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| **ATTACHMENT A**  **of Research Plan –**  *Research Projects* |

**FINAL VERSION (23 September 2015)**

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

*Project length* – 24 months

*Project start date* – 01/07/2015

*Project end date* – 01/07/2017

*Project Leader* – Peter Kyne (FTE – 100%)

*Lead Research Organisation* – Charles Darwin University

*Total NESP funding* - $754,880

*Total Recipient and Other Contributions (co-contributions)* - $754,880

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|  | *2015* | *2016* | *2017* |
| *NESP funding* | *$349,000* | *$340,000* | *$65,880* |
| *Cash co-con* |  |  |  |
| *In-kind co-con* | *$349,000* | *$340,000* | *$65,880* |

**Project Summary**

Euryhaline elasmobranchs represent over half of the EPBC-listed threatened sharks and rays, with northern Australia of national importance for this threatened species community. Critical information gaps remain, limiting the implementation of Recovery Plan objectives. This project will fill many data gaps through the application of acoustic telemetry, traditional and advanced molecular research (population genetics and close-kin mark-recapture), life history studies and Indigenous knowledge and education. End-users will be provided with information necessary to improve management and facilitate recovery of these threatened species, focusing on three 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.

**Problem Statements**

*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*

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.

*What solution will this research provide?*

This research will provide the Department of the Environment 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*

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*

This project comprises three themes with the following research components:

Theme 1: Monitoring and understanding euryhaline species

1. 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)
2. 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
3. Investigate the optimal design of acoustic receiver arrays to measure long term movement and mortality of euryhaline elasmobranchs in NT, QLD and WA rivers
4. Develop statistical methods for estimating annual juvenile mortality accounting for movement and uneven coverage of acoustic arrays (due to the periodic loss of receivers)
5. 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)
6. Determine the age of *Glyphis glyphis* for demographic models and potentially testing DNA ageing, using existing specimens and collection of 8 medium to larger-sized animals from the Adelaide River
7. Synthesize and report on habitat use (including critical habitat), long-term movements and biologically important areas for euryhaline elasmobranchs (synthesising all NESP phase 1and NERP research)

Theme 2: Indigenous partnerships for management of euryhaline species

1. 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)
2. 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)
3. 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

1. Undertake field collection of *Glyphis garricki* tissue samples in unsurveyed NT habitat (Daly, Finniss, Moyle, Fitzmaurice, Victoria, Keep Rivers) and WA distribution (Cambridge Gulf, King Sound) in partnership with Indigenous Ranger Groups
2. Examine population structure of *Glyphis garricki* (using existing and newly collected tissue samples)
3. Establish lower bound population size estimate (close-kin mark-recapture) for *Glyphis garricki*
4. Using data gained from the above research, undertake a reassessment of the EPBC 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*

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*

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*

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

*Specific management or policy outcomes*

* 1. 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
  2. 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
  3. 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*

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**

* EPBC status reassessment for river sharks
* 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 DoE.

**Delivery of Project**

*Project leader’s track-record*

* The project leader has successfully delivered a large collaborative NERP project with substantial outputs, stakeholder engagement, Indigenous collaboration and delivery of products and expertise to DoE.

**Project Milestones**

Theme 1: Monitoring and understanding euryhaline species

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| **Milestones** | **Due date** |
| Working group on euryhaline elasmobranch species | Due 01 December 2015 |
| Annual monitoring of tagged euryhaline elasmobranchs | Due 01 December 2015 |
| Neonate river shark tagging for mortality estimates | Due 01 December 2015 |
| Large river shark tagging for adult occurrence delineation and philopatry | Due 01 December 2015 |
| Statistical methods for estimating annual juvenile mortality | Due 01 December 2015 |
| Optimal design of receiver arrays | Due 01 December 2015 |
| River shark ageing for demography | Due 1 August 2016 |
| Annual monitoring of tagged euryhaline elasmobranchs | Due 1 December 2016 |
| Retrieval of acoustic receiver array (thereafter for future NESP projects) | Due 1 August 2017 |
| Synthesize and report on habitat use, biologically important areas and long-term movements of euryhaline elasmobranchs | Due 1 August 2017 |

Theme 2: Indigenous partnerships for management of euryhaline species

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| **Milestones** | **Due date** |
| Develop Indigenous partnerships for sawfish knowledge assessment | Due 01 December 2015 |
| Indigenous workshops for sawfish knowledge assessment | Due 01 December 2015 |
| Protocols for annual Daly River Indigenous sawfish survey | Due 01 December 2015 |
| I-Tracker tool development for Daly River Indigenous sawfish survey and relocation | Due 01 December 2015 |
| Daly River Indigenous sawfish survey and relocation | Due 01 December 2015 |
| Develop sawfish education package for Indigenous communities | Due 1 August 2016 |
| Daly River Indigenous sawfish survey and relocation | Due 1 December 2016 |

Theme 3: Knowledge for the reassessment of river shark status

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| --- | --- |
| **Milestones** | **Due date** |
| WA sampling | Due 01 December 2015 |
| Western NT marine survey | Due 01 December 2015 |
| *Glyphis garricki* population structure | Due 1 August 2016 |
| *Glyphis garricki* lower bound population size | Due 1 December 2016 |
| River shark EPBC reassessment | Due 1 December 2016 |

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE 2015** | **FTE 2016** | **FTE 2017** |
| Peter Kyne – Charles Darwin University | Project leader/Field ecology/telemetry/Indigenous partnerships | 1.0 | 1.0 | 0.2 |
| Christy Davies - NAILSMA | Indigenous partnerships | 0.5 | 0.5 | - |
| Pierre Feutry – CSIRO | Molecular research | 0.3 | 0.3 | - |
| Richard Pillans – CSIRO | Field ecology/telemetry | 0.3 | 0.2 | 0.2 |
| Toby Patterson – CSIRO | Mortality & movement models | 0.2 | - | - |
| Mark Bravington – CSIRO | Population assessment & modelling | 0.2 | 0.2 | - |
| Grant Johnson – NT Fisheries | Field ecology | 0.2 | 0.2 | 0.1 |
| David Morgan – Murdoch University | WA field ecology | 0.1 | - | - |
| Jeff Whitty – Murdoch University | WA field ecology | 0.1 | - | - |
| Michelle Heupel - AIMS | Life history/field ecology | 0.1 | 0.1 | - |

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).

**Partner contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| Charles Darwin University | $331,529 |  | $331,529 |
| CSIRO | $216,500 |  | $216,500 |
| AIMS | $22,676 |  | $22,676 |

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

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| --- | --- | --- | --- |
| **Organisation/name** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| NAILSMA | $123,000 |  | $123,000 |
| Murdoch University | $22,500 |  | $22,500 |
| Northern Territory Fisheries | $38,675 |  | $38,675 |
| Kakadu National Park | $0 |  |  |
| Malak Malak Ranger Group | $0 |  |  |

**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.

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| **Research End Users (section/programme/organisation)** | **Name/s (optional)** |
| Department of the Environment | Wildlife, Heritage and Marine Division |
| Department of the Environment | Threatened Species Commissioner |
| Department of the Environment | Parks Australia (Kakadu National Park) |
| Malak Malak Ranger Group |  |
| Other Indigenous ranger groups | TBD through consultation and engagement |
| Indigenous land councils |  |
| NT Fisheries |  |
| WA Fisheries |  |
| NT Seafood Council |  |
| **Key Stakeholders (organisation/programme)** |  |
| Department of the Environment | Wildlife, Heritage and Marine Division |
| Department of the Environment | Threatened Species Commissioner |
| Department of the Environment | Parks Australia (Kakadu National Park) |
| Malak Malak Ranger Group |  |
| Other Indigenous ranger groups | TBD through consultation and engagement |
| Indigenous land councils |  |
| NT Fisheries |  |
| WA Fisheries |  |
| NT Seafood Council |  |

**Knowledge Brokering and communication**

Knowledge brokering and communications will be a core component of the project. Communications tools will include newsletter articles, short films, media releases and media packages (for example around the high-profile western NT threatened marine species survey) 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 DoE, 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.

**Expenditure Summary**

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**

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

**Indigenous Consultation and Engagement**

Key components of this project will be undertaken in partnership with Indigenous organisations, communities and Ranger Groups. 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 Northern 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 Nyikina-Mangala 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)**

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

**Exclusions (out of scope)**

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

**Risks**

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. There is a risk around not being granted approval from relevant authorities to lethally sample a small number of *Glyphis glyphis* for essential ageing.

**Project Keywords**

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

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

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

\*Wildman, West Alligator, East Alligator

#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)**

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

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| **Project title/number:** | ***Project A1* – Northern Australian hotspots for the recovery of threatened euryhaline species** |

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| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project 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 of management of threatened euryhaline species * Indigenous Ranger Group training in threatened species surveying and management |
| 2. What management 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) |
| 3. What trial programmes to improve the physical environment will be conducted? | N/A |
| 4. How will this research improve the environment and how will 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 listed), 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. |
| 5. Does the project align with an identified high priority need? | *Alignment with NESP Research Priorities*  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. |
| 6. What other research or management investment will the project leverage? | 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. |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | The project leader has successfully delivered a large collaborative NERP project with substantial outputs, stakeholder engagement, Indigenous collaboration and delivery of products and expertise to DoE. |
| 8. Can the project be delivered on time and within budget? | The project has developed a set of milestones structured around three themes of research with clear end dates and budget items against each of these. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications |  |

Project A2 – Quantification of national ship strike risk

*Project length* – 30 Months

*Project start date* – 01/07/2015

*Project end date* – 31/06/2018

*Project Leader* – David Peel (0.45) and Natalie Kelly (0.45)

*Lead Research Organisation* – CSIRO

*Total NESP funding* - $280,000

*Total Recipient and Other Contributions (co-contributions)* - $305,000

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
| NESP funding | $80,000\* | $100,000 | $100,000 | X | x | x | x |
| Cash co-con | $0\* | $0 | $0 | X | x | x | x |
| In-kind co-con | $85,000\* | $110,000 | $110,000 | X | x | x | x |

**Project Summary**

Given Australian coastal development, and associated increases in shipping, ship collisions with marine fauna (specifically marine mammals and turtles) is of increasing concern. Tools and research are needed to spatially quantify the risk of ship strike to help develop management strategies. This work will use shipping density/speed data from the recent past, in parallel with species distribution/habitat models, to produce relative risk maps that can be used to identify areas and times where there is co-occurrence of at-risk marine fauna and shipping. From these maps, strategies (such as speed reduction zones/times) could be implemented to minimise the impact of vessel strike on marine fauna.

**Problem Statements**

*Problem*

With substantial increases in coastal and port development, and an associated increase in recreational and commercial shipping along the Australian coastline, ship collisions with marine fauna (specifically marine mammals and turtles) is of increasing concern. Tools and research are needed to quantify this risk of ship strike spatially to help develop management strategies to minimise this risk.

*How Research Addresses Problem*

This project will provide estimates of relative—and, where possible, absolute—risk of ship strike through space and time, based on shipping density/speed and species distribution/habitat models. These estimates of risk can be used to identify areas and times (throughout the year, and possibly diurnal) where there is co-occurrence of at-risk marine fauna and shipping. Taking individual vessel speeds into account, this further provides an indication of where fatal interaction is most likely to occur. From these maps, strategies (such as speed reduction zones/times) could be implemented to minimise the impact of vessel strike on marine fauna.

*Alignment with NESP Research Priorities*

This work will have use in the development of the National Ship Strike Strategy, and the various individual species conservation and recovery plans. 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*

It is proposed that research under this project will be conducted in a number of stages, some will be run in parallel, and may be at different timings for different species:

*Stage 0: Scoping [i.e., done before the official start of the project]*

As part of an Australian Marine Mammal Centre (AMMC) project on humpback ship strike risk in the Great Barrier Reef, a workshop is being held in June 2015 to present the final report to stakeholders and hold discussions about possible further extensions to the work. Therefore, the initial step of this proposed NESP project will be to use this meeting to add a session with stakeholder and key marine mammal/turtle researchers. The main aim will be to identify for which of the at-risk species there is sufficient data to build a distribution/habitat models and their extent, and whether that data is accessible to projects under NESP. A key the success of this project will be engagement and collaboration with key marine mammal and turtle researchers to work toward developing appropriate distribution models and champion/represent this work within the individual species research communities. These collaborations will be put in place as this project proposal is developed.

*Stage 1: National shipping data*

The Australian Maritime Safety Authority (AMSA) can provide fine-scale ‘raw’ shipping data from 2012 onwards which represents the details, locations and speeds of larger vessels operating in Australian waters. For our purposes, we must clean/filter this data, and convert it from a time based sampling to distance based. Some time is required for this processing. The data is then 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. When examining risks of ship strike for smaller marine mammals/turtles, etc., we need to consider that smaller vessels are capable of destructive encounters. Therefore, for these species, the AMSA shipping data, which is not likely to contain records for smaller, recreational vessels (i.e., those vessels not required to carry AIS equipment) may 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. Obviously, this will be very general and fine-scale risk maps will not be possible. Hence, when accessing species in Stage 0 both the size of vessels likely to be of concern (and the amount of state data available) and the amount of species distribution data available will be considered when ranking the species in terms of ease to analyse risk.

*Stage 2: Species distribution models*

For the species identified as feasible in Stage 0, we will build the most complete distribution models possible. Some methodological development may be required during this stage to consolidate disparate data types, for example sighting survey data and movement/satellite tag data.

*Stage 3: Relative risk maps*

By overlaying models of species density and shipping density, relative risk can be estimated to indicate areas, and possibly times, where risk of ship strike is higher. We 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 probabilistic and provides a relative index proportional to the expected number of ship strike fatalities, incorporating vessel speed and beam, and animal dive behaviour.

*Stage 4: Absolute risk ranking*

On species where there is data available on ship strike injury/fatality (i.e., potentially sea turtles), 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.

*Links with other projects and hubs*

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.”*

The species distribution data/models identified and developed in the project will be able to be used in project A2 if it proceeds in future. Conversely, any relevant data/models collected in project D1 (D10) can inform our habitat models.

*Related research*

This project is related to a previous AMMC 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.*

And it will leverage on a number of methodological developments from AMMC 13-46, specifically:

* 1. data processing of the AMSA-derived shipping data from point position data to polyline transects and, finally, raster maps of density and average speed (in collaboration with scientists from NOAA in the USA)
  2. habitat modelling of east-coast Australian/GBR humpbacks should help in developing a similar model for the west-coast Australian humpback whales
  3. Some of the methodological developments dealing with 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.

This proposed NESP project will build on AMMC 13-46 by

* 1. Considering all at-risk-species, rather than only considering E breeding stock humpback whales
  2. having a national scope rather than just the GBR, hence shipping data will be processed on a national scale.
  3. Further developing the relative fatality index that was developed as a proof of concept in AMMC 13-46.
  4. Better framework to encapsulate uncertainty
  5. Further analysis of projected future risk based on projected shipping growth and animal population predictions.

**Expected Outcomes**

*Outcomes*

*Stage 0*

* List of availability and extent of data/distribution models for at-risk marine species.

[Furthermore, this stage will be useful in identifying holes in coverage of data/models and to inform future resource allocation to surveys and other data collection.]

Stage 1

* National shipping density and speed map (based on shipping data recorded every 5-minutes) with vessel length, beam information. [These results will have uses beyond this project, e.g., when looking at the issue of marine noise upon marine animals.]

Stage 2

* Consolidated distribution data and models of selected marine animals.

[This could further aid in TEPS and management decisions.]

*Stage 3-4*

* Development of maps for national relative ship strike risk for species identified in Stage 0. In cases where there is insufficient distribution or habitat use data, we can use general wide scale knowledge of species extent and shipping data to give maps showing broad-scale locations of potential interaction. This information can help direct future survey effort to fill the data gaps.
* Development of methods and absolute risk maps for species *where ship strike fatality data is available.*

*Specific management or policy outcomes*

Initially the outcome for 2015 (i.e., the scoping document) will provide information for funding bodies, various stakeholders and marine mammal/turtle/dugong researchers to consider when prioritising future allocation of resources to study animal distribution, specifically for locations and species for which more information is needed in terms of quantifying ship strike risk.

Before, the project begins as part of AMMC 13-46 a workshop is being held in June 2015 with invitees form AMSA, AMMC, CSIRO, DoE, Marine Safety Queensland, NOAA, Murdoch University, Blue Planet Marine, GRPMPA, IFAW and DoD, where there will be further discussion of potential uses of this work by each stakeholder.

Ultimately, the final outcome of the project would be to produce a comprehensive report on national ship strike risk to the limits of current data and knowledge e.g. species risk maps. From these risk maps, spatial and temporal strategies/recommendations could be implemented to minimise the impact of vessel strike on marine fauna. These could range from ‘no action required’ through to active management, including options such as

* 1. speed reduction zones at certain times (the methods developed in the project can quantify the reduction in risk),
  2. requirements for increased observation of marine mammals in the path of vessels by bridge crew and
  3. modification of vessel routes to avoid areas of higher whale density.
  4. Recommendations for further targeted small-scale surveys to establish fine-scale spatial animal distribution in the identified risk area, or surveys to establish and map small recreational vessel density

*Value*

The ultimate value to the environment would be reduced pressure on at-risk marine fauna. However, for many of the species, the prevalence of ship strike is difficult to ascertain, so measuring the effectiveness of management and value to the environment is also difficult--except possibly via comprehensive vessel based monitoring, and on species where fatalities are washed ashore and recorded the incidence of ship strike injured animals could be monitored. However, even this would need an ongoing measure of relative abundance; otherwise, any inferred change in ship strike incidence may simply be confounded by a change in abundance.

**Planned Outputs**

**Outputs for the 2015**

* 1. Initial scoping report of ship strike risk, summarising what is currently known on at-risk species, the data available, shipping size/type data needed and providing recommendations on what species to investigate ranked from easiest to most difficult;
  2. Identification of data deficiencies;

**Outputs for 2016-2017**

* 1. Full Australia-wide fine-scale shipping density and average speed maps for 2012 – present;
  2. A suite of distribution information/maps for the various species investigated;
  3. Risk map for selected species. With individual species, results delivered during the life of the project. 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.

**Delivery of Project**

*Project leader’s track-record*

Both proposed project leaders have delivered outputs (including reports, papers, chapters for an International Court Justice case memorial, metadata reports, etc), under research projects within the Australian Marine Mammal Centre (in particular, a three-year aerial survey for Antarctic minke whales in the Southern Ocean, and towards the Antarctic Blue Whale Project). Furthermore, the proposed project leaders have contributed significantly the SESSF FIS project, and an AMMC project on the risk of ship strike on humpback whales in the GBR.

*Delivery on time and within budget*

The design of the project is such that there are numerous stand alone outcomes (i.e. individual species, distribution and shipping) to some extent these can be run in parallel. The initial step will be to gather all information available and to categorise species based on the data availability and effort required. This will allow an informed strategic approach to the work plan to minimise the risk of delays or budget overruns. Furthermore, this initial work in 2015 of establishing a detailed view of available data and models and taking what has been learnt from previous work on humpback whales should reduce the possibility of unforeseen issues. The exact timelines and longer term funding of the project will to some extent be dependent on the number of species that are chosen to be examined/included. The plan would be of a staged approach with individual species results delivered during the life of the project.

**Project Milestones**

Milestones for year 2/3 will be revisited once the species scoping exercise in year 1 is complete. However, generally they will be the following.

|  |  |
| --- | --- |
| **Milestones** | **Due date** |
| Milestone 1  Report summarising at-risk species, data availability and recommendations on species. Species will be grouped into three tiers of based on importance and feasibility. | Due 31 December 2015 |
| Milestone 2.1  Risk Map of first test species | Due 30 June 2016 |
| Milestone 2.2  Initial National map of shipping density and speed | Due 31 December 2016 |
| Milestone 2.3  Risk Map of second tier of species | Due 31 December 2016 |
| Milestone 3.1  Risk Map of third tier of species | Due 1 June 2017 |
| Milestone 3.2  Refined National map of shipping density and speed | Due 31 September 2017 |
| Milestone 3.3  Final report on national ship strike risk to the limits of current data and knowledge | Due 31 December 2017 |

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE 2015**  **(6months)** | **FTE 2016** | **FTE 2017** |
| Natalie Kelly/CSIRO | Statistician/Marine Mammal Modelling | 0.6 | 0.4 | 0.4 |
| David Peel/CSIRO | Statistician/Shipping data/ship strike | 0.6 | 0.4 | 0.4 |
| Josh Smith/Murdoch University | Marine Mammal scientist | 0.3 | 0.2 | 0.2 |
| Jessica Redfern/NOAA | Ecologist/Shipstrike | 0.04 | 0.04 | 0.04 |
| TJ Moore/NOAA | AIS Shipping data expert | 0.04 | 0.04 | 0.04 |
| AIMS/GA/UTAS? \* | Potential collaboration on specific species or certain modelling aspects? |  |  |  |

\* Specific partner researchers will depend on the outcome of the workshop in June with regards to species/data availability

**Partner contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| CSIRO | 280,000 | 0 | 280,000 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Organisation/name\*** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| NOAA/Jessica Redfern (4% FTE) | 0 | 0 | $12,500 |
| NOAA/ TJ Moore (4% FTE) | 0 | 0 | $12,500 |
| Murdoch University/Josh Smith (20% FTE) | 0 | 0 | Cost to project is $55,000 and is just salary component. So Murdoch is co-investing overhead costs. |

\* Depending on species and data availability that is established in Stage 0 other contributors/organisations may potentially be engaged, this will be clearer after discussions and a workshop meeting in June 2015. For example, researchers at UQ, SCU, AIMS, JCU.

**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)** |
| Australian Marine Mammal Centre (AMMC) /Australian Antarctic Division (AAD) | Mike Double/Eleanor Bell |
| Australian Maritime Safety Authority (AMSA) |  |
| International Whaling Commission | Human Induced Mortality (HIM) subcommittee |
| Australian Marine mammal and turtle researchers |  |
| Great Barrier Reef Marine Park Authority (GBRMPA) |  |
| All State and Territory Governments |  |
| Threatened Species Commissioner (DoE) |  |
| Department of Defence (particularly the Defence Science and Technology Organisation) |  |
| National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) |  |
|  |  |
| **Key Stakeholders (organisation/programme)** |  |
| Australian Marine Mammal Centre/AAD | Mike Double/Eleanor Bell |
| AMSA |  |
| International Fund for Animal Welfare (IFAW) | Sharon Livermore |
| Blue Planet Marine NZ | Simon Childerhouse |
|  |  |

**Knowledge Brokering and communication**

There are a variety of known and potential end-users, stakeholders and partners for this project, such as: Department of Environment, including the Threatened Species Commissioner and the Great Barrier Reef Marine Park Authority, in addition to the Australian Marine Mammal Centre and the Australian Antarctic Division; the Australian Maritime Safety Authority (AMSA); the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) specific oil and gas industry companies, as appropriate; the Department of Defence, particularly the Defence Science and Technology Organisation; State and Territory Government and conservation agencies; and the original custodians of any marine mammal abundance and distribution data gathered and used in this project. The project will communicate with raw data (as appropriate, and potentially with the need for permission from original custodians), cutting-edge science, interpretations for laypersons, and advice for action and behaviour change. Delivery of such will sensitive to the context in which information will be received and used, as per guidance from the Hub’s specialist knowledge broker, and in alignment with the Hub’s Knowledge Brokering and Communication Strategy. The key output of the first year of the project will be: maps and associated spatial data products; reports will be publically available, and, where possible, methods published as scientific papers, in open-access journals (where possible and appropriate).

**Expenditure Summary**

All funding will be used for staffing and meeting key data custodian/researchers/stakeholders.

**Location of Research**

The research impact will be national

**Indigenous Consultation and Engagement**

We recognise the importance of Indigenous consultation and engagement and, as such, we will seek advice from the hub executive, as well as the researchers we are engaging with for specific species, to ascertain potential Indigenous interest in this work. Furthermore, we will ensure, via discussion with the hub, and the species researchers, that any opportunity to seek consultation and engagement with the Indigenous community is identified and taken. We will also ensure that if any existing data we use incorporated Indigenous intellectual and/or traditional knowledge that permission is granted for its use and this input is acknowledged and respected. We believe this approach is congruous with the Hub’s Indigenous Engagement and Participation Strategy.

**Inclusions (in scope)**

All species in Australian national waters at potential risk from ship strike injury

**Exclusions (out of scope)**

No data collection, but rather the identification of knowledge gaps and need of further data collection

**Risks**

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 mammal researchers and industry data owners to enable the development of collaborative access to suitable data to build the species distribution models.

**Project Keywords**

Marine mammal; large marine vertebrates; ship strike; cetacean; risk; Distribution

|  |  |
| --- | --- |
| **Project title/number:** | **A2 - Quantification of national ship strike risk** |

|  |  |
| --- | --- |
| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | * For 2015,   + Initial scoping report of ship strike risk, summarising what is currently known on at-risk species; the associated data available; shipping size/type data needed and provision of recommendations on what species to investigate ranked from easiest to most difficult;   + List of availability and extent of data/distribution models for at-risk large marine species. This will useful to help identify holes in coverage of data/models and to inform future resource allocation to surveys and other data collection.      * Consolidated distribution data and models of selected marine animals. This could further aid in TEPS and management decisions. * National shipping density and speed map (based on data recorded at 5 minute-intervals) with vessel length, beam information. (These results will have uses beyond this project, e.g. when looking at the issue of marine noise upon marine animals.) * Development of maps for national relative ship strike risk for species identified in Stage 1. In cases where there is insufficient distribution or habitat use data, we can use general broad scale knowledge of species extent and shipping data to give maps showing locations of potential interaction (still at the broader scale). This information can help direct future survey effort to fill the data gaps. * Could potentially develop absolute risk maps for species *where ship strike fatality data is available.*   1. Ultimately, the final outcome of the project would be to produce a comprehensive report on national ship strike risk within the limits of existing/current data and knowledge e.g. species risk maps. From these risk maps, spatial and temporal strategies/recommendations could be implemented to minimise the impact of vessel strike on marine fauna. These could range from ‘no action required’ through to active management. |
| 2. What management action will be able to be taken as a consequence of the delivery of this project? | Initially for 2015 the impact for management decisions will be information for funding bodies, various stakeholders and marine mammal/turtle/dugong researchers to consider when prioritising future allocation of resources to study animal distribution. In particular, this will be locations and species for which more information is needed in terms of quantifying ship strike risk.  For the 2016-2017 phase, the management actions that will be enabled as a consequence the risk maps produced by this work are spatial and temporal strategies/recommendations that could be implemented to minimise the impact of vessel strike on large marine fauna. These could range from ‘no action required’ through to active management, including options such as   * + speed reduction zones at certain times (the methods developed in the project can quantify the reduction in risk),   + requirements for increased observation of marine mammals in the path of vessels by bridge crew and   + modification of vessel routes to avoid areas of higher whale density.   + Recommendations for further targeted small-scale surveys to establish fine-scale spatial animal distribution in the identified risk area, or surveys to establish and map small recreational vessel density |
| 3. What trial programmes to improve the physical environment will be conducted? | N/A |
| 4. How will this research improve the environment and how will this be measured? | The ultimate value to the environment would be reduced pressure on at-risk marine fauna. However, for many of the species, the prevalence of ship strike is difficult to ascertain, so measuring the effectiveness of management and value to the environment will be difficult. |
| 5. Does the project align with an identified high priority need? | Aligns with 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.” |
| 6. What other research or management investment will the project leverage? | Methods/capability developed in ***Australian Marine Mammal Centre Project 13-46****: Quantitative assessment of the risk of shipping traffic to whales: a case study for humpback whales in the Great Barrier Reef* will be leveraged in this project. Specifically:   * + data processing of the AMSA-derived shipping data from point position data to polyline transects and, finally, raster maps of density and average speed (in collaboration with scientists from NOAA in the USA)   + habitat modelling of east-coast Australian/GBR humpbacks should help in developing a similar model for the west-coast Australian humpback whales   Some of the methodological developments dealing with 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.  *Extensive use of existing survey data sets, the collection of which were previously funded by government.* |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | Both proposed project leaders have delivered outputs (including reports, papers, chapters for an International Court Justice case memorial, metadata reports, etc), under research projects within the Australian Marine Mammal Centre (in particular, a three-year aerial survey for Antarctic minke whales in the Southern Ocean, and towards the IWC-SORP Antarctic Blue Whale Project). Furthermore, the proposed project leaders have contributed significantly the SESSF FIS project, and an AMMC project on the risk of ship strike on humpback whales in the GBR. |
| 8. Can the project be delivered on time and within budget? | The design of the project is such that there are numerous stand alone outcomes (i.e., individual species, distribution and shipping) to some extent these can be run in parallel. The initial step will be to gather all information available and to categorise species based on the data availability and effort required. This will allow an informed strategic approach to the work plan to minimise the risk of delays or budget overruns. Furthermore, the initial work in 2015 of establishing a detailed view of available data and models and taking what has been learnt from previous work on humpback whales should reduce the possibility of unforeseen issues. The exact timelines and longer term funding of the project will to some extent be dependent on the number of species that are chosen to be examined/included. The plan would be of a staged approach with individual species results delivered during the life of the project. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications | There are a variety of known and potential end-users, stakeholders and partners for this project, such as: Department of Environment, including the Threatened Species Commissioner and the Great Barrier Reef Marine Park Authority, in addition to the Australian Marine Mammal Centre and the Australian Antarctic Division; the Australian Maritime Safety Authority (AMSA); the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), and specific oil and gas industry companies, as appropriate; the Department of Defence, particularly the Defence Science and Technology Organisation; State and Territory Government and conservation agencies; and the original custodians of any marine mammal abundance and distribution data gathered and used in this project. The project will communicate with raw data (as appropriate, and potentially with the need for permission from original custodians), cutting-edge science, interpretations for laypersons, and advice for action and behaviour change. Delivery of such will sensitive to the context in which information will be received and used, as per guidance from the Hub’s specialist knowledge broker, and in alignment with the Hub’s Knowledge Brokering and Communication Strategy. The key output of the first year of the project will be: maps and associated spatial data products; reports will be publically available, and, where possible, methods published as scientific papers, in open-access journals (where possible and appropriate).  We recognise the importance of Indigenous consultation and engagement and, as such, we will seek advice from the hub executive, as well as the researchers we are engaging with for specific species, to ascertain potential Indigenous interest in this work. Furthermore, we will ensure, via discussion with the hub, and the species researchers, that any opportunity to seek consultation and engagement with the Indigenous community is identified and taken. We will also ensure that if any existing data we use incorporated Indigenous intellectual and/or traditional knowledge that this is acknowledged and respected. We believe this approach is congruous with the Hub’s Indigenous Engagement and Participation Strategy. |

Project A3 - A national population assessment for white sharks

*Project length* - 2.5 years

*Project start date* – 1/07/2015

*Project end date* – 30/12/2017

*Project Leader* – Barry Bruce (FTE – 25%)

*Lead Research Organisation* – CSIRO Oceans & Atmosphere

*Total NESP funding* - $644,000

*Total Recipient and Other Contributions (co-contributions)* - $644,000

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* | *2021* |
| *NESP funding* | *$194,000* | *$250,000* | *$200,000* | *x* | *x* | *x* | *x* |
| *Cash co-con* |  |  |  | *x* | *x* | *x* | *x* |
| *In-kind co-con* | *$194,000* | *$250,000* | *$200,000* | *x* | *x* | *x* | *x* |

**Project Summary**

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 to 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.

**Problem Statements**

*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 Western Australia, NSW and South Australia due to a series of shark attacks attributed to the species and claims of increasing interaction frequency, highlight the need to assess population status and trends in white sharks in order 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 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.

*How Research Addresses Problem*

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*

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.
* 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**

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. 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 that 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. These were specifically designed to provide the required data for refining east-coast population estimates and for developing methods to estimate future 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

NESP research in 2015 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,
* Consolidating samples and undertaking initial assays of archived tissue to establish requirements for making population estimates for the western white shark population, and
* Establish and test tools for estimating population trend from existing samples and cost effective strategies for monitoring juvenile abundance

This will be achieved by:

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

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. The efficacy of these data streams to provide robust information for future monitoring will be reviewed and assessed to inform research planning for 2016 and 2017. 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 will be trialled in the Port Stephens area (in collaboration with NSW DPI) to test their utility for assessing abundance and monitoring tagged juvenile white sharks. 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 this trial 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 o 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.

1. 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.

1. 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.

1. 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*

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*

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*

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*

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**

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).

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.

New 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.

Provide information that identifies movement corridors, hotspots and contributes to management strategies for top-order marine predators

Estimate juvenile white shark survival and abundance for input into integrated national population assessment models in order to refine population estimates.

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.

Identify national strategies to monitor white shark populations.

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.

**Delivery of Project**

*Project leader’s track-record*

The project leader successfully delivered project outputs under NERP and 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*

We will regularly review and report on progress towards project outputs and outcomes against budget trajectories. Any unanticipated challenges will be immediately discussed with Hub leadership to identify implications and identify pathways to ensure project delivery on time and budget.

**Project Milestones**

Note: Only 2015 project milestones have been provided in detail; details of 2016-17 milestones will be established on the outcome of 2015 research.

|  |  |
| --- | --- |
| **Milestones** | **Due date** |
| Incorporate established 2015 data streams into refines population estimates for white sharks in eastern Australia and test the evaluate the efficacy of these data streams for future monitoring; archive acoustic data in IMOS?AATAAMS database | October-December 2015 |
| 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 | October – December 2015 |
| Run initial assays and analyses on archived western population tissue sets to assess requirements for estimating population size | October-December 2015 |
| 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 and an extension of statistical kin-finding methods to incorporate genomic data (from half sibs to half cousins)\* | December 2015 |
| Archive acoustic tag data into IMOS/AATAMS database | December 2015 |
| Establish details of research plan for 2016-17 based on the above data streams and analyses | October – December 2015 |

\* These results may be enough to estimate contemporary trend for white sharks, or may indicate that further work (and how much) would be required.

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

|  |  |  |
| --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE (2015)** |
| Barry Bruce (CSIRO) | Project leader | 0.25 |
| Russell Bradford (CSIRO) |  | 0.20 |
| Peter Grewe (CSIRO) |  | 0.10 |
| Mark Bravington (CSIRO) |  | 0.10 |
| Richard Hillary (CSIRO) |  | 0.10 |
| David Harasti (NSW DPI) |  | 0.05 |
| Technical staff (NSW DPI) |  | 0.15 |

**Partner contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| CSIRO | 564,000 |  | 564,000 |
| NSW DPI | 80,000 |  | 80,000 |
|  |  |  |  |

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

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

**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 | | 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) | | |  | | --- | | Ashley Leedman/Lesley Giddings | | Threatened Species Commissioner |   Barry Hayden  Paul Vogel |

|  |  |
| --- | --- |
| **Key Stakeholders (organisation/programme)** |  |
| NSW DPI  WA Department of Fisheries  PIRSA  AFMA |  |

**Knowledge Brokering and communication**

Knowledge brokering and communication strategies were well established during our activities under NERP and will be continued under NESP. The primary end user of the information is the Marine and Freshwater Species Conservation Section: Wildlife, Heritage and Marine Division of DoE, 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 DoE 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.

**Expenditure Summary**

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

**Location of Research**

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

**Indigenous Consultation and Engagement**

The extent to which project actions, outputs and outcomes are of 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. Our initial engagement strategy will be to 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. 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. We will seek guidance from the Hub and NESP leadership as to the most appropriate groups to make contact with and the most appropriate strategy to do so. The outcomes of these contacts will guide the extent of future Indigenous engagement strategies for the project.

**Inclusions (in scope)**

This project will refine 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. The project will identify national scale strategies/requirements for future monitoring of these populations.

**Exclusions (out of scope)**

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

**Risks**

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**

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

|  |  |
| --- | --- |
| **Project title/number:** | **A3 - A national population assessment for white sharks** |

|  |  |
| --- | --- |
| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | This project will refine 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. It will provide the first national scale assessment of population status for white sharks. NESP project work will also provide scientifically robust tools and assessment procedures to measure and monitor future trends as well as providing improved knowledge of the species’ movement patterns and habitat use. |
| 2. What management action will be able to be taken as a consequence of the delivery of this project? | 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. |
| 3. What trial programmes to improve the physical environment will be conducted? | No trial programs are proposed as part of this project. |
| 4. How will this research improve the environment and how will this be measured? | This project will provide efficient and effective biodiversity data, information and knowledge systems, through its collaborative approach and integration of existing expertise and data. |
| 5. Does the project align with an identified high priority need? | This project fulfils the highest priority of the national recovery plan for the species and contributes to the high priority objective of “Identifying hot spots and management strategies for top order marine predators, including research to identify effective non-lethal measures to manage human-shark interactions” |
| 6. What other research or management investment will the project leverage? | The project builds on the research undertaken as part of NERP as a scheduled staged approach to determining the size and status of white shark populations in Australian waters. It leverages previous extensive work by CSIRO on white shark biology and movement patterns and is leverages of various current research platforms established by NSW DPI, WA Fisheries, SARDI, Flinders University to achieve a nationally coordinated goal. |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | The project leader has an extensive track record in areas of shark research, project delivery and specifically in leading projects at national scales. |
| 8. Can the project be delivered on time and within budget? | The research is the second phase of estimating population size and status of white sharks in Australian waters and follows on from the first stage completed under NERP. It builds on the success of the NERP research which established much of the ground-work for this NESP proposal. The success of the preceding NERP project and the focus on annual evaluation and planning maximises the success in achieving project delivery on time and on budget. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications |  |

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\*

\*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 title/number:** | **A4 - The status of human-shark interactions and initiatives to mitigate risk in Australia** |

|  |  |
| --- | --- |
| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | 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. It will provide a clearly articulated and collective understanding of current initiatives and developments in the management of human-shark interactions (nationally and internationally) identify knowledge gaps and ensure the alignment of potential NESP investment in this space to Departmental and policy requirements in context with State Government initiatives. |
| 2. What management action will be able to be taken as a consequence of the delivery of this project? | This project will provide a sound basis for the Department and Minister to comment on strategies to minimise human-shark interactions in Australia. |
| 3. What trial programmes to improve the physical environment will be conducted? | No trial programs are proposed as part of this project. |
| 4. How will this research improve the environment and how will this be measured? | 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. |
| 5. Does the project align with an identified high priority need? | This project forms the basis for addressing the identified high priority action of: “… research to identify effective non-lethal measures to manage human-shark interactions”. It will also contribute to |
| 6. What other research or management investment will the project leverage? | 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. |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | The project leader 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. |
| 8. Can the project be delivered 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. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications |  |

Project A5 – Establishing the status of Australia’s hammerhead sharks

*Project length* – 8 Months

*Project start date* –1/5/2015

*Project end date* – 31/12/2015

*Project Leader* – Michelle Heupel (FTE – 20%)

*Lead Research Organisation* – Australian Institute of Marine Science

*Total NESP funding* - $503,601

*Total Recipient and Other Contributions (co-contributions)* - $518,080

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* | *2021* |
| *NESP funding* | *$103,601* | *$200,000* | *$200,000* |  |  |  |  |
| *Cash co-con* | *x* | *x* | *x* |  |  |  |  |
| *In-kind co-con* | *$118,080* | *$200,000* | *$200,000* |  |  |  |  |

**Project Summary**

Hammerhead sharks are the focus of conservation management through recent listing on CITES and CMS. However, the state of knowledge of hammerhead sharks in Australia requires exploration. Data on hammerhead interactions with fisheries, life history and ecology will be gathered to address this need. Collected data will be used to construct a series of conceptual models of population structure of hammerhead sharks in Australia. This analysis will refine the status of these species and identify required research or management. This project precedes targeted research to provide information required for effective management of these populations.

**Problem Statements**

*Problem*

Conservation and management initiatives require information on the status of Australian hammerhead populations. Linkages between Australia, Papua New Guinea and Indonesia where high fishing and mortality occurs also need to be fully defined. There is currently fragmentary knowledge of stock structure and resolving this will have important implications for management and conservation actions. Three species are being considered for EPBC listing highlighting the potentially threatened status of these populations and the imminent need for accurate data on population status and trends.

*How Research Addresses Problem*

This project will produce a comprehensive analysis of data available for hammerhead sharks in Australian waters. Several disparate data sources exist, but a national approach has not yet been applied integrating multiple data sets (e.g. fisheries data, shark control program data, baited remote underwater video survey data, etc). This synthetic approach will provide a significant advance on the current state of knowledge and provide guidance for future research and management requirements for these species. This will include exploration of data gaps and potential expansion of genetic stock structure analysis. Data from adjacent regions (Indonesia and Papua New Guinea) will be incorporated where possible and factored into research prioritisation.

*Alignment with NESP Research Priorities*

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. Improve the management of marine and coastal biodiversity by evaluating and quantifying the results of management interventions.
  3. Better understand issues that are common to the fishing industry and the environment including identifying solutions to mutual benefit.
  4. 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*

This project will integrate existing data to define the status of hammerhead sharks within Australia. Information on hammerhead catches, fishing effort, discarding, etc. will be gathered from participating state, territory and commonwealth agencies including data from commercial and recreational fisheries and the Qld and NSW shark control programs. Data from baited underwater video surveys, fishery observer programs and citizen science programs such as reef life survey will also be integrated to enhance the outcomes of the initial analyses. Information on life history, stock structure and ecology will also be gathered. Data from Indonesia and Papua New Guinea will be incorporated where possible. Ecology and stock structure data will be used to construct a series of conceptual models of possible stock structures of hammerhead sharks in the Australian region. This is the first stage of a multi-year research effort. Outcomes of this scoping study will inform research plans for 2016 and beyond.

*Links with other projects and hubs*

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

*Related research*

This project will leverage data collected under NERP Tropical Ecosystems Hub project 6.2. It will also take advantage of publicly available data, integrate data from collaborators and access underutilised data sets.

**Expected Outcomes**

*Outcomes*

* Synopsis of knowledge of scalloped and great hammerhead sharks in Australian waters for use by stakeholders (include DoE, state agencies, commercial and recreational fishing bodies).
* Conceptual models of the stock structure of hammerhead shark species caught in Australian fisheries, current data supporting these models and a plan for defining stock structure.
* Preliminary status assessment of hammerhead populations and identification of key knowledge gaps and research priorities.

*Specific management or policy outcomes*

A comprehensive analysis of currently available data for hammerhead sharks will be directly relevant to EPBC listing and assessment of these species, reporting under CITES and CMS. Outcomes are also relevant to state fishery management agencies. 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*

This project will establish the status of hammerhead sharks in Australian waters and 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 management.

**Planned Outputs**

Outputs of the project will include:

* A report outlining the current state of knowledge for hammerhead sharks in Australia including conceptual models of stock structure and status assessment. Research and management priorities will be highlighted.
* Presentation of results to key stakeholders and end users
* Presentation of recommendations at scientific conferences
* Communication of findings to the broader community via social media

**Delivery of Project**

*Project leader’s track-record*

Dr Heupel has a long track record of successful research results and delivery as demonstrated through on time reporting and production of over 15 journal publications from NERP research. NERP projects met all milestones on time and within budget.

This research will be based on several existing data sets which will help ensure success in a timely fashion. Integration of data sets and modelling will be conducted based on the available data and within the time frames of the research program. The main costs involved are salary time to conduct data synthesis and modelling. The time allocate for these tasks is appropriate and as such the project will be completed within budget. Project updates will be available for Sept and November TSSC meetings.

**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** |
| Milestone 1 – Produce a report compiling the data gathered, conceptual population models and species status. Report will include recommendations for data additional collection and ongoing research efforts. | Due 1 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 | Project leader, responsible for compiling report | 0.2 |
| Will White – CSIRO | Data advisor relative to Indonesian fishing and genetics | 0.1 |
| Colin Simpfendorfer – James Cook University | Population modeller, fisheries advisor | 0.05 |
| Andrew Chin – James Cook University | Data analyst, data collection, assimilation and analysis | 0.35 |

**Partner contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| AIMS | $200,043 |  | $200,043 |
| CSIRO | $68,933 |  | $68,933 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Organisation/name** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| James Cook University | $48,266 |  | $249,104 |
|  |  |  |  |
|  |  |  |  |

**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 |  |
| 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 |  |

**Knowledge Brokering and communication**

Recent engagement with DoE and GBRMPA has indicated hammerhead sharks as a research priority. This project builds upon those discussions to fill identified knowledge gaps and refine research needs for these species. Based on 2015 data gathering, a report will be compiled including recommendations to DoE, GBRMPA, DoA and state fisheries agencies. This report will form the basis of ongoing discussions around the research priorities for subsequent years of NESP to ensure appropriate and useful outputs are achieved. Presentations of preliminary findings will be completed for key end users in conjunction with discussions about the current and future directions of hammerhead shark research. Communication of the hammerhead status assessment will be also 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**

Expenditure will include salary for participation of key researchers (Heupel, White, Chin, Simpfendorfer), provide travel funds to access data from relevant agencies and present outcomes to Department of the Environment staff.

**Location of Research**

This research will be conducted in Townsville, QLD based on co-location of three participants. Since the project is primarily a desk-top study the project location is not critical.

**Indigenous Consultation and Engagement**

Sharks have varying levels of significance and use in Indigenous communities, but it is unknown how important hammerhead sharks are in particular. 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 as totems or food resources. 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)**

This project addresses data gaps and requirements of hammerhead shark populations as described above.

**Exclusions (out of scope)**

The project focuses exclusively on hammerhead sharks and as such excludes similar issues for other shark species.

**Risks**

There are no significant risks associated with this project

**Project Keywords**

Hammerhead shark, fisheries, conservation, management, connectivity

|  |  |
| --- | --- |
| **Project title/number:** | **A5 - Establishing the status of Australia’s hammerhead sharks** |

|  |  |
| --- | --- |
| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | * Synopsis of knowledge of scalloped and great hammerhead sharks in Australian waters for use by stakeholders (include DoE, state agencies, commercial and recreational fishing bodies). * Conceptual models of the stock structure of hammerhead shark species caught in Australian fisheries, current data supporting these models and a plan for defining stock structure. * Preliminary status assessment of hammerhead populations and identification of key knowledge gaps and research priorities. |
| 2. What management action will be able to be taken as a consequence of the delivery of this project? | A comprehensive analysis of currently available data for hammerhead sharks will be directly relevant to EPBC listing and assessment of these species, reporting under CITES and CMS. Outcomes are also relevant to state fishery management agencies. These data are likely to be used in species assessment and subsequent management and policy decisions. |
| 3. What trial programmes to improve the physical environment will be conducted? | None |
| 4. How will this research improve the environment and how will this be measured? | Hammerhead sharks are exploited within and beyond Australia with their populations listed as threatened in many regions including within Australia (NSW). This national synthesis of available fisheries and research data will provide a preliminary assessment of the population and highlight data gaps for effective further research to refine management and conservation of Australian populations. |
| 5. Does the project align with an identified high priority need? | This project aligns with several NESP priorities including:   * 1. Improve our knowledge of key marine species and ecosystems to underpin their management and protection.   2. Improve the management of marine and coastal biodiversity by evaluating and quantifying the results of management interventions.   3. Better understand issues that are common to the fishing industry and the environment including identifying solutions to mutual benefit.   4. 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. |
| 6. What other research or management investment will the project leverage? | This project will take advantage of already collected data from research (e.g. AIMS) and management (e.g. state fisheries agencies) and as such will leverage significant previous investment. |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | Dr Heupel has a long track record of successful research results and delivery as demonstrated through on time reporting and production of over 15 journal publications from NERP research. NERP projects met all milestones on time and within budget. All requested metadata from NERP research are housed in the eAtlas prior to project completion as required. |
| 8. Can the project be delivered on time and within budget? | Yes. Given the desktop nature of this project it will be completed within the defined time frames meeting all objectives within budget. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications |  |

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 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 title/number:** | **A6 - Prioritisation of research and management needs for Australian elasmobranch species** |

|  |  |
| --- | --- |
| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | * 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. * Case study on how new methods can be applied to management issues |
| 2. What management action will be able to be taken as a consequence of the delivery of this project? | 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.  More flexible options for management (specifically elasmobranchs, but also other TEPS in the future) that can be adaptive and scalable.  Outcomes may be relevant to actions and reporting under international agreements such as CITES and CMS. |
| 3. What trial programmes to improve the physical environment will be conducted? | None |
| 4. How will this research improve the environment and how will this be measured? | A number of elasmobranch species are classified as meeting IUCN threat criteria, but even greater numbers are listed as data deficient. Lack of appropriate data and methods to assess population status make it difficult to fully assess these populations and initiate management and conservation actions. This project will highlight priority species of concern within Australia and explore the best available methodologies for quickly and effectively assessing the status of potentially vulnerable Australian elasmobranchs as well as how new methods can be applied to management. |
| 5. Does the project align with an identified high priority need? | 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 elasmobranch species within Australian waters. |
| 6. What other research or management investment will the project leverage? | This project will take advantage of already collected data from IUCN assessments, an ongoing FRDC project, available research approaches and management based information. Thus this project will leverage significant previous investment. |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | The PIs have a long track record of successful research results and delivery as demonstrated through on time reporting and production from NERP research projects. NERP projects met all milestones on time and within budget. |
| 8. Can the project be delivered on time and within budget? | Yes. This project includes a single workshop and desktop case study and as such will be completed within the defined time frames meeting all objectives within budget. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications |  |

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 Leader* – John Bannister (FTE 30%)

*Lead Research Organisation* – The Western Australian Museum

*Total NESP funding* - $120,000 (over 3 years), GST and inflation exclusive

*Total Recipient and Other Contributions (co-contributions)* - $15,000

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* | *2021* |
| *NESP funding* | *$40,000* | *$40,000* | *$40,000* | *x* | *x* | *x* | *x* |
| *Cash co-con* | *x* | *x* | *x* | *x* | *x* | *x* | *x* |
| *In-kind co-con* | *$5,000* | *$5,000* | *$5,000* | *x* | *x* | *x* | *x* |

**Project Summary**

Continuation (since 1993) of annual aerial surveys, to include counts and identification photographs, of Southern Right whales between Cape Leeuwin (WA) and Ceduna (SA), where wintering animals come close to the coast – adult females to calve, at approximately three-year intervals, other adults and juveniles less regularly. The area is the main wintering ground of a major ‘western’ subpopulation of ‘Australian’ right whales, differing in number and extent of recovery (from 19th century hunting) from an ‘eastern’ subpopulation which so far shows little if any recovery. Counts allow estimation of population trend and current numbers; identification photographs allow estimation of life history parameters. .

**Problem Statements**

*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*

a) From annual counts: estimates of numbers and hence trend in population growth since 1993.

b) 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

*Alignment with NESP Research Priorities*

* 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*

Objectives:

a) 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.

b) 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.

c) 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*

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*

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*

Expected outcomes will be:

* Updated population trend, 1993-2015 and on
* Updated population size, 2015 and on
* Updated sightings database
* Updated photo-catalogue

*Specific management or policy outcomes*

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*

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**

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.

**Delivery of Project**

*Project leader’s track-record*

Successful application for Commonwealth Government funding of this project annually since 1993 – apart from 2011 when the funding decision was made too late for the fieldwork and funds were obtained from the Island Foundation, Massachusetts, USA.

Data management has been approved by the AMMC and AAD, with data currently housed at AAD and in the AMMC-funded ARWPIC.

*Delivery on time and within budget*

The project will be delivered on time and within budget by meeting set deadlines, and ensuring cost controls.

**Project Milestones**

|  |  |
| --- | --- |
| **Milestones** | **Due date** |
| 1 - undertake aerial survey | 15 August -15 September 2015 |
| 2 - analyse count data | by 30 October 2015 |
| 3 - select identification photos from aerial survey | by 15 November 2015 |
| 4- provide Progress Report on 2015 activities | by 30 December 2015 |
| 5 - incorporate sightings data in the sightings database | by 30 January 2016 |
| 6 - provide Final Report on 2015 activities | by 30 March 2016 |

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

|  |  |  |
| --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE** |
| John Bannister– WA Museum (Hon Associate) | Project Leader/ Manager | 30% |
| Jenny Schmidt (Great Southern Aviation) | Pilot | 2% |
| Andrew Halsall (A.H Photography) | Observer/photographer | 2% |
| Prof Phil Hammond (St Andrews Uni) | Statistical advice | <1% |

**Partner contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner** | **NESP $$ requested** | **Cash contribution** | **Co-investment** |
| None |  |  |  |
|  |  |  |  |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Organisation/name** | **NESP $$ requested** | **Cash contribution** | **Co-investment** |
| WA Museum. |  |  | In kind provision of admin services |

**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)** |
| Migratory Species Section/ Wildlife Heritage and Marine Division/Commonwealth Dept of Environment  Marine Science Program/WA Dept of Parks and Wildlife | Chris Schweizer  Holly Raudino |
| **Key Stakeholders (organisation/programme)** |  |
| International Whaling Commission/Scientific Committee/Head of Science | Greg Donovan |

**Knowledge Brokering and communication**

Through Final Report to the funding agency, with results conveyed to WA Dept of Parks and Wildlife, AAD, Commonwealth Dept of the Environment, Scientific Committee of the International Whaling Commission.

**Expenditure Summary** (per year, excl GST and inflation)

Aerial survey: $19,000

Photography: $3,300

Data extraction/analysis/databasing/report writing: $17,700

**Location of Research**

WA Museum

**Indigenous Consultation and Engagement**

This project has been running for >20 years without any request for engagement from Indigenous organisations. However the project leader will take advantage of the opportunity for Indigenous engagement provided by the Marine Biodiversity Hub to ensure that this is one of the projects whose results are presented to relevant representative bodies to assess their interest in further engagement.

**Inclusions (in scope)**

Survey results – counts, population trend, numbers

Updated Databases – sightings, identified individuals

**Risks**

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**

Right whale population trends, numbers.

**References**

Bannister, J L, 2014 a). Monitoring population dynamics of southern right whales off southern Australia, 2012 and 2013. Final report to the Australian Marine Mammal Centre, 20 pp.

Bannister, J L, 2014 b). Monitoring population dynamics of southern right whales off southern Australia, 2014. Progress report to the Australian Marine Mammal Centre, 3pp.

Hiby, L and Lovell, P, 2001. A note on an automated system for matching the callosity patterns on aerial photographs of southern right whales. Journal of Cetacean Research and Management (Special Issue 2): 291-295.

Leaper, R, Cooke, J, Trathan, P, Reid, K, Rowntree V, and Payne, R, 2006. Global climate change drives southern right whale (*Eubalaena australis*) population dynamics. Biology Letters 2: 289-292.

|  |  |
| --- | --- |
| **Project title/number:** | **A7 – Monitoring population dynamics of ‘Western’ Right whales off southern Australia** |

|  |  |
| --- | --- |
| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | Results from this project will inform management activities developed to improve the physical environment including CMR management plans and Environmental Impact Assessments for activities including oil and gas exploration and development through NOPSEMA. |
| 2. What management 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. |
| 3. What trial programmes to improve the physical environment will be conducted? | This project is monitoring the recovery from a historic trial programme in the marine environment – commercial whaling |
| 4. How will this research improve the environment and how will 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). |
| 5. Does the project align with an identified high priority need? | The project aligns with the following priority needs identified by DoE for 2015  • 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. |
| 6. What other research or management investment will the project leverage? | Results from this project will inform decisions through the International Whaling Commission, including a demonstration of the value of non-lethal research. |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | Successful application for Commonwealth Government funding of this project annually since 1993 – apart from 2011 when the funding decision was made too late for the fieldwork and funds were obtained from the Island Foundation, Massachusetts, USA. |
| 8. Can the project be delivered on time and within budget? | The project will be delivered on time and within budget by meeting set deadlines, and ensuring cost controls, matching the success of previous years’ surveys. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications | Data management has been approved by the AMMC and AAD, with data currently housed at AAD and in the AMMC-funded ARWPIC. It is thus available to the public and can be linked to other publically available databases.  A Final Report will be provided to the Marine Biodiversity Hub, with results conveyed to WA Dept of Parks and Wildlife, AAD, Commonwealth Dept of the Environment, Scientific Committee of the International Whaling Commission.  This project has been running for >20 years without any request for engagement from Indigenous organisations. However the project leader will take advantage of the opportunity for Indigenous engagement provided by the Marine Biodiversity Hub to ensure that this is one the projects whose results are presented to relevant representative bodies to assess their interest in further engagement. |

Project B1 – Road testing decision support tools via case study applications

*Project length* – 36 Months

*Project start date* – 1/7/2015

*Project end date* – 30/6/2018

*Project Leader* – Terry Walshe (FTE – 65%)

*Lead Research Organisation* – AIMS

*Total NESP funding* - $895,000 ($145,000 in Year 1)

*Total Recipient and Other Contributions (co-contributions)* - $895,000 ($145,000 in Year 1)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | *2015* | *2016* | *2017* | *2018* |
| *NESP funding*  *- AIMS*  *- UWA*  *- CSIRO*  ***Total*** | *$85,000*  *$49,000*  *$11,000*  *$145,000* | *$172,000*  *$106,000*  *$22,000*  *$300,000* | *$172,000*  *$106,000*  *$22,000*  *$300,000* | *$85,000*  *$54,000*  *$11,000*  *$150,000* |
| *Cash co-con* | *-* | *-* | *-* | *-* |
| *In-kind co-con*  *- AIMS*  *- UWA*  *- CSIRO*  ***Total*** | *$85,000*  *$49,000*  *$11,000*  *$145,000* | *$172,000*  *$106,000*  *$22,000*  *$300,000* | *$172,000*  *$106,000*  *$22,000*  *$300,000* | *$85,000*  *$54,000*  *$11,000*  *$150,000* |

**Project Summary**

This project will assist Commonwealth Marine Reserve managers assess critical needs in effective decision-making and resource allocation, and identify the tools that can meet those needs. It will insulate against arbitrary losses in environmental outcomes that arise from poor decision support. Case studies will treat selected decision problems in detail. The project will provide:

* Appraisal of the strengths and weaknesses of a suite of decision-support tools for the kinds of problems encountered by CMR policy-makers and managers.
* Demonstration of use of selected tools in two topical case study problems.
* Enhanced capacity among DoE personnel in the selection and use of decision support tools.

In year 1 outcomes for research in subsequent years will be identified, including those related to economic and social research.

**Problem Statement**

A difficult challenge for policy-makers is to identify the right tool for their specific context and constraints. The elements of a decision problem comprise objectives, defensible value judgments around the relative or absolute importance of each objective, alternative courses of action, and credible causal judgments of the performance of alternatives against objectives. The broad array of decision support tools place varying degrees of emphasis on these elements. This project will assist Commonwealth Marine Reserve managers sketch a set of policy and management issues, assess critical needs in effective decision-making, and identify the tools that can best meet those needs. Subsequent case studies will treat selected decision problems in detail.

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.

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.*

**Research**

This project will (a) identify different decision problems faced by CMR managers and policy-makers, (b) identify decision support tools that can alleviate critical bottlenecks in these decision problems, (c) explore selected tools in detail via case study applications, and (d) develop capacity among DoE personnel for routine deployment of a subset of tools.

Among the many decision-support tools and techniques available to managers and policy-makers are those that deal with:

The characterisation of risks (probability weighted consequences):

* Qualitative risk assessment
* Quantitative risk assessment
  + Logic trees
  + Bayesian Belief Networks
  + Monte Carlo simulation
* Horizon scanning

The valuation of market and non-market consequences

* Revealed preference techniques
* Stated preference techniques, including social surveys (e.g. choice modelling and choice experiments)
* Benefit transfer

The selection of better options among a set of candidates:

* Cost-effectiveness analysis
* Cost-benefit analysis
* Multi-criteria analysis
* Scenario analysis
* Value of information analyses
* Adaptive management

These tools vary in the kinds of problems they address, the resources and technical competencies required to deploy them, repeatability and transparency, the temporal scales and uncertainties they can accommodate, and the extent to which they demonstrate diligent discharge of legal responsibilities.

The approach of the project entails five phases. In Year 1 we will complete Phases 1 and 2.

* Phase 1: Review – collation of examples of tools used in the marine reserve setting.
* Phase 2: interviews with CMR managers and policy-makers and decision support experts to develop a typology of decision problems encountered by CMR business units and functions and the tools that can be used to address them. CMR business units to be consulted include Compliance and Enforcement, Stakeholder Engagement and Assessments and Authorisations.

Pending support, in subsequent years we will complete Phases 3 – 5.

* Phase 3: workshop with CMR managers and policy-makers to develop rapid prototypes of a subset of decision problems.
* Phase 4: detailed exploration of the strengths and weaknesses of a subset of tools in two case study applications. Case studies will be flexible and responsive to departmental needs.
* Phase 5: capacity building via short (1 day) courses in a subset of tools and development of excel-based protocols for their routine deployment.

This project builds on research undertaken in Theme 2 of the NERP Marine Biodiversity Hub, *Supporting management of marine biodiversity*. There are also opportunities to work collaboratively with research providers engaged under the Threatened Species Recovery Hub.

**Expected Outcomes**

The first year of this project will provide:

* A review of decision support tools and their application in marine reserve management.
* An analysis of the needs and constraints of CMR business units and identification of the subset of decision support tools that best meet those needs and constraints.
* Identification of proposed outcomes for future research undertaken under this project.

Beyond Year 1, this project will provide:

* An appraisal of the strengths and weaknesses of a suite of decision-support tools for the kinds of problems encountered by CMR policy-makers and managers.
* Demonstration of use of selected tools in two topical case study problems.
* Enhanced capacity among DoE personnel in the selection and use of decision support tools.

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 tools.

**Planned Outputs**

Year 1

* Review – collation of examples of tools used in the marine reserve setting.
* Matrix describing alternative tools and their strengths and weaknesses against a suite of organisational needs for internal reference.
* Identification of proposed outcomes for future research undertaken under this project.

Beyond year 1 (pending further support)

* Two reports describing case study outcomes.
* At least two publications in high impact peer-reviewed journals.
* Training and associated materials

**Delivery of Project**

Walshe has an excellent track record of delivering timely and polished products in research and consultancy. In his past role as Knowledge Broker for the Environmental Decisions Hub, he worked extensively with DoE line areas, including productive collaboration with Parks Australia. 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** |
| Milestone I Report of Phase 1 and 2 outcomes | Due 1 Jan 2016 |
| Milestone II Progress Report of Phases 3, 4 and 5 outcomes | Due 1 Jan 2017 |
| Milestone III Final Report describing outcomes of entire project | Due 1 Jul 2018 |

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

|  |  |  |
| --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE** |
| Terry Walshe – AIMS | Project Leader | 0.65 |
| Prue Addison - AIMS | Partner investigator | 0.10 |
| Michael Burton - UWA | Partner investigator | 0.10 |
| Sean Pascoe - CSIRO | Partner investigator | 0.10 |
| Fiona Gibson - UWA | Partner investigator | 0.10 |
| Postdoc – UWA; to be appointed | Partner Investigator | 0.50 |

**Partner contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| Department of the Environment (CMR) personnel |  |  | 0.50 FTE |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Organisation/name** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| NA |  |  |  |

**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)** |
| Parks Australia (Cth Marine Reserves) | Barbara Musso |
| **Key Stakeholders (organisation/programme)** |  |
| Dependent on case studies undertaken |  |

**Knowledge Brokering and communication**

Knowledge brokering and communication are core elements of this project. We will conduct 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.

**Expenditure Summary**

Project funding provides direct salary costs for

* The project leader (Walshe)
* Partner investigators (Pascoe and Burton/Gibson) and
* A postdoc (to be appointed)

Plus operating costs, including

* Workshops and
* Travel and accommodation.

**Location of Research**

Workshops will be held in Canberra and/or Hobart. Case study applications may involve workshops and travel to other destinations.

**Indigenous Consultation and Engagement**

We will assume Indigenous interests are relevant to selected case studies. We will seek feedback and approval on case studies from appropriate authorities. We will invite Indigenous representation in the development of case studies. We will confirm ethics approval prior to undertaking research, and we will ensure the conduct of research respects cultural and intellectual property and traditional knowledge. The approach to Indigenous engagement will be consistent with the Hub’s Indigenous Engagement and Participation Strategy.

**Inclusions (in scope)**

All decision support tools are candidates for exploration under this project.

**Exclusions (out of scope)**

Nil

**Risks**

The success of this project is highly dependent on engagement of CMR managers. Considering the high priority placed on this project by DoE this risk is characterised as low.

**Project Keywords**

Decision support tools, Prioritisation, Multi-criteria analysis, Scenario planning, Cost-effectiveness

|  |  |
| --- | --- |
| **Project title/number:** | **Project B1 – Road testing decision support tools via case study applications** |

|  |  |
| --- | --- |
| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | • Appraisal of the strengths and weaknesses of a suite of decision-support tools for the kinds of problems encountered by CMR policy-makers and managers.  • Demonstration of use of selected tools in two topical case study problems.  • Enhanced capacity among DoE personnel in the selection and use of decision support tools. |
| 2. What management action will be able to be taken as a consequence of the delivery of this project? | Improved efficiency, repeatibility and transparency in the discharge of Commonwealth Marine Reserve responsibilities. |
| 3. What trial programmes to improve the physical environment will be conducted? | Nil |
| 4. How will this research improve the environment and how will this be measured? | Poor choice and use in decision support can lead to 30 – 50% losses in environmental benefits. This project will avoid these arbitrary losses through informed selection and use of appropriate tools. |
| 5. Does the project align with an identified high priority need? | This project directly addresses the need to *develop and trial decision making tools that will support policy makers and managers to identify options, and prioritise activities in Commonwealth Marine Reserves.* In addition, selected case studies will *improve the management of marine and coastal biodiversity by evaluating and quantifying the results of management actions.* |
| 6. What other research or management investment will the project leverage? | This project builds on research undertaken in Theme 2 of the NERP Marine Biodiversity Hub, *Supporting management of marine biodiversity*. |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | Yes. Walshe has an excellent track record of delivery timely and polished products in research and consultancy. In his past role as Knowledge Broker for the Environmental Decisions Hub, he worked extensively with DoE line areas, including productive collaboration with Parks Australia. |
| 8. Can the project be delivered on time and within budget? | Yes. But the success of this project is highly dependent on engagement of CMR managers. Considering the high priority placed on this project by DoE this risk is low. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications |  |

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 Leaders* –Simon Barry

*Lead Research Organisation* – UTAS/CSIRO

*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 title/number:** | **B2 - Analysis and elicitation to support State of the Environment reporting for the full spectrum of data availability** |

|  |  |
| --- | --- |
| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | * SoE reports currently rely heavily on expert opinion * This project will provide guidance on how to formalise the use of expert information within SoE reports, and how to integrate this information with existing sources of data. * Subject to time and cost constraints the project will provide a demonstration of scientifically defensible expert elicitation techniques for SoE reporting |
| 2. What management action will be able to be taken as a consequence of the delivery of this project? | Managers will be given greater confidence in the expert information that is used within the SoE reports. |
| 3. What trial programmes to improve the physical environment will be conducted? | N/A |
| 4. How will this research improve the environment and how will this be measured? | This research will improve the information base upon which SoE reports are based, by improving confidence in the use of expert opinion in SoE reports |
| 5. Does the project align with an identified high priority need? | Aligns with NESP Marine Biodiversity research priority:   * Meaningful and accessible information on the status and trends of key social and economic values associated with the marine environment |
| 6. What other research or management investment will the project leverage? | Project C2: Continental-scale tracking of threats to shallow Australian reef ecosystems |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | Project leader is a senior research scientist with an extensive track record of successful project delivery both within federal government agencies (BRS) and CSIRO. |
| 8. Can the project be delivered on time and within budget? | Yes |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications | This project will liaise with the NESP and SoE data managers to test the relevance of expert-based information in the NESP and SoE data management procedures, and where appropriate provide guidance on the storage and dissemination of this type of information.  The project will comply with any hub strategies for Indigenous engagement and knowledge brokering. |

Project B3 – Enhancing access to relevant marine information – a pilot service for searching, aggregating and filtering collections of linked open marine data

*Project length* – Initial phase, 6 months of scoping and prototype design with the intention of developing the full product beyond January 2016.

*Project start date* – 01/07/2015

*Project end date* – 31/12/2015 end of initial phase. Potential project extension to 2016+.

*Project Leader* – Johnathan Kool (FTE – 15%)

*Lead Research Organisation* – Geoscience Australia

*Total NESP funding* - $40,250 initial – possible extension to 2016+ ($81,710)

*Total Recipient and Other Contributions (co-contributions)* - $64,140 initial – possible extension to 2016+ ($154,820)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* | *2021* |
| *NESP funding* | *$40,250* | *$41,460* | *x* | *x* | *x* | *x* | *x* |
| *Cash co-con* | *x* | *x* | *x* | *x* | *x* | *x* | *x* |
| *In-kind co-con* | *$64,140* | *$90,680* | *x* | *x* | *x* | *x* | *x* |

**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 would improve access to existing data collections, and would also facilitate the development of new applications by acting as an aggregator of links to streams of marine data. The work will benefit managers by providing faster and easier access to online marine information. The initial phase of the work would consist of scoping the needs of stakeholders and identifying the desired functionality of the interface.

**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 to search, filter and deliver connections to linked open marine data (this tool could also be applied to data within the Department). 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 the Department, 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-type search for marine information/data). The initial scoping phase would involve identifying the needs of stakeholders such as IMOS, ERIN/Department of the Environment, AIMS and others, planning out the desired functionality of the interface, and ensuring that the work aligns with existing information delivery strategies (e.g. National Plan for Environmental Information, National Environmental Information Infrastructure).

*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 is intended to 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/), [ElasticSearch](https://www.elastic.co/products/elasticsearch)). 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.

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).

During the initial scoping phase (the first six months) project activities would include:

* Consultation with stakeholder organizations to identify key aspects of interface design;
* Undertaking a review of existing and available sets of linked open marine data;
* Generate prototype collections of linked open marine data;
* Confirmation of interoperability of the software and products with existing information delivery frameworks, and;
* Addition of linked-open data functionality to an initial test set of data products (e.g. data generated through previous CERF and NERP hubs).

*Links with other projects and hubs*

This type of work has application across the spectrum of NERP/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. This project would also seek to directly engage with other Hubs with regards to information management and data delivery approaches. As indicated above, value would also be added to existing products by adding linked-open data functionality to them.

*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 stakeholders and the general public to identify targeted data of interest and relevance for their needs. This will improve the efficiency of information retrieval, simplifying information access for stakeholders (including government agencies) and the general public.

The initial scoping phase will generate a document detailing the required features and functions of the linked open data search tool in consultation with stakeholder partners, and will identify how the tool aligns with existing marine information delivery strategies. The document will also provide an assessment of what data are available online, and some work will be carried out to add linked-open capability to existing data sets (e.g. GA curated data generated through the CERF and NERP Hubs).

Holding meetings with stakeholder organizations will also help enhance communication among government data managers, resulting in more coordinated management and delivery of Hub data across the organizations.

*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.

*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/) initiatives. 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**

Deliverables in 2015

* A scoping document for an integrated smart information discovery and delivery system.
* Addition of linked-open data capability to a pilot collection of existing data sets (e.g. GA, CERF and NERP data sets).
* A documented review of additional sources of linked open marine data available from partner organizations.

Deliverables 2016+ (future developments)

* Delivery of open source code to perform the search functions described above.
* A simple initial web interface for performing the search and retrieving results.
* Testing with representatives from the Department of the Environment and other stakeholder partners to ensure capability and value above and beyond existing data search capabilities.
* Expanding 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.
* Improving the identification of data sets of similar interest (similar to Amazon’s ‘you may also like’ feature).
* Linking with efforts such as the [Ocean Data Interoperability Platform](http://www.odip.eu) and [Earthcube](file:///C:\Users\u83869\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\LKV0LZ1K\earthcube.org) to facilitate synthesis of data at the international level.
* Development of decision-support modules/services that take advantage of the linked open data architecture (2017+).
* Investigating data search and usage patterns to simplify and refine the interactive user experience (business analytics) (2017+).

**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.

*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 (either the 1st of Jan or June)** |
| Completion of a scoping document detailing the proposed design and functions of the linked open data search tool in consultation with partner stakeholders and embedded in the context of existing information delivery strategies. The scoping document will also include a review of existing linked open marine data available from project partners. | 1 January 2016 |
| Delivery of a prototype open-source linked open data search tool, with user testing. | 1 January 2017 proposed, contingent on the results of the scoping study and continuing funding. |

**Researchers and Staff**

|  |  |  |
| --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE** |
| Johnathan Kool – Geoscience Australia | Project Leader/Data Scientist | 0.15 |
| Brendan Brooke – Geoscience Australia | Project Advisor | 0.05 |
| Software Developer | Software Development | 0.2 |

**Research End Users and Key Stakeholders**

|  |  |
| --- | --- |
| **Research End Users (section/programme/organization)** | **Contact Name/s (optional)** |
| Parks Australia | Amanda Parr |
| Department of the Environment | Nicole Coombe, Amelia Tandy |
| ERIN | Carolyn Armstrong |
| IMOS/AODN | Tim Moltmann, Roger Proctor |
| AIMS | Eric Lawrey |
| CSIRO | Piers Dunstan |
| APPEA | Damien Hill |
| NOPSEMA | Cameron Grebe |
| GBRMPA | Cherie Malone |
| Department of Industry and Science |  |
| Public |  |

**Knowledge Brokering and communication**

The principal goal of the scoping exercise will be to consult with research end users and stakeholders regarding desired functionality of the linked open data tool. To this end, we will engage in meetings, communicate and share designs electronically (among stakeholder partners), and 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).

**Expenditure Summary**

Funding will primarily be used for performing initial scoping work, including meetings with stakeholders and performing some prototype development. Some prototype software development will take place within Geoscience Australia following the stakeholder meetings.

**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 CSIRO, IMOS/AODN, and AIMS.

**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.

**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.

|  |  |
| --- | --- |
| **Project title/number:** | B3 - Enhancing access to relevant marine information – a pilot service for searching, aggregating and filtering collections of linked open marine data |

|  |  |
| --- | --- |
| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | 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 (envision the development of an Amazon-type interface for searching, filtering, and browsing marine environmental information, discovering linked items, and forwarding collections to other web services). |
| 2. What management action will be able to be taken as a consequence of the delivery of this project? | Targeted and effective discovery of information to satisfy needs for immediate access to many different types of information (data, documents, services, images etc.) |
| 3. What trial programmes to improve the physical environment will be conducted? | N/A |
| 4. How will this research improve the environment and how will this be measured? | This research will facilitate the development of new web applications, will identify gaps in provisioning information, and will improve access to existing and future sources of marine information. This can be quantitatively measured through online access statistics such as hit counts, response time, and through monitoring submission requests. |
| 5. Does the project align with an identified high priority need? | Although the project does not align with (bolded) high priority items, it does align directly with the priority to “develop and trial decision making tools that will support policy makers and managers to identify options, and prioritise activities”. |
| 6. What other research or management investment will the project leverage? | Geoscience Australia will provide co-investment in the project, and the work will help improve the value of existing data holdings by providing improved access, as well as new means of combining different streams of information. |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | Johnathan Kool has 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). Johnathan has 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. |
| 8. Can the project be delivered on time and within budget? | The costings have been run internally at GA, and we believe that the project can be delivered both on time and within budget based on our current work plan. For more information regarding how the project will be delivered on time and within budget, please refer to the Marine Hub Performance and Evaluation Protocols. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications | The development of the linked open data search tool will be conducted in consultation with information delivery professionals at IMOS, AIMS and ERIN to ensure that the product conforms to NPEI and NEII guidelines.  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. If data sets exist that are of particular interest to Indigenous groups, these could be incorporated as data elements if desired. |

Project B4 – Underpinning the repair and conservation of Australia’s threatened coastal-marine habitats –   
phase I.

*Project length* - 6 Months

*Project start date* - 01/05/2015

*Project end date* - 31/10/2015

*Project Leader* - Colin Creighton, Trop Water, JCU (FTE - 60% over the 6 months); Chris Gillies, The Nature Conservancy (FTE-1 5% over the 6 months, 50% in kind)

Lead Research Organisation – JCU

Total NESP funding - $130,000 in 2015.

**Total Recipient and Other Contributions (co-contributions)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| NESP funding | $130,000 | 2015 scoping project collates existing knowledge, underpins works investments, defines precise research activities and seeks support for co-funding [e.g. from FRDC, ARC, state agencies, CSIRO]  Estimate NESP funding for 2016 onwards is $75,000 per annum | | | | |
| Cash contrib. | $Nil this scoping project | Shellfish work builds on TNC and Vic Gov initial $300,000 investment. Saltmarsh work builds on a range of prior studies including FRDC's funding of "Revitalising Australia's Estuaries", NSW DPI saltmarsh restoration investments and NRM groups salt marsh repair in Qld and SA. Target for cash co-contribution 2016 onwards is to exceed NESP funding. | | | | |
| In-kind contrib. | $50,000 | In-kind co-contribution for 2015 project delivered through participation of the research scoping team across the jurisdictions of WA, SA, Tas, Vic, NSW and Qld – both research institutions and agencies.  Target for in-kind contribution 2016 onwards is to at least match all cash contributions | | | | |
| JCU  TNC  Others | 85,000  10,000  35,000 | Others accounts for about 2,500 for all other PIs. | | | | |

**Problem Statement**

In brief – Native shellfish reefs are currently considered “functionally extinct” ecosystems in Australia. Saltmarshes 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 fish production, improving water quality and reducing coastal erosion. Saltmarshes also act as carbon sinks and provide foraging habitat for migratory birds protected under bilateral migratory bird agreements such as CAMBR and JAMBR.

Work is underway to start repair works to re-establish shellfish reefs and saltmarshes and to improve conservation outcomes by increasing community knowledge on their social, economic and ecological values. Underpinning repair works and education with science will maximise the opportunities for success in key locations across Australia and provide the evidence to foster multi-party**,** public and private sector co-investment in future repair activities.

**Description of project alignment with Departmental research priorities**

* This project meets the NESP 2015 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.
* In addition, it contributes to the NESP 2015 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 location of past shellfish middens. The collaborative, multi-partner, multi-agency aspect of the project will strengthen connections between NESP partners and key external (researcher, funding and end-user) stakeholders.

**What Government policy objective is this project addressing?**

(Shellfish reefs)

EPBC act:

* Conserve Australia’s biodiversity - nationally threatened ecological communities.

(Saltmarshes)

EPBC act:

* Subtropical and Temperate Coastal Saltmarsh Threatened Community Recovery Plan
  + Undertaken effective community engagement and education to promote the value of the ecological community
  + Undertake surveys encompassing a wide taxonomic range, across the national extent of the ecological community to identify:
    - sites of high conservation priority
    - threatened species that may require conservation measures
    - areas that would most benefit from removal of tidal restriction and/other regeneration restoration efforts”

**Research**

The objective of this research is to support the scaling-up of repair efforts for two threatened nearshore marine ecological communities, shellfish reefs and saltmarshes. Both habitats harbor significant marine biodiversity and play a critical role in supporting healthy estuarine and nearshore systems. Specifically, the project will synthesize current knowledge of their distribution, ecology and ecosystem function, and for saltmarshes, will develop the case for using prawns as surrogates of primary productivity, to improve community understanding of the functional importance of saltmarshes to estuarine health and food production. 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 from private industry stakeholders.

*Shellfish reefs in detail*

The Nature Conservancy’s recent global report *Shellfish Reefs at Risk* <http://www.nature.org/ourinitiatives/habitats/oceanscoasts/explore/shellfish-reefs-at-risk.xml> revealed that shellfish reefs are the most threatened marine habitat on earth: ‘Globally, 85% of oyster reefs have been completely lost and there are signs that reefs are ’functionally extinct’ in many areas, particularly in Australia. This report catalyzed recent interest in the protection and restoration of shellfish reefs in Australia’s bays and estuaries. Yet the scaling-up of in-water works is currently inhibited by a lack of fundamental understanding and synthesis of the general ecology and services provided by Australian shellfish reefs. The shellfish component of this project therefore seeks to collate:

* Evidence of the current and past geographic extent, community composition, reasons for decline and current condition of shellfish reefs across southern and eastern Australia to develop an understanding of priority areas for repair, management and where appropriate conservation;
* Criteria that need to be met in order to successfully re-establish shellfish reefs - across biological, social and economic aspects of repair activities;
* Quantification of the ecological function of shellfish reefs in terms of benefits such as fish production, water quality improvement, coastal protection and Indigenous cultural value to articulate the likely benefits of investment in shellfish reef repair and undertake effective community and Indigenous education and engagement in repair and conservation activities.

Through research reviews and a series of expert workshops, the shellfish reef component of this project will syntheses all current knowledge of native shellfish reefs and identify knowledge gaps to define future research priorities*.*

The work will be conducted state by state by members of the recently established Shellfish Reef Restoration Network and within their agencies and institutions (which includes NESP hub partners), facilitated and integrated by Colin Creighton and Chris Gillies.

*Saltmarshes in detail*

Traditionally ecologists when articulating marine productivity talk of net primary productivity using C, DO or N and P flows and fluxes. Clearly, given the decline in our productivity this language has not had traction with those making management decisions. Nor does it articulate in ways the community can understand why we should protect and repair coastal ecosystems, let alone provide a business case to underpin investment. Therefore this project proposes to use the various species of prawns [e.g. Eastern school *M. macleayi*, Western School *M. dalli*, Banana *F. indiius* and *F. merguiensis*] as the basis for building the case for repair and protection of Australia’s saltmarshes with the multiple flow on benefits to marine biodiversity, fisheries, economic activity, social and recreational benefits.

The saltmarsh component of this project will:

* Synthesize as a basis for detailed research current saltmarsh extent and condition exploiting current mapping and vegetation / ecosystem assessments for southern and eastern Australia, in order to identify priority opportunities for repair, focusing specifically in areas under threat from further loss due to inappropriate land use or hydrological impair;
* Identify and recommend indicators (key prawn species) of ecological function as a surrogate for Net Primary Production and which can also be used in community awareness and education programs to improve community understanding of the value of saltmarshes;
* Research, review and design a research and education agenda that a will draw together funding and support for repair and conservation activities from different stakeholders including industry, community and government

Through research reviews and a series of expert workshops, the saltmarsh component of this project will syntheses all current knowledge of prawns as NPP surrogates and identify knowledge gaps to define future research priorities to improve saltmarsh conservation.

**Links to other projects and hubs**

Project C3 - GA/UTAS pilot project in Marine Biodiversity Hub to use the last 20+ years of satellite data to identify changes in the coastal environment, including the extent and condition of mangroves, appearance of ponded paddocks, appearance of hardened shorelines, and other features that may be detected.

* Project C2 - UTAS/CDU/CSIRO project to identify the changes in biological communities downstream of major population centres (Sydney, Melbourne, Hobart) using Reef Life Survey data coupled with advanced environmental monitoring including estimates of the footprint of sewerage treatment plants. Especially Reef Life Survey will need to also inventory any remaining shellfish reefs such as the remnant reef near St Helens, Tasmania and remnants in D’Entrecasteaux Channel as context for its Hobart work.
* Projects C1, C4 and C5 – these three projects will all provide excellent links, especially as this project, B4 details the water quality and quantity conditions amenable to Shellfish Reef repair. Links to salt marsh environments, especially tidal water quality also apply.

**Details of related / previous research**

* *For shellfish reefs*

The main body of research to date in Australia has been desktop assessments to determine historic loss, current status, and possible causes of loss (Beck *et al*. 2011, Diggles 2013, Hamer *et al*. 2013, Alleway and Connell 2015) and a scoping review of potential for restoration in Port Phillip Bay (Hamer *et al*. 2013). Work is now underway as part of a three year repair trial ($300K investment from TNC and Vic Gov) to develop, test and evaluate approaches for restoring native flat oyster and mussel reefs in Port Phillip Bay. This is the first attempt at restoration of shellfish reefs in Australia and recent work in New Zealand has begun to trial restoration of mussel beds. Much of the work of shellfish restoration to date has focused on the actual repair activities and measuring success in term of repaired area of shellfish. There remains a strong need to increase evaluation and research on the environmental, ecological, social and economic benefits of restoration. At a species level there has been work on oyster genetics, such as wild oyster (*Sacosstrea commercialis*) populations in NSW to be resistant to various diseases, such as QX disease. These results could help guide choice of oyster stock used in any rehabilitation project.

* *For saltmarshes*

As examples of current projects - NSW DPI FRDC 2013/006 - *The impact of habitat loss and rehabilitation on growth, survival and recruitment to the NSW eastern king prawn fishery* and FRDC 2015/011 - *Understanding the factors contributing to decrease school prawn productivity in Camden Haven River and associated lakes, to target ameliorative actions* both provide necessary contextual information for this work. This includes estimates for prawn/fishery productivity and economic value figures for estuarine habitat.

This project will take those results further and more precisely document the expected benefits that could be realized at specific locations across Australia if they were rehabilitated using identified sites, their current condition and potential for improvement / rehabilitation. It will also expand the species/fisheries investigated to document the cumulative benefits likely to be achieved, as most estuarine wetland support more than one prawn species and multiple other fish and crustacean species.

**Expected Outcomes**

* Nationally - Information towards the development of a national recovery plan.
* State and Regionally, Natural Resource Management Agencies, Catchment Management Authorities, state government environmental and resource agencies and Indigenous groups - increase financial and resource support for shellfish reef and saltmarsh 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 relating to both nearshore areas and commonwealth marine reserves
* Coastal managers and repair project managers - to improve communication on the value of shellfish reefs and saltmarshes in terms of their services (e.g. productivity for prawn species, water filtration, coastal protection) which in turn will increase community support for coastal repair projects
* Marine private sector stakeholders - information upon which to increase support for and investment in repair activities

**Define what practical and tangible outcome/s the project will deliver**

This investment will collate much of the base information required to scope repair investment opportunities for Australia most threatened coastal-marine habitats. Equally importantly, it will define the elements of a science project that can be delivered in parallel with repair, thereby ensuring, by coupling science with works, maximum community return from all repair investments. Estuary habitat repair is a developing area of community interest, especially in those states with recreational fishing license levies as habitat improvements generally rank at the top of the investment priorities of recreational fishing communities.

The practical outcomes this project will deliver include:

1. Improved understanding of the functional role of shellfish reefs and saltmarshes in supporting the ecological health of estuaries (documented in a journal paper and in media)
2. 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
3. Summary evidence of the productivity and economic benefits that are expected to be generated with repair (shellfish and saltmarsh)
4. List of priority locations for shellfish reef and saltmarsh repair that includes their historic extent and also their historic Indigenous
5. List of suggested attributes for data collection, analysis and reporting to accompany any repair investment
6. Recommended future research priorities to support shellfish reef and saltmarsh repair activities
7. A community understandable surrogate for net primary productivity associated with saltmarsh communities

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

If the science delivers comprehensively on the potential benefits of shellfish reef and saltmarsh repair it is anticipated that works investment will increase, a major outcome in repairing Australia’s marine biodiversity and improving the health of bays and estuaries. Equally importantly, the science will be advocating levels of protection and management for shellfish reefs and their environs. It is quite likely that this will lead state agencies to determine improved marine management arrangements, including allocating new resources to shellfish and saltmarsh repair works. Further, by including non-confidential information on current and prior shellfish middens, the strong linkages between coastal food resources and Indigenous use will be well demonstrated.

The research will also support The Nature Conservancy in seeking increased support for marine repair activities from private sector investments (including philanthropy, corporate businesses, commercial and recreational fishers). This funding is used as co-investment with state and Australian government agencies to financially resource in-water repair works, such as the Port Phillip Bay shellfish project. Such a private-public partnership has been extremely successful in the U.S. in driving policy change and increased investment in coastal repair.

For example, based on 15 years of coastal restoration science and a business case detailing the benefits to regional economies and new job creation, TNC built the case for the inclusion of coastal restoration projects as part of the American Recovery and Reinvestment Act of 2009 (ARRA). $USD 167 million from was ultimately allocated from the ARRA to the federal government agency NOAA, to work with NGO and community restoration partners to restore coastal habitat and help jump-start the nation’s regional economies.

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

This project will synthesize the scientific evidence, Indigenous and social, economic and ecological value for restoring shellfish reefs and saltmarshes to drive an increase in financial investment and community support for habitat repair and conservation. The long-term outcomes of this work will ultimately be measurable in the number of shellfish and saltmarsh repair works proposed or undertaken by state agencies, NRM agencies, research institutes, Indigenous groups and other community groups such as recreational fishing.

The identification of priority research outcomes will be measurable through the number of new researcher projects related to saltmarsh and shellfish reef repair proposed or funded by NESP, ARC, FRDC and other research support agencies. The new information generated by this further research, will improve the success of repair works and ultimately increase extent, management and protection of shellfish reefs and saltmarshes nationally.

**Delivery of Project**

Colin Creighton has led, delivered to time, and budget multiple R& D programs. Examples include the $50M National Land and Water Resources Audit, the $10M Reef Rescue I R&D program, $12M Managing Climate Variability and the $9M Climate Change Adaptation - marine biodiversity and fisheries program. Colin is now attached to TropWATER at JCU.

The Nature Conservancy (TNC) has been leading shellfish reef and estuary marine repair in the USA. TNC is a global leader in coastal and marine restoration—with a major focus on the restoration of bivalve reefs for their multiple ecosystem services.   Over the past fifteen years, TNC has worked with a wide range of partners to implement more than 140 estuarine restoration projects in the United States, including 60 Shellfish restoration projects. (Schrack*et al.* 2012). TNC has also led the development of science and monitoring protocols for shellfish projects, including the recently published Oyster Habitat Restoration Guide (Baggett et al. 2014) developed in partnership with NOAA and multiple academic institutions.

**How will this project be delivered on time and within budget?**

See *Marine Hub Performance and Evaluation Protocols.*

**A list of all outputs planned under the project, including communication and promotional material**

*Shellfish reefs:*

* A peer-reviewed scientific paper summarising current and past geographic extent, prior Indigenous use based on non-confidential information on middens, community species composition, reasons for decline and current condition of native *shellfish* reefs (prepared as a draft document)
* A public policy paper highlighting the multiple social, environmental and economic benefits of repairing shellfish reefs and which identifies priority areas for shellfish reef repair
* A further (years 2 & 3) proposal identifying research priorities for shellfish repair and for further work to underpin partnerships towards repair between Indigenous and other community groups including agency support. (also provided to potential partners such as FRDC, ARC)

*Saltmarshes:*

* A peer-reviewed scientific paper synthesis current knowledge on Australia’s salt marshes, their history, extent, ecological function and current condition, and the benefits likely to accrue from repair using prawns as a surrogate – (prepared as a draft)
* Opportunities for repair – initial summary case study examples – prepared as overview information at the community awareness / short fact sheets – community brochures style and detailing areas for further study in years 2 and 3;
* Community benefit and business proposition – written at the level required for input to public policy - as a draft position paper
* A further (years 2 &3) proposal identifying research priorities for salt marsh repair and fir further work to underpin partnerships towards repair, including agency support (also provided to potential partners such as FRDC, ARC)

**Project Details**

*Project Milestones*

|  |  |
| --- | --- |
| **Milestones** | **Due date (either the 1st of Jan or June)** |
| Milestone 1 – Confirmation of project partners/ paper authors, scope of research works (by each partner) and workshop dates | Due: 30 June 2015 |
| Milestone 2 – Final publications and reports – including those outputs listed under xi above | Due: 31 Oct 2015 |

**Researchers and Staff**

| **Name/Organisation** | **Project Role** | **Weeks 2015** |
| --- | --- | --- |
| Colin Creighton, Trop Water, JCU | Project leader | 12 weeks |
| Chris Gillies, Marine Manager, Australian Program, TNC | National Coordination + link to USA experiences | 4 weeks  50% inkind by TNC |
| WA – Anthony Hart, WA Fisheries | State lead contacts – all will compile the State by State sections or Situation Statement and participate in setting the strategic directions for both works and research components | Workshop attendance (3 days) and compilation of state materials (1-2 weeks) 50% inkind |
| SA – Heidi Alleway, SARDI |
| Vic – Paul Hamer, Fisheries Victoria |
| Tas – Christine Crawford, UTAS |
| NSW – Kylie Russell, NSW Fish |
| Qld – Ben Diggles, DigFish Services |
| Vic – Paul Boon, Vic Univ. |
| Tas – Jeff Ross, UTAS |
| WA and National – Russ Babcock + Mat Vanderklift, CSIRO |
| Qld- Marcus Sheaves, JCU |

**Research End Users and Key Stakeholders**

|  |  |
| --- | --- |
| **Research End Users** | **Organisation/Section** |
| Marine ecologists | Multiple – universities, CSIRO, agencies |
| Marine and estuary managers | All jurisdictions, State, GBRMPA |
| National Estuary Network | All jurisdictions |
| NRM, Indigenous and other community groups such as recreational fishing focussing on repair of coastal ecosystems | All jurisdictions |
| **Key Stakeholders** |  |
| MEPA advocates and managers | All jurisdictions |
| Fishers / resource users – commercial, recreational and Indigenous | All jurisdictions, exception is Commonwealth fishery |
| Conservation groups | Local to national and international [e.g. WWF and its Pacific coastal resources program] |
| Nature appreciation groups | e.g. Birds Australia |

**Expenditure Profile**

The project will entail the following phases [estimates of % resources indicated]:

1 – two team workshops (one each for shellfish and saltmarsh), ensuring methods have consistency and comparability across states in collation of evidence of the location and nature of past reefs and middens – extent, function, key shellfish species, previous environmental conditions, reasons for decline and current condition [ 10%]

2 – resources for each state allocated as subcontracts to collate and present this information [40%]

3 – draft papers prepared by Colin Creighton and Chris Gillies defining a suite of criteria that need to be met for the successful re-establishment of reefs - across biological, social and economic aspects of repair activities and outlining scenarios and data collection protocols for real time monitoring as repair works proceed [ 40%]

4 – second team workshops (one each for shellfish and saltmarsh), entailing finalization of papers/reports and development of the proposed ongoing science program [10%]

**Data and Information**

All data derived from the project will become part of the IMOS system

All information will be widely communicated as part of the processes to foster investment in estuary repair. Key players include:

* Management agencies – marine biodiversity and fisheries agencies
* Recreational fishing groups – major investors in repair works and beneficiaries
* Commercial fishers – major investors in repair works and beneficiaries
* Aquaculture industry – with substantial expertise in various species of mussels, oysters and prawns
* Community – to develop an understanding that we can care for and repair our marine resources
* Seafood restaurants – to gauge interest in “cloud funding type arrangements” as in USA to fund repair works
* Traditional owner representatives in the locations identified for research and especially linking midden location to the current condition of the nearby food resource, [generally in a degraded state and requiring repair if it is once again to become a food resource]

**Knowledge Brokering and Communication**

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** – the project includes agreements with management agencies as part of project delivery. Their active involvement is a crucial component to brokering project outcomes.
* **interface to policy groups in management agencies** - by virtue of the active involvement of management agencies the interaction with their policy arms is virtually assured. Specific policy papers and briefing papers will also be part of project outputs.
* **broader science engagement** – at least two science papers, one on the status of shellfish reefs and repair opportunities and the other an overview paper on prawns as an indicator of salt marsh value are part of the project outputs. These papers will be submitted to a key Journal, possibly Aust. J Marine and Freshwater Research as part of fostering further and more broader science discussion
* **action groups, especially investment in repair and protection** – Local Government, State agencies, NRM, Indigenous and key groups such as recreational fishing and others will be communicated with throughout the project as part of the processes to foster applications for investment in repair and protection. An active example is the NRM groups across the GBR and the moves to rehabilitate ex ponded pastures. The project leader is also on the GBR Ministerial Task Force – another point of engagement with those responsible for protection and repair.
* **interest groups and community investors** – by virtue of recreational fishing levies and related activities for commercial fishing, these groups are advocates for investment in repair and protection. Likewise applies to NGO’s involved in environmental repair. The existing pilot shellfish project in Port Phillip provides an excellent example – the lead investors being The Nature Conservancy, the Victorian Government for commercial fishing and the local Port Phillip [Albert Park] recreational fishing group. Communication of project findings will seek to build similar partnerships in other jurisdictions.
* **Indigenous groups** – as noted under the Indigenous engagement section, the local Indigenous groups around Pumicestone Passage are already keen to invest some of their resources in shellfish reef repair. Through this project and its Indigenous engagement it is hoped to foster similar partnerships in other states. Linking non-confidential information on shellfish middens with the consent of the local Indigenous groups to the condition of the current resource as a potential food resource is central to fostering discussions and engagement with Indigenous leaders towards their role in ecosystem repair and protection.
* **broader community awareness –** summary articles in periodicals such as “Fish” and then their reprinting in conservation and fishing magazines will aid in broader community awareness.

To conclude, the Hub’s Knowledge Brokering and Communication Strategy will provide for this project broad direction on communication mechanisms and communication protocols and these will be applied within the context of this project.

**Location of Research**

For shellfish:

WA – e.g Oyster Bay; SA – eg Gulfs; Vic – eg Port Phillip and Westernport; Tas – e.g. D’Entrecasteaux Channel and east coast such as St Helens and Little Swanport; NSW e.g. Hunter River entrance and all the “Limeburners Creeks” such as northern arm of Hastings; SE Qld – e.g. Pumicestone Passage and Moreton Bay.

For saltmarsh:

Estuarine and coastal areas from northern Queensland, especially relict areas that were once altered for ponded pastures; NSW coastal floodplains, such as Lake Wooloweyah, Clarence estuary, though many occurrences in NSW either have been irrevocably lost or are now well protected; Victorian coast including Corner Inlet, Westernport hinterland and the estuaries to the west of Port Phillip; SA coast including upper Coorong through to SA Gulfs; Tasmanian east and northern coasts; parts of south western WA through to the Swan and its relict remaining salt marsh areas such as in the Canning sub-catchment.

**Indigenous Consultation and Engagement**

Shellfish reefs were once probably THE major coastal food resource. Possibly the best background reference is Betty Meehan [1982] – *From Shellbed to Midden*. Meehan demonstrated that shellfish reefs and their harvesting by women and children were often the staple daily protein, supplemented only occasionally by such as successful kangaroo and dugong hunting. Creighton [1984] detailed this further for the Keppel Islands and the then Woppaburra tribe.

Any quick scan of coastal history reinforces the role of shellfish reefs as key to traditional Indigenous food resources. Many of the huge Indigenous middens around southern Australia were the first sources of lime for the developing colonies. Their size reflected long term traditional Indigenous use of these shellfish resources.

This project, by defining the full extent of the losses that have occurred since European settlement, and then starting the journey towards getting these living resources back would represent recovery of lost Indigenous resources which were of significant cultural heritage to traditional owners, and hence would be a major achievement for both Indigenous and the wider community.

As an example, members of the project team have already outlined this proposal with the Indigenous groups of Pumicestone Passage. These groups are ready to co-invest their time and resources in the repair of the shellfish reefs that were once prevalent in both the Passage and Moreton Bay proper. As the project is initiated, because of the importance of shellfish reefs to traditional users the project team will seek engagement, region by region with key Indigenous groups. By doing this at project inception we will be well placed to ensure Indigenous needs are included in project design and conduct. At the same time the project team recognises the time required for appropriate Indigenous engagement will need to extend well beyond the timelines that are in place for all Marine Biodiversity Hub projects for 2015. The practical approach of including non-confidential records and current knowledge of middens as part of the project will to some degree reduce the risks of not having meaningful engagement. Linking to communities via FRDC’s and GBRMPA’s Indigenous programs will also assist. Nevertheless fostering full engagement and then participation towards repair will require continued efforts at least including the proposed project out years of 2016 and 2017.

For salt marshes, many remnants are now in freehold title. The biggest exception to this generalization is South Australia where large extents of salt marshes are still in public ownership, often without secure title. These therefore may in time, once rehabilitated, become parts of the Indigenous estate.

Irrespective of title, many Indigenous groups will be interested in rehabilitation projects that might flow on from this project. This is because salt marshes as the interface to the substantial food resources of estuaries were highly valued, including directly for food resources such as waterfowl and crabs. All case studies of benefits where Indigenous presence is still high [eg SA Gulfs] will seek to include the local Indigenous groups as part of community discussions from project inception and detailed design through to project final delivery. Nevertheless, as above and as detailed in the Risk section, meaningful engagement towards participation takes time.

To conclude, the project team will ensure all activities are consistent with the Hub’s Indigenous Engagement and Participation Strategy.

***Inclusions (in scope)***

For shellfish reefs:

Temperate to sub-tropical Australia and GBR lagoon, generally within estuary, embayment or sheltered waters

For Saltmarshes:

Temperate and tropical areas within estuary, embayment or sheltered waters

***Exclusions (out of scope)***

On-ground repair initiatives and new research/field work. This project is focused on synthesizing current scientific knowledge and preparing

For shellfish reefs:

Much of Tropical Australia beyond the Great Barrier Reef. [Incidentally the Great Barrier Reef once had massive oyster accretions on rocky substrate such as Keppel and Whitsunday Islands.]

**Constraints**

In the brief timeframe of this project, the following constraints are likely:

* Incomplete coverage of all historical records re previous middens and shellfish reefs, their condition, extraction and causes of decline
* An adaptive and flexible approach to proposed protocols and scenarios for monitoring repair works
* Inability to fully consult and engage with all the potential beneficiaries and stakeholders, especially within year 1 such as all recreational fishing, Indigenous and other key coastal interest groups
* Inability to have the scientific papers published by end of the project, papers will be submitted for review in the timeframe of the project

**Risks**

*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. Monthly telephone hook-up 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 engaging their agency communication departments. Media alerts produced and shared amongst all co-investigator communication departments. The Nature Conservancy will coordinate media releases on behalf of co-investigator agencies.

*Risk:* Meaningful Indigenous engagement throughout all locations of the project during 2015. *Mitigation:* Firstly, 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, existing Indigenous networks such as that of FRDC and GBRMPA and States will be used as points of introduction to key coastal groups. Thirdly and most importantly, Indigenous groups such as the team already building around the Pumicestone Passage proposals will provide a good initial reference point for others across Indigenous Australia to link with.

To conclude, should the project proceed as planned in 2016 and 2017 building on the initial base provided in 2015 should lead to substantial engagement towards partnerships in repair.

**Project Keywords**

Shellfish Reefs; Restoration Ecology; Ecosystem Repair; Salt Marsh; Prawns; Net Primary Productivity

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| **Project title/number:** | **B4 - Underpinning the repair and conservation of Australia’s threatened coastal-marine habitats – phase I.** |

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| --- | --- |
| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | Repair and information to support protection and management of two of our most endangered coastal ecosystems. Shellfish reefs being assessed as “functionally extinct” and salt marshes listed as endangered in several states and still under threat of further losses. |
| 2. What management action will be able to be taken as a consequence of the delivery of this project? | For both shellfish reefs and salt marshes nationally the project will establish a consistent information base. Equally importantly, by working with key agencies and NGOs such as The Nature Conservancy the science will underpin the protection and repair of both shellfish reefs and saltmarshes. |
| 3. What trial programmes to improve the physical environment will be conducted? | The Nature Conservancy and the Victorian Government are already funding pilot repair of shellfish reefs in Port Phillip. This investment will provide the science to underpin repair in Port Phillip and extension of works initiatives to similar environments across southern Australia. Examples include Oyster Harbour, Albany, SA Gulfs, D’Encastreax Channel, Tasmania, Moreton Bay and Pumicestone Passage Qld and lower Hunter / Broken Bay in NSW.  For salt marshes the biggest repair programs currently underway are part of the Great Barrier Reef “Reef Rescue II” systems repair package [ex ponded pastures] with much more needed to be done right around Australia. |
| 4. How will this research improve the environment and how will this be measured? | Shellfish reef repair delivers in-water habitat, water filtering and shoreline buffering. TNC have already documented improvements in USA and part of the rationale of this entire proposal is to extend and build on lessons learnt already in USA. Likewise with salt marshes, “Revitalising Australia’s Estuaries” [funded by FRDC and Biodiversity Fund] detailed the opportunity and broad benefits. It’s timely to take the underpinning science on productivity benefits further to foster increased protection and investment in repair. |
| 5. Does the project align with an identified high priority need? | Yes – see application for full details. Explicit priority for this Hub. |
| 6. What other research or management investment will the project leverage? | Active partners are likely to include State agencies, possibly co-investment from other R&D funders such as FRDC and of course TNC. |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | Yes – see application for details. Colin Creighton has designed and led major programs that have always delivered major outcomes including National Land and Water Resources Audit, Australia’s Marine Bioregionalisation, CSIRO Water Flagship, Reef Rescue I and the systems repair component of Reef Rescue II, Managing Climate Variability, Climate Change Adaptation – Marine Biodiversity and Fisheries. Colin does similar as a volunteer for the World Academy of Science and specific projects in the Pacific. Colin is now attached to JCU TropWATER, is on the GBR Ministerial Task Force and will lead this project. |
| 8. Can the project be delivered on time and within budget? | Yes – all designed with clear well defined deliverables. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications | 100% consistent; all data derived to also go on the IMOS system;  Indigenous communities are already on board to establish a shellfish reef pilot in Pumicestone Passage  By including non-confidential knowledge on prior and existing shellfish middens in the project we will have an excellent information base to build and enduring partnership with Indigenous communities.  Knowledge brokering and communication already part of the project deliverables |

Project C1 – Improving our understanding of pressures on the marine environment

Project length – 36 Months

Project start date – 1/7/2015

Project end date – 31/12/2018

Project Leader – Piers Dunstan (FTE – 30%)

Lead Research Organisation – CSIRO

Total NESP funding - $825,000

Total Recipient and Other Contributions (co-contributions) - $825,000

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
| NESP funding | $75,000 | $250,000 | $250,000 | $250,000 | x | x | x |
| Cash co-con | x | x | x | x | x | x | x |
| In-kind co-con | $75,000 | $250,000 | $250,000 | $250,000 | x | x | x |

**Project Summary**

The marine environment in Australia is influenced by a wide range of different pressures that impact on different parts of the marine ecosystem in different ways. This project aims to assist DoE understand how the spatial distribution of pressures and trends can be applied to decisions under the EPBC Act (acceptability of proposed activities, evaluation of effectiveness of mitigation measures) and how it may assist future marine spatial planning exercises.

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 whether pressure mapping can 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 processes into the future.

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.

**Problem Statements**

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 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 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.

**Research**

Work to 1 Jan 2016

1. In the previous NERP Hub, pressure data was collected for a broad range of pressures on the commonwealth marine environment. Summaries of pressures aggregated to 5 yearly SoE reporting periods to 2010 are available from AODN and the NERP Hub Marine Information Portal (MIP; <http://www.nerpmarine.edu.au/maps>). Summaries of fisheries data are awaiting final approval from AFMA. This project will work to 1 Jan 2016 to compile the additional data for the period to the end of 2014 (and potentially 2015 if available) to provide a set of pressures layers relevant to the upcoming SoE reporting period. The project will map the changes and trends in the use of the marine environment over the last 20 years. This information will be made available on the Hub Marine Information Portal to enable easy access. The project will coordinate with Project B2 (Analysis and elicitation to support State of the Environment reporting for the full spectrum of data availability) to ensure that the information that is delivered is complementary.
2. The project will spend the first 6 months refining the project proposal to ensure that the needs and priorities for research into pressure mapping, relative and cumulative impact and risk assessment frameworks are clearly identified and agreed on. This will be achieved, in part, through a workshop with DoE, including the Marine Biodiversity Hub and the Tropical Water Quality Hub to explore the varying needs of DoE for understanding pressures. This workshop will identify where information on the status and trends of pressures may be used in regulations, evaluation of reporting arrangements, strategic assessment, CMRs, SOE and species listing/recovery. A proposal for a framework to use conservation values in ecological impact assessment (currently in review for a journal publication) will be used to begin this discussion.

Work Post 1 January 2016 after consultation with DoE

1. 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.
2. The project will assist the department with a re-evaluation of the pressure assessments published in the 2012 Marine Bioregional Plans and the SOE 2011 assessments. Part of this work will include an assessment of the strengths and weaknesses of both methodologies used, and exploration of what methodology may be used for both products into the future, ensuring consistency of output.
3. 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.
4. 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. Specifically, the project will identify:
5. 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?
6. If there is what happens to the ascribed value when the pressures change? Further, can the value of biodiversity change?
7. 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”?
8. 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?

The project will collaborate with a Cumulative impacts project in the Tropical Water Quality Hub on methods of assessment and the 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).

**Expected Outcomes**

* DoE will have an improved understanding of the current state of pressures and historical trends in the data
* DoE will have a methodology for pressure assessment that serves both SOE and MBP reporting
* 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.

**Planned Outputs**

* 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
* 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 and the SOE 2011 assessments, including the strengths and weaknesses of methodologies, and what methodology may be used for both products into the future, ensuring consistency of output.
* 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

**Delivery of Project**

The Project Leader has delivered on a similar project in the NERP Marine Biodiversity Hub, collating pressures to 2010, producing new pressure information and estimates of impact. The project team has a long history of engagement with the Department of Environment. The Project leader authored the NERP Marine Biodiversity Hub data policy with the Deputy Director.

Deliverables from this project are available from http://www.nerpmarine.edu.au/maps/. Pressure data sets range from 1996 to 2010 and are arranged corresponding to SoE reporting periods. This data includes new estimates of the change in SST and the variance associated with this. This analysis and application of the same methods to ocean productivity has been used to support the National Monitoring Blueprint.

The PL has also authored the NERP hub data framework and the development of the Marine Information Platform (MIP), which is hosted on the NERP hub web site at http://www.nerpmarine.edu.au/maps/.

**Project Milestones**

|  |  |
| --- | --- |
| **Milestones** | **Due date (either the 1st of Jan or June)** |
| The project will provide data for the period from 2011 to the end of 2014 (and potentially 2015 if available) to provide a set of pressures layers relevant to the upcoming SoE reporting period. The project will map the changes and trends in the use of the marine environment over the last 20 years. | 1 Jan 2016 |
| Workshop with DoE, the Marine Biodiversity Hub and the Tropical Water Quality Hub to ensure that the project meets the needs and priorities of DoE and to ensure mechanisms are put in place to coordinate delivery between projects and Hubs. The output will be a targeted proposal the ensures the needs and priorities for research into pressure mapping, relative and cumulative impact and risk assessment frameworks are clearly identified and agreed on. | 1 Jan 2016 |
| Summary of changes and trends in pressures the offshore commonwealth marine environment from 1991 to 2015. | 1 Jan 2016 |
| Re-evaluation of the pressure assessments published in the 2012 Marine Bioregional Plans and the SOE 2011 assessments | 1 Jan 2017 |
| Initial report on progress on links between conservation, socio economic values and pressures | 1 Jan 2017 |
| Summary of changes in the marine environment (onshore & offshore) between 1991 & 2015 | 1 Jan 2017 |
| Summary of changes in pressures 2016 | 1 June 2017 |
| Report on assessment of likely future states (for example, climate (interannual and decadal), shipping, modification of fisheries activity, coastal eutrophication) | 1 Jan 2018 |
| Report on assessment of response of values to changing pressures | 1 Jan 2018 |
| Summary of changes in pressures 2017 | 1 Jun 2018 |
| Report on a risk based framework to manage the uncertainty information bases for different decision making requirements with example case | 1 Jan 2019 |
| Report on the role of changing socio-economic valuing of conservation values to the concept of acceptable impact, or acceptable risk of impact | 1 Jan 2019 |

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

|  |  |  |
| --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE** |
| Jeff Dambacher | Qualitative models | 0.1 |
| Piers Dunstan | Project leader | 0.3 |
| Michael Fuller | Analysis of summaries | 0.3 |
| Michael Burton | Socio-Economic Research | 0.1 |
| Sean Pascoe | Socio-Economic Research | 0.05 |
| PostDoc (TBA) | Linking Pressures and Values | 1 |
| Cass Hunter | Collation of Pressure data | 0.3 |

**Partner contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| CSIRO | 590,000 |  | 590,000 |
| UWA | 235,000 |  | 235,000 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Organisation/name** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| Foundation, Uni, etc. |  |  |  |
|  |  |  |  |

**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)** |
| Parks Australia/ DoE | Amanda Parr |
| Domestic and International Policy/ DoE | Nicole Coombe |
| EACD/ DoE |  |
| SoE / DoE | Lin Boon |
| **Key Stakeholders (organisation/programme)** |  |
| NOPSEMA |  |
| AMSA |  |
| AFMA |  |

**Knowledge Brokering and communication**

* Research end users and key stakeholders will be involved in the development of the project & a contact schedule developed to ensure ongoing communication
* Ongoing engagement will be maintained with DoE through regular meetings associated with project deliverable. 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, 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.

* All data outputs will be stored on NPEI compliant servers and accessible through AODN and specialised web services on the NESP Hub website.
* Other communication mechanisms identified on the Hubs Knowledge Brokering and Communication Strategy will be adopted as necessary to ensure broad uptake.

**Expenditure Summary**

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**

The research outputs will be for the Australian EEZ.

**Indigenous Consultation and Engagement**

The identification of traditional and cultural values has become an increasingly important topic, at local, national and global levels. The project will test DoE 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 Indigenous cultural and heritage values and the pressures that are acting on them. The details of this engagement will need to be scoped with DoE 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.

**Inclusions (in scope)**

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

**Risks**

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**

impact, pressure, risk, socio-economic values, conservation values

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| --- | --- |
| **Project title/number:** | **C1 - Improving our understanding of pressures on the marine environment** |

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| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | * DoE will have an improved understanding of the current state of pressures and historical trends in the data * DoE will have a methodology for pressure assessment that serves both SOE and MBP reporting * 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. |
| 2. What management action will be able to be taken as a consequence of the delivery of this project? | 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 and other regulators (such as NOPSEMA and AFMA). |
| 3. What trial programmes to improve the physical environment will be conducted? | None |
| 4. How will this research improve the environment and how will this be measured? | The marine environment in Australia is influenced by a wide range of different pressures that impact on different parts of the marine ecosystem in different ways. This project aims to assist DoE understand how the spatial distribution of pressures and trends can be applied to decisions under the EPBC Act (acceptability of proposed activities, evaluation of effectiveness of mitigation measures) and how it may assist future marine spatial planning exercises.  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 whether pressure mapping can 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 processes into the future. |
| 5. Does the project align with an identified high priority need? | The project aligns with Improving our understanding of pressures on the marine environment. The project will coordinate the delivery of information on pressures to DoE from the Marine Biodiversity Hub. The project will assist in the identification of past and current pressures on the marine environment and estimation of their impact, identify trends in pressures and potential relationships between pressures and improve prediction of likely future pressures and their potential impacts on marine and coastal biodiversity. |
| 6. What other research or management investment will the project leverage? | The project extends work done in the NERP Marine Biodiversity Hub, linking work on values with pressures. The project will link with NESP Marine Biodiversity Hub projects A2 (Quantification of national ship strike risk), B4 (Underpinning the repair and conservation of Australia’s threatened coastal-marine habitats), C2 (Continental-scale tracking of threats to shallow Australian reef ecosystems) and Project B2 (Analysis and elicitation to support State of the Environment reporting for the full spectrum of data availability) It will link with projects in the Tropical Water Quality Hub on methods for cumulative impact assessment and with the Earth Systems and Climate Change Hub on climate variability at multi-annual to multi-decadal time scales. |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | The Project Leader has delivered on a similar project in the NERP Marine Biodiversity Hub, collating pressures to 2010, producing new pressure information and estimates of impact. The project team has a long history of engagement with the Department of Environment. The Project leader authored the NERP Marine Biodiversity Hub data policy with the Deputy Director.  Deliverables from this project are available from http://www.nerpmarine.edu.au/maps/. Pressure data sets range from 1996 to 2010 and are arranged corresponding to SoE reporting periods. This data includes new estimates of the change in SST and the variance associated with this. This analysis and application of the same methods to ocean productivity has been used to support the National Monitoring Blueprint.  The PL has also authored the NERP hub data framework and the development of the Marine Information Platform (MIP), which is hosted on the NERP hub web site at http://www.nerpmarine.edu.au/maps/. |
| 8. Can the project be delivered on time and within budget? | Yes. But the success of this project is highly dependent on engagement of CMR managers. Considering the high priority placed on this project by DoE this risk is low. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications |  |

Project C2 - Continental-scale tracking of threats to shallow Australian reef ecosystems

*Project length* – 30 Months

*Project start date* – 1/7/2015

*Project end date* – 31/12/2017

*Project Leader* – Graham Edgar (FTE – 20%)

*Lead Research Organisation* – University of Tasmania

*Total NESP funding* - $796,981

*Total Recipient and Other Contributions (co-contributions)* - $1,776,328

|  |  |  |  |
| --- | --- | --- | --- |
|  | *2015* | *2016* | *2017* |
| *NESP funding* | *$322,197* | *$237,392* | *$237,392* |
| *Cash co-con* | *$0* | *$0* | *$0* |
| *In-kind co-con* | *$490,492* | *$642,918* | *$642,918* |

**Project Summary**

The project will: (i) integrate detailed tropical and temperate fish, macro-invertebrate, sessile invertebrate, and algal datasets that span the Australian continent, including comparison of AIMS, Reef Life Survey and UTAS data from co-located sites, (ii) survey distribution of pollutants at inshore reef sites, (iii) identify impacts of major environmental stressors (sewage, heavy metals, fishing, rising sea temperature, introduced species) on reef communities, (iv) identify a suite of sensitive state-of-the-environment indicators derived from ecological survey data to accurately map changing distribution of impacts around the Australian continent, and (v) collate ecological condition data for input to 2016 State of the Environment reporting. The first year of the project will focus on outputs required for SoE reporting. A detailed research plan for subsequent years will also be developed, based on consultation with the Department and stakeholders, to fill knowledge gaps associated with ongoing environmental condition reporting, Essential Environmental Measures, the National Monitoring Blueprint, and evaluation of Commonwealth Marine Reserves.

**Problem Statements**

*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*

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. A detailed research plan will also be prioritised in Year 1 that includes timeline for realisation of products that efficiently fill outstanding knowledge gaps associated with 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*

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 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**

Five 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 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, and (v) collation and provision of indicator data for improved SoE reporting.

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.

1. 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
2. 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.
3. 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 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, 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), 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 for inclusion in the SoE marine thematic chapter. Given the short 9-month timeframe available for development of these products for the 2016 SoE Report, some 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 contribute to the Essential Environmental Measures initiative, which is expected to provide more detailed and updated information on marine status and trends.

The project will coordinate with Project B2 (Analysis and elicitation to support State of the Environment reporting for the full spectrum of data availability) to ensure complementarity of the information delivered.

*Links with other projects and hubs*

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:

* ‘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.

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 and assessment of cumulative impacts. Details will be finalised once projects within the TWQ Hub are confirmed. The project 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.

**Related 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*

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 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.
* 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*

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*

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**

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.

**Delivery of Project**

*Project leader’s track-record*

Graham Edgar is a global leader in conservation science, one of only three scientists to be awarded Australia’s highest honours in both environmental science (Eureka Award) and marine science (AMSA Jubilee Award). He has published over 120 scientific journal articles, including in the most highly regarded journals *Nature* and *Science*, and received three Whitley Awards for popular books on the marine environment. Prof Edgar has successfully completed many projects of this scale, including ARC Linkage projects involving multiple government partners, the only CERF Significant Project awarded fully in the marine space, and related projects within CERF and NERP Marine Biodiversity Hubs.

*Delivery on time and within budget*

The project will fully adhere to the Marine Hub Performance and Evaluation Protocols to ensure it is managed to deliver on time and within budget. The partners engaged in this project have successfully collaborated on similar research within the CERF and NERP Marine Biodiversity Hubs, and investigators including Edgar, Sweatman, Barrett, Stuart-Smith and Jordan all have significant experience and track record in managing large research projects involving multiple staff and multi-disciplinary teams.

**Project Milestones**

Program activities extending from 2016 will fundamentally 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.

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| --- | --- |
| **Milestones** | **Due date (either the 1st of Jan or June)** |
| Initial meeting of investigators, end users and stakeholders to scope project details including specific sampling design.  Undertake field surveys and complete processing of pollution markers.  Undertake initial validation surveys to compare LTMP, LTMPA and RLS survey data outputs.  Commence analysis of discrepancies between outputs of different survey programs.  Commence analysis of most useful threat indicators.  Identify interim set of indicators based on ecological survey data that are sensitive to specific threats and appropriate for SoE reporting.  Work with Departmental staff and SoE marine theme leaders to deliver interim results for key components for inclusion in SoE 2016 report.  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 | 1 Jan 2016 |
| Complete survey validation fieldwork  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.  Identify cost-effective and sensitive threat indicators that summarise ecological monitoring data.  Finalise charting of trends in threat indicators to 2015 for SoE reporting.  Hold annual meeting of investigators and end users outlining project outputs and implications for management.  Contribute data and information to Essential Environmental Measures initiative and the National Monitoring Blueprint | 1 June 2016 |
| 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 | 31 Dec 2016 |
| Complete final reporting on ecological indicators and analysis of relationships between threats, indicators and community structure.  Submit at least 8 scientific papers to international journals.  Hold meeting of investigators and stakeholders outlining project outputs and implications for management  Finalise products agreed as useful for Essential Environmental Measures initiative and the National Monitoring Blueprint | 31 Dec 2017 |

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

|  |  |  |
| --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE 2015** |
| Graham Edgar (UTAS) | Oversight of project, including participation of RLS citizen scientists, statistical analyses, student supervision, and reporting | 0.2 |
| Rick Stuart-Smith (UTAS) | Oversight of indicator development statistical analysis, and reporting | 1.0 |
| Database manager (UTAS) | Oversight of data quality, inputs and outputs | 0.5 |
| Technical Officers (UTAS) three positions, year 1 only | Field sampling of pollution markers | 0.25 |
| Researcher (AIMS) | Oversight of GBR validation trials, LTMP input, statistical analysis, and reporting | 0.4 |
| Hugh Sweatman (AIMS) | LTMP input, statistical analysis, and reporting | 0.15 |
| Neville Barrett (UTAS) | LTMPA input, statistical analysis, student supervision, and reporting | 0.1 |
| Alan Jordan (NSW DPI) | Input of management expertise | 0.05 |
| Peter Davies (NSW DPI) | Contribute expertise on distribution and consequences of pollution impacts along NSW coast | 0.1 |

**Partner contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| University of Tasmania | 589,764 |  | 875,987 |
| AIMS | 189,136 |  | 225,000 |
| NSW DPI |  |  | 135,341 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Organisation/name** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| Reef Life Survey Foundation Inc |  |  | $180,000 |

**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)** |
| Parks Australia, Department of the Environment | Amanda Parr |
| Environmental Information Policy and Reporting, Department of the Environment | Boon Lim, Jason Ferris |
| **Key Stakeholders** |  |
| 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**

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.

**Expenditure Summary**

|  |  |  |  |
| --- | --- | --- | --- |
| Budget item | 2015 | 2016 | 2017 |
| UTAS postdoctoral fellow Stuart-Smith | $ 60,991.00 | $ 121,982.00 | $ 121,982.00 |
| UTAS data manager/technical support (HEO4 0.5 FTE) | $ 37,155.00 | $ 37,155.00 | $ 37,155.00 |
| UTAS staff field surveys | $ 46,443.75 |  |  |
| AIMS staff salary (total 0.4 FTE, Level 6) half costs including overheads | $ 32,727.27 | $ 65,454.55 | $ 65,454.55 |
| Field survey costs (food, accommodation, boat, vehicle, flights - 36 days) | $ 35,580.00 | $ - | $ - |
| Field survey consumables (underwater water proof paper, transect tapes, bags, diving gear repairs) | $ 8,000.00 | $ - | $ - |
| AIMS vessel costs for survey comparisons between programs | $ 25,500.00 | $ - | $ - |
| Sample processing costs (heavy metals $35, sediment chemistry $30, stable isotopes $60, sewage markers $100) | $ 63,000.00 | $ - | $ - |
| Travel for meetings | $ 12,800.00 | $ 12,800.00 | $ 12,800.00 |
|  |  |  |  |
| Total | $ 322,197.02 | $ 237,391.55 | $ 237,391.55 |
|  |  |  |  |
| In kind contributions |  |  |  |
| ProfEdgar, Level E, 0.2 FTE + 1.2x overheads | $ 46,596.00 | $ 93,192.00 | $ 93,192.00 |
| DrBarrett Level C, 0.1 FTE + 1.2x overheads | $ 16,304.64 | $ 32,609.28 | $ 32,609.28 |
| DrJordan 0.05 FTE + 1.2 x overheads | $ 9,022.75 | $ 18,045.50 | $ 18,045.50 |
| DrDavies 0.1 FTE + 1.2 x overheads | $ 18,045.50 | $ 36,091.00 | $ 36,091.00 |
| Dr Sweatman 0.15 FTE | $ 12,272.73 | $ 24,545.45 | $ 24,545.45 |
| AIMS staff salary (total 0.4 FTE, Level 6) half costs | $ 32,727.27 | $ 65,454.55 | $ 65,454.55 |
| Oncosts associated with UTAS postdoctoral, database manager and technical support positions | $ 173,507.70 | $ 190,964.40 | $ 190,964.40 |
| Reef Life Survey Foundation (volunteer diver time ($300 / day x 500 diver days = $150,000) + boat costs ($30,000) | $ 180,000.00 | $ 180,000.00 | $ 180,000.00 |
|  |  |  |  |
| Total | $ 490,491.59 | $ 642,918.18 | $ 642,918.18 |

**Location of Research**

Analysis of data Australia-wide, including all States and Territories.

Field surveys to collect sediment cores and to compare datasets along eastern Australian seaboard.

**Indigenous Consultation and Engagement**

The project will extend and strengthen past collaborations between Reef Life Survey Foundation and Indigenous communities (e.g. surveys with Carpentaria Land Council at Mornington Island). 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)**

Field surveys to collect sediment samples for analysis of sewage and heavy metal markers of pollution.

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.

Report 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)**

LTMP, RLS and UTAS field surveys, other than those undertaken for cross-comparison and validation of the three ecological datasets.

**Risks**

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**

Ecological indicators, inshore monitoring, reef condition, sewage impacts, heavy metal pollution impacts

|  |  |
| --- | --- |
| **Project title/number:** | **C2 - Continental-scale tracking of threats to shallow Australian reef ecosystems** |

|  |  |
| --- | --- |
| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | The project will: (i) align and validate outputs of the major shallow reef monitoring programs underway around Australia, (ii) identify impacts of major environmental stressors (sewage, heavy metals, fishing, rising sea temperature, introduced species) on reef communities, and (iii) identify a suite of sensitive state-of-the-environment indicators that accurately map changing distribution of impacts around the Australian continent. |
| 2. What management action will be able to be taken as a consequence of the delivery of this project? | 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, and can be incorporated 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. |
| 3. What trial programmes to improve the physical environment will be conducted? |  |
| 4. How will this research improve the environment and how will this be measured? | 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 AIMS LTMP and UTAS LTMPA. |
| 5. Does the project align with an identified high priority need? | This project contributes to the majority of MBH 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 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. |
| 6. What other research or management investment will the project leverage? | 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. In addition to the project building on outputs of both CERF and NERP, it leverages from costs of ongoing ecological survey surveys undertaken through the AIMS LTMP and UTAS LTMPA monitoring programs, the latter primarily covered by state agencies, who are responsible for field survey and some analysis costs. Investment also builds on efforts from ca. 100 citizen divers, and contributes to diver participation in the Reef Life Survey program. |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | Prof Graham Edgar is a global leader in conservation science, one of only three scientists to be awarded Australia’s highest honours in both environmental science (Eureka Award) and marine science (AMSA Jubilee Award). He has successfully completed many projects of this scale, including ARC Linkage projects and the only CERF Significant Project awarded fully in the marine space. |
| 8. Can the project be delivered on time and within budget? | The project is ambitious but well within the capabilities of the extended researcher team, with activities divided amongst participants. In addition to the experience of project leaders, full-time postdoctoral appointment Rick Stuart-Smith undertook comparable projects for NERP (MBH) and NESP (Significant Project). Members of the research team have consistently delivered projects on time and on budget. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications | Project activities and outputs will follow NESP Data and Information Management Guidelines. Derived data products such as SoE indicators will be distributed publicly in consultation with the Department, while access to Reef Life Survey field survey data will be facilitated through the AODN portal.  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.  The project will extend and strengthen past collaborations between Reef Life Survey Foundation and Indigenous communities (e.g. surveys with Carpentaria Land Council at Mornington Island). 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. |

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 Leader* – Stephen Sagar (FTE – 30%)

*Lead Research Organisation* – Geoscience Australia

*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.

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**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)** |
| State governments |  |
| DoE |  |
| **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 title/number:** | **C3 - Change detection and monitoring of key marine and coastal environments – application of the Australian Geoscience Data Cube** |

|  |  |
| --- | --- |
| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | 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.  Development of an inter-tidal zone change detection algorithm will demonstrate the capability provided by the Australian Geoscience Data Cube (AGDC) and provide managers with detailed spatial information on the extent and timing of change in inter-tidal coastal habitats across the 27yrs of the Landsat archive. This capability can then be extended to a range of other parameters in Phase 2 of the project, including benthic substrates & ocean colour. |
| 2. What management action will be able to be taken as a consequence of the delivery of this project? | Information produced by the algorithms developed in 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. |
| 3. What trial programmes to improve the physical environment will be conducted? | A validated change detection algorithm for coastal processes and properties can be implemented on both the historical archive of satellite data, as well as in near real time to new observations. This allows timely assessment of environmental responses to management decisions and environmental change, not before possible at these spatial and temporal scales. |
| 4. How will this research improve the environment and how will this be measured? | Study sites selected for development of change detection algorithms will be completed in consultation with stakeholders to ensure that sites have sufficient validation data. This ensures that the change information detected can be assessed for accuracy, and the algorithm can be used with confidence when providing decision information to better manage the environment. |
| 5. Does the project align with an identified high priority need? | 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 |
| 6. What other research or management investment will the project leverage? | 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. |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | 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). |
| 8. Can the project be delivered on time and within budget? | Yes, the project will be managed in a manner that complies with the established Geoscience Australia project management framework. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications |  |

Project C4 - National Outfall Database

*Project length* – 48 Months

*Project start date* – 1/7/2015

*Project end date* – 30/6/2019

*Project Leader* – John Gemmill (FTE – 20%) Dr. John Cumming (FTE – 10%)

*Lead Research Organisation* – **Clean Ocean Foundation**

*Total NESP funding* - $400,000

*Total Recipient and Other Contributions (co-contributions)* - $400,000

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | *2015*  *Half year* | *2016* | *2017* | *2018* | *2019* |  |
| *NESP funding* | *$65,000* | *130,000* | *130,000* | *55* | *20* |  |
| *Cash co-con* | *$nil* | *$nil* |  | | | |
| *In-kind co-con* | *$30,000* | *$50,000* | *In-kind co-contribution kept at same nominal level until end of project – subject to annual review* | | | |

**Problem Statements**

The NOD (National Outfall Database) project addresses the government and community need to understand what the impacts on health and the ocean environment are occurring from sewerage outfalls around Australia. Governments need to be 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. This can be aided by a suitable database that provides information about pollutants arising from sewerage treatment and the distribution of these from sewerage outfalls.

The recreational water users also have a capacity to input into safer and cleaner water. This knowledge needs to be developed and utilised to better advantage with improved communication of the interplay of human impacts on water systems and human wastes entering these systems.

By and large outfall data is available but it has not been consolidated from across the country. The consolidation of this data together with checking of data completeness and accuracy can be used to the advantage of water users as well as those planning improvements to the treatment of sewerage.

This data can show 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. Mapping of high pollution areas can be examined in relation to areas of marine biodiversity and areas of endangered marine species.

**Research**

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:

1)      A literature and datasets search

2)      Selection of studies based on quality criteria

3)      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 to other Projects**

It will link to C2 and C4 as well as projects on marine pollution being conducted by the Tropical Water Quality and the Northern Hubs

**Expected Outcomes**

The outcomes of the research are:

1. A national outfall database and reports for public consumption
2. Ranking of the outfalls (and sewerage treatment systems) according to health and impact criteria with peer review of the ranking system and resulting ranking outcomes.
3. Comparison of geographical regions in sewerage volume pollution and impact
4. Mapping of the database
5. Community engagement in conduct of this research and consumption of the outcomes

This data can then be used by governments and the water industry alike to establish priority health and environmental hazards and consequent improvement actions to be taken. This will be facilitated by government involvement in the development of the ranking outcomes and community awareness of this work. Community knowledge can also lead to better community involvement and actions also at a community level.

Improvements in outfalls can be tracked using the NOD and improvements in water and wastewater usage efficiency.

**Delivery of Project**

The project leaders have experience with community engagement through the Clean Ocean Foundation and other NGO activities over several decades. They have a foundation of knowledge in the water industry and have experience in environmental monitoring from a practical as well as a theoretical standpoint. Peter Smith and John Gemmill have worked within the surfing and recreational water using community to improve understanding of environmental and health issues for many years. John Cumming is an appointed Environmental Auditor, has worked with the water industry for many years and has experience in PhD supervision at RMIT University from 2000 to 2012.

Simon Perraton has recently completed his PhD thesis at the University of Tasmania and has been a participant in Clean Oceans Foundation for over a decade. Simon brings a strong knowledge of the work at hand with an overview of the governing framework of wastewater treatment.

**Outputs**

Publically accessible website and related app.

Appropriate information brochures on scope of project to stakeholders

Media opportunities featuring community involvement

**Project Milestones**

|  |  |
| --- | --- |
| **Milestones** | **Due date** |
| Milestone 1 – project activities plan | Due 1 July 2015 |
| Milestone 2 – database designed / web site live | Due 1 January 2016 |
| Milestone 3 – treatment data collected for 2015 | Due 1 July 2016 |
| Milestone 4 – 1st community monitoring program undertaken (2 states) | Due 1 August 2016 |
| Milestone 5 – extended community monitoring program undertaken (all states) | Due 1 July 2017 |
| Milestone 6 - treatment data collected for 2016 | Due 1 August 2017 |
| Milestone 7 – data analysis report 2015 and 2016 | Due 1 November 2017 |
| Milestone 8 – data analysis report 2017 | Due 1 July 2018 |
| Milestone 9 – data analysis report 2018 | Due 30 June 2019 |
|  |  |

Researchers and Staff

|  |  |  |
| --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE**  **2015-19** |
| John Gemmill – Clean Ocean Foundation | Project director | 20% |
| Peter Smith – Clean Ocean Foundation | Communications director | 5% |
| John Cumming – Infotech Research | Technical director | 10% |
| Simon Perraton – Clean Ocean Foundation | Project manager | 80% |
| Andrew Fischer | Project Support | 10%\*\*\*\* |
| Anthony Hill - Surfrider | Community Education officer | 40% |
| Rebecca Banks, Marci Katz | Project officers | 40% |

\*\*\* Yet to be confirmed

$$

|  |  |
| --- | --- |
| **Funds over Project Life** |  |
| Clean Ocean Foundation | 390 |
| UTAS - scholarship to research students 2017 & 2018 (still to be negotiated) | 10 |

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

|  |  |
| --- | --- |
| **Organisation/name** | **Contribution** |
| Surf Riders Association | Beach and water monitoring |
| Recreational fishers | Water monitoring |
| Local Environment Groups | Beach and water monitoring |

Research End Users and Key Stakeholders

|  |  |
| --- | --- |
| **Research End Users** | **Organisation/Section** |
| All stakeholders in Coastal Sewerage Impacts | Federal and State governments  the water industry  Marine researchers  Recreational marine water using community |
| **Key Stakeholders** |  |
| Australian Federal Government | Federal government  IMAS / University of Tasmania  Clean Ocean Foundation |

**Expenditure Profile**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | *2015* | *2016* | *2017* | *2018* | *2019* | *Total (1000)* |
| *Outfall Analysis N* | *40 (15)* | *60 (20)* | *25 (15)* | *10 (10)* | *2 (2)* | *137* |
| *Ocean condition and outfall monitoring C* | *30 (55)* | *60 (90)* | *90 (95)* | *55 (55)* | *2 (2)* | *237* |
| *Ranking Outfalls R* | *5 (10)* | *10 (20)* | *5 (10)* | *5 (5)* | *1 (1)* | *26* |
|  | *75 (75)* | *130(130)* | *120(120)* | *70 (70)* | *5 (5)* | *400* |

() In kind– In kind contribution from researchers and staff. Community volunteers will contribute significantly more in latter years of project especially in C and R

***Data and Information***

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.

***Location of Research***

Australian Coastline, focussed around sewerage outfalls.

***Indigenous Consultation and Engagement***

Indigenous water users will be approached to participate in monitoring and communications.

**Inclusions (in scope)**

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)**

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.

**Constraints**

Cooperation of relevant water authorities, limited funds for data collection and analysis, community engagement and involvement in monitoring activities particularly in remote areas.

**Risks**

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 datasets will be completed 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.

**Project Keywords**

Citizen science, sewerage, coastal, environment, ranking, aquatic pollution

Project D1 – Developing a Toolbox of Predictive Models for the Monitoring and Management of KEFs and CMRs in the North and North-west regions.

*Project length* – Six months with planned extension to 3 years

*Project start date* – 01/07/2015

*Project end date* – 31/12/2018

*Project Leader* – Karen Miller (FTE – 13%), Scott Nichol (2IC; FTE – 10%)

*Lead Research Organisation* – Australian Institute of Marine Science

*Total NESP funding* (2015) - $371,200

*Total Recipient and Other Contributions (co-contributions)* - $459,712

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| --- | --- | --- | --- | --- | --- | --- |
|  | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* |
| *NESP funding* | *AIMS - $221,000*  *GA - $65,200*  *UWA - $85,000* | *AIMS - $300,000*  *GA - $150,000*  *UWA - $170,000* | *Funding kept at same nominal level until end of project – subject to annual review* | | | |
| *Cash co-con* |  |  | *Cash co-contribution kept at same nominal level until end of project – subject to annual review* | | | |
| *In-kind co-con* | *AIMS - $174,112*  *GA - $200,600*  *UWA - $85,000* | *AIMS - $580,000*  *GA - $438,300*  *UWA - $170,000* | *In-kind co-contribution kept at same nominal level until end of project – subject to annual review* | | | |

**Problem Statements**

Australia’s North and North-west (NW) marine bioregions boast an array of highly diverse ecological communities. The North and NW contain 14 and 15 Key Ecological Features and 115 and 151 species protected under the *EPBC* Act as threatened, migratory, cetacean or listed species, respectively. This diversity and conservation value is reflected in the Commonwealth Marine Reserve (CMR) network with 21 reserves established across the North and NW. Research expeditions completed through the NERP Marine Biodiversity Hub confirm the hotspot status of CMRs for megafauna and sponge habitat. The region also hosts large populations of megafauna, such as whales, turtles and sharks, some of which are endemic to the region. At the same time, these regions support important cultural and economic activities. Traditional owners have deep connections in the regions, including to sea country. Modern activities in the regions include commercial and recreational fisheries, pearling and aquaculture, defence, shipping, and petroleum exploration and production, with the latter representing Australia’s most significant reserves of conventional oil & gas. Geopolitically, the North is Australia’s closest continental connection to regional neighbours and the NW is positioned importantly on the Indian Ocean rim. Ensuring ecologically sustainable use of this area is a major national challenge involving multiple government, industry and community stakeholders including the oil & gas, tourism and fishing sectors, the Marine Division of the Department of the Environment (DoE), Department of Industry, Parks Australia, NOPSEMA, Department of Fisheries and numerous other Commonwealth and State Government agencies.

A key responsibility of DoE and other agencies is ensuring that management interventions are delivering conservation outcomes while supporting sustainable use of marine resources. Management interventions can include initiatives such as the establishment of the CMR network, threatened species recovery plans and oversight of industry regulation. Critical to such evaluation is information on the status of the marine environment and its response to the intervention. For instance, as part of the continued development of the CMR network, the DoE are now undertaking a process to review zoning within CMR’s, and to develop a framework for their management and monitoring against CMR objectives. In addition, effective environmental compliance and risk mitigation across a range of industries (oil and gas, fishing, tourism) will be strengthened when areas at risk can be assessed in a broader bioregional context, and in a setting that incorporates the best available baseline data and acknowledges natural levels of environmental variation.

The North and NW marine regions of Australia are large and remote, restricting our capacity to generate direct knowledge of their status and functioning. Significant investment in knowledge generation through programs such as NERP, WAMSI, IMOS and joint industry/government research collaborations has however generated considerable empirical information that has been the foundation for the development of spatial predictive models for focal areas. For example, the AIMS benthic community model combines physical and biological data from key submerged reefs and shoals and has been used to estimate the extent and nature of submerged reef habitat across the North and NW including KEFS such as the carbonate banks of the Sahul Shelf, pinnacles of the Bonaparte Basin, and waters surrounding emergent reef features such as Scott/Seringapatam Reefs, Ashmore Reef, Rowley Shoals and Ningaloo. Similarly, the GA 4D connectivity model has been used to predict larval dispersal across the North and NW, specifically among CMRs from the Oceanic Shoals, to the Kimberly CMR and as far south as the Abrolhos CMR.

Key to supporting government department, regulators and industry in management, monitoring and risk assessment for the North and NW regions is translating the existing data and model predictions into regional knowledge and understanding. This is a three step process: (1) consolidating and synthesizing existing information for the region and identifying gaps; (2) using existing models and approaches to generate predictions about priority areas (as determined in consultation with managers, regulators and stakeholders) for which empirical data are limited; (3) testing model efficacy by gathering new data in priority areas to assess best-practice for assessing status and function.

This project will consolidate new and existing data for the North and NW shelf areas and work closely and iteratively with key stakeholders to:

* provide reliable data and maps on the location, status and sensitivity of key ecological features, fauna and “sensitive receptor” areas, such as reefs and shoals, that are of particular interest to industry and government to inform management and/or assess the potential impacts associated with exploration and development activities in the region
* allow the status of KEFs and sensitive receptor sites to be put into a regional context through the collation of existing data at a regional scale, modelling of regional distributions, and strategic gap-filling with new data. This is of direct interest to industry as it would, for example, provide information against which NOPSEMA can verify the basis of industry risk assessments. This information will also provide background on reference sites for assessment of impacts in the event of a major incident and allow prioritising of response efforts to minimise impacts on megafauna. Such data will also directly inform decisions within DoE about future research and monitoring within CMRs
* Provide detailed information on the species and community composition and sensitivities of areas both within and outside the current CMR boundaries that can be used to develop plans that prioritise management of particularly sensitive sites and megafauna.
* Provide information to DoE on the status of key values in the North and NW that will enable them to determine if the integrity of the system is being maintained.

**Description of project alignment with Departmental research priorities**

This project aligns with several marine biodiversity research priorities identified by DoE. Through the consolidation of existing data, application and assessment of predictive models, and future targeted research surveys, it will provide new data to improve our knowledge of marine species and ecosystems to underpin their better management and protection. 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 provision of baseline data, the refinement of predictive models that can be used to understand spatial distribution of diversity and ecological processes in the North and NW regions, and together be used to assess the relative risks associated with marine activities in the area as well as the performance of CMRs. Finally, through the development and expansion of existing spatial models to incorporate processes such as cumulative impacts and threats, this project will also improve the prediction of future pressures on the marine ecosystem and their potential impacts on marine biodiversity. For example, predictive models will be developed to enable the disaggregation of impacts (i.e. storms vs. industry activities) and to incorporate a range of spatial scales from small (within CMR) to large (among CMRs) that will cumulatively enable the prediction of the effects of natural and anthropogenic disturbance on ecological processes. While the work undertaken in this project is focused on the North and the NW bioregions, it will provide a framework for similar approaches nationally.

With respect to specific identified priorities, this project thus contributes to:

* Improving our understanding of pressures on the marine environment
* 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.
* 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 to underpin management of Commonwealth Marine Reserves.
* Improve our knowledge of key marine species and ecosystems to underpin their better management and protection.

**What Government policy objective is this project addressing?**

This project addresses the Clean Water component of the Cleaner Environment Policy, specifically 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 in the North and NW regions of Australia.

**Research**

Year 1 (to Dec 2015): During the first year the project will:

* Collate existing information from various sources (NERP, WAMSI, IMOS and a range of joint projects with Industry) and develop a set of maps and other information products that document the distribution of communities and key species including megafauna in the North and NW region, and identify areas of vulnerability in the face of natural and anthropogenic impacts. These products will draw not only on the significant repositories of biological and physical data, but will also use currently available models to predict the existence of likely new areas of interest that can be sampled in future years. Integrated data collation and modelling in a case-study context will form an input to end-user and stakeholder workshops.
* Convene workshops with end-users and key stakeholders (i.e. DoE, AFMA, NOPSEMA, DFAT, Oil & Gas industry, fishing industry, Indigenous communities) to discuss and refine information needs in the context of decision settings. These workshops will focus on identifying the management framework for the North and NW Regions, and how knowledge gaps might be filled to meet the needs for monitoring, management and risk assessments.
* Evaluate existing predictive models with respect to their utility for addressing potential management and monitoring needs. These models include the 4D connectivity model (GA), pelagic hotspot model (UWA), benthic community model for the offshore banks and shoals (AIMS) and models of megafauna migration pathways and habitat use (AIMS).
* Apply existing models to identify areas of greatest uncertainty and potential data gaps and make testable predictions that can be assessed by data collected from future field surveys.
* Develop a program of research for future years for model refinement and additional data collection that will significantly improve the quality and useability of information products and advice on key management questions in the North and NW region.

Year 2 (2016): During the second year, the project will:

* Undertake field surveys to collect biological and physical data that can be used to test key predictions developed from models.
* Refine current predictive models for the North and NW. Model refinement will incorporate new data to facilitate model outputs that are of direct relevance to identified management needs, including the development of management and monitoring plans for the North and NW CMRs, and risk assessments associated with oil and gas industry operations.
* Reconvene with stakeholders and key stakeholders through formal and informal meetings to disseminate research findings and to ensure project progress and direction remains relevant to management needs

Year 3 (2017): During the third year the project will:

* Continue refinement of analyses and prediction using additional data collected in Year 2 field surveys and to incorporate a range of spatial scales, ecological processes and performance measures.
* Produce updated maps and data syntheses for end-users that capture key environmental attributes of the North and NW regions, and incorporate risk.
* Undertake further detailed discussion/workshops with DoE and other key stakeholders and end-users to outline the results from the project and to refine future management needs/directions and further extension of project especially in the context of developing appropriate monitoring approaches based on new biological and physical data, as well as the potential for development of new, targeted models. We will also assess the value of collecting additional information according to specified decision contexts (e.g. allocation of conservation management resources, EPBC Act approvals).

**Links to other projects and hubs**

Within the Marine Biodiversity Hub, this project links directly with the project ‘*Evaluating and monitoring the status of marine biodiversity assets on the continental shelf*’ within this theme which will enable sharing of datasets (e.g. shelf reef maps) and approaches and modelling tools to be tested across ecosystems. The development of the toolbox for monitoring will occur in conjunction with the *Marine Values as a Basis for Allocation of Monitoring and Management Resources* project under the *Evidence-based Decision-making* theme, to ensure the integration of outputs in a risk-weighted decision-support framework and the incorporation of social and economic factors in the interpretation of model outputs for integration with management and monitoring decisions. For the survey component of this project, outputs from the project ‘*Analysis methods and software to support Standard Operating Procedures for survey design, condition assessment and trend detection*’ will be utilised in designing sampling strategies and analytical procedures. In addition, datasets and map layers generated in this project will be discoverable through the web service tool being developed within the project “*Enhancing access to relevant marine information – scoping the development of a service for searching, aggregating and filtering collections of linked open marine data*”.

More broadly, this project also will contributed to projects in the Hub’s Threatened Species area by providing capacity to predict, for instance, ecological hotspots used by such species, and will contribute to projects in the Pressures Area by improving regional-scale knowledge.

**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 and partner institutions in the collection of physical and biological data across the North and NW bioregions as well as the development of predictive models for Australia’s marine ecosystems, including the offshore banks and shoals, canyons and associated habitats, as well as other areas identified as priorities. These initiatives build on previous research in the North and NW under the CERF and NERP programmes, research undertaken and underway in Western Australia through the WAMSI programme, oceanographic data collected as part of IMOS, as well as data collected as part of the oil and gas industry research and monitoring efforts (and that will be accessible through initiatives such as IGEMS).

Importantly, this project reflects an evolution from data collection and modelling to synthesis of information and the evaluation of predictive models. 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. Using the North and NW bioregions as focal study areas, this approach will be extendable to other regions in the marine estate.

**Expected Outcomes**

In Year 1, the project will deliver the following outcomes:

* A synthesis of existing physical and biological data sets for the North and NW marine regions that will underpin and leverage research in subsequent years of the project to directly inform management decisions, risk assessments and future research priorities;
* An agreed understanding of the properties of predictive models that currently exist for the North and NW marine regions, their strengths and weaknesses, and a pathway to be adopted for their refinement to expand the scope and improve confidence in the application of predictive models to specific management and monitoring needs;
* An improved understanding of the regional context of the spatial patterns and ecosystem processes maintaining marine biodiversity in the North and NW marine regions, and how they can inform risk assessments and management decisions;
* An agreed understanding between end-users and research providers regarding the priorities for managing and monitoring in the North and NW marine regions that will inform and be used to prioritise future research within the project, specifically to fill recognised data gaps and reduce knowledge uncertainties;
* An agreed understanding between end-users and research providers of a set of priorities for future field data collection and collection methods that cost-effectively maximises knowledge generation against identified needs and existing understanding.

Research undertaken through years 2 and onwards will build on data gaps and management needs identified in Year 1 with the ultimate goal of providing a knowledge framework to underpin the development of ongoing management and monitoring of CMRs in the North and NW Regions, and to provide a scientific basis for risk assessment to ensure sustainable development. Through the tools developed within this project, there will be an evolution from precautionary management based on minimal information to more informed and effective management decisions based on a more rigorous scientific understanding of these ecosystems. The products of this research that will underpin more informed management will include:

* Baselines for monitoring in CMRs and KEFS priority areas to maximise information value relative to return on investment;
* A more comprehensive understanding of the biodiversity, spatio-temporal dynamics of CMRs, KEFs and other features of significant conservation value in the North and NW CMRs, and the ecological processes structuring these ecosystems, along with the chronic and cumulative impact of a suite of pressures and stressors;
* An increased understanding of the distribution and structure of tropical marine biodiversity in the North and NW regions, which will provide a greater bioregional context of their significance in tropical Australia, as well in a global context as part of the broader Indian Ocean ecosystem;
* A synthesis of data sets for the North and NW regions that will provide the knowledge to underpin CMR and KEF monitoring and management, as well as a context for risk assessments to inform approvals processes for sustainable use of marine resources in the region;
* A clearer and more effective set of information for future management, monitoring and regulatory approvals to ensure sustainable use of the North and NW regions, as well as a framework within which to assess the performance of CMRs in conserving biodiversity and ecosystem processes; and
* Maintenance and building of research and management capability within Australia, building on previous government and industry investment;
  + Construction of a model of habitat use and migration pathways that will allow us to objectively identify the areas of importance for marine megafauna within the North-West Marine Regions, their representation in the CMR network, and their proximity to current and prospective industrial developments and the large-scale processes that influence their migration. These analyses will support spatial management of the North-West marine ecosystems, an area where no such synthetic overview is currently possible.

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

The outcomes from this project will be of direct relevance for management of CMRs and monitoring of KEFs and will inform a range of management and policy actions. Approvals under the EPBC Act are essentially binary decisions around whether or not a proposal poses acceptable risk. The notion of acceptable risk requires fundamental information on the spatial distribution of values 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.

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

This project will lead to better informed EPBC Act approvals, more informed prioritisation of management actions and monitoring in the North and NW 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.

**Delivery of Project**

The project will be jointly lead by Karen Miller (AIMS) and Scott Nichol (GA). Together, these scientists have experience in the management of multi-million dollar research programmes, have worked closely with government departments, research organisations and universities to effectively deliver scientific outcomes relevant to the management of Australia’s marine environment.

Karen Miller has worked in State (e.g. NSW MPA) and Commonwealth Government departments (e.g. Dept of Environment) in the development of policies and identification of research needs for management. Over 20 years in marine science she has led multiple national and international collaborative projects that have both an applied (e.g. fisheries management, deep sea conservation) and strategic (biodiversity discovery, evolutionary and ecological) research framework; and all of these being completed on time and within budget. She currently is a Senior Research Scientist at the Australian Institute of Marine Science delivering on projects providing baseline data to the oil and gas industry as well as understanding biogeographic and ecological processes in tropical marine ecosystems in Australia’s North and NW regions.

Scott Nichol is a senior marine geoscientist at Geoscience Australia with 25 years of experience leading research projects in Australia and overseas (NZ, Ireland, Canada). Since 2011, he led the development and delivery of Theme 3 – National Ecosystems Knowledge of the NERP Marine Biodiversity Hub, and worked closely with Julian Caley and Jessica Meeuwig in Theme 4 – Regional Biodiversity Discovery to Support Marine Bioregional Plans. Both themes generated new datasets and knowledge for the North and NW marine regions, with tailored products delivered to DoE to support uptake at the policy level. These projects met all delivery and budgetary requirements, with datasets accessible through AODN and the new web services tool on the Marine Biodiversity Hub website.

*How will this project be delivered on time and within budget?*

See Marine Hub Performance and Evaluation Protocols.

*A list of all outputs planned under the project, including communication and promotional material.*

The outputs from the first year of this project will include:

* Written and verbal reports to the Marine Biodiversity Hub, DoE and other relevant agencies on the outcomes from workshops in year 1 that highlight management needs and application of data in the North and NW Region, including a strategy for filling key data gaps and refining, testing and validation of existing predictive models in subsequent years;
* A synthesis of existing knowledge on the North and NW marine regions disseminated to key end-users and stakeholders through maps and products from models that are tailored to the needs of management and that identify areas at risk or vulnerable and that inform management on key current issues while indicating priority areas for survey activities in subsequent years;
* Spatial data layers relevant to the North and NW for management and planning available via an integrated web platform for the benefit of all end-users and stakeholders; and
* Contributions to the development of the North West Marine Atlas which will provide a comprehensive web portal for accessing and sharing environmental and socio-economic data on the NW region.

**Project Milestone**

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| **Milestones** | **Due date (either the 1st of Jan or June)** |
| Report from end-user workshop describing decision support needs | Due 1 Jan 2016 |
| Report from workshop of research collaborators to document the range of existing data and modelling approaches and to develop a strategy for developing and synthesising these in subsequent years | Due 1 Jan 2016 |
| Delivery of maps and products synthesising existing knowledge and data from the North and NW regions, including data layers available through the NW Atlas | Due 30 June 2016 |
| Report from field survey(s) including progress report on refinement of predictive models | Due 1 Jan 2017 |
| Delivery of final report | Due 1 June 2018 |

**Researchers and Staff**

|  |  |  |
| --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE 2015** |
| Karen Miller – AIMS | Project Leader, benthic ecologist | 0.13 |
| Ben Radford – AIMS | Ecological modeller | 0.1 |
| Marji Puotonin -AIMS | Ecological modeller | 0.06 |
| Andrew Heyward - AIMS | Benthic Ecologist | 0.04 |
| Julian Caley – AIMS | Ecologist | 0.04 |
| Mark Meekan - AIMS | Megafauna Ecologist | 0.06 |
| Michele Thums - AIMS | Megafauna Ecologist | 0.02 |
| Camille Mellin - AIMS | Ecological modeller | 0.04 |
| Rebecca Fisher - AIMS | Ecological statistician | 0.06 |
| Mary Wakeford – AIMS | Benthic ecologist | 0.38 |
| Scott Nichol – GA | Project 2IC, geoscientist | 0.1 |
| Johnathan Kool – GA postdoc | Connectivity modeller, ecologist | 0.55 |
| Zhi Huang – GA postdoc | Spatial analyst | 0.3 |
| Rachel Przeslawski - GA | Ecologist | 0.1 |
| Kim Picard – GA | Geoscientist, seabed acoustician | Year 2 |
| Justy Siwabessy - GA | Seabed acoustician | Year 2 |
| Lynda Radke - GA | Geochemist | 0.1 |
| Jin Li - GA | Ecological modeller | 0.1 |
| Floyd Howard - GA | Geoscientist | Year 2 |
| Jessica Meeuwig - UWA | Ecologist | 0.1 |
| Phil Bouchet – UWA postdoc | Modeller | 0.50 |
|  |  |  |

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

|  |  |
| --- | --- |
| **Organisation/name** | **Contribution** |
| CSIRO – John Keesing | In-kind |
|  |  |

Research End Users and Key Stakeholders

|  |  |
| --- | --- |
| **Research End Users** | **Organisation/Section** |
| Amanda Parr | DoE/Parks Australia |
| Nicole Coombe | DoE- Regional Marine Planning |
| Boon Lim | DoE SoE reporting. |
| Christine Lamont | NOPSEMA (secondary beneficiary) |
| **Key Stakeholders** |  |
| APPEA | Oil and Gas Industry – APPEA and individual companies |
|  |  |
| AFMA |  |
| State Mining, Fishery and Conservation agencies |  |
| Regional fishing and conservation groups |  |
| NAILSMA, KLC |  |

**Expenditure Profile**

Year 1 – funding will be used to convene two workshops to synthesise existing information and clarify decision support needs of relevant agencies. These workshops will be supported by collated existing data sets from the North and NW regions and existing predictive models.

Year 2 and 3 – funding will support marine surveys that test predictive capacity of models, and address data gaps in the North and NW regions based on workshops and ongoing discussions with end-users. Predictive models will be refined based on survey inputs and monitoring and assessment recommendations will be generated as part of the final project synthesis.

**Data and Information**

* Spatial data layers describing benthic and pelagic ecosystems, incorporating new and existing samples, observations and measurements.
* Predictive models describing the distribution, composition and potential connectivity of select benthic and pelagic communities.
* Web services interface (Atlas detailing spatial layers and model outputs)

**Location of Research**

Analysis and synthesis will focus on the North and NW regions of Australia, including CMRs and KEFS and building on existing knowledge for offshore banks and shoals, canyons and the pelagic ecosystems. Specific areas for focal surveys will be identified through collaboration with end-users.

**Indigenous Consultation and Engagement**

Indigenous communities in the North and NW bioregions have a very strong connection to sea-country with a recognised need for improved Indigenous employment outcomes in regional economic activity. Consultation will focus on Indigenous leadership groups (i.e. NAILSMA, KLC, TO organisations) to understand their knowledge of the region and knowledge needs. Team members are also currently participating in a range of projects (e.g. WAMSI program) in the Kimberley and Pilbara that involve engagement and collaboration with traditional owners such as the Bardi Jawi and Dambimangari people whose sea country encompasses the North and North-west regions. Engagement associated with the NESP project will build on these existing relationships and could include participation in knowledge generation (i.e. linking traditional knowledge into expert elicitation processes) and participation in research activities through Indigenous internships. Outputs from the programme will be tailored to meet the needs of traditional owners in building knowledge and managing their sea country and in assessing risks of industry activities within their country. Research results will be shared with Traditional Owners through a combination of formal and informal meetings with Elders and relevant Aboriginal Councils. In addition, TOs will be provided with access to research outputs (spatial data layers, written reports) so that the results of research can be incorporated in their own management processes.

**Inclusions (in scope)**

The project will deliver reports from workshops with key end-users and stakeholders that consolidate management priorities for the North and NW Regions, and identify data gaps and future directions for research to underpin informed management of these regions. Deliverables for 2015 include:

* Report from stakeholder workshop that summarises information needs and priorities for management and monitoring in the North and NW Regions
* Report from researchers workshop that summarises existing biological, physical and socio-economic knowledge and examines the application and development of predictive models relevant to the management and monitoring of the North and NW marine regions
* A synthesis of management requirements against existing resources to identify knowledge needs and develop a strategy for filling key data gaps and for refining, testing and validating existing predictive models to incorporate new biological, physical and socio-economic information to directly address management and monitoring needs. This synthesis will inform the direction and development of the project in subsequent years
* Spatial data layers relevant to the management and of the North and NW will be made available through the North West Marine Atlas

**Exclusions (out of scope)**

Out of scope factors will be agreed upon with DoE during the end-user workshop as guided by Department priorities for the North and NW regions, in terms of geographic areas of focus and key biodiversity values.

**Constraints**

This project is potentially constrained by the level of funding to support survey work in particular and by timely access to staff resources from the partners. However, this can be minimised through careful project management and setting of achievable objectives for surveys and subsequent analysis of samples and data collected.

**Risks**

* The success and relevance of the workshops planned for year one will be contingent on the engagement of stakeholders and research organisations to ensure the outcomes are of highest relevance. If participants cannot be certain of the longer-term directions of the project, then there is a risk that they may not engage in the early stages. [moderate]
* The success and relevance of the workshops is contingent on good inputs to these workshops (i.e. data availability, model outcomes) and means adequate resources need to be allocated to allow researchers to develop these inputs [low].
* Risk of loss of key staff [low]
* Risk of insufficient resources for field surveys to rigorously test model predictions which would compromise the understanding of the confidence of predictions from the models and hence their usefulness for monitoring and management. [moderate]

**Project Keywords**

predictive modelling, monitoring, North and NW Australia, Commonwealth Marine Reserves, Key Ecological Features

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| **Project title/number:** | D1 - Developing a Toolbox of Predictive Models for the Monitoring and Management of KEFs and CMRs in the North and North-west regions |

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| --- | --- |
| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | Year 1 (2015)   * A common understanding between the project partners and stakeholders of the priorities for management and monitoring in the N and NW marine regions; * A synthesis of existing physical and biological data sets for the N and NW regions relevant to the identified management priorities; * A common understanding among project partners of existing predictive models as applied to the N and NW regions and a pathway for refinement of models to meet specific management and monitoring priorities; and * A clear and sanctioned set of priorities for future research to fill recognised data gaps, test predictive models and meet management and monitoring objectives.   Year 2 onwards   * An improved understanding of the biodiversity and spatio-temporal dynamics of CMRs, KEFs and other features of significant conservation value in the N and NW, and the ecological processes structuring these ecosystems, along with the cumulative impact of a suite of pressures and stressors; * An increased understanding of the distribution and structure of tropical marine biodiversity in the N and NW regions, which will provide a greater bioregional context of their significance in tropical Australia, as well in a global context as part of the broader Indian Ocean ecosystem; * Baselines for monitoring in CMR and KEF priority areas to maximise information value relative to return on investment; * An updated synthesis of data sets for the N and NW regions that will provide the knowledge to underpin CMR and KEF monitoring and management, as well as a context for risk assessments to inform approvals processes for sustainable use of marine resources in the region; * A defined pathway for future management, monitoring and regulatory approvals to ensure sustainable use of the N and NW regions, as well as a framework within which to assess the performance of CMRs and the effectiveness of NOPSEMA in conserving biodiversity and ecosystem processes; and * Maintenance and building of research and management capability within Australia, building on previous government and industry investment.   + Construction of a model of habitat use and migration pathways that will allow us to objectively identify the areas of importance for marine megafauna within the N and NW, their representation in the CMR network, and their proximity to current and prospective industrial developments and the large-scale processes that influence their migration. |
| 2. What management action will be able to be taken as a consequence of the delivery of this project? | The outcomes from this project will be of direct relevance for management of CMRs and monitoring of KEFs and will inform a range of management and policy actions. This includes assessments of proposed activities under the EPBC Act, including levels of acceptable risk, and which requires fundamental information on the spatial distribution of values and the risk of 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 proposed actions insulate against pressures. |
| 3. What trial programmes to improve the physical environment will be conducted? | N/A |
| 4. How will this research improve the environment and how will this be measured? | This project will lead to better informed EPBC Act approvals, more informed prioritisation of management actions in the N and NW CMRs and will assist industry in refinement of its environmental plans (e.g. oil spill response plans, risk assessments). 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. |
| 5. Does the project align with an identified high priority need? | The project does not align with either of the two high priority research areas. However, it will deliver to a range of DoE priorities for the Marine Biodiversity Hub, that will improve our understanding of pressures on the marine environment as well as improve our understanding of biophysical, economic and social aspects of the marine environment including:   * 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; * Determine and trial practical and repeatable methods for monitoring the status and trends of key coastal and marine species and environments; * Improve our knowledge of key marine species and ecosystems to underpin their better management and protection. |
| 6. What other research or management investment will the project leverage? | This project will draw on past investment by the Marine Biodiversity Hub and partner institutions in the development of predictive models for Australia’s marine ecosystems, with a focus on the N and NW regions. These initiatives build on previous research under the CERF and NERP programs, plus WAMSI and data available through IMOS, and data collected as part of industry research and monitoring efforts (accessible through IGEMS). Research investment from the MBH will also be used to further engage with industry in developing additional research opportunities to extend the existing knowledge base in the N and NW region into the future to inform sustainable development. |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | The project will be jointly led by Karen Miller (AIMS) and Scott Nichol (GA). Together, these scientists have experience in the management of multi-million dollar research projects and have worked closely with government departments, research organisations and universities to effectively deliver scientific outcomes relevant to the management of Australia’s marine environment. Karen Miller has 20+ years of experience leading marine science national and international collaborative projects that have both an applied (e.g. fisheries management, deep sea conservation) and strategic (biodiversity discovery, evolutionary and ecological) research framework. Scott Nichol also has 20+ years of experience leading research projects in Australia and overseas. Since 2011, he led the development and delivery of Theme 3 – National Ecosystems Knowledge of the NERP Marine Biodiversity Hub, and worked closely with senior Hub researchers in Theme 4 – Regional Biodiversity Discovery to Support Marine Bioregional Plans. These projects met all delivery and budgetary requirements, with datasets accessible through AODN and the new web services tool on the Marine Biodiversity Hub website. |
| 8. Can the project be delivered on time and within budget? | Project costings are based on contributions from a multi-disciplinary research team from AIMS, GA, UWA and CSIRO with each allocated an FTE % that is consistent with their role in the project. Timelines for 2015 Milestones are achievable provided the project workshops occur in July/August. For more information regarding how the project will be delivered on time and within budget, please refer to the Marine Hub Performance and Evaluation Protocols. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications | * The project will deliver spatial datasets that will be discoverable and accessible through a web services interface (The NW Atlas), in addition to links to the AODN; * The project will consult with Indigenous leadership groups in the N and NW (e.g. NAILSMA, KLC, TO organisations) to understand their knowledge of the region and knowledge needs. Team members will also leverage existing collaboration with traditional owners such as the Bardi Jawi and Dambimangari people whose sea country encompasses the N and NW regions. These relationships will be used to identify opportunities for Indigenous participation in project activities, including through internships. More broadly, project leaders will work with the Hub knowledge broker to identify opportunities to communicate research findings, including development of tailored products for stakeholders. |

Project D2 – Analysis methods and software to support Standard Operating Procedures for survey design, condition assessment and trend detection

*Project length* – 2 Years

*Project start date* – 01/07/2015

*Project end date* – 30/06/2017

*Project Leader* – Scott Foster *Lead Research Organisation* – CSIRO

*Total NESP funding* - $299,000

*Total Recipient and Other Contributions (co-contributions)* - $299,000

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* | *2021* |
| *NESP funding* | *$100,000* | *$199,000* | *x* | *x* | *x* | *x* | *x* |
| *Cash co-con* | *x* | *x* | *x* | *x* | *x* | *x* | *x* |
| *In-kind co-con* | *$100,000* | *$199,000* | *x* | *x* | *x* | *x* | *x* |

**Project Summary**

Understanding of the status and trends of Australia’s marine environment requires efficient monitoring. Without standardisation of the methods to perform this monitoring, and the methods to report the findings, the monitoring efforts are doomed to provide limited, piecemeal snapshots of the environment that cannot be linked (due to confounding of signal and sampling effects).

This project will build on the monitoring blueprint produced by the NERP Hub by providing the foundation for Standard Operating Procedures in the collection and analysis of monitoring data. The project’s two components are: 1) providing a simple tool for designing surveys in space, and 2) providing a core set of analysis methods. Both components will be developed and tested on a set of ‘no regret’ objectives, which will be developed in conjunction with the DoE and the NESP Hub’s partners. We will work closely with other projects within the NESP Hub to further mutual aspirations (e.g. developing design tool and generating designs for surveys).

**Problem Statements**

*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 organisation or agencies collect data to serve the same, or comparable, objectives that it is collected, analysed and reported in a consistent manner. Inconsistent survey design, data collection and analysis impedes analysis of status and trend detection.

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. The IMF was written for the Great Barrier Reef but the essentially 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*

This project aims to provide the foundation for Standard Operating Procedures in the collection and analysis of monitoring data for (at least in the first two years) a limited set of “no-regrets” objectives by: 1) providing a simple tool for designing surveys in space, and 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. A putative set of objectives will be developed in collaboration with the Hub projects D1 and D3, which both have survey aspects that will benefit from the tools developed within this project. This putative set will be refined with input from the DoE.

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 gear deployment (design), 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, 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.

*Alignment with NESP 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

**Research**

*Description of research*

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:

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.
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.
3. Identify methods for status assessment and trend detection relevant to response variables identified in item 2
4. Develop prototype of easily used software for spatial survey design and analysis in the R statistical programming language.
5. 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.

Year 2:

1. Finalise survey design and analysis software, release this as an R-package.
2. 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.
3. 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.

*Links with other projects and hubs*

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) as this provides the clearest ‘no regrets’ opportunities.

* “Evaluating and monitoring the status of marine biodiversity assets on the continental shelf”,
* “Developing a Toolbox of Predictive Models for the Monitoring and Management of KEFs and CMRs in the North and North-west regions”, and
* “Monitoring and assessing impact of sewage and other pollutants on inshore fish, invertebrate, algal and microbial ecosystems”.

It is also related to the reporting/elicitation/analysis project:

* “Analysis and elicitation to support State of the Environment reporting for the full spectrum of data availability”

*Related research*

This project leverages off the outcomes of Theme 1 and Theme 2 of the NERP marine biodiversity hub, and also builds on capacity learning made during the CERF marine biodiversity hub.

**Expected Outcomes**

*Outcomes*

It is expected that this project will contribute to an improved information flow from survey through to management decision. 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 periods in time and space. This, in turn, enables effective national-scale analyses that would have previously been problematic. In particular this project will inform discussions between the Department of the Environment and NOPSEMA, on a set of minimum requirements for survey design, data processing and analysis, to ensure that data collected at local scales by disparate agencies is comparable and useable in national scale assessments.

*Specific management or policy outcomes*

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. This increases the utility of datasets beyond the narrow confines that they were originally collected for and will help to ensure that data collected at local scales can be collated into a national scale assessment

*Value*

With increased information and increased clarity comes increased capacity to manage the environment. 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**

The outcomes for this project will consist of:

* Standard Operating Protocol (SOPs) for deploying observation platforms, processing raw data and then analysing processed data for a set of ‘no regrets’ objectives. This includes clear recommendations about how to choose sampling locations and how to analyse the resulting survey data.
* 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, that will form the template for future surveys.

**Delivery of Project**

*Project leader’s track-record*

Scott Foster has been a core member of projects within both previous Marine Biodiversity Hubs. He has taken responsibility for sections of those projects and delivered results on time and on budget. He has the support of more experienced researchers that are willing to advise him with administrative and programme requirements.

*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 Milestones**

|  |  |
| --- | --- |
| **Milestones** | **Due date** |
| Prototype R-package for Spatial Survey Design. | 1 Jan 2016 |
| Identification of “no regrets” objectives. | 1 Oct 2015 |
| Identification of outcomes, covariates and scale to address “no regrets” objectives. | 1 Jan 2016 |
| Identification of analysis methods for status estimation and trend detection | 1 June 2016 |
| Worked R-scripts to act as a pattern for future researchers | 1 Jan 2017 |
| Final R-package | 1 Jan 2017 |

**Researchers and Staff**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE 2015/2016** | **FTE 2016/2017** |
| Scott Foster – CSIRO | Project lead | 0.45 | 0.22 |
| Emma Lawrence, CSIRO | Design and analysis | 0.3 | 0.1 |
| Geoff Hosack – CSIRO | Design and analysis | 0.31 | 0.11 |
| Keith Hayes – CSIRO | Design and analysis | 0.25 | 0.1 |
| Nev Barrett – UTas | Field ecologist | 0.05 | 0.05 |
| Julian Caley – AIMS | Quantitative ecologist | 0.05 | 0.05 |
| Scott Nichol – GA | Geomorphologist | 0.05 | 0.05 |

**Partner contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| CSIRO | $254K |  | $254K |
| UTas | $15K |  | $15K |
| AIMs | $15K |  | $15K |
| GA | $15K |  | $15K |

**Other contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Organisation/name** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| None |  |  |  |
|  |  |  |  |

**Research End Users and Key Stakeholders**

|  |  |
| --- | --- |
| **Research End Users (section/programme/organisation)** | **Name/s (optional)** |
| Parks Australia  State of the Environment Reporting  Marine Bioregional Planning | Amanda Parr  Lin Boon  Nicole Coombs |
| **Key Stakeholders (organisation/programme)** |  |
| NOPSEMA |  |

**Knowledge Brokering and communication**

This project will be seeking guidance and collaboration, from partners and the DoE, to aid in refining the scope and direction of this research. In the first instance, this will be in the form of a workshop to define a set of putative “no regrets objectives”, which will be refined with the aid of DoE. During implementation, the methods will be developed using survey design issues from other Hub projects (e.g. D1 and D2). This will require close collaboration between partners and researchers. At the end of the project, the software will be made available as an R package (on CRAN – the Comprehensive R Archive Network) and a workshop demonstrating its utility should be held in conjunction with a Hub-wide meeting.

**Expenditure Summary**

Funding will be primarily used to pay salaries. Initially a workshop will be held to identify ‘no regrets’ objectives and to finalise the scope of the project.

**Location of Research**

Research impact is national. This study will be conducted on the computers of researchers in Hobart, Brisbane, Canberra, and Townsville. On ground work will be conducted through associated NESP projects.

**Indigenous Consultation and Engagement**

We acknowledge the importance of conducting this project in a way that is respectful of Indigenous culture, intellectual property and traditional knowledge. We will take advice about the level of Indigenous interest in the project, and the project will be consistent with the Hub’s Indigenous Engagement and Participation Strategy. The researchers involved with this project will all conduct their research with the highest ethical standards.

**Inclusions (in scope)**

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

**Exclusions (out of scope)**

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.

**Risks**

* 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).

**Project Keywords**

Standard operating procedure, survey methods, analysis methods, core information, monitoring

|  |  |
| --- | --- |
| **Project title/number:** | **D2 – Analysis methods and software to support Standard Operating Procedures for survey design, condition assessment and trend detection** |

|  |  |
| --- | --- |
| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | It is expected that this project will contribute to an improved information flow from survey through to management decision. 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 periods in time and space. This, in turn, enables effective national-scale analyses that would have previously been problematic. In particular this project will inform discussions between the Department of the Environment and NOPSEMA, on a set of minimum requirements for survey design, data processing and analysis, to ensure that data collected at local scales by disparate agencies is comparable and useable in national scale assessments. |
| 2. What management action will be able to be taken as a consequence of the delivery of this project? | This project will provide a minimum standard that, when adhered to, will ease the difficult task of national collation and analysis of data sets collected by disparate agencies and at disparate times. This increases the utility of datasets beyond the narrow confines that they were originally collected for and will help to ensure that data collected at local scales can be collated into a national scale assessment*.* |
| 3. What trial programmes to improve the physical environment will be conducted? | N/A |
| 4. How will this research improve the environment and how will this be measured? | With increased information and increased clarity comes increased capacity to manage the environment. 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. |
| 5. Does the project align with an identified high priority need? | 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 |
| 6. What other research or management investment will the project leverage? | This project will build on the monitoring blueprint produced by the NERP Hub by providing the foundation for Standard Operating Procedures in the collection and analysis of monitoring data. The project’s objectives (in detail) will be developed and tested on a set of ‘no regret’ objectives, which will be developed in conjunction with the DoE and the NESP Hub’s partners. We will work closely with other projects within the NESP Hub to further mutual aspirations (e.g. developing design tool and generating designs for surveys). |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | Scott Foster has been a core member of projects within both previous Marine Biodiversity Hubs. He has taken responsibility for sections of those projects and delivered results on time and on budget. He has the support of more experienced researchers that are willing to advise him with administrative and programme requirements. |
| 8. Can the project be delivered 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. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications | The whole point of this project is to gather data in a consistent manner, analyse it in a consistent manner (so that the outputs are comparable to other surveys), and to provide a resource for future studies that may wish to leverage this data resource. This project will not only abide by the data and information management guidelines, but it may even influence what those guidelines are. |

Project D3 – Evaluating and monitoring the status of marine biodiversity assets on the continental shelf

*Project length* – 30 Months

*Project start date* – 01/07/2015

*Project end date* – 30/12/2017

*Project Leader* – Neville Barrett (FTE – 30%)

*Lead Research Organisation* – University of Tasmania

*Total NESP funding* - $1,435,000

*Total Recipient and Other Contributions (co-contributions)* - $2,266,000 in-kind

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
| NESP funding | UTAS  $122,000  GA  $98,000  CSIRO $42,000  NSW DPI $76,500  NSW OEH  $26,500  UWA $13,000  AIMS $10,000  Total $388,000 | UTAS $213,000  GA $85,500  CSIRO $83,000  NSW DPI $53,000  NSW OEH $53,000  UWA  $26,000  AIMS $10,000  Total $523,500 | UTAS $213,000  GA $85,500  CSIRO $83,000  NSW DPI $53,000  NSW OEH $53,000  UWA  $26,000  AIMS $10,000  Total $523,500 | x | x | x | x |
| Cash co-con | x |  |  | x | x | x | x |
| In-kind co-con | UTas $187,000  GA $225,000 (pending approvals)  CSIRO $52,000  NSW DPI $82,000  NSW OEH $32,000  UWA 16,000  AIMS 13,000  Total $607,000 | UTas $354,000  GA $222,000 (pending approvals)  CSIRO $104,000,  NSW (OEH and DPI) $110,000  UWA $33,000  AIMS $12,500  Total  $835,500 | UTas $354,000  GA $222,000 (pending approvals)  CSIRO $104,000,  NSW (OEH and DPI) $110,000  UWA $33,000  AIMS $12,500  Total  $835,500 | x | x | x | x |

**Project Summary**

Rocky reefs form an important habitat on the continental shelf and one subject to disproportionate fishing pressure given the high productivity of this habitat relative to adjacent sandy seabed. Despite this, little is known of the extent and nature of these systems beyond their value to the fishing industry. This project collates all known mapping data from government and industry (including data acquired during CERF and NERP Hubs) to provide an updated map of this key habitat around Australia, and will identify critical gaps in this knowledge to be filled by targeted surveys. This will significantly improve the knowledge of these environmental assets within CMRs and marine regions required for development of effective management approaches, and implementation of the National Monitoring Blueprint for monitoring of rocky reef assets. A classification system will be developed for these reefs, and matched with refinement of inventory and monitoring approaches to track reef health through time, including standard approaches to SOE understanding and reporting consistent with measures developed for coastal systems within NESP. In addition, the first year of the project will set up a clear research plan for subsequent years, based on consultation with the Department and stakeholders, to ensure key knowledge gaps are addressed, and the National Monitoring Blueprint implemented as effectively as possible for rocky reef KEFS.

**Problem Statements**

*Problem*

Significant gaps remain in our knowledge of the distribution of key biodiversity assets of the marine estate on the continental shelf, their condition, and management actions required to ensure these assets are adequately protected. This is equally the case for CMRs and off-reserve locations managed under 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 reefs and those formed on relict 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. This information is critical for evaluating the need for, or consequences of management strategies. 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 need to have a common approach to reporting of outputs that are consistent at a national scale for State of Environment (SoE) understanding and reporting. The importance of these reef systems to threatened and protected sharks also warrants further examination, as relict coastline reefs are thought to provide an important migration pathway. Improved mapping of such systems will allow this relationship to be better evaluated.

*How Research Addresses Problem*

In this project we will take a stepwise approach to filling these knowledge gaps and utilising this information to further develop and refine appropriate survey and monitoring protocols to inform effective management of the commonwealth’s marine estate.

This project will improve our understanding of the characteristics and distribution of these key habitats nationally and provide a spatial basis to understand the impacts of, and recovery from, fishing pressure. In year one, it will provide an updated national map of the distribution of reef features on the shelf, and a geomorphological classification of reef types to aid in structuring monitoring programs and explaining spatial patterns in biodiversity. This will be facilitated through collation of all existing mapping information and associated biological values from Hub partners (including data acquired during CERF and NERP Hub research), stakeholders, including government and industry, in addition to a priority survey in NSW to identify the key reef features associated with the Hunter CMR in NSW. This combined task has high upfront costs as it, by necessity, involves a large time contribution across state and commonwealth agencies (including NESP partners). This time includes collation and processing both the physical data, and where possible, available biological data, to ensure the new map layer is as comprehensive as possible, and relationships between reef physical classification and associated biodiversity are clearly defined. This latter component will also significantly enhance our ability to make predictions about the distribution of biodiversity values in cross-shelf ref systems.

The project will also allow an improved assessment and prioritisation of knowledge gaps that could be addressed through further targeted surveys in years two to three in consultation with the Department and stakeholders. These gap filling surveys will be undertaken with methods developed and refined within the NERP Hub, and will be guided by the National Monitoring Blueprint. This new knowledge will allow refinement of KEF maps 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.

In summary, year one is focussed on delivering a substantially refined map of the distribution, extent and structure of shelf reef KEFs throughout Australian waters, and a nationally standardised classification scheme for these reef systems. This mapping layer and associated extensive collation of current mapping data, associated biological attributes, and identification of major knowledge gaps will be the significant output from year 1. A workshop will be held in 2015 for discussions on reef classification and collation of datasets, with a workshop report by Dec 2015 listing the identified datasets, describing methods for updating the shelf reef map and a preliminary reef classification system. The workshop report with be the major output from 2015.

Years 2-3 would be focussed on filling priority gaps in this understanding through surveys of both physical habitat distribution and biological processes that build upon the methods and knowledge obtained during NERP Hub research. Work in this space will be guided by the Department, stakeholders, and the National Monitoring Blueprint, with discussions held throughout year 1 to clearly identify the objectives and outcomes of research undertaken during years 2-3. The knowledge gained will lead to refinement of KEF profile descriptions and models, and improved KEF mapping that informs CMR management and decision support for 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. Where possible, the National Monitoring Blueprint will be implemented via new surveys, and existing data from previous surveys further analysed to provide baseline inventories and refine performance indicator metrics.

*Alignment with NESP Research Priorities*

This project aligns to at least five 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, 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.

**Research**

*Description of research*

The first phase of this multi-year project is designed to encompass a desk-top analysis of our current knowledge of continental shelf reef habitats that will deliver a nationally consistent assessment of the distribution and structure of shelf reefs, and identify the major gaps in that knowledge. This will be coupled with, and informed by a second phase that will include:

• trialling and testing of biophysical habitat modelling that aligns with the predictive modelling toolbox developed in the North and North West,

• targeted field surveys to fill major gaps in our understanding of shelf reefs and their associated biology,

• amending qualitative KEF models of shelf reef systems using local data if this proves necessary,

• informing evaluation of the status of ecosystem condition and of the efficacy of management actions, including CMR representation and current management arrangements.

The targeted surveys will refine our approaches to monitoring priorities based on the monitoring blueprint, with the endpoint being a functional framework from which the department may transition towards a routine monitoring program. This transition will be supported by the outcomes and products of the NESP Standard Operating Procedures project. Related Hub PhD projects will examine a range of indicator metrics derived from AUV still imagery and video to refine approaches to monitoring and reporting.

Research tasks and timeline as follows:

Year 1 (to 30 June 2016)

i. Initiate the project with a workshop of key stakeholders and NESP partners to identify datasets and appropriate methods for updating the shelf reef map, as well as identifying the most critical information gaps to be targeted by Hub partners directly or through opportunities such as transit voyages of “RV Investigator”. The workshop will also focus on reef classification systems based on both physical characters such as geology and geography, and patterns in biological assemblages. A workshop report will be produced by December 2015 as the first major output from this project, describing the range of datasets available and methods to be used to collate datasets, update the mapping layer, interpolate gaps, develop a reef KEF classification scheme, and integrate biological knowledge into this scheme.

ii. Collate existing spatial layers for shelf rocky reefs from partner institutions, previously funded Departmental programs (CERF and NERP), and collaborating agencies such as Parks Victoria, Australian Hydrographic Office, and develop them into a nationally consistent GIS (shape file) format. An example of current data is GA’s existing national reef shapefile, which could be readily updated with multibeam data from the 50 m national grid. In addition to the production of a new rocky reef KEF map, and identification of priority gaps, all collated mapping data will be fully described by metadata records on the AODN portal, and where possible, original fine scale mapping outputs will also be added to national databases.

iii. Develop and complete the reef classification system based on geomorphology, biology, depth and latitude that can be applied at a national scale for the entire continental shelf. This classification scheme can be used for planning, as a monitoring framework, evaluation of representation of the CMR network, and as a basis for predicting and describing the associated biodiversity values.

iv. Trial and evaluate habitat modelling tools (against reef and macro-invertebrate maps compiled in the NERP and CERF hubs) being further developed in the North and North West under NESP, align and/or amend models as necessary to move towards a national applicable toolbox possibly with region-specific variations.

V Clearly identify, with stakeholders including the Department, the proposed outputs and outcomes of projects planned for years 2-3, establishing a clear research plan for these subsequent years.

Year 2 and 3 +

vi. Informed by the desk-top reef mapping and classification results, and the habitat modelling where successful, design a cost-efficient and targeted survey series to acquire high resolution acoustic and biotic data for currently unmapped or poorly mapped regions of the shelf in priority areas chosen in consultation with DoE and AFMA. This work will be undertaken concurrently with studies based on existing NERP and CERF physical and biological data that will refine image sampling protocols (both field collection approaches and post-collection analysis of imagery) for inventory, monitoring and interpretation of bioregion-specific patterns and processes. Thus building on the approaches to survey designs and methods developed during CERF/NERP, by further refinement based on lessons learnt during the limited field programs undertaken. Overall, the extent that research in years 2-3 is balanced between technique refinement and further surveys will be contingent on the availability of additional funding to cover field-based costs in addition to staff costs which are covered here.

For potential new surveys, the survey design will be developed with reference to:

• the extent to which the existing marine reserve network encapsulates the bioregional and cross shelf reef diversity

• the current and historical distribution of fishing activity and other pressures

• relevant habitat and connectivity model predictions developed under the CERF and NERP programs: and,

• 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, Marine Bioregional Plans and related biodiversity management measures in Commonwealth and coastal waters.

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-surface profilers, Baited Underwater Remote Video (with additional rear facing cameras), and the IMOS Automated Underwater Vehicles facility, to acquire acoustic and biological data. Survey designs will build on the knowledge gained during NERP Hub research to optimise the tools used for the task, the underlying statistical design for surveys, and post-survey analysis of acquired data. Where possible, such surveys will also target CMR locations where little or no current knowledge is available on the nature and extent of shelf habitats within them. Ultimately, the project will provide all the essential background knowledge necessary to transition from a survey design and evaluation phase to a planned monitoring program for shelf reef KEFs, and further our baseline understanding of shelf habitats within CMRs.

*Links with other projects and hubs*

This project links and is complementary to the project D1, “Developing a Toolbox of Predictive Models for the Monitoring and Management of KEFs and CMRs in the North and North-west regions” and delivering to similar Departmental Research Priorities. Specifically, the development of predictive models for shelf reef KEFs in the N/NW will be informed by the reef distribution and classification developed within this project, and the models used here to refine our understanding of the distribution and function of these habitats.

The project is also linked with the project D2, “Analysis methods and software to support Standard Operating Procedures (SOPs) for survey design, condition assessment and trend detection”. In stage two of the project, in years 2-3, we will undertake a series of small gap-filling surveys. These will be based on standard operating procedures developed within the NERP Hub for shelf reef inventory and monitoring studies, to be refined within the SOPs project. That project will in turn 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 the 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 as phase 2 of this project 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 marine monitoring blueprint 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.

Work and data collated on reef KEF’s within this project will be utilised by B2, “Analysis and elicitation to support State of the Environment reporting for the full spectrum of data availability”, and in turn, the needs for SOE reporting identified in project B2 will inform the optimal data management and reporting of outputs from this project for SoE objectives.

As rocky cross-shelf reefs are KEF’s that significantly intersect a range of anthropogenic pressures and CMRs, the knowledge gained within this study will potentially inform B1, “Road testing decision support tools via case study applications” as the management of human pressures within shelf-areas of CMRs is likely to be a key area where decision support tools are needed.

Linked with the project B2 above, project C1 “Improving our understanding of pressures on the marine environment” By significantly improving our understanding of the spatial extent and nature of shelf reef KEFs around Australia, we will provide the knowledge necessary to understand 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.

In addition, datasets and map layers generated in this project will be discoverable through the web service tool being developed within the project B3. “Enhancing access to relevant marine information – scoping the development of a service for searching, aggregating and filtering collections of linked open marine data”.

*Related research*

The project will leverage off three previous projects undertaken by the Marine Biodiversity Hub: (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 also 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, and; (iv) state-based seabed mapping projects in WA, Vic, Tas and NSW that have conducted considerable mapping of reefs on their respective continental shelfs. 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 monitoring program for reef systems.

**Expected Outcomes**

*Outcomes*

Many of the project outcomes can be measured against the NESP research priorities for the Marine Biodiversity Hub.

1. *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.

2. *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.

3. *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. Eg introduced species, climate change, ecological effects of fishing in marine and coastal waters.

4. *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.

5. *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.

6. *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 DoE research priorities above. They will inform a wide range of management and policy actions, including effective management of core CMR 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 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 Commonwealths off-reserve assets in this space, and inform national approaches to ecosystem-based management of this Key Ecological Feature.

*Specific management or policy outcomes*

This project will deliver essential information on the physical and biological assets contained within Commonwealth and adjacent State waters on the continental shelf; specifically the location, extent and nature of rocky reef habitats, as these are currently poorly known. This information, gained through collation and analysis of existing data and targeted gap filling studies, is critical to development of management planning for CMRs, implementation of regional marine plans, and ensuring fisheries are managed on an ecologically sustainable basis (via links with AFMA). It identifies the types of assets that need to be managed, and by furthering our understanding of the regional variability in biological assets within these reef system, allows refinement and development of appropriate monitoring programs for CMRs and regional areas, providing information essential to adaptive management.

*Value*

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 DoE and fisheries values managed through AFMA Moreover, through refining and developing inventory 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**

The first substantial output will be a workshop report (by Dec 2015) detailing the workshop outcomes, including identified data sources and stakeholders, methods for developing the mapping layer for cross-shelf reefs, the draft reef classification system and approaches for refining the final classification system.

The major output of the first phase of the project (June 2016) will be an updated and significantly improved map of the shelf reef KEF around Australia, with an associated classification system that allows reef types to be better classified and associated biodiversity attributes to be better characterised and predicted. This will also include an associated GIS-based collation of the underlying mapping data used to generate the KEF maps to be made readily available to all agencies involved in marine management.

Subsequent outputs will include a series of detailed inventory and baseline reports on each targeted field program (guided by gaps identified in the desk-top study and input of priority areas from DoE).

Linking with the SOPs project, a recommended set of monitoring protocols tailored to regional needs, reef classifications and key species of interest.

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).

A data trawler and web service capability to more effectively identify and utilise marine spatial data holdings of Hub partners, state and national institutions.

An updated monitoring blueprint for reef KEFs, including updated qualitative models and indicator predictions if necessary, around Australia that builds on the learning within this project, and guides future inventory and monitoring of these features.

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.

**Delivery of Project**

*Project leader’s track-record*

This project brings the strength of a range of partner investigators, a number of whom have collaborated within the CERF and NERP Marine Biodiversity Hubs to develop and deliver major research projects. These are in addition to individual projects that researchers have delivered for funding agencies including ARC and FRDC. For example, Barrett and Nichol collaborated effectively within the CERF Hub to evaluate the effectiveness of multibeam sonar (MBS) as a surrogate for prediction of habitat and key species distribution in a project that met all delivery and budgetary requirements and formed the basis of widespread MBS use within NERP Hub research, and widespread adoption of this tool in shelf-based surveys of CMRs.

More recently, investigators Hayes, Nichol, Barrett, Jordan and Davies collaborated effectively within the NERP Hub to develop and refine survey tools and methodology for the effective evaluation of CMR physical and biological assets. In all cases the program research requirements were met and all data generated is either deposited in national data facilities or is in the process of doing so.

*Delivery on time and within budget*

The project will fully adhere to the Marine Hub Performance and Evaluation Protocols to ensure it is managed to deliver on time and within budget. The partners engaged in this project have successfully collaborated on similar research within the CERF and NERP Marine Biodiversity Hubs, and investigators including Barrett, Nichol, Hayes and Jordan all have significant experience and track record in managing large research projects involving multiple staff and multi-disciplinary teams.

**Project Milestones**

|  |  |
| --- | --- |
| **Milestones** | **Due date (either the 1st of Jan or June)** |
| Milestone 1 Completion of Y1 research plan | Due 1 June 2015 |
| Milestone 2. Completion of workshop on mapping and classification approaches | Due 30 October 2015 |
| Milestone 3. Completion of Workshop report | Due 30 Dec 2015 |
| Milestone 4 Completion of desk top study report and collation of all existing shelf reef mapping data, identification of gaps | Due 1 June 2016 |
| Milestone 5. Completion of report on national classification scheme for shelf reef systems | Due 1 June 2016 |
| Milestone 6. Completion of forward research plan with DoE for gap-filling research projects | Due 1 June 2016 |
| Milestone 7. Completion of initial gap-filling survey and associated survey report | Due 1 June 2016 |
|  |  |
| Milestone 8. Data trawler developed to a national standard facility and incorporated within the national data infrastructure | 1 Dec 2016 |
| Milestone 9. Report on national database management protocols for acquired survey data, and links with data trawler | 1 Dec 2016 |
| Milestone 10. Updated blueprint on monitoring reef KEFs | 1 June 2017 |
| Milestone 11, completion of survey reports | 30 Dec 2017 |

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

|  |  |  |
| --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE 2015** |
| Neville Barrett, University of Tasmania | Project co-ordination, ecological studies | 0.3 |
| Postdoc, Utas | Collation of regional data and planning of biological studies | 0.5 |
| Technical officer for project support (Utas) | Assist in collation/analysis of datasets, workshop and field studies | 1.0 |
| Vanessa Lucieer University of Tasmania | Spatial analyst co-ordinating | 0.5 |
| Keith Hayes, CSIRO | Project coordination | 0.1 |
| Tara Martin, CSIRO | Marine mapping/GIS collation | 0.1 |
| Alan Williams, CSIRO | Ecological input to reef Kef Classification | 0.05 |
| Rudy Kloser/Gordon Keith | Marine mapping/GIS collation | 0.1 |
| Dave Watts | Data aggregation for shelf reefs | 0.15 |
| John Keesing | GIS collation (NW) | 0.05 |
| Franziska Althaus | Ecological input to reef Kef Classification | 0.05 |
| Scott Nichol, Geoscience Australia | Mapping/Geomorphology | 0.2 |
| Zhi Huang, Geoscience Australia | Spatial Analyst | 0.25 |
| Johnathon Kool, Geoscience Australia | Mapping/connectivity/modelling | 0.15 |
| Floyd Howard, Geoscience Australia | Mapping/Geomorphology | 0.3 |
| Brendan Brooke, Geoscience Australia | Geomorphology | 0.1 |
| Tim O’Hara, Museum Victoria | Biodiversity | 0.05 |
| Peter Davies, NSW OEH | Mapping | 0.1 |
| Tim Ingelton, NSW OEH | Mapping | 0.1 |
| Alan Jordan, NSW DPI | Mapping/Ecological studies | 0.1 |
| David Harasti NSW DPI | Mapping/Ecological studies | 0.1 |
| Spatial analyst, NSW DPI | Mapping collation | 0.5 |
| Jessica Meeuwig, University of Western Australia | Mapping collation/ecological studies | 0.1 |
| Postdoc, UWA | Mapping collation and reef classification | 0.25 |
| Julian Caley, AIMS |  | 0.1 |

**Partner contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| UTAS | 548,000 |  | 895,000 |
| GA | 269,000 |  | 669,000 |
| CSIRO | 208,000 |  | 260,000 |
| NSW DPI | 182,500 |  | 192,000 |
| NSW OEH | 132,500 |  | 142,000 |
| UWA | 65,000 |  | 82,000 |
| AIMS | 30,000 |  | 38,000 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Organisation/name** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| Dr Stefan Williams, IMOS AUV facility |  |  | IMOS capacity |
| Dr Stefan Howe, Parks Vic. Coastal mapping |  |  | Mapping data |

**Research End Users and Key Stakeholders –**

|  |  |
| --- | --- |
| **Research End Users (section/programme/organisation)** | **Name/s (optional)** |
| DoE- Parks Australia (CMRs) | Amanda Parr |
| DoE- Parks Australia-SE CMR management | Andrew Reed |
| DoE- Regional Marine Planning | Nicole Coombe |
| DoE SoE reporting. | Boon Lim |
| **Key Stakeholders (organisation/programme)** |  |
| AFMA |  |
| NOPSEMA |  |
| State Fishery and Conservation agencies |  |
| Regional fishing and conservation groups |  |

**Knowledge Brokering and communication**

End users will be engaged in a range of formats during this project. As DoE will be a key end user we 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. The primary output of the first year of the project is the detailed mapping layer of shelf reef systems and reef classification scheme which is particularly invaluable for understanding the nature of CMR assets on the shelf, and values within marine bioregional plans. This output will be actively promoted to the department.

In addition it will also be promoted to other 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. As gap-filling surveys are proposed to be undertaken in the second phase of the study, along with refinement of monitoring approaches and KEF models, DoE will be actively engaged in the process of identifying and selecting propriety locations for additional surveys. 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.

**Expenditure Summary**

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 an initial workshop and collate existing mapping data, to identify gaps in that knowledge and to generate a classification scheme for rocky shelf reefs. 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**

This research will focus on shelf rocky reef systems around Australia. The initial focus includes all such systems in the data collation phase, with targeted future surveys intended to inform major knowledge gaps. 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**

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. The Hub’s knowledge broker will, as part of consultation for the wider Hub community, raise awareness of our findings in this area and stimulate engagement with interested members of the Indigenous community. There is also scope for engagement with some state-based Indigenous consultative groups and processes that are relevant to this project. This engagement will refer back to the Hub’s Indigenous Engagement and Participation Strategy.

**Inclusions (in scope)**

The scope includes (1) a revised and significantly enhanced spatial layer for rocky reef KEFs, (2) new gap-filling surveys for reef KEFs, (3) refinement of survey methodology, post processing, analysis and reporting of survey data, (4) improved data access via links to a web services tool and an upgraded data trawler.

**Exclusions (out of scope)**

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 DoE.

**Risks**

The major constraints to the success of the project are the level of funding and the extent of engagement by DoE 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.

**Project Keywords**

biodiversity, rocky reef, monitoring, CMR, Key Ecological Feature (KEF).

**CONTEXT**

|  |  |
| --- | --- |
| **Project title/number:** | **D3 – Evaluating and monitoring the status of marine biodiversity assets on the continental shelf** |

|  |  |
| --- | --- |
| **NESP Project Assessment Criteria** | **Response** |
| 1. What practical and tangible outcomes will the project deliver? | Year 1 (2015-June 2016   * A synthesis of existing physical and biological data sets for shelf rocky reef habitat around Australia, with a particular focus on multibeam survey data. The data will be collated for ready access in the future. * A detailed map layer of the spatial distribution of shelf rocky reefs at a national scale, including a classification of these reef systems on a range of geomorphological and biological features. This will better inform current knowledge of the reef KEF assets of the Commonwealth estate, informing CMR management planning, marine regional plans, and sustainable fishing practices. * A clear indication of critical knowledge gaps in our understanding of the distribution of cross-shelf reef systems and their associated biota and how they intersect DoE management information needs such as that required for CMRs and implementing actions under marine regional plans. This information will be used to prioritise future surveys and research activities in general, including direct NESP surveys, and those undertaken by partners and broader national programs such as IMOS and prioritisation of use of the national marine facility “R.V. Investigator”.   Year 2 onwards  Targeted surveys will be undertaken where possible on cross-shelf reef KEFs in critical gaps and CMR locations necessary to refine reef mappings and understanding of key ecological processes. The improved mapping will better inform overall management of the marine state, including knowledge of the intersection of reef assets and anthropogenic pressures.   * Baseline monitoring in CMR and reef KEF areas will be provided by gap filling surveys, thus gaining new knowledge for CMR and regional asset management, as well as a framework for future monitoring programs. * Further development of inventory and monitoring techniques will help refine standard operating protocols for subsequent monitoring programs for CMRs, reef KEFs, and lead to development of national standard indicators for SoE understanding and reporting that are consistent with those developed for coastal marine systems. * Maintenance and building of research and management capability within Australia, building on previous government and industry investment. |
| 2. What management action will be able to be taken as a consequence of the delivery of this project? | * Specific management outcomes include: * • The initial mapping and categorisation will provide information for improved management of CMRs and reef KEF assets in general under regional marine plans and via other commonwealth management tools such as fishery management via AFMA. * The gap identification process will allow management to prioritise research needs with respect to filling critical knowledge gaps, either via Hub activities or through a range of other tools including deployment of national facilities, and identifying priority areas for commonwealth research agencies and funding programs.. * Refinement of monitoring and inventory methods and protocols will allow management actions related to establishment of monitoring CMRs within the new CMR estate, and monitoring programs in general aimed at SoE understanding and reporting within reef KEFs |
| 3. What trial programmes to improve the physical environment will be conducted? | N/A |
| 4. How will this research improve the environment and how will this be measured? | * This research will improve our knowledge of part of our environment that is heavily utilised by a range of human activities, including extractive activities, but one where there is very little mapped knowledge of its spatial distribution and nature, and even less on the overall biological values other than value of commercial species extracted. Understanding the distribution and nature of this asset with respect to pressures will help to ensure it is managed sustainably, identify areas of vulnerability and address these where necessary via management tools. * Similarly, through development of monitoring and inventory protocols and techniques, and initiation of baselines for such programs in some locations, the knowledge gained will help identify a wide range of threats from physical damage, removal of top predators, introduced species, climate change, allowing responses to be developed to improve the environment. * The value will ultimately be measured in the longer term, certainly longer than this project covers. However, as in the case with coral loss in the GBR, determining relationships with crown of thorns seastars and implementing effective actions to improve coral cover, the value of such work will be ultimately measured by the extent it informs management change and that such change is effective. |
| 5. Does the project align with an identified high priority need? | The project will deliver to a range of DoE priorities for the Marine Biodiversity Hub, that will improve our understanding of pressures on the marine environment, particularly within the Commonwealth’s marine estate, and in the shelf environment where significant human pressure intersects conservation values managed by tools such as CMR’s and marine regional plans. DoE priorities addressed include:  1. *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.  2. *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.  3. *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.  4. *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.  5. *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.  6. *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. |
| 6. What other research or management investment will the project leverage? | This project will draw on past investment by the Marine Biodiversity Hub and partner institutions in the mapping and biological inventory of Australia’s cross-shelf reef ecosystems. These include CERF and NERP programs developing surrogate methods of understanding the extent of reef systems via multibeam sonar surveys, and combining such methods with new tools such as Autonomous Underwater Vehicles (AUVs) and Baited Underwater Videos (BUVs) to develop cost-effective monitoring approaches for CMRs and KEFs within the Commonwealth marine estate. Similar tools and approached were developed via WAMSI and Marine Futures in WA, and were supported through investments via national facilities such as IMOS, as well as partner agencies. The project will also lever against mapping data generated by the Australian Hydrographic Service, State agencies, and industry through engagement with NOPSEMA. |
| 7. Does the project leader have a positive track record in delivering previous research projects, including timely delivery of outputs, administrative requirements and data and metadata? | This project brings the strength of a range of project leaders from partner investigators, a number of whom have collaborated within the CERF and NERP Marine Biodiversity Hubs to develop and deliver major research projects. These are in addition to individual projects that researchers have delivered for funding agencies including ARC and FRDC. For example, Barrett and Nichol collaborated effectively within the CERF Hub to evaluate the effectiveness of multibeam sonar (MBS) as a surrogate for prediction of habitat and key species distribution in a project that met all delivery and budgetary requirements and formed the basis of widespread MBS use within NERP Hub research, and widespread adoption of this tool in shelf-based surveys of CMRs.  More recently, investigators Hayes, Nichol, Barrett, Jordan and Davies collaborated effectively within the NERP Hub to develop and refine survey tools and methodology for the effective evaluation of CMR physical and biological assets. In all cases the program research requirements were met and all data generated is either deposited in national data facilities or is in the process of doing so. |
| 8. Can the project be delivered on time and within budget? | The investigators on this project have a track record of delivering projects on time and within budget, as well as the skill sets and research teams necessary to deliver this project at a high standard.  For more information regarding how the project will be delivered on time and within budget, please refer to the Marine Hub Performance and Evaluation Protocols. |
| Comment on how this project is consistent with:   * the NESP Data and Information Management Guidelines * hub strategies for Indigenous engagement, monitoring and evaluation, and knowledge brokering and communications | * The project will deliver a range of spatial datasets (including the shelf-reef mapping layer) that will be discoverable and accessible through a range of data portals provided by AODN, with all information and metadata stored and made accessible following NESP guidelines. As per outputs for CMR biological surveys and mapping within the CERF and NERP Hubs, all data will be made readily available as rapidly as possible. * 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. The Hub’s knowledge broker will, as part of consultation for the wider Hub community, raise awareness of our findings in this area and stimulate engagement with interested members of the Indigenous community. There is also scope for engagement with some state-based Indigenous consultative groups and processes that are relevant to this project. This engagement will refer back to the Hub’s Indigenous Engagement and Participation Strategy. More broadly, project leaders will work with the Hub knowledge broker to identify opportunities to communicate research findings, including development of tailored products for stakeholders. |

Project D4 – Best practice spatial management of marine biodiversity

*Project length* – 6 Years

*Project start date* – 01/07/2015

*Project end date* – 31/12/2020

*Project Leader* – Tim O’Hara (FTE – 70%)

*Lead Research Organisation* – Museum Victoria

*Total NESP funding* *(to 2017)* - $420,000

*Total Recipient and Other Contributions (co-contributions)* - $1,053,093

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* | *2021* |
| *NESP funding* | *$120,000* | *$150,000* | *$150,000* |  |  |  |  |
| *Cash co-con\** |  |  |  |  |  |  |  |
| *In-kind co-con\*\** | *$202,803* | *$418,106* | *$432,183* |  |  |  |  |

\*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

**Project Summary**

This project will fill data gaps and evaluate methods relevant to building a comprehensive understanding the spatial distribution of seafloor biota for the Australian marine domain, with the objective of preparing Australian governments for a future best-practice review of Australia’s marine bioregionalisation, a key information layer for national and regional marine spatial planning. The project will incorporate results from field trips to unexplored offshore areas of Australia’s marine domain.

**Problem Statements**

*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 reviews of marine spatial planning and management (e.g. decadal reviews of CMR network management plans) will have to incorporate substantial amounts of new data, comprehensive oceanographic models, and newer innovative analyses

*How Research Addresses Problem*

The primary objective of this project is to incrementally build the required information based by identifying and filling data gaps and evaluating the importance of new data layers, models and technologies to marine spatial planning at national scales. This will enable Australian governments to incorporate current information into bioregional reviews or assessments when they are required. A second objective is to increase our knowledge of biodiversity from unexplored parts of Australia’s marine domain, including the deeper areas of the CMR network, and to communicate this knowledge to the people of Australia.

*Alignment with NESP Research Priorities*

The project aligns with the following NESP Research Priorities: a) supporting national approaches to marine planning including research to support evidence-based decision making and b) building national capacity for monitoring and reporting on coastal and marine species and ecosystems.

**Research**

*Description of research*

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*

The research is linked to other NESP projects including the fine-scale mapping of shelf reefs, which will release a consistent fine-scale dataset of shelf topology, and the NW ecosystem modelling.

*Related 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*

* Enhancing Australia’s capacity to spatially manage its extensive marine domain.
* Prepare Australian Governments for a future best-practice reviews of the existing bioregionalisation products and review of marine spatial planning and management approaches (e.g. decadal review of CMR network management plans), 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.
* 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 and the marine life protected in deep water reserves off Australia’s east coast.

*Specific management or policy outcomes*

Reviews of marine spatial planning at regional or national levels (e.g. decadal review of Commonwealth Marine Reserve Network Management Plans, future reviews of Australian Government marine bioregional plans and future reviews of natural heritage values)

*Value*

In the marine environment, where seascapes cannot be viewed and appreciated directly, surrogates such as maps, specimens and images are essential for conservation planning and communication with the general public. The quality of the spatial analyses can be progressively measured by comparing maps derived from differing biological datasets and methodological approaches.

**Planned Outputs**

* Report evaluating the usefulness of phylodiversity (genetic diversity) to spatial marine planning (2015)
* Report outlining extensions of known statistical approaches to be able to utilise available mixed-resolution biological data (including museum and historical data) for the production of best-evidence bioregional maps (2015)
* Report evaluating the usefulness of connectivity (current) models to spatial marine planning (2016)
* Report including description and images of deep-sea biological communities of the east coast, including the CMR network, on a scheduled November 2016 expedition of the NMF ‘Investigator’ (mid 2016-7). This survey will result in significant media 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’ (mid 2017-8 – to be confirmed)
* 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 bathymetry (provided by the shelf mapping project), acoustic and water movement data (2019 – to be confirmed).
* Bioregionalisation of a test invertebrate dataset that focuses on smaller fauna of shallow-water estuarine and bay habitats (2016-8) – PhD project.

**Delivery of Project**

*Project leader’s track-record*

Tim O’Hara has participated in the CERF marine biodiversity hub as a researcher, and in the NERP hub as a project leader and researcher. He has participated in numerous Government processes (e.g., SOE, bioregionalisation) and committees (e.g., marine introduced pests, bioregional planning, fishery management, research management) at various levels of government. He chairs an international scientific working group on biogeography. He has co-authored over 60 scientific articles in peer-reviewed journals and numerous reports to government.

*Delivery on time and within budget*

• The project will be delivered on time and within budget by breaking it down into smaller tasks that can be completed within one year. The data for most tasks have already been collected, meaning that the project can focus on analysing and evaluating management recommendations.

**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** |
| Milestone 1: executive summary of phylodiversity evaluation task | 1 Jan 2016 |
| Milestone 2: executive summary of connectivity evaluation task | 1 Jan 2017 |
| Milestone 3: Report into the deep-sea biological communities of the east coast CMR network. | 1 Jun 2017 |

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

|  |  |  |
| --- | --- | --- |
| **Name/Organisation** | **Project Role** | **FTE** |
| Tim O’Hara, Museum Victoria | Project leader, researcher | 0.70 |
| Robin Wilson, Museum Victoria | Researcher | 0.30 |
| Andrew Hugall, Museum Victoria | Post-doc | 0.50 |
| Skipton Woolley, University of Melbourne | PhD student | 0.50 |
| Lupita Bribiesca, University of Melbourne | PhD student | 0.50 |

**Partner contributions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner** | **NESP $$ requested** | Cash contribution | **Co-investment** |
| Museum Victoria | $420,000 | - | $1,053,093 |

**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)** |
| DoE Parks Australia | Amanda Parr |
| DoE Wildlife, Heritage and Marine Division (Natural Heritage) | Tania Laity |
| DoE Wildlife Heritage and Marine Division (Domestic Marine Policy) | Nicole Coombe |
| State Governments (marine spatial planning) | Various (e.g. Bob Creese from NSW Government, Kim Friedman WA, Lawrence Ferns, Vic) |
| **Key Stakeholders (organisation/programme)** |  |
| As above |  |

**Knowledge Brokering and communication**

We will work in collaboration with the end-users and stakeholders to develop a shared understanding of the project and how it incrementally steps towards an improved bioregionalisation to inform marine spatial planning at national and regional scales. We will also discuss with stakeholders the options for tailoring the structure and content of the research outputs to ensure that the findings are communicated effectively and key messages are understood. Effective engagement with DoE will be important, particularly in developing a shared understanding about how research in this area can inform future reviews of Commonwealth Marine Reserve Network Management Plans (Amanda Parr), reviews of marine bioregional plans for Commonwealth waters (Nicole Coombe) and assessments of natural heritage values (Tania Laity).

We will work closely with key stakeholders in preparing communication products, such as media releases, arising from bio-discovery fieldwork, this will be particularly important in the lead up to and post collection of biodiversity data for the deep-sea regions of the east coast CMR network

**Expenditure Summary**

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.

**Location of Research**

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 around within the Christmas Is/Cocos Keeling Territories.

**Indigenous Consultation and Engagement**

Indigenous communities will be consulted if any native title claims overlap with proposed fieldwork.

**Inclusions (in scope)**

Preparation of data layers, evaluations and methodologies to support best-practice bioregionalisation in Australia’s marine domain.

**Exclusions (out of scope)**

A formal replacement of the existing bioregionalisation (IMCRA5).

**Risks**

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 next application round.

**Project Keywords**

Spatial management, bioregionalisation, connectivity, phylodiversity, deep-sea

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)