the marine environment. Through informing the yachting community of the environmental impacts of traditional moorings, and undertaking the replacement of a small number of moorings with eco-friendly designs, we will work to build better stakeholder support and engagement in the management of marine and coastal environments.

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

As part of the 2016 work we developed a statistical model for the monitoring program through to 2021. This design was provided as an attachment to our August 2016 progress report. The design includes aspects of both random and repeat measures as well as BACI. The design will be used as a test case by other NESP researchers to best develop a spatial balanced sampling scheme.

Methods are now well established by Lynch *et al*., (2015) and Wong (2015). The new method is approximately 4 x more cost efficient in terms of statistical power compared to the previous fix transect approach, requiring 108 transects as compared to 360 transects to survey 9 sites. Our proposal is to survey 9 sites prior to the handfish breeding season (mid-August 2016), conducting 12 transects at each. Following further discussion with stakeholders we plan to conduct 6 further dives in the d’Entrecasteaux Channel following the mating season to see if we can discover egg-masses and confirm that this area contains a breeding population and not just vagrants. This will be a systematic survey across a wider range of sites with the aim to detect rather than assess densities of spotted handfish.

The Derwent study sites are now well described and half of all transect start location will be randomised within the study site’s boundary and the other half will be repeat measures in accordance with the sampling plan. The transect length is determined by the search speed and time spent searching, and maximised dependant on the available air. SCUBA divers swim along the bottom either 2 or 3 abreast, each diver independently searching a 1.5 m swath for handfish, the optimal search width for spotted handfish (Green M., unpublished data). Divers are all experienced in handfish surveys and we will control for variable numbers of divers in the team in our density estimations, with strip transect width either 3 m (2 divers) or 4.5 m (3 divers). One diver in the party will tow a small surface buoy with a GPS logger (Holux GPSport 245) inside a water resistant case. Similar to methods developed by Green *et al*., 2012 the GPS will be set to record a location every 5 s and cameras will be synchronised to the GPS clock.

Transect start and finish positions, in addition to all fish recorded, will be photographed, allowing accurate positions and distances to be determined post hoc from the GPS track with proprietary software (Holux™ ez Tour for Loggers v2.4). One diver in the party will navigate, using a compass and depth gauge to remain within a depth strata and to move in a consistent direction to avoid backtracking. Two transects will be conducted on each dive with a random number of swim kicks taken to separate transects while maintaining safe dive profiles. Transects will also be separated by depth. For each transect we will determine the density of handfish per hectare based on the UVC count of fish observed (ni), transect width and length, which we multiply to an area in metres (ai), and then calculate the density for transect per hectare.

This method will allow for the replication of surveys across multiple years at all known sites with the one methodology, addressing recovery plan actions 4a, 4b, 4d and 4e by forming a scientifically robust monitoring program to track conservation trajectories.

Data from our innovative geo-reference photographic method for cataloguing individual fish will also allow future implementation of recovery plan actions. This includes providing control data for a Before, After, Control, Impact (BACI) approach for targeted placement and performance assessment of artificial spawning habitat (ASH) (Actions 1c and 1d). As well, we will develop a capture-mark-recapture model to determine sustainable capture of brood-stock for captive breeding Actions 3b and 3c based on a minimum population size estimate.

The most appropriate version of I3S appears to be I3S pattern, which automatically plots patterns for comparisons to a database. When compared to a database, pattern returned a score of ~ 12 for similarity for known re-captures and ~ 53 for similar sized non-recaptured individuals. This compares well with results from I3S tutorial databases for other species. By the end of the study we should have around ~300 individual observations of fish to work with from 2014-2017, with multiple images from each observation, often with both left and right sides of the fish photographed.

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

The research in 2017 commences the proposed captive breeding program. Extensive due diligence and liaison with both government and industry has already been undertaken on the concept of re-establishing the captive breeding of handfish. Three workshops 26-27/10/ 2015, 2/2/2016 and 5/8/2016 have been held at the CSIRO in Hobart with the Zoo and Aquarium Association (ZAA), industry partners and both Federal and Tasmanian state governments representatives to develop plans to capture and breed fish in 2017. With stakeholders we have secured significant in-kind funding support to host ‘ambassador’ fish to commence a captive breeding program. Seahorse World Pty Ltd has agreed to take 5-10 fish at their facility in Northern Tasmania and Merlin Pty Ltd have also agree to take ‘ambassador fish’ at their Melbourne facility. A draft MoU between all parties (State and Federal governments, CSIRO, ZAA and aquariums) has been developed and is awaiting signatures based on funding decisions. The State government as agreed to assist with initial permitting with Seahorse World to host fish. The workshops steps towards a captive breeding strategy are closely integrated with our proposed monitoring and on-ground recovery actions.

Two meetings have been held with Scott Foster who developed a statistical model to continue the work which was provided with the August 2016 progress report. Dr Foster has also indicated that he and colleagues will use the handfish sampling as an example of how to construct efficient designs in space and time.

A CSIRO CAPEX bid has been submitted to fund the establishment of temporary holding facilities for small fish. The ability to receive, quarantine and release captive bred animals in the future will also be an important part of the captive breeding program. This is because fish cannot be either destroyed or sold hence captive bred fish must be either transferred to new tanks, which increases costs for the aquariums, or released back into the wild.

Development of genetic markers for spotted handfish has commenced as part of a separate NCRIS hub project led by Dr Sharon Appleyard, with material opportunistically sourced from previously collected specimens for the development of co-dominant polymorphic nuclear markers.

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

The research builds on the 2014 ‘proof of concept’ (Lynch *et al*., 2015) the 2015 larger pilot study (Wong 2015) and the 2016 sampling. Novel methods, which increased statistical power and controlled costs were developed specifically for the study and were published in an international, high-impact factor journal. The expanded pilot study was then funded by the Threatened Species Commissioners Office to establish a baseline assessment across all known sites in the one year. The 2016 survey was funded by NESP, the DoEE and the DEP. Prior to this, other research has included a recent honours project (Moriarty 2012) which established the consistency of spot patterns for individual identification of handfish. This suggests they may be a suitable species for the application of image ID software to our photographic geo-referenced database. A small number of published taxonomic works and a wide variety of grey literature is also available on spotted handfish that extends back to 1996. The proposed research leverages off this work to move recovery plan actions forward.

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

The project will provide new knowledge by helping to achieve minimum replication for trends (n≥3) of relative fish densities at each site with a consistent method, allowing tracking of handfish sub-populations through time. This will allow for both flagging of sites where sub-populations may be on trajectories of localised extinction and also assessing the success of management actions towards recovery.

A consolidated database of all available data on spotted handfish imagery, length frequency and GPS plots will allow for capture, mark, recapture of individuals. This will provide a database to assess minimum population size for permitting of sustainable capture of brood stock for future captive breeding.

Eco-moorings will be deployed and monitored as part of a larger study of the impacts of swing moorings on soft sediment communities. This on-ground conservation work will conserve handfish habitat as part of Action 2c.

With Seahorse World and ZAA with permitting from the State and Federal government and governance under the MoU we will establish a pilot program for a captive bred population of spotted handfish. These ambassador fish will provide greater public awareness of this endangered species and the ecological community that they occupy. This will leverage community participation in the project (Actions 6a) and will be combined with talks and publications.

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

* Time-series of handfish densities and demographics is a ‘priority 1’ action in the recovery plan that will inform the implementation of multiple other actions in the recovery plan and allow species managers to monitor population health for this rare and threatened species.
* Based on densities, capture-mark-recapture and length frequency, informed decisions will be made regarding the suitability of locations for the capture of handfish for brood stock, and priority locations for on-ground conservation actions such as ASH, predator suppression and eco-moorings.
* Following liaison with DEP and MAST and stakeholders eco-mooring will be deployed and monitored within known handfish breeding habitat.
* Spotted handfish will once again be held in captivity within an ambassador fish and pilot captive breeding program fulfilling Action 3b-c and 6a of the Recovery Plan.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

The value of the project is to provide a critical step towards securing the spotted handfish from extinction. The project allows for the monitoring of a critically endangered species to identify any further declines, enable rapid and targeted management responses and rigorously measures the impact of conservation actions. It allows for the identification and collection of suitable brood stock for the establishment of a captive population that will be used to bolster wild populations in the future, raise awareness and help insure against the extinction of the species. Furthermore, the extension of this project will allow alternative on-ground management actions to be trialled, and their effectiveness to be assessed, in order to conserve the species into the future.

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

* The current database of all available handfish information including identification photographs will be extended.
* Underwater photographs will be uploaded to the NESP site
* We will submit one publications to a high quality journals based on our research and also present at a professional conference.
* A final report will be delivered to the NESP Hub and collaborators
* Public seminars will be held with stakeholder groups

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1 - Deployment of all eco-moorings | 30th January 2017 |  |
| Milestone 2 – All research users and stakeholders have been engaged and understand the project and opportunities for further engagement | 1 March 2017 |  |
| Milestone 3 – Permitting submitted | 1st March 2017 |  |
| Milestone 4 – Signing of MoU for captive breeding | 20th April 2017 |  |
| Milestone 5 – assessment of minimum population size | 15th May 2017 |  |
| Milestone 6 – Capture of brood stock | 1st June 2017 |  |
| Milestone 7 - Development of a culturally sensitive fact sheet with NRM south and indigenous contacts | 30th June 2017 |  |
| Milestone 7 - Submission of detailed project plan (2018-2021) | 1st October 2017 |  |
| Milestone 8 – Completion of dive surveys | 30th August 2017 |  |
| Milestone 9 – Final report | 30th December 2017 |  |
| Milestone 10. All project outputs including sharing of the consolidated database to be made accessible to the public | 30th January 2018 |  |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| Tim Lynch (0.275 FTE) | CSIRO | Principal investigator/Diver/Coxswain |
| Lincoln Wong (0.01 FTE) | CSIRO | Co-investigator/diver |
| Neville Barrett | UTAS | Advisor/co-supervisor |
| Tim Ingelton | NSW OEH | Co-supervisor |
| Luke Hedge | UNSW | Co-supervisor |
| Mark Green (0.025 FTE) | CSIRO | Advisor/Diver/Coxswain |
| Scott Foster (0,025 FTE) | CSIRO | Statistical design |
| Early career researcher | UTAS/CSIRO/UNSW/OEH | PhD and/or Honours students |
| Carlie Devine (0.025 FTE) | CSIRO | Diver and database officer |
| Claire Davies (0.05 FTE) | CSIRO | Dive Officer/Coxswain |
| Curt Chalk (0.05 FTE) | CSIRO | Diver/Coxswain |
| Matt Lansdell (0.025 FTE) | CSIRO | Diver |
| Cassie Schwanger (0.025 FTE) | CSIRO | Diver/Coxswain |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
| Christine Coughanowr | Derwent Estuary Program | In-kind labour (10K), assist with consolation with swing mooring owners and deployment of eco-moorings |
| Napelle Crane | NRM South | Indigenous and community liaison |
| Dr Rachelle Hawkins | Seahorse Pty Ltd | In-kind (8.5k), captive husbandry and collection of brood stock |
| Craig Thorburn | Zoo and Aquarium Association (ZAA) | Cash (40k) |

Research End Users and Key Stakeholders **–** Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| Marine and Freshwater Species Conservation Section Wildlife, Heritage and Marine Division  Department of Environment (DoEE) | Ashley Leeman | [Ashley.Leedman@environment.gov.au](mailto:Ashley.Leedman@environment.gov.au) |
| Threatened Species Policy and Conservation Advice Branch Department of Primary Industries, Parks, Water and Environment (DPIPWE) | Andrew Crane | Andrew.Crane@dpipwe.tas.gov.au |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| Derwent Estuary Program | Coughanowr, Christine | Christine.Coughanowr@environment.tas.gov.au |
| Zoo and Aquarium Association (ZAA) | Craig Thorburn | Craig Thorburn <Craig.Thorburn@kellytarltons.co.nz> |
| Merlin Pty ltd | Paul Hale | Paul.Hale@melbourneaquarium.com.au |
| Natural Resource Management (NRM) South | Nepelle Crane | ncrane@nrmsouth.org.au |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

Knowledge brokering and communication activities will be planned and implemented in accordance with the Hub’s Knowledge Brokering and Communication Strategy.

While scoping and developing the proposal the project team has undertaken extensive engagement with research investors, users and stakeholders. This made use of existing relationships with both federal and state government through DoEE, NRM South, OEH and DPIPWE including the DEP, as well as through research institutes such as IMAS/UTAS, UNSW and CSIRO and industry with Seahorse Pty Ltd, Merlin and ZAA. This engagement involved development of the research aims and outputs through review and comment on the draft proposal and meetings to brief stakeholders. The research team leader is a member of both the Federal recovery plan team and the State recovery project team.

This knowledge brokering and communication with end users at both state and federal levels will continue throughout the project through formal meeting with both the recovery team (Federal) and the Derwent Estuary Program recovery project (State). Other end-user knowledge brokering will include continued workshops with ZAA and the captive breeding team and regular informal updates with DoEE and DPIPWE key stakeholders: Andrew Crane, Ashley Leeman and Debbie Rudd.

This strategy will enable the project team to engage with research users and stakeholders to refine understanding of required outputs to maximise project impact, provide updates of progress with research, package research outputs to meet research user needs and to confirm impact of research.

The spotted handfish is a charismatic species, which has strong public recognition. Media exposure during 201/16 occurred across state, national and international outlets, including popular articles in the Mercury, the Age and the Sydney Morning Herald as well as in Science and American Naturalist. Besides media, additional outreached opportunities will be taken through work with TMAG, NRM South indigenous outreach staff and presentations to yacht clubs, MAST and the Rotary Club.

Specific communications mechanisms to use will include:

* An update to the CSIRO blog which acts as a press release and content for social media circulated to the large number of media contacts that have shown previous interest in spotted handfish conservation.
* Regular postings to both Twitter and Facebook social media platforms
* Public outreach activities at Seahorse World
* Communication of research and conservation objectives through the DEP and NRM network
* Presentations to local community groups such as Rotary and yacht clubs
* Development of a culturally sensitive fact sheet
* Continued engagement with stakeholders based on the plan that this project will continue

Knowledge brokering and communication contact:

Name: Tim Lynch

Email: tim.lynch@csiro.au

Phone: 0416089749

### Data and Information Management

Research outputs will be made publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

This project will collate species distribution datasets and produce reports that include species distribution maps (see milestones). Data and information will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. Species distribution datasets will be stored in a long-term secure storage, metadata will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal http://portal.aodn.org.au/aodn/

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website http://www.nespmarine.edu.au. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

The primary contact point for data and information management contact for this project is the project leader (see details in front page).

A key part of the research is consolidation of data and data management. CSIRO will consolidate, with appropriate metadata and data, all geo-referenced photographs using Access.

We will publish in peer reviewed international journals. Other outputs such as power-point presentations, data reports and high resolution underwater photography will be provided to the NESP biodiversity hub and DoEE.

Journal papers in late stages of drafting:

Wong et al – Sub-population density estimates and microhabitat choice by spotted handfish.

Lynch et al – Conservation biology and behavioural ecology of the spotted handfish.

Journal paper proposed:

Lynch et al – Capture-mark-recapture via photo-analysis of spotted handfish

Database officer

Name: Mr Lincoln Wong

Email Address: Lincoln.wong@csiro.au

Phone Number: 62905192

### Expenditure Summary

We undertook an audit of expenditure across 2016 figures which showed only minor adjustments were required for our 2017 budget request from NESP. In 2016 surveys of the 9 Derwent estuary sites required 62.5 FTE days of which 19 were by students and 43.5 FTE days of salaried staff.

The 40k cash contribution is still to be confirmed, however ZAA would like to receive an application for funding support to ensure this program continues. ZAA member Craig Thorburn has spoken to the executive who advised that they will contact our funding committee members to accept an application between their meetings. Department of the environment may also be able to contribute as will the Derwent Estuary Program.

Table 1. Budget overview

|  |  |  |
| --- | --- | --- |
|  |  |  |
| |  |  | | --- | --- | | Labour | $66,961 | | Overhead | $ 54,581 | | Operating | $ 12,000 | | Sea horse + DEP in-kind | $ 97,500 | | Total | $ 231,142 |   Table 2. Labour breakdown in FTE days \* desonates in-kind   |  |  | | --- | --- | | Activity | Days | | Diving staff | 47 | | | Diving student | 20\* | | | Brood stock capture | 4\* | | | Data entry | 10 | | | Reporting | 10 | | | Permitting/grants | 3 | | | Consultation | 10 | | | Design | 5 | | | Captive breeding | 12 | | | Mooring consultation | 20\* | | | |  |

Staff FTE days mapped are 97 most of which are mapped to officers that are available to dive as members of the CSIRO dive team. In addition to this labour students will also be members of the dive team for 20 days. Seahorse World will also provide in–kind 4 days of diving FTE labour for collection. The DEP contribution of $10,000 in-kind labour has been modelled to be 20 FTE days of labour.

Table 3. Captive breeding and husbandry cost breakdown



### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

There are ten sites: 9 in the Derwent and one in the D'Entrecasteaux Channel. Sites names and GPS locations are provided in Table 3.

Table 3. Location of research for spotted handfish

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Site | Code | Estuary | Lat | Long |
| Battery Point | BP | Derwent | -42.88944 | 147.33937 |
| Half Moon Bay | HMB | Derwent | -43.01396 | 147.40306 |
| Opossum Bay | OB | Derwent | -42.98298 | 147.39555 |
| Ralph Bay | RB | Derwent | -42.93350 | 147.42542 |
| Mary-Ann Bay | MAB | Derwent | -42.97004 | 147.40157 |
| Sandy Bay | SB | Derwent | -42.90749 | 147.34911 |
| Howrah Beach | HB | Derwent | -42.88295 | 147.39508 |
| Tranmere | TR | Derwent | -42.92501 | 147.41055 |
| Bellerive | BR | Derwent | -42.88010 | 147.37820 |
| Flathead Bay | FB | D'Entrecasteaux | -43.28807 | 147.10004 |

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

This research project that has a field component within the project and which may involve participation with an Indigenous community, organization or group. This identifies it as a Category 2 project.

Category 2 - a research project that has a field component within the project and which may involve participation with an Indigenous community, organization or group. A Category two project will be expected to:

• Clearly identify how the research will be relevant and of benefit to Indigenous communities and/or organisations and if not why.

• Ensure the research is conducted according to the highest ethical standards and respects Indigenous priorities and values.

• Explore opportunities for Indigenous engagement, employment, skills transfer, sharing of knowledge and the increase of cultural awareness amongst all parties.

• Develop a process for the generated knowledge, data and research results to be effectively shared and communicated between Indigenous peoples, communities and organisations.

As part of the DEP handfish project, NRM South has offered to provide an avenue for consultation and engagement with the Indigenous community through their Indigenous community engagement officer. Engagement of Indigenous communities will be conducted in accordance with the Hub Engagement and Participation Strategy, will meet ethical standards and respect and acknowledge the relevance and importance of Indigenous knowledge of these species. We will also explore opportunities for Indigenous skills transfer, sharing of knowledge and increase of cultural awareness within the constraints of project resourcing.

To undertake this we will develop with NRM South and their community contacts culturally sensitive fact sheet to explain the work and facilitate engagement with Indigenous and other communities.

The team will work with the Hub Executive to develop a process for the generated knowledge, data and results to be effectively shared and communicated between Indigenous peoples, communities and organisations. This will include communication to the Hub Research-user Committee and Steering Committee, the FRDC Indigenous Reference Group and the DoEE Indigenous Advisory Group.

Indigenous engagement and participation contact:

Name: Tim Lynch

Email: tim.lynch@csiro.au

Phone: 0416 089 749

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

* Standardised surveys of 12 transects at 9 sub-population sites
* Consolidation of all imagery and data into a database and capture-mark-recapture estimates
* Permitting for research (ethics and scientific) for 3 years
* Liaison with yacht mooring and mooring permit holders ‘
* Eco-mooring placement
* Transfer of knowledge for captive breeding
* Collection of brood stock animals
* Purchase and set up of holding tanks for transfer of captive breeding stock at CSIRO if funded

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

* Planting of ASH. The current array is old and in need of repair and this should be a priority for 2018
* Predator controls at any sites

### Risks

List all significant risks to the success of the project

For the time-series data to be un-interrupted and comparable, sampling needs to occur outside of the species 2017 Austral spring (September) breeding season, as fish move from a solitary to an aggregated distribution. The survey work of 108 transects (54 buddy pair dives) must thus be completed between February and August 2017. While as many as 8 transects can be completed in one day of intense survey work, we found in 2014-16 this rarely could be achieved. Due to weather, logistics, staffing availability and diver health we found that lower intensity sampling utilising small components of labour spread across a larger dive team was required to safely complete the work. This involved half FTE days (morning or afternoon diving) or, if conditions were ideal, full FTE days. Therefore, the main project risk is delays in starting the project, which would constrict the available time for surveying before the breeding season, when the behaviour of the fish changes and confounds inter-annual density comparisons.

There are also health and safety risks associated with the use small boats and diving. This risk will be mitigated by having adequate time and flexibility to choose good weather windows and the smooth continuation of the work with the well-established and seasoned team.

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

Spotted handfish, critically endangered, fish

**References**

Barrett, N., Bruce, B.D., and P.R. Last. 1996. Spotted handfish survey. Report to Australian Conservation Agency Endangered Species Project # 538. CSIRO, Hobart, 27 pp.

Bruce, B.D., Green M.A., and P.R., Last. 1997. Developing husbandry techniques for spotted handfish (*Brachionichthys hirsutus*) and monitoring the 1996 spawning season. Final report to Environment Australia Endangered Species Program. CSIRO Division of Marine Research.

Bruce, B.D., Green, M.A. & Last, P.R. 1998. Threatened fishes of the world: *Brachionichthys hirsutus* (Lacepède, 1804) (Brachionichthyidae). Environmental Biology of Fishes, 52, 418.

Channell R., and M.V. Lomolino. 2000. Dynamic biogeography and conservation of endangered species. Nature 403, 84-86, doi:10.1038/47487.

Crook D.A., Lowe W.H , Allendorf F.W., et al. 2015. Human effects on ecological connectivity in aquatic ecosystems: Integrating scientific approaches to support management and mitigation. Science of the Total Environment 534 (2015) 52–64

Commonwealth of Australia. 2016. Recovery Plan for Three Handfish Species. Spotted handfish Brachionichthys hirsutus, Red handfish Thymichthys politus, Ziebell’s handfish Brachiopsilus ziebelli. 2015. Commonwealth of Australia.

Green, M.A., 2007. Distribution of the spotted handfish. Derwent Estuary Program Symposium in 2007. <http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64418#australian_distribution>.

Green M.,Pfister A., B.D., Bruce. 1999. Pilot scale rearing and spawning of endangered spotted handfish. CSIRO report.

Green, M, 2007. Implementing handfish Recovery Plan 2006/7. CSIRO Division of Marine and Atmospheric Research, Hobart. Report for Threatened Species Section Tasmanian Department of Primary Industry, Water and Environment.

Green, M.A. and Bruce, B.D. (2002) Spotted handfish Recovery Plan 1999–2001 – Year 3 Final Report to Environment Australia, Endangered Species Program. CSIRO Hobart, 18 pp.

Green MA, Stuart-Smith RD, Valentine JP, Einoder LD, Barrett NS, Cooper AT, Stalker MD (2012) Spotted handfish monitoring and recovery actions - 2011-2012. CSIRO Marine and Atmospheric Research/ Institute of Marine and Antarctic Studies, Hobart.

Last, P. R., Scott, E. O. G., and F.H., Talbot. 1983. Fishes of Tasmania. Tasmanian Fisheries Development Authority, Hobart.

Last, P.R., Gledhill, D.C., Holmes, B.H. 2007. A new handfish, *Brachionichthys australis* sp. nov. (Lophiiformes: Brachionichthyidae), with a redescription of the critically endangered spotted handfish, B. hirsutus (Lacepède). Zootaxa, 1666, 53–68.

Levin, A. 2006. Recent progress in understanding larval dispersal: new directions and digressions. Integr. Comp. Biol. (2006) 46 (3): 282-297. doi: 10.1093/icb/icj024

Lynch T.P., Green M., and C. Davies. 2015*.* Diver towed GPS to estimate densities of a critically endangered fish. *Biological Conservation.*191:700-706.

Lynch T.P. and L. Wong. 2015. Direct Conservation Actions for Critical Endangered Spotted Handfish. Progress report to the Threatened Species Commissioner. CSIRO Oceans and Atmosphere.

Lynch T.P., Green M. and L. Wong. 2016. Direct Conservation Actions for Critical Endangered Spotted Handfish. Final report to the Threatened Species Commissioner. CSIRO Oceans and Atmosphere.

Marine and Safety Tasmania. 2016. MAST Mooring review. MAST p. 19.

Moriarty T. 2012. Can a spotted handfish (*Brachionichthys hirsutus*) change its spots? Assessing photo-identification and spot matching software to study a critically endangered species. Bachelor of Marine Science (Honours) BMarSc (Hons) thesis, University of Tasmania, Hobart

Wong L. 2015. Assessing local densities and habitat preference of spotted handfish (*Brachionichthys hirsutus*) for deployment of new artificial spawning habitat. A thesis submitted in partial fulfilment of the requirements of the degree Bachelor of Applied Science (Marine Environment) with Honours Institute of Marine and Antarctic Sciences (IMAS) University of Tasmania.

Strathmann, R.R., Hughes, T.P., Kuris, A.M., Lindeman, K.C., Morgan, S.G., and J.M., Pandolfi and R. Warner. 2002. Evolution of local recruitment and its consequences for marine populations. Bulletin of Marine Science 70(1) Suppl.: 377–396.

Stoner, A.W. and M. Ray-Culp. 2000. Evidence for Allee effects in an over-harvested marine gastropod: density-dependent mating and egg production. Marine Ecology Progress Series. Vol. 202: 297–302, 2000.

# Project A11 – Shark action plan

Project length – 2 Years

Project start date – 10/1/2017

Project end date – 31/12/2018

Project approval date - TBC (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - To be approved under RPV3

Project Leader – Michelle Heupel (FTE – 25%)

Lead Research Organisation – Australian Institute of Marine Science

Project leader contact details: - [m.heupel@aims.gov.au](mailto:m.heupel@aims.gov.au); 07 4753 4205

### Project Funding

|  | 2017 | 2018 | TOTAL |
| --- | --- | --- | --- |
| NESP funding | AIMS $38,779  CDU $35,377  CSIRO $3,649  Workshop 1 $12,000  $89,805 | AIMS $92,735  CDU $36,792  CSIRO $3,760  Workshop 2 $12,000  $145,287 | $235,092 |
| Cash co-con | x | x | x |
| In-kind co-con | AIMS $48,847  CDU $35,377  CSIRO $3,649  JCU $50,073  $137,946 | AIMS $117,290  CDU $36,792  CSIRO $3,760  JCU $65,095  $222,937 | $360,883 |
| TOTAL | $227,751 | $368,224 | $595,975 |

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

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 impeding conservation and management. This Plan will help guide policy for Australian elasmobranchs developed by DoEE and fishery managers. On-ground conservation will be developed from recommendations in this plan.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

N/A – new project

### Problem Statements

#### Problem

Description of the specific problem

Designing effective conservation and management of elasmobranch species is a complex issue due to a wide array of factors. With increasing numbers of elasmobranch species nearing thresholds where they require national and international protection, a broader perspective on their status and our national approach to their management is required. We propose development of a Shark Action Plan (SAP) to define management needs for Australian elasmobranch species. The plan will be comprised of several components including an understanding of the level and extent of threats, potential management solutions, development of Significant Impact Guidelines and Conservation Advices, updated species status via current IUCN Red List of Threatened Species Assessments, exploration of implications of climate change and exploration of key knowledge gaps and how these can be overcome. The SAP will provide a framework for how to approach fished (Conservation Dependent) and threatened elasmobranchs as a tool to help DoEE as well as State, Territory and Commonwealth fishery managers increase efficiency and efficacy of elasmobranch management plans.

#### How Research Addresses Problem

What solution will this research provide?

This project will produce a Shark Action Plan (SAP) to help develop a national perspective on conservation and management of elasmobranch species. This will include the development of key policy documents, in conjunction with DoEE. Components of the SAP will include:

* Context of the SAP relative to international treaties (CMS, CITES)
* Overview of status of species within Australian waters (including current IUCN assessments)
* List of common threats among species
* Exploration of threats relative to species status
* Prioritised conservation and management actions for at-risk species
* Significant Impact Guidelines
* A framework for how to handle Conservation Dependent Species
* Integrated Conservation Advices for species groups
* Exploration and identification of key data gaps and suggestions to eliminate gaps and improve management
* Implications of climate change

Compilation and synthesis of existing data and knowledge will result in a Plan that can be applied to national level decisions around the management and protection of elasmobranch species. This project will build on data collected from the 2015 NESP project “Prioritisation of research and management needs for Australian elasmobranch species” and already completed IUCN assessments.

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

This project will provide direct guidance relative to several Departmental research priorities under NESP including:

* 1. Improve our knowledge of key marine species and ecosystems to underpin their management and protection.
  2. Identify past and current pressures on the marine environment, and understand their impact to better target policy and management actions.

This project will also help inform species assessment for administration under the EPBC Act relative to species listing, and obligations under CITES and CMS.

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

As indicated above, this project will consist of a series of documents and analyses to address concerns and issues around management and conservation of elasmobranch species. Policy documents will be developed in consultation with DoEE staff and based on Michelle Heupel’s experience as a former member of the Commonwealth Threatened Species Scientific Committee. Species assessments will be compiled using the IUCN Red List standards. A workshop of key experts will be convened to assist with completion of difficult assessments.

The project will take advantage of expert elicitation in NESP Project A5 as a basis for sections of the SAP. In addition, a workshop of select fishery managers and Indigenous representatives will be sought through the Fisheries Research Development Corporation Indigenous Reference Group to discuss significant issues around management and conservation of fished (Conservation Dependent) species. The outcome of this workshop will be a framework for how to best deal with these species within the context of the EPBC Act and fisheries management plans.

Assessments of threat and prioritisation of actions will also be conducted to reveal instances where management intervention may have greatest effect. For example, consideration will be given to the capacity of spatial closures such as the GBR Marine Park and Commonwealth Marine Reserves to improve management and conservation outcomes for elasmobranchs. Examination of species distribution and movement patterns relative to protected areas will form a key component of this approach. Identification of knowledge gaps and solutions to solving those gaps will also be explored to improve knowledge and thus the capacity to improve management.

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

Outcomes of this project will have relevance to the Threatened Species Hub.

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

This project will leverage data collected under NESP Marine Biodiversity Hub project A5 “Prioritisation of research and management needs for Australian elasmobranch species”. This project will also draw information from recent work carried out under the Fisheries Research and Development Corporation “Australian Shark Report card” project and current IUCN Red List assessments for the Oceania region.

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

* National perspective on the status of Australian elasmobranch species
* Improved understanding of threats and their effect on groups of elasmobranch species
* Identification of key knowledge gaps, prioritisation of data needs and advice on how to obtain necessary data, including potential of national programs such as IMOS
* A framework for dealing with fished species nominated for EPBC listing

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

This project will deliver a series of management and policy documents that can be used by DoEE for the purposes of managing and conserving at risk elasmobranch species. The outputs of this project will include Significant Impact Guidelines, Conservation Advices and a framework for processing Conservation Dependent species that can be applied by the Threatened Species Scientific Committee and DoEE. This information will be directly relevant to EPBC listing and assessment of these species, reporting under CITES and CMS, and WTO assessments of Australian fisheries. Outcomes are also relevant to State and Territory fishery management agencies who may need to consider joint management arrangements or policy changes.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

This project will provide a national perspective on the status, management needs and data gaps related to Australian elasmobranch species. Outputs will include policy documents applicable to DoEE and EPBC Act requirements and information relevant to international treaties (e.g. CITES, CMS). Identification of threats to species and conservation priorities will also be produced for use by DoEE, the Threatened Species Scientific Committee and fishery managers.

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

Outputs of the project will include:

* Shark Action Plan relevant to management of Australian elasmobranchs including an assessment of current threats, prioritised conservation and management actions for at-risk species and guidance on future management and data needs
* Integrated Conservation Advices for multiple species with similar threats
* Significant Impact Guidelines for Australian elasmobranchs
* Discussion paper outlining a framework for how to apply conservation strategies for fished (Conservation Dependent) species
* Presentation of results to key stakeholders and end users
* Manuscripts for scientific journals outlining the results of project components (eg, Conservation Dependent species framework)

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1 – Meet with DoEE staff to agree full list of policy documents for delivery | Due 1 April 2017 |  |
| Milestone 2 – Produce list of common threats and begin implications of climate change analysis. Compile species assessments. | Due 1 June 2017 |  |
| Milestone 3 – Organise workshop to assist in species assessments and define data gaps. | Due 15 July 2017 |  |
| Milestone 4 – Deliver common threats and climate change analyses. Begin report on data gaps and data needs for elasmobranchs in Australian waters and case study relative to CITES/CMS conventions. Continues species assessments. | 30 November 2017 |  |
| Milestone 5 – Deliver Significant Impact Guidelines for Australian elasmobranchs. | 30 Jan 2018 |  |
| Milestone 6 – Begin threat risk mapping, organise Conservation Dependent species workshop, continue species assessments. | 1 March 2018 |  |
| Milestone 7 – Deliver data gaps analysis, begin prioritisation of conservation actions. | 30 May 2018 |  |
| Milestone 8 – Deliver case study, threat mapping, Conservation Dependent species framework and species assessments. | 15 August 2018 |  |
| Milestone 9 – Produce integrated Conservation Advices and prioritisation results. | 30 October2018 |  |
| Milestone 10 – Compile overview of taxa, prioritised list of management actions and summary of potential management solutions. | 30 November 2018 |  |
| Milestone 11 – Produce full Shark Action Plan | 31 December 2018 |  |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| Michelle Heupel (0.25 FTE) | Australian Institute of Marine Science | Project leader, responsible for compiling report |
| Terry Walshe (0.1 FTE) | Australian Institute of Marine Science | Prioritisation of outcomes and management |
| Peter Kyne (0.4 FTE: 0.2 NESP, 0.2 CDU) | Charles Darwin University | Synthesis of IUCN species assessments |
| William White (0.05 FTE) | CSIRO | Advise on taxonomy and deep sea sharks |
| Colin Simpfendorfer (0.1 FTE from JCU) | James Cook University | Advise on policy and management documents |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
|  |  |  |

Research End Users and Key Stakeholders **–** Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| Department of the Environment and Energy – Marine and Freshwater Species Conservation Section | Ivan Lawler |  |
| Department of the Environment and Energy – Sustainable Fisheries Section | Josh van Limbeek, Nathan Hanna |  |
| Department of the Environment and Energy – Wildlife Trade Assessments Section | Shaneen Coulson, Suzanne Ferguson |  |
| Great Barrier Reef Marine Park Authority | David Wachenfeld, Darren Cameron |  |
| Parks Australia | Amanda Parr |  |
| NGO groups (e.g. WWF, HSI) |  |  |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| New South Wales Fisheries |  |  |
| Queensland Fisheries |  |  |
| Northern Territory Fisheries |  |  |
| Western Australian Fisheries |  |  |
| South Australian Fisheries |  |  |
| Victorian Fisheries |  |  |
| Tasmanian Fisheries |  |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

Research end-users will be included in project workshops and policy documents developed to ensure engagement and knowledge transfer. The pathway to impact will largely be based on direct consultation and collaboration on the shape and scope of policy documents developed. Interactions are required to ensure documents are easily incorporated and applied in a policy context. This will be facilitated through phone and face to face meetings to ensure progress matches the needs and expectations of stakeholders. Workshop reports will be completed to inform stakeholders about the outcomes of those discussions in addition to other reports and output products. Recommendations regarding methodological approaches, research priorities and critical data needs for threatened and data deficient elasmobranchs to be shared with the science community as well as end-users. Presentations of these findings will be completed for key end users coupled with meetings to discuss results and future directions to meet end-user and stakeholder needs. Interactions with stakeholders will also be used to prioritise future conservation, management and policy needs for elasmobranchs in Australia. Communication will also be completed through press releases, social media and web-based information outlets (eg, AIMS web page) as appropriate. Activities will be aligned with and coordinated through the Hub’s Knowledge Brokering and Communication Strategy.

Knowledge brokering and communication contact

Name: Michelle Heupel

Email Address: m.heupel@aims.gov.au

Phone Number: 07 4753 4205

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

This project will compile information from other sources and as such will not generate data per se. Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website <http://www.nespmarine.edu.au>. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

The primary contact point for data and information management contact for this project is the project leader (see details in front page).

Contact person

Name: Michelle Heupel

Email Address: m.heupel@aims.gov.au

Phone Number: 07 4753 4205

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

NESP funds will be used to support salaries for key project personnel and costs associated with workshops.

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

The location of workshops is yet to be determined but will be based on the location of participants to reduce costs and travel requirements. Desktop work will be conducted at AIMS and CDU campuses.

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

This project is a national scale desktop study that does not include field work and is therefore considered a category three project for Indigenous engagement.. However, in recognition of the iconic nature of shark species in Indigenous culture we will work to include Indigenous representation where possible, including workshops with fishery managers. The approach will include communication to the Hub Research-user Committee and Steering Committee, the Fisheries Research and Development Corporation Indigenous Reference Group and the DoEE Indigenous Advisory Group to provide advice on who to include in consultation. Direct guidance will be sought from Stan Lui to invite appropriate Indigenous representatives to workshops. The team will work with the Hub Executive and Indigenous advisory groups (as above) to develop a process for the generated knowledge, data and results to be effectively shared and communicated between Indigenous peoples, communities and organisations. Furthermore the project team will seek to lever off effective engagement for research on euryhaline elasmobranchs and hammerhead sharks, future engagement will build upon the contacts and approaches employed for these species and utilise links already established at AIMS and CDU. All Indigenous engagement will apply the Hub’s Indigenous Engagement and Participation Strategy to consultation on relevant species as identified from this exercise.

Contact person for Indigenous engagement:

Name: Michelle Heupel

Email Address: m.heupel@aims.gov.au

Phone Number: 07 4753 4205

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

This project addresses species status, threats and risks to Australian elasmobranch species as described above. Integrated and prioritised conservation advice will be provided relative to elasmobranch species within Australian waters.

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

This project focuses exclusively on elasmobranch species and as such excludes similar issues for other marine fauna.

### Risks

List all significant risks to the success of the project

There are no significant risks associated with this project. Required data are publicly available and listed researchers and stakeholders are available, supportive and engaged. These scenarios will lead to on time delivery of project outputs.

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

Elasmobranch, conservation, management, threats, prioritisation

# Project A12 – Scoping a seascape approach to managing and recovering northern Australian threatened and migratory marine species

Comments received from DOEE in the document ‘Research Plan V3b Assessment’, along with ongoing engagement with DOEE will be used to refine and modify this project proposal with a deadline of 15 February 2017 provided by DOEE

*Project length* – 1 Year

*Project start date* – 01/01/2017

*Project end date* – 31/12/2017

*Project approval date* - TBC

*Project current status* - To be approved under RPV3

*Project Leader* – Peter Kyne (FTE – 40%)

*Lead Research Organisation* – Charles Darwin University

*Project leader contact details:* –peter.kyne@cdu.edu.au, 0477 306 344

**Project Funding**

|  | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* | *2021* | ***TOTAL*** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *NESP funding* | *x* | *x* | *Total*  *$234,921*  *AIMS $35,948*  *CSIRO*  *$0*  *CDU $158,973*  *GA $40,000* | *x* | *x* | *x* | *x* | *234,921* |
| *Cash co-con* | *x* | *x* | *$18,195* | *x* | *x* | *x* | *x* | *18,195* |
| *In-kind co-con* | *x* | *x* | *Total*  *$256,726*  *AIMS $35,948*  *CSIRO $40,000*  *CDU $140,778*  *GA $40,000* | *x* | *x* | *x* | *x* | *256,726* |
| ***TOTAL*** | ***x*** |  | ***$509,842*** | ***x*** | ***x*** | ***x*** | ***x*** | ***509,842*** |

**Project Summary**

Northern Australia is the current focus of substantial economic development, which has the potential to cause impacts on biological assets and cultural values. The Northern Seascape scoping project will assess pressures, biological assets, Indigenous priorities and the intersections between them in relation to Threatened and Migratory Marine Species (TMMS) across northern Australia. The focus will be at the multiple taxa level, including elasmobranchs (sharks, sawfishes, devil rays), shorebirds, turtles and cetaceans, and include an assessment of the associated key coastal habitats. The project will scope research needs and directions for a broad Northern Seascape project from 2018 to 2020.

**Summary of changes since previous Research Plan**

(only for projects which are being resubmitted for approval under RPV3)

N/A – new project

**Problem Statements**

*Problem*

The current ‘Developing the North’ agenda includes plans and potential for large-scale development activities such as agriculture, aquaculture, port development, mineral industry infrastructure and water extraction which have the potential to impact biodiversity and cultural values. The need to balance future development with existing industries (for example, commercial fisheries), Matters of National Environmental Significance (MNES), and Indigenous priorities drives the need for a broad landscape (here termed ‘seascape’) approach to managing and recovering TMMS.

*How Research Addresses Problem*

The Northern Seascape scoping project will undertake a stocktake of pressures, biological assets, Indigenous priorities and the intersections between them in relation to TMMS and their coastal habitats across northern Australia. This will inform the strategic and on-ground direction of investment in future TMMS research across the north.

*Alignment with NESP Research Priorities*

This project will scope and guide future investment in the following NESP Research Priorities:

* 1. Improve our knowledge of key marine species and ecosystems to underpin their management and protection.
  2. Identify key opportunities to collaborate and build Indigenous participation and knowledge into the management and protection of marine species.
  3. Determine the causes of, and relationships between, pressures on the marine and coastal environment, to inform government investment.
  4. Identify past and current changes in and pressures on the marine and coastal environment, and understand their impact to better target policy and management actions.
  5. Better understand issues that are common to the fishing industry and the environment including identifying solutions of mutual benefit.

Furthermore, the intersection between pressures, biological assets and Indigenous priorities of MNES addressed under the project make it of relevance to the administration of the EPBC Act.

**Research**

*Description of research*

The Northern Seascape scoping project will focus on the following key areas:

* A review of pressures on TMMS across northern Australia (pressure mapping)
* A review of existing knowledge on biological assets, in particular biologically important areas, movements and corridors, habitat and ecology, and hotspots/critical areas of TMMS across northern Australia (mapping and gap analysis that builds on the analysis completed by Project D1 for the North and NW regions)
* Maps and time-series products that depict the extent and timing of change in key coastal habitats over the last three decades at selected locations in northern Australia. This research will utilise the reprocessed and restructured Australian Landsat archive (Data Cube) and the available field-based coastal habitat data for validation. It will help identify the drivers of change in habitat extent, and determine the feasibility of developing a Data Cube habitat-change analysis tool that can be applied across the coast of northern Australia
* A review of Indigenous TMMS research and management priorities (engagement and community participation)
* An examination of the intersection between pressures, biological assets and Indigenous priorities (spatial mapping)
* Broad stakeholder engagement to define TMMS research needs, including working with the commercial fishing industry to identify key issues in TMMS bycatch and research priorities for bycatch mitigation (regional workshops)

*Links with other projects and hubs*

This project draws on data and analyses undertaken in project C1 (‘Improving our understanding of pressures on the marine environment’) and project D1 ('Ecosystem understanding for the North and North-west marine regions'). It will provide data to project A11 (‘Shark Action Plan’) in relation to threatened and migratory elasmobranchs. It will link to the new D1 project (‘National data collation, synthesis and visualisation to support sustainable use, management and monitoring of marine assets’) to provide information products and visualisations in a nationally consistent approach. It is linked to the Threatened Species Recovery Hub Project 5.2.1 ‘Strategic planning for the Eastern Curlew’. The project links to an independent CDU/AIMS research user needs project, but project A12 is focused solely on threatened and migratory marine species. Project A12 will however aim to engage strongly with that process.

*Related research*

The project will draw on any research undertaken across northern Australia on TMMS in relation to reviewing biological assets.

**Expected Outcomes**

*Outcomes*

The scoping project will deliver a synoptic overview of biological assets (threatened and migratory marine species biodiversity assets and habitats), Indigenous TMMS priorities and state and trend in pressures on TMMS across the northern region. Furthermore, it will result in a shared understanding of links to the Threatened Species Recovery Hub.

*Specific management or policy outcomes*

Natural resource managers are currently making decisions on conservation programs and development applications in northern Australia. This project will improve this decision making process by providing accessible information that can be used by proponents and managers to identify and where possible avoid unnecessary impact. The project will deliver readily accessible map layers identifying important habitat and migratory corridors for TMMS across northern Australia and the existing pressures that those habitats are exposed to. It will identify where pressures on TMMS have increased over the last 20–30 years (where such data is available) and where the amount or quality (data dependent) of habitat has changed. Lastly it will identify where migratory corridors may have been impacted by increasing pressures.

The synoptic overview delivered by the scoping project will be used to guide the development of a proposal for a clear and defined program of research on threatened and migratory marine research across the Northern Seascape for 2018–2020 to support species recovery plans in an integrated manner. This will be achieved by incorporating Departmental, Indigenous, state/territory and industry needs, with well-articulated links to the Threatened Species Recovery Hub.

*Value*

The project will develop a northern-wide perspective on knowledge and knowledge gaps for threatened and migratory marine species and their key habitats, accessible to decision makers, industry and the public.

**Planned Outputs**

- A report on Indigenous marine research and management priorities regarding TMMS

- A map of biological assets and a gap analysis of research and data needs regarding TMMS

- Identification of TMMS bycatch and bycatch mitigation research priorities

- Maps and time-series graphs that depict the extent and timing of changes in coastal habitats that are important for TMMS

- Maps of state and trends in pressures, biological assets and the intersection between them

- Data visualisation and summaries available online through an appropriate web-based portal and/or existing internal DoEE information products.

- Project report synthesizing northern Australian biological assets, Indigenous priorities, pressures, coastal habitat change and fisheries bycatch mitigation research priorities.

**Project Milestones**

| **Milestones** | **Due date** | **Milestone Status** |
| --- | --- | --- |
| ***Project planning & methods*** |  |  |
| Project design workshop | Due 1 March 2017 |  |
| DOEE scoping meeting | Due 1 April 2017 |  |
| Partner workshop | Due 1 April 2017 |  |
| Define Indigenous priorities methods | Due 1 April 2017 |  |
| ***Data collation*** |  |  |
| Pressure data collation | Due 1 April 2017 |  |
| Biological assets mapping & gap analysis | Due 1 July 2017 |  |
| Fisheries & TMMS workshop | Due 1 July 2017 |  |
| Indigenous priorities workshops | Due 1 July 2017 |  |
| 30 yr Landsat data for selected key coastal habitats | Due 1 July 2017 |  |
| Coastal habitat field-based data | Due 1 July 2017 |  |
| ***Outputs*** |  |  |
| Pressure mapping | Due 1 August 2017 |  |
| Synthesis workshop (recommendations for RPV4) | Due 1 August 2017 |  |
| Habitat change - Landsat time series analysis (maps & graphs for selected sites) | Due 1 August 2017 |  |
| Indigenous priorities report | Due 1 October 2017 |  |
| Intersection mapping | Due 1 October 2017 |  |
| Remote sensing of coastal habitat change report | Due 1 October 2017 |  |
| Project report | Due 31 December 2017 |  |

**Researchers and Staff** (including early career researchers/PhDs – if names not yet known, list position/role)

| **Name** | **Organisation** | **Project Role** |
| --- | --- | --- |
| Peter Kyne (0.4 FTE) | Charles Darwin University | Project leader |
| Christy Davies (0.5 FTE) | NAILSMA | Indigenous priorities |
| Michele Thums (0.1 FTE) | AIMS | Biological assets |
| Luciana Ferreira (0.2 FTE) | AIMS | Biological assets |
| Ruth Patterson | CDU | PhD project (cetaceans) |
| Leo Lymburner (0.15 FTE) | GA | Habitat change analysis |
| Zhi Huang (0.1 FTE) | GA | Habitat change analysis |
| Lynda Radke (0.05 FTE) | GA | Benthic habitats & future project scoping |

**Co-contributors** – only list contributors who are not already identified as Researchers and Staff

| **Name** | **Organisation/** | **Contribution** |
| --- | --- | --- |
| Piers Dunstan (Project C1) | CSIRO | Pressure mapping (C1) |
| TBD (Project C1; 0.2 FTE) | CSIRO | Pressure mapping (C1) |
| Adrianne Laird | NPF Industry | NPF data |
| Grant Johnson | NT Fisheries | NTF data |
| Carol Palmer | NT DLRM | Cetacean expertise |
| Hamish Campbell | CDU | Biological assets |

**Research End Users and Key Stakeholders –**

Additional research end-users and key stakeholders to be added to these tables based on comments from DOEE and ongoing discussions with them, and state/territory agencies

Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| **Research End Users (section/programme/organisation)** | **Name/s** | **Email (optional)** |
| --- | --- | --- |
| Department of the Environment and Energy | Geoff Richardson, Lesley Gidding-Reeve, Ashley Leedman, Fiona Bartlett, Sylvana Maas |  |

| **Key Stakeholders (organisation/programme)** | **Name/s** | **Email (optional)** |
| --- | --- | --- |
| Northern Territory Fisheries |  |  |
| Western Australian Fisheries |  |  |
| Queensland Fisheries |  |  |
| Indigenous land councils |  |  |
| NPF Industry |  |  |
|  |  |  |

**Knowledge Brokering and communication**

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

A significant component of the project will involve stakeholder engagement to direct the course of the project and to understand user research needs for threatened and migratory marine species. This will include a stakeholder workshop and Indigenous priorities workshops. Workshop reports and communication materials will be produced summarising workshop outputs. Activities will be aligned with and coordinated through the Hub’s Knowledge Brokering and Communication Strategy.

Knowledge brokering and communication contact

Name: Peter Kyne

Email: peter.kyne@cdu.edu.au

Phone: 0477 306 344

**Data and Information Management**

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by NESP Programme Guidelines.

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hub website <http://www.nespmarine.edu.au>. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

Contact person

Name: Peter Kyne

Email Address: peter.kyne@cdu.edu.au

Phone Number: 0477 306 344

**Expenditure Summary**

A brief statement describing how project funding will be used (e.g. staffing, events, products).

NESP funds will be used to support salaries for key project personnel and costs associated with running workshops.

**Location of Research**

The project has a broad scope across northern Australia, from Torres Strait, Queensland through the Northern Territory to the Kimberley region of Western Australia. It encompasses the North marine bioregion.

**Indigenous Consultation and Engagement**

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

This research project will be undertaken in direct collaboration with Indigenous organisations and groups as identified primary users of the research (i.e. this is a Category 1 project for Indigenous engagement and participation). NAILSMA, as a research collaborator, will be leading the assessment of Indigenous research and management priorities of northern Australian threatened and migratory marine species. The team will also develop a process for the generated knowledge, data and results to be effectively shared and communicated between Indigenous peoples, communities and organisations. This will include communication to the Hub Research-user Committee and Steering Committee, the FRDC Indigenous Reference Group and the DoEE Indigenous Advisory Group.

Contact person for Indigenous engagement:

Name: Christy Davies

Email Address: Christy.Davies@nailsma.org.au

Phone Number: 0467 778 484

**Inclusions (in scope)**

The project reviews pressure, biological assets and Indigenous priorities of threatened and migratory marine species (EPBC-listed) across riverine, estuarine, coastal and shelf habitats of northern Australia.

**Exclusions (out of scope)**

The project does not cover species not-listed as threatened or migratory on the EPBC, or areas outside of the North and Northwest marine bioregions.

**Risks**

The short time frame of the project presents several risks. The most significant is around availability and access to data sets required for mapping biological assets and undertaking the gap analysis, and for mapping pressures. The short time-frame may also constrain input from some stakeholders and research end-users, due to capacity and other commitments. Enabling effective Indigenous participation across northern Australia within the short time-frame will be managed by accessing existing networks through NAILSMA and the NESP MBH.

**Project Keywords**

Threatened species, migratory species, biological assets, Indigenous priorities, pressures

# Project B1 – Road testing decision support tools via case study applications

Project length – 36 Months

Project start date – 01/07/2015

Project end date – 30/06/2018

Project approval date - xx/xx/xxxx (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - Submitted for re-approval

Project Leader – Terry Walshe (FTE – 50%)

Lead Research Organisation – Australian Institute of Marine Science

Project leader contact details: - [T.Walshe@aims.gov.au](mailto:T.Walshe@aims.gov.au); 03-9035 6413, 0437-829055

### Project Funding

*Total NESP funding* - $484,400 ($193,920 in 2017)

*Total Recipient and Other Contributions (co-contributions)* - $484,400 ($193,920 in 2017)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | *2015* | *2016* | *2017* | *2018* | *Total* |
| *NESP funding*  *- AIMS*  *- CSIRO*  *- UWA*  *- UTas*  ***Total*** | *$85,000*  *$11,000*  *$49,000*  *-*  *$145,000* | *$113,920*  *$ 41,000*  *$ 29,000*  *$ 10,000*  *$193,920* | *$113,920*  *$ 41,000*  *$ 29,000*  *$ 10,000*  *$193,920* | *$ 56,960*  *$ 20,500*  *$ 14,500*  *$ 5,000*  *$ 96,960* | *$629,800* |
| *Cash co-con* |  | *-* | *-* | *-* |  |
| *In-kind co-con*  *- AIMS*  *- CSIRO*  *- UWA*  *- UTas*  ***Total*** | *$85,000*  *$11,000*  *$49,000*  *-*  *$145,000* | *$113,920*  *$ 41,000*  *$ 29,000*  *$ 10,000*  *$193,920* | *$113,920*  *$ 41,000*  *$ 29,000*  *$ 10,000*  *$193,920* | *$ 56,960*  *$ 20,500*  *$ 14,500*  *$ 5,000*  *$ 96,960* | *$629,800* |
| ***Total*** | *$290,000* | *$387,840* | *$387,840* | *$193,920* | *$1,259,600* |

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

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 judgments, and economic analysis.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

In response to interest in decision-support beyond Parks Australia, the project now includes additional case study applications in (i) prioritising investment in research and monitoring of threatened and migratory species or threatened communities, and (ii) prioritising the restoration of saltmarsh and shellfish reef habitats.

The addition of these new case studies provides an effective risk spreading strategy. Until very recently, various issues have limited progress and prospects for adoption within Parks Australia’s Commonwealth Marine Reserves. These issues now look to be more or less resolved with Parks Australia articulating a clear imperative to strengthen its research strategy and to decide on a core set of baseline indicators. This project is now well placed to play a key role in assisting the organisation deliver on these imperatives. Nevertheless, should difficulties persist, the additional case studies offer avenues for traction and adoption.

### Problem Statements

#### Problem

Description of the specific problem

The considered and defensible allocation of finite resources in marine settings is challenging. When faced with complex problems, managers typically rely on simple heuristics to filter and identify priorities. These heuristics are known to be frail and biased. For improved outcomes, sparse data and expert judgment need to be combined in coherent and structured protocols for characterising the non-market benefits and monetary costs of candidate investments. Among the many settings that could benefit from the development and deployment of structured decision-making protocols, this project will focus on:

* Identifying cost-effective baseline indicators for monitoring Commonwealth Marine Reserves under an adaptive management framework;
* Prioritising research and monitoring investment among threatened and migratory species or threatened communities based on assessment of the value of information to managers seeking to discern the merit of two or more candidate actions.
* Prioritising restoration of saltmarsh and shellfish habitats (in collaboration with B4 researchers) based on estimated return on investment, where the return encompasses both market and non-market values.

#### How Research Addresses Problem

What solution will this research provide?

#### Via a series of end-user interviews and workshops, this project will develop, test and deploy a range of tools from economics and the decision sciences to address the three identified case study problems. These tools include:

* The development of objectives hierarchies via values-based thinking,
* Decision trees,
* Value of information analyses,
* Cost-effectiveness analysis,
* Multi-criteria decision-making, and
* Benefit-costs analysis.

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

This project will develop and trial decision making tools that will support policy makers and managers to identify options, and prioritise activities in Commonwealth Marine Reserves, threatened species and communities and migratory species management, and coastal and near-shore habitat restoration.

Selected case studies will improve the management of marine and coastal biodiversity by evaluating and quantifying the results of management actions.

This project provides the methodological underpinning of Marine Planning under the policy A Cleaner Environment. Specifically: A more balanced approach to Marine Protected Areas will mean the areas are assessed in accordance with scientific, economic and social evidence. This will continue to protect marine environments and the fishing communities that rely on them.

This project also aligns with Recommendation 5 in the National Marine Science Plan to develop a dedicated and coordinated science program to support decision-making by policy makers and the marine industry. Specifically, the project team will work with planners and managers from government and non-government organisations to develop and refine decision support tools that will translate knowledge and data into useful information for effective decision-making

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

Working with Parks Australia (Case Study 1), Wildlife Heritage & Marine Division (Case study 2), the Nature Conservancy and state-based agencies (Case study 3) we will crisply formulate each resource allocation problem, estimate the consequences of each candidate investment against objectives, undertake trade-offs analysis and identify priorities. The approach will encompass structured elicitation of expert judgment, a series of stakeholder workshops, value of information analyses, multi-attribute cost-effectiveness analyses and benefit-cost analyses.

Case Study 1, *Ecological monitoring of Commonwealth Marine Reserves*, will focus on informing the prioritisation of information acquisition through research and monitoring. It will also demonstrate how a subset of monitoring indicators can be used in adaptive management via identification of decision thresholds that may trigger a change in management. This case study will build on parallel work undertaken for the 2014 Portfolio Budget Statement deliverable for the Director of National Parks, ***Marine ecosystem health indicators have a baseline established by 30 June 2017.***

Case study 2, *Management actions for threatened and migratory species,* will work with the Department of Environment’s Wildlife Heritage and Marine Division to prioritise research and monitoring for recovery of threatened species and communities. While previous work under the NESP Threatened Species Recovery Hub has developed prioritisation protocols, this work will refine and extend the approach to include marine species or communities. Also, its emphasis will be prioritising research and monitoring to *inform* management, rather than the prioritisation of management actions.

Case study 3, Restoration *of saltmarsh and shellfish habitats*, will support researchers Colin Creighton and Ian McLeod in producing business cases for saltmarsh and shellfish reef repair as part of Project B4: *Underpinning the repair and conservation of Australia’s threatened coastal-marine habitats- Phase 2*. Specifically, this will build on the return on investment projections [e.g. prawn production or fish production] to provide a framework for spatial prioritization / decision making that will include multiple costs and benefits.

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

In considering indicators and decision thresholds under Case Study 1, this project will liaise with leaders and outcomes of

* C1 - Improving our understanding of pressures on the marine environment
* C2 - Continental-scale tracking of threats to shallow Australian reef ecosystems
* D1 – Ecosystem understanding to support sustainable use, management and monitoring of marine assets in the north and north-west regions
* D2 – Standard Operating Procedures for survey design, condition assessment and trend detection.
* D3 – Preparing for and implementing monitoring of CMRs and the status of marine biodiversity assets on the continental shelf

Case study 2 will work in parallel with Theme A, especially

* C1 - Improving our understanding of pressures on the marine environment (Dunstan)

There are also opportunities to work collaboratively with research providers engaged under the NESP Threatened Species Recovery Hub.

Case study 3 involves direct collaboration with

* B4: Underpinning the repair and conservation of Australia’s threatened coastal-marine habitats

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

While previous work under the NESP Threatened Species Recovery Hub has developed prioritisation protocols, this work will refine and extend approaches to include marine species, communities and ecosystems. Also, in Case Studies 1 and 2 its emphasis will be prioritising research and monitoring to *inform* management, rather than the prioritisation of management actions.

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

At the end of 2017 this project will provide:

* Priorities for CMR research and monitoring.
* Demonstrated application of decision thresholds to adaptive management for selected monitoring indicators.
* Value of information analyses to compliment multi-criteria approaches to prioritisation of research and monitoring.
* Enhanced capacity within the Department to prioritise cost-effective investments in recovery of threatened species and communities, including the use of structured approaches to produce a short list of investment priorities for research and monitoring of listed marine species and communities.
* A national list of priority sites and projects for the restoration of saltmarshes and shellfish habitats

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

* Case Study 1 will deliver to Parks Australia a defensible and transparent rationale for selection of ecosystem health indicators underpinning adaptive management of CMRs, consistent with the 2014 Portfolio Budget Statement deliverable, *Marine ecosystem health indicators have a baseline established by 30 June 2017****.***.
* Case Study 2 will provide Wildlife Heritage & Marine a defensible and transparent rationale for allocating resources to research and monitoring, leading to enhanced prospects for the recovery of threatened and migratory species and communities.
* Case study 3 will provide The Nature Conservancy and its state agency partners a prospectus and business case for the restoration of saltmarsh and shellfish habitats.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

Recent research indicates that poor choice in decision support protocols can lead to 30 – 50% losses in environmental benefits[[1]](#footnote-1). This project will avoid these arbitrary losses through informed selection and use of appropriate decision-support tools.

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

This project will demonstrate the application of decision support tools in a range of settings of relevance to marine biodiversity managers, including actions aimed at equipping managers with an evidence base for future decision-making (monitoring), minimising exposure to losses (in matters of national environmental significance) and maximising exposure to gains (in restoration).

Specific outputs include:

* Progress Report on Case Study 1 – formulation of the decision problem concerning prioritisation of monitoring indicators for CMRs.
* Progress Report on Case Study 1 – first iteration of monitoring priorities.
* Convene workshop for Case Study 1 – performance evaluation of alternative monitoring indicator portfolios against CMR objectives.
* Convene workshop(s) for Case Study 2 - performance evaluation of alternative candidate sites against restoration objectives.
* Report on workshop outcomes for Case Study 2 – first iteration of saltmarsh restoration priorities
* Report on workshop outcomes for Case Study 2 - first iteration of shellfish habitat restoration priorities
* Convene workshop for Case Study 3 - performance evaluation of alternative research portfolios against recovery objectives.
* Report on workshop outcomes for Case Study 3 - first iteration of research and monitoring priorities
* Draft Report on outcomes of Case Studies 1 – 3.
* Final Report on outcomes of Case Studies 1 - 3, including specific recommendations.
* At least three peer-reviewed journal articles describing key elements of each of the three case studies.

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Delivery Milestone 1: Progress Report on Case Study 1 | Due 1 Jul 2016 | Delayed to 28 Oct 2016 |
| Delivery Milestone 2: Progress Report on Case Study 1 | Due 1 Jan 2017 | Delayed to 30 Apr 2017 |
| Activity Milestone 1: Convene workshop for Case Study 1 | Due 28 Feb 2017 | On track |
| Activity Milestone 2: Convene workshop(s) for Case Study 2 | Due 15 May 2017 | On track |
| Delivery Milestone 3: Report on workshop outcomes for Case Study 2 - saltmarsh | Due 31 May 2017 | On track |
| Delivery Milestone 4: Report on workshop outcomes for Case Study 2 - shellfish | Due 30 Sept 2017 | On track |
| Activity Milestone 3: Convene workshop for Case Study 3 | Due 31 Dec 2017 | On track |
| Delivery Milestone 5: Report on workshop outcomes for Case Study 3 | Due 28 Feb 2018 | On track |
| Delivery Milestone 6: Draft Report on Case Studies 1 – 3. | Due 31 May 2018 | On track |
| Delivery Milestone 7: Final Report on Case Studies 1 - 3, including specific recommendations. | Due 1 Jul 2018 | On track |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| Terry Walshe (0.50 FTE) | AIMS | Project leader |
| Sean Pascoe (0.20 FTE) | CSIRO | Partner investigator |
| Abbie Rogers (0.20 FTE) | UWA | Partner investigator |
| Neville Barrett (0.05 FTE) | University of Tasmania | Partner investigator |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
| Nil |  |  |

Research End Users and Key Stakeholders

Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| Parks Australia (Cth Marine Reserves) | Amanda Parr |  |
| Wildlife Heritage & Marine | Geoff Richardson |  |
| Wildlife Heritage & Marine – Marine Policy | Amelia Tandy, |  |
| Wildlife Heritage & Marine – Marine Policy | Karen Arthur, |  |
| Wildlife Heritage & Marine – Marine Policy | Ashley Leedman |  |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| Reserve Network Stakeholder Forums |  |  |
| The Nature Conservancy | Chris Gillies |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

Knowledge brokering and communication are core elements of this project. Pathways to impact include interviews with CMR business units to gain a full appreciation of decision support setting, needs and constraints. We will arrange end-user and stakeholder targeted workshops to develop case studies. We will build capacity via delivery of dedicated training modules. Generic elements are addressed in the Hub’s Knowledge Brokering and Communication Strategy.

Contact for Knowledge brokering and communication

Name: Terry Walshe

Email Address: [T.Walshe@aims.gov.au](mailto:T.Walshe@aims.gov.au)

Phone Number: 03-9035 6413, 0437-829055

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

This project will collect data describing expert judgment and organisational values, and produce reports (see milestones). Data and information will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. A project level metadata record will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal <http://portal.aodn.org.au/aodn/>

Publications and reports will be made publically and freely accessible and available on the Hubs website <http://www.nespmarine.edu.au>. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

Contact person

Name: Terry Walshe

Email Address: [T.Walshe@aims.gov.au](mailto:T.Walshe@aims.gov.au)

Phone Number: 03-9035 6413, 0437-829055

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

Project funding provides direct salary costs for:

* The project leader (Walshe)
* Partner investigators (Pascoe, Rogers and Barrett)

Plus operating costs, including:

* Workshops and
* Travel and accommodation.

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

Workshops will be held in Canberra and/or Hobart. Case study applications may involve workshops and travel to other destinations.

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

The project will be managed consistent with the Hub’s Indigenous Engagement and Participation Strategy. The project is considered a category 3 project - a research project that is laboratory or desktop based and does not have direct collaboration with an Indigenous community, organisation, group or individual. The team will develop a process for the generated knowledge, data and results to be effectively shared and communicated between Indigenous peoples, communities and organisations. This will include communication to the Hub Research-user Committee and Steering Committee, the FRDC Indigenous Reference Group and the DoEE Indigenous Advisory Group.

Contact person

Name: Terry Walshe

Email Address: [T.Walshe@aims.gov.au](mailto:T.Walshe@aims.gov.au)

Phone Number: 03-9035 6413, 0437-829055

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

All decision support tools are candidates for exploration under this project.

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

Nil

### Risks

List all significant risks to the success of the project

The success of Case Study 1 is highly dependent on engagement of CMR managers. Considering the high priority placed on this project by Parks Australia this risk is characterised as low.

Similarly Case Studies 2 and 3 rely on engagement with Wildlife Heritage and Marine Division and The Nature Conservancy and its stakeholders, respectively. Again, motivated end-users suggest the risk to project success is low.

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

Adaptive management, Prioritisation, Multi-criteria analysis, Value of Information, Cost-effectiveness

# Project B2 - Analysis and elicitation to support State of the Environment reporting for the full spectrum of data availability

*Project length* – 24 Months

*Project start date* – 01/07/2015

*Project end date* – 30/06/2017

*Project current status - Suspended*

*Project Leaders* –Simon Barry

*Lead Research Organisation* – UTAS/CSIRO

*Funding as at project suspension*

|  |  |  |  |
| --- | --- | --- | --- |
|  | *2015* | *2016* | *Totals* |
| *NESP funding* | *$21,275* | *$41,667* | $62,942 |
| *Cash co-con* |  |  |  |
| *In-kind co-con* | *$63,640* |  | *$63,640* |
| *Totals* | *$84,915* | *$41,667* | *$126,582* |

*Below is the original RPV1 Budget Funding*

*Total NESP funding* - $300,000 (Indicative figures at this stage)

*Total Recipient and Other Contributions (co-contributions)* - $300,000

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* |
| *NESP funding* | *$250,000* | *$50,000* | Project may continue into a third year by extending the data sources that are analysed | | | |
| *Cash co-con* |  |  |  | | | |
| *In-kind co-con* | *$250,000* | *$50,000* |  | | | |

**Problem Statement**

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.

We currently lack a principled process for utilising and merging data of varying quality and from different sources to form a national perspective to support State of the Environment reporting. The key unifying principle to support such a process is the extent to which the available data is representative of the environmental asset in question. As the extent to which the empirical observations accurately represent the state of the asset in both space and time diminishes, so the reliance on expert opinion increases, to the limit where the only available information is expert opinion.

This project will provide an over-arching framework to consider these issues, develop practical protocols for blending different data streams with or without experts’ judgement as appropriate, and thereby provide a foundation for improving State of Environment reporting for all types of data sources, from high to low quality. It will do this by developing and applying protocols to support development of the marine chapter of SoE 2106. This currently being developed within a separate CSIRO funded project. The project will use the experience of developing this chapter to make recommendations about appropriate methodologies for future environmental reporting.

Importantly the statistical approach and analysis principles will be consistent regardless of the amount or quality of the information available. As a result the framework and analysis methods will remain relevant, even as the quality and quantity of environmental data at the department’s disposal changes. This will provide the consistency of analysis and reporting that is essential to SoE.

**Alignment with NESP Research Priorities**

*Description of project alignment with Departmental research priorities*

This project aligns to two DoE research priorities that together seek to maximise the efficacy of managing Australia’s marine environment and call for an improved understanding of that environment, specifically:

* Determine and trial practical and repeatable methods for monitoring the status and trends of key coastal and marine species and environments to underpin management of Commonwealth Marine Reserves.
* Meaningful and accessible information on the status and trends of key social and economic values associated with the marine environment

*What Government policy objective is this project addressing?*

Cleaner Environment Policy - Clean Water

**Research**

Research tasks and timeline as follows:

Year 1:

1. Work closely with CSIRO team working on the marine chapter for SOE 2016 and through this liaise with SoE team and ERIN.
2. Contingent on successful outcome of 1, evaluate status and availability of data streams relevant to these exemplars specifically targeting the high and low end of the data availability spectrum.
3. Based on these exemplars develop two or three protocols for assessment the representativeness of existing data as well as analysis methods for merging and elicitation of expert based components.

Year 2:

1. Finalise report and methodology.
2. Contingent on the availability of resources, timing and appropriate input from the department, provide input into the marine chapter of the 2016 State of the Environment report

**Links to other projects and hubs**

Many of the outcomes of this project will be applicable across many environmental domains. While the case studies will have a marine focus the general methodology will be more general.

In particular, this project is designed to link to, Graham Edgars project Continental-scale tracking of threats to shallow Australian reef ecosystems (Project C3) , It is also will build on the outcomes of CSIRO funded research into the availability of data streams for each of the SoE reporting elements.

*Related research*

This project leverages off research into environmental reporting, elicitation and statistical modelling of disparate data sources conducted by CSIRO over many years

**Expected Outcomes**

This project will provide a strategic assessment of ways to integrate disparate data sources to support regional/national reporting. It will produce a taxonomy of the different scenarios that exist in SOE reporting, a consistent logical framework to framing the analysis and will develop implementable protocols to perform the analysis, typically involving an expert based component.

This will provide a more systematic approach to the development of the SOE reporting and more explicitly link the report to data and expert opinion. It will build confidence in the process and product increasing its influence and value to policy makers and supporting informed public debate.

Practical outcomes are the provision of two or three examples that demonstrate a unified approach to the use of expert opinion in SoE reporting. These examples will be identified in close collaboration with the Department and will be developed in time to support the marine chapter of 2016 State of the Environment report, contingent on the availability of resources in the second year of the project and timely interaction with the department.

Assessments of the status and trends of environmental assets in the State of the Environment report will be based on a principled and statistically defensible process that can merges and utilises data from all sources including expert opinion.

Efficient and transparent assessment of environmental condition provides the basis for risk based decision making and efficient allocation of limited resources to the highest priority issues.

**Delivery of Project**

Simon Barry is a senior research scientist at CSIRO and a research project leader. He has successfully managed project of this magnitude and complexity for the previous 17 years. He has extensive experience of delivering policy relevant results into a range of government departments.

*Delivery on time and within budget*

The project leader and science support team will implement standard project management and reporting mechanisms to ensure that the project stays on track, and cost/time deviations are identified early and if appropriate reported to NESP leadership team. The project will also be subject to the project management and reporting procedure implemented across the entire NESP biodiversity hub, which will include regular (monthly) progress reports that will be routinely delivered to the hub’s steering committee.

**Project Milestone**

|  |  |
| --- | --- |
| **Milestones** | **Due date** |
| Meeting with ERIN and SoE to understand constraints and identify exemplars | 31st Aug 2015 |
| Analysis of representativeness of data types available to marine chapter of SoE and presentations of options for formal use of expert opinion. | 1st Jan 2016 |
| Development of protocol and application of examples to marine chapter of SoE 2016 | To match SoE 2016 timeline |

Researchers and Staff

|  |  |  |  |
| --- | --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE 2015/16** | **FTE 2016/17** |
| Graham Edgar, UTAS | Biologist, data custodian | 0.1 | .02 |
| Neville Barry, UTAS | Biologist and data custodian | 0.1 | .02 |
| Hugh Sweatman, AIMS | Biologist and data custodian | 0.15 | .02 |
| Simon Barry, CSIRO | Statistician | 0.2 | .03 |
| Keith Hayes, CSIRO | Statistician | 0.1 | .02 |
| Emma Lawrence CSIRO | Statistician | 0.2 | .05 |
| Geoff Hosack, CSIRO | Statistician | 0.5 | .05 |
| Adrian (tbc) | Statistician | 0.4 | 0 |

**Partner contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| CSIRO | $220,000 |  | $220,000 |
| UTas | $50,000 |  | $50,000 |
| AIMs | $30,000 |  | $30,000 |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

|  |  |
| --- | --- |
| **Organisation/name** | **Contribution** |
| None |  |
|  |  |

Research End Users and Key Stakeholders

|  |  |
| --- | --- |
| **Research End Users** | **Organisation/Section** |
| Jason Ferris | Australian government SoE reporting |
| Various SoE reporting officers | State government SoE reporting |

**Knowledge Brokering and communication**

In the initial scoping stage the project will engage the key staff in SoE such as Jason Ferris and Boon Lim, and the current SoE 2016 marine chapter authors (Nic Bax and David Smith) to develop a shared understanding of how expert opinion is currently used within the SoE reporting process, and to agree to what extent this project is able to provide input to the marine chapter of SoE 2016, recognising the limitations imposed by the time lines of the two processes. Subsequently the project will present to these key stakeholders, together with key personnel from the state-based SoE report, on options for a more formal engagement of experts within the spectrum of data availability. This will be achieved by a workshop with invited participants.

**Expenditure Summary**

Funding will be primarily used to pay salaries, with a small operating budget for travel.

**Location of Research**

This study will be conducted by researchers in Hobart, Brisbane, Canberra, and Townsville.

**Indigenous Consultation and Engagement**

The project will in the first instance seek to understand the role of the Indigenous community within past SoE reporting and the Indigenous communities’ aspirations for any future role of the Indigenous community in the SoE. As part of its wider analysis of the role of expert knowledge within SoE the project will consider any specific issues and opportunities associated with the use of Indigenous knowledge in SoE reports.

**Inclusions (in scope)**

Analysis of data that is immediately available to the project is included within the scope of the project.

**Exclusions (out of scope)**

Analysis of the representativeness of data, and demonstration of examplar protocols for data that is not made available to the project is out of scope.

**Constraints**

Input to the marine chapter 2016 State of the Environment report will be constrained by the resources allocated to the second year of the project, and will be contingent upon progress made in the first year and successful interaction with, and input, from the department during the first year.

**Risks**

Inaccessibility of data

Inaccessibility of expert for the elicitation

***Project Keywords***

State of the Environment reporting, meta-analysis, expert elicitation

# Project B3 – Enhancing access to relevant marine information – developing a service for searching, aggregating and filtering collections of linked open marine data

*Project length* – 18 months to develop a working prototype linked open data delivery system, and to perform usability testing with stakeholder groups.

*Project start date* – 01/07/2015

*Project end date* – 31/12/2016

Project status - Completed

*Project Leader* – Johnathan Kool (FTE – 10%)  
*Lead Research Organisation* – Geoscience Australia  
[johnathan.kool@ga.gov.au](mailto:johnathan.kool@ga.gov.au)  
02 6249 5842

*Total NESP funding* - $91,750

*Total Recipient and Other Contributions (co-contributions)* - $106,000

|  |  |  |  |
| --- | --- | --- | --- |
|  | *2015* | *2016* | *Totals* |
| *NESP funding* | *$40,250* | *$51,500* | *$91,750* |
| *Cash co-con* | *x* | *x* | *x* |
| *In-kind co-con* | *$54,500* | *$51,500* | *$106,000* |
| *Totals* | *$94,750* | *$103,000* | *$197,750* |

**Project Summary**

We aim 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. This 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.

**Problem Statements**

*Problem*

An emerging priority in information management is building smarter information search engines that are tailored to specific types of end users. These end-user-focused systems can provide highly targeted and relevant results immediately, in contrast to the common experience of sifting through extensive collections of potentially irrelevant items.

*How Research Addresses Problems*

We intend to develop a flexible interface focused on the information requirements of the Department of the Environment (DOE) to search, filter and deliver connections to linked open marine data (this tool could also be applied to data within DOE). This will help provide efficient access to a wide range of information sources using a Google-type search interface that will be familiar to most users. The interface will accept a single search string, and will return an ordered/sorted list of results. The ranking of the results would be weighted on the basis of user type (e.g. specific types of users within DOE, scientists, general public). The resulting collections of data resources can then be forwarded on to other web services for plotting, ingestion into modelling tools and virtual laboratories, or saving as a report. This contrasts with previous efforts to generate map ‘portals’ by providing a targeted subset of information tailored to individual needs that can be updated dynamically (akin to an Amazon search for marine information as opposed to books and household goods).

*Alignment with NESP Research Priorities*

The proposed project aligns with Marine Biodiversity Research Priorities to:

• Develop and trial decision making tools that will support managers to define and prioritise activities.

• Provide meaningful and accessible information on the status and trends of key social and economic values associated with the marine environment.

• Improve our knowledge of key marine species and ecosystems to underpin their better management and protection

• Enhance the role of citizen science in the management of marine biodiversity.

**Research**

*Description of research*

The proposed project will apply data science to develop an online tool that can be used to search, filter and deliver sources of marine data (geospatial or otherwise), and to aggregate and forward these information streams to web services for analysis, delivery or visualisation. The concept would be similar to the interface of Amazon.com which allows for search and retrieval of different products, classification of different product types, as well as providing user-specific recommendations for linked items of interest. There would be three components to the initial development of the tool: *data harvesting, data searchability,* and *web service delivery*.

It is important to distinguish the capabilities of the proposed project from existing information portals. Most existing portals emphasize online mapping capability. The proposed project will handle multiple types of information (e.g. documents, images, tables, hyperlinks as well as spatial data). The data elements will also have semantic tags added to them, permitting queries across collections of heterogeneous data objects (the linked open data concept). To the best of our knowledge, no existing service leverages the capabilities of linked open data, which is a key reason for this pilot initiative. Taking advantage of enterprise search technologies such as Solr and ElasticSearch also make it possible to provide user-specific recommendations (i.e. search results for an environmental manager could be different than those of a researcher or industry specialist). Lastly, the tool would have the capability of saving the collection of filtered information objects so that they can be forwarded on to other web services for further processing (e.g. mapping, downloading, or custom aggregation).

The harvesting component will identify and ingest sources of metadata (and potentially data, as available) from a range of different providers, including GA, AIMS, IMOS/AODN, CSIRO, GBRMPA and possibly BOM. Although many data sources will consist of spatial information (i.e. GIS data), the tool will be able to accommodate a variety of sources, including documents, images and video. For this stage, we will also be developing ways of linking the data with formal semantic descriptions/tags (machine-interpretable definitions of what the data *is* – e.g. temperature, currents, coastal infrastructure).

Searchability will be accomplished through the use of industry-standard software libraries (e.g. [Solr](http://lucene.apache.org/solr/) and [ElasticSearch](https://www.elastic.co/products/elasticsearch) – built on [Lucene](https://lucene.apache.org/)). In addition to possessing full-text search capability, these libraries can be used to perform fuzzy topic searches, identify closely related items, cluster groups of items into categories, sort items by relevance, and filter out low-ranked items. Search strings can be monitored to identify usage patterns and hotspot topics, including topics of interest that are missing from the base of searchable information. [Stanbol](https://stanbol.apache.org/) can be used to automate the extraction of semantic tags from unstructured documents.

Web service delivery will consist of retrieving hyperlink information from the filtered subset of information resources, and presenting these links as an organized collection for ingestion by online services. Examples might include plotting the resources on a map (if they are tagged as being mappable), downloading as a collection of text files (if they are a type of resource that can be converted to text), or aggregating data into a time series (e.g. measurements of a consistent temperature type, in conjunction with having a time attribute).

Project activities would include:

* Generate prototype collections of linked open marine data;
* Confirmation of interoperability of the software and products with existing information delivery frameworks;
* Addition of linked-open data functionality to an initial test set of data products (e.g. data generated through previous CERF and NERP hubs); and
* User testing with stakeholder organizations to refine interface design

*Distinguishing features*

* *Development of capability for leveraging linked open data*. Linked open data makes it possible to connect online information (documents, images data) with one another via hyperlinks that provide a formal definition of the relationship. This makes it possible to quickly identify linked items of interest, follow branching link chains, and automatically aggregate information (the relationships are machine-readable). The principal value for managers lies in being able to survey a broad range of information in a distributed manner (i.e., across multiple data sources/websites), identify the most relevant items, and synthesize them quickly and concisely into a product list.
* *Browsing and filtering general information (not just maps).* We are proposing adding linked open data functionality to a range of information (e.g. documents, regulations, topics of interest) not just spatial data. We expect that synthesizing and being able to link to a wide range of products and topics will be of value to users faced with finding general marine and coastal research on a broad range of topics and locations collected by a broad suite of agencies.
* *An interface designed specifically for non-technical users.* With the development of the user interface patterned after familiar commercial product search pages, users will be able to take advantage of the benefits of linked open data without needing to delve into the details of the process. We also intend to make a clear separation between the back-end search engine and the front-end graphic user interface, making it possible to easily set up multiple entry points if desired.
* *Leveraging proven and highly performant open-source technology (Lucene for search, Stanbol for semantic content management).* These technologies are in widespread use in large, commercial operations (e.g. Twitter, LinkedIn, Comcast) and are supported by extensive and well-developed user communities.

*Links with other projects and hubs*

This type of work has application across the spectrum of NESP research in that it improves the accessibility and delivery of information in general. The tools and techniques developed as part of this project will have immediate application for other hubs and areas of research. Within the Marine Biodiversity Hub, we can confirm collaborations with AIMS and CSIRO relating to projects D1 and D3 as a way of demonstrating the capability of the service. We explicitly state our commitment to complement the work of IMOS/AODN to improve data delivery as a whole, anticipating that the workflows and data products that we pilot-test as part of this project can be incorporated into their systems once their value has been demonstrated. We envision working closely with the Hub Data manager to ensure strong alignment with the Hub’s Data Management Strategy and broader initiatives (e.g. National Environmental Information Infrastructure, National Plan for Environmental Information Initiative). This project would also seek to directly engage with other Hubs with regards to information management and data delivery approaches.

*Related research*

The project leverages off of existing data holdings generated through previous generations of the Marine Biodiversity Hub (i.e. CERF, NERP) as well as existing data collections belonging to partner organisations (e.g. GA, AIMS, CSIRO, IMOS/AODN) by helping to improve the exposure and delivery of these resources.

**Expected Outcomes**

*Outcomes*

The project will ultimately enhance the ability of Department of the Environment officers, partner organizations and the general public (i.e. not just researchers) to find, filter and retrieve information related to Australia’s coastal and marine environments.

We intend to develop a working prototype linked open data delivery web service. The service will search general sources of marine information (e.g. documents, images, spatial and non-spatial data); synthesize information on the basis of semantic links; rank, facet and filter the information; and select subsets of the information for forwarding on to other online services.

Meeting and collaborating with stakeholder organizations will help enhance communication among government data managers, resulting in more coordinated management and delivery of Hub data across the organizations. We also intend to link with efforts such as the [Ocean Data Interoperability Platform](http://www.odip.eu) (<http://www.odip.eu/>) to facilitate synthesis of data at the international level.

*Specific management or policy outcomes*

The concrete form of this effort will ultimately be the availability of the search tool described above, as well as the further development of web services using the tool as a mechanism for delivering information streams. The user interface will be developed with non-technical users in mind, with a search flow similar to commercial websites such as eBay or Amazon’s main search page.

*Value*

This work will improve the value of existing data holdings through increased exposure and accessibility, as well as laying the foundations for IT innovation through the development of new websites, smartphone and tablet applications or [GovHack](http://www.govhack.org/about-us/) (https://www.govhack.org/about-us/) initiatives. We also foresee that the information could be used to feed information to social media applications (e.g. new data updates), or be used by citizens to identify information sources of interest/use to them. Another potential use of the tool would be for reviewing information sources for the State of the Environment and State of the Reef reports (DoE/GBRMPA). The use of the tool can be quantitatively measured through web hits, statistics and performance measures (e.g. response time) and usage patterns can be tracked by monitoring submitted search terms. Value will also be obtained by adding linked-open data functionality to selected existing data sets (e.g. existing NERP and CERF data) where feasible.

**Planned Outputs**

* Delivery of open source code to perform the search functions described above.
* A simple initial web interface for performing the search and retrieval of results.
* Expanded collections of data holdings available in linked open format, including the use of semantic mark-up to enable fully-automated data aggregation and web services. In particular, addition of linked-open data capability to a pilot collection of existing data sets (GA, CERF and NERP data sets).

**Delivery of Project**

*Project leader’s track-record*

Johnathan Kool and Brendan Brooke have both been part of GA’s efforts as part of the NERP Marine Biodiversity Hub, and were able to successfully deliver project deliverables associated with Themes 3 and 4 (National ecosystems knowledge and Regional biodiversity discovery to support marine bioregional plans). Both Kool and Brooke have interacted with stakeholders at the Department of the Environment and other partner organizations. GA is committed as an organization towards effective data and metadata management, and the project described here will further enhance our capability to deliver in this regard. Project impact will be identified through user uptake and website metrics.

*Delivery on time and within budget*

For information regarding how the project will be delivered on time and within budget, please refer to the Marine Hub Performance and Evaluation Protocols.

**Project Milestones**

|  |  |
| --- | --- |
| **Milestones** | **Due date** |
| 1. All research users and stakeholders for this project have been engaged and understand project and how it relates to their interests. | 1 April 2016 |
| 1. Conduct a workshop involving representatives from the Department of the Environment and other stakeholder partners to ‘beta’ test the product to ensure capability and value above and beyond existing data search capabilities | In advance of 1 September 2016. |
| 1. Delivery of a prototype user-tested open-source linked open data search tool to the Department of the Environment and stakeholder partners (see Research End Users and Key Stakeholders list for anticipated contacts), with the additional possibility of eventual uptake by businesses capable of leveraging linked open data sources (e.g. for app development), and the general public. For a detailed project timeline see Attachment A. | 1 January 2017 |
| 1. All project outputs and data will be made publically and freely accessible and available on the internet | 1 January 2017 |

**Researchers and Staff**

|  |  |  |
| --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE** |
| Johnathan Kool – Geoscience Australia | Project Leader/Data Scientist | 0.10 |
| Brendan Brooke – Geoscience Australia | Project Advisor | 0.05 |
| Software Developer | Software Development | 0.15 |

**Research End Users and Key Stakeholders**

|  |  |
| --- | --- |
| **Research End Users (section/programme/organization)** | **Contact Name/s (optional)** |
| Parks Australia | Nyssa Brunk, Suzie Gaynor |
| Department of the Environment | Amelia Tandy |
| ERIN | Jeffrey Tranter (meeting arranged) |
| IMOS/AODN | Tim Moltmann, Roger Proctor |
| AIMS | Scott Bainbridge, Eric Lawrey |
| CSIRO | Piers Dunstan, Tara Martin |
| GBRMPA | Leath Muller, Trevor Gilbert |
| Bureau of Meteorology | Jamie Treleaven |

Note that as part of our initial scoping work, we have already engaged in consultations with Parks Australia, the Department of the Environment, IMOS/AODN, AIMS, CSIRO, GBRMPA and the Bureau of Meteorology (meetings with remaining stakeholders are planned for later in 2015). The consensus among the stakeholders appears to be that the project is feasible, and that the project does have the capability to deliver value through an improved ability to synthesize and deliver information products in general. In particular, GBRMPA noted how the project could generate efficiencies and time savings when assembling their State of the Reef and Outlook Reports, and there was clear interest by Parks Australia officers in the ability to synthesize a broad range of information types via a simple search interface.

**Knowledge Brokering and communication**

The principal goal of the project will be to develop a working prototype of the linked open data delivery service. To this end, we will hold at least one workshop among research end users and key stakeholders to work through the design of the tool, as well as discussing aspects of the user interface design. The final product would be intended to be made available as an online service, and should be designed for intuitive use by an untrained user. Well-used similar interfaces have already been developed (e.g. Amazon, eBay) that can inform the design of the tool. Advertising the availability of the tool can take place via GA’s web page, GA’s media group, and also through NESP communication channels (e.g. fact sheets, tweets, presentations). We also intend to make any code or workflows associated with the service available as open-source (e.g. in a GitHub repository). The project will adhere to the principles and protocols outlined in the Marine Hub’s Communication Strategy.

**Data and Information Management**

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

This project is focused on improving discovery and access to data. It will make use of a range of existing data to demonstrate the benefits of the prototype data search tool. Data and information generated by this project will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub.

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website <http://www.nespmarine.edu.au>. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

The primary contact point for data and information management contact for this project is the project leader (see details in front page).

Although the project is intended to facilitate access to existing information sources, the project will be enhancing metadata with semantic markup. This information will be exposed in its entirety through the delivery tool’s web interface. We will also make any software developed as part of this project available through GitHub.

**Expenditure Summary**

Funding will primarily be used for performing prototype development. Funds will also be used for travel to perform stakeholder engagement, and to host a workshop regarding the development of the service.

**Location of Research**

Most of the software development work will take place at Geoscience Australia, however we also expect to have close collaborative ties with partner organisations such as IMOS/AODN, AIMS, and CSIRO.

**Indigenous Consultation and Engagement**

The project primarily involves delivery of existing data sources as linked open data, meaning that there will be equal opportunity to access the data across all user groups. The project will seek advice from Hub leadership regarding points of contact in order to assess the level of indigenous interest in the work. If there is significant interest from indigenous groups in participating as a stakeholder group, we will incorporate elements identified as relevant within the data collection to the extent that they are available. We will also ensure that the project remains consistent with the Hub’s Indigenous Engagement and Participation Strategy. All work undertaken as part of this project will be conducted according to ethical research standards, and will be performed in a manner that respects and acknowledges cultural and intellectual property as well as traditional knowledge.

**Inclusions**

The project will include the development of a prototype linked open data delivery service, and working up of prototype linked open data collections. We will also engage with stakeholders and partner organizations (as set out above), to align the development of the tool to complement their needs.

**Exclusions**

The tool will be developed as a prototype. Although we will design the system such that it can be upgraded and enhanced, a software system that incorporates any and all sources of marine information from both inside and outside of the Marine Biodiversity Hub is clearly outside the scope and budget of the project. While we anticipate that the tool will harvest metadata, it will not be designed to ingest raw data or data streams. The tool is also intended as a means of accessing sources of information (via their metadata), and forwarding metadata on to other services, however development of these processing services will be a subsequent project. The prototype will be for demonstration purposes, with the intent of further development if it is found to meet user needs.

**Constraints and Risks**

There is some risk relating to unavailability of developers with requisite skills, however this is mitigated by GA’s ability to hire on external contractors if required. Linked open data sets will need to be ingested into the tool, however there are a number of data elements available at GA and through the previous CERF and NERP Hubs that can be worked up to use during prototype development.

**Project Keywords**

Marine Data; Linked Open Data; Web Services; Business analytics; Information accessibility.

**Attachment A – Project Timeline**



Commencement of

proposed 2016 work

Note: timelines are indicative, and represent duration intervals, not effort (i.e. 7 days to work on a task, not 7 days of work on a task)

# 

# Project B4 – Underpinning the repair and conservation of australia’s threatened coastal habitats – phase 2

*Project length – 2 Years*

*Project start date – 01/01/2016*

*Project end date – 31/12/2017*

*Project approval date - 24/02/2016*

*Project current status - In progress*

*Project Leader – Ian McLeod (FTE – 60%) Principal Investigator and joint Project Leader*

*Lead Research Organisation – James Cook University*

*Project leader contact details: - (*[*ian.mcleod1@jcu.edu.au*](mailto:ian.mcleod1@jcu.edu.au)*, office phone 07 4781 5474, office mobile 0449 840 082)*

*Project Leader – Colin Creighton (FTE – 30%) joint Project Leader*

*Lead Research Organisation – James Cook University*

*Project leader contact details: - (colinmwnrm@bigpond.com, home office 07 4958 4775, office mobile 0418 2258 94)*

*Project Leader – Chris Gillies (FTE – 25% in-kind) Leadership Team*

*Lead Research Organisation – The Nature Conservancy Australia*

*Project leader contact details: - (chris.gillies@tnc.org, office phone 03 8346 8600, office mobile 0412 663 506)*

**Project Funding**

|  | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* | *2021* | *TOTAL* |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *NESP funding* | *$130,000* | *$195,000* | *$195,000* | *TBA* | *TBA* | *TBA* | *TBA* | *$520,000* |
| *Cash co-con* | *x* | *x* | *x* | *x* | *x* | *x* | *x* |  |
| *In-kind co-con* | *$180,000* | *$195,000* | *$195,000* | *x* | *x* | *x* | *x* | *$375,000* |
| *TOTAL* | *$310,000* | *$390,000* | *$390,000* | *x* | *x* | *x* | *x* | *$895,000* |

**Project Summary**

*100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.*

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.

**Summary of changes since previous Research Plan**

*(only for projects which are being resubmitted for approval under RPV3)*   
*Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.*

No changes to the accepted work plan except there will be a delay in the delivery of the salt marsh final report due to delays in contract signing between JCU and UTAS/NESP. This report was due to be submitted by 1 January 2017 and now will be submitted by 1 October 2017.

**Problem Statements**

*Problem*

*Description of the specific problem*

Native shellfish reefs are considered imperilled marine ecosystems within Australian coastal waters, nominally classified as “Functionally Extinct” by Beck et al. (2011) and “Collapsed” by Kirby et al. (2009). Salt marshes are listed as “Vulnerable*”* under the EPBC Act and *“*Endangered*”* under the NSW Threatened Species Conservation Act 1995. Both habitats are vital to the health of Australia’s bays and estuaries supporting high levels of marine biodiversity and providing ecosystem benefits such as fish production, improving water quality and reducing coastal erosion (Creighton et al. 2015; Gillies et al. 2015). Both shellfish reefs and salt marshes are ‘listed habitat types’ under the Ramsar Convention. Saltmarshes also act as carbon sinks and provide foraging habitat for migratory birds protected under bilateral migratory bird agreements such as CAMBA and JAMBA.

*How Research Addresses Problem*

*What solution will this research provide?*

**Shellfish reefs**

This project will address several of the *Priority Actions* (detailed in the Phase 1 report; Gilles et al. 2015), which we believe are urgently required to underpin current and future shellfish reef restoration efforts and which align with the broader research and engagement objectives of the NESP Marine Biodiversity Hub.

This project will focus on addressing *Priority Action 4*:

* Quantify the benefits and ecology of Australian shellfish reefs (including nitrogen cycling, filtration capacity, fish production, shoreline protection and biodiversity) to better understand their ecological, social and economic value.

The project will also contribute to *Priority Action’s 1 and 2:*

* Improve community knowledge and awareness of the value of shellfish reef habitats through the development of communication campaigns and materials (*Priority Action 1*);
* Increase Indigenous engagement in restoration activities by capturing and communicating Indigenous knowledge and stories and invest in programs which support the inclusion of traditional ecological knowledge in shellfish reef management and restoration (*Priority Action 2*).

We will prioritize the reef-forming shellfish complex of Sydney rock oyster (*Sacosstrea glomerata*) dominated reefs, which, of the eight known reef-forming species documented in Gillies et al. (2015), are, along with *Ostrea angasi* (native flat oyster) the most imperiled and have the highest restoration potential.

This work will directly support and underpin the management and restoration objectives of existing shellfish reef repair projects and will assist future projects and management decision-making by developing appropriate methods and setting of repair targets based on natural reference conditions.

The communication media and resources produced will, amongst other locations (e.g. NESP Marine Biodiversity website; partner websites, social media), be hosted on the shellfish reef restoration website which was developed during Phase 1 of the project (www.shellfishrestoration.org.au).

**Salt marshes**

The Phase 1 report for saltmarshes (Creighton et al. 2015) highlighted the lack of detailed understanding of the ecosystem benefits provided by Australian saltmarshes. Furthermore, the report identified that different saltmarsh communities are likely to support different types and values of ecosystem benefits (e.g. fish production, carbon sequestration and shoreline protection) and hence a ‘once size fits all’ approach to communicating the ecosystem benefits of Australian saltmarshes is not appropriate.

Phase 2 of the salt marsh project will pair up with works in NSW and GBR to quantify prawn production, in two contrasting community types (tropical and temperate). The project will also develop communication resources, which articulate these and the more detailed values of salt marshes. This will be an important contribution to the protection, conservation and repair of Australian salt marshes.

*Alignment with NESP Research Priorities*

*Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)*

* Contributes to the NESP research priority: Maximising the efficacy of managing Australia’s marine environment and in particular: *Identify and trial methods to restore degraded habitats such as oyster and mussel beds, seagrass, and intertidal habitats to underpin on-ground management actions*;
* Contributes to the NESP research priority: *Improving our understanding of the marine environment including biophysical, economic and social aspects*, and in particular: *Better understand issues that are common to the fishing industry and the environment including identifying solutions of mutual benefit and: Meaningful and accessible information on the status and trends of key social and economic values associated with the marine environment*;
* The project will also develop a number of educational resources accessible to public and seek contributions to the research from indigenous groups, such as the location and/or historic locations of past shellfish middens, the need for management of culturally significant sites and how best to re-establish indigenous customary food resources.

**Research**

*Description of research*

*Detailed description of research being conducted, including description of methods*

**Shellfish**

Shellfish reef ecosystems were historically overfished to near extinction and their natural recovery is inhibited by a loss of suitable substrate and recruitment. Active repair is therefore required and efforts have begun with the promise of significant benefits. These projects (and future efforts), however, require a detailed understanding of the ecology and benefits to develop appropriate repair methods and to set targets based on natural reference conditions.

Research will focus on Sydney rock oysters (*Sacosstrea glomerata*) as it has been identified as a promising species for successful restoration efforts, repair works are about to start in both NSW and southeast Queensland and we have been successful in gaining support to underpin repair efforts for more temperate reefs such as *Ostrea angasi,* Vic, SA and WA.

In 2017 we will bring together lessons learnt in all repair efforts to develop a national business case.

In addressing *Priority Action* *4* listed in the Phase 1 report (Gillies et al. 2015) of *Quantify the ecosystem benefits and ecology of Australian shellfish reefs (including nitrogen cycling, filtration capacity, fish production, shoreline protection and biodiversity) to better understand their ecological, social and economic value* this component of the project has three key objectives:

* Describe the extent, morphology and size class of natural *Sacosstrea glomerata* reefs in order to develop nationally relevant methods for the construction and deployment of new shellfish reefs;
* Quantify the biodiversity (fish, invertebrates, algae and meiofauna) inhabiting *Sacosstrea glomerata* reefsto determine their biodiversity value and to develop targets for current and future works projects;
* Conduct preliminary investigations to quantify the benefits (supporting secondary productivity, providing habitat for fish and their food, water filtration and nitrogen cycling) of natural *Sacosstrea glomerata* reefs to inform appropriate sampling design for the next stage of research (to quantify the ecological, social and economic benefits of shellfish reefs).

Known locations for *Sacosstrea glomerata* dominated reefs (Qld, NSW) will be surveyed and described using a combination of sampling methods including: size class measurements, and biodiversity assessments using a combination of quadrat, transect and core sampling protocols. The ecology and benefits of shellfish reefs will be compared to other coastal marine habitats (e.g. rocky reef, seagrass meadows) to assess their ecological function, benefits and unique biodiversity attributes. These results will be compared amongst the broader marine seascape as a means to better support coastal management and conservation decision-making.

As well as addressing *Priority Action* *4*, Phase 2 will also include an Indigenous community engagement component in support of *Priority Action* *2* - *Increase Indigenous engagement in restoration activities by capturing and communicating Indigenous knowledge and stories* and will continue to build publically accessible and open source communication resources - *Priority Action* *1*: *Improve community knowledge and awareness of the value of shellfish reef habitat through the development of communication campaigns and materials*.

The Indigenous engagement component of the project has two key objectives:

* Increase engagement of Indigenous Australians in shellfish reef restoration by capturing cultural stories and Traditional Ecological Knowledge (TEK) of shellfish reef use and restoration to strengthen relationships and build trust amongst restoration practitioners and local Indigenous groups;
* Communicate the cultural significance of shellfish reefs to the broader Australian public by promoting stories and TEK through videos, webpages, brochures, social media and media releases.

The project will be led by our most active Indigenous group and at least, will extend to all the Indigenous groups that were involved in the Phase I work.

**Salt marsh**

Australia’s coastal salt marshes comprise a variety of habitats ranging from samphire flats, through salt couch to mangroves. Salt marsh habitats are vital to biodiversity and fisheries. As well as providing essential habitats for significant marine biodiversity, they play critical roles in supporting healthy estuarine and nearshore ecosystems and coastal fisheries. This support involves both their vital role of integrating terrestrial nutriments into coastal food webs and the provision of essential nursery grounds for a wide range of species, including many of high fisheries value.

The project provides primary research to address two vital inter-related objectives:

* Collect data on prawn and fish productivity in estuaries and relate that to the size, type, extent and condition of associated salt marshes / seascapes;
* Assess the economic and environmental costs and benefits of repair by actively working with proposed repair activities, especially those in around the GBR.

These are critical to ensure effective rehabilitation of salt marshes and associated wetlands. All are dependent on objective 1 which represents a critical gap in our knowledge (Creighton et al. 2015) that prevents definitive understanding of the specific values that repair can bring, identification of optimal sites for repair, and understanding of the best and most effective approaches to repair.

The project will be based in GBR catchments where repair works to seascapes are planned to start in 2016-17 (e.g. $4M Aus. Govt. – Greening Australia partnership) and on the Clarence, which is the largest school prawn fishery in NSW. These two subtropical and tropical study areas should enable the establishment of a widely applicable model of prawn and fish productivity and its relationship to the size, type, extent and condition of associated salt marshes.

These areas have been selected because there is already a substantial database that can underpin directed studies. The available knowledge will be collected and assessed to determine the specific research needed to acquire the required knowledge and appropriate research sites. Following on from this, studies to expand and refine the existing knowledge will be conducted in replicate estuaries or sub-estuary components with different levels of wetland extent, type and condition. This will provide a series of estimates of productivity and its relationship to wetland characteristics that will allow the development of models that can provide valid estimates of the relationship between wetland productivity and prawn and fish productivity. These models will provide the basic information needed to underpin subsequent restoration and repair work, and stand as base models that can be adapted and tested for other areas.

*Links with other projects and hubs*

*Links to other projects and hubs including collaboration and potential overlap*

* Project C3 - GA/UTAS to use the last 20+ years of satellite data to identify changes in the coastal environment;
* Project C2 - UTAS/CDU/CSIRO - to identify the changes in biological communities downstream of major population centres (Sydney, Melbourne, Hobart);
* Projects C1, C4 and C5 – these three projects will all provide excellent links, especially as this project details the water quality and quantity conditions amenable to shellfish reef repair. Links to salt marsh environments, especially tidal water quality also apply.

*Related research*

*Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?*

* Refer to Phase 1 reports for shellfish (Gillies et al. 2015) and salt marshes (Creighton et al. 2015).

**Expected Outcomes**

*Description of expected outcomes, including what practical and tangible outcome/s the project will deliver*

* Nationally - Information towards the development of a national recovery plan. Identification and description of reference sites to underpin best practice restoration;
* State and Regionally - Natural Resource Management Agencies, Catchment Management Authorities, state government environmental and resource management agencies become aware of loss of shellfish reefs and their ecosystem benefits and convinced of benefits of restoration;
* Local groups - increase financial and resource support for shellfish reef and salt marsh repair and conservation;
* Indigenous groups - these groups have the information to link remaining historic shellfish middens to the condition of the current nearby shellfish resource - an important basis to understand ecological change and important information upon which to advocate recovery of the resource;
* Science investment - to determine further research priorities in terms of marine repair and habitat ecosystem services;
* Coastal managers and managers of repair programs - to improve communication on the value of shellfish reefs and salt marshes in terms of their ecological services (e.g. productivity for prawn and fish species, water filtration, coastal protection) and economic value which in turn will increase community support for coastal repair projects;
* Marine private sector stakeholders - information on value upon which to increase support for and investment in repair activities.

*Specific management or policy outcomes*

*Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.*

This investment will provide base information required to inform and scope large-scale repair investment opportunities for Australia’s most threatened coastal marine habitats. Equally importantly, it will be paralleled by investments in hands-on repair in a number of small to medium scale projects.

Estuary habitat repair is a developing area of community interest, especially in those states with recreational fishing license fees, as habitat improvements generally rank at the top of the investment priorities of recreational fishing communities. Importantly, ‘habitat’ is also the common ground between the recreational and commercial fishing sectors and environmental groups.

The practical outcomes this project will deliver include:

* Improved understanding of the location, ecology and functional role of shellfish reefs and salt marshes and their role in supporting the ecological health and productivity of estuaries (documented in journal papers and in media);
* Documented, synthesized current and past national distributions for shellfish reefs, nearby middens and thereby providing a link for Indigenous groups between history and current resource condition and availability;
* Summary evidence of the productivity and economic benefits that are expected to be generated with repair (shellfish and salt marsh);
* Framework for data collection, analysis and reporting to accompany/evaluate any repair investment and best-practice restoration;
* Provide an easily understandable demonstration of the benefits of salt marshes and their repair to the community (prawn productivity).

*Value*

*What value does the project demonstrate for the environment and how can this be measured?*

The long-term outcomes of this work will ultimately be measurable in the number, size and success of shellfish and salt marsh repair works proposed or undertaken by state agencies, NRM agencies, research institutes, Indigenous groups and other community groups such as recreational fishing. The hectares restored and projected productivity improvements will provide evidence of the value of the investment.

**Planned Outputs**

*List planned outputs from the project, including data and information outputs and communication and promotional material.*

*Shellfish*

* A scientific paper published in an eminent, peer-reviewed journal describing the ecology and biodiversity of shellfish reefs and biodiversity comparison against other marine habitats;
* A scientific paper published in an eminent, peer-reviewed journal which identifies trajectories of change from past baselines to current condition and develops achievable targets for repair;
* News stories, web articles, social media, brochures and oral presentations at national/international conferences, which communicate the key research findings to coastal stakeholders such as fishers, divers, NRM groups and government agencies;
* News stories, web articles and social media which communicate the importance of shellfish reefs and shellfish food sources to Indigenous Australians;
* Summary of community benefit and business propositions for coastal wetland repair expanding on the vision of a rejuvenated coastal ecology and written at the level required for input to various investors, agencies and public policy;
* Updates at the end of 2016 as part of stakeholder engagement and continued communication.

*Salt marsh*

* A scientific paper published in an eminent, peer-reviewed journal quantifying and contrasting prawn productivity in healthy and degraded salt marsh communities in tropical and temperate environments;
* Publically accessible communication resources (brochures, social media, media releases and webpages), which articulate simply the prawn productivity values of salt marshes and links this to the need for the protection, conservation and restoration of degraded salt marsh communities.

**Project Milestones**

*A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)*

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Confirmation of project partners/ scope of research works and key dates for delivery | Due 1 Jan 2016 | Complete |
| Final report for salt marsh component and mid-project update for shellfish reefs | Due 1 Jan 2017 | Salt marsh final report is unlikely to deliver on due date (this report will now be delivered in October 2017). A mid-project update will be included for shellfish and salt marsh in the December progress report |
| Conduct workshop to integrate expert option into the draft business case for salt marsh restoration at the Australian Mangrove and Saltmarsh Network meeting in Tasmania | 24 March 2017 | On track |
| Conduct workshop to elicit expert opinion into prioritisation of coastal restoration activities in the Great Barrier Reef catchment at the Australian Coastal Restoration Symposium in Townsville | 30 April 2017 | On track |
| Distribute draft shellfish restoration business case to Australian Shellfish Reef Restoration Network members for expert advice | 01 August 2017 | On track |
| Distribute draft salt marsh restoration business case to experts and end users identified at the 24 March workshop members for expert advice | 01 August 2017 | On track |
| Integrate advice into salt marsh restoration business case | 30 September 2017 | On track |
| Integrate advice into shellfish restoration business case | 30 September 2017 | On track |
| Deliver the shellfish and salt marsh restoration business case to NESP management for review | 30 October 2017 | On track |
| Final publications and reports for shellfish together with a summary business proposition for major investment in coastal repair – shellfish reefs and salt marsh and draft science papers | Due 1 Jan 2018 | On track to deliver on due date (in research plan) |
| All project outputs and data will be made publically and freely accessible and available on the internet | Due 1 Jan 2018 | On track to deliver on due date (in research plan) |

**Researchers and Staff** (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| Ian McLeod | JCU | Principal Investigator/ Joint Project Leader |
| Colin Creighton | JCU | Joint Project Leader |
| Chris Gillies | TNC | Leadership team |
| Marcus Sheaves | JCU | Researcher leader for salt marshes in QLD |
| Matthew Taylor | NSW DPI | Researcher leader for salt marshes in NSW |
| Vishnu Vahalad | UTAS | Researcher leader for salt marshes in Tasmania |
| Ben Diggles | DigsFish Services | Research associate for shellfish |
|  |  |  |
|  |  |  |
|  |  |  |

**Co-contributors** – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
| Joe Smith | Foundation for X | e.g. Cash, Undertake X management activity on which research will be based |
|  |  |  |

**Research End Users and Key Stakeholders –** Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. *The Department may contact identified end users to discuss the project.*

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| DoEE/ Threatened Species | Melina Rafic |  |
| DoEE/ Climate Change | Zoe Sinclair |  |
| DoEE/ Marine Policy | Gavin Hinten |  |
| Greening Australia | Ross Andrewartha |  |
| Healthy Waterways and Catchments | Joel Bolzenius |  |
| NSW DPI | Kylie Russel |  |
| TNC | James Fitzsimons |  |
| OceanWatch | Andrew Myers |  |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| Conservation groups |  |  |
| Fishers / resource users – commercial, recreational and Indigenous |  |  |
| Nature appreciation groups |  |  |
| Marine ecologists/ Multiple – universities, CSIRO, State agencies |  |  |
| Marine and estuary managers and policy groups (including fisheries agencies)/ All jurisdictions, State, GBRMPA |  |  |
| National Estuary Network |  |  |
| NRM, Indigenous and other community groups such as recreational fishing focussing on repair of coastal ecosystems |  |  |

**Knowledge Brokering and communication**

*Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.*

For both salt marshes and shellfish reefs, all information derived will be widely communicated as part of the processes to foster investment in protection and repair. Knowledge brokering, exchange and communication is built into the project design as follows:

* participation of key management agencies;
* interface to policy groups in management agencies;
* broader science engagement (multiple research groups engaged);
* action groups, especially investment in repair and protection;
* interest groups and community investors (e.g. private sector, fishing groups);
* Indigenous groups;
* broader community awareness (social media, media releases, websites).

The Hub’s Knowledge Brokering and Communication Strategy will assist the communication and engagement objectives of this project and Hub Communication Protocols will be applied within the context of this project.

**Data and Information Management**

*Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.*

*Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.*

*Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.*

*Name:*

*Email Address:*

*Phone Number:*

*Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.*

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

Data to be delivered by this project will include:

* Spatial data layers showing past and current distribution of shellfish reefs.

Data and information will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. Distribution datasets will be stored in a long-term secure storage and made freely available through the internet via James Cook University’s Tropical Data Hub.

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website http://www.nespmarine.edu.au. These outputs will also made publically available through the website [www.shellfishrestoration.org.au](http://www.shellfishrestoration.org.au).

The project will adhere to the NESP requirement that all journal publications be made publicly and freely available within 12 months of publication. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

The Department of the Environment and Energy will be informed by email to marinemetadata@environment.gov.au each time a dataset is published and provided with a link to the full dataset.

Contact person

Name: Dr Ian McLeod

Email Address: [ian.mcleod1@jcu.edu.au](mailto:ian.mcleod1@jcu.edu.au)

Phone Number: 07 4781 5474

**Expenditure Summary**

*A brief statement describing how project funding will be used (e.g. staffing, events, products).*

The project will entail:

* Shellfish reefs, including $40,000 specifically allocated for Indigenous - $300,000 over 2016 and 2017;
* Salt marshes - $90,000 over 2016 and 2017.

**Location of Research**

*Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.*

*Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.*

Australia’s developed east coasts – NSW through to and including the Great Barrier Reef.

**Indigenous Consultation and Engagement**

*A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.*

This is covered in detail in the project plan – Indigenous involvement and outcomes are an integral part of the project and its implementation.

The project team will also ensure all activities are consistent with the Hub’s Indigenous Engagement and Participation Strategy.

**Inclusions (in scope)**

For shellfish reefs:

* Temperate to tropical Australia and GBR lagoon, generally within estuary, embayment or sheltered waters.

For salt marshes:

* Subtropical and tropical areas within estuary, embayment or sheltered waters.

**Exclusions (out of scope)**

Actual on-ground repair works – this project provides research that underpins works.

**Risks**

*List all significant risks to the success of the project*

*Risk:* Co-investigators fail to provide resources in timely fashion.

*Mitigation:* All co-investigators engaged early in process with project timeline outlined in initial workshops. Regular telephone and email meetings convened to ensure everyone is on track.

*Risk*: Stakeholders not engaged/aware of final outcome or research results.

*Mitigation*: Co-investigators consult early to engage their agency communication departments. Media alerts produced and shared amongst all co-investigator communication departments. James Cook University’s communication team will coordinate media releases on behalf of co-investigator agencies.

*Risk:* Meaningful Indigenous engagement does not happen throughout all locations of the project.

*Mitigation:* By including non-confidential information on current and prior middens in the assessment the team will have an excellent practical base to explore partnership opportunities with Indigenous groups. Secondly, by working through Gubbi as the lead Indigenous group for the project we expect strong Indigenous support to continue.

**Project Keywords**

Shellfish Reefs; Restoration Ecology; Ecosystem Repair; Salt Marsh; Prawns; Net Primary Productivity

**References**

Alleway, H. and Sean D. Connell, S. (2015) Loss of an ecological baseline through the eradication of oyster reefs from coastal ecosystems and human memory. Conservation Biology. DOI: 10.1111/cobi.12452

Baggett LP, Powers SP, Brumbaugh R, Coen LD, DeAngelis B, Greene J, Hancock B, Morlock S. (2014). Oyster habitat restoration monitoring and assessment handbook. The Nature Conservancy, Arlington, VA

Beattie, K. (2001). Oyster culture in Queensland. Queensland Department of Primary Industries. Information Series. ISSN 0727-6273. 28pp

Beck MW, Brumaugh RD, Airoldi L, Carranza A, Coen LD, Crawford C, Defeo O, Edgar GJ, Hancock B, Kay MC, Lenihan HS, Luckenbach MW, Toropova CL, Zhang G and Guo X (2011) Oyster Reefs at Risk and Recommendations for Conservation, Restoration, and Management. Bioscience 61: 107-116

Chavez, F.P. Messié M., and Pennington J.T (2011) Marine Primary Production in Relation to Climate Variability and Change. Annual Review of Marine Science 3: 227-260

Creighton, C (1984) Keppel Islands Environmental Survey – a baseline for archaeological reconstruction, the Woppaburra and their food resources and for resource management. Archaeology Branch, Dept. of Community Services Brisbane and Australian Heritage Commission

Creighton, C (2013) Revitalizing Australia’s Estuaries. FRDC Report 2012-036 http://frdc.com.au/research/Documents/2012-036-Business-Case.pdf

Creighton, C., Boon, P., Brookes, J., and Sheaves, M (2015) Repairing Australia’s estuaries for improved fisheries production: What benefits, at what cost? Journal of Marine and Freshwater Research 66: 493-507

Creighton, C Gillies C, McLeod IM (In Review). Saltmarsh habitats: A synopsis to underpin the repair and conservation of Australia’s environmentally, socially and economically important bays and estuaries. TropWATER Report 15/59 for the NESP Biodiversity Hub.

Diggles BK (2013) Historical epidemiology indicates water quality decline drives loss of oyster (*Saccostrea glomerata*) reefs in Moreton Bay. Australia New Zealand Journal of Marine & Freshwater Research, 2013.

Gillies C, Creighton C, McLeod IM (In Review). Shellfish reef habitats: A synopsis to underpin the repair and conservation of Australia’s environmentally, socially and economically important bays and estuaries. TropWATER Report 15/60 for the NESP Biodiversity Hub

Great Barrier Reef NRM groups (2015) Investment Plan – responding to the Long Term Sustainability Plan 2050 <http://www.rgc.org.au/wp-content/uploads/2015/01/Investment-Plan-NRM-proposal-190115.pdf>.

Hamer, P., Pearce, B., Winstanley, R. (2013) Towards reconstruction of the lost shellfish reefs of Port Phillip Bay. Recreational Fishing Grants Program Research Report. Project SG/117. 35pp

Howarth, R.W, (1988) Nutrient Limitation of Net Primary Production in Marine Ecosystems Annual Review of Ecology and Systematics Vol. 19: 89-110

Nell, J.A. (2001). The history of oyster farming in Australia. Marine Fisheries Review. 63: 14-25

Huston, MA and Wolverton S (2009) The global distribution of net primary productivity: resolving the paradox Ecological Monographs 79(3) pp 343-377

Schrack, E., Beck, M., Brumbaugh, R., Crisley, K. and Hancock, B. (2012). Restoration works: Highlights from a decade of partnership between The Nature Conservancy and the National Oceanic and Atmospheric Administration’s Restoration Center. The Nature Conservancy, Arlington, VA, USA

# Project C1 – Improving our understanding of pressures on the marine environment

Project length – 30Months

Project start date – 01/07/2015

Project end date – 31/12/2017

Project approval date - xx/xx/xxxx (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - In progress

Project Leader – Piers Dunstan (FTE – 25%)

Lead Research Organisation – CSIRO Oceans and Atmosphere

Project leader contact details: - [Piers.Dunstan@csiro.au](mailto:Piers.Dunstan@csiro.au); 03-6232 5382

### Project Funding

|  | 2015 | 2016 | 2017 | 2018 | TOTAL |
| --- | --- | --- | --- | --- | --- |
| NESP funding | 65,000 | 215,125 | 271,153 | x | 551,278 |
| Cash co-con | x | X | x | x |  |
| In-kind co-con | 65,000 | 215,125 | 271,153 | x | 551,278 |
| TOTAL | 130,000 | 430,250 | 542,306 | x | 1,102,556 |

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

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.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

* Russell Gorddard, Mike Dunlop and Judy Upston added to project staff at no additional cost.
* Reallocation of UWA staff to CDU and NSW DPI
* Addition of milestone on integration of commonwealth and NSW pressure data
* Addition of milestone on aggregation of pressure data on Northern Australia – link to project A12
* Changes in staff overall have led to a slight increase in budget but this is accounted for by an expansion of effort to coastal waters, especially in Northern Australia.

### Problem Statements

#### Problem

Description of the specific problem

Under the marine bioregional plans, pressure analyses were undertaken for four of the six marine regions. These pressure analyses provide a high level signal to proponents and decision-makers as to the likelihood of significant impact of proposed activities. The analyses also provide some sense of possible cumulative impact arising from multiple pressures (of concern, or of potential concern) operating on the values.

While the MBP high level analyses is an important advance, a more spatially refined (within, rather than across marine regions) understanding of pressures (and their likely contribution to significant impact) would be useful for decision-making by both DoE, Parks Australia and other regulators (such as NOPSEMA and AFMA).

In addition, the analyses do not inform prioritisation of action to support recovery or conservation of values. For instance, light pollution is a pressure of concern for turtles in the NW Marine Region, but so too is marine debris, physical habitat modification, human presence at sensitive sites and invasive species. The MBP analysis does not provide insight into which of those pressures may be the most appropriate to target in setting of conditions, in recovery actions, in spatial planning and other possible interventions. Prioritisation based on relative contribution that pressures make to values, will inform the project’s proposed investigation of relative and cumulative impact and proposed development of a risk assessment framework to help prioritise interventions. Estimating risk will also include attribution of the relative impacts and risk from multiple different pressures where appropriate. The project will work with DoE and Parks Australia to identify options for risk assessment at an ecosystem level, consistent with processes outlined in strategic assessment.

Another issue is that of inconsistency between pressure assessments published in the 2012 MBPs and the 2011 SOE Report. A methodology that can serve possible annual reporting under SOE and which can also inform a potential review of MBPs is required.

#### How Research Addresses Problem

What solution will this research provide?

The project will support both federal and state authorities to access information on the distribution and intensity of pressures on the marine environment and their impacts on MNES and state values.

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

The project will feed into the NESP Marine Biodiversity Research priorities:

* Identify past and current pressures on the marine environment, and understand their impact to better target policy and management actions.
* Determine the causes of, and relationships between, pressures on the marine and coastal environment to inform government investment.
* Improve prediction of likely future pressures and their potential impacts on marine and coastal biodiversity and economic and social values to enable the mitigation of avoidable impacts.

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

Work Post 1 January 2016 after consultation with DoE

* The project will continue the aggregation of pressure data and expand the scope to include all waters in the Australian EEZ (state and commonwealth). The project will identify what the spatial distribution mapping of pressures can add to the analyses of pressures already achieved under the MBP process and the SOE2011 process. We will produce summaries of pressure data to better inform the outputs of SOE and to inform CMAR management. The project will continue to collate pressure data for the life of the project to ensure that up to date information on the state and trend of pressures is available. Trends in the changes in pressures over the next decade will be explored and explore how impact might change over that timescale. The project will coordinate with Project B4 (Underpinning the repair and conservation of Australia’s threatened coastal-marine habitats) and Project C2 (Continental-scale tracking of threats to shallow Australian reef ecosystems) to include coastal pressures in this analysis and will include summaries of available data for marine debris.
* The project will assist the department with a re-evaluation of the pressure assessments published in the 2012 Marine Bioregional Plans and will provide pressure profiles for the CMRs, KEFs, BIAs, and Marine Bioregions. Summaries of pressure profiles, historical footprints and projected future trends will be delivered for the Commonwealth Marine Area, with additional summaries for CMRs, KEFs, BIAs, & Marine Bioregions. These summaries will be delivered through web services that can be incorporated into DoE web tools (in collaboration with ERIN).
* The project will work with CDU to collate pressure data for northern Australia to support from A12
* Given that the department and other regulators need to make decisions with varying levels of confidence in the information base (both in terms of certainty around values, and certainty about presence and impact of pressures), we will investigate a framework (based on risk) to manage that uncertainty. We will provide DoE with case studies on how the framework can be applied in different decision-making requirements. The project will coordinate activities and approaches with Project A2 (Quantification of national ship strike risk) and cumulative risk projects in the Tropical Water Quality Hub to ensure that species and ecosystem based approaches are complementary.
* The project will provide key capability home for qualitative modelling for other Marine Biodiversity Hub Projects. The support for qualitative modelling will be used by projects C1, C2, D1, D2 and D3.
* The project will also investigate the role of changing socio-economic valuing of conservation values to the concept of acceptable impact, or acceptable risk of impact. The project will consult with the DoE to determine the appropriate methodologies, and build on work already completed through NERP with UWA. Specifically, the project will identify:
  + Is there a link between the value (intrinsic or extrinsic) of biodiversity components (such as conservation values & MNES) & the pressures that are acting on them?
  + If there is what happens to the ascribed value when the pressures change? Further, can the value of biodiversity change?
  + Are there thresholds and trigger points in the interactions between values and pressures such that management of interactions becomes increasingly important? Does this link to “social licence to operate”?
  + Do values change the response to significant impacts? Are some biodiversity components valued so highly that they should ideally remain below significant impact whereas others are valued so little that they can exceed significant impacts?

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

* The project will provide key capability home for qualitative modelling for other Marine Biodiversity Hub Projects. The support for qualitative modelling will be used by projects C1, C2, D1, D2 and D3
* The project will collaborate with an Earth Systems and Climate Change hub on interannual to decadal climate variability. It will integrate data on pressures coming from other Marine Biodiversity Hub projects (eg C2, B4).
* The pressure theme held a theme level workshop in April 2016. At this meeting a number of collaborative outputs were identified.
* Projects C1, C5 & C2 agreed to collaborate on the development of shipping maps (data processing/information), on the quantification and mapping of Small boat activities, both from outboards and other vessels that are not covered by AIS, and to work together on a platform for Ship strike risk and noise maps.
* Projects C1, C4 & C2 also agree to collaborate on an analysis and delivery of coastal pressures and outfalls into DoE.
* The project will work with NSW DPIWE to include all the information collected through the NSW risk assessment process.
* The project will support project A12 through the collection of pressure data for northern Australia with CDU to focus effort on the North and NW to obtain state based and coastal data sets.
* Data from the project has been included in the NW-Atlas and used by UWA in the analysis of biodiversity patterns.

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

* The project will involve a re-examination of the pressure analyses undertaken through the marine bioregional planning program and the 2011 SOE Report (marine chapter) and determine where pressure mapping can be improved to enhance those analyses (for instance for those pressures for which data deficiency was identified). It will also examine the strengths and weaknesses of the different pressure assessment methodologies used by both the MBP process and the SOE 2011 process and propose a methodology that can support both initiatives into the future. The project will provide pressures profiles for CMRs and will assist Parks Australia in understanding how pressures interact with the values they identify in CMRs.
* The project will also consider relative impact, and how spatial mapping can assist in understanding both relative and cumulative impact. As an adjunct to the cumulative impact investigation, the project will also investigate how changes in socio-economic valuing of conservation values may influence the degree of investment in understanding and management of cumulative impact. This particular work will further the risk-based approach to cumulative impact that was investigated under the NERP Hub.

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

* DoE will have an improved understanding of the current state of pressures and historical trends in the data for the Australian EEZ. The project will deliver summaries for all KEFs and all CMRs.
* The project will assist the Department in addressing the Strategies outlined in the Marine Bioregional Plans; in particular
  + Strategy B (Establish and manage a Commonwealth marine reserve network … as part of a national representative system of marine protected areas
  + Strategy C (Provide relevant, accessible and evidence-based information to support decision-making with respect to development proposals that come under the jurisdiction of the EPBC Act)
  + Strategy D (Increase collaboration with relevant industries to improve understanding of the Impacts of anthropogenic disturbance and address the cumulative effects on the region’s key ecological features and protected species) and
  + Strategy F(Improve monitoring, evaluation and reporting on ecosystem health in the marine environment)

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

* DoE will have a methodology for pressure assessment that serves both SOE and MBP reporting and can assist in informing CMR management.
* DoE will have improved understanding of the relationship between pressures and impacts, including cumulative impacts, particularly in the inshore area.
* DoE will have improved understanding of the links between socio-economic values and pressures and impacts.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

* The project will continue the aggregation of pressure data and expand the scope to include all waters in the Australian EEZ (state and commonwealth). The project will identify what the spatial distribution mapping of pressures can add to the analyses of pressures already achieved under the MBP process and the SOE2011 process. We will produce summaries of pressure data to better inform the outputs of SOE and to inform CMAR management. The project will continue to collate pressure data for the life of the project to ensure that up to date information on the state and trend of pressures is available. Trends in the changes in pressures over the next decade will be explored and explore how impact might change over that timescale. The project will coordinate with Project B4 (Underpinning the repair and conservation of Australia’s threatened coastal-marine habitats) and Project C2 (Continental-scale tracking of threats to shallow Australian reef ecosystems) to include coastal pressures in this analysis and will include summaries of available data for marine debris.
* The project will assist the department with a re-evaluation of the pressure assessments published in the 2012 Marine Bioregional Plans and will provide pressure profiles for the CMRs, KEFs, BIAs, and Marine Bioregions. Summaries of pressure profiles, historical footprints and projected future trends will be delivered for the Commonwealth Marine Area, with additional summaries for CMRs, KEFs, BIAs, & Marine Bioregions. These summaries will be delivered through web services that can be incorporated into DoE web tools (in collaboration with ERIN).

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

* Produce description of summary of changes and trends in pressures on the commonwealth marine environment in the offshore marine environment from 1991 to 2010.
* Production of inshore and offshore pressure summaries to inform SOE reporting (2011-2015).
* Produce description of trends in pressures acting on the commonwealth marine environment (onshore & offshore) between 1991 & 2015, with refined summaries for all KEFs and CMRs.
* Distribute pressure data and pressure data summaries through NPEI compliant data infrastructure.
* Produce analysis and description of the likely future states (for example, climate (interannual and decadal), shipping, modification of fisheries activity, coastal eutrophication).
* Re-evaluation of the pressure assessments published in the 2012 Marine Bioregional Plans, ensuring consistency of output, updating the profiles for all KEFs.
* Report on the changing socio-economic valuing of conservation values to the concept of acceptable impact, or acceptable risk of impact.
* Report on a risk based framework to manage the uncertainty information bases for different decision making requirements with example case.

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1: Summary of changes and trends in pressures the offshore commonwealth marine environment from 1991 to 2015, delivered to Marine Policy section and Parks Australia. | Due 1 January 2016 | complete |
| Milestone 2: Delivery of Summary of changes and trends in pressures the offshore commonwealth marine environment from 1991 to 2015 delivered to SoE to meet SoE 2016 delivery. Data Sets and maps will be delivered through web services, delivered in collaboration with ERIN | Due 1 March 2016 | complete |
| Milestone 3: All research users and stakeholders have been engaged and understand the project and opportunities for further engagement | Due 1 April 2016 | complete |
| Milestone 4: Re-evaluation of the pressure assessments published in the 2012 Marine Bioregional Plans delivered to Marine Policy section and SOE | Due 1 June 2017 |  |
| Milestone 5: Initial report on progress on links between conservation, socio economic values and pressures delivered to Marine Policy section | Due 1 June 2017 |  |
| Milestone 6: Summary of changes to natural and anthropogenic pressures acting on the marine environment (onshore & offshore) between 1991 & 2015, delivered to Marine Policy section and Parks Australia. | Due 1 June 2017 |  |
| Milestone 7: Summary of changes in pressures 2016 to the Commonwealth Marine Environment (including CMRs, KEFs & BIAs) | Due 1 June 2017 |  |
| Milestone 8: Report on assessment of likely future states (for example, climate (interannual and decadal), shipping, modification of fisheries activity, coastal eutrophication) based on scenario development from projected sectoral changes, delivered to Marine Policy section and Parks Australia | Due 1 June 2018 |  |
| Milestone 9: Summary of all data sets developed by project delivered to ERIN & location where they can be accessed using web services. | Due 1 June 2018 |  |
| Milestone 10: Report on assessment of response of values (social, economic and ecological) to changing pressures to the Commonwealth Marine Environment (including CMRs, KEFs & BIAs), delivered to Marine Policy section | Due 1 June 2018 |  |
| Milestone 11: Summary of changes in pressures 2017 to the Commonwealth Marine Environment (including CMRs, KEFs & BIAs) | Due 1 June 2018 |  |
| Milestone 12: Collation and distribution of pressure data for Northern Australia, with particular emphasis on NT | Due 1 June 2018 |  |
| Milestone 13: Integration of Commonwealth data on pressures with data collected to inform NSW risk assessment process. | Due 1 June 2018 |  |
| Milestone 13: Report on a risk based framework for the impacts of pressures to manage the uncertainty information bases for different decision making requirements with example case, delivered to Marine Policy section | Due 1 January 2019 |  |
| Milestone 14: Report on the role of changing socio-economic valuing of conservation values to the concept of acceptable impact, or acceptable risk of impact, delivered to Marine Policy section | Due 1 January 2019 |  |
| Milestone 15: All project outputs and data to be made accessible to the public | Due 1 January 2019 |  |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| Jeff Dambacher | CSIRO | Qualitative models |
| Piers Dunstan | CSIRO | Project leader |
| Michael Fuller | CSIRO | Data management and analysis |
| Judy Upston | CSIRO | Data collation and summaries |
| Russell Gorddard, Mike Dunlop | CSIRO | Linking Pressures and Values (socio-economic researcher) |
| TBA | CDU | Assessment of pressure in Northern Australia – linking to A12 ($20K) |
| TBA | NSW DPI | Integration of Commonwealth and NSW pressure assessments ($30K) |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
|  | CSIRO | Co-investment |
|  | CDU | Co-investment |
|  | NSW DPI | Co-investment |

Research End Users and Key Stakeholders **–**

Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| Parks Australia/DoE | Amanda Parr |  |
| Domestic and International Policy/DoE | Jillian Grayson |  |
| EACD/DoE | Mat Whitting |  |
| SoE/DoE | Boon Lim |  |
| ERIN | , Carolyn Armstrong |  |
| Biodiversity Conservation Division – Reef Trust | Kevin Gale  Ingrid Cripps | [Kevin.Gale@environment.gov.au](mailto:Kevin.Gale@environment.gov.au)  [Ingrid.Cripps@environment.gov.au](mailto:Ingrid.Cripps@environment.gov.au) |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| NOPSEMA | Christine Lamont/Cameron Sim |  |
| AMSA | Matt Johnstone, Paul Irving |  |
| AFMA | Beth Gibson, Sally McCathy |  |
| APPEA | Libby Howitt |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

The approach to engaging research end-users and stakeholders will be consistent with the Hub’s Knowledge Brokering and Communication Strategy. The following will be implemented to ensure an effective pathway to project impact:

* Research end users and key stakeholders will be involved in the development of the project & a contact schedule developed and maintained to ensure ongoing communication.
* Ongoing engagement will be maintained with DoEE through regular meetings, in particular to develop and refine fit-for purpose project deliverables. Opportunities will be taken to expand the access to outputs with other groups such as the SE SMR stakeholder forum, NOPSEMA, the Oil and Gas industry (APPEA), state fishery and conservation agencies and commercial and recreational fishing groups.Summaries of scientific outputs will be made available as both written documents and as digital downloads to ensure easy access. Where possible existing engagement mechanisms will be used. Multi-stakeholder workshops and presentations will also be used to generate a shared understanding about access to project outputs and interactions between pressures.
* All data outputs will be stored on NPEI compliant servers and accessible through AODN and specialised web services on the NESP Hub website.
* The project will engage with end-users and stakeholders at appropriate periodic intervals to ensure projects outputs and outcomes continue to align with the NESP priorities and the needs of other potential research users. The project will use the Hubs Data Management Framework to ensure timely and easy access to research datasets, outputs and synthesis and ensure that any publications receive the necessary approvals.

Knowledge brokering and communication contact

Piers Dunstan

Ph: 03 6232 5382

Email: Piers.Dunstan@csiro.au

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

This project will collate a broad range of pressure data and produce reports that include pressure maps (see milestones). Data and information will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. Pressure datasets will be stored in a long-term secure storage, metadata will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal <http://portal.aodn.org.au/aodn/>. An email will be sent to [marinemetadata@environment.gov.au](mailto:marinemetadata@environment.gov.au) each time a data set is published.

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website <http://www.nespmarine.edu.au>. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

The primary contact point for data and information management contact for this project is the project leader (see details in front page).

Data sets that will be released from January 2016 will be:

|  |  |
| --- | --- |
| Pressures | Spatial Management |
| Fisheries (grouped by gear, over SOE period) | CMR, KEF, BIA |
| Seismic | Fisheries Closures/Fisheries Zones |
| SST | Cable & Pipeline Exclusions |
| Pollution | Sea-Lanes |
| Shipping | Oil & Gas leases |
| Population | PSSA & Areas to be Avoided |
| Cables |  |
| Pipelines |  |
| Oil & Gas Infrastructure |  |
| Marine Debris (global analysis, microplastics) |  |
| Cyclones |  |

Data management contact:

Piers Dunstan

Ph: 03 6232 5382

Email: Piers.Dunstan@csiro.au

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

The funds will be used to support analysis of existing data that was collected during the NERP hub to produce trends in the pressures on the marine environment over the previous 20 years. We will also begin scoping DoE support for cumulative risk assessment, including an understanding of where socio-economic values could be used.

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

The research outputs will be for the Australian EEZ.

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

This project is primarily a desktop study with no field work and is considered a category 3 project for Indigenous engagement. Our approach to engagement will primarily involve provision of updates to the DoEE Indigenous Advisory Group the Fisheries Research and Development Corporation Indigenous Reference Group. These groups will also be asked for advice on opportunities to enhance Indigenous engagement in this project. The identification of traditional and cultural values has become an increasingly important topic, at local, national and global levels. The project will test DoEE interest in including Indigenous knowledge and heritage into the conservation values considered by the project. This will include an option to use the values component of the project to support the identification of indigenous cultural and heritage values and the pressures that are acting on them. The details of this engagement will need to be scoped with DoEE and include the Hub Knowledge Broker. The further development of the project will build this engagement (where appropriate) consistent with the Hub’s Indigenous Engagement and Participation Strategy.

Indigenous consultation and engagement contact:

Piers Dunstan

Ph: 03 6232 5382

Email: Piers.Dunstan@csiro.au

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

A brief statement to highlight what elements are in the scope of the project.

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

A brief statement to highlight what elements are out of the scope of the project.

### Risks

List all significant risks to the success of the project

The project requires engagement with DoE at several key points to achieve process outcomes around values and risk assessment. The project will also require access to data that will be held by external stakeholders.

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

impact, pressure, risk, socio-economic values, conservation values

# Project C2 – Continental scale tracking of threats to shallow Australian reef ecosystems

Project length – 30 Months

Project start date – 01/07/2015

Project end date – 31/12/2017

Project approval date - xx/xx/xxxx (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - In progress

Project Leader – Graham Edgar (FTE – 20%)

Lead Research Organisation – University of Tasmania

Project leader contact details: - [G.Edgar@utas.edu.au](mailto:G.Edgar@utas.edu.au); 03-6227 7238

### Project Funding

|  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | TOTAL |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NESP funding | 322,197 | 247,475 | 237,475 | x | x | x | x | 807,147 |
| Cash co-con | x | x | x | x | x | x | x |  |
| In-kind co-con | 488,478 | 635,276 | 635,276 | x | x | x | x | 1,759,030 |
| TOTAL | 810,675 | 882,751 | 872,751 | x | x | x | x | 2,566,177 |

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

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.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

### Problem Statements

#### Problem

Description of the specific problem

The marine environment is out of sight, with little standardised information available on its ecological state. Available data are generally qualitative, collected for different reasons with different methodology in different studies, and highly patchy in space, time and target taxa. Yet without good information on ecosystem condition, management actions can be inefficient, with resources prioritised in some cases at threats that have little ecological impact, while other critically-important threats could potentially be overlooked. Moreover, high-quality ecological monitoring data represent a critical tool when assessing the success or otherwise of management interventions, in part for project evaluation, but also when considering extensions of those interventions to other locations.

A related problem is a lack of a standard suite of indicators that distil important ecological detail and can be used for state and national State of the Environment reporting. These need to reduce the multivariate complexity associated with marine ecosystems to univariate metrics that are sensitive to specific threats. Data streaming protocols are additionally needed that collate and publicly distribute relevant marine ecological indicators in near real time.

#### How Research Addresses Problem

What solution will this research provide?

This NESP project will in part address these problems by aligning and validating outputs of the major shallow reef monitoring programs underway around Australia, most notably AIMS Long Term Monitoring Program (LTMP), Reef Life Survey (RLS), and UTAS Long Term Marine Protected Area Monitoring Program (LTMPA). The project will use these data and co-located data on pollutants, natural environmental stressors and socio-economic conditions to clarify relationships between magnitude of major anthropogenic stressors (pollution, sea temperature rise, fishing, introduced species) and ecological change. It will identify key ecological indicators that are sensitive to different environmental stressors, and that can be used by all major marine ecological monitoring programs for consistent continent-wide State of the Environment reporting. Through regular consultation with Department staff and Marine theme leaders, Year 1 project outputs will be tailored to align and feed into 2016 SoE reporting. Research plans for Years 2 and 3 are designed to efficiently fill outstanding knowledge gaps associated with data needs of other Marine Biodiversity Hub projects, ongoing environmental condition reporting, the Essential Environmental Measures initiative, the National Monitoring Blueprint, and evaluation of biodiversity conservation goals associated with Commonwealth Marine Reserves.

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

This project contributes to the majority of Departmental research priorities:

* Determine and trial practical and repeatable methods for monitoring the status and trends of key coastal and marine species and environments to underpin management of Commonwealth Marine Reserves

This priority represents the core aim of this project.

* Improve the management of marine and coastal biodiversity by evaluating and quantifying the results of management interventions.

The project will quantify ecological consequences for marine and coastal biodiversity of different management interventions associated with regulations and planning in the coastal zone. This will include extension of CERF and NERP analyses outlining benefits to marine biodiversity from declaration of marine protected areas (MPAs), including how different design features of MPAs (e.g. size, configuration) affect ecological responses.

* Identify past and current pressures on the marine environment, and understand their impact to better target policy and management actions.

Through analysis of impact indicators developed through NERP and NESP projects, which are associated with threats of overfishing, pollution, introduced species, bleaching, and warming, current pressures on the marine environment will be quantified and mapped. Historical pressures will also be tracked through the past 25 years by analysis of LTMP and LTMPA data, which extend back over two decades and encompass all six states and Commonwealth waters at Jervis Bay

* Determine the causes of, and relationships between, pressures on the marine and coastal environment to inform government investment.

The project will directly assess impacts of different stressors on biodiversity of marine and coastal environments.

* Define the impact of sewerage outfalls and stormwater runoff on Australia’s marine environment to identify real actions to improve outcomes for marine water quality.

Field surveys of sewage, microplastics, and heavy metal levels at polluted and reference ecological sites undertaken through the project will allow ecological impacts of sewerage outfalls and other pollutants on Australia’s shallow reef environments to be quantified and mapped.

* Improve prediction of likely future pressures and their potential impacts on marine and coastal biodiversity and economic and social values to enable the mitigation of avoidable impacts.

A key output is improved knowledge of tipping points in relationships between pressures and ecological condition, with tools produced that allow tracking of proximity to critical ecological transitions, which can thereby be avoided.

* Improve our knowledge of key marine species and ecosystems to underpin their better management and protection.

Through field surveys that quantify abundances of >3000 marine species spanning the Australian continent, including reptiles and large predatory fishes, the project will greatly improve knowledge of numerous key and threatened species. The combined LTMP, RLS and LTMPA datasets provide the only quantitative information available to assess population trends for the majority of non-commercial species surveyed.

* The role of citizen science in the management of marine biodiversity.

Over 100 highly-trained citizen scientists will provide data that contributes to the project through the Reef Life Survey program, with educational extension of results through RLS to the diving community via public presentations, articles, website etc.

* Better understand issues that are common to the fishing industry and the environment including identifying solutions of mutual benefit.

Through analysis of ecological changes in fished versus unfished (i.e. no-fishing marine reserve) areas, outputs will provide a much clearer understanding of the impacts of fishing on conservation values, and improved ways to maximise conservation benefits while minimising economic cost to fishers.

* Identify key opportunities to collaborate and build Indigenous participation and knowledge into the management and protection of marine species.

The project will extend and strengthen ongoing collaborations between Reef Life Survey citizen scientists and Indigenous communities.

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

Six major research components contribute to this project: (i) integration of Australian long-term ecological reef datasets (AIMS LTMP, RLS and UTAS LTMPA), (ii) collection of data on levels of sewage, microplastics and heavy metals at ecological monitoring sites, (iii) statistical cross-matching of fish, macro-invertebrate, sessile invert, algal, environmental, socio-economic and pollutant datasets to identify impacts of different anthropogenic stressors on reef communities, (iv) identification of indicators specific to particular stressors, which can be tracked long-term through the three on-going long-term monitoring programs, (v) collation and provision of indicator data for improved SoE reporting, and (vi) collation and provision of data for other NESP Marine Biodiversity Hub projects and Parks Australia.

Integration of Australian long-term reef datasets

Three long-term ecological monitoring programs using standardise protocols that extend across Commonwealth/State jurisdictions are currently underway around Australia

* AIMS Long-term Monitoring Program (LTMP). This program grew out of surveys of crown-of-thorns starfish populations on the Great Barrier Reef (GBR) that began in the early 1980s. The program was expanded to include detailed surveys of reef fishes and benthic organisms in 1992. Marked sites are surveyed annually or more recently, in alternate years, on the NW slopes of 47 reefs. The reefs are grouped by latitude and by position across the continental shelf, since the major biophysical gradients in the GBR are between the Coral Sea and the Queensland coast. Fish from a list of 191 species, representing 10 families, are counted on the five 50m transects in each of three sites at each reef. Benthic organisms are surveyed from sequences of photos taken along the same transects. The same transects are also surveyed for coral disease and other sources of coral mortality such as predatory snails, *Drupella* sp. The entire perimeter of each reef is surveyed for crown-of-thorns starfish (*Acanthaster planci*) and general cover of hard coral, which provides a wider context for the surveys on the fixed sites at each reef. See: <http://www.aims.gov.au/docs/research/monitoring/reef/sampling-methods.html> and <http://www.aims.gov.au/docs/research/monitoring/reef/sops.html>
* UTAS Long Term Marine Protected Area Monitoring Program (LTMPA). The LTMPA program encompasses >600 sites distributed across the temperate Australian coast from Jervis Bay (NSW) to Jurien Bay (WA) and around Tasmania. Surveys are conducted in collaboration with state government personnel (NSW DPI, Parks Victoria, Tasmania Parks and Wildlife Service, SA DEWNR, WA DPaW), and provide a consistent framework for state MPA assessment programs. Densities and size-structure of all fishes within 5 m wide bands, and cryptic fishes and mega-invertebrates within 1 m wide bands, are assessed along 50 m transect lines. Percent cover of sessile invertebrates and macro-algae are estimated along the same transects by in situ counts by divers. Sites surveyed extend back to 1992 in Tasmania, to 1996 in NSW, to 1997 in WA, to 1998 in Vic, and to 2004 in SA. This dataset is unprecedented globally in geographic span (~4,000 km) for assessing temperate reef ecosystem change over decadal scales.
* Reef Life Survey (RLS). Following a pilot study from 2007-10 funded through the Commonwealth Environmental Research Facilities Program (the forerunner of NERP and NESP), the Reef Life Survey Foundation, a charitable environmental NGO, was established to support the training and activities of committed diving citizen scientists. Volunteer divers trained to a scientific level in underwater visual census techniques have now established marine biodiversity baselines through field surveys at more than 2500 sites worldwide. Over 500,000 species abundance counts for 4500 species have been recorded, and annual surveys are conducted at priority sites around Australia. RLS is unique in its combination of standardised underwater census methods, fine taxonomic and body size resolution, and rigorous training of participants, which include both professional scientists and skilled citizen scientists. Using the RLS protocol, sizes and abundances of all fishes. and abundances of all large mobile invertebrates, sighted are recorded along 50 m transects, plus cover of macroalgae and sessile invertebrates (including corals) obtained for ~60 functional groups (following the CATAMI classification scheme, a NERP product) using digitised photoquadrats (for methods see http://reeflifesurvey.com/files/2008/09/rls-reef-monitoring-procedures.pdf). While the quality of citizen science data is sometimes queried, RLS differs from other volunteer dive programs in its primary emphasis on quality of data outputs rather than wide public engagement, headhunting the best and most committed divers. Data quality has been assessed rigorously, with differences in data produced by volunteers and professional scientists statistically non-significant and trivial (<0.5%) in comparisons of variation between divers, depths, transects, sites and regions (Edgar & Stuart-Smith 2009).

While the three long-term ecological monitoring protocols are consistent in major features, such as use of 50 m transect tapes as the basic unit, they differ in details, most notably in target taxa (all observed species are counted in LTMPA and RLS versus a large subset of species for LTMP), transect replication within sites, depth of transects, method of laying transects (between permanent stakes versus GPS), and application of in situ counts versus quadrats for assessing sessile cover. These differences may or may not generate substantial errors when data are aggregated across methods and compared. If major errors are detected, then integration remains possible if appropriate correction factors can be identified and applied.

Huge benefits would be generated through integration of data from reef monitoring programs Australia-wide. Such benefits include establishment of the largest marine ecological dataset available for any country for SoE reporting, scientific analysis of biogeographic patterns and ecosystem function, and assessment and tracking of ecological impacts generated by human-related stressors.

The main step in integration of monitoring outputs is validation of data from different programs. This is most accurately undertaken through field surveys where multiple methods are applied along the same transects. Given available data density and statistical noise contributed with each added methodology, this NESP project will focus on field validation for the three major programs plus other programs with similar methods (e.g. CoralWatch). Validation surveys will be conducted on the GBR, with major desired outcome the identification of any correction factors needed when cross-linking outputs from the different survey sources.

Survey of pollutants at ecological monitoring sites

Investigations of the impact of sewage, microplastics and heavy metal inputs on inshore rocky reef communities have been limited to date because the scale of information on levels of pollutants has been much broader than the span of transects at sites investigated. As a consequence, analyses have been confounded by poor information on the variety of stressors operating at any site. Finer resolution data on pollutants are needed.

To address this deficiency, the influence of sewage, microplastics, heavy metals and other pollutants will be assessed by collecting sediment samples at RLS ecological monitoring sites and measuring a range of associated markers. These will include basic biogeochemical information (pH, salinity, turbidity, grain size, total phosphate, TKN, total organic carbon), stable isotopes (delta15N, delta13C), microplastics, heavy metal concentrations, hydrocarbon concentrations, and routine bacterial counts (faecal coliforms, enterococci).

Identification of impacts of different anthropogenic stressors on reef communities

Relationships between pollutants, environmental covariates, and community-level responses (e.g. filamentous algal cover, herbivorous fish biomass, large carnivore biomass, proportion of introduced species) will be identified using a variety of statistical, machine learning and modelling techniques, including new methodologies recently developed through the CERF and NERP Marine Biodiversity Hubs. Methods previously used by investigators and to be applied in this project include generalised linear models (GLMs), quantile regression, generalised additive models (GAMs), and machine learning procedures (e.g. random and gradient forests, boosted regression trees). Structural equation modelling will also be used to disentangle intermediate microbial and nutrient pathways linking pollutants to macro-community condition. Notably, the great quantity of coincident biological and environmental data available through the three long-term monitoring programs and Hub partners (CSIRO, AIMS and GA) should allow system non-linearities and the magnitude of interactions between covariates to be considered and formally assessed, in most cases for the first time. Available data to be included in analyses encompass thousands of sites Australia-wide.

Identification of ecological indicators

This NESP study will generalise and extend NERP outputs dealing with fishing and climate indicators, including the identification of sensitive indicators associated with different types of pollution and invasive species. Emphasis will be placed on identifying indicators that apply generally across a range of habitats and realms, such as fish body size indicators that correspond with the magnitude of fishing pressure.

Fundamentally, analyses will seek to reduce complex multidimensional patterns pertaining to ecological communities along time and space gradients of each threat to simple but informative univariate metrics. Thus, a major aim is to identify which taxonomic components of reef communities are most affected by a particular threat, and which summary statistics capture the range of responses to that threat in the simplest and most informative manner. For some threats, the magnitude of impact should be readily estimated using simple metrics that are largely independent of other environmental factors, and hence can be robustly applied in most situations; however, other threats may interact with environmental factors, resulting in a need for more complex models to be developed to explicitly account for covariation in the geospatial and natural environment.

Analytical procedures will assess the value of existing SoE metrics, such as those based on species richness or other recognised properties of community structure. They will also identify which taxonomic elements of reef communities are most affected by a particular threat, and break-points and other non-linearities in relationships between community structure and level of threat, allowing the construction of robust metrics based on these elements. For example, if one or two taxonomic or functional groups are found to be disproportionately affected by a particular threat, then these functional groups will be incorporated into the relevant ecological indicator metric. The value of “multi-metrics” that integrate several component metrics (Henriques et al. 2008) will also be assessed.

Metrics will be developed for five major threats:

Introduced and invasive species. Simple metrics are presently available that involve, for example, summing densities or number of invasive species at sites. However, invasive species differ individually in their impacts on native components of reef communities, hence risk associated with individual species ideally should also be taken into account. Impacts of individual introduced species will be assessed here using time series data to quantify ecological changes to other local species that accompany arrival of introduced (e.g. the kelp *Undaria pinnatifida*) and invasive (e.g. *Acanthaster, Centrostephanus*) species at individual sites, while using nearby uninvaded sites as control reference sites.

Over-fishing. A variety of metrics of effects of fishing have been developed, including species richness, size-distribution and trophic indices (Murawski 2000, Fulton et al. 2005). The predictive value of these metrics will be assessed by comparing metrics calculated for the range of sites studied with indices of fishing pressure ([i.e., distance from port, number of fishing boats observed in aerial photos, see Stuart-Smith et al. 2008](#_ENREF_6)), and by comparing patterns inside versus outside long-established MPAs, including using time series data since MPA establishment where available. New metrics based on the size-distribution of communities will be developed and their predictive ability compared with established metrics.

Organic and heavy metal pollution. Pollution impacts will be assessed using outputs from analyses based on new field data on levels of pollution at RLS ecological monitoring sites.

Urbanisation. Effects of urban development will be assessed using gradient analysis based on human population density in the coastal fringe adjacent to sites studied.

Sea warming. Metrics of thermal stress, a surrogate of climate change impact, will be developed using the subset of sites with long-term ecological monitoring data and warming trends. These metrics include the recently developed ‘community thermal index’, as developed through NERP ([Bates et al. 2014a](#_ENREF_1)).

Application of ecological indicators

Long-term ecological monitoring data will be reduced to quantitative indicators to underpin the marine thematic chapter in SoE reporting. Given the short 9-month timeframe available for development of these products for the 2016 Report, some products advanced over this period will be interim. These will be finalised in subsequent years, and all ecological indicators maintained within an area on the AODN website that is planned to provide the quantitative information underpinning future SoE reporting. Ecological monitoring data will also contribute to the Essential Environmental Measures initiative, which is to provide more detailed and updated information on marine status and trends.

Provision of data products for other NESP MBH projects and Parks Australia

The project will maintain close linkages with the three Australian long-term monitoring programs described above, and value-add ecological data generated through monitoring into products needed as foundational layers for other MBH projects. These will include continent-scale maps describing pressures on the inshore marine environment, for utilisation through project C1. Products will also include reporting on new data streams established through the Reef Life Survey program, such as baseline data for Northern Australian Commonwealth Marine Reserves, and repeat surveys of sites to assess change in the Coral Sea Marine Reserve.

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

Data developed and provided through this project will contribute as an important input to:

* ‘C1 Improving our understanding of pressures on the marine environment’, and
* ‘B2 Analysis and elicitation to support State of the Environment reporting for the full spectrum of data availability’, and
* ‘D2 Analysis methods and software to support Standard Operating Procedures for survey design, condition assessment and trend detection’.

Project outputs also integrate with several other projects, including:

* ‘B1 Road testing decision support tools via case study applications’
* ‘D3 Evaluating and monitoring the status of marine biodiversity assets on the continental shelf’, and
* ‘D4 Best practice spatial management of marine biodiversity’.

Outside the NESP Marine Biodiversity Hub, this project aligns directly and will feed into the development of an integrated monitoring program (IMP) for the GBR, which is a significant initiative under the *Reef 2050 Long-Term Sustainability Plan.* Alignment of RLS with the AIMS LTMP potentially allows coverage of reefs in the GBRWHA to be extended significantly in a cost effective manner, including surveys undertaken in the largely unknown far northern GBR region and Coral Sea, as well as providing an additional component of citizen science into the GBR IMP. This objective also aligns with two of the research priorities of the NESP Tropical Water Quality Hub:

* Combine existing indicators and monitoring programmes to develop a cost-effective integrated monitoring programme to support natural resource management, evaluate results and communicate trends.
* Explore the opportunities for citizen science and Indigenous participation to improve tropical water quality awareness and outcomes.

In part through AIMS contribution and participation of Dr Sweatman across Hubs, this Marine Biodiversity Hub project will also link closely with projects established through the Tropical Water Quality Hub, particularly projects associated with monitoring of environmental condition. Data and products associated with this project will also link in with the Threatened Species Recovery Hub led by Prof Hugh Possingham. Direct engagement between this project and the TSR hub through participation in a Lady Elliot Island collaborative workshop will lead to shared progress towards goals of both Hubs with respect to threatened marine species.

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

The project adds substantial value to the three largest reef monitoring datasets in Australia by integrating their outputs into readily-comprehensible products. The Reef Life Survey dataset was a product of CERF, with development of data products and analytical outputs facilitated through NERP, including applications of new statistical tools developed through that Hub. The project also leverages off the cost of ongoing ecological survey surveys undertaken through the LTMP, RLS and UTAS monitoring programs, the latter two primarily covered by non-Commonwealth agencies, with field survey costs and some analysis costs covered.

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

Specific outcomes of the project include:

* Compilation and categorisation of different shallow-water monitoring programs currently in place around Australia.
* Integration of outputs of the three largest standardised marine ecological monitoring programs operating in Australia.
* Characterisation of levels of sewage, microplastics and heavy metal pollution at ecological monitoring sites, and application of pollutant markers to assess impacts of pollutants on reef condition.
* Identification of nonlinear ‘break points’ in relationships between reef communities and threats that are appropriate as benchmarks of condition in SOE reporting.
* Application of metrics to long-term monitoring datasets to identify trends in impacts of stressors on marine ecosystems over the past 25 years.
* Establishment of data streams that feed routinely into State of the Environment Reporting and the Essential Environmental Measures initiative.
* Mapping of the condition of shallow reef ecosystems and associated pressures at a national scale.
* Reporting on biodiversity values and trends in condition of shallow reef systems within the Commonwealth Marine Reserve Network.
* Generation of conceptual models that explain the underlying functional basis of threats, including how interacting threats influence the resilience of inshore marine communities.
* Increased training and mentoring of postdoctoral fellows and postgraduate students within a near ideal collaborative research framework.

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

Through improved management decision-making and wider public knowledge, the project will lead to improved condition of the inshore environment relative to ‘business as usual’. Long-term measurement of condition comprises an output of the project itself, through expanded ecological surveys conducted by RLS divers and continued observations through LTMP and LTMPA.

Specific management outcomes include:

* Improved decision-making when managers assess cost/benefit trade-offs for threats that potentially affect marine biodiversity, including considering the scale of fishing impacts on marine biodiversity relative to other threats.
* Identification and dissemination of a suite of metrics and numerical models that sensitively characterise the impacts of different threats to Australia’s shallow marine biodiversity.
* Incorporation of long-term ecological marine datasets into SoE reporting.
* Increased environmental stewardship through expanded engagement of diving citizen scientists in activities that map and track the distribution of stressors on Australian shallow marine environments.
* Increased public knowledge on the distribution and ecological impact of threats to inshore marine biodiversity.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

The project will lead to better monitoring of the marine environment and better understanding of the impacts of different anthropogenic threats, leading to improved and more cost-effective management intervention, and improved environmental condition relative to ‘business as usual’.

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

Publications describing:

* Environmental values at all sites investigated in Commonwealth waters by Reef Life Survey divers
* Compatibility of survey data obtained through LTMP, RLS and LTMPA programs, and corrections factors needed when linking outputs of these monitoring programs
* Time series data depicting interannual variation over the past two decades in ecological indicators specific to individual threats
* Relationships between anthropogenic stressors and reef condition, with emphasis on impacts of sewage and heavy metal pollution, fishing, warming sea temperature, urbanisation and introduced species
* Sensitive and cost effective indicators of threats to environmental condition

Coherent marine ecological data streams that feed into SoE reporting, the Essential Environmental Measures initiative, and future evaluation of Commonwealth Marine Reserves.

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

Program activities extending from 2017 will depend on the outcomes from the 2015-16 review and analyses. Thus, 2015 and 2016 activities will explicitly be directed at determining what is needed by DoE in terms of a global synopsis of the status and trends of reefs around Australia, what are the best indicators of this, and also what gaps exist in terms of spatial, taxonomic or functional coverage that need to be filled with additional surveys by the partners in later years.

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1: Initial meeting of investigators, end users and stakeholders to scope project details including specific sampling design. | Due 1 January 2016 |  |
| Milestone 2: Undertake field surveys and complete processing of pollution markers. | Due 1 January 2016 |  |
| Milestone 3: Undertake initial validation surveys to compare LTMP, LTMPA and RLS survey data outputs. | Due 1 January 2016 |  |
| Milestone 4: Commence analysis of discrepancies between outputs of different survey programs. | Due 1 January 2016 |  |
| Milestone 5: Commence analysis of most useful threat indicators. | Due 1 January 2016 |  |
| Milestone 6: Identify interim set of indicators based on ecological survey data that are sensitive to specific threats and appropriate for SoE reporting. | Due 1 January 2016 |  |
| Milestone 7: Work with Departmental staff and SoE marine theme leaders to deliver interim results for key components for inclusion in SoE 2016 report. | Due 1 January 2016 |  |
| Milestone 8: Finalise charting of trends in threat indicators to 2015 for SoE reporting. | Due 1 March 2016 |  |
| Milestone 9: Complete survey validation fieldwork. | Due 1 June 2016 |  |
| Milestone 10: Produce report detailing the magnitude of any major discrepancies between outputs of different survey programs, with recommendations on any corrections needed for consistent program output. | Due 1 June 2016 |  |
| Milestone 11: Identify cost-effective and sensitive threat indicators that summarise ecological monitoring data. | Due 1 June 2016 |  |
| Milestone 12: Hold annual meeting of investigators and end users outlining project outputs and implications for management. | Due 1 June 2016 |  |
| Milestone 13: Contribute data and information to Essential Environmental Measures initiative and the National Monitoring Blueprint. | Due 1 June 2016 |  |
| Milestone 14: Submit draft report describing reef condition, biogeographic relationships and conservation issues associated with sites investigated in Commonwealth waters by Reef Life Survey divers to DoE. | Due 31 December 2016 |  |
| Milestone 15: Work with Departmental staff to develop detailed research plan for extended NESP Hub project that effectively fills knowledge gaps associated with environmental condition reporting, Essential Environmental Measures, the National Monitoring Blueprint, and evaluation of Commonwealth Marine Reserves. | Due 31 December 2016 |  |
| Milestone 16: Complete final reporting on ecological indicators and analysis of relationships between threats, indicators and community structure. | Due 31 December 2017 |  |
| Milestone 17: Submit at least 8 scientific papers to international journals. | Due 31 December 2017 |  |
| Milestone 18: Hold meeting of investigators and stakeholders outlining project outputs and implications for management. | Due 31 December 2017 |  |
| Milestone 19: Report to the Department on marine reserves and recommended survey methodologies. | Due 31 December 2017 |  |
| Milestone 20: Finalise products agreed as useful for Essential Environmental Measures initiative and the National Monitoring Blueprint. | Due 31 December 2017 |  |
| Milestone 21: All project outputs and data will be made publically and freely accessible and available on the internet (see section on data and information management). | Due 31 December 2017 |  |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| Graham Edgar | University of Tasmania | Oversight of project, including participation of RLS citizen scientists, statistical analyses, student supervision, and reporting |
| Rick Stuart-Smith | University of Tasmania | Oversight of indicator development statistical analysis, and reporting |
| Database manager | University of Tasmania | Oversight of data quality, inputs and outputs |
| Technical Officers – 3 positions, year 1 only | University of Tasmania | Field sampling of pollution markers |
| Researcher | Australian Institute of Marine Science | Oversight of BGR validation trials, LTMP input, statistical analysis, and reporting |
| Hugh Sweatman | Australian Institute of Marine Science | LTMP input, statistical analysis, and reporting |
| Neville Barrett | University of Tasmania | LTMPA input, statistical analysis, student supervision, and reporting |
| Alan Jordan | NSW DPI | Input of management expertise |
| Peter Davies | NSW Office of Environment and Heritage | Contribute expertise on distribution and consequences of pollution impacts along NSW coast |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
|  | University of Tasmania | Cash, co-investment |
|  | AIMS | Cash, co-investment |
|  | Reef Life Survey Foundation Inc | Co-investment |
|  | NSW DPI | Co-investment |

Research End Users and Key Stakeholders **–** Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| Parks Australia, Department of the Environment | Amanda Parr |  |
| Department of Environment and Energy - Environmental Information Policy and Reporting | Lee-Anne Shepherd, Boon Lim, Emma Hyland |  |
| Department of Environment and Energy – Biodiversity Conservation Division – Biodiversity Policy Section | Tia Stevens  Gavin Hinten | [Tia.Stevens@environment.gov.au](mailto:Tia.Stevens@environment.gov.au)  [Gavin.Hinten@environment.gov.au](mailto:Gavin.Hinten@environment.gov.au) |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| Tas Parks and Wildlife Service | Peter Mooney |  |
| NSW Department of Primary Industries | Nathan Knott |  |
| Parks Victoria | Stefan Howe |  |
| DEWNR, SA | Daniel Brock |  |
| GBRMPA | Fergus Molloy |  |
| Dept Parks and Wildlife, WA | Tom Holmes |  |
| Dept Primary Industry and Fisheries, NT | Brian McDonald |  |
| Reef Life Survey Foundation Inc | Scoresby Shepherd |  |
| NRM Councils |  |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

Project outputs will be distributed following guidelines described in the Marine Biodiversity Hub ‘Knowledge Brokering and Communication Strategy’. End users and stakeholders will be engaged throughout the project using a range of formats. In particular, project investigators and staff will engage directly with DoE at all stages of the project, including via an early planning workshop and during ongoing meetings with the Department, both directly to key staff and indirectly via the Hub knowledge broker. DoE will also provide input through the Reef Life Survey Foundation Advisory Committee, which *inter alia* provides direction on priority locations for field surveys. Additional communication will be through the Hubs’ knowledge broker in alignment with the Hub’s Knowledge Brokering and Communication Strategy.

Regular discussions will also be held with stakeholders and interested groups to identify opportunities for increased uptake of products. Outputs will be communicated through RLS and NESP Marine Biodiversity Hub websites, and general media releases, describing project outputs and outcomes. Project findings will also be presented as scientific talks at national (e.g. AMSA, ASFB, ESA, Coast to Coast) and international conferences (e.g. International Temperate Reefs Symposium, International Coral Reefs Symposium), and by publication in key peer-reviewed journals. Given track record of the research team and the unprecedented geographic scale of project outcomes, we expect these publications to include the most highly-cited journals. Media liaison personnel at the University of Tasmania and AIMS will actively assist the process of disseminating knowledge about the project.

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

This project will produce status and trend data (ecosystem and pressure data) and produce reports (see milestones). Data and information will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. Datasets will be stored in a long-term secure storage, metadata will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal <http://portal.aodn.org.au/aodn/>. All RLS data will be made immediately available through the online portal (<http://reeflifesurvey.imas.utas.edu.au/portal/home>) which is directly accessible to the AODN and MBH systems. The Department will be informed by email to marinemetadata@environment.gov.au when any data additional to these RLS data are published, and provided with a link to the full dataset.

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website <http://www.nespmarine.edu.au>. The project will adhere to NESP requirements that all journal publications are made publicly and freely available within 12 months of publication.

The primary contact point for data and information management contact for this project is the project leader (see details in front page).

Contact persons

Name: Antonia Cooper

Email Address: [Antonia.Cooper@utas.edu.au](mailto:Antonia.Cooper@utas.edu.au)

Phone Number: 03 6226 8283

Name: Just Berkhout

Email Address: [Just.Berkhout@utas.edu.au](mailto:Just.Berkhout@utas.edu.au)

Phone Number: 0401 999 725

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

|  |  |  |  |
| --- | --- | --- | --- |
| Budget item | 2015 | 2016 | 2017 |
| UTAS postdoctoral fellow Stuart-Smith | 60,991 | 121,982 | 121,982 |
| UTAS data manager/technical support (HEO4) | 37,155 | 69,966 | 69,966 |
| UTAS staff field surveys | 46,444 | 0 | 0 |
| AIMS staff salary (total 0.2 FTE, Level 6) half costs including overheads | 32,727 | 32,727 | 32,727 |
| Field survey costs (food, accommodation, boat, vehicle, flights - 36 days) (UTAS) | 35,580 | 0 | 0 |
| Field survey consumables (underwater water proof paper, transect tapes, bags, diving gear repairs) (UTAS) | 8,000 | 0 | 0 |
| AIMS vessel costs for survey comparisons between programs | 25,500 | 0 | 0 |
| Sample processing costs (heavy metals $35, sediment chemistry $30, stable isotopes $60, microplastics $80, sewage markers $100) (UTAS) | 63,000 | 10,000 | 0 |
| Travel/meetings (UTAS) | 12,800 | 12,800 | 12,800 |
| Total | 322,197 | 247,475 | 237,475 |
|  |  |  |  |
| In kind contributions |  |  |  |
| ProfEdgar, Level E, 0.2 FTE + 1.2x overheads | 46,596 | 93,192 | 93,192 |
| DrBarrett Level C, 0.1 FTE + 1.2x overheads | 16,305 | 32,609 | 32,609 |
| DrJordan 0.05 FTE + 1.2 x overheads | 9,023 | 18,046 | 18,046 |
| DrDavies 0.1 FTE + 1.2 x overheads | 18,046 | 36,091 | 36,091 |
| Dr Sweatman 0.15 FTE | 12,273 | 12,273 | 12,273 |
| AIMS staff salary (total 0.2 FTE, Level 6) half costs | 32,727 | 32,727 | 32,727 |
| Oncosts associated with UTAS postdoctoral, database manager and technical support positions | 173,508 | 230,338 | 230,338 |
| Reef Life Survey Foundation (volunteer diver time ($300 / day x 500 diver days = $150,000) + boat costs ($30,000) | 180,000 | 180,000 | 180,000 |
| Total | 488,478 | 635,276 | 635,276 |

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

Analysis of data Australia-wide, including all States and Territories.

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

This project is primarily a desktop study focused on analysis of Reef Life Survey data and is considered a category 3 project for Indigenous engagement. . Our approach to engagement will primarily involve provision of updates to the DoEE Indigenous Advisory Group the Fisheries Research and Development Corporation Indigenous Reference Group. These groups will also be asked for advice on opportunities to enhance Indigenous engagement in this project. Engagement of Indigenous groups will follow guidelines described in the Marine Biodiversity Hub ‘Indigenous Engagement and Participation Strategy’. Efforts will also be made to extend and strengthen past collaborations between Reef Life Survey Foundation and Indigenous communities (e.g. http://reeflifesurvey.com/northern-australian-surveys-sea-country/). Information pertaining to sea country will be obtained and communicated in consultation with local Indigenous groups. The Hub’s knowledge broker will, as part of consultation for the wider Hub community, also raise awareness of our findings and stimulate engagement with interested members of the Indigenous community. This engagement will follow the Hub’s Indigenous Engagement and Participation Strategy.

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

Field surveys to cross-reference co-located data from AIMS LTMP and RLS programs.

Analysis and integration of LTMP, RLS and UTAS reef ecological monitoring data.

Reports describing all RLS ecological monitoring data collected from locations within Commonwealth jurisdiction other than the Coral Sea, with assessment of ecological condition and relationships between sites surveyed.

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

LTMP, RLS and UTAS field surveys, other than those undertaken for cross-comparison and validation of the three ecological datasets.

### Risks

List all significant risks to the success of the project

Loss of key staff, or difficulty in finding appropriate people during appointment process.

Mitigated by the broad mix of expertise amongst project investigators and staff, with duplication of all skills needed.

Availability of LTMP, RLS and UTAS data.

Mitigated by institutional agreements that allow access to data, and ready availability of compiled data.

Bad weather interfering with field surveys.

Mitigated by three month window available for undertaking field surveys, allowing considerable flexibility for timing of surveys if postponement is necessary due to weather.

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

Ecological indicators, inshore monitoring, reef condition, sewage impacts, microplastics, heavy metal pollution impacts

# Project C3 - Change detection and monitoring of key marine and coastal environments – application of the Australian Geoscience Data Cube

*Project length* – 1 Year / 7 Months

*Project start date* – 5 / 2015

*Project end date* – 12 / 2016

*Project current status - Completed*

*Project Leader* – Stephen Sagar (FTE – 30%)

*Lead Research Organisation* – Geoscience Australia

*Revised Funding Budget*

|  |  |  |
| --- | --- | --- |
|  | *2015* | *Totals* |
| *NESP funding* | *$56,500* | *$56,500* |
| *Cash co-con* | *x* | *X* |
| *In-kind co-con* | *$72,400* | *$72,400* |
| *Totals* | *$128,900* | *$128,900* |

*Below is the original RPV1 Budget Funding*

*Total NESP funding* - $56,500 per year

*Total Recipient and Other Contributions (co-contributions)* - $88,300 per year

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* | *2021* |
| *NESP funding* | *$56,500* | *$56,500* | *Funding kept at same nominal level until end of project – subject to annual review* | | | | |
| *Cash co-con* | *x* | *X* | *Cash co-contribution kept at same nominal level until end of project – subject to annual review* | | | | |
| *In-kind co-con* | *$88,300* | *$88,300* | *In-kind co-contribution kept at same nominal level until end of project – subject to annual review* | | | | |

**Project Summary**

This project aims at leveraging 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.

In Phase 1 of this project we aim 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.

.

**Problem Statements**

*Problem*

The ability to detect, measure and monitor change in coastal and marine environments can assist in both targeting management decision processes and evaluating the results of management interventions. Change detection utilising satellite data requires robust time series data at spatial scales that can provide context for meaningful interpretations of coastal and marine ecosystems. Previously, this analysis has employed time consuming methods that hampered the efficient extraction of key information on environmental change and trends.

The recently developed Australian Geoscience Data Cube (AGDC) provides a quantum step forward in our ability to utilise these data for environmental monitoring. The AGDC provides a platform for efficient processing and analysis of these data, enabling quantitative information to be extracted from the full 27-year time series of the Landsat data archive, or from a wide range of current and future satellite data streams (e.g. Sentinel series of satellites) to provide rapid, robust environmental monitoring.

However, this new technology has not as yet been applied to coastal and marine environments. This project aims to develop and test methods of utilising the AGDC to measure coastal and marine environmental change, detect spatial environmental patterns that reflect key ecosystem processes and enable near real-time monitoring at temporal and spatial scales not previously possible

*How Research Addresses Problem*

This research will develop change detection algorithms specific to properties in the marine environment, to demonstrate the potential of utilising the AGDC to interpret the archive of time-series satellite data. Utilising field data to validate the algorithm outputs from the historical archive, this research can then enable confidence in the ongoing application of the algorithms for real-time monitoring to inform management decisions.

*Alignment with NESP Research Priorities*

Accurately quantifying how coastal and marine environments have responded to management actions and the provision of cost-effective and repeatable methods of monitoring the status and trend of marine and coastal environments are key NESP priorities (11,21,30) aimed at improving the efficacy of the management of the Australian marine environment and improving our understanding of this extensive and diverse realm.

**Research**

*Description of research*

The proposed research in this project is broken into two components, corresponding to the phases in the NESP:

**Phase 1 – Demonstrator Phase (2015)**

In this phase we are focused on developing an algorithm to map, monitor and detect change in the inter-tidal zone using the Landsat image archive on the AGDC. The proposed methodology involves a significant adaptation and refinement of water detection techniques used for terrestrial applications to the coastal inter-tidal region. Study sites will be selected in consultation with stakeholders, based on the availability of field data and the nature of the tidal regime and changes expected to be observed and captured by the algorithm.

Through the attribution of tidal phase data to observations across the 27-year Landsat archive, the new algorithm will aim to model the extent of the observed inter-tidal zone, and the morphology of the inter-tidal flats. This research aims to build statistical analysis into the algorithm to enable isolation of areas and periods of change throughout the time-series archive. Methods will be developed to interpret the nature of these changes in the inter-tidal zone and near shore morphology.

Validation using field based data will then be completed at each study site to test the accuracy of the algorithm results.

**Phase 2 – Expansion Phase (2016)**

This phase expands upon the capabilities demonstrated in the inter-tidal change detection analysis, by extending algorithm development to other key parameters and environments in the coastal and marine zone (e.g. water quality, benthic substrate, mangrove habitat, chlorophyll-a).

The scope and direction of this phase of the research will be determined after consultation with stakeholders following initial outputs and progress made in Phase 1. This allows flexibility in the project to address priorities and potential partnerships with stakeholders such as CSIRO (e.g. MODIS data analysis for ocean colour change).

**Links with other projects and hubs**

The project will form collaborative links with the Northern Australia Environmental Resources Hub and the Tropical Water Quality Hub where the AGDC is also highly relevant to mapping and monitoring terrestrial and GBR environments.

**Related research**

This project leverages the last three years of research undertaken by CSIRO, Geoscience Australia and the National Computational Infrastructure facility (ANU) in the development of the Australian Geoscience Data Cube. The project will represent the first application of this new technology to problems in coastal and marine environmental management.

**Expected Outcomes**

*Outcomes*

Better informed management of Australia’s coastal and marine ecosystems and environments through improved access to accurate, fine-scale spatial and temporal information on changes that have and are occurring.

The project will develop and assess the utility of new algorithms for forensically measuring past changes in, and monitoring of, coastal and marine habitats that can complement existing approaches. Phase 1 of this project utilise the AGDC to provide an analysis of the Landsat time series archive for two inter-tidal regions, in tropical and temperate settings, selected based on discussions with Department of the Environment (DoE), other stakeholders, and the availability of validation data. For the study regions, managers will be provided with detailed spatial information on the extent and timing of change in inter-tidal coastal habitats across the 27yrs of the Landsat archive. The outputs will be made available as open access web data services.

Phase 1 of the project will seek to demonstrate the value of these methods as a basis for exploiting the new AGDC framework, with Phase 2 then expanding the scope for further environmental parameters to be examined based on stakeholder priorities.

*Specific management or policy outcomes*

This project will generate new insights into past changes and the dynamics of selected coastal and marine habitats and environments that are not currently available to managers. The project aims to accurately quantify when and how the selected coastal and marine environments have changed, providing a means of assessing environmental responses to management actions. This approach is likely to represent a new cost-effective method of obtaining robust data on the status and trend of marine and coastal environments.

*Value*

This project represents excellent value for the environment due to the very significant leverage from the AGDC Project and the high potential of the project to provide a new cost-effective method of quantifying and monitoring coastal and marine environmental change, with impact measured through more efficient and targeted management decisions for key areas

**Planned Outputs**

The project plans to provide the following outputs: Progress Report, Demonstrator summary Report, Data Products (GIS maps and data, delivered from the GA website as a web service), Marine Biodiversity Hub article, presentation at the Australian Marine Science Association Conference.

**Delivery of Project**

*Project leader’s track-record*

The Project Leader has delivered a range of reports and external publications on the application of earth observation data to marine and coastal environmental characterisation during his several years’ service at Geoscience Australia, and is a leader in this field. He has successfully delivered and managed projects on time and within budget for external stakeholders such as AusAID and the Pacific Islands Applied Geoscience Commission (SOPAC, now SPC).

*Delivery on time and within budget*

The project will be managed in a manner that complies with the established Geoscience Australia project management framework.

**Project Milestones**

Milestones for Phase 1 2015 only.

|  |  |
| --- | --- |
| **Milestones** | **Due date** |
| Progress Report | 1 July 2015 |
| Summary report and Datasets | 1 December 2015 |

**Researchers and Staff** (including early career researchers/PhDs – if names not yet known, list position/role)

|  |  |  |
| --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE** |
| Stephen Sagar – Geoscience Australia | Project Leader | 0.3 |
| Zhi Huang – Geoscience Australia | Data Analysis | 0.1 |
| Medhavy Thankappan – Geoscience Australia | Science Advice | 0.05 |

**Partner contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| TBD for Phase 2 |  |  |  |

**Other contributions** – only list contributors who are not already identified as Partners

|  |  |  |  |
| --- | --- | --- | --- |
| **Organisation/name** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| State governments (validation data) |  |  |  |
| Integrated Marine Observing System (IMOS) (validation data) |  |  |  |
|  |  |  |  |

**Research End Users and Key Stakeholders –** Identify at least one section or programme within DoE who will be an end user for this project, as well as any end users external to the department.

|  |  |  |
| --- | --- | --- |
| **Research End Users (section/programme/organisation)** | **Name/s (optional)** | **Email** |
| State governments |  |  |
| DoE |  |  |
| Department of Environment and Energy – Biodiversity Conservation Division – Biodiversity Policy Section | Tia Stevens  Gavin Hinten | [Tia.Stevens@environment.gov.au](mailto:Tia.Stevens@environment.gov.au)  [Gavin.Hinten@environment.gov.au](mailto:Gavin.Hinten@environment.gov.au) |
| Department of Environment and Energy – Biodiversity Conservation Division – Reef Trust | Kevin Gale  Ingrid Cripps | [Kevin.Gale@environment.gov.au](mailto:Kevin.Gale@environment.gov.au)  [Ingrid.Cripps@environment.gov.au](mailto:Ingrid.Cripps@environment.gov.au) |
| **Key Stakeholders (organisation/programme)** |  |  |
| National Estuaries Network |  |  |
| CSIRO/IMOS |  |  |

**Knowledge Brokering and communication**

During scoping of the project we will engage with end users through a workshop and email communication to determine the relevant study areas and refine the nature of the proposed outputs to ensure they are fit for purpose.

Existing engagement mechanisms are in place between GA and key stakeholders (NEN, CSIRO), and these meetings and communication channels will be used throughout the project to further ensure the relevance of proposed outputs, and to inform the research process for the specific study sites.

Outputs from the project will be communicated to key stakeholders and research end users via the project reports, web service deliverables and articles and conference presentations.

**Expenditure Summary**

Project funding will be used to offset 50% of science staff salaries for 2015 and cover the cost of validating the EO products.

**Location of Research**

Study sites will be selected following discussions with state Government marine managers and relevant marine DoE staff.

**Indigenous Consultation and Engagement**

In the initial phase of the project as a desktop study, we will seek advice as to the level of Indigenous interest in our research, and in particular the study sites selected.

We acknowledge the importance of conducting our research according to ethical standards and respecting Indigenous knowledge and property.

Throughout the project, engagement will be consistent with the Hub’s Indigenous Engagement and Participation Strategy, especially if field/validation data collection is considered

**Inclusions (in scope for Phase 1)**

• Development of an inter-tidal change detection algorithm for time-series Landsat satellite data, and application to two key coastal study sites using the AGDC.

• Report on the results of the analysis.

• Delivery of data products and project report as web services

**Exclusions (out of scope for Phase 1)**

• Algorithm development for further environmental parameters and datasets (MODIS etc) (Phase 2)

• Expansion to National scale analysis with partners (e.g. CSIRO/IMOS) (Phase 2)

**Risks**

Potential risks are relevant staff leaving GA/CSIRO; availability of field validation data

**Project Keywords**

Environmental change detection; Coastal and Marine Monitoring; Australian Geoscience Data Cube; Earth Observation; Landsat.

# Project C4 – The National Outfall database project (Clean Ocean Foundation)

Project length – 48 Months

Project start date – 01/07/2015

Project end date – 30/06/2019

Project approval date - xx/xx/xxxx (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - In progress

Project Leader – John Gemmill (FTE – 20%), Dr John Cumming (FTE – 10%)

Lead Research Organisation – Clean Ocean Foundation

Project leader contact details: - [johng@cleanocean.org](mailto:johng@cleanocean.org)

### Project Funding

|  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | TOTAL |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NESP funding | 65,000 | 135,000 | 100,000 | 100,000 | x | x | x | 400,000 |
| Cash co-con | x | x | x | x | x | x | x |  |
| In-kind co-con | 65,000 | 135,000 | 100,000 | 100,000 | x | x | x | 400,000 |
| TOTAL | 130,000 | 270,000 | 200,000 | 200,000 | x | x | x | 800,000 |

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

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:

* A publically accessible national outfall database and reports.
* 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.
* Comparison of geographical regions in sewerage volume and pollution impact.
* Mapping of the database.
* Community engagement in conduct of this research and consumption of the outcomes.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

Updates made to the Knowledge Brokering and Communication Section and the Indigenous Consultation and Engagement Section

### Problem Statements

#### Problem

Description of the specific problem

The performance of existing Australian sewerage treatment plants is thought to be variable with potential residual impacts on human health and the environment. Pollutant load levels around Australia are also very hard to find based and this is exacerbated by data that is either not available, not collected or very hard to find, as well as being inconsistent in terms of quality and specificity.

Governments and the community alike would benefit from being able to prioritise action on sewerage treatment systems with reference to the impacts on both the aquatic environment and the recreational use of the oceans.

There is also a lack of data on the potential for sewerage pollution impacts on sensitive marine areas such as marine Ramsar sites, national marine parks and marine areas under stress from development

#### How Research Addresses Problem

What solution will this research provide?

This project brings existing data together and using analysis and mapping techniques will provide a national perspective outfalls around Australia to assist with identification of pressures on the marine environment

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

This project aligns directly with the NESP Research Priorities for the Marine Biodiversity Hub, specifically:

* Define the impact of sewerage outfalls and stormwater runoff on Australia’s marine environment to identify real actions to improve outcomes for marine water quality. This is to be informed on a national scale by the completion of a national ocean outfall database.

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

The research will address the parameters of outfall flows, pollutant concentrations and loads by initial use of the sewerage treatment company monitoring data and consolidated data determined by regulatory authorities in each state. This data will be cross checked with a program that will utilise community action in a similar way to the program “WaterWatch” which uses the community to monitor fresh water systems, but with a research learning aspect from community knowledge about ocean conditions.

The NOD database will be developed with a mapping function that provides an assessment of the volume and pollution loads per capita serviced in geographical regions. It is recognised that major population centres will have contributions to sewerage inflow from industry, commerce as well as residential wastewater. This will be examined with the view to adjusting volumes and pollutant loads to reflect the impacts of residential wastewater.

A significant amount of work has been undertaken by different state bodies to examine the health and environmental impacts of ocean pollution. This work will be examined and used where possible to improve the outcomes of the research work to develop the NOD.

In reviewing data we will conduct a statistical analysis of data from different outfall studies to identify patterns among study results and to further understand relationships between the multiple studies.  The meta analysis will include:

* A literature and datasets search
* Selection of studies based on quality criteria
* Selection of meta-regression statistical model and multivariate analyses (e.g. simple, fixed-effect meta-regression or random effect meta regression)

The breadth and depth of this analysis will depend on resources available to the study.

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

The project will link to B4, C2, C4 and C5 as well as projects on marine pollution being conducted by the Tropical Water Quality and the Northern Hubs.

* B4
* C2
* C4
* C5
* Tropical Water Quality and Northern Hubs

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

Picks up from Victorian Preliminary Audit 2007 – Clean Ocean Foundation. Now national and with the more comprehensive data set.

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

The outcomes of the research are:

* A national outfall database and reports for public consumption.
* 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.
* Comparison of geographical regions in sewerage volume pollution and impact.
* Mapping of the database.
* Community engagement in conduct of this research and consumption of the outcomes.
* Improvements in outfalls can be tracked using the NOD and improvements in water and wastewater usage efficiency.

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

* Contribute to decision making on funding for wastewater management/infrastructure.
* Provide data the National Pollution Inventory.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

* Collecting standardised data on pollution loads from outfalls and their potential impact on human and marine environment will provide and objective understanding level not possible with current ad-hoc access to pollution data.

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

* The National Outfall Database will be in the form of a publically accessible website and related app.
* Appropriate information brochures on scope of project to stakeholders.
* Media opportunities featuring community involvement.
* Published data will be subject to data accuracy and peer review in accordance with the NESP Data and Accessibility Guidelines, will follow the principles outlined in the NERP Data and Information Guidelines, and reflect current industry standards for data management. Data collected from public agencies is publically available information and will be treated in accordance with the objectives of the Freedom of Information Act 1999 (Cth) and equivalent legislation in each jurisdiction, which require government agencies to make information publically available, subject to certain exceptions listed in that legislation.

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1: project activities plan including responses to the detailed comments by DoE in the Summary Assessment report | Due 30 March 2016 |  |
| Milestone 2: all research users and stakeholders have been engaged, understand project and opportunities for further engagement | Due 30 March 2016 |  |
| Milestone 3: database designed / web site operational and ready for review by project stakeholders | Due 30 June 2016 |  |
| Milestone 4: treatment data for at least one state and one water authority collected for 2015 | Due 30 June 2016 |  |
| Milestone 5: database/web site made public for information that has been peer reviewed | Due 30 December 2016 |  |
| Milestone 6: 1st community monitoring program undertaken and reported (2 states) | Due 30 June 2017 |  |
| Milestone 7: treatment data collected and available for review on database/web-site for at least 3 states for 2016 | Due 30 September 2017 |  |
| Milestone 8: data analysis report 2015 and 2016 | Due 30 December 2017 |  |
| Milestone 9: rankings of participating outfalls and sewerage treatment systems available for peer review | Due 30 December 2017 |  |
| Milestone 10: extended community monitoring program undertaken and reported (all states) | Due 30 June 2018 |  |
| Milestone 11: rankings of participating outfalls and sewerage treatment systems made public | Due 30 June 2018 |  |
| Milestone 12: data analysis report 2017, summarising progress and providing options to complete national coverage for treatment data and/or community monitoring where not yet available | Due 30 June 2018 |  |
| Milestone 13: data analysis report 2018, including geographic comparisons of volume, impact and effectiveness of community monitoring. | Due 30 June 2019 |  |
| Milestone 14: prospectus for continuation of NOD and community engagement available following feedback from all stakeholders | Due 30 June 2019 |  |
| Milestone 15: All project outputs and data publically and freely accessible and available on the internet (see section on data and information management) | Due 30 June 2019 |  |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| John Gemmill | Clean Ocean Foundation | Project director |
| John Cumming | Infotech Research | Technical director |
| Simon Perraton | Clean Ocean Foundation | Project manager |
| Andrew Fischer | University of Tasmania | Advisor |
| Cate Caven | Clean Ocean Foundation | Community Education officer |
| Rebecca Banks, Marci Katz, Meagan Donahue | Clean Ocean Foundation | Project officers |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
|  | Clean Ocean Foundation | Cash |
|  | University of Tasmania | Scholarship to research students 2017 & 2018 (still to be negotiated) |
|  | Surfrider Association | Beach and water monitoring |
|  | Recreational Fishers | Water monitoring |
|  | Local Environment Groups | Beach and water monitoring |

Research End Users and Key Stakeholders **–** Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| All stakeholders in Coastal Sewerage Impacts | Federal and State governments  the water industry  Marine researchers  Recreational marine water using community |  |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| Australian Federal Government | Federal government  IMAS / University of Tasmania  Clean Ocean Foundation |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

The approach to engaging research end-users and stakeholders in this project will be consistent with the Hub’s Knowledge Brokering and Communication Strategy. Research users and stakeholders will be involved in all stages of the project including project scoping, progress updates and development and communication of research outputs. Where possible existing engagement mechanisms will be used to engage research-users and stakeholders.

A critical step in engagement with water authorities and local councils were appropriate is to explain why the project is needed, how it will proceed and intended project outputs and outcomes, for example

* National Database Website and Community ranking of outfalls on a yearly basis beginning at end of 2017. This data will be live and freely accessible to the public.
* Opportunities to publicise the database will be used to build awareness and opportunities to spread datasets into other public systems will be openly investigated.
* This database will be archived and learnings will be published at all opportunities to foster its longevity and usefulness for the marine research community.

Key requirements from engagement with water authorities and local councils are:

* securing their commitment and cooperation for access to sewage outfall data.
* validating results of sewage outfall data analysis
* consulting and soliciting feedback on criteria used to rank sewage outfalls.

The project team will also engage with the Australian Government Department of Environment and Energy to identify and explore specific pathways to impact by informing the development of environmental policies and initiatives on pollution and waste, for example the National Pollution Inventory and potential impacts to Great Barrier Reef World Heritage Area and Ramsar sites.

Community involvement in the citizen science component of the project will grow as the project proceeds, particularly as the project team develops a better shared understanding of the issues and opportunities identified by the variety of partners and stakeholders involved in the project. For example, the project team has identified a number of sites where community involvement are likely to want a better understanding about marine water quality issues or the effect of recent/proposed changes to sewage treatment facilities.

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

This project will collate sewage outfall datasets and citizen science data and produce reports (see milestones). Data and information will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. Datasets will be stored in a long-term secure storage, metadata will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal <http://portal.aodn.org.au/aodn/>

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website <http://www.nespmarine.edu.au>. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

Also access to website directly is available (not public yet) through <http://www.nod.org.au/>

Using the password “clean”

The primary contact point for data and information management contact for this project is the project leader (see details in front page).

Contact person

Name: Dr Simon Perraton

Email Address: simonp@cleanocean.org

Phone Number: 0407 806 668

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 2015 | 2016 | 2017 | 2018 | 2019 | Total (1000) |
| Outfall Analysis N |  | 100 (100) | 40 (40) | 30 (30) |  | 170 |
| Ocean condition and outfall monitoring C |  | 85 (85) | 45 (45) | 55 (55) |  | 185 |
| Ranking Outfalls and Communication R |  | 15 (15) | 15 (15) | 15 (15) |  | 45 |
|  |  | 200 (200) | 100 (100) | 100 (100) |  | 400 |

* In kind contribution from researchers and staff. Community volunteers will contribute significantly more in latter years of project especially in C and R

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

* Australian Coastline, focussed around sewerage outfalls.

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

This project research is considered a category two project for Indigenous engagement because it is highly likely to include a small field component within the project that may involve participation with an Indigenous community, organization or group. A Category two project will be expected to:

* Clearly identify how the research will be relevant and of benefit to Indigenous communities and/or organisations and if not why.
* Ensure the research is conducted according to the highest ethical standards and respects Indigenous priorities and values.
* Explore opportunities for Indigenous engagement, employment, skills transfer, sharing of knowledge and the increase of cultural awareness amongst all parties.
* Develop a process for the generated knowledge, data and research results to be effectively shared and communicated between Indigenous peoples, communities and organisations.

There are two main avenues for Indigenous engagement in this project. The first is through provision of updates to the DoEE Indigenous Advisory Group and the Fisheries Research and Development Corporation Indigenous Reference Group. These groups will also be asked for advice on opportunities to enhance Indigenous engagement in this project. The second avenue is through involvement of Indigenous communities or organisations in citizen science component of the project. The project team will explore opportunities to progress these we possible, for example the project team intends to contact the Indigenous Surf Association to explore their interest to be involved in citizen science aspects of the project.

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

* All treated sewerage outfalls registered across the country will be included in the survey and database of outfalls. This will be undertaken for three years 2016-2018.

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

* The project does not include septic tank discharge, untreated sewerage discharge and pumping station overflows. The database will record treated water recycled but not examine water quality in detail.

### Risks

List all significant risks to the success of the project

Cooperation of relevant water authorities, limited funds for data collection and analysis, community engagement and involvement in monitoring activities particularly in remote areas.

Each element of the project as given presents a risk of inadequate or poor quality of inputs:

* Availability of complete data on outfalls – cooperation of water companies
* Correlation of sea water monitoring with outfall water quality over time
* Correlation of pollution loads with visible impacts on water quality where people use it
* The ability to engage sufficient people to volunteer to undertake a satisfactory monitoring program.

It is unlikely that existing datasets will be complete for each of the registered treated sewerage outfalls. While this will be pursued and we do expect state governments to cooperate, some allowance for data gaps will be required. These gaps can be tolerated in the short term and renewed efforts to fill gaps will be undertaken.

The monitoring program with community involvement will develop with a broad cast of analyses initially to see which pollutant monitoring elements best fit the criteria of marine impact and correlation with overall pollution loads. Ongoing efforts in community education and monitoring support with communication of outcomes will build volunteer enthusiasm and skills in this program.

The NESP Marine Biodiversity Hub Steering Committee requested that UTAS conduct a risk assessment for this project which was developed outside the standard Hub procedures. The risk assessment highlighted the comparative lack of experience of Clean Ocean Foundation in running large research projects, despite the expertise of individual participants. The risk assessment recommended that a senior UTAS researcher, with experience in research project management and coastal water quality be appointed as an advisor to this project. Dr Andy Fischer a lecturer at IMAS has accepted this position.

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

Citizen science, sewerage, coastal, environment, ranking, aquatic pollution

# Project C5 – Quantification of risk from shipping to large marine fauna across Australia

*(previously A2)*

Project length – 30 Months

Project start date – 01/07/2015

Project end date – 31/12/2017

Project approval date - xx/xx/xxxx (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - In progress

Project Leader – David Peel (FTE – 0.5%)

Lead Research Organisation – CSIRO

Project leader contact details: - [David.Peel@csiro.au](mailto:David.Peel@csiro.au), 03-6232 5179

### Project Funding

|  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | TOTAL |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NESP funding | 80,000 | 131,000 | 156,000 | x | x | x | x | 367,000 |
| Cash co-con | x | x | x | x | x | x | x |  |
| In-kind co-con | 85,000 | 141,000 | 166,000 | x | x | x | x | 392,000 |
| TOTAL | 165,000 | 272,000 | 322,000 | x | x | x | x | 759,000 |

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

Given the substantial increases in coastal/port development along the Australian coastline, and 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 and the impact of chronic ocean noise. Research is urgently needed to quantify these risks in both a spatial and temporal context to help develop and implement appropriate management strategies. This project aims to provide directed science (species- and area-specific) to inform decision-making by the Department of Environment in its application of the EPBC Act.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

One of the project leaders has been removed as they have left CSIRO.

Christine Erbe added to the project

Milestone 2.3 timing has been moved from the 30 June 2016 to 31 Dec 2016

Milestone 2.3 timing has been moved from the 31 Dec 2016 to 31 Apr 2017

### Problem Statements

#### Problem

Description of the specific problem

Collisions with ships is a significant cause of anthropogenic mortality to baleen whales and other large marine fauna worldwide. While humpback whales are one of the most frequently reported victims of vessel strikes worldwide, there has been little focus on the impacts of vessel strikes on this or other species in Australian waters. Increasing noise from growing vessel traffic and other marine activities has also been implicated as significant risk to large marine fauna. To better understand these risks and potential impacts of ship strike and ship noise on large marine fauna, it is necessary to accurately assess and quantify risk.

#### How Research Addresses Problem

What solution will this research provide?

The project will provide quantitative estimates of relative and, where possible, absolute risk of ship strike through space and time, based on the integration of data on (1) shipping type, density and speed (i.e., from AIS data) and (2) species distribution/habitat models. These estimates of risk can be used to identify areas and times when there is co-occurrence of at-risk marine fauna and shipping. Using known individual vessel speeds, it will be possible to provide an indication of where and how frequently lethal and/or sub-lethal interactions are most likely to occur. This quantitative assessment will provide the basis for making informed and accurate management decisions for example, mitigation strategies (including, but not limited to, recommendations such as speed reduction zones/times) could be implemented to minimise the impact of vessel strike on marine fauna.

With respect to noise, this project will provide the first steps towards mapping temporal, spatial, and spectral characteristics of resulting shipping noise. These maps will use environmental descriptors and the distribution, density, and acoustic characteristics of human activities within Australian waters to develop first-order estimates of their contribution to ambient noise levels at multiple frequencies, depths and spatial/temporal scales. A similar exercise is presently underway for the USA and this project will build on lessons learned from that process (e.g., NOAA’s SoundMap/CetMap project for an example of sound mapping; see: <http://cetsound.noaa.gov/sound-index>).

Much of the data required to quantify ship strike risk is the same as that required to develop a national ship noise map. For example, both components will require (1) processed data of shipping density, vessel type and speeds to produce vessel density/traffic maps and (2) species habitat models to produce maps of co-occurrence of vulnerable species. This project will include initial scoping and the development of preliminary models of national shipping noise. It may also be possible for the outputs of these models to be assessed and ground truthed against existing data (e.g., data from passive acoustic loggers maintained by the Integrated Marine Observing System (IMOS)) and the potential for integrating it with shipping data.

Furthermore, a workshop will be held in 2017 (i.e., the second year of the project), bringing together relevant Australian researchers and stakeholders to produce a plan to develop a national map of shipping noise, and to discuss the issue more broadly (including the issue of acute noise, such as that produced during oil and gas exploration).

As this project will explore ship strike and shipping noise pollution risk on a number of large marine fauna species around the coastline of Australia, several Commonwealth Marine Reserves, Biologically Important Areas and Key Ecological Features will be covered/included in analyses to some degree. Therefore, results of this project could also potentially inform and/or refine delineation of these areas and features. Findings from this project will support implementation of multiple strategies in four Marine Bioregional Plans, including: provision of relevant, accessible and evidence-based information to support decision-making with respect to development proposals (strategy C); collaboration with industry, to improve understanding of the impacts of anthropogenic disturbance and address the cumulative effects on protected species (strategy D); developing targeted collaborative programs for species recovery (strategy E) Furthermore, results of the project will provide guidance for the further development of the National Ship Strike Strategy, and for future revision of the North East Shipping Management Plan, which will outline how shipping traffic in the Great Barrier Reef is to be managed. Results from this project will also provide guidance for development or revision of Recovery Plans and Threat Abatement Plans and management of Commonwealth Marine Reserves (e.g. strategies 1 and 2 in the South-east Commonwealth Marine Reserve Network Management Plan).

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

This work will be fundamental to the further development of the National Ship Strike Strategy, and conservation and recovery plans for various individual species.

Furthermore, this research would feed into the NESP Marine Biodiversity research priority:

“Identify past and current pressures on the marine environment, and understand their impact to better target policy and management actions. For example, identify the impact of cetacean ship strike.”

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

Work to Dec 2015 – Phase 1

An initial project to begin work on quantifying ship strike for marine animals in Australian waters was approved as a short-term project in the first 2015 NESP cycle. The aims of the short-term project are to produce a qualitative analysis of large marine fauna data and information to identify the best 2-3 examples of species that have both a putative higher risk of ship strike and reasonable quality data on distribution, migration and abundance to support analysis of habitat use. Specifically:

* To coordinate the 2016-2017 project component, we need to identify for which of the at-risk species there is sufficient available data to build distribution/habitat models. A process vital to the success of this work will be engagement and collaboration with key large marine animal researchers. The aim being to work toward developing appropriate distribution models, and to champion/represent this work within the research communities focussed on individual species. These collaborations are being already underway as part of this project.
* Investigation of data sources detailing fatalities or injury, such as the various State stranding data bases and the potential for identifying indications of injury from marine species photographic identification data bases (e.g., whales, dolphins, turtles, dugongs, whale shark).
* The Australian Maritime Safety Authority (AMSA) can provide fine-scale and highly detailed ‘raw’ shipping data from 2012 onwards, which represents the details, locations and speeds of larger vessels operating in Australian waters. In this phase we shall acquire commercial shipping data from AMSA, and proceed with development of processing protocols for cleaning such data for our purposes.
* When examining risks of ship strike for smaller species such as dolphins, turtles, and dugongs, we need to consider the impact of smaller vessels, which are also potentially capable of both lethal and sub-lethal interactions. This data is presently not consistently collected by AMSA. Therefore, a review of the potential for modelling and estimating recreational vessel usage in Australian waters is required (most likely at a small- or regional-scale) with scope for extending to broader regions around the Australian coastline.

Work January 2016

For the species identified as potentially at-risk in Phase 1, and those species with enough data to support further analyses, we will build the most complete distribution models possible, describing species’ distributions in space and time. To reach this goal the following work will be completed:

* Gather and integrate the available data, and build species habit usage models. Some methodological development may be required during this stage to consolidate disparate data types, for example, sighting survey data and movement/satellite tag data.
* To estimate ship strike risk, the AIS data must be cleaned/filtered, and converted from a time based sampling to distance based. Utilising data at the Australian National level will require significant time and computer resources for this grooming and processing. The data is then further processed to produce summary maps detailing features such as vessel density, median speed, etc. Due to the size of the data sets involved, analysis for this work is not trivial. This current processes, protocols and analysis methods will be updated and streamlined, including scaling up for the larger Australia-wide data, to allow data to be processed efficiently.
* By overlaying models of species density and shipping density, relative risk can be estimated to indicate possible areas and times where risk of ship strike is higher. We currently have two risk metrics. The first, known as ‘co-occurrence’, is simply based on the idea that the more vessels and animals using a given location the greater the risk of interaction will be. The second method being developed is based on probabilities and provides a relative index proportional to the expected number of ship strike fatalities, incorporating vessel speed and beam, and animal dive behaviour. Some further methodological development will be done on both of these risk measures.
* When examining risks of ship strike for smaller species such as dolphins and turtles, we need to consider the impact of smaller vessels, which are also potentially capable of lethal and sub-lethal interactions. The AIS shipping data doesn’t contain many records for smaller, recreational vessels (i.e., those vessels not required to carry AIS equipment) and, therefore, modelling the risk of ship strike for such species, will need to be augmented with supplementary information from sources such as the Moorings Database, or the Small Boat Registrations, for various States and Territories. Given this broad-scale information, we can potentially build a general map of small vessel distribution and produce regional comparisons of ship strike risk. However, this is likely to be high-level and fine-scale risk maps will probably not be possible given the limited data available on small vessel traffic.
* In June 2015, during a stakeholder meeting for the presentation of results of modelling the risk of ship strike for humpback whales in the Great Barrier Reef, attendees suggested they were interested in quantification of ship strike risk in terms of absolute numbers of fatalities and injuries. For species where there is data available on ship strike fatalities and injuries (e.g., most likely to be various sea turtle species), models of the relationship between shipping density and fatality rate may be possible to allow the conversion of relative risk to absolute risk. Where data is not available, expert elicitation and worldwide findings may be used to provide some indication to rank of species’ absolute risk. We shall investigate evidence of ship related mortality in data sources such as the various State stranding data bases and the potential for identifying indications of injury from photo identification data bases.
* With regard to working towards a better understanding of the extent and impact of shipping noise, much of the work planned to address ship strike risk is also relevant for the noise issue. That is:
  + Processing and mapping the shipping density, vessel type and speed is the first step toward producing general maps of shipping noise (for example NOAA link).
  + Having species habitat models can allow us to produce maps of co-occurrence of vulnerable species and shipping noise.
* To produce general maps of shipping noise from the AIS shipping data work will be done on the acoustic modelling. The potential for using existing data shall be examined (e.g., data from IMOS passive acoustic loggers) to help build and validate these models. These maps will feed directly into NESP project C1 and form part of the suite of data/information available within that project.
* Finally, a workshop will be held in 2017 (i.e., the second year of the project), bringing together relevant Australian researchers and stakeholders with the aim of producing a collaborative plan to develop a national map of shipping noise, and to discuss the issue more broadly (including the issue of acute noise from processes such as oil and gas exploration, for example).

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

As part of this research, existing distribution data and models of large marine vertebrates will have to be identified and consolidated, which could also feed into the NESP Threatened Species research priority:

“Improved information on the distribution of threatened species and ecological communities to better pinpoint their location. Including the review of current species distribution models, and incorporating the capacity for species to adapt to climate change.”

This research will potentially engage with the following NESP projects:

Project D1: North West Shelf

The shipping data and ship strike risk methodologies can be applied to any models the project produces. Conversely, any relevant data/models collected in project D1 can possibly inform our more general habitat models.

Project C1: Improving our understanding of pressures on the marine environment

The project on risk to marine fauna from shipping (ship strike and noise) has strong links and integration with NESP project C1, with our final risk maps adding to the overall picture of pressures that Project C1 will be quantifying. Furthermore, the AIS data acquisition and initial processing/cleaning will be done with engagement and coordination with the work done for project C1. Other data/models developed in the project may be of interest or done in collaboration with Project C1, e.g. general probability map of approximated small vessel distribution. Finally, habitat models developed under this project on risk of shipping to marine fauna may be useful when looking at other risks covered by project C1.

The project should have linkages with the following organisations:

Geoscience Australia

Geosciences Australia is engaged in surveys that may collect data useful to the project so there will be future discussions.

IMOS (Integrated Marine Observing System)

The IMOS network will be extremely useful in terms of data and expertise for the noise/acoustic modelling component. This link will be developed further once the project commences.

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

This project is related to a previous Australian Marine Mammal Centre (AAD) project:

**AMMC project 13-46**: Quantitative assessment of the risk of shipping traffic to whales: a case study for humpback whales in the Great Barrier Reef.

This project will benefit from leverage from a number of methodological developments made within AMMC 13-46, specifically:

* AIS data processing, protocols and analysis (in collaboration with scientists from NOAA in the USA).
* Habitat modelling of east-coast Australian/Great Barrier Reef humpback whales should help in developing a similar models for other populations (e.g. West-coast Australian humpback whales) or other cetacean species.
* Some of the methodological developments for how to combine the shipping and animal distribution maps to produce indications of relative risk of vessel-animal interaction are directly of use in this project.

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

Phase 1: For work up to Dec 2015 (i.e., RPV1)

* The Commonwealth Department of Environment (DOE) and other stakeholders will have a short-list of species at risk of ship-strike that are best suited for detailed analysis.
* DOE, related NESP hub projects, and other stakeholders will have a better understanding of the availability and extent of data/distribution models for at-risk marine species. This will involve an assessment of data deficiencies in terms of coverage of data/models to inform future resource allocation to surveys and other data collection.
* As part of a collaboration, the related NESP projects will have access to a single source of cleaned and processed AIS data (dated from 2012 onwards).

Phase 2: For work from Jan 2016 (i.e., RPV2)

* DOE and other stakeholders will have a better understanding of shipping density and speed.
* DOE, related NESP hub projects, and other stakeholders will have a better understanding of national distribution and habitat usage of the key species identified in Phase 1 of the project.
* DOE and other stakeholders will have a better understanding of national ship strike risk for key species selected in Phase 1.
* DOE and other stakeholders will have a better understanding projected future risk (for key species selected in Phase 1) based on projected shipping growth and animal population predictions (where available).
* DOE and other stakeholders will have a better understanding of the absolute risk of ship strike on marine fauna, where such estimates are feasible and their uncertainty.
* DOE and other stakeholders will have a better understanding of the issue of shipping noise, preliminary maps proof of concept for general shipping noise mapping and a roadmap for future work.

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

Information collated and synthesised during Phase 1 will provide information for funding bodies, various stakeholders and marine fauna (i.e., mammal, turtle, dugong) researchers to consider when making decisions such as prioritising future allocation of resources to study animal distribution, specifically for locations and species for which more information is needed in terms of quantifying risk from ship strike.

Ultimately, the final outcome of the project would be to produce a comprehensive report on national risk from ship strike to the limits of current data and knowledge (e.g., species risk maps). From these risk maps, spatial and temporal mitigation strategies and recommendations could be implemented to minimise the impact of vessel strike large marine fauna. These could range from ‘no action required’ through to active management, including options such as:

* Speed reduction zones at certain times as the methods developed in the project can potentially quantify the reduction in risk associated with various management scenarios.
* Requirements for increased observation of marine mammals in the path of vessels by bridge crew in higher risk areas.
* Modification of vessel routes to avoid areas of higher animal density.
* Recommendations for further targeted small-scale surveys to establish fine-scale spatial animal distribution in the identified risk areas, or surveys to establish and map small recreational vessel density.

These outcomes can inform management and administrative decision-making by the Department of Environment in its application of the EPBC Act. Findings from this project may also contribute to strategies repeated in the various marine bioregional plans, including: provision of relevant, accessible and evidence-based information to support decision-making with respect to development proposals that come under the jurisdiction of the EPBC Act; and, in collaboration with industry, to improve understanding of the impacts of anthropogenic disturbance and address the cumulative effects on the/a regions key ecological features and protected species. Furthermore, results of the project will provide guidance for the further development of the National Ship Strike Strategy, and for future revision of the North East Shipping Management Plan, which will outline how shipping traffic in the Great Barrier Reef is to be managed. Results from this project will also provide guidance for development or revision of Recovery Plans and Threat Abatement Plans.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

The ultimate value to the environment would be reduced pressure on at-risk marine fauna arising from management decisions informed by this research. Some major outcomes of this project include:

* A prioritisation list of marine species for which we think ship strike may be an issue and, equally importantly, species for which we assess there as being a lower or no risk.
* A quantitative assessment of areas and times where and when risk is likely to an issue for key marine megafauna.
* A quantitative assessment of the utility of possible mitigation and management measures (e.g., speed limitations, alternative shipping routes).
* Overall, all these models will allow for the effective and appropriate allocation of resources and actions by management agencies commensurate with risk.

However, for many of the species, the prevalence of ship strike and impacts of noise is difficult to ascertain (particularly given a lack of physical evidence), so measuring the effectiveness of management and value to the environment is also difficult. Some potential monitoring methods could be available such as via comprehensive vessel based monitoring or for land based monitoring for species where fatalities are washed ashore and recorded. However, even this would need an ongoing measure of relative abundance; otherwise, any inferred change in ship strike incidence may be confounded by a putative change in abundance.

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

Outputs for the phase 1 2015 (RPV1)

* Initial scoping report of ship strike risk summarising what is currently known about species that were tentatively nominated as being at-risk for ship strike, the data available, shipping size/type data needed and recommendations on what species to investigate further with a qualitative ranking from easiest to most difficult.
* AIS data base for the Australian EZ and initial processing protocols.

Outputs for phase 2 2016-2017 (RPV2)

* Full Australia-wide fine-scale shipping density and average speed maps for 2012 – present including information such as vessel length, beam and draft. This data will directly feed into future noise mapping.
* A national map of approximate density of small vessel distribution based on available proxies such as population density, boat registration data and boat ramp locations.
* A suite of distribution and density surfaces for the various species nominated during Phase 1.
* Spatial and temporal risk profiles for selected species. The risk maps will range from full fine-scale maps when data is present, to coarse-scale ‘regions of concern’ for species where distribution data is limited to approximate extent.
* An updated version of a database of ship strikes (historical and recent) within the Australian EEZ Report on national ship strike risk to the limits of current data and knowledge.
* Report on our ship strike risk methodological developments.
* Report on initial shipping noise mapping.
* Report on the recommendations and findings of the 2017 workshop on chronic noise in the marine environment.
* Reports to IWC Human Impact Sub-committee.
* Manuscripts on historical Australian Ship strike data will be submitted to an appropriate academic journal

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1  **Deliverable**: Report summarising at-risk species, data availability and recommendations on species. Species will be grouped into three tiers of based on importance and feasibility.  **Key end-users:**  AMMC, DoE and specific researchers/interested parties identified in end-user section. | Due 31 December 2015 |  |
| Milestone 2.1  **Deliverable:** Establish channel of communication (ostensibly, email and phone) with nominated stakeholders. So that all research users and stakeholders understand the project and how it relates to their interests | Due 31 March 2016 |  |
| Milestone 2.2  **Deliverable:** Updated Australian EEZ historical reported ship strike data base  **Key end-users:** AMMC, DoE – to report to the IWC Human Induced Mortality (HIM) subcommittee | Due 1 June 2016 |  |
| Milestone 2.3  **Deliverable:** Risk Map of first test species  **Key end-users:**  - AMMC, DoE - for use in developing the National Ship Strike Strategy, and informing relevant conservation and recovery plans for specific individual species.  - Species specific researchers/interested parties identified in end-user section. | Due 31 Dec 2016 |  |
| Milestone 2.4  **Deliverable:** Initial National maps of shipping density and speed and summary of recreation vessel information  **Key end-users:** DoE, other NESP projects/researchers | Due 31 December 2016 |  |
| Milestone 2.5  **Deliverable:** Risk Map of second tier of species  **Key end-users:**  - AMMC, DoE - for use in developing the National Ship Strike Strategy, and informing relevant conservation and recovery plans for specific individual species.  - Species specific researchers/interested parties identified in end-user section. | Due 31 April 2016 |  |
| Milestone 3.1  **Deliverable:** Risk Map of third tier of species  **Key end-users:**  - AMMC, DoE - for use in developing the National Ship Strike Strategy, and informing relevant conservation and recovery plans for specific species.  - Species specific researchers/interested parties identified in end-user section. | Due 1 June 2017 |  |
| Milestone 3.2  **Deliverable:** Preliminary map of shipping noise  **Key end-users:**  - AMMC, DoE - for use in conservation and recovery plans for specific individual species.  - All stakeholders – for discussion at workshop | Due 1 June 2017 |  |
| Milestone 3.3  **Deliverable:** Workshop on shipping ocean noise  **Key end-users:**  AMMC, DoE, AMSA, GBRMPA, DoD – to allow input/engagement on a plan for future research on ocean noise issues. | Due July 2017 |  |
| Milestone 3.4  **Deliverable:** Refined National maps of shipping density and speed and small non-AIS vessel information.  **Key end-users:** DoE, other NESP projects/researchers | Due 31 September 2017 |  |
| Milestone 3.5  **Deliverable:** Report on national shipping risk to the limits of current data and knowledge  **Key end-users:** All end-users and stakeholders. Particularly for AMMC/DOE for use in National Ship Strike Strategy, and conservation and recovery plans for specific individual species. | Due 31 December 2017 |  |
| Milestone 4  **Deliverable:** All project outputs and data will be made publically and freely accessible and available on the internet (see Data and Information Management section) | Due 31 December 2017 |  |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| David Peel (0.5 FTE) | CSIRO | Statistician/Shipping data/ship strike |
| Josh Smith (0.3 FTE) | Murdoch University | Marine Mammal scientist |
| Toby Patterson (0.15 FTE) | CSIRO | Modeller – tagging/movements |
| Simon Childerhouse (0.05 FTE) | BPM | Marine mammal scientist |
| Cristine Erbe ( 0.2 FTE) | Curtin University | Acoustician/Acoustic modeller |
|  | AIMS/GA/UTAS | Potential collaboration on specific species/areas or certain modelling aspects as they arise |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
|  | CSIRO | Cash and co-investment |
| Jessica Redfern | NOAA | Ecologist/ship strike  Co-investment |
| TJ Moore | NOAA | AIS shipping data expert  Co-investment |
|  | Murdoch University | Co-investing staff overhead costs. |
|  | Curtin University | Co-investing staff overhead costs. |

\* Depending on species and data availability that is established in Phase 1 of the project, other contributors/organisations may potentially be engaged. e.g., researchers at UQ, SCU, JCU.

Research End Users and Key Stakeholders **–** Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| Australian Marine Mammal Centre (AMMC) /Australian Antarctic Division (AAD) | Mike Double; Elanor Bell |  |
| Department of the Environment (DoE) | Sylvana Maas/Peter Benson |  |
| Australian Maritime Safety Authority (AMSA) |  |  |
| International Whaling Commission (IWC) | Human Induced Mortality (HIM) subcommittee  Russel Leaper  Fabian Ritter |  |
| Australian Marine mammal and turtle researchers   * Acoustics * Dugong * Turtle * Dolphin * Humpback whale * Southern right whale * Whale Shark * Other species | Doug Cato (DSTO) Helene Marsh (JCU)  Russ Babcock (CSIRO)  TBC  TBC  John Bannister (WA museum)  Barry Bruce (CSIRO)  TBA |  |
| Great Barrier Reef Marine Park Authority (GBRMPA) | Andrew Simmonds |  |
| All State and Territory Governments   * MSQ | various |  |
| Threatened Species Commissioner (DoEE) | Gregory Andrews |  |
| Department of Defence (particularly the Defence Science and Technology Organisation) | Steve Cole |  |
| National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) | Christine Lamont/Cameron Sim |  |
| Parks Australia | Amanda Parr |  |
| Australian Marine Mammal Centre (AMMC) /Australian Antarctic Division (AAD) | Mike Double; Elanor Bell |  |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| AMMC/AAD | Mike Double/Elanor Bell/Brian Miller |  |
| DoE | Sylvana Maas/Peter Benson |  |
| AMSA | Paul Irving |  |
| IMOS | Ana Lara-Lopez |  |
| International Fund for Animal Welfare (IFAW) | Rebecca Keeble |  |
| APPEA | Libby Howitt |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

The approach to engage research end-users and stakeholders will be consistent with the direction provided in the Hub’s Knowledge Brokering and Communication Strategy. The main pathways to policy impact for the ship strike component will be via providing knowledge and data to inform revision of the National Ship Strike Strategy and its subsequent implementation.

Research end-users and stakeholders will be involve at all stages in the project, including project scoping, project updates and development and communication of project outputs. Where possible existing engagement mechanisms will be used to engage stakeholders and research end-users. Multi-stakeholder workshops will also be used to communicate research progress and results and validate research direction and alignment with priorities. A multi-stakeholder workshop will be convened in 2017 as a key mechanism to engage with stakeholders and research-users to explore options and understanding to develop a national noise map for shipping. completion the ship strike risk maps and noise map will integrated with project C1’s to form one of a number of national pressure layers available to research-users via the AODN (see section on data management .

Also there are a variety of known and potential end-users, stakeholders and partners for this project as indicated in the Table above. The project will communicate results (as appropriate, at regular intervals, and potentially with the need for permission from original data custodians). Packaging and delivery of such will be sensitive to the context in which information will be received and used (i.e. it will be fit-for-purpose). The key outputs of the project will generally be in the form of: maps and associated spatial data products; reports will be available via the Hub’s Data Management Framework to provide open and easy access. Finally, where possible, methods will be published as scientific papers (after receiving necessary approvals), in open-access journals (where possible and appropriate).

Contact person

Name: Dave Peel

Email Address: [David.Peel@csiro.au](mailto:David.Peel@csiro.au)

Phone Number: 03-6232 5179

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

This project will collate species distribution and shipping movement and pressure datasets and produce reports that include species distribution and pressure maps (see milestones). Data and information will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. Species distribution datasets will be stored in a long-term secure storage, metadata will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal <http://portal.aodn.org.au/aodn/>

Spatial data layers of results, models, summaries, etc, of both species distributions and shipping-associated features, will be provided to the DoE at various spatial scales and extents, including Marine Bioregions and Commonwealth Marine Reserves, Key Ecological Features and Biologically Important Areas.

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website <http://www.nespmarine.edu.au>. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

The primary contact point for data and information management contact for this project is the project leader (see details in front page).

Contact person

Name: Dave Peel

Email Address: [David.Peel@csiro.au](mailto:David.Peel@csiro.au)

Phone Number: 03-6232 5179

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

Majority of the funding will be used for staffing and meeting key data custodian/researchers/stakeholders. $20k is budgeted for the workshop in 2017, to bring together researchers and stakeholders to develop a roadmap for the issue of noise.

There was an increase in budget from the initial draft 2015 proposal, to incorporate the noise issue, notably the funding of the workshop and extra project team time and the addition of an acoustic modeller to the project. There is potential to use this investment to source external funds to increase the acoustic modelling capability further.

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

The research impact will be at the National level.

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

This project is predominantly a desktop analysis and does not include a field work component, therefore is considered to be Category 3 project in terms of indigenous engagement. Our approach to engagement will primarily involve provision of updates to the DoEE Indigenous Advisory Group the Fisheries Research and Development Corporation Indigenous Reference Group. These groups will also be asked for advice on opportunities to enhance Indigenous engagement in this project. Furthermore, we will ensure, via discussion with the hub, and the species researchers, that opportunities to seek consultation and engagement with the Indigenous community are identified and where appropriate are explored. We will also ensure that if any existing data we use incorporates Indigenous intellectual and/or traditional knowledge that permission is granted for its use and this input is acknowledged and respected. Our approach will be consistent with the Hub’s Indigenous Engagement and Participation Strategy.

Contact person

Name: Dave Peel

Email Address: [David.Peel@csiro.au](mailto:David.Peel@csiro.au)

Phone Number: 03-6232 5179

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

All species in Australian national waters at potential risk from ship strike injury and general mapping of shipping noise.

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

This project will not look at other shipping risk to the ocean environment (for example oil spills, non-animal vessel collisions/grounding or biosecurity issues with bilge/ballast water).

No field work is included in this project, but rather the identification of knowledge gaps and need of further data collection.

A final component of quantifying the risk from noise is an understanding of the biological effects/response on individual species this will not be within the remit of this project, but shall be discussed at the workshop.

### Risks

List all significant risks to the success of the project

The main risk to the project is difficulty finding enough accessible data to build distribution models. To minimise this risk, extra effort, especially in the first stage of the project, will be put towards building engagement and collaborations with key researchers and relevant industry groups. Also, identification of the absence of appropriate data is useful to identify future survey work for relevant researchers. The project has collaboration with the Murdoch University Cetacean Research Unit, and engagement with AMMC and industry consultants. It is planned that the project will use these established engagement pathways with marine fauna researchers and industry data owners to enable the development of collaborative access to suitable data to build the species distribution models.

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

Marine mammal; large marine vertebrates; ship strike; shipping noise; cetacean; risk; Distribution.

# Project D1 – National data collation, synthesis and visualisation to support sustainable use, management and monitoring of marine assets

Project length – 3.5 Years

Project start date – 01/07/2015

Project end date – 31/12/2018

Project approval date - TBC (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - Submitted for re-approval

Project Leader – Karen Miller (FTE – 25%); Scott Nichol (DIC FTE – 5%)

Lead Research Organisation – Australian Institute of Marine Science

Project leader contact details: - [k.miller@aims.gov.au](mailto:k.miller@aims.gov.au), 08-6369 4007; [scott.nichol@ga.gov.au](mailto:scott.nichol@ga.gov.au), 02-6249 9346

### Project Funding

|  | 2015 | 2016 | 2017 | 2018 | 2019 | TOTAL |
| --- | --- | --- | --- | --- | --- | --- |
| NESP funding | AIMS 221,000  GA 65,200  UWA 85,000 | AIMS 220,000  GA 130,000  UWA 159,000 | AIMS 160,350  GA 140,000  UWA 20,000  UTAS 30,000  CSIRO 30,000 | AIMS 160,350  GA 140,000  UWA 20,000  UTAS 30,000  CSIRO 30,000 | x |  |
| NESP total | 371,200 | 509,000 | 380,350 | 380,350 |  | 1,640,900 |
| Cash co-con | x | x | x | x | x |  |
| In-kind co-con | AIMS 174,112  GA 95,000  UWA 85,000 | AIMS 319,000  GA 135,000  UWA 170,000 | AIMS 140,350  GA 140,000  UWA 20,000  UTAS 30,000  CSIRO 30,000 | AIMS 140,350  GA 140,000  UWA 20,000  UTAS 30,000  CSIRO 30,000 | x |  |
| In-Kind Total | 354,112 | 624000 | 360,350 | 360,350 |  | 1,698,812 |
| TOTAL | 725,312 | 1,133,000 | 740,700 | 740,700 | x | 3,339,712 |

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

Effective management of marine assets requires an understanding of ecosystems and the processes that influence patterns of biodiversity. Through collation and synthesis of existing data this project will improve access to, and the useability 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 the 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.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

In 2017 this project will broaden in scope from beyond the North and NW regions to encompass a national scale, while maintaining a focus on CMRs. Key national scale marine environmental datasets will be updated and used to develop new descriptions of CMRs in the national CMR network. More detailed synthesis of the ecosystems in selected CMRs, identified through the National Prioritisation Workshop scheduled for early 2017, will build on the experience and knowledge gained from developing synthesised data products developed for the NW, especially the Oceanic Shoals CMR and the Glomar Shoals. The project will also build on priority stakeholder needs identified through Workshops held in 2015/16 (see Przeslawski et al. 2016), by development of new synthesis and visualisation products for the Kimberley and Gascoyne CMRs, and/or areas prioritised at the National Prioritisation Workshop, including predictions of the nature and extent of benthic and demersal fish communities where there is sufficient existing data (see Przeslawski et al 2015). Visualisation will include synthesis products for spatial data and knowledge (e.g. maps, figures and summaries) delivered via the Northwest Atlas and other products developed in consultation with end-users (see Knowledge Brokering and Communication Section). The expansion to national-level data collation in 2017 will underpin the roll-out of similar approaches in reserves in other regions as prioritised through the National Prioritisation Workshop in 2017 (e.g. Flinders, Tasman Fracture and/or Lord Howe). Together the national coverage of CMRs using readily available data and more detailed syntheses for selected CMRs will provide a foundation on which to continue with Parks Australia to improve knowledge and public appreciation of biodiversity in CMRs nationally.

Note: The reduction in project budget from 2016 to 2017 is due largely to removal of marine surveys (field work) and associated research-user/stakeholder/Indigenous engagement costs and the partial reassignment of researchers from UWA to project D2. The skills mix in the revised researcher team is designed to ensure delivery of data and related visualisation products and spatial modelling products.

Przeslawski, R., Miller, K., Nichol, S., Bouchet, P. Huang, Z. Kool, J., Radford, B., Thums, M. (2015). NESP Project D1: 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 to the NESP Marine Biodiversity Hub. 28pp

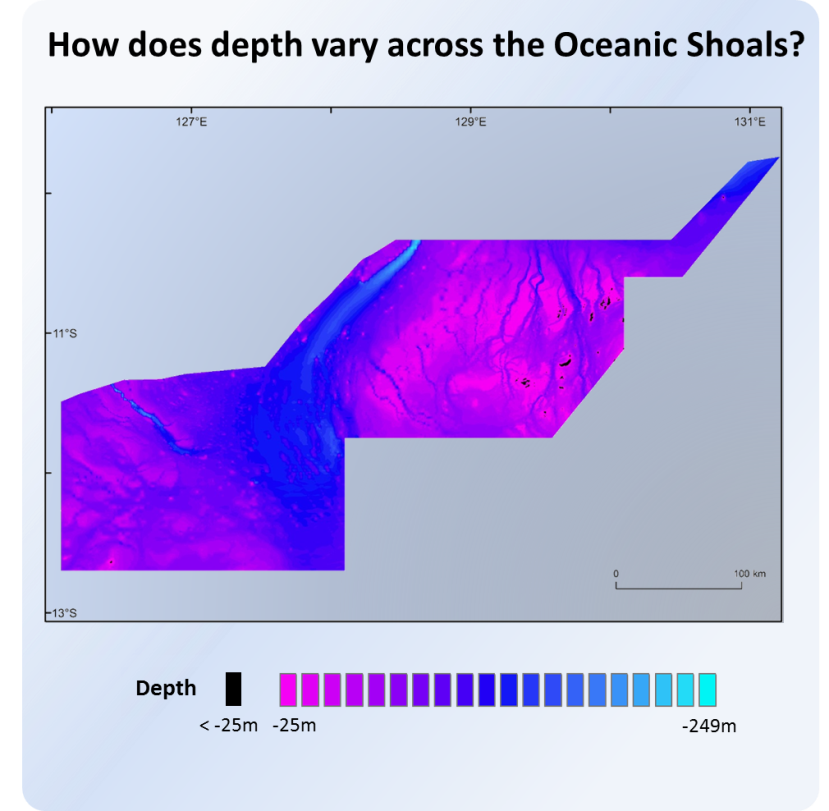
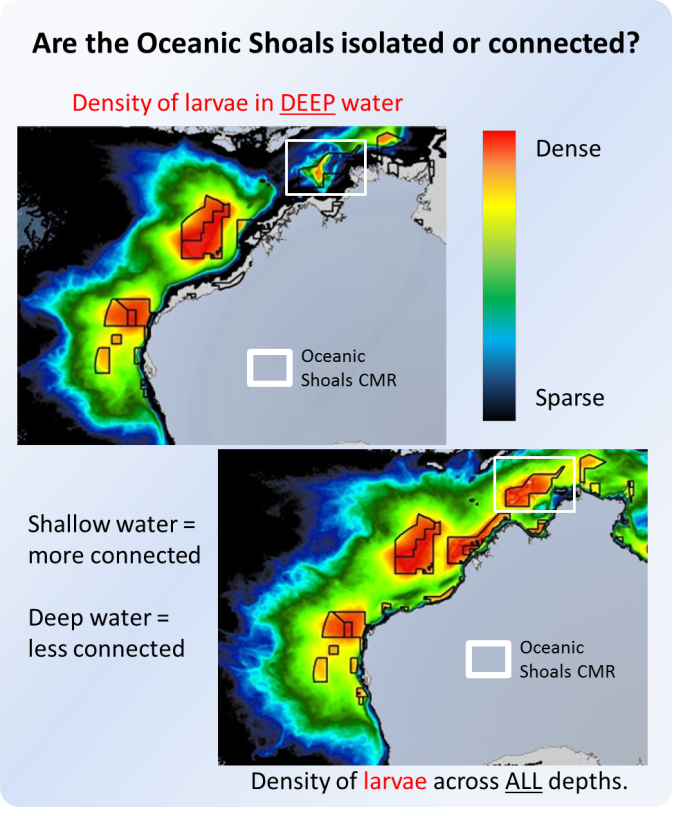
Przeslawski, R., Miller, K., Meeuwig, J. (2016) NESP Project D1: Ecosystem understanding to support sustainable use, management and monitoring of marine assets in the North and North-west regions. Stakeholder Workshop Report to the NESP Marine Biodiversity Hub. 23pp

### Problem Statements

#### Problem

Description of the specific problem

Knowledge of natural assets and their biological value is needed to underpin planning, monitoring and sustainable development throughout Australia’s Marine Estate. Essential to the dissemination of this knowledge is easy access to relevant, readily useable marine data and derived information. To begin to address this problem, in 2015/16 Project D1 focussed on characterising biodiversity and natural assets in Northern Australia through data collation and integration, with an initial focus on synthesising information to build on knowledge gained through previous investment in CERF and NERP. This has resulted in synthesised data products for the Oceanic Shoals CMR and Glomar Shoal KEF being easily available for stakeholders and managers through the Northwest Atlas website and has included visualisation of spatial data to facilitate understanding and uptake (e.g. Figure 1) and will underpin decisions around monitoring and management at a CMR scale. The approach developed to date for the NW and Oceanic Shoals CMR, which has had strong end-user uptake and endorsement, will be discussed at the National Prioritisation Workshop and proposed as a template for this project going forward.



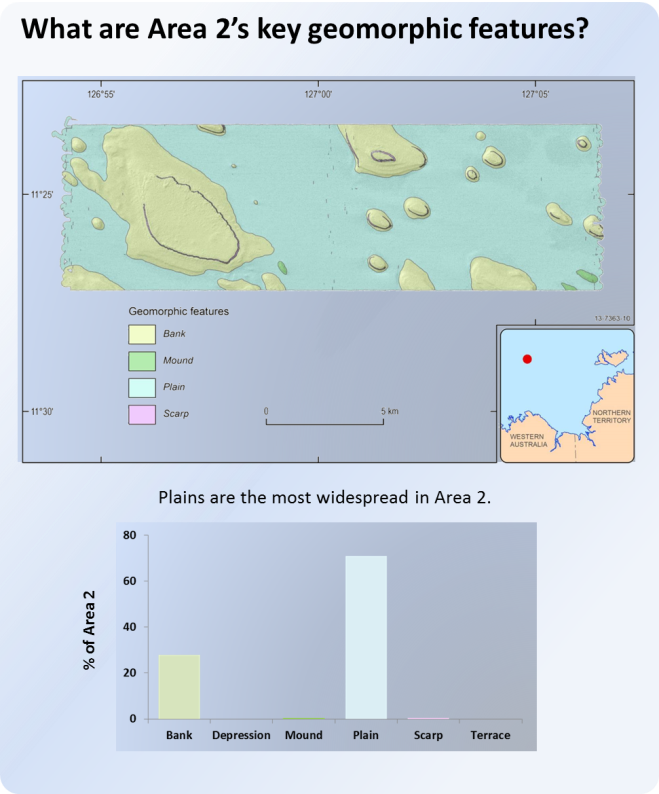
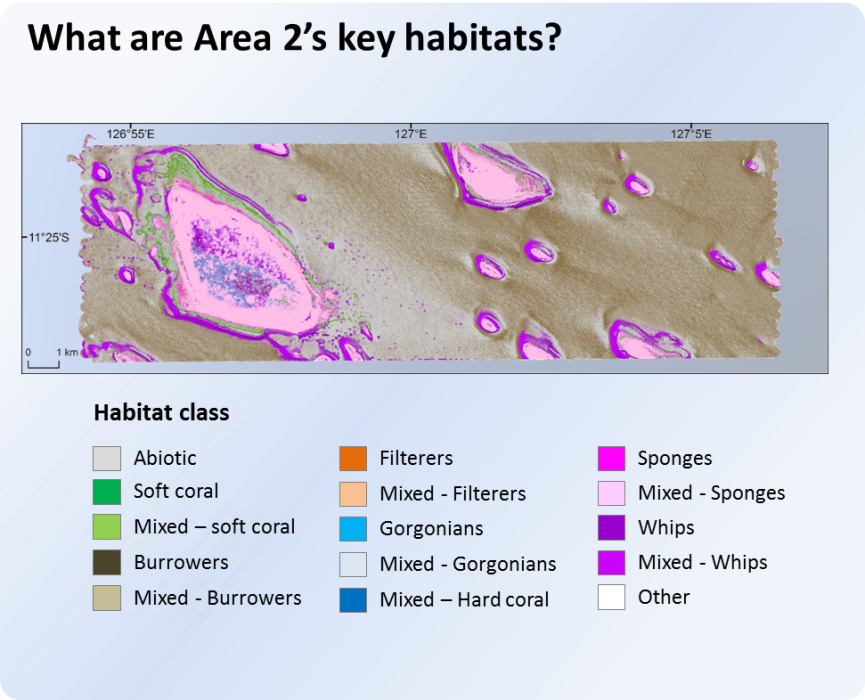


Figure 1: Example data coverage for the Oceanic Shoals CMR (e.g. depth), connectivity predictions for the Oceanic Shoals CMR and benthic habitat predictions for one section (Area 2 surveyed in NERP) of the Oceanic Shoals CMR available on the Northwest Atlas through work undertake in Project D1 to date. See [www.northwestatlas.org](http://www.northwestatlas.org) for more detail.

Ensuring ecologically sustainable use of the Commonwealth marine area is a major national challenge involving multiple government, industry and community stakeholders including the oil and gas, tourism and fishing sectors, the Wildlife, Heritage and Marine Division of the Department of the Environment and Energy (DoEE), Parks Australia, Department of Industry, NOPSEMA, Department of Fisheries and other Commonwealth and State Government agencies. A key responsibility of DoEE and other agencies is ensuring that management actions are delivering conservation outcomes while supporting sustainable use of marine resources. Management includes initiatives such as the establishment of the CMR network, threatened species recovery plans; oversight of industry regulation; and information to underpin and assess the effectiveness of these management activities is critical. For instance, following the release of the CMR zoning review, Parks Australia will be working to develop network management plans and to monitor CMR performance nationally against specific objectives. Baseline knowledge of assets, their inherent values and their current status is needed to underpin this process; a requirement that is echoed in the National Marine Science Plan 2015-2025. In addition, environmental compliance and risk mitigation across a range of industries (e.g. oil and gas, fishing, tourism) will be strengthened when areas at risk can be assessed in a broader bioregional context, including the rarity/uniqueness of habitats and natural levels of environmental variation.

The risks associated with management in the absence of knowledge are recognised, however the challenge presented across Australia is that the marine estate is large and remote, restricting our capacity to gather comprehensive baseline data of values, status, functioning and pressures across the region. The scale of regional predictive models developed under CERF and used to support planning the CMR network and developing IMCRA 4 do not have the level of resolution needed to establish baselines or monitor impacts. However, significant investment in knowledge generation through programs such as CERF, NERP, WAMSI, IMOS, State-based activities and joint industry/government research collaborations has generated considerable empirical information that has been the foundation for the development of fine-scale spatial predictive models for focal areas. Regional, national and focal area datasets and model outputs can now be used to synthesise and predict the extent of biodiversity assets at a scale relevant to management, and to inform monitoring. For example, AIMS research combines physical and biological data from submerged reefs and shoals to estimate the extent and nature of benthic habitats (Figure 1), including within marine reserves and across KEFs (e.g. carbonate banks of the Sahul Shelf, pinnacles of the Bonaparte Basin, and waters surrounding emergent reef such as the Scott Reefs, Ashmore Reef, Rowley Shoals, Ningaloo and Glomar Shoal). Similarly, the GA national canyon database and 4D connectivity model can be used to examine likely connections through larval dispersal within and among CMRs across Australia to assess the efficacy of CMRs as networks. FishAtlas data and information from commercial fisheries can also be used to identify where endemic species or hotspots of abundance/diversity occur. Likewise, data on pelagic species and megafauna migrations can identify important corridors and foraging grounds e.g. for flatback turtles. An opportunity exists therefore to utilise existing data and models to strategically improve the ability of end users to greatly improve their knowledge of the CMR network through the generation of more accessible and end-user focused data products.

#### How Research Addresses Problem

What solution will this research provide?

The main focus of this project is to leverage prior investment in data collection under CERF, NERP and through the research of Partner Organisations, to develop improved and more accessible descriptions of natural assets in the CMR network that will enhance the knowledge base for managers and raise public appreciation of their environmental value. Based on the outcomes from Science and Stakeholder workshops conducted in 2015 and 2016 as part of Project D1, we have been able to assess the extent of data availability and stakeholder priorities to refine targeted focal areas for ongoing work in Northern Australia in 2017 as the prediction of the extent of benthic habitats/communities in the Kimberley and Gascoyne CMRs. The outcomes of these workshops will be reviewed in the national context in the National Prioritisation workshop in early 2017. In addition, formal gap analyses undertaken through 2015/16 have identified key information gaps relevant to the management of CMRs in the North and Northwest and will be used, in consultation with DoEE staff, to prioritize and plan future activities necessary to fill the most important data gaps relevant to management and monitoring of the CMR network. The roll-out of this approach in additional marine regions nationally in 2017 will be based on the success of our collation and synthesis approaches in 2015/16.The project is proceeding as a three step process:

* Collation and synthesis of information to support the visualisation of key ecosystem attributes for CMRs
* Identify and prioritise opportunities to fill data gaps, based on formal gap analysis and the information needs of DoEE and in conjunction with Project D3 in ways that will maximize the gain of new information for these priority areas to underpin monitoring and to consolidate our understanding of biodiversity values and ecosystem function; and
* Apply equivalent approaches in marine regions nationally, based on NW regional learnings.

Access to information is fundamental to effective decision-making. This project will contribute to the ongoing development of eAtlas, initially the Northwest Atlas ([www.northwestatlas.org](http://www.northwestatlas.org)), Ningaloo Atlas ([www.ningaloo-atlas.org.au](http://www.ningaloo-atlas.org.au)) and the Northern Atlas (prototype scheduled to be operational in November 2016), and provide a foundation for development of a national information portal to be scoped at the National Prioritisation Workshop (e.g. a CMR eAtlas). The Atlas allows managers, regulators and industry stakeholders to access synthesised data products through maps. E-Atlas tools are a proven product and their uptake has already been demonstrated via industry co-funding and the utilisation of data from the Ningaloo Atlas to underpin EIAs and risk assessments. Furthermore, the user-friendly interface of the NW Atlas and links to social media will strengthen public engagement and understanding of the value of the marine environment in the North and NW regions. The project will also investigate options for integrating linked-open data search capability (developed in project B3 in 2015/16) into the existing eAtlas infrastructure, and for delivering to other portals such as National Map.

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

This project aligns with several key marine biodiversity research priorities identified by DoEE. Through increased knowledge generation based on the consolidation of existing data and synthesis approaches generated through significant past investments by CERF, NERP and collaborating institutions, this project will provide new integrated information on the marine assets to *improve our knowledge of key marine species and ecosystems to underpin their better management and protection*. This knowledge will be accessible to end-users through the Northwest Atlas, new E-Atlases (e.g. Northern Atlas), and where possible through additional portals as determined in consultation with Parks Australia, and through communication documents (e.g. fact sheets, full colour brochures, etc.). In addition, this project will contribute to the development of *practical and repeatable methods for monitoring the status and trends of key marine species and environments* through the synthesis ofbaseline data that can be used to understand the spatial distribution of diversity, supporting project D2 (Standard Operating Procedures). The work already undertaken in this project, focused on the NW region in 2016, provides an effective framework for the extension to other areas nationally in 2017 and beyond. It builds on other regional work (Great Barrier Reef, Torres Strait and the South West of Australia), where regional approaches have provided significant steps forward in building a national picture of our marine environment.

This project also addresses the Clean Water component of the Cleaner Environment Policy, by providing information and tools to assess the significance and performance of CMRs, to identify and monitor KEFS, and to underpin the protection of marine environments.

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

The project builds on the results of the collation of spatial data, existing synthesis approaches and the identification of key data gaps in the context of CMRs and KEFs in the North and NW that was delivered as part of the 2015 D1 Science and Stakeholder Workshops. Through subsequent consultation with DoEE, we have identified key areas for which we have the greatest confidence that the existing data will adequately inform predictive modelling (i.e. Kimberley and Gascoyne CMRs). Through 2017 the approach adopted in the NW in 2015/16 will be extended to incorporate national data collation to a) provide national data layers that can be used to provide information on almost all CMRs, and b) provide at least one targeted synthesis for a CMR based on the outcomes of the National Prioritisation Workshop.

The approaches that we will use to synthesise information in this project will identify values and assets within CMRs that will underpin future monitoring and management initiatives across Australia’s marine estate, and will be developed based on consultation with DoEE. For example, the overlay of existing data, gap analyses and synthesis approaches could enable us to describe benthic habitats within CMRs, identify BIAs, develop and refine predictions of migratory corridors, foraging and breeding grounds, and characterise pelagic communities as well as prioritise areas for future investment in field surveys. This knowledge would underpin assessments of sensitivity to environmental variability and anthropogenic pressures, as well as improving our understanding of the value of CMRs and KEFs in a national context. Testing predictions from syntheses against field data would ensure that management authorities will have a clear measure of the accuracy and the degree of confidence of predictions, and their utility in underpinning monitoring and management programs across large spatial scales.

This proposal maps out a three year project (2016-2018), during which we will:

Year 1 (to Dec 2016):

* Finalise the collation of information for the North and NW regions by building on prior CERF & NERP investment in data acquisition and development of predictive tools, and workshops held in 2015.
* Analyse and report on the links between benthic communities, fish biomass, megafauna migration routes, oceanography and the geomorphic features for prioritised locations (e.g. Ancient Coastline KEF) based on the collation of existing baseline data undertaken in 2015 (bathymetry, towed video and BRUVs).
* Model the spatial-temporal dynamics of natural pressures affecting biota in the North and NW (e.g. cyclones, significant wave energy, thermal stress and oceanographic conditions) and identify how these might affect ecological processes such as turtle migration pathways, larval dispersal and fish biomass that need to be considered in management planning.
* Contribute to a National Prioritisation Workshop in conjunction with other Marine Hub projects (i.e. D3, C1) to inform decisions regarding future information and research needs of stakeholders.
* Work with the DoEE to incorporate new data and ecosystem knowledge to refine descriptions and build qualitative models for existing KEFs (where previously none could be developed because of insufficient data, e.g. Glomar Shoals) and identify potential new KEFs in the North and NW.
* Integrate model and synthesis outputs to develop a series of communication products (e.g. fact sheets) including maps of the spatial distribution of communities, qualitative models of ecosystem functioning of target CMRs and KEFs in the North and NW region.
* Relate the integrated datasets and predictive models to the CMR network across the North and NW and assess the potential for these approaches to provide baseline information that is of value to DOE (i.e. standardised and comparable) and to support the prioritisation of areas for future monitoring efforts as part of the National Prioritisation Workshop with Project D3. Specifically, we will use the results from the Oceanic Shoals CMR as a test case for the application of predictive modelling for identifying assets and values in the marine estate and as a guide for stakeholders in identifying future data needs and tools required to adopt a similar approach nationally.
* Upload new information identified and developed through this project to the Northwest Atlas web platform to make data readily accessible to end users and engage with key stakeholders (DOE, NOPSEMA, industry, traditional owners) to support decision-making in the region, including, environmental risk assessments.

Year 2 (to Dec 2017):

* Extend the collation of existing data to the national level and where possible make data and summary products accessible through E-Atlases and/or other portals.
* Contribute synthesis products and outcomes from gap analyses undertaken through 2016 to inform the National Prioritisation Workshop in March 2017 in guiding future research and choosing which data portal(s) to support for visualising products.
* Synthesise existing data for selected CMRs (including Kimberley and Gascoyne; as identified through Science and Stakeholder workshops and at least one other CMR as identified through the National Prioritisation Workshop eg. Flinders, Tasman Fracture or Lord Howe) and make predictions about the nature and extent of benthic communities within those CMRs.
* Create synthesis and visualisation products for the Kimberley, Gascoyne and at least one other CMR to inform management and make these easily accessible to stakeholders through web portal(s) e.g. E-Atlas.
* Reconvene with stakeholders through formal and informal meetings to disseminate research findings and to ensure project progress and direction remains relevant to management needs.

Year 3 (to Dec 2018):

* Based on outcomes from National Prioritisation Workshop in March 2017 and in collaboration with Project D3, undertake data collation and synthesis exercises which would support field survey(s) by NESP or other agencies, to collect biological and physical data that can be used to improve the baselines, test predictions and support monitoring of CMRs (identified in consultation with Parks Australia).
* Support the development of management and monitoring plans for areas selected in consultation with DoEE, and risk assessments associated with marine industry operations by providing new and existing data to enhance knowledge of important ecosystems and habitats.
* Reconvene with stakeholders through formal and informal meetings to disseminate research findings and to ensure project progress and direction remains relevant to management needs. Incorporate results on biodiversity distributions and pressures into management decision frameworks in collaboration with DOE and Projects B1, C1 and potentially A12 and use this forum to develop interactive threat maps.
* Continue knowledge dissemination through the E-Atlases and/or other selected portals and upload relevant data layers as well as the inclusion of synthesis products. Produce updated maps, data syntheses, and communication tools for end-users that capture key environmental attributes of the focus areas, and incorporate identified threats.
* Undertake detailed discussion/workshops with DoEE and other key stakeholders and end-users to disseminate the results from the project and to refine our on-going understanding of management needs/directions and further the extension of this project. Our communications into the department will focus on: describing assets within the CMR network and their regional context; the ongoing need for additional information based on new biological and physical data, and; the potential for developing new, targeted models to address key knowledge gaps and prioritise data collection needs. We will also assess the value of collecting additional information against the need to support specifics (e.g. allocation of conservation management resources, EPBC Act approvals).

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

Within the Marine Biodiversity Hub, this project links directly with:

Project D3 ‘*Evaluating and monitoring the status of marine biodiversity assets on the continental shelf*’ which has a focus on shelf reefs and is national in scope. Opportunities exist, therefore, to share datasets (e.g. shelf reef maps for the North and NW) and to use the reef classification scheme developed in Project D3 as a framework for interpreting biodiversity patterns.

The information generated in this project can also be used for the case studies proposed by Project B1 – ‘*Road testing decision support tools via case study applications.*’ In particular, baseline information assembled for CMRs in the North and NW (e.g. Oceanic Shoals, Kimberley CMRs) and associated models for features such as carbonate banks and shoals can provide the required scientific framework for informing the decision support process developed in Project B1. To facilitate this transfer of information, Project B1 will include an FTE commitment into this Project in Year 3.

Other project links in the Marine Biodiversity Hub include:

Project D2 - ‘Analysis methods and software to support Standard Operating Procedures for survey design, condition assessment and trend detection’, whereby outputs related to sampling design and analytical procedures (e.g. BRUVs, towed video images) will be used for the survey component of this project and results used to refine SOPs where necessary.

Project B3 – ‘Enhancing access to relevant marine information – a pilot service for searching, aggregating and filtering collections of linked open marine data’, whereby datasets and map layers generated in our project (and loaded onto the NW Atlas and AODN) will be discoverable through the web service tool being developed within Project B3.

Project C1 ‘*Increasing our understanding of pressures in the marine environment’* is focussing on anthropogenic pressures and their associated threat. Our predictive models will both inform and be informed by the outputs from C1. It is intended to include an FTE commitment in Project C1 in Year 2 to facilitate this integration.

More broadly, this project also will contribute to projects in the Hub’s Threatened Species Theme by providing capacity to better understand functional relationships between benthic environments (e.g. ancient coastline features) and the migratory behaviour of fauna such as whales and turtles.

In particular:

Project A12 *‘Scoping a Seascape Approach to Managing and Recovering Northern Australian Threatened and Migratory Marine Species’* will be developing approaches to overlay threats on distributional maps of habitat used by threatened and migratory species. Shelf data collected for Northern Australia will inform this project. Techniques developed in A12 will support similar threat assessments in this project.

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

This project will draw on past investment by the Marine Biodiversity Hub (CERF and NERP) and partner institutions in the collection of physical and biological data and development of predictive models. The focus of this past work has been on benthic habitats associated with carbonate banks, reefs and shoals, and submarine canyons. Under the NERP program this work extended into the pelagic realm, through analysis of fish distributions in relation to benthic environments. Separately, through WAMSI, a wealth of information is now available on the spatial and temporal behavioural patterns of megafauna (humpback whales, whale sharks) and other listed species (e.g. flatback turtles). Further, the project aims to draw upon oceanographic data collected as part of IMOS, fish and invertebrate data collected by CSIRO (where it overlaps CMRs) and other relevant datasets that are available. For the first time, this project will begin the integration of these multiple datasets with the express purpose of building a comprehensive understanding of biodiversity in CMRs.

Importantly, this project reflects an evolution from data collection to synthesis of information and evaluation in relation to stakeholder requirements. This approach will generate knowledge relevant to management and monitoring and will guide investment in future data collection to underpin management of Australia’s marine estate with an initial focus on the CMR network. The approaches developed initially for the North and Northwest will be reviewed for national application to improve our knowledge of key marine species and the CMR network to underpin their better management and protection.

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

* Improved access to and utilisation of the Hub’s data and derived information products by the DoEE, industry and the community to better inform management of the marine estate and improve public understanding and value of the biodiversity of Australia’s marine environment.
* A knowledge framework to support management plans for CMRs, particularly for maintaining patterns of marine biodiversity and associated ecosystem processes;
* Guidance to end-users on uncertainty in our understanding of ecosystems and the implications of this uncertainty for decision making;
* Maintenance and building of research and management capability within Australia, building on previous government and industry investment.

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

* Improved access to information on the biodiversity assets and conservation values within the national CMR network to support new management plans and broader marine estate to inform approvals processes for sustainable use of marine resources;
* Baselines for monitoring in previously surveyed CMRs to maximise information relative to return on investment;
* An increased understanding of the distribution and structure of marine biodiversity in Australia, which will provide a greater bioregional context of their national significance.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

The outcomes from this project will be of direct relevance for management of CMRs and will inform a range of management and policy actions. Approvals under the EPBC Act are binary decisions around whether or not a proposal poses acceptable risk. The notion of acceptable risk requires fundamental information on the spatial distribution of conservation values and assets, and their exposure to a proposal’s footprint. Likewise, prioritising management actions in CMRs requires core knowledge of the distribution of biodiversity, its exposure to threats, and the extent to which candidate actions insulate against pressures.

This project will lead to better informed EPBC Act approvals, more informed prioritisation of management actions and monitoring in CMRs and will assist industry in risk assessments and the refinement of its environmental plans (e.g. oil spill response plans). The value of the project can be demonstrated by comparing the costs and outcomes of informed decision-making with those of less informed approvals and management and by demonstrating the value of CMR implementation.

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

Project outputs from 2016 will include:

* A report on the synthesis (based on collations completed in 2015/16) of datasets and models for the North and NW identifying areas of greatest information coverage, gaps and themed to CMRs and KEFs in those regions. This report will also describe key spatial patterns in biodiversity (benthic and pelagic) and associations between benthic environments, fish and megafauna and large scale processes (e.g. oceanography).
* Predictions and related products (maps) of the spatial distribution of biodiversity across the Oceanic Shoals CMR that encompasses benthic habitat, pelagic and demersal fish and megafauna communities. This will provide an example/test case at the National Prioritisation Workshop of how confidently predictive modelling can be used to describe assets and values in data poor areas to inform management and monitoring.
* An updated conceptual model of ecosystem processes (benthic and pelagic) within the Oceanic Shoals CMR based on extension of modelling into pelagics.
* A review of existing knowledge of the Ancient Coastline KEF.
* A qualitative model of Glomar Shoal KEF (to be confirmed in consultation with DOE).
* Communication products that capture activities and general interest stories of scientific results disseminated through NW Atlas social media links.
* Upload of new relevant spatial data layers in NW Atlas for management and planning, and engagement with end users to maximize uptake of the NW Atlas products.

Through the life of the project, we will target the dissemination of our research results through multiple avenues to ensure broad uptake; these include fact sheets, full colour brochures, peer reviewed publications in the scientific literature, conference presentations and social media.

Project outputs in 2017 will include:

* Contributions to the report on the outcomes from the National Prioritisation Workshop **(Milestone 10; jointly with project D3)**
* Data synthesis products and maps that describe key elements of the spatial distribution of benthic biodiversity across selected CMRs (including Kimberley and Gascoyne CMRs and at least one other CMR as determined through the National Prioritisation Workshop) that encompasses benthic habitat and demersal fish communities (**Milestone 11**).
* Updated national-scale marine environmental spatial datasets presented for CMRs, including physical (e.g. bathymetry, geomorphic features, sediments), oceanographic (e.g. sea surface temp, turbidity, Chl-a) and biological (e.g. fish) layers **(Milestone 12).**
* Science synthesis report on ecologically important features of well-sampled CMRs based on the collated datasets and any new information available **(Milestone 14).**

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1: All research users and stakeholders for this project have been engaged and understand project and how it relates to their interests | 30 April 2016 | Completed |
| Milestone 2: New maps and products based on existing data and knowledge from the North and NW available to all end-users through the NW Atlas to support development of CMR management plans and updates to KEF descriptions | 1 July 2016 | Completed |
| Milestone 3: **Activity Milestone**. Contribute to National Prioritisation Workshop in collaboration with Projects D3 (Shelf Reefs) and C1 (Pressures) and stakeholders | 31 March 2017 | Rescheduled by MBH from September 2016 |
| Milestone 4: **Delivery Milestone.** Report summarising outputs from synthesis of datasets and predictive models for the North and NW, including priority areas identified through stakeholder consultation to support development of CMR management plans | 1 December 2016 | Progressing |
| Milestone 5: **Activity Milestone**  Development of qualitative model for Glomar Shoals KEF | January – March 2017 |  |
| Milestone 6: **Activity Milestone**  Collation of national datasets for all CMRs, including meetings of project team | January – June 2017 |  |
| Milestone 7: **Delivery Milestone**. Qualitative model(s) to end users for priority areas identified through consultation (e.g. Glomar Shoals KEF) to inform ecosystem understanding of priority KEFs in the North and NW | 30 April 2017 |  |
| Milestone 8: **Delivery Milestone**. Input to Draft report from the National Prioritisation Workshop to be delivered to DoEE for comment | 30 June 2017 |  |
| Milestone 9: **Activity Milestone**  Project meeting to review datasets available for data synthesis/analysis in selected CMRs | 1 July 2017 |  |
| Milestone 10: **Delivery Milestone**. Delivery of Final Report from the National Prioritisation Workshop | 30 August 2017 |  |
| Milestone 11: **Delivery Milestone**. New maps and information based on existing data and knowledge for selected CMRs (Kimberley, Gascoyne and one other based on NPW) available through web portal. | 1 November 2017 |  |
| Milestone 12 – **Delivery Milestone**. National data layers for physical, biological and oceanographic data available through web portal for all CMRs | 1 December 2017 |  |
| Milestone 13: **Delivery Milestone**. Draft report on ecologically important features of selected CMRs (and regions) submitted to DoEE for comment | 1 January 2018 |  |
| Milestone 14: **Delivery Milestone**. Final report on ecologically important features of selected CMRs (and regions) | 30 April 2018 |  |
| Milestone 15: **Delivery Milestone**. All project datasets made accessible to the public (see section on Data and Information management) | 31 December 2018 |  |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| Karen Miller (0.25 FTE) | AIMS | Project leader, benthic ecologist |
| Ben Radford (0.1 FTE) | AIMS | Ecological modeller |
| Marji Puotinen (0.3 FTE) | AIMS | Spatial scientist |
| Claire Streten (0.15 FTE) | AIMS | Ecologist |
| Michele Thums (0.05 FTE) | AIMS | Megafauna ecologist |
| Eric Lawrey (0.05 FTE) | AIMS | E-Atlas developer |
| Scott Nichol (0.1 FTE) | GA | Geoscientist |
| Johnathan Kool (0.15 FTE) | GA | Connectivity modeller, data consultant |
| Zhi Huang (0.3 FTE) | GA | Spatial analyst |
| Rachel Przeslawski (0.15 FTE) | GA | Ecologist |
| Kim Picard (0.1 FTE) | GA | Geoscientist, seabed acoustician |
| Rachel Nanson (0.05 FTE) | GA | Geoscientist |
| Dave Watts (0.15 FTE) | CSIRO | Data aggregation |
| John Keesing (0.05 FTE) | CSIRO | Data aggregation |
| Franziska Althaus (0.05 FTE) | CSIRO | Data aggregation |
| Dan Gledhill (0.05 FTE) | CSIRO | Fish ecologist |
| Phil Bouchet (0.15 FTE) | UWA | Fish modeller |
| Jessica Meeuwig (0.05 FTE) | UWA | Fish ecologist |
| Vanessa Lucieer (0.1 FTE) | UTas | Spatial scientist |
| Roger Proctor (0.05 FTE) | AODN/UTAS | Data scientist |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
| TBA | IMOS | In-kind: data contribution |
|  |  |  |
|  |  |  |

Research End Users and Key Stakeholders **–** Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| DoEE/Parks Australia | Amanda Parr |  |
| DoEE/Parks Australia | Scott Francis |  |
| DoEE –Marine Policy | Amelia Tandy |  |
| DoEE- Marine Policy | Jillian Grayson |  |
| DOEE SoE reporting. | Boon Lim |  |
| NOPSEMA (secondary beneficiary) | Christine Lamont/Cameron Sim |  |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| APPEA | Oil and Gas Industry – APPEA and individual companies |  |
| AFMA |  |  |
| State Mining, Fishery and Conservation agencies |  |  |
| Regional fishing and conservation groups |  |  |
| NAILSMA, KLC |  |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

The approach to interaction with research-users and stakeholders will be consistent with the Marine Biodiversity Hub’s Knowledge Brokering and Communication Strategy. The pathway to impact will rely on engagement of research-users in all stages of the project, in particular project scoping, communicating project progress and development and delivery of project outputs. Where appropriate, the project team will make use of existing effective engagement mechanisms and new engagement mechanisms will be used where none exist. For example, the National Prioritisation Workshop will provide a key forum to understand the needs of research users, in particular the collation, synthesis and visualisation needs for managing CMRs from a national perspective. The workshop will also be important for understanding the use-case scenarios and preferences of research users, in particular for managing CMRs, for access to information. The project team will also engage with research-users and stakeholders to discuss the development and delivery of synthesis products to ensure they are fit-for-purpose, in particular products for Commonwealth Marine Reserves.

The project will develop a schedule for product delivery and stakeholder engagement in consultation with the Marine Hub Knowledge Broker, and this will be modified in consultation with research-users on an as-needs basis to maximise impact

Knowledge brokering and communication contact

Name: Scott Nichol

Email: scott.nichol@ga.gov.au

Phone: 02 6249 9346

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

Data to be delivered by this project will include:

* Spatial data layers describing benthic and pelagic ecosystems incorporating new and existing samples, observations and measurements.

Data and information will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. Species distribution datasets will be stored in a long-term secure storage, metadata will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal <http://portal.aodn.org.au/aodn/>

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hub website <http://www.nespmarine.edu.au>. Web services interface will also be delivered through the Northwest Atlas <http://northwestatlas.org> with spatial data layers and model outputs. The National Prioritisation workshop may also identify other data portals that the project need to deliver data to meet the needs of research-users, in particular DoEE. The project will adhere to the NESP requirement that all journal publications be made publicly and freely available within 12 months of publication. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

The Department of the Environment will be informed by email to [marinemetadata@environment.gov.au](mailto:marinemetadata@environment.gov.au) each time a dataset is published and provided with a link to the full dataset.

Data and information management contacts for project are Ben Radford (AIMS) [b.radford@aims.gov.au](mailto:b.radford@aims.gov.au) and Zhi Huang (GA) [zhi.huang@ga.gov.au](mailto:zhi.huang@ga.gov.au).

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

In 2017, funding will be used to support the deployment of staff resources from AIMS, GA, CSIRO, UTAS and UWA to provide requisite expertise in analysis and interpretation of physical and ecological data and predictions, plus data management and delivery. Funds will also support travel to facilitate interactions among researchers across partner organisations to ensure integration of data and predictive models to understand ecosystem processes. The budget request also factors in travel to attend workshops and Hub meetings as required.

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

In 2017, collation and synthesis will become national in scope but with a continued focus on CMRs prioritised through Stakeholder consultations and the National Prioritisation Workshop. Work will continue on CMR focal studies of the Kimberley and Gascoyne CMRs to directly address the outcomes from the Science and Stakeholder requirements identified in 2015/16 for the NW and include one other CMR based on the outcomes of the National Prioritisation Workshop, where high quality datasets can support the development of synthesis and visualisation products.

The gap analysis being undertaken in 2015/16 will be used to identify target areas for future year’s work and will be developed in consultation with stakeholders and as part of the 2017 National Prioritisation Workshop.

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

2015-16 – Category 2

The project will directly address the Hub’s communication priority for Indigenous Engagement and Participation through consultation with Indigenous communities and encouraging the participation of Traditional Owners in all aspects of the science. AIMS and UWA have established relationships with Traditional Owners across the North and NW region linked to ongoing projects within WAMSI. Engagement is regular and includes meetings with land councils and ranger groups to understand the cultural significance and use of coastal study areas and integrate traditional knowledge of biological use/significance into research projects. We are also actively engaging traditional owners in established field projects; for example Bardi Jawi rangers join WAMSI field work around the Cygnet Bay area and we are collaborating with Dambimangari Sea Rangers to gather additional temporal and spatial data on benthic communities in the nearshore areas around Camden Sound. The importance of the offshore areas that are the focus of this hub project to Indigenous groups is poorly understood. However through our established relationships with Kimberley Indigenous groups, and additional relationships we aim to develop as part of this project e.g. through the Rangelands NRM and NESP Hubs, we will have the opportunity to build an understanding of the cultural significance of offshore areas and incorporate this into data synthesis, survey planning and the development of the project overall to ensure relevance and participation of Indigenous communities. In later years of the project, we plan to extend invitations to the Indigenous community to participate in field surveys that overlap with any areas of cultural significance and thus build a stronger link between indigenous, scientific and management agencies as well as capture the cultural as well as biological significance of CMRs and KEFs within communication products such as the NW Atlas.

2017 onward – Category 3

The refined project is a desk top study (i.e. it does not include a field work component – this potential element of project approved in the superseded 2016 Research Plan will be considered in project D3 of this research plan) and is therefore considered a category three project for Indigenous engagement. Our approach to engagement will primarily involve provision of updates to the DoEE Indigenous Advisory Group the Fisheries Research and Development Corporation Indigenous Reference Group. These groups will also be asked for advice on opportunities to enhance Indigenous engagement for this project. The project team will also explore options for developing synthesis outputs targeted to Indigenous communities.

The team will continue to engage with Indigenous communities that were engaged in 2015-16 to ensure generated knowledge, data and results are effectively shared with and communicated to Indigenous peoples, communities and organisations.

Contact person for Indigenous engagement:

Name: Karen Miller

Email Address: [k.miller@aims.gov.au](mailto:k.miller@aims.gov.au)

Phone Number: 08-6369 4007

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

The project will deliver data synthesis and visualisation products for the CMR network. For example, bathymetry (at best available resolution), seabed physical characteristics, sea surface properties (temperature, turbidity) and fish diversity. Application of predictive models of the nature and extent of benthic communities and pelagic hotspots, where information is available to support the models. (eg Kimberley and Gascoyne and Lord Howe CMRs as well as Ancient Coastline KEFs and Glomar Shoal KEF). Qualitative models of ecosystem processes across the North and NW will be developed through the synthesis of predictive models. Spatial data layers relevant to the management and monitoring of the North and NW will be made available through the Northwest and Northern E-Atlases. Data for the national CMR network will be made available through a new E-Atlas portal and/or other portals as identified in the National Prioritisation workshop.

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

Out of scope factors will be agreed upon with DoEE during ongoing consultation as guided by Department priorities.

### Risks

List all significant risks to the success of the project

There are a number of risks that will need to be managed to deliver the outputs and outcomes specified in this project plan with agreed timeframes, they are:

* Project is potentially constrained by timely access to staff resources from the partners. However, this can be minimised through careful project management and setting of achievable objectives.
* Ineffective supervision and coordination of partner efforts affecting the development of synthesis outputs and/or resulting in late delivery on milestones
* A lack of effective engagement by research users, in particular a lack of clarity of user needs, preferences and use-case scenarios
* Loss of key researchers from the project team

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

Ecosystems processes, marine assets, marine environmental baselines, Commonwealth Marine Reserves, Key Ecological Features

# Project D2 – Standard Operating Procedures (SOP) for survey design, condition assessment and trend detection

Project length – 3 Years

Project start date – 01/07/2015

Project end date – 15/12/201

Project approval date - TBC (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - Submitted for re-approval

Project Leaders – Scott Foster (2017 FTE – 22%) and Rachel Przeslawski (2017 FTE – 15%)

Lead Research Organisation – CSIRO

Project leader contact details: - [scott.foster@csiro.au](mailto:scott.foster@csiro.au), 03-6232 5178, [rachel.przeslawski@ga.gov.au](mailto:rachel.przeslawski@ga.gov.au) 02 6249 9101

### Project Funding

|  | 2015 | 2016 | 2017 | 2018 | 2019 | TOTAL |
| --- | --- | --- | --- | --- | --- | --- |
| NESP funding | 100,000 | 111,700 | **GA $55,000**  **UTAS $8,583**  **CSIRO $82,355**  **UWA $72,000**  **AIMS $8,583**  **Total $226,521** | x | x | 438,221 |
| Cash co-con | x | x | x | x | x |  |
| In-kind co-con | 100,000 | 111,700 | **GA $55,000**  **UTAS $8,583**  **CSIRO $82,355**  **UWA $72,000**  **AIMS $8,583**  **Total $226,521** | x | x | 438,221 |
| TOTAL | 200,000 | 223,400 | 453,042 | x | x | 876,442 |

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

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 4) assess approaches for monitoring pelagic ecosystems.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

The current Standard Operating Procedures (SOP) project (up to the end of 2016) provides methods and software to support survey design and analysis. However, it does not aim to provide advice/prescription on survey methods themselves (e.g. comparisons of gear types, field manuals, data management). There remain distinct gaps, of which two notable ones are: 1) field manuals for frequently used gear types, and 2) consideration of the pelagic ecosystem.

The development of field manuals is important as, when adhered to, they can enable meta-analyses of multiple surveys (e.g. for individual CMRs). This is the one of the goals of the project extension. The different sampling gears will be prioritised early in the project and field manuals will be developed based on this prioritisation.

The national marine estate network covers a greater volume of pelagic habitats than any other type, and monitoring methods relevant to these habitats are needed. Integration of ocean monitoring methods such as those supported by IMOS (i.e. satellites, mid-water acoustics, continuous plankton recorder, drifting buoys and gliders) with mid-water baited remote underwater video systems (BRUVS), an analogue of seabed BRUVS that form the backbone of reef sampling, will allow the development of a cohesive approach to monitoring pelagic biodiversity. This project will provide this cohesion for surveying pelagic biodiversity, and will use a similar approach to that used in the NERP Hub’s monitoring blueprint (for benthic habitats). In addition to integration, field manuals will be produced after a prioritisation of the current sampling platforms.

### Problem Statements

#### Problem

Description of the specific problem

Reporting on the status and trends of environmental resources requires cost effective monitoring. In an area as large as the Commonwealth Marine Area, it is undesirable and unrealistic to expect monitoring activities to be conducted by any one single agency or organisation. It is important that when different organisations collect data to serve the same, or comparable, objectives that data are collected, analysed and reported in a consistent manner. Inconsistent survey design, data collection and analysis impedes analysis of status and trend detection. When data cannot be collected using the same methods (e.g. sleds are not appropriate to target small macrofauna), a comparative assessment of the method’s efficacy (including catchability etc.) relative to other methods must be made.

Theme 1 of the NERP Marine Biodiversity Hub demonstrated and implemented a standard approach to survey design. At the end of Hub, two things were clear: 1) designing a monitoring effort is technically demanding and requires highly specialised skills, and 2) the analysis of the resulting data is non-trivial because of the large variety of sampling tools, data scoring methods and analysis methodologies. This project will build on the lessons learnt in NERP Theme 1, and will demonstrate how to implement the essential monitoring functions listed in the Integrated Monitoring Framework (IMF) developed in the Theme for both benthic and pelagic habitats. The IMF was written for the Great Barrier Reef but the monitoring functions it lists are generic, and based on the procedures developed and implemented by the United State National Parks Service.

#### How Research Addresses Problem

What solution will this research provide?

This project aims to develop Standard Operating Procedures in the collection and analysis of monitoring data by: 1) providing a simple tool for designing surveys in space, 2) providing a core set of analysis methods, tailored to specific survey methods, that should be undertaken as a routine part of the monitoring process, and 3) comparatively assessing these sampling platforms to detect ecological patterns to see if there is any complementarity/redundancy in the platforms. A putative set of objectives will be developed in collaboration with the Hub project D3, which has survey aspects that will benefit from the tools developed within this project. This putative set will be refined with input from the DoEE.

If the design tool is used and analysis techniques are followed, then management authorities and industry consultants will be provided with concise, consistent, interpretable and fit-for-purpose evidence on the status and trends of environmental assets.

The project will identify the sampling locations (design), gear type (target), data scoring (processing) and statistical methods (analysis) that support evidence based decision-making and evaluation of the empirical evidence with respect to management benchmarks. Further, due to the standardisation of these methods and comparative assessment, the information will be comparable from one project to the next. This establishment of clear design and analytic guidelines will provide the foundation for Standard Operating Procedures designed to support the Department’s management and monitoring requirements in the CMA.

**Changes for 2017**: In addition to the survey design work, which has already progressed, it is proposed that more ‘gaps’ in the survey pipeline are addressed. One operationally important gap is the production of field manuals for different gear types. These are operational guidelines that ensure that survey gear is deployed and samples processed in a similar fashion each and every time. Since survey platforms are evolving, care will be taken to make these field manuals as mutable as possible (to form ‘living documents’ that evolve using version controls). However, changes to SOPs should not be undertaken lightly – to ensure consistent temporal trend data, ground-truthing of old and new SOPs will be needed, which can require substantial survey effort. This project will be closely linked to project D3, which will be undertaking some surveys. In particular, the gear types that D3 plan to utilise will be, quite naturally, prioritised for SOP development within the benthic component of this project.

SOPs are more than just field manuals. They are a set of protocols for all aspects of surveying, which are agreed upon by Hub partners and important collaborators. This agreement, to produce “endorsed” protocols is vital for the longevity and impactfulness of this project’s outcomes. Without endorsement, “proposed” protocols are likely to be useful only in the research provider from where they originated.

We recognise that not all gear is appropriate for all environments or monitoring objectives. A comparative assessment is therefore proposed in which ecological relationships among data collected from different gear types in different environments is assessed to inform decisions for efficient and effective future monitoring activities. This work was initially developed in NERP (‘Comparison of sampling methods to assess benthic marine biodiversity: are spatial and ecological relationships consistent among sampling gear?’ GA Record 2015/07), but was limited by a lack of data. Data collected as part of the NERP Hub and that proposed by Project D3 will help expand available datasets for comparison. We note that this falls short of a “Rosetta stone” that translates the expected catches in different sampling platforms/environments. Whilst this would be a fantastic resource for mapping, status estimation and trend detection, it is not practical given current data resources and capability investment.

The project will now include aspects of remote sensing where it forms a priority and where it is feasible. Due to advancing technologies and increasing access to large remote-sensing datasets, these data are becoming increasingly important in monitoring activities over large continuous regions, particularly as related to baseline establishment for benthic environments (e.g. through MBES) and sea-surface environments (e.g. through MODIS). We envisage starting with MBES, and moving onto satellite-derived data, which is a rapidly expanding stream of data. Both techniques have established observation and analysis techniques. Our approach in the first instance will be to assess the existing techniques for consistency and complementarity, including the identification of possible gaps requiring future research.

In this project, the Hub will expand its research on pelagic systems, providing a similar level of rigour to that previously developed for benthic systems. Monitoring the pelagic system, like the benthic system, requires a consistent and reasoned approach: What type of gear? IMOS’ current armoury includes water-column acoustics, continuous plankton recorders, satellite data, gliders and drifters; and Hub partners have extensive experience in pelagic BRUVs. A complete picture of how the combined use of these gear types can answer specific research and management questions is needed, similar to the approach taken to produce the Monitoring Blueprint from the NERP Biodiversity Hub. Once all the tools for pelagic monitoring have been assessed and combined, field manuals can be produced to enable consistent deployment. Of course, a fundamental component of standardisation is survey design and data analysis which will thus link into the original part of this project.

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

This project aligns to two DoEE research priorities that together seek to maximise the efficacy of managing Australia’s marine environment and call for an improved understanding of that environment, specifically:

* Determine and trial practical and repeatable methods for monitoring the status and trends of key coastal and marine species and environments to underpin management of Commonwealth Marine Reserves.
* Improve our knowledge of key marine species and ecosystems to underpin their better management and protection

Any successful standard operating procedure requires 'buy-in' from stakeholders and end-users. To this end, the project will actively engage key scientists and managers throughout all types of organisations. This will be done through individual discussions, conference presentations, workshops and publications.

The project also addresses one of the eight priorities identified in the National Marine Science Plan 2015-2015:

* Establish and support and National Marine Environmental Baselines and Long-Term Monitoring Program, to develop a comprehensive assessment of our estate, and form the basis for management of Commonwealth and State Marine Reserve networks

The Marine Biodiversity Hub will work with the National Marine Science Committee to contribute our findings to meeting this priority. A member of IMOS staff will also be part of this project to provide links to the national marine observation infrastructure and researchers.

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

This project is a desk-top analysis of techniques that if implemented correctly will deliver nationally consistent assessments of CMA assets and will inform the evaluation of the status of ecosystem condition and of the efficacy of management actions.

Research tasks and timeline as follows:

Year 1:

* Choose a limited set of “no regret” objectives, relevant to NESP monitoring/survey projects (see below for identified projects to partner with). These objectives will be chosen from the list developed in Project 1.2 from Theme 1 of NERP marine biodiversity hub, and be informed by outputs from Project 2.1 from Theme 2.
* Identify response variables (the things we measure and subsequently analyse) based on monitoring methods and scoring techniques (e.g. broad scale versus fine scale scoring on CATAMI schema), and identify relevant marine environment covariates, and where appropriate relevant management interventions.
* Identify methods for status assessment and trend detection relevant to response variables identified in item 2.
* Develop prototype of easily used software for spatial survey design and analysis in the R statistical programming language.
* Recommend standard operating procedures for survey design, scoring and data analysis to support evidence based decision making, for example, to test the efficacy of commonwealth marine reserves.

Years 2 and 3:

* Finalise survey design and analysis software, release this as an R-package.
* In conjunction with survey design and data collected in Year 2 of NESP project: “Evaluating and monitoring the status of marine biodiversity assets on the continental shelf” demonstrate application of the R-package to continental shelf reef monitoring objectives.
* Provide a worked example of the process for survey design and analysis. This will be an R-script for generating a survey design, ingestion of survey data into R, and data analysis. The outcome from this will be a set of detailed R-scripts that will act as a template for future researchers.

**Changes for 2017**: In addition to the work above, it is proposed that in 2017:

1. Sampling platforms are prioritised for likely benefit from producing field manuals. These field manuals will then be developed using the most important (according to the prioritisation). Extra priority will be given to those sampling platforms utilised in project D3. These platforms are likely to include some of the following: 1) autonomous underwater vehicles (AUVs), 2) stereo-towed video, 3) baited remote underwater video (BRUVs), 4) benthic sleds, grabs, or boxcores, and 5) multi-beam sonar.
2. Mirroring 1, but for application to pelagic systems. Sampling platforms to consider for their potential to contribute to a pelagic sampling package suitable to monitoring CMRs and KEFs include: 1) pelagic BRUVs, 2) continuous plankton recorders, 3) satellite imagery, 4) gliders, 4) drifters and 5) water column acoustics.
3. An assessment of different benthic sampling and data processing techniques will also be undertaken to guide prioritisation for production of field manuals (e.g. strengths and limitations of a given sampling method, ubiquity of deployment, optimal environments or objectives for deployment), as well as to provide comparison among surveys or environments that use different sampling methods. The comparisons will be limited to the comparing the ecological relationships between variables. This consideration will build upon the outputs of the monitoring blueprint from theme 1 of the NERP Biodiversity Hub.
4. Mirroring 3), but for pelagic systems, the different gear types will also be assessed for compatibility, efficacy, practicality and cost.
5. Assess how information from pelagic monitoring can be utilised for management of, and scientific inference about biodiversity patterns in the pelagic environment. Two examples are: 1) Can we provide enough evidence to ascertain whether pelagic species utilise CMRs more or less frequently than other areas (i.e. is there a CMR effect)? 2) Do the biogeographic patterns provided by these sampling platforms match those from other data sources (e.g. fisheries data)? In the second example, and in the case of a difference, a set of reasonable hypotheses causing the differences will be proposed.

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

This project is designed to link to the on-the-ground monitoring and survey projects. We expect that particularly strong links to the first project (below).

* D3: “Evaluating and monitoring the status of marine biodiversity assets on the continental shelf”,
* D1: “National data collation, synthesis and visualisation to support sustainable use, management and monitoring of marine assets”.
* C2: “Continental scale tracking of threats to shallow Australian reef ecosystems”.
* A10: “Monitoring and conservation of spotted handfish”

**Changes for 2017**: The benthic sampling portion of this project is tightly aligned with the re-worked project D3 (Implementing a CMR monitoring program). The project as a whole is also aligned with the re-worked project D1 (national visualisation). The design part of this project will also be used to provide survey designs for use within projects D3 and A10 (and any other project that will undertake sampling).

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

This project leverages off the outcomes of Theme 1 and Theme 2 of the NERP marine biodiversity hub, and also builds on capacity gained during the CERF marine biodiversity hub (prediction and surrogate themes). Whereas the NERP Hub theme focussed on holistic and integrated marine monitoring aspects, our project targets the design, sampling, and analysis approaches underpinning all monitoring activities to feasibly achieve the recommendations set forth in previous projects.

A Hub workshop in early 2017 will focus on marine survey data collection, interpretation and visualisation in support of DoEE priorities, especially developing baselines and monitoring for the CMR network. Additional focussing of tasks in this project may develop at that workshop.

The Great Barrier Reef Management Authority is currently in the process of developing an integrated monitoring program WHA, including development of monitoring protocols. This project will interact with that process, where possible, so that work does not proceed in parallel.

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

It is expected that this project will:

1. Contribute to an improved information flow from survey through to management decision for the task of managing benthic and pelagic communities.
2. Aid stronger and more general inferences about ecological processes to further scientific understanding.
3. In addition, it will aid the cost-effective sampling of the national marine estate – even when that sampling is performed by different institutions at different times.
4. The SOPs will provide a reference point for regulatory and management agencies with a requirement to monitor the trend and status of communities and individual species.

Expected beneficiaries of this work include: 1) The DoEE for ecosystem health monitoring; 2) Parks Australia for monitoring CMRs; 3) NOPSEMA for regulating oil and gas activities; 4) GBRMPA for integrated monitoring of the GBRWHA; and 5) the scientific community by establishing a data resource that is broad in space and time that has minimal extraneous sources of variation. Outcomes from this project will support ongoing aims of IMOS and Priority #3 of the National Marine Science Plan 2015-2025.

The production of field manuals, which are endorsed by researchers, is an important task – only when all/most surveys are performed using standardised methods will the potential benefit be maximised. This means that SOPs, and field manuals in particular, will need to be “endorsed” by the Hub partners and collaborators that are influential for the gear type under consideration.

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

This project will provide a minimum standard that, if adhered to, will enable the national collation and analysis of data sets collected by disparate agencies and at disparate times. The first phase of the project (2015-2016) used monitoring of benthic fish communities as a ‘no regret’ objective, which illustrative the spectrum of considerations for developing SOPs and demonstrated how software could be used to standardise approaches to design and analysis for deploying BRUVs to determine status and trends on demersal fish communities. We now expand to include additional components: field protocols for deploying a broader range of the benthic community sampling gear and begin to do the same for pelagic communities. While we have focussed on fish in the first instance, many/most of the lessons learnt and the tools developed are applicable to a broader range of other monitoring objectives.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

With increased information and increased clarity comes increased capacity for evidence-based management. This project aims to assist the flow of information from surveys to decisions, and further it aims to standardise a core component of the information content between surveys. The standardisation of information content allows more straight-forward, and more holistic, synthesis of multiple surveys by multiple institutions.

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

The outputs for this project will consist of:

* Standard Operating Protocol (SOPs) for deploying observation platforms and analysing data for a set of high priority objectives and sampling platforms. This includes clear recommendations about how to choose sampling locations, data collection platforms and analytical methods.
* A piece of software (an R package) that implements spatially balanced designs. The software will require a minimal skill level.
* A worked example, from a partner project (D3), which will form the template for future surveys.
* Scientific publications and reports.

**Changes for 2017**:

* A report providing a comparative assessment of field benthic sampling platforms. This will provide a means to prioritise different platforms for production of endorsed field manuals.
* Field manuals for an agreed set of high priority benthic survey platforms, the choice of which ones will be based primarily on the needs of project D3 and emerging priorities.
* A report providing a comparative, critical and quantitative assessment (where possible) of field pelagic sampling platforms for providing status and trends. What are the major sources of variation and what kind and magnitude of spatial/temporal signals are detectable, or could be in the future?
* Field manuals for selected pelagic sampling platforms. The exact list to be taken from the comparative and quantitative assessment and subsequent prioritisation.
* A report and/or manuscript providing a quantitative comparative analyses assessing the pelagic biogeographic patterns obtained from various data sources, including fisheries data.
* A web-presence, through the Hub’s website, where protocols can be housed in a single place. This page will also provide a repository for ‘non-endorsed’ protocols used in other Hub projects (e.g. the dive protocol in project A10).

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1: Identification of “no regrets” objectives to partners, and with partners, for finalisation and scene setting. | Due 1 October 2015 |  |
| Milestone 2: Prototype R-package for Spatial Survey Design to partners for trial use. | Due 15 January 2016 |  |
| Milestone 3: All end-users and stake-holders have been engaged and understand project and how it relates to their interests. | Due 15 January 2016 |  |
| Milestone 4: Initial draft manuscript regarding a description of monitoring for evidence-based management to end-users for input, feedback and discussion. | Due 30 June 2016 |  |
| Milestone 5: Initial draft manuscript regarding spatial survey design (describing methods in the R-package) to end-users for input, feedback and discussion. This is expected to be a technical document, but the Abstract and Introduction will be assessable to all interested in monitoring. | Due 15 September 2016 |  |
| Milestone 6: Identification of analysis methods for status estimation and trend detection. Developed in collaboration with partners and for agreement to enable further forward movement. | Due 15 December 2016 |  |
| Milestone 10: **(Change 2017)**  Meeting to determine what survey platforms to target for field manuals. Partner presence required. D3 input mandatory. Activity milestone | Due 15 March 2017 |  |
| Milestone 11: **(Change 2017)**  Scoping report - Proposal and scoping for comparative assessment of benthic observation platforms, including remote sensing data. Output milestone. | Due 15 July 2017 |  |
| Milestone 12: **(Change 2017)**  Scoping report - Proposal and scoping for comparative assessment of pelagic survey platforms. Requires collaboration with IMOS. Output milestone. | Due 15 March 2017 |  |
| Milestone 13: **(Change 2017)**  A report describing a comparative, critical and quantitative assessment (where possible) of pelagic survey platforms. Output milestone. | Due 15 May 2017 |  |
| Milestone 14: **(Change 2017)**  Knowledge brokering plan document. How partners and stakeholders going to get the outputs and how do we garner ‘buy-in’? Output milestone. | Due 15 May 2017 |  |
| Milestone 15: **(Change 2017)**  A draft manuscript (or report) on the quantitative comparison of biogeographic analyses based on the different pelagic survey platforms. Use of existing data. Output milestone. | Due 15 Oct 2017 |  |
| Milestone 7: Preliminary worked R-scripts (and R package for design *and* analysis) to act as a pattern for future researchers. Delivered to partners and all associates for comment in input. Activity milestone. | Due 15 October 2017 |  |
| Milestone 8: Final R scripts and package to the end-users for use in future surveys. Output milestone. | Due 15 December 2017 |  |
| Milestone 9: All project outputs and data will be made publically and freely accessible and available on the internet (see section on Data and Information Management. | Due 15 December 2017 |  |
| Milestone 16: **(Change 2017)**  A report describing a comparative assessment roadmap and report on different benthic platforms completed. Output milestone. | Due 15 December 2017 |  |
| Milestone 17: **(Change 2017)**  Finalised field manuals for selected benthic survey platforms. Output milestone. | Due 15 December 2017 |  |
| Milestone 18: **(Change 2017)**  Finalised field manuals for selected pelagic survey platforms. Output milestone. | Due 15 December 2017 |  |
| Milestone 19: **(Change 2017)**  Repository for SOPs created on Hub webpage and populated with design protocols and field manuals. Output milestone. | Due 15 December 2017 |  |
| Milestone 19 **(Change 2017)**  Executive summary, in non-technical language, describing the progress made by the project. | Due 15 December 2017 |  |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | 2017 FTE | Organisation | Project Role |
| --- | --- | --- | --- |
| Scott Foster | 0.22 | CSIRO | Project co-lead, Design & analysis |
| Rachel Przeslawski | 0.15 | GA | Project co-lead, Field ecologist |
| Emma Lawrence | 0.1 | CSIRO | Design and analysis |
| Geoff Hosack | 0.15 | CSIRO | Design and analysis |
| Keith Hayes | 0.1 | CSIRO | Design and analysis |
| Alan Williams | 0.05 | CSIRO | Field ecologist |
| Neville Barrett | 0.05 | University of Tasmania | Field ecologist |
| Hugh Sweatman | 0.05 | AIMS | Quantitative ecologist |
| Jin Li | 0.05 | GA | Design and analysis |
| Zhi Huang | 0.05 | GA | Remote sensing |
| Andrew Carroll | 0.05 | GA | Field Ecologist |
| Kim Picard | 0.05 | GA | Seabed mapping |
| Justy Siwabessy | 0.05 | GA | Seabed acoustics |
| Phil Bouchet | 0.6 | UWA | Design and analysis; Pelagics |
| Jessica Meeuwig | 0.1 | UWA | Design and analysis; Pelagics |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
|  | CSIRO | Cash and co-investment |
|  | University of Tasmania | Cash and co-investment |
|  | AIMS | Cash and co-investment |
|  | UWA | Cash and co-investment |
|  | GA | Cash and co-investment |
| TBD | IMOS |  |

Research End Users and Key Stakeholders **–** Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| DoEE, Wildlife, Heritage and Marine Division (marine policy) | Amelia Tandy |  |
| DoEE, Environmental Standards Division (assessments) | TBA |  |
| DoEE, Environmental Resources Information Network (incl. State of Environment Reporting, Essential Environmental Measures Program and Protected Places Section) | Lee-Anne Shepherd (SoE)  Emma Hyland (EEM)  Carolyn Armstrong (PP) |  |
| Parks Australia, Commonwealth Marine Reserves | Amanda Parr |  |
| GBRMPA, Integrated Monitoring | Fergus Molloy |  |
| NOPSEMA, Environmental Effects | Christine Lamont/Cameron Sims |  |
| IMOS/AODN | Tim Moltmann |  |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| AIMS | David Souter |  |
| GA | Adam Lewis |  |
| CSIRO | David Smith |  |
| UTAS | Craig Johnston |  |
| IMOS | Tim Moltmann |  |
| APPEA | Libby Howitt |  |
| Other (AUV) | Attendees as recent AUV workshop for national approach |  |
| Other | TBA but includes Stefan Howe (Vic Parks) |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

This project will be seeking guidance and collaboration, from Hub partners, the DoEE and other stakeholders, to aid in refining the scope and direction of this research. Without collaboration, and ‘buy-in’ from these groups, the impact of SOPs will be diminished and likely to be only felt within a research organisation. This project will build upon existing approaches, where possible and appropriate, to enhance applicability to a wider set of stake-holders (and to diminish development time). Maximum impact will be achieved when the developed SOPs are used widely and as often as possible. To encourage this to occur, we will actively seek engagement from research users and stakeholders throughout the project. For 2017, with the project having a larger scope, a communication plan will be drawn up. Possible activities for communication and for transferring perceived/real ownership to the Hub partners include:

1. Workshops for comparisons of sampling gear.
2. Activities around commonly attended conferences (e.g. AMSA, Hub-wide meetings) – perhaps special sessions?
3. Co-authorship of SOPs, where possible and where plausible.

At the end of the project, all project outputs will be made available to the public, researchers-users and stakeholders. However, we do not intend to deliver only at the end of the project and the project team will develop an engagement and communication document (Output 14). This will require the project team to think about communication and to document a planned approach. The project will be managed in accordance with the Hub’s Knowledge Brokering and Communication Strategy and its Communication Plan.

Engagement and communication contact:

Name: Rachel Przeslawski

Email Address: Rachel.Przeslawski@ga.gov.au

Phone Number: 02 6249 9101

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines. The Hub has developed a Data Management Framework providing direction on agreed data management standards and requirements.

This project will collate information to produce a standard operating procedure and develop a software package (see milestones). Information and data will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. Species distribution datasets will be stored in a long-term secure storage, metadata will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal <http://portal.aodn.org.au/aodn/>

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website <http://www.nespmarine.edu.au>. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions.

The primary contact point for data and information management contact for this project is the project leader (see details in front page).

Contact person

Name: Scott Foster

Email Address: scott.foster@csiro.au

Phone Number: 03 62325178

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

Funding will be primarily used to pay salaries, and facilitate meetings (where/when appropriate).

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

Research impact is national. This study will be conducted on the computers of researchers in Brisbane, Canberra, Hobart, Perth and Townsville. On ground work will be conducted through associated NESP projects.

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

The project is a desktop study focused on the development of standard operating procedures for deploying marine survey gear to collect data and in this context is considered a category three project for Indigenous engagement. Our approach to engagement will primarily involve provision of updates to the DoEE Indigenous Advisory Group the Fisheries Research and Development Corporation Indigenous Reference Group. These groups will also be asked for advice on opportunities to enhance Indigenous engagement in this project. It will be important to identify any Indigenous communities that are or will deploy gear types targeted for SOP development, for example BRUVs, for the purpose of collecting scientific data to determine status and trends. The project will be managed consistent with the Hub’s Indigenous Engagement and Participation Strategy.

Contact person for Indigenous engagement:

Name: Rachel Przeslawski

Email Address: Rachel.Przeslawski@ga.gov.au

Phone Number: 02 6249 9101

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

A review and critical analysis of observation platform deployment, raw data processing and processed data analysis for a set of “no regret” objectives around the status and trends of environmental assets within the commonwealth marine area.

**Changes for 2017**: A set of field manuals. The number will depend on how quickly work progresses. The field manuals will be for the survey platforms defined by the partners and stake-holders in the early 2017 meeting.

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

The project will initially be limited to a set of monitoring objectives drawn from the progress made, and outcomes of, Theme 1 and Theme 2 of the NERP biodiversity hub. This analysis will be limited to no more than three specific well-operationalised objectives, as defined in the Integrated Monitoring Framework report.

**Changes for 2017**: A complete set of field manuals for all possible gear types. A “rosetta stone” that quantifies the relationships between different sampling platforms in different environments.

### Risks

List all significant risks to the success of the project

* Failure for the department to agree on a limited set of “no regrets” objectives.
* Loss of key researchers from the hub (Foster, Hosack, Lawrence, Hayes, Przeslawski).
* Failure to get partner and collaborator buy-in to develop, promote and use developed Standard operating procedures (SOPs)

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

Standard operating procedure, survey methods, analysis methods, core information, monitoring

**Changes for 2017**: field manuals, comparative assessment, inclusion of remote sensing

# Project D3 – Preparing for and implementing monitoring of CMRs and the status of marine biodiversity assets on the continental shelf

Project length – 36 Months

Project start date – 01/01/2017

Project end date – 30/12/2019

Project approval date - xx/xx/xxxx (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - Submitted for re-approval

Project Leader – Neville Barrett (FTE – 30%)

Lead Research Organisation – University of Tasmania

Project leader contact details: - [Neville.barrett@utas.edu.au](mailto:Neville.barrett@utas.edu.au), 03-62268210

### Project Funding

**Note** UWA adjusted to 0.2 FTE (30k) and CSIRO reduced by $30K which transferred to D1 to add national CSIRO dataset discovery to D1

|  | | 2015 | | 2016 | | 2017 | 2018 | 2019 | TOTAL |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NESP funding | Total  388,000 | | Total  533,000 | | GA $128,000  UTAS $193,000  CSIRO $53,000  NSW DPI $53,000  NSW OEH $53,000  UWA $30,000  AIMS $20,000  Prioritisation work-shop and data management $25,000  BRUV-based national marine monitoring program workshop $20,000  **Total $575,000**  But see note re CSIRO reduction due to transfer to D1 for engagement | | GA $130,000  UTAS $193,000  CSIRO $53,000  NSW DPI $53,000  NSW OEH $53,000  UWA $30,000  AIMS $20,000  UTAS travel  support $20,000  **Total $552,000** | GA $132,000  UTAS $193,000  CSIRO $53,000  NSW DPI $53,000  NSW OEH $53,000  UWA $30,000  AIMS $20,000  UTAS travel  support $20,000  **Total $554,000** | 2,602,000 |
| Cash co-con |  | |  | | x | | x | x |  |
| In-kind co-con | Total  526,000 | | Total  692,500 | | GA $128,000  UTAS $324,000  CSIRO $53,000  NSW DPI $53,000  NSW OEH $53,000  UWA $30,000  AIMS $25,000  **Total $666,000** | | GA $130,000  UTAS $324,000  CSIRO $53,000  NSW OEH $53,000  NSW DPI $53,000  UWA $30,000  AIMS $25,000  **Total $668,000** | GA $132,000  UTAS $324,000  CSIRO $53,000  NSW OEH $53,000  NSW DPI $53,000  UWA $30,000  AIMS $25,000  **Total $670,000** | 3,222,500 |
| TOTAL | 914,000 | | 1,225,500 | | 1,241,000x | | 1,220,000x | 1,224,000x | 5,824,500 |

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

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.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

The updated version of this plan has been refined to ensure the Hubs focus on future surveys in shelf waters is contained within one project, rather than across two projects (D1 and D3) under the previous research plan. In addition, there is a more clearly stated intent to work with the wider marine community to implement key recommendations of the National Marine Science Plan, namely establishment of a national integrated marine monitoring program. Note milestone 8 in the previous plan continues as milestone 8 in this plan, detailing a report on national database management protocols. It is anticipated that significant additional progress will be made on national databases in 2017, partly facilitated by this project, resulting in completion of databases adequate for BRUV and AUV data, and significant progress towards a national approach to collating multibeam mapping data.

Updated section on Indigenous engagement and consultation.

### Problem Statements

#### Problem

Description of the specific problem

There is a significant and time critical need to support Parks Australia in the establishment of a baseline inventory and monitoring program for CMR networks, as well as initiating the integrated long-term monitoring program identified as a key need and recommendation in the National Marine Science Plan 2015-2025 (NMSP). Currently such programs do not exist in commonwealth waters, and the new CMR network provides a significant national, regional, and bioregional framework around which such programs could be developed.

Hence, the proposed CMR inventory and monitoring program ideally integrates with, and sits within, the broader requirement to monitor and report on the marine ecosystem health of the Commonwealth marine environment, and is complimentary to state marine environment monitoring programs. A national approach is required to understand priority information needs and identify opportunities for cost-effective, national-scale collaborations that foster a standards-based approach to collecting new marine data and information. This approach should encourage innovative approaches to data collection, including learning by doing.

While addressing this need is a large task, one initial prioritisation has been to focus effort into environments where anthropogenic pressures are typically greatest (the continental shelf), and further during the initial phase of this project/program, onto hard substrates (reefs) that usually have greater biodiversity levels than soft substrates.

Currently, significant gaps remain in our knowledge of the distribution of key biodiversity assets of the marine estate on the continental shelf, their condition, and the management actions required to ensure these assets are adequately protected. This is equally the case for CMRs and off-reserve locations and conservation values identified in Marine Bioregional Plans.

One of the key gaps is the extent and nature of rocky reefs on Australia’s continental shelf, which consist of both rock and coral dominated substrate, including those formed on relict (drowned) coastlines (hereafter reefs). These are recognised in marine bioregional plans as a related set of Key Ecological Features (KEFs) that support a range of benthic and pelagic marine communities, including migratory species. Despite their nationally significant status, the extent and distribution of reef habitats remains poorly delineated across the continental shelf, and particularly within Australia’s marine reserve network. Further, many of these reef systems are actively targeted by commercial fishers using traps, droplines, lobster pots and demersal trawl. Hence these habitats are subject to a wide range of pressures that may require managing to maintain biodiversity values. Within the CMR network, some or all of these activities have been excluded, but in virtually all cases the extent of impact and their subsequent rate of recovery is unknown, there is little or no baseline inventory in shelf waters of most CMRs and virtually no monitoring programs are in place. Once the extent of reef systems are known (to underpin biological inventory and monitoring programs), such programs can begin in earnest. This biological information will be critical for evaluating the need for, or effectiveness of management interventions. Hence, survey and monitoring programs are needed to both identify the biological values of such habitats, and the extent that these may be protected via various management tools, including CMRs, adjacent state marine reserves, Marine Bioregional Plans and traditional fisheries management. Such programs will benefit from having a common approach to reporting of outputs that are consistent at a national scale for State of Environment (SoE) understanding and reporting, and utilise methods and locations that are integrated into a national marine monitoring program as envisaged in the National Marine Science Plan. By initiating, establishing and supporting key components of a national marine baselines and long-term monitoring program, and linking these to CMR baselines and monitoring, a significant step can be taken towards our understanding, and monitoring of Australia’s marine biodiversity assets.

#### How Research Addresses Problem

What solution will this research provide?

The project will work with DoEE, Hub partners, IMOS and the wider research community to develop, test and refine a minimum set of national standard approaches to collecting and analysing data for baselines and monitoring biodiversity in Australia’s marine estate with a primary focus on monitoring to inform management of the new CMR network and working with Parks Australia to facilitate implementation of a national CMR monitoring program. It will link these approaches to facilitate development of a broader, nationally integrated monitoring program, including strong partnerships with state-based programs, RIMREP (Reef 2050 Integrated Monitoring and Reporting Program) and IMOS, developing a community of research providers to meet future needs and provide an ongoing reporting framework for CMRs, SOE, national estate and state-based information needs, including informed EPBC decisions on environmental protection. These partnerships will be enhanced during the project through the establishment of a national MPA scientific monitoring forum, with six-monthly meetings of state and commonwealth managers and scientists to coordinate activities, methods and share learnings. While the project will not specifically develop or manage the national integrated monitoring program envisaged in the NNSP, it will facilitate this through coordination of key components (AUV and BRUV benthic monitoring) at a national scale, as well as development of matching databases and providing a forum for collaboration across agencies and jurisdictions.

Importantly, the project will link with the SOP project (D2), bringing the expertise of the biological domain represented by project participants to assess the adequacy of current State agency, and MBH/partner approaches to marine reserve monitoring for meeting CMR and national marine estate baseline and monitoring needs. The project will employ existing data and robust standard indicators to inform the monitoring approach, and develop a standard surveys database and reporting template. The project will link with project B1 and to develop a prioritisation framework for CMR research and monitoring, and we will work with DoEE and the marine science community to prioritise new CMR surveys under this project. Based on these priorities, new, cost-effective CMR surveys will be undertaken with potential DoEE co-funding to initiate the national CMR field program, test the generality of SOP’s under a wider range of environmental conditions, and refine methods.

New surveys will be guided by the [*Monitoring Australia’s oceans: towards a blueprint*](http://www.nespmarine.edu.au/document/towards-blueprint-monitoring-key-ecological-features-commonwealth-marine-area)(noting that this is consistent with the [Integrated Monitoring Framework for the GBRWHA](http://www.environment.gov.au/system/files/resources/7a77c5fd-4318-4336-ad76-ff42f57d8081/files/integrated-monitoring-framework.pdf), and the National Marine Science Plan priority to establish key components of a national integrated marine monitoring program. This new knowledge will allow refinement of KEF maps and understanding of CMR values through infilling critical regional gaps in our understanding. It will also allow refinement of approaches for monitoring the status and trends of key coastal and marine species and environments within reef systems, with programs and tools tailored to suit the reporting and management needs of all agencies involved in biodiversity conservation. This would inform both CMR management and decisions undertaken within Marine Bioregional Plans. By providing the detailed spatial information on habitats and ecosystems it will allow refinement of Key Ecological Feature models at bioregional scales, information necessary to evaluate the pressures on shelf reef systems associated with activities including resource use, marine pollution, biosecurity, and climate change.

Research from 2017 onwards will be coordinated with project D1, and knowledge obtained in the project D3 during 2015/16 to provide a national focus on filling priority gaps in this understanding through surveys of both physical habitat distribution and biological processes. This will build upon methods and knowledge obtained during CERF and NERP Hub research, this project, planned work in D1 and the SOP project (D2). New surveys will be guided by the Department and key stakeholders, with an initial prioritisation workshop held in early 2017 to refine approaches to survey location selection. It is anticipated that CMRs will be a major focus of field surveys, particularly where these intersect shelf reef KEFs. The knowledge gained will lead to refinement of KEF profile descriptions and models, and improved KEF mapping that informs CMR management and implementation of Marine Bioregional Plans, in addition to refinement of cross-shelf inventory and monitoring techniques and capability developed through the NERP Marine Biodiversity Hub.

In summary, the research will

1. provide the support required for implementation of a baselines and monitoring program within the CMR network;
2. provide the framework for, and develop, key components of a national integrated monitoring program linking commonwealth, university and state initiatives;
3. result in new knowledge essential for CMR management, management of the national marine estate, and SOE reporting.

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

This project aligns to at least five DoEE research priorities that together seek to maximise the efficacy of managing Australia’s marine environment and call for an improved understanding of that environment. Specifically, the project will provide shelf reef information necessary to: (i)improve the management of marine biodiversity through an evaluation of the results of management interventions on shelf reefs; (ii) develop and apply methods for monitoring the status and trends of key marine species associated with reef habitats, (iii) build the knowledge base of key marine species and ecosystems associated with reefs in waters of the Australian continental shelf, particularly within CMRs, (iv) identify pressures on the marine environment, and understand their impact to better target policy and management actions , and (v) better understand issues that are common to the fishing industry and the environment including identifying solutions of mutual benefit.

This project is also strongly aligned with recommendation 2 in the National Marine Science Plan - Establish and support a national marine baselines and long-term monitoring program, to develop a comprehensive assessment of our estate, and to help manage Commonwealth and State marine reserves

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

In the first phase of project D3, completed during 2015/16, we collated all available mapping data on the shelf to inform our knowledge of the distribution of key habitats on the shelf in general (with a focus on shelf reef KEFs), and within CMRs in particular. This is currently being complimented by collation of known biological data within the CMR reef habitats to produce detailed summaries for each CMR where data exists. In the first phase of project D1, biological data from extensive surveys in habitats in North and NW Australia has been used for development of predictive models to inform the likely biota associated with key habitats within the CMRs in the N and NW. It is anticipated that future surveys in this region will be targeted to validate/invalidate these predictions. The combined outputs from projects D1 and D3 will be used to inform discussions with DoEE and key stakeholders in early 2017 about prioritising future CMR surveys within a national framework, and the survey methods most applicable to each of these and their associated management plans/objectives. This process will include a workshop proposed to be held in Hobart in Feb/March 2017.

A key focus of this project will be working with DoEE to initiate new CMR surveys throughout 2017 and onwards, to leverage DoEE funding for CMR monitoring/inventory through the expertise and staffing resources able to be delivered through this project, and closely linked projects (D1 and D2). While the Hub may not be the only research provider involved with monitoring/inventory of CMRs through time, we anticipate that in the early stages of a program there will be a need to both initiate surveys within a logical framework and adapt protocols in response to learning. Hence a learning by doing approach. We know that the extent and level of co-funding for such surveys is as yet unknown, and hence plan an adaptive work program based on co-funding opportunities, DoEE priorities, and opportunistic ship time (RV Investigator time and similar vessel access). Thus, with moderate co-funding, multiple CMR surveys may be undertaken over the life of the project, whereas if funding is restricted, surveys may be restricted to opportunistic use of vessels deploying low-cost survey methods.

Given the constraints above, year 1 (2017) will focus on reviewing and analysing data available from existing monitoring programs (e.g. State agency and partner organisations, Hub surveys in existing CMRs including the Flinders, Freycinet and Huon) to assess the suitability of current survey protocols for potential adoption in a national CMR baselines and monitoring program (e.g. assess value of information provided, ability to generate biologically meaningful indicators- for SOE/CMR reporting) and be fully integrated within a wider national integrated monitoring program. The review will include past MBH projects in CMR’s to ensure lessons learned from surveys of complex but important offshore habitats (e.g. relict coastlines) are incorporated into future survey designs. Specific components will include the power provided by current AUV surveys to detect significant changes in indicators such as the cover of sponges, and the power of BRUV surveys to detect biologically meaningful changes in the abundance of indicators such as biomass or abundance of target species.

This component will include a limited new survey in the Hunter CMR to build baselines and test the generality and applicability of particular survey protocols in new bioregions and varying geomorphology. Specifically this will include AUV and BRUV surveys. In addition, if ship-time opportunity arises in strategic locations (e.g. a possible collaboration with the AHO in RV Investigator), we will explore potential field survey collaborations that further DOEE priorities. This work compliments SOP development in project D2 by both field-testing proposed protocols (including statistical designs) if surveys are supported, and by working with partners and the wider scientific community to develop and evaluate metrics for national reporting at the CMR to SOE level.

A key component underpinning integrated national monitoring and the capacity to cost-effectively survey CMRs on a regional basis is the establishment of collaborative research networks within and external to the Hub. A focus throughout this project will therefore be to develop networks of researchers/agencies to integrate robust monitoring methods into a national marine monitoring program (linking CMR monitoring to the broader marine estate and State waters, RIMREP, and National Marine Science Plan objectives) that enables capacity building and collaboration, leading to the generation of national-scale metrics for environmental condition reporting. Initial phases of this have led to the establishment of a national benthic monitoring program based on the IMOS AUV facility and this will be further developed here. It is proposed that a similar (and integrated) program will be developed for BRUVs (baited underwater video), with the Hub to facilitate a national workshop in 2017 to initiate the process. Importantly, this network building will involve generation of several publications focussed on the capacity of current and future AUV and BRUV programs to deliver effectively into SOE reporting and form an efficient national network.

In parallel to building a collaborative national monitoring network, we also propose to establish a national MPA scientific monitoring forum to bring together state and commonwealth managers and researchers on a regular basis to share experiences, coordinate activities, and facilitate the integration of monitoring programs at a national level. An initial forum is planned for July 2017, with subsequent six-monthly meetings facilitated throughout the project,

Finally, the initial mapping workshop and subsequent mapping collation within D3 has identified the need for improved collaboration and co-ordination of seabed mapping across commonwealth/state government agencies and universities. Geoscience Australia are leading a workshop in late 2016 to review current arrangements and improvements, and this project will facilitate collaboration and coordination to establish an agreed national framework for future mapping and data storage/access (in addition to SOP developments in D2). In all cases we will work with AODN and related data management facilities to ensure acquired data are available within one data facility for access for both CMR needs and national reporting.

New marine surveys throughout 2017-19 will be prioritised in collaboration with DoEE and partners as outlined above. This process will be informed by a CMR prioritisation framework developed with DoEE and by ongoing discussions with the Department. As a minimum framework, full surveys will be undertaken using nationally agreed standard methods with a focus on benthic hard substrates (e.g. using BRUVs, AUVs, Multibeam Sonar, Towed Video) and complimented with other methods if/as required. Collaborative links will be made with existing national programs (e.g. IMOS AUV-based benthic monitoring program) and state-based programs to ensure all acquired knowledge is both undertaken cost-effectively and in alignment with broader program objectives such as bioregional representation. These surveys will form a key component of Parks Australia’s CMR baselines and monitoring program, while additionally informing knowledge of cross-shelf habitats essential for marine bioregional planning, SOE reporting, and providing a central plank of a national integrated monitoring program.

For potential new surveys, the survey design will be developed with reference to:

* the need for surveys to provide an adequate inventory for baseline understanding of biodiversity assets, while also providing a robust experimental design for future monitoring aimed at evaluating the effectiveness of CMR’s (including zonation), Marine Bioregional Plans and related biodiversity management measures in Commonwealth and coastal waters.
* major regional gaps identified in initial stages of D1 and D3
* the current and historical distribution of fishing activity and other pressures
* pragmatic limitations of survey costs and regional partner capacity
* management drivers (e.g. assessing adequacy of protection and zonation categories)
* likely hard substrate habitat availability
* integration with national and state monitoring programs
* relevant habitat and connectivity model predictions developed under the CERF and NERP programs, and;

A series of targeted field programmes will be designed to better delineate the boundaries of shelf reef habitat, improve our understanding of their physical and biological characteristics, and where possible improve our understanding of the way in which they recover from fishing pressure. The surveys would deploy high resolution Multibeam Sonar, sub-bottom profiler, Baited Underwater Remote Video (with additional rear facing cameras), and the IMOS Automated Underwater Vehicles facility, to acquire acoustic and biological data.

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

This project links and is complementary to project D1, “National data collation, synthesis and visualisation of key marine values" and will facilitate field surveys to validate CMR predictions for shelf reef KEFs in the N/NW developed in the initial stages of D1, and will add new knowledge on CMRs to be included in the data access and visualisation focus of D1 through 2017-19.

The project is also linked strongly with project D2, “Standard Operating Procedures (SOPs) for survey design, condition assessment and trend detection” by providing the biological domain expertise of project participants where necessary, including via the proposed MPA monitoring Forum. Research will include field evaluation (in D3) of proposed SOPs and experimental designs (developed in D2) under a range of practical applications across the CMR network. In turn, D2 will assist in developing field programs, and be further informed by the results of such programs, including the applicability of SOPs across a range of bioregions.

The project will link with and complement project C2, “Continental-scale tracking of threats to shallow Australian reef ecosystems”. Ultimately, both projects intend to inform SoE reporting and sound environmental management of reef ecosystems via approaches identified in the marine monitoring blueprint. The former does this on shallow reefs, while this project continues the development of this on deeper cross-shelf reefs. SOP protocols developed during the NESP Hub and refined in the SOPs project above, allow reef indicator metrics such as indices of trophic structure and target species biomass to be tracked by standardised methods. Gap-filling surveys undertaken during this project, coupled with the proposed establishment of national collaborations, will add to the biogeographical coverage provided by such standardised methods on shelf reefs, establishing a baseline for future SoE reporting and adaptive management. Guided by the document *Monitoring Australia’s Oceans: toward a blueprint*, and the National Marine Science Plan, both projects aim to develop a common approach to delivery of outputs and advice such that we have a standardised way to deliver information on national studies and report on SoE objectives.

Likewise, project C1 “Improving our understanding of pressures on the marine environment” will be further informed by significantly improving our understanding of the spatial extent and nature of shelf reef KEFs around Australia, and the biological resources associated with them. This will provide the knowledge necessary to understand habitat/biota drivers of the spatial distribution of pressures, how these may intersect with reef systems, and how management approaches designed to minimise these pressures (such as CMRs) are located spatially with respect to such pressures and conservation values.

Finally, we will work with Hub project B1, “Road-testing decision support tools” to assist in identification of sound investments for “Ecological monitoring of Commonwealth Marine Reserves” , including prioritisation of indicators by bringing expertise from key components of the biological monitoring domain, including expertise from state managers and scientists via the proposed MPA monitoring forum.

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

The project will leverage off previous projects undertaken by the Marine Biodiversity Hub and state government agencies: (i) Physical Surrogates research undertaken under the CERF Program which acquired high resolution datasets (multibeam sonar, AUV) for reef habitats in the South-east (TAS), Temperate East (Lord Howe) and South-west (Ningaloo) marine regions; (ii) Approaches to Monitoring developed under NERP which also acquired reef information and applied new sampling designs to inform monitoring, (iii) Models developed under the National Ecosystems Theme of NERP that can be used to test connectivity relationships for large scale reef and relict reef features, (iv) state-based seabed mapping projects in WA, NT, Vic, Tas and NSW that have conducted considerable mapping of reefs on their respective continental shelfs, and (v) mapping collation (gap analysis) in stage 1 of D3, and predictive model development in stage 1 of D1.

This project will extend this previous work by (1) integrating datasets and methods from those programs and applying them to targeted studies of reef condition and trends, (2) infilling critical gaps in our knowledge of the extent of reef systems within shelf waters, and their representation in CMRs, (3) utilising the learnings from NERP Hub research to ensure the series of field programs undertaken are adequate to describe the features of interest, and can act as robust biological baselines for future monitoring programs, (4) completing all necessary steps required to transition from a methods development phase to a full baselines and monitoring program for reef systems, (5) integrating CMR-based inventory and monitoring into a national monitoring program framework (with integration of methods and locations, as well as across agencies and national programs).

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

Many of the project outcomes can be measured against the NESP research priorities for the Marine Biodiversity Hub.

* *Develop and trial decision making tools that will support managers to define and prioritise management actions in Commonwealth Marine Reserves*. This work will provide a robust understanding of shelf reef systems (a Key Ecological Feature), their representation in the CMR network, the biological assets associated with them, and the types of threats that these systems may be facing. This information will be critical to evaluating the management actions within the CMR network necessary to adequately protect the ecological values of this KEF.
* *Identify past and current pressures on the marine environment, and understand their impact to better target policy and management actions. For example, identify the impact of cetacean ship strike*. This work will focus on evaluating CMR shelf reef associated biological assets, and by linking on-ground studies of these assets and potential threats with validation and testing of current models of KEF ecosystem function, will inform the likely extent of the impact of pressures on this marine environment and potential management responses if these pressures have adverse consequences.
* *Determine the causes of, and relationships between, pressures on the marine and coastal environment to inform government investment.* As above, by contrasting information from CMR surveys and models with off-reserve surveys and models, we will be able to inform management of the various pressures on shelf reef systems in general, and highlight issues, or regions of particular concern, e.g. introduced species, climate change, ecological effects of fishing in marine and coastal waters.
* Determine and trial practical and repeatable methods for monitoring the status and trends of key coastal and marine species and environments to underpin management of Commonwealth Marine Reserves. A core focus of this project will be to bring expertise developed in the CERF and NERP Marine Biodiversity Hubs, and by partner agencies, to this task with a focus on shelf reef systems. This expertise is well developed and advanced in its application to the task of informing CMR management, and the intention of the current project is to refine this expertise, apply it to as broad a range of CMRs as practicable, and to be able to use this more generally to monitor the status and trends in both on-reserve and off-reserve environments. In addition, we propose to do this within a prioritisation framework that allows for a planned, stepwise approach to support Parks Australia to develop and implement their CMR baseline and monitoring program, and via the proposed national MPA scientific monitoring forum, ensure methods are consistent with state programs and their outputs fully align with management needs.
* *Better understand issues that are common to the fishing industry and the environment including identifying solutions of mutual benefit.* The fishing industry, the marine environment and protection of biodiversity are intrinsically linked. This project better defines the shelf reef KEF that is a critical habitat for many of our fisheries. Threats that impact this habitat (e.g. introduced pests, ecosystem effects of fishing) are equally important to understand for both on-reserve and off-reserve management, hence, knowledge gained here will be critical for co-management of fishing and conservation issues in the marine environment.
* *Improve our knowledge of key marine species and ecosystems to underpin their better management and protection.* Shelf reef systems have been identified as a Key Ecological Feature with national representation, hence the focus of this project on better understanding this feature. The work will provide the information to refine existing ecosystem models of this KEF, and specifically to inform this priority on the key species of this KEF and the ecosystems that support them.

All of the above outcomes are both practical and tangible and are readily benchmarked against the DoEE research priorities above. They will inform a wide range of management and policy actions, including effective management of CMR conservation values and assets through development of an understanding of the nature and extent of these, their status, and the threats to them that may be addressed by management measures. In addition to informing on-reserve management, the outcomes are equally informative to managing off-reserve conservation values and assets in Commonwealth and coastal waters, such as through Marine Bioregional Plans, and providing benefits to both conservation and fishery management.

The environmental value that the project brings is essentially the significantly enhanced understanding of the shelf reef features of Australia’s waters and their associated biodiversity necessary to effectively manage CMRs and other spatial closures that represent this habitat, to manage the Commonwealth's off-reserve assets in this space, and inform national approaches to ecosystem-based management of this Key Ecological Feature.

This project will provide a key part of the approach to address the national challenge of marine biodiversity conservation and ecosystem health identified in the National Marine Science Plan. Specifically it will provide a cornerstone to establish and support a National marine biodiversity baseline and long-term monitoring program to develop a comprehensive assessment of the marine estate, and to help managed Commonwealth and State marine reserves.

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

The core outcome of this project will be to assist Parks Australia with the key steps towards implementation of a national CMR monitoring program via initiation of baseline surveys within a standard framework. Establishing this program is a central component of Management plans in place for the SE CMR network, and is anticipated to be a central component to management plans for the remainder of the CMR network. Information from these surveys will be essential for refining management plans and objectives of the CMRs in the future as a fuller understanding of the bio-physical assets they contain is made available. Hence the knowledge gained will flow directly into on-ground actions, such as adaptive changes to management prescriptions necessary to protect CMR values. Collaborative networks established by the project, coupled with strategically located surveys, will provide the framework for an integrated national marine monitoring program that will contribute directly to management objectives of effective and meaningful SOE reporting, and implementation of key recommendations in the National Marine Science Plan. Effective SOE reporting can also flow into on-ground actions, including adaptive changes to human activities at local to national scales to protect SOE values.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

The project actually identifies the values of the marine environment across the shelf. Currently, many shelf areas within the Commonwealth marine estate have little to no mapping, including within existing and newly established CMRs. By identifying physical assets and their underlying biological values, we will be adding significant measurable value to all aspects of this estate, including conservation values managed through DoEE and fisheries values managed through AFMA. Moreover, through refining and developing baseline and monitoring approaches through new surveys and approaches to analysing acquired data, we will establish the mechanism through which these values can be benchmarked through time and tracked through SOE reporting using national standard approaches.

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

* A report (by June 2017) detailing the outcomes of the survey prioritisation workshop (scheduled for March 2017), including a decision framework for integrating CMR management needs with national and state programs and drivers, and wider engagement with key stakeholders such as AFMA and NOPSEMA.
* A report by June 2017 detailing the outcomes of the Baited Remote Underwater Video workshop (scheduled for January/February 2017) intended to develop a national marine monitoring program capacity with collaborative partners and facilitate discussions and publications on standard approaches to analysis and reporting at a national level. This will compliment a similar workshop facilitated by the Hub in July 2016 that established a national benthic monitoring program based on the IMOS AUV facility, and the new workshop will focus on developing the integration of these programs at a national level.
* A detailed baseline and inventory report on each targeted field program (guided by gaps identified in the desk-top study and input of priority areas from DoEE). We will develop a standard reporting template for CMR surveys for departmental use, and link all survey outputs to the data access and visualisation mechanisms being developed in D1. The first of these reports will be on Hunter CMR surveys undertaken in 2017.
* A national database protocol for repository of all acquired data from surveys of Commonwealth assets (i.e. effectively utilising the AODN and associated data facilities) that also forms the framework for all data generated as part of an integrated national marine monitoring program (i.e. national databases for BRUV, AUV, multibeam survey data).
* Research publications in collaboration with national/regional partners, developing appropriate indicators for SOE/CMR reporting from BRUV and AUV-based national monitoring programs, applicable at national scales and to best practice international metrics.
* Additional communication and promotion will be undertaken within the overall Hub communication plan, and will involve regular presentations at forums such as the SE CMR stakeholder forum (with representatives from a wide range of key stakeholders present), national conferences, publication of results in the scientific literature and media opportunities as they arise.

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1: Completion BRUV national monitoring program workshop | 28 Feb 2017 |  |
| Milestone 2: Completion of prioritisation workshop | 31 March 2017 |  |
| Milestone 3: Completion of prioritisation workshop report | 30 June 2017 |  |
| Milestone 4: Completion of BRUV workshop report | 30 June 2017 |  |
| Milestone 5: First National MPA scientific monitoring forum (management and science) | July 2017 |  |
| Milestone 6: Report on outcomes from the first national marine monitoring forum | 30 September 2017 |  |
| Milestone 7: Report on national database management protocols for acquired survey data | 1 December 2017 |  |
| Milestone 8: Completion of agreed reporting template for CMR survey reporting | 1 December 2017 |  |
| Milestone 9: Completion of initial survey report from Hunter CMR surveys in 2017 | 30 December 2017 |  |
| Milestone 10: Report on analysis of current CMR/MPA datasets for power/suitability of a range of potential indicators for national level reporting (inc AUV and BRUV datasets). | 30 December 2017 |  |
| Milestone 11: Report on national progress towards a national integrated monitoring program and how CMR monitoring may sit within it | 30 December 2017 |  |
| Milestone 12: All project outputs and data will be made publically available and freely accessible on the internet | 30 December 2017 |  |
| Milestones 13+ for 2018 and 2019 to be developed in consultation with DoEE during 2017 as project is refined in light of likely co-funding for future field surveys. | TBA |  |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| Neville Barrett | University of Tasmania | Project co-ordination, ecological studies |
| Neville Barrett 0.3 FTE | University of Tasmania | Project leader |
| Jacquomo Monk 1 FTE | University of Tasmania | Collation/analysis of regional data and planning of biological studies |
| Justin Hulls - Technical officer for project support 1 FTE | University of Tasmania | Assist in collation/analysis of datasets, workshop and field studies |
| Vanessa Lucieer 0.1 FTE | University of Tasmania | Spatial analyst co-ordinating |
| Keith Hayes 0.1 FTE | CSIRO | Project coordination |
| Tara Martin 0.1 FTE | CSIRO | Marine mapping/GIS collation |
| Alan Williams 0.05 FTE | CSIRO | Ecological input from CSIRO |
| Rudy Kloser 0.1 FTE | CSIRO | Marine mapping/GIS collation |
| Scott Nichol 0.1 | Geoscience Australia | Mapping/Geomorphology |
| Brendan Brooke 0.05 FTE |  |  |
| Zhi Huang 0.15 | Geoscience Australia | Spatial Analyst |
| Johnathon Kool 0.05 | Geoscience Australia | Connectivity/modelling |
| Kim Picard/Justy Siwabessy/Lynda Radke 0.2 FTE (combined) | Geoscience Australia | Seabed acoustics/mapping/geochemistry |
| Rachel Nanson 0.05 FTE | Geoscience Australia | Geomorphology |
| Rachel Przeslawski/Andrew Carroll 0.2 FTE (combined) | Geoscience Australia | Ecology & link to Project D2 |
| Tim O’Hara 0.05 FTE | Museum Victoria | Biodiversity |
| Peter Davies 0.1 FTE | NSW OEH | Mapping |
| Tim Ingelton 0.1 FTE | NSW OEH | Mapping |
| Alan Jordan 0.1 FTE | NSW DPI | Mapping/Ecological studies |
| David Harasti 0.1 FTE | NSW DPI | Mapping/Ecological studies |
| Spatial analyst 0.5 FTE | NSW DPI | Mapping collation |
| Tim Langlois 0.1 FTE | University of Western Australia | Benthic BRUV national database and analysis/ surveys |
| Renae Hovey 0.1 FTE | University of Western Australia | AUV national analysis/database and surveys |
| Hugh Sweatman 0.1 FTE | AIMS | Research coordination GBR/Coral Sea |
| Karen Miller 0.1 FTE | AIMS | Lead for AIMS NW surveys and D1 linkages |
| Roger Proctor | IMOS/AODN | National Database development (BRUV/AUV) |
| Stefan Williams | IMOS | National AUV program integration |
|  |  |  |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
| Dr Stefan Williams | IMOS AUV facility | Co-investment IMOS capacity |
| Dr Stefan Howe | Parks Vic. Coastal mapping | Co-investment – Vic MPA survey protocols and data |

Research End Users and Key Stakeholders **–** Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| DoEE- Parks Australia (CMRs) | Amanda Parr/ Jason Mundy |  |
| DoEE- Parks Australia-SE CMR management | Hilary Schofield/John Lloyd |  |
| DoEE- Regional Marine Planning | Jillian Grayson /Amelia Tandy |  |
| DoEE SoE reporting. | Boon Lim |  |
| Department of Environment and Energy – Biodiversity Conservation Division – Biodiversity Policy Section | Tia Stevens  Gavin Hinten | [Tia.Stevens@environment.gov.au](mailto:Tia.Stevens@environment.gov.au)  [Gavin.Hinten@environment.gov.au](mailto:Gavin.Hinten@environment.gov.au) |
| Department of Environment and Energy – Biodiversity Conservation Division – Reef Trust | Kevin Gale  Ingrid Cripps | [Kevin.Gale@environment.gov.au](mailto:Kevin.Gale@environment.gov.au)  [Ingrid.Cripps@environment.gov.au](mailto:Ingrid.Cripps@environment.gov.au) |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| AFMA | Yvonne Zunic/Beth Gibson |  |
| NOPSEMA | Christine Lamont/Cameron Sim |  |
| State Fishery and Conservation agencies | e.g. Alan Jordan (NSW DPI- Fisheries), Dr Lynda Bellchambers, WA Fisheries. |  |
| Regional fishing and conservation groups |  |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

End users will be engaged in a range of formats during this project. As DoEE will be a key end user we will engage directly with DoEE at all stages of the project, including via an early planning workshop and during ongoing meetings with the department, both directly to key staff and indirectly via the Hub knowledge broker. An initial component of the first year of the project will be a CMR survey prioritisation workshop with DoEE and key stakeholders that will continue current engagement with end users in this space, and set up a framework for ongoing engagement. As the intent of this project is to take all necessary steps to establish a national CMR monitoring program, we will be constantly communicating with DoEE in relation to research needs and priorities.

In addition, the project and ongoing work will be communicated to key stakeholders via meetings such as the SE CMR stakeholder forum and similar forums that offer the opportunity to interact with stakeholders such as AFMA, NOPSEMA, the Oil and Gas industry, state fishery and conservation agencies and commercial and recreational fishing groups. Remaining communication will be via the outputs listed earlier, and actively promoted to stakeholders by the Hubs knowledge broker in alignment with the Hub’s Knowledge Brokering and Communication Strategy as the major pathway to impact.

Knowledge brokering and communication contact

Name: Neville Barrett

Email Address: Neville.barrett@utas.edu.au

Phone Number: 0408334569

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

Data and information will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. Datasets will be stored in a long-term secure storage, metadata will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal <http://portal.aodn.org.au/aodn/>. Currently the project plans to have two main components to data management. The first is to work with the wider marine community to ensure data generated by key methods used in CMR surveys (BRUV, AUV, and multibeam) is able to be stored (or linked directly to) in national data facilities developed for each of these, and linked to an national integrated marine monitoring program. The second component will be new datasets generated by new CMR surveys that will be identified through the prioritisation process and subsequent project refinement. This data will be stored on the new data facilities (above) with metadata retained on the AODN portal.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website http://www.nespmarine.edu.au. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions. The Hub is also developing data access and visualisation methods in project D1, and we will work with that project to ensure all information products are readily discoverable and available to the department and are freely and openly available.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name: Neville Barrett

Email Address: Neville.barrett@utas.edu.au

Phone Number: 0408334569

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

The funding will be used in accordance with a project schedule to be agreed with the department. In the first year it is anticipated funding will be primarily utilised by the research partners to undertake the initial prioritisation workshop and employ staff in initial phases of surveys planning, and by working with partners and the wider scientific community to develop and evaluate metrics for national reporting at the CMR to SOE level, and national collaborative monitoring programs. Depending on department priorities this may also be used to fund new small-scale surveys in known significant gaps. In subsequent years it funds further surveys, and postdoc, PhD and research positions in partner agencies to address the projects objectives.

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

This research will focus on new surveys of shelf hard substrate habitats within CMRs around Australia. The location of these surveys will be guided by the gaps identified and the priorities of the department, including gaining new knowledge on CMRs and for best informing regional marine plans.

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

Shelf habitat mapping is revealing many features unseen to the eye but potentially known to the indigenous peoples through stories of coastal occupation handed down through stories. These include ancient river paths, and connecting features such as relict coastlines.

This project research is considered a category two project for Indigenous engagement because it is highly likely to include a field component within the project that may involve participation with an Indigenous community, organization or group. A Category two project will be expected to:

* Clearly identify how the research will be relevant and of benefit to Indigenous communities and/or organisations and if not why.
* Ensure the research is conducted according to the highest ethical standards and respects Indigenous priorities and values.
* Explore opportunities for Indigenous engagement, employment, skills transfer, sharing of knowledge and the increase of cultural awareness amongst all parties.
* Develop a process for the generated knowledge, data and research results to be effectively shared and communicated between Indigenous peoples, communities and organisations.

The approach to Indigenous consultation and engagement will be consistent with the Hub’s Indigenous Engagement and Participation Strategy. There are two main avenues for Indigenous engagement in this project. The first is through provision of updates to the DoEE Indigenous Advisory Group and the Fisheries Research and Development Corporation Indigenous Reference Group. These groups will also be asked for advice on opportunities to enhance Indigenous engagement in this project.

The second avenue is through involvement of Indigenous communities or organisations in gathering and sharing of knowledge about biodiversity assets on the continental shelf. We will work with the department (DoEE) to explore opportunities for Indigenous collaboration, and our regional partners and, where appropriate, regional NRM groups to further identify communication and collaboration opportunities. For example, we will engage with the SE CMR Network Forum established by Parks Australia. The forum has Indigenous representation, and it is anticipated this type of forum may be replicated in other regional CMR networks as Parks Australia develops and implements new CMR network management plans.

The project team is interested to explore how collated information on shelf reefs could be used to reveal Indigenous knowledge on ancient coastlines. Indigenous engagement with the project may provide opportunities to learn more about the values of sea country through the knowledge gained and/or participation in research programs. The research will be conducted according to the highest ethical standards and respects Indigenous priorities and values.

We will explore opportunities for Indigenous engagement, employment, skills transfer, sharing of knowledge and the increase of cultural awareness amongst all parties. Where opportunity exists, representatives of the community will be invited to participate in research cruises to gain first hand experience of sea country.

Indigenous engagement and participation contact:

Name: Neville Barrett

Email Address: Neville.Barrett@utas.edu.au

Phone Number: 03-62268210

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

The scope includes (1) all necessary steps (in consultation with DoEE) for preparation and initiation of a CMR monitoring program, (2) development of a community of researchers to enable the implementation of a national marine monitoring program, (3) improved databases and data access, the latter via linkage to D1.

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

Exclusions are to be discussed with the department, as the intent is to further our knowledge of the key elements that structure shelf-based biodiversity in Australia’s coastal waters, and the most effective way to identify threats to these and to monitor biodiversity values within CMRs and the commonwealth marine estate in general. The project is readily adaptable to either excluding or including components at the direction of DoEE.

### Risks

List all significant risks to the success of the project

The major constraints to the success of the project are the level of funding and the extent of engagement by DoEE with all stages of this. The project is intended to meet high priority needs of the department with results readily adopted within management frameworks for commonwealth waters, including CMRs, bioregional plans, SoE reporting, and ecosystem-based management of marine resources.

The project team contains a mix of researchers with a proven record of project delivery and completion. Hence, while some elements may be less successful than others (e.g. a particular field survey), the demonstrated level of collaboration between partners is such that all intended outputs have a high level of success with low risk.

A specific risk associated with field surveys is availability of suitable vessels, suitable weather windows and availability of key equipment such as the IMOS AUV facility at a time when vessels, staff and weather align. For proposed Hunter CMR research this is a low risk for BRUV-related research and a moderate level risk for AUV-related research. Risk management will include flexible approaches to survey scheduling to accommodate equipment availability and weather windows.

Additionally there is a risk associated with of the extent of coordination and cooperation between partners and individual researchers. This is particularly the case for this project given the large number of partners and associated staff involved. The project will be managed via regular fortnightly phone meetings along with a set of clear milestones, such that progress can be readily benchmarked and lack of engagement or delivery can be readily identified and addressed.

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

biodiversity, rocky reef, monitoring, CMR, Key Ecological Feature (KEF).

# Project D4 – Expanding our spatial knowledge of marine biodiversity to support future best-practice reviews

Project length – 3.5 Years

Project start date – 01/07/2015

Project end date – 31/12/2018

Project approval date - xx/xx/xxxx (if approved as part RPV1/RPV2 process, if to be approved under RPV3 write TBC)

Project current status - In progress

Project Leader – Tim O’Hara (FTE – 70%)

Lead Research Organisation – Museum Victoria

Project leader contact details: - [tohara@museum.vic.gov.au](mailto:tohara@museum.vic.gov.au), 03-8341 7441

### Project Funding

|  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | TOTAL |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NESP funding | 120,000 | 170,000 | 200,000 | 150,000 | x | x | x | 640,000 |
| Cash co-con | x | x | x | x | x | x | x |  |
| In-kind co-con | 202,803 \*\*\* | 418,106 \*\*\* | 432,183 \*\*\* | 443,852 | x | x | x | 1,496,944 |
| TOTAL | 322,803 | 588,106 | 632,183 | 593,852 | x | x | x | 2,136,944 |

\*The University of Melbourne is effectively contributing two PhD scholarships through the APA and MIRS/MIFRS schemes (total value approx $75,000 per annum).

\*\* Calculated according to Australian Research Council funding rules

\*\*\* Does not include contributed salaries of co-investigators of MNF voyages which would be in excess of $300,000

### Project Summary

100 word succinct summary of the project to help when communicating about this project to non researchers. Please include why the project is important, and its relevance to end-users and brief description of outcomes. If possible, please consider having this summary reviewed by your communications specialist before submission as the summary may be provided to the Minister and placed on the Department website.

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.

### Summary of changes since previous Research Plan

(only for projects which are being resubmitted for approval under RPV3)

Summarise changes that have been made to this project since the previously approved Research Plan with further details of the changes outlined. Please provide further detail of changes (where applicable) at relevant headings below.

### Problem Statements

#### Problem

Description of the specific problem

Australia’s existing bioregionalisation is based on limited information (demersal fish only) and imperfect analyses (one dimensional species range analyses) that were available at the time of compilation (shelf: 1995, slope: 2005). Subsequent studies have suggested different patterns. A future best-practice review of Australia’s bioregionalisation or zoning within the CMR network will have to incorporate substantial amounts of new data, comprehensive oceanographic models, and newer innovative analyses.

#### How Research Addresses Problem

What solution will this research provide?

The primary objective of this project is to identify and fill data gaps and evaluate the importance of new data layers, models and technologies to marine spatial planning at national scales. This will enable DOE to undertake bioregional reviews when they are required. A second objective is to increase our knowledge of biodiversity from unexplored parts of Australia’s marine domain through targeted MNF voyages, including the deeper areas of the CMR network, and to communicate this knowledge to the people of Australia.

#### Alignment with NESP Research Priorities

Description of project alignment with the NESP Research Priorities (i.e. clearly list the relevant priorities and describe how the project directly addresses each listed priority)

The project aligns with the following NESP Research Priorities:

* Supporting national approaches to marine planning including research to support evidence-based decision making.
* Building national capacity for monitoring and reporting on coastal and marine species and ecosystems.

### Research

#### Description of research

Detailed description of research being conducted, including description of methods

Tasks include an assessment of the usefulness of phylodiversity and connectivity data to spatial marine planning, enhancing methodologies to utilise as much existing data as possible, surveying the major gaps in national marine knowledge (the major spatial gaps are: the deep-sea and the Cocos Keeling/Christmas Island Territories) by value-adding to research time on the NMF ‘Investigator’, testing the surrogacy of existing biological datasets to predict macro-faunas, and assessing the potential to downscale bioregional maps to scales useful for site environmental assessment and heritage protection.

#### Links with other projects and hubs

Links to other projects and hubs including collaboration and potential overlap

The research is linked to other NESP projects including D1 and D3.

#### Related research

Details of related / previous research – What previous research does this project leverage off? How is it different to the previous research?

This project will utilise the marine distributional and phylodiversity data accumulated for the NERP project ‘National maps of biodiversity and connectivity’.

### Expected Outcomes

#### Outcomes

Description of expected outcomes, including what practical and tangible outcome/s the project will deliver

* Enhancing Australia’s capacity to spatially manage its extensive marine domain.
* Prepare DOE for a future best-practice reviews of the existing bioregionalisation products, including management zoning of the CMR network, review of KEFs by preparing biological data layers, enhancing methodologies, and evaluating the usefulness of new technologies and oceanographic datasets.
* Baseline biodiversity data for the deep-sea regions of the east coast CMR network, including community, species and genetic diversity data and summary spatial layers.
* Improved understanding of the environmental and evolutionary drivers that structure biodiversity in Australia’s marine domain.
* Improved public understanding of biodiversity values of the deep-sea and Australia’s offshore territories.

#### Specific management or policy outcomes

Outline what management or policy action will be able to be taken as a consequence of the delivery of this project.

This research will prepare DOE for a future best-practice reviews of the existing bioregionalisation products, including management zoning of the CMR network, review of KEFs by preparing biological data layers, enhancing methodologies, and evaluating the usefulness of new technologies and oceanographic datasets.

#### Value

What value does the project demonstrate for the environment and how can this be measured?

Bioregionalisations are spatial frameworks that have been used to identify areas that have particular conservation values, describe ecosystem boundaries, delineate bioregional planning activities, organise environmental inventories, contextualise environmental assessments, and map the marine domain. They are also an important tool for scientific investigations and education.

Specifically, this project will:

* Prepare biological data layers, enhanced methodologies, and evaluations of the usefulness of new technologies and oceanographic datasets to future best-practice bioregionalisations.
* Communicate the conservation values of deepsea habitats within the CMR network to the Australian public, through scientific explorations using Marine National Facility ‘Investigator’.

### Planned Outputs

List planned outputs from the project, including data and information outputs and communication and promotional material.

* Report evaluating the usefulness of phylodiversity (genetic diversity) to spatial marine planning (2015 funded project).
* Report summarising methodological approaches that could be used in future bioregionalisations (December 2016).
* Report including description and images of deep-sea biological communities of the east coast, including the CMR network, on a scheduled May 2017 expedition of the NMF ‘Investigator’. This survey will be presented to the public in the format of a “bioscan” which will result in significant media, education and outreach opportunities to promote the values of the CMR network.
* Report including description and images of banks, seamounts and pelagic aggregations within the Cocos Keeling/Christmas Island territories. This would require a successful application for ship-time on the NMF ‘Investigator’ (2nd half of 2018 – to be confirmed in March 2017)
* Report investigating the possibility of downscaling biogeographic maps to the typical scale of areas of conservation concern (1-100 km) by utilising emerging fine-scale multibeam and water movement data (2018).

The geographical scope of the project will include all of the Australian marine domain (including State waters and Antarctica) and surrounding waters, at all depths, within the area from 60E-160W, 0-70S.

### Project Milestones

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass project outputs as well as regular reporting of results in a clear, digestible format suitable for use by decision makers. For approved projects, please provide a status for the milestone (etc on track, delayed, completed)

| Milestones | Due date | Milestone Status |
| --- | --- | --- |
| Milestone 1: All research users and stakeholders engaged and understand project and opportunities for further engagement | Due 1 April 2016 |  |
| Milestone 2: Report summarising methodological approaches that could be used in future bioregionalisations | Due 31 December 2016 |  |
| Milestone 3: Report into the deep-sea biological communities of the east coast CMR network. | Due 31 December 2017 |  |
| Milestone 4: Report into the biological communities of the Cocos/Christmas EEZs [only if MNF voyage approved for 2017]. | Due 1 July 2018 |  |
| Milestone 5: Report evaluating the potential of using multi-beam seafloor habitat and current flow data to inform bioregional studies | Due 1 July 2018 |  |
| Milestone 6: Report comparing marine bioregional patterns derived from different animal groups | Due 1 December 2018 |  |
| Milestone 7: All project outputs and data will be made publically and freely accessible and available on the internet | Due 1 December 2018 |  |

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

| Name | Organisation | Project Role |
| --- | --- | --- |
| Tim O’Hara | Museum Victoria | Project leader, researcher |
| Robin Wilson | Museum Victoria | Researcher |
| Andrew Hugall | Museum Victoria | Post-doc |
| Lupita Bribiesca | University of Melbourne | PhD student |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

| Name | Organisation/ | Contribution |
| --- | --- | --- |
|  | Museum Victoria | Cash and co-investment |
|  |  |  |

Research End Users and Key Stakeholders **–** Please identify at least one section or programme within DoEE who will be an end user for this project, as well as any end users external to the department and ensure that you have in principal support from them before submitting your application. The Department may contact identified end users to discuss the project.

| Research End Users (section/programme/organisation) | Name/s | Email (optional) |
| --- | --- | --- |
| Parks Australia | Amanda Parr |  |
| Australian National Heritage Assessment Tool | Tania Laity |  |
| Department of Environment and Energy – Biodiversity Conservation Division – Biodiversity Policy Section | Tia Stevens  Gavin Hinten | [Tia.Stevens@environment.gov.au](mailto:Tia.Stevens@environment.gov.au)  [Gavin.Hinten@environment.gov.au](mailto:Gavin.Hinten@environment.gov.au) |
| Department of Environment and Energy – Biodiversity Conservation Division – Reef Trust | Kevin Gale  Ingrid Cripps | [Kevin.Gale@environment.gov.au](mailto:Kevin.Gale@environment.gov.au)  [Ingrid.Cripps@environment.gov.au](mailto:Ingrid.Cripps@environment.gov.au) |

| Key Stakeholders (organisation/programme) | Name/s | Email (optional) |
| --- | --- | --- |
| Parks Australia |  |  |
| National Heritage Assessment Tool |  |  |
| CSIRO | Dan Geldhill |  |

### Knowledge Brokering and communication

Describe the knowledge brokering and communication approach for this project - how do you plan to engage end users? What are the pathways to adoption for the outputs of the project? Ensure this approach aligns with the Hub’s Knowledge Brokering and Communication Strategy.

The approach to engagement of research end users and stakeholders will be consistent with the Hub’s Knowledge Brokering and Communication Strategy. Research end users and stakeholders will be involved in all stages of the project including project scoping, communication of progress and development and communication of project outputs. We will work in collaboration with the DOEE team preparing the Australian National Heritage Assessment Tool to map phylodiversity across Australia’s marine domain. We will work closely with Parks Australia in preparing media releases arising from bio-discovery fieldwork.

We will work within the guidelines of the Marine Biodiversity Hub’s Communications Strategy to:

* Promote the values of the CMR network and the overall marine domain to the Australian public.
* Ensure that milestone reports meet the standards and expectations of end users

### Data and Information Management

Data management: Please briefly list all datasets and data products that will be collected or generated during this project. For each dataset or data product please outline the timing of collection, the repository on which the data will be published, the expected date of publishing and the metadata standard that will be used.

Information management: Please briefly outline the information products (e.g., publications, factsheets etc) expected to be generated throughout this project and describe how and where these will be made freely and openly available on the internet as per the Data and Information Accessibility Guidelines.

Please provide the contact details of the person responsible for ensuring data and information products arising from this project are made freely and openly accessible.

Name:

Email Address:

Phone Number:

Please note that it is acknowledged that projects may not have the information requested above at this point in time and the provision of a brief strategy as to how these requirements will be met and a point of contact will be sufficient.

Hub researchers are required to make their research outputs publically and freely accessible and available on the internet, for use by all persons, as required by the NESP Programme Guidelines.

This project will collate species distribution datasets, generate new data on benthic invertebrate communities and produce reports (see milestones). Data and information will be managed in accordance with the data management framework for NESP Marine Biodiversity Hub. Species distribution datasets will be stored in a long-term secure storage, metadata will be created to meet the Marine Community Profile for metadata and published on the Australian Ocean Data Network Portal <http://portal.aodn.org.au/aodn/>. The Department will be informed by email to marinemetadata@environment.gov.au each time a dataset is published and provided with a link to the full dataset.

Publications, reports, factsheets, maps and images will be made publically and freely accessible and available on the Hubs website <http://www.nespmarine.edu.au>. Journal publications be made publicly and freely available within 12 months of publication. Access to journal publications will also be provided via the Hub’s website to the extent permitted by journal licensing conditions. The primary contact point for data and information management contact for this project is the project leader (see details in front page).

Contact person

Name: Tim O’Hara

Email Address: tohara@museum.vic.gov.au

Phone Number: (03) 8341 7441

### Expenditure Summary

A brief statement describing how project funding will be used (e.g. staffing, events, products).

The majority of the project expenditure will be used to fund a post-doc position at Museum Victoria that will focus on best practice bioregionalisation. Other expenditure will support communication activities associated with successful MNF voyage proposals.

### Location of Research

Please list the approximate location of any on-ground work, and/or the approximate location the research output will impact upon.

Once a project has been approved, a link will be provided to map this location. This information will be included in a spatial database for communication, reporting and Departmental decision-making.

The scope of the project is national (including eastern Antarctica) but much of the data has already been collected. Two planned surveys include a NMF Investigator expedition to the abyssal plain off Australia’s east coast (Brisbane to Hobart) scheduled for November 2016, and a potential application for ship time in late 2017 to explore seamounts, banks and pelagic aggregations within the Christmas Is/Cocos Keeling Territories.

### Indigenous Consultation and Engagement

A brief statement on the approach to Indigenous consultation and engagement as it relates to this project. This should refer back to the Hub’s Indigenous Engagement and Participation Strategy, including details of how the Strategy will apply to this project.

The project involves a combination of desk top analyse and field surveys. Field surveys are unusual in that they will be deploying gear onto the abyssal plan in deep ocean in the outer limits of Australia’s Exclusive Economic Zone. Under these circumstances the project is considered a category three project for Indigenous engagement. Our approach to engagement will primarily involve provision of updates to the DoEE Indigenous Advisory Group the Fisheries Research and Development Corporation Indigenous Reference Group. These groups will also be asked for advice on opportunities to enhance Indigenous engagement in this project.

### Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

Preparation of data layers, evaluations and methodologies to support best-practice bioregionalisation in Australia’s marine domain

### Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

A formal replacement of the existing bioregionalisation (IMCRA5).

### Risks

List all significant risks to the success of the project

The proposed survey of the marine domain within the Christmas Is/Cocos Keeling Territories is dependent on a successful application for NMF-funded ship-time on the RV Investigator in the current application round.

### Project Keywords

A list of 5 keywords to describe the research project. It is expected these key words will aid reporting and search functionality at a later date

Spatial management, bioregionalisation, connectivity, phylodiversity, deep-sea

# Emerging Priority Marine Plastics Project - Assessing effectiveness of waste management in reducing the levels of plastics entering Australia's marine environment

*This is a draft project plan that will be refined in consultation with Hub partners, research-users and stakeholders*

*Project length* – 12 Months

*Project start date* – 01/07/2016

*Project end date* – Stage I: 30/06/2017

Stage II: TBC

*Project Leader* – Denise Hardesty

Lead R*esearch Organisation* – CSIRO

*Partners* (awaiting confirmation): NSW OEH, NESP TWQ Hub, others

*Total NESP funding* – Stage I $60k

Stage II TBD possibly in the range of $200-400k

*Total Recipient and Other Contributions (co-contributions)* - $TBD but ≥Total NESP funding

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | *2016* | *2017* | *2017* | *2018* | *2019* | *2020* |
| *NESP funding* | *$60k* | *$TBD* | *Funding kept at same nominal level until end of project – subject to annual review* | | | |
| *Cash co-con* |  | *$TBD* | *Cash co-contribution kept at same nominal level until end of project – subject to annual review* | | | |
| *In-kind co-con* | *$60k* | *$+++* | *In-kind co-contribution kept at same nomimal level until end of project – subject to annual review* | | | |

## Problem Statement

Forty-five percent of the world’s population lives in the coastal zone. Taken together, these people put an estimated 8.5 million tons of plastic waste into the ocean in 2010 alone. The volume of plastic moving into the ocean is increasing exponentially, tracking production, with a doubling time of approximately 11 years. Thus, between 2014 and 2025, we will put as much plastic into the ocean as we have since it went into commercial production in the late 1940s.

Australia is not immune to this problem. A recent study suggested Australia loses approximately 14,000 tons of plastic into our marine environment each year. Surveys of the Australian coastal zone documented densities of plastic up to 40,000 items per km2. Our coastlines are also increasingly affected, with a national survey estimating approximately 6 plastic items per meter of coastline.

The plastic waste moving into the ocean has a wide array of effects. It has been documented to cause direct economic losses of up to US $1.2 Billion globally, through impacts on tourism, fishing and shipping. Tourism impacts are particularly stark, with clear evidence of reduced visitation rates driven by plastic debris washing up along the coastline, a relevant issue for many tourism dependent coastal communities. Impacts on biodiversity are also substantial, and highly relevant here in Australia. Approximately 65% of seabirds globally have been demonstrated ingesting plastic, and the global hotspot is thought to be in the southern Tasman Sea. Approximately 30% of turtles globally are thought to have plastic in their digestive tract, and approximately 1/3 of all turtles washing up on Australia’s coasts.

It is widely recognized that addressing plastic pollution at its source is the key to stemming the problem. Evidence suggests that if sources are stopped, plastic disappears from the ocean over the course of 10 to 20 years. Stopping waste moving into the environment at the source is also much less expensive, with container deposit schemes, waste disposal facilities and stormwater traps costing a fraction of coastal or offshore removal.

However, effective targeting of investments in abatement measures is critical for designing costs effective policies. Coastal councils spend over 40% of their total budgets on waste management, thus while there are abundant demands on their resources, there is likely also an opportunity to optimize those investments to maximize their impact on the environment.

This research project is planned in two stages making the most of opportunities to receive input from jurisdictions and other interested parties to guide project development in Stage II, and generate national collaborations.

**Stage I**: The first is an analysis of coastal waste management policies implemented by local councils, and their effectiveness in reducing the loss of waste into the ocean and onto the coastline based on existing survey data. This, together with existing data on the national distribution of plastics on Australian beaches, will inform a second national workshop on the issues and opportunities to reduce the level of plastic wastes reaching Australia’s marine environment (noting that one national workshop has already occurred by not all States and Territories were able to attend). **Stage II** will be determined by the outcomes of the workshop, but is anticipated to involve collaboration with citizen science and volunteer groups to identify the most important pinchpoints that could be targeted to intercept plastic waste prior to its loss to the sea. Together these two components will inform development of the most cost-effective options to reduce the volume of plastic waste entering Australian waters from domestic land-based sources.

This project directly addresses Commonwealth government priorities outlined in the Threat Abatement Plan for Marine Debris, authorized under the EPBC Act. The plan is currently under revision for reauthorization, and to date the priority for identifying and promoting effective policy solutions has not been addressed in a substantive way. The project is linked to Department’s work with the UN Environment Program to address Land Based Pollution Sources, under the UN Convention on Law of the Sea. The project directly aligns with the Department’s priority (#6) identified for the Marine Biodiversity NESP to “Define the impact of sewerage outfalls and stormwater runoff to identify real actions to improve outcomes for water quality”. The work also addresses the Department’s other priorities for the hub, including engaging with citizen scientists to enhance biodiversity management (#15) through use of some of the most extensive citizen science datasets collected in Australia. The work is tightly tied to priorities for evaluation of management interventions (#2).

## Research

To understand where littering and other losses of solid waste into the environment are occurring, requires addressing 3 questions: 1) what is the relationship between debris in the marine environment and litter data from nearby sites; 2) are there identifiable pathways through which litter moves into the marine environment; 3) are there particular investments in facilities, policies, or outreach that are effective in reducing the input from littering onto coasts and into the oceans.

**Stage I:** In the first stage of the project, we will analyze the effect of state, regional, and council activities on the amount of debris on the coast and the litter observed at each type of site, using existing datasets (from CSIRO, Clean Up Australia and other volunteer-collected data). We will evaluate three different types of government activities and whether they have a distinguishable impact on littering or coastal debris: 1) investment in infrastructure and facilities, 2) in-place policies, 3) outreach and other action programs. Based on the results of these analyses we will organize a workshop to present the results to all States and NT, noting that this might require the support of the Commonwealth Minister for the Environment.

**Stage II**: Development of the second stage of the project will depend on outcomes and deliberations of the first national workshop. While not prejudging the outcomes of that workshop, we anticipate that stage II research will include identifying the pathways through which plastic waste enters the marine environment. Four datasets are available: two representing sources of litter and other rubbish at a wide range of sites, a third covering plastic debris on the coastline, and a fourth measuring debris in the ocean around Australia’s coasts. These include existing volunteer collected data available from Clean Up Australia and Keep Australia Beautiful activities from the last 2-5 years, as data are made available (CUA data are already in hand and KAB has verbally committed to providing data to us); a systematic national dataset recently collected by CSIRO measuring coastal debris every 100 km around the entire continent, and lastly results from a CSIRO offshore study, with samples approximately every 150 km around the entire Australian coast. Additional data sources will be sought at the workshop concluding Stage I.

Stage II will conclude with a second workshop at which these results will be presented to the States and NT and other interested parties. This second workshop will discuss the most cost-effective options to reduce the amount of plastics entering the oceans and propose ongoing monitoring programs that would measure both the reduction in plastic inputs over time and identify which options are providing the best return on investment.

This research is linked closely to several other projects in the Pressures Theme of the Marine Biodiversity Hub, including work on the distribution of microrplastics on temperate estuarine reefs close to Hobart, Melbourne and Sydney led by Graham Edgar UTAS and work on sewerage outflows led by the Clean Ocean Foundation. NSW OEH is anticipated as a key partner in this project, having been previously engaged in many aspects of this work. The NESP TWQ will be key partner in the research with their experience and resources in tropical waters. The work will complement proposed research on solid waste management and plastic pollution in the Northern Biodiversity Hub. The work builds on the extensive efforts of several volunteer cleanup organizations and CSIRO’s past national marine debris program in assembling the relevant datasets. This work differs from previous research in the area in that to date there has been no mechanistic assessment of the sources of solid waste being transmitted into the ocean. This will also be the first systematic assessment of the impact of local and state policies and investments on these flows. The proposed research will provide the first picture of its kind (probably in the world), allowing targeting of investments in outreach, facilities and other policies.

## Expected Outcomes

Key outputs from Stage I include an investigation of the effectiveness of different government investments in reducing litter moving into the marine environment. Key outputs from Stage II will depend on the advice from the first workshop but could include a set of statistically robust estimates of the roles various types of sources play in determining the amount of refuse making its way into the marine environment. These estimates would be used to identify hot spots of littering, likely pathways for litter and other refuse to reach the marine environment.

Planned Outputs from this project will lead to a range of outcomes, depending on project duration, including: 1) identifying key issues and trends in littering, with associated opportunities for reducing litter at source points; 2) the improved ability for making cost effective decisions based upon high quality data from reputable data sources; and 3) pinpointing key approaches and sites to enhance recycling of packaging away from sources and households. Flow-on effects from this includes a reduction of littering and other solid waste impacts on terrestrial and marine ecosystems.

Additional outcomes from this work include increased knowledge to underpin and develop cost-effective waste policies that are useful for councils at regional and state levels. We will also discuss at the national workshop the potential of research in Stage II to identify behavioral change that can be targeted by corporations to reduce consumer waste and improve recycling.

Specific outputs from this project include:

**Stage I**

* Report summarizing outcomes and discussions from stakeholder meeting(s)
* Detailed list of activities and programs associated with litter reduction in coastal areas for each state/territory
* Ranking of activities and programs in terms of effectiveness in reducing waste in the environment and the cost of each activity or program.

**Stage II**

* List of site usages associated with higher/lower levels of littering (e.g. industrial, retail, recreational, etc.)
* Identification of locations or times where debris flows to the environment are particularly concentrated (e.g. recreational sites near shopping areas, stormwater outflows in high density retail areas) which provide opportunities for behavioural change by consumers or other interventions such as stormwater waste traps.
* Suggestions for potential inexpensive cost-effective strategies or solutions for reducing littering and increasing waste reduction considering infrastructure, policies and outreach
* List of specific suggestions for reducing upstream losses
* Identification of target areas to reduce litter inputs to minimize interactions with Australian marine vertebrate fauna in Australian waters that are a focus in the Marine Debris Threat Abatement Plan (seabirds, turtles, marine mammals)

## Delivery of Project

The project leader, Denise Hardesty is a world-renowned researcher on marine debris and plastics in particular. She led the national assessment of plastic waste on Australian beaches, that included extensive community engagement. Her expertise is recognized and used by the CBD and UNEP.

She will be supported by collaborators from at least NSW OEH and the NESP Tropical Water Quality Hub and outcomes of two national workshops.

## Project Milestone

A description of all key project milestones. Progress will be judged against delivery of the milestones. It is expected that project milestones should encompass regular reporting of results in a clear, digestible format suitable for use by decision makers.

|  |  |
| --- | --- |
| **Milestones** | **Due date (either the 1st of Jan or June)** |
| Detailed research plan | Due 1 June 2016 |
| Workshop report | Due 31 Dec 2016 |
| Further milestones | TBD |

Researchers and Staff

|  |  |  |
| --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE 2016** |
| Denise Hardesty/CSIRO | Project leader | .08 |
| Tim Pritchard/NSW OEH | Jurisdictional advisor | .05 |
| Tonya van der Velde | Logistics, data and meeting coordination | .15 |
| Others TBD |  |  |

Co-contributors – only list contributors who are not already identified as Researchers and Staff

|  |  |
| --- | --- |
| **Organisation/name** | **Contribution** |
| NSW OEH (subject to confirmation) | At or above agreed NESP 50:50 co-investment |
| TWQ Hub | TBD |

Research End Users and Key Stakeholders

|  |  |  |
| --- | --- | --- |
| **Research End Users** | **Organisation/Section** | **Email** |
| NSW, Qld, NT, Vic, Tas, SA EPA or equivalent | States and Territories |  |
| Department of Environment and Energy – Biodiversity Conservation Division – Biodiversity Policy Section | Tia Stevens  Gavin Hinten | [Tia.Stevens@environment.gov.au](mailto:Tia.Stevens@environment.gov.au)  [Gavin.Hinten@environment.gov.au](mailto:Gavin.Hinten@environment.gov.au) |
|  | Municipal councils |  |
| **Key Stakeholders** |  |  |
| Lesley Gidding | DoE |  |
| CEO | Clean Up Australia |  |
| CEO | Keep Australia Beautiful |  |

Expenditure Profile

*A brief statement describing how and when project funding will be used.*

Funds in Stage I will support the collation of information on municipal legislation and its relationship to existing maps of the distribution of marine plastics. Funds will also support a national workshop to which all States and Territories and other interested parties will be invited.

Funds in Stage II TBD

Funds in Stage II will support research activities aimed to identify activities, policies and locations of high litter inputs to the marine environment (e.g. hotspots). Funds will also support research aimed to analyse where marine fauna (turtles, marine mammals, seabirds) likely interact with marine debris within the Australian economic exclusion zone (EEZ).

*Data and Information*

All data and information from this project will be made available nationally and accessible through the AODN under Creative Commons Licenses. There may be some restrictions on data provided in confidence (eg. by local councils) or on third party datasets, but all efforts will be made to make all data publically available through recognised national data portals.

*Location of Research*

Scope of project is national. Actual work is desk-based or meetings.

Some fieldwork in Stage II will take place in capital cities to empirically estimate litter flows and loss rate hotspots (e.g. Melbourne, Sydney, Hobart/TBD). Research outputs will directly act upon coastal and marine environments within the Australian EEZ.

*Indigenous Consultation and Engagement*

Indigenous representatives will be invited to participate in the workshop at the end of Stage I, where results will be presented and the focus of Stage II, determined.

Inclusions (in scope)

This project focuses on federal Threat Abatement Plan processes aiming to identify target areas to reduce litter losses into the coastal and marine environment and impacts on federally identified vertebrate marine taxa in Australian waters.

Exclusions (out of scope)

Geographic regions outside of the Australian EEZ, case studies in remote coastal regions; inland waterways.

Risks

The project requires engagement with stakeholders and DoE at several key points to achieve process outcomes around values and risk assessment. The project will also utilize data that is be held by external stakeholders.

*Project Keywords*

marine debris, risk analysis, flow rates, litter losses, threat abatement plan

1. Pannell, D.J. and Gibson, F.L. (2014) Testing metrics to prioritise environmental projects, Australian Agricultural and Resource Economics Society Conference (58th), February 5-7, 2014, Port Macquarie, Australia. [↑](#footnote-ref-1)