Annual Work Plan

National Environmental Research Program (NERP)

MARINE BIODIVERSITY HUB

January 2014 – December 2014

Contents

Introduction

The National Environmental Research Program (NERP) is an Australian Government program that provides funding for applied public good research. It builds on the Commonwealth Environment Research Facilities (CERF) program with a specific focus on biodiversity.

The program's objective is: To improve our capacity to understand, manage and conserve Australia's unique biodiversity and ecosystems through the generation of world-class research and its delivery to Australian environmental decision makers and other stakeholders.

As the NERP research activities span several years, the Annual Work Plan (AWP) is the key document for defining, justifying, budgeting for and scheduling activities on an annual basis. It relates directly to the Hub Multi-Year Research Plan (MYRP) which broadly describes the scope of the research work program over four years (July 2011-December 2014).

The Annual Work Plan is an annual planning tool for research administrators, researchers, communications staff and Australian Government staff. Other interested stakeholders may be non-hub researchers (seeking collaborations), industry and other end users, government and non-government organisations and the general public (seeking information on the Hubs).

For the Hub, the Annual Work Plan:

- provides a management tool for the Leader and teams including outlining the projects and activities planned and their timing

- links outputs and outcomes with monitoring and evaluation

- links to Australian Government Environment Portfolio policies and programs and end users

- provides the basis for reporting progress of Hub activities, for example when the current status of a project is compared to what had been foreseen in the work plan and

- provides for opportunities to present a visual outline or illustration of the sequence of projects. This can facilitate presentations and negotiations concerning the projects.

The primary audience for the AWP is the Department of Sustainability, Environment, Water, Population and Communities (DOTE) and the Hub with its researchers.

Each Annual Work Plan provides an implementation plan for the coming year and provides:

- justification, if required, for the proposed program of work,

- a detailed work plan, describing and scheduling activities, links to end users and expected outputs, outcomes and benefits,

- a budget that sets out the costs of implementing the work,

- a check-point to ensure the monitoring and evaluation plan is current, or updated as appropriate,

- a check-point to ensure the communication plan is current, or updated as appropriate, and

- a review and update of the risk in relation to functions and activities (see Attachment A – Risk).

This Annual Work Plan will cover the period between January 2014 to December 2014. It should be read in conjunction with the Multi-Year Research Plan.

- This template comprises of:

- This covering document,

- Part A – Hub Administration Activities,

- Part B – Hub Knowledge Brokering and Communication Activities,

- Part C – Hub Projects, and

- Part D – Staff, Income, Expenditure Finance Tables and

    - Attachment 1 – Risk

    - Attachment 2 – Monitoring and Evaluation Plan (where necessary)

    - Attachment 3 – Communication Plan (where necessary)

Endorsement and Approval of the Annual Work Plan

Each year the Hub prepares the first draft of the annual work plan, based on the Multi Year Research Plan, and finalises this plan after endorsement by the Hub Steering Committee. The endorsed AWP should then provided by the Hub Leader to the DOTE for approval.

If the AWP involves significant changes to the scope of the Hub and planned projects as outlined in the Multi Year Research Plan, then Ministerial approval will be required to modify the Multi-Year Research Plan.

DOTE must give final approval of the AWP to the Hub Leader, authorising the Hub Leader to implement the AWP.

Overview of 2014 Annual Work Plan

Research activity in the Hub is at a peak, with all projects underway and early results arriving. The 2011-12 AWP had a large component of preparation and developing the agreed projects with DOTE to ensure they matched the Department's needs. Scientific results started to show in 2013. Further results will appear in 2014 with all major science activities being completed by June 2014 and the second half of the year focussed on project and theme reporting, including the preparation of journal articles. It will be particularly important in 2014 to match the presentation of scientific results to

Departmental programs, priorities and timelines. Important components of the 2014 AWP include:

- Make the best us of collaborations that have been developed between projects, themes, Hubs and agencies, to deliver relevant information and guidance that has a broad base of support;

- Focus science outputs and products on the questions of most interest to the Department and other partner agencies;

- Following Departmental request, extend the monitoring blueprint from an exclusive focus on ecosystem health and the CMR network to include all the Department's marine monitoring needs. A new project has been added to Theme 1;

- Identify opportunities for high profile scientific papers and communication opportunities, especially those that match the partners' strategic research interests and contribute to the collaborative effort;

- Continue to build engagement with the Department and between the Department and other partners to increase understanding of individual capabilities and potential in supporting Departmental priorities;

- Continue to build the nodes of the collaborator's network so that scientific outputs increase in their relevance to the broader marine science and management communities;

- Ensure that data and information products are ready for archiving in an accessible and secure environment;

- Continue to identify and build support for further scientific research and capacity building that would support Departmental decision making in the NERP program or any successor.

Theme-specific highlights of the 2014 AWP follow:

Theme 1: National Monitoring, Evaluation and Reporting

Project .1.1: Collation and analysis of existing data sets

This project is focussed on identifying, accessing and analysing data that can be used to monitor Key Ecological Features (KEFs) as part of national-scale marine ecosystem health, and identifying and accessing data relevant to monitoring the Commonwealth South East Marine Reserve network.

In 2014, this project will complete a data catalogue of existing data sources for at least one KEF; extend the SE CMR network catalogue developed with CSIRO to include data from GA, AIMS and UTAS; continue to progress a national analysis of existing data sources with IMOS and AODN; and, continue to develop and apply new statistic models to identify reliable trends in the collected data.

A risk to achieving full success in this project is the differences between the data delivery of the main partners complicating their interpretation through AODN and the

3

lack of specific search options in AODN. It has proven necessary to work with individual partners to obtain detailed data searches – an approach has been developed with CSIRO and is now being replicated at AIMS, GA and IMAS. This will provide the most relevant national survey data, but depends on each institution's data structure, and is unlikely to be automatically updated. We will also work with the Hub's main partners and AODN to see whether it is possible to develop a single nationally consistent data delivery standard, and the tools to access these data to meet DOTE's needs. The risk that is entailed with the time taken to realize satisfactory data extraction and assimilation is being managed by increasingly focussing on the survey data that will be most relevant to long-term monitoring.

The development of new statistical models and analyses is ambitious and may require prioritisation to achieve clear outcomes by December 2014. Some of the major model development is being undertaken by PhD students whose term extends beyond the final report for the Hub.

There has been some expectation creep in this project with the intention to develop a national blueprint for marine monitoring that addresses DOTE's general management needs (ie. more than CMRs and KEFs). This is being discussed with DOTE and will be managed by the Deputy Director – see Theme 5.

Project 1.2: Analysis of approaches for monitoring biodiversity in Commonwealth waters

The project has designed and implemented ways to integrate new and existing survey and monitoring methods at three locations: the Flinders CMR, the coral/kelp KEF to the east of the Houtman-Abrolhos islands and the shelf KEF and Commonwealth Reserve south of the Solitary Islands. All field surveys are now complete.

In 2014, this project will be analysing and reporting on the results obtained from these surveys, and in particular: recommending an approach for monitoring the CMR network that meets DOTE operational objectives; assessing gaps in data available for reporting nationally on marine ecosystem health; and, identifying the capacity mobilization and/or capacity building necessary to achieve these outcomes.

This project is proceeding well. The number of partners involved and the diversity of research will require effective coordination through regular progress meetings.

New Project 1.3: Blueprint for monitoring marine ecosystems of the EEZ

Developments in 2012/13 with integrated monitoring for the GBRWHA, and expectation creep in Theme 1 project 1 (to extend beyond contributing to two blueprint for marine monitoring for CMRs and KEFs) has brought us to a point where it makes sense to develop a single blueprint for marine ecosystem monitoring that will consider a broader range of DOTE's marine program and decision making needs. The development of the blueprint will be treated as a new project in Theme 1 and managed by the Deputy Director.

Adding this project to the Deputy Director's workload does have its risks in less time being available for knowledge brokering in general, however this project represents a key deliverable requested by the Department that will draw together numerous research outputs from all the Hub's research themes, and following our experience

with the GBRWHA Integrated Monitoring Framework project, it makes sense and is manageable.

Theme 2: Supporting Management of Marine Biodiversity

Project 2.1: Integrating social, economic and environmental values

This project will provide knowledge and advice regarding the economic and social dimensions of marine conservation in complex multi-jurisdictional and multi-sectoral environments. This will be achieved through three related activities:

- Supporting the development of a monitoring strategy for the Commonwealth South-east marine reserve network

- Valuing marine biodiversity

- Understanding the role of incentives including offsets in marine conservation and management

In 2013 this project will continue working with DOTE to develop a framework and set of guiding principles for identifying performance indicators and allocating monitoring resources in the SE CMR. It will prepare two papers on the existing use and potential of market-based incentives in the marine environment and conduct with DOTE two case studies illustrating the application of marine offsets. Finally, it will report on three surveys that investigate how public values might affect their acceptance of primary offsets, acceptance of alternative offsets, and the use and influence of economic valuation in coastal and marine decision-making.

After a delayed start, resulting from the need to jointly identify research priorities with DOTE, this project is now on track. The loss of a key researcher, Olivier Thebaud to France, has been managed and an EO has been appointed to facilitate workshops and meetings. The main risk to this project is a change to the DOTE policy environment with a new government. This risk is being managed through regular contact with departmental personnel.

Project 2.2: Integrating threats, values and assets for management

This project will bring together existing data and information on key threats to marine biodiversity. The link between threats and biodiversity values will be identified for simple one to one relationships and then expanded to consider multiple threats on biodiversity values. Several approaches will be taken to link threats and values and tested against data. Finally, cumulative threats will be mapped. The project has also taken on shared responsibility for developing the data management plan for the Hub.

Data management workflow and metadata tools were supplied to all Hub researchers in 2013; these will be actively used in 2014 to provide secure archival and access to the Hub's data products. National pressure layers will be made available through AODN and a framework for assessing cumulative risks and impacts will be developed in collaboration with Theme 1 Project 1.

This project is on track with national pressure maps being delivered to AODN and one application of the cumulative risk model in a data rich environment. The main risk in

2014 is that there will be insufficient data in the other areas (ie. the Northwest) to link pressures and biodiversity especially through cumulative impacts.

Project 2.3: Landscape approaches to managing high conservation priority species(Task 1) and values (Task 2)

This project focuses on integrated management solutions to key threatened groups and habitats including on and off reserve management. Task 1 focuses on the Australian chondrichthyan fauna, which is at risk from a variety of human uses, particularly fishing. Task 2 focuses on the benthic impacts and recovery in the South East Marine Bioregion.

In 2014, Task 1 will complete refined species distribution maps for sharks and rays in South-east Australia, including nursery, foraging and migration corridors. It will also provide a preliminary analysis of off and on reserve management options using the ecosystem model Atlantis. Task 2 will complete cataloguing and mapping relevant data sources for actual and predicted benthic biodiversity, human use and management. It will use these new maps and a previously developed model capable of representing risk to benthic habitats to evaluate the effect of alternative management options in the South East Marine Bioregion.

This project is on track. The key risk to be managed in 2014 is that both tasks use sophisticated interpretations of existing data. The robustness of their outputs will depend on the quality of that data. The risk will be managed by reporting uncertainties in any conclusions.

Project 2.4: Supporting management of listed and rare species

This project will develop innovative methods to assess the population status of data-poor, low abundance, rarely-encountered, threatened euryhaline and estuarine elasmobranchs in order to inform conservation and management of these species. The initial focus was the largetooth (previously freshwater) sawfish in the NT with key river systems being the Daly, East Alligator, South Alligator and Victoria Rivers, however low capture rates led to the focus being expanded to include the speartooth shark *Glyphis glyphis*.

Acoustic telemetry (including updated methods for determining range and habitat use) and close-kin genetics are the major methods being applied, and 2014 will provide continued field efforts on these approaches as well as initial results and evaluation. An expert workshop will be held to provide to DOTE an evaluation of management options for data-poor, rarely encountered, threatened species.

This project is proceeding well and in 2013 managed the risk of being unable to catch sufficient largetooth sawfish by expanding the sampling to include speartooth shark. The major risk to this project is that insufficient samples will be obtained by the end of this project to reliably estimate population parameters. This risk will be managed in three ways: first, identifying opportunities to continue data collection and analysis past the end of this project; second, by ensuring that analytical approaches are completed by the end of the project; and third by holding an expert workshop to identify management options before the end of the project.

Project 2.5: White shark population and abundance trends

In mid 2013, the Hub was granted $500,000 under the Emerging Priorities funding for a new project to develop estimates of the abundance and population trends of white sharks in Australian waters initially focussing on the eastern Australian population.

Work in 2014 will complete the Port Stephens tagging and aerial survey program. A tagging study in SE Victoria will be started in June 2014. A close-kin population estimation program will be well underway by the end of 2014 with an initial population estimate for the eastern Australian white shark population provide together with an assessment of the effectiveness of the close-kin and, tagging and aerial survey approaches.

This project is just starting in 2013 but builds on a decade or more of smaller field studies. The major risk in this project will be in managing expectations as the most substantive results will result from data collected in years beyond 2014. This risk has been managed through discussing key dates and deliverables with DOTE.

Theme 3: National Ecosystems Knowledge

Project 3.1: Shelf and canyon ecosystems – functions and processes

Physical features on the continental shelf and in submarine canyons were identified as important areas for biodiversity in marine regional plans. However, we lack a detailed understanding of the influence of physical features and associated oceanographic processes on patterns of biodiversity across the shelf and in the vicinity of canyons. This project will provide a better understanding of these linkages for targeted areas in Northern Australia through integrated analysis and modelling of available physical and biological datasets and nationally for canyons using available data.

In 2013, this project will produce a national summary of the physical characteristics and biodiversity potential of Australian submarine canyons and adjacent slope areas. This summary will be complemented by a continental scale connectivity model, and a description of large-scale relationships between pelagic biodiversity and canyon distribution. There will be a NW focus to the outputs which will include analysis of the Oceanic Shoals CMR survey. Results will be prepared as fact sheets to facilitate their use by DOTE in addition to referred journal publications.

This project is on track to deliver a plethora of interesting results. The key risks to this project result from an ambitious set of deliverables and the need to ensure that these deliverables are in a format that will have impact with DOTE. This risk is being managed through regular meetings between project partners and a product delivery schedule.

Project 3.2: National maps of connectivity and biodiversity

There are few national maps of biodiversity for the Australian marine environment. Consequently, biological assessments of MPAs, KEFS and areas of economic interest have to be conducted without comparable data from other regions. This project will take advantage of recently developed and upgraded biodiversity databases, supplemented with new genetic information, to map hotspots of biological and genetic diversity, explore potential changes to faunal compositions under climate change and

assign relative values to marine assets. The research products will inform conservation management at medium to large scales.

In 2014, this project will complete mapping of seafloor phylogenetic endemism, complete mapping of seafloor species richness and turnover for two invertebrate groups, prepare a national atlas of connectivity and biodiversity and identify hotspots of distribution and endemicity for Australian demersal sharks, rays and selected teleosts.

This project is on track to exceed initial expectations due to its extension to include global museum collections. A risk for this project is that although it will have a high international scientific profile, it may not have immediate uptake by DOTE. The Deputy Director will help manage this risk by working with the scientists to ensure that outputs are presented in a way that has clear value to DOTE managers.

Theme 4: Regional Biodiversity Discovery to Support Marine Bioregional Plans

Project 4.1: Twenty-one day RV Solander survey

Marine habitats in Northern Australia host globally significant biodiversity. This biodiversity faces rapidly increasing pressures from human activities, while extensive regional-scale knowledge gaps threaten to compromise efforts to conserve and manage it. This project will begin to fill these knowledge gaps in one of the most poorly known regions, the Oceanic Shoals Marine Reserve, by mounting a voyage-of-discovery to this region where extensive sampling of both the physical environments and biological communities will be done. The information from this cruise will support the research goals of the other three themes in the Marine Biodiversity Hub.

The survey was completed in the 2012. 2013 was spent analysing and reporting on the data collected and extending the value of the information obtained by accessing data from similar surveys in the two bioregions. In 2014, a baseline characterisation of the Ocean Shoals CMR will be provided to DOTE, and the metadata and/or data will be uploaded to the Hub website and AODN. Data analysis will be continued in Theme 3.

This project is on track to deliver (with Theme 3) a clear baseline characterisation of the Oceanic Shoals CMR. No high risks are identified, but it will be important to be realistic about what can be achieved from a single survey of this large area. This risk will be managed through early communication with DOTE.

Theme 5: Science and Policy Initiatives

The single project in this theme – *Great Barrier Reef World Heritage Area (GBRWHA) Integrated Monitoring* Framework project – was completed successfully in 2013 and no further research led by the Marine Biodiversity Hub is anticipated in 2014 for this project.

Monitoring and Evaluation Plan

See Attachment 2 for the Monitoring and Evaluation Plan. Minor refinements may be required in 2014.

Communication Plan

See Attachment 3 for the Communication Plan. Minor requirements may be required in 2014.

NERP Emerging Priorities or other Australian Government Funding

The Hub is partnering CSIRO, DOTE, WHOI, NOAA Marine Sanctuaries Program, USNPS and the Marine National Facility on a 52-day *Interdisciplinary investigation of Coral Sea Deepwater Shipwrecks and their Environment* in May/June 2015. The MNF ship time represents an investment of $4.18M and the US team are now approaching their government and private foundations to generate a similar amount which will be needed to supply 4-6 deepwater AUVs, one deepwater ROV and potentially a second support vessel.

At least $1M (fully matched) will be needed for the collection and analysis of the data from this survey. NERP Emerging Priorities funds are one source of funding that needs to be explored.

Part A: Marine Biodiversity Hub Administration Activities

Annual Work Plan 2014

Administration Activities Leader: Vicki Randell
Organisation: UTAS
Total NERP Budget (ex GST): No NERP funds are used for administration activities
Total 2014 Non-NERP Cash/In-Kind Budget (ex GST): $459,602
UTas 2014 Scholarships Budget (ex GST): $313,861

Activities and Milestones in 2014

Milestone 9 (Due 1 April 2014):
- The following are provided to and accepted by the Department:
- Progress Report 6 and associated financial report (period covered: 1 July – 31 Dec 2013)
- Annual financial report for 2013 calendar year

Milestone 10 (Due 1 October 2014):
- The following are provided to and accepted by the Department:
- Progress Report and associated financial report (period covered 1 Jan – 30 June 2014)

Reporting

- Preparation and submission of Progress Reports – 6-7

Finance

- Overview and management of annual budgets – cash and inkind contributions

- Payments to Research Organisations and payment of Research Organisation invoices

- Organisation of 2013 annual audit report.

Legal

- Liaise with DOTE, partner organisations and UTas legal office as required, eg for contract variation approvals.

Governance

See [Governance](#) on website for current listing of Steering Committee and Research Leadership Team.

Roles and responsibilities of all committees, executive and management roles in the Hub have been defined in the Roles and Responsibilities document that has been endorsed by the Steering Committee and is available on the website.

Paul Hedge has joined the Hub on secondment from the Marine Division (DOTE) as Deputy Director with communications, knowledge broking, and data management as his primary duties.
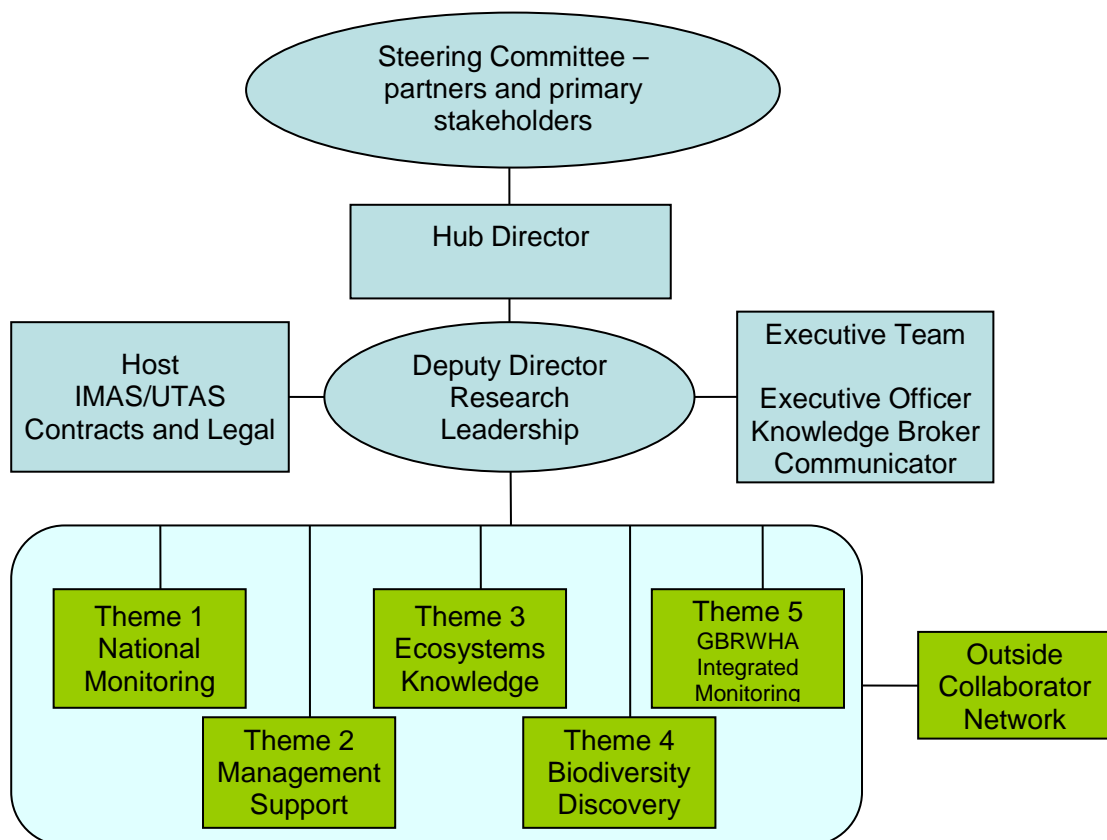
Steering Committee

The **Steering Committee** consists of major stakeholders (DOTE, AFMA, APPEA, IMOS, a member of the NERP Secretariat, an independent chairman elected by the committee, and senior representatives of major partners.

The Hub Director reports to this committee, which meets twice a year to oversee Hub progress and reporting, and hold an annual strategic review of the Hub.

The Steering Committee approves reports to be provided to the NERP Secretariat.

Research Leadership Team

The **Research Leadership Team** consists of Theme Leaders, Project Leaders, partners (optional), the Director, Deputy Director/Knowledge Broker, and Communication Support Officer.

The Leadership Team meets monthly via teleconferences for administrative matters and progress updates, and twice a year for review, reporting and planning.

The Research Leadership Team prepares reports for Steering Committee approval.

Key Risks in 2014 and Risk Management Strategy

Loss of key staff - Larger organisations have capabilities to fill key gaps. Regular meetings and reporting means that key information will not be lost.

Reporting timetable not met - any administrative or governance issues to be raised and discussed in weekly meetings held between Director, Deputy Director and Executive Officer.

Financial probity not met - Annual accounts audited

Part B: Marine Biodiversity Hub Knowledge Brokering and Communications Activities

Annual Work Plan - 2014

Knowledge Brokering and Communication Leader: Paul Hedge

Organisation: University of Tasmania

Total 2014 NERP Budget (ex GST): $400,889

Total 2014 Non-NERP Cash/In-Kind Budget (ex GST): $495,324

Hub Knowledge Brokering and Communication

Activities undertaken in 2011-13 have provided a firm base to continue the Hub's approach to knowledge brokering and communication activities in 2014. Activities will continue to be generally guided by the Science Communication Plan (attached) and Monitoring and Evaluation Plan (attached). The following are primary work areas for 2014:

- Shaping, delivering and communicating the Hub's research outputs to meet the needs of DOTE and other primary stakeholders;

- Continuing to improve engagement between the Hub and DOTE, particularly at SES and cross divisional levels, to ensure priorities and needs are met;

- Enhancing the profile of the Hub and the importance of its research outputs to inform the Minister, DOTE, other primary stakeholders, research community and the public;

- Providing public access to Hub data and leadership for public access to marine biological data via the AODN; and

- Refining the Hub's systems and approaches for communicating and reporting on Hub's outputs and project impact, in particular through development of Hub's final report.

- Defining the scope and content of the Hub's final report and obtaining final project reports from each theme and project leaders.

Knowledge brokering will build capacity in the science policy interface by ensuring data and information are shaped and delivered for a shared understanding between the Hub and DOTE. Established communication mechanisms (e.g. Hub Research Leadership Team meetings, NERP Communicators meetings, fortnightly Hub/DOTE meetings and regular communications between the Hub and DOTE) will continue to be important means for effective knowledge brokering. The product delivery schedule will be used to raise awareness and increase certainty about development, delivery and communication of the Hub's research outputs.

The Hub will build on work undertaken in 2011-13 on its branding position and key messages to refine its approach to communications to enhance its profile and the importance of its research. Use of media releases, newsletters, the website, publications and sponsorship/leadership/attendance at workshops and conferences will continue to be important to enhance the profile of the Hub.

The Hub will continue to work with its partners and the AODN in 2014 to establish the necessary processes and tools to ensure the Hub's data are made available to the public. The Data Management Framework for the Hub will be implemented and refined as required.

The Hub will continue to implement its Monitoring and Evaluation Plan. The Hub will work closely with its scientists, DOTE and other key stakeholders to identify and communicate the impact of its research. This will include work to scope the Hub's final report including final project reports from each of the Hub's themes and projects.

Key Outcomes in 2014

- Enhanced profile for NERP Marine Biodiversity Hub with the Minister, DOTE, research community and public

- Increased capacity to understand and meet DOTE and other primary stakeholder needs

- Shared understanding about project outputs and delivery times with DOTE and other primary stakeholders

- Improved public access to biological data for marine environment through AODN

- Shared understanding between Hub and DOTE about project outputs and impacts

Key Outputs in 2014

- Updated Science Communications Plan (minor refinements)

- Updated Monitoring and Evaluation Plan (minor refinements)

- Updated Data Management Framework (ongoing refinements as required)

- Stakeholder and cross disciplinary workshops

- Metadata records published on AODN Portal

- Product Delivery Schedule (ongoing refinements as required)

Activities and Milestones in 2014

- Engage DOTE and Hub scientists to refine the Product Delivery Schedule (ongoing)

- Revise Science Communication Plan and Monitoring and Evaluation Plan to incorporate refinements (ongoing)

- Engage with Hub partners and scientists, AODN and DOTE to implement, and where necessary refine, the Hub's Data Management Plan (ongoing).

- Convene triennial meetings with members of the DOTE SES and project contacts (ongoing)

- Engage in fortnightly meetings with Hub/DOTE coordination contacts (ongoing)

- Engage in monthly meetings with NERP Communicator Group (ongoing)

- Provide NERP progress reports to DOTE – as required under contract (April and September 2014)

Key Risks in 2014 and Risk Management Strategy

- Loss/replacement of key staff - the Deputy Director provides leadership for knowledge brokering and communication. The Deputy Director is seconded from DOTE to the Hub. The secondment agreement extends to the end of Jan 2014. Management strategy - the Director and Deputy Director will meet with DOTE in the last quarter of 2013 to consider options and agree on a succession plan before the end of 2013.

Links and Dependencies to other Hubs and projects

- Monthly meetings with NERP Communicators

Part C: Marine Biodiversity Hub Projects and Themes

Annual Work Plan 2014

Theme 1: National Monitoring, Evaluation and Reporting

This theme will contribute towards a blueprint for national marine monitoring, originally focussed on a) a sustained national environmental monitoring strategy designed to evaluate marine ecosystem health, and b) a sustained monitoring strategy to help manage the Commonwealth Marine Reserve Network (focussing on the Southeast Marine Region), but extended at the Department's request in 2014 to include all their major marine monitoring needs. This research aligns broad strategies in the Marine Bioregional Plans and with a number of research priorities identified by the Marine Division of DOTE. It will facilitate closer liaison between federal agencies such as DOTE, BOM, and DIISR, and state agencies responsible for the management of Marine Protected Areas (MPAs), to identify the data infrastructure requirements and logistical/statistical constraints of a sustained national marine monitoring strategy.

Outputs from this theme depend critically on and are contingent upon, results from existing research in the Southeast Marine region, and results from new research in Theme 2 (project 1) to assist definition of operational objectives for the Commonwealth Southeast Marine Reserve Network.

There are two original and one new project in this Theme:

1. Collation and analysis of existing data sets
2. Analysis of approaches for monitoring biodiversity in Commonwealth waters
3. Blueprint for monitoring marine ecosystems of the EEZ

Projects 1 and 2 are managed by the Theme leader with the assistance of senior project research staff. Project 3 will be managed by the Hub's Deputy Director. The theme has monthly (Project 1) and fortnightly (Project 2) phone meetings to exchange information and review progress (Project 3 TBD). These meetings are augmented by additional half-yearly whole of project and/or whole of Theme meetings.

Theme Leader: Keith Hayes

Organisation: CSIRO

Total NERP Budget (ex GST): $ 2,938,408
2014 NERP Budget (ex GST): $57,394

Total Non-NERP Cash/In-Kind Budget (ex GST): $3,928,887
2014 Non-NERP Cash/In-Kind Budget (ex GST): $114,914

Project 3 has been added at no additional cost to the Department
(the budget does not include additional in-kind support from Hub collaborators e.g. NSW DECC and OEH, WA Fisheries and IMOS)

16

Project 1.1: Collation and analysis of existing data sets

Continuing project

Project Leader: Keith Hayes

Organisation: CSIRO

Total NERP Budget (ex GST): $1,194,184

2014 NERP Budget (ex-GST): $30,637

Total Non-NERP Cash/In-Kind Budget (ex GST): $1,582,952

2014 Non-NERP Cash/In-Kind Budget (ex GST):$83,004

Project Description

Project 1 will:

1. Source and analyse available relevant data sources to validate predictions associated with KEF indicators for national-scale marine ecosystem health;

2. Develop new techniques to analyse time series data for seasonality, change point and trend detection;

3. Source available data relevant to the operational objectives for the Southeast Marine Reserve Network (ie. in collaboration with Theme 2 Project 1), a process that will be relevant to Marine Reserve Networks in all bioregions; and,

4. Include an analysis of available data to identify gaps and propose a way forward for meeting the data requirements for reporting on national-scale ecosystem health and managing the Southeast Commonwealth Marine Reserve Network.

Key Researchers

The key researchers in Project 1, together with their institution and roles, are:

1. Keith Hayes, CSIRO - Project leader, data analysis
2. Jeffrey Dambacher, CSIRO - Qualitative modelling, data collation and analysis
3. Geoffrey Hosack, CSIRO - Statistician, data analysis and methods development
4. Emma Lawrence, CSIRO - Statistician, data analysis and methods development
5. Julian Caley, AIMS - Senior biologist, data analysis and methods development
6. Hugh Sweatman, AIMS - Biologist, data collation and analysis
7. Camille Mellin, AIMS Postdoc - data analysis and methods development
8. Neville Barrett, UTAS - Senior biologist, data collation and analysis
9. Rick Stewart-Smith, UTAS - Biologist, data collation and analysis
10. Gary Kendrick, UWA - Senior biologist, data collation and analysis

Problem Statement

The Australian Government is unlikely to be able to support sustained ecological monitoring, at a scale necessary to monitor the health of Australia's EEZ and manage the Commonwealth Marine Reserve Estate, without integrating, and leveraging off, the monitoring and survey resources of different departments and institutions. Project 1

will catalogue and collate existing data sets, and evaluate their suitability as the basis for a sustained national marine monitoring system that is capable of collecting indicator data to evaluate marine ecosystem health and manage the CMR estate in the south east marine planning region. The project will attempt to source and analyse relevant data sources to (in)validate predictions associated with KEF and/or CMR indicators in a fashion that is consistent with DOTE objectives for ecosystem health monitoring, management of the CMR estate and the Marine Environment Reporting Framework (MERF). The project will also develop new multivariate State Space Modelling techniques (that allow for the confounding effects of observation error) to complement analysis with traditional time series methods for seasonality, change point and trend detection.

Outcomes

The expected outcomes of Theme 1 are:

1. Improved reporting on national-scale marine ecosystem health for input to the 2016 SoE report, based on access to the relevant data analyses (within limits of existing data);

2. Improved choice of marine ecosystem health indicators through a review of existing indicator analysis methods, together with their strengths and weaknesses, and the application and development of new methods; and,

3. Development of a long-term plan to improve national marine ecosystem health through identifying the need and opportunities to mobilise national capacity to provide the required data (especially IMOS and NPEI).

Outputs (products and services) in 2014

Whole of project and specific 2014 outputs are:

1. Identify the evidence-base/data requirements for managing the Southeast network of Commonwealth Marine Reserves and by extension networks in other bioregions. Specific 2014 output:

    i. SE CMR network catalogue has been completed for data sets held in the CMAR data warehouse. In 2014 we will attempt to replicate this for data sets held by Geosciences Australia (GA), the Australian Institute of Marine Science (AIMS) and Institute for Marine and Antarctic Science - UTAS (IMAS).

2. Identify the evidence-base/data requirements to evaluate and report on national marine ecosystem health. Specific 2014 output:

    i. complete at least one KEF catalogue of existing data sources listing the metric, observation platform, location, start and end of time series and frequency of observations

3. Data analysis (within limits of existing data) to inform national-scale marine ecosystem health input to the 2016 SoE report. Specific 2014 output:

ii. continue to progress a national analysis of existing data sources listing the metric, observation platform, location, start and end of time series and frequency of observations with a report on progress by the end of 2014.

4. Develop and where possible apply new and existing statistical models for multivariate trend and change point detection with and without observation error: Potential outputs in 2014 (completion of some outputs may be deferred until 2015 depending on the degree of technical challenges to be overcome):

iii. Existing models: Application of GLM and GLMM methods to the Reef Life Survey, Long Term Reef Monitoring Programme (LTRMP) and/or Temperate Reef Monitoring Data (TRMD) set.

iv. New models: development and application of compound processes for discrete and continuous variables.

v. Empirical indicators, new models: possible application of new compound process models for modelling size spectra.

vi. Existing models: application of state space models (incorporating detection probability) to LTRMP data sets.

vii. Methods review: what are the data requirements for more complex hierarchical models and/or state space models?

viii. New models: consider the application of Markov Decision Processes to statistical process control analysis.

ix. New models: development and application of regime switching and change point models.

Activities and Milestones in 2014

Project milestones in 2014:

1. Ongoing milestone: Catalogue of existing data sources and their relevance to KEFs and/or CMRs in the south east marine planning region;

2. Ongoing milestone: Identification and prioritisation of key data gaps for a sustained national marine environmental monitoring;

3. Ongoing milestone: Development and where possible application of new and existing statistical models for multivariate trend and change point detection with and without observation error;

4. Ongoing milestone: Progress report on results to date including a presentation to DOTE to provide opportunity for feedback and input to final year's research (for projects 1 and 2);

5. Ongoing milestone: Report list of proposed publications and authors (June 2014); and

6. New milestone: Provide input to Hub final report in approved template (Dec 2014).

Expected Benefits

The short, medium and long term benefits of Project 1 (in conjunction with Project 2) are as follows:

- Short term: Greater understanding and alignment between institutional and government department environmental information needs and priorities

- Medium term: Greater understanding of the logistical and statistical resources required to monitor the effectiveness of individual CMRs and a network of CMRs.

- Medium term: Prioritisation of future infrastructure needs to meet the objectives of a sustained national environmental monitoring strategy for the South East Commonwealth Marine Reserve network and ecosystem health assessment of Australia's EEZ.

- Long term: Statistical and logistical foundation for the first assessment of marine ecosystem health of Australia's EEZ.

- Long term: Status and trend reporting for SoE 2016 from relevant extant datasets.

Key Risks in 2014 and Risk Management Strategy

1. Unable to replicate data catalogue search utility in either individual institutions (GA, AIMS, IMAS) or AODN.

2. Not meeting milestones: managed by regular project progress meetings

Research Questions (Environment Portfolio)

Project 1 contributes to the following NERP research questions

2.1 How can we improve our capacity to understand, monitor and evaluate ecosystem function/health, including by using predictive models/tools, to ensure:

- key ecosystem functions can be understood and maintained through effective management

- threats to values, such as biodiversity or important ecosystem functions, can be detected

- trends can be monitored and tipping points/thresholds, that indicate species, population or ecosystem collapse, can be predicted, and

- which management actions are effective and timely, can their success be measured over time, and how can their relevance/effectiveness be evaluated as the environment changes (i.e. use of adaptive management systems)?

2.2 What are practical models for incorporating complex ecosystem science into management, e.g. through managing key drivers such as keystone species, core processes and human activities?

- What are the minimum data needed to determine the health of an ecosystem?

4.2 As land and marine use intensifies, how can we improve approaches to strategic environmental assessments of nationally important areas and regions?

4.4 How can Australia's marine environment be best managed to maximise ecosystem health, ecosystem resilience, and ecosystem goods and services?

Policies and Programs

1A Biodiversity Conservation;

1E Maintaining/building a Marine reserve systems and protected areas;

B1 Environmental Regulation;

B3 Protection and Management of Heritage Values;

C1 Antarctic Science and Environmental Management.

6A Environmental Reporting – SOE reporting, Marine Environmental Reporting Framework

Key Events and Dates in 2014

- Whole of NERP hub meeting in late 2014.
- Presentation of progress for discussion with DOTE late 2014

End Users

- Travis Bover, Director, Domestic Marine Policy, DOTE

- Barbara Musso, Director, CMR Policies and Programs Coordination, Parks Australia, DOTE

- Jason Ferris, Director, Environment Information, Policy and Reporting (SoE and NPEI), DOTE

- Martin Riddle & Andrew Constable, Australian Antarctic Division, DOTE

Links and Dependencies to other Hubs and projects

Collation of available data relevant to the operational objectives of the Southeast Marine Reserve Network is contingent on these objectives being identified by DOTE as part of Theme 2 Project 1.

Start Date and Duration (in months)

July 2011, 42 months

Project 1.2: Analysis of approaches for monitoring biodiversity in Commonwealth waters

Continuing project

Project Leader: Keith Hayes

Organisation: CSIRO

Total NERP Budget (ex GST): $1,744,224

2014 NERP Budget (ex GST): $34,044

Total Non-NERP Cash/In-Kind Budget (ex GST): $2,345,935

2014 Non-NERP Cash/In-Kind Budget (ex GST): $62,547

Project Description

Project 2 will:

1. Design, implement and test ways to integrate new and existing survey and monitoring methods at three locations: the shelf of the Flinders CMR in the Southeast IMCRA transition bioregion, the coral/kelp KEF to the east of the Houtman-Abrolhos islands and the east-coast shelf KEF adjacent to the Solitary Islands marine reserve,

2. Access existing CMR (and other MPA) monitoring datasets from the partners for the Southeast Marine Bioregion (i.e. Freycinet, Huon, Tasman Fracture and Zeehan CMRs and Maria Island MPA) and thereby attempt to extend the spatial coverage of survey and monitoring methods to include all depths and habitat-types contained in the Commonwealth Southeast Marine Reserve Network (excepting the abyssal plain),

3. Use these new and existing datasets to examine: a) economic and logistical issues, such as the costs and benefits (developed by Theme 2 project 1) of the survey methods, and the use of regular versus event-initiated surveys; and, b) scientific and statistical survey design issues, such as the choice of biodiversity metric and seasonal variation in species group indicators of ecological health, and their impact on the variance and bias of survey data and hence our ability to reliably detect change with these data.

Key Researchers

The key researchers in Project 2, together with their institution and roles, are:

1. Keith Hayes, CSIRO - Project leader, data analysis
2. Jeffrey Dambacher, CSIRO - Qualitative modelling
3. Emma Lawrence, CSIRO, Statistician, survey design
4. Russ Babcock, CSIRO - Senior Biologist, survey methods and design
5. Rhys Leeming, CSIRO - Senior Chemist, isotope survey methods
6. Alan Williams, CSIRO - Senior Biologist, deep water survey methods and design
7. Neville Barrett, UTAS - Senior biologist, survey methods
8. Nicole Hill, UTAS, Postdoc - Survey methods and design
9. Vanessa Lucieer, UTAS - Acoustic swath mapping

22

10. Gary Kendrick, UWA - Senior biologist, survey methods
11. Euan Harvey, UWA - Senior biologist, survey methods
12. Scott Nichol, GA - Senior research scientist, acoustic swath mapping

Problem Statement

The Commonwealth government needs to develop the capacity to undertake targeted and cost-effective data collection on a sustained basis in order to inform evaluations of marine ecosystem health and to measure the performance of the Commonwealth Marine Reserve Estate against stated objectives. Project 2 will examine the logistical and statistical issues associated with some non-extractive survey and monitoring methods that are likely to form key components of any sustained environmental monitoring strategy. The project will design, implement and test ways to integrate new and existing survey and monitoring methods at three locations: the shelf of the Flinders CMR in the South East IMCRA transition bioregion, the coral/kelp KEF to the east of the Houtman-Abrolhos islands and the east-coast shelf KEF adjacent to the Solitary Islands marine reserve. The project will also examine: a) logistical issues, such as the costs and benefits of the survey methods and the use of regular- versus event-initiated surveys; and, b) statistical issues such as the use of General Random Tessellated Stratified (GRTS) designs in relation to the determinants of a method's power to detect change, particularly the variance and bias associated with the survey methods. Non-extractive survey and monitoring methods have recently been developed for deployment at depths that preclude divers, and for ecosystem attributes that cannot be monitored via satellite. These methods include single- and dual-head multi-beam sonar, single- and stereo-underwater video (towed behind vessels or deployed via remote or autonomous underwater vehicles) and deep, baited remote underwater video systems. Project 1 will examine the extent to which these methods, alongside other new (Nitrogen isotope assay) and existing methods, provide a suitable platform for initial survey and sustained ecological monitoring of Key Ecological Features (KEFs) and Commonwealth Marine Reserves (CMRs) in Australia's Exclusive Economic Zone.

Outcomes

The expected outcomes of Project 2 are:

1. A considered understanding of the data requirements for managing a network of Commonwealth Marine Reserves including how to mobilise national capacity to provide the required data

2. A considered understanding of the data requirements to evaluate and report on national marine ecosystem health including how to mobilise national capacity to provide the required data (especially IMOS and NPEI)

Outputs (products and services) in 2014

Whole of project and specific 2014 outputs are:

1. An analysis of alternative approaches for monitoring biodiversity in the Commonwealth Marine Reserve network, based on scientific, economic, and logistical considerations

2. In conjunction with Project 1, a gap analysis for national ecosystem health and Southeast marine reserve network monitoring in the Commonwealth Waters, including recommendations for how to mobilise national capacity to provide the required evidence/data

Activities and Milestones in 2014

Project milestones in 2014:

1. On-going milestone: Analysis of swath data collected in the Houtman-Abrolhos KEF survey, and identification of coral-kelp habitats in commonwealth waters

2. Ongoing milestone: Analysis of data from Phase I and II of the Flinders CMR survey, including

   x. power analysis for specific objectives (shelf Baited Remote Underwater Videos – BRUVs – and Stereo Towed Video – STV – on the slope)

   xi. inventory of shelf and slope habitats in the Flinders CMR, include additional swath mapping of new areas, based initially on broad scale scoring results and then fine-scale scoring results

3. Ongoing milestone: Analysis of data from Solitary Islands survey, including

   xii. autocorrelation and power analysis for specific objectives (BRUVs)

   xiii. comparison of video monitoring techniques, specifically the use of oblique forward looking mono/stereo videos on STV and AUVs;

   xiv. inventory of shelf habitats in the Solitary islands KEF, include additional swath mapping of new areas based initially on broad scale scoring results and then fine-scale scoring results

4. Ongoing milestone: Progress report on results to date including a presentation to DOTE to provide opportunity for feedback and input to final year's research (for projects 1 and 2); and

5. Ongoing milestone: Report list of proposed publications and authors (June 2014).

6. New milestone: Provide input to Hub final report in approved template (Dec 2014).

Expected Benefits

The short, medium and long term benefits of Project 2 (in conjunction with Project 1) are as follows:

- Short term: Greater understanding and alignment between institutional and government department environmental information needs and priorities

- Medium term: Greater understanding of the logistical and statistical resources required to monitor the effectiveness of individual CMRs and a network of CMRs.

- Medium term: Prioritisation of future infrastructure needs to meet the objectives of a sustained national environmental monitoring strategy for the South East Commonwealth Marine Reserve network and ecosystem health assessment of Australia's EEZ.

24

- Long term: Statistical and logistical foundation for the first assessment of marine ecosystem health of Australia's EEZ.

- Long term: Status and trend reporting for SoE 2016 for relevant extant datasets.

Key Risks in 2014 and Risk Management Strategy

Not meeting milestones: managed by regular project progress meetings

Research Questions (Environment Portfolio)

Project 1 contributes to the following NERP research questions

2.1 How can we improve our capacity to understand, monitor and evaluate ecosystem function/health, including by using predictive models/tools, to ensure:

- key ecosystem functions can be understood and maintained through effective management

- threats to values, such as biodiversity or important ecosystem functions, can be detected

- trends can be monitored and tipping points/thresholds, that indicate species, population or ecosystem collapse, can be predicted, and

- which management actions are effective and timely, can their success be measured over time, and how can their relevance/effectiveness be evaluated as the environment changes (i.e. use of adaptive management systems)?

2.2 What are practical models for incorporating complex ecosystem science into management, e.g. through managing key drivers such as keystone species, core processes and human activities?

- What are the minimum data needed to determine the health of an ecosystem?

4.2 As land and marine use intensifies, how can we improve approaches to strategic environmental assessments of nationally important areas and regions?

4.4 How can Australia's marine environment be best managed to maximise ecosystem health, ecosystem resilience, and ecosystem goods and services?

Policies and Programs

- Commonwealth Marine Reserve Network Management Plans
- Monitoring for Marine Bioregional Plans
- SOE 2016

Key Events and Dates in 2014

- Whole of NERP hub meeting in late 2014.
- Presentation of progress for discussion with DOTE mid 2014

End Users

- Travis Bover, Director, Domestic Marine Policy, DOTE

- Barbara Musso, Director, CMR Policies and Programs Coordination, Parks Australia, DOTE

- Jason Ferris, Director, Environment Information, Policy and Reporting (SoE and NPEI), DOTE

- Martin Riddle & Andrew Constable, Australian Antarctic Division, DOTE

Links and Dependencies to other Hubs and projects

Monitoring benefits will be addressed in Theme 2 Project 1.

Start Date and Duration (in months)

July 2011, 42 months

26

Project 1.3: Blueprint for monitoring marine ecosystems of the EEZ

New project

Project Leader: Paul Hedge

Organisation: University of Tasmania

Total NERP Budget (ex GST): Nil
2014 NERP Budget (ex GST): Nil

Total Non-NERP Cash/In-Kind Budget (ex GST): Nil

2014 Non-NERP Cash/In-Kind Budget (ex GST): Nil

Project Description

The project team will work closely with the Department of the Environment (DOTE) to identify its priority monitoring needs and with Hub researchers and collaborators to identify current and potential monitoring capacities and capability. They will draw together the monitoring outputs from Theme 1 (analysis of monitoring approaches, data collation and gaps for monitoring marine ecosystem health and managing Commonwealth Marine Reserves), Theme 2 (collation of pressure data and identification of performance indicators for Commonwealth Marine Reserves), Themes 3 and 4 (data collation and baseline characterisation for CMRs in North-West) and Theme 5 (guidance for integrated monitoring) and distil them in a document that provides DOTE with practical direction and options to establish an effective national approach to monitoring the EEZ.

Key Researchers

1. Paul Hedge, UTAS – Deputy Director and project leader
2. Nic Bax, UTAS - Director
3. Keith Hayes, CSIRO – Theme and project leader
4. Neville Barrett, UTAS – Senior marine scientist
5. Tony Smith, CSIRO – Theme and project leader
6. Piers Dunstan, CSIRO – project leader
7. Scott Nichol, GA – Theme and project leader
8. Julian Caley, AIMS – Theme leader
9. Jessica Meeuwig, UWA – Senior marine scientist

Problem Statement

The DOTE has a broad range of marine programs and initiatives (implementation of marine bioregional plans, management of Commonwealth Marine Reserve networks, recovery of listed species, State of the Environment Reporting and Sustainability Reporting) that require 'fit-for-purpose' monitoring data to inform decision making for biodiversity protection and sustainable use of the marine environment in the EEZ, but the priorities for monitoring data, capacities and gaps for sustained delivery and gaps in priority monitoring data have not been identified.

The provision of 'fit-for-purpose' monitoring data to address priorities is likely to be reliant on cooperation from and capacities of other agencies (industry portfolio, AFMA,

etc) and institutions (IMOS, AODN, etc), and in some cases stakeholders (commercial fishers, oil and gas explorers and producers, commercial shipping), but the priorities for cooperation and collaboration have not been identified.

Outcomes

The expected outcomes of project 1.3 are:

1. Greater clarity about how existing monitoring initiatives contribute to meeting the priority reporting and decision making needs of the DOTE and their stakeholders

2. Greater clarity about to how to mobilise national capacity to build on existing monitoring initiatives to meet the priority needs of DOTE and its stakeholders

3. Greater consistency and comparability in monitoring design, implementation and analysis

4. Increased cost-effectiveness with Australian Government investments in marine data collection, management, analysis and reporting.

Outputs (products and services) in 2014

The project will establish a blueprint for monitoring marine ecosystems of the EEZ that identifies:

- DOTE drivers and high level objectives for marine ecosystem monitoring

- DOTE priorities for marine ecosystem monitoring and identification of sources of priority data and gaps in priority data that are not being met

- Governance requirements for a national approach to marine monitoring and options for governance including use of exiting governance arrangements

- The essential monitoring functions that need to be established and the identification of existing capacities and capabilities and gaps in capacities and capability

- Options and opportunities to fill gaps in priority data and capacities and capabilities for marine ecosystem monitoring

Activities and Milestones in 2014

Milestone 1: Identification of DOTE drivers and high-level objectives for national marine ecosystem monitoring (March 2014)

Milestone 2: Identification of governance requirements and options for DOTE marine ecosystem monitoring (April 2014)

Milestone 3: Identification of DOTE monitoring priorities for marine ecosystems (July 2014)

Milestone 4: Gap analysis of marine ecosystem monitoring priorities and essential monitoring functions (Sep 2014)

Milestone 5: Draft blueprint for marine ecosystem monitoring for the EEZ (Dec 2014)

Milestone 6: Provide draft input to Hub final report in approved template (Dec 2014).

Expected Benefits

This project will inform the strategic assessment of the GBRWHA, future monitoring activities in the GBRWHA and will also provide a monitoring framework that could be used for strategic assessments in other coastal and marine regions in future.

Key Risks in 2014 and Risk Management Strategy

Risk 1 - that DOTE priorities for ecosystem monitoring for the EEZ are not identified.

Strategy 1- Provide regular updates to Senior Executives of DOTE providing progress against milestones and convene meetings to discuss issues

Strategy 2 - Work closely with DOTE project contacts manage project expectations and scope creep.

Risk 2 – that key inputs from other Hub research themes are not provided when needed.

Strategy 3 – Work closely with other relevant Hub Theme and project leaders to understand progress with inputs and address issues where necessary.

Risk 3 – that project stalls because due to loss of project leader

Strategy 4 – Convene meeting with DOTE prior to 2014 to discuss extension of secondment for Deputy Director.

Research Questions (Environment Portfolio)

2.3   How can we improve our capacity to understand, monitor and evaluate ecosystem function/health, including by using predictive models/tools, to ensure:

- key ecosystem functions can be understood and maintained through effective management

- threats to values, such as biodiversity or important ecosystem functions, can be detected

- trends can be monitored and tipping points/thresholds, that indicate species, population or ecosystem collapse, can be predicted, and

- which management actions are effective and timely, can their success be measured over time, and how can their relevance/effectiveness be evaluated as the environment changes (i.e. use of adaptive management systems)?

29

2.2 What are practical models for incorporating complex ecosystem science into management, e.g. through managing key drivers such as keystone species, core processes and human activities?

- What are the minimum data needed to determine the health of an ecosystem?

3.9 How can the different threats to biodiversity be prioritised for management and investment purposes, and how can cumulative threats be assessed?

Policies and Programs

1A Biodiversity Conservation

6A Environmental Reporting

Key Events and Dates in 2014

- Progress against milestones in progress report for NERP Marine Biodiversity Hub (Aug 2014)
- Workshop – Marine ecosystem monitoring priorities (Mar/Apr 2014)
- Workshop – essential monitoring functions gap analysis (June 2014)
- Workshop – monitoring priorities gap analysis (Aug/Sep 2014)

End Users

- Travis Bover, Domestic Marine Policy, WH&M, DOTE
- Barbara Musso, CMR Policies and Programs Coordination, PA, DOTE
- Jason Ferris, Environment Information, Policy and Reporting, SPAD, DOTE
- Roger Proctor, Australian Ocean Data Network
- Tim Moltmann, Integrated Marine Observing System
- Keld Knudsen, Australian Petroleum Production and Exploration Association
- Christine Lamont, NOPSEMA
- Nick Rayns, Australian Fisheries Management Authority

Links and Dependencies to other Hubs and projects

Monitoring outputs from Themes 1, 2, 4 and 5 will provide key inputs to project 1.3.

Start Date and Duration (in months)

August 2013 (15 months)

Theme 2: Supporting Management of Marine Biodiversity

This theme will provide methods and tools to value marine biodiversity, identify threats and cumulative impacts, and evaluate and provide guidance on the effectiveness of management tools to meet conservation objectives in a multi-jurisdictional and multi-sectoral environment. Tools and options will be designed to add value to existing management processes; including implementing marine bioregional plans, monitoring the Southeast Marine Reserve Network, and assessing and managing listed species under the EPBC Act. Our goal is to provide scientific advice that can be used by conservation and resource management agencies, thus supporting a shared understanding of the environmental and economic values, and options for monitoring and management.

Theme Leader: Tony Smith

Organisation: CSIRO

Total NERP Budget (ex GST): $2,499,212 + $500,000 Emerging Priorities (EP)

2014 NERP Budget (ex GST): $35,563 + $200,000 (EP)

Total Non-NERP Cash/In-Kind Budget (ex GST): $4,209,393 + $500,000 (EP)

2014 Non-NERP Cash/In-Kind Budget (ex GST): $115,768 + $148,350 (EP)

Project 2.1 – Integrating social, economic and environmental values

Continuing project

Project Leader: Sarah Jennings

Organisation: University of Tasmania

Total NERP Budget (ex GST): $814,506
2014 NERP Budget (ex GST): $15,845

Total Non-NERP Cash/In-Kind Budget (ex GST): $1,177,693
2014 Non-NERP Cash/In-Kind Budget (ex GST): $20,233

Project Description

This project will develop socio-economic approaches to valuing biodiversity to support implementation of management objectives in the CMR network management plan, and approval and permitting of new infrastructure developments. The project will have three main components: 1) to assist development of performance indicators in the Commonwealth Southeast Marine Reserve Network; 2) to develop options for using incentives to increase stewardship of CMRs, especially in support of monitoring and compliance in multiple-use zones; and 3) provide biodiversity valuations to support decisions on new approvals (in areas to be determined in consultation with the Department).

An early emphasis will be on working with the Marine Division to understand management objectives for the Southeast CMR network management plan, with the

31

aim of providing quantifiable measures that can be used to compare the efficacy and cost of different options to monitor and manage marine biodiversity, including assessing the data needs. The initial task will use a variety of approaches in working with the Marine Division to develop quantitative performance indicators for managing the Southeast CMR network. This is an essential component of developing a sustained monitoring blue-print for marine monitoring, and this project will developed jointly with the DOTE and Theme 1 and Theme 5.

The second component will be to work with the Marine Division to identify management options and incentives that would support a sharing of responsibility and stewardship of the CMR network, with an initial focus on the Southeast. The goal of this work will be to assess how best to involve marine users in the monitoring and performance assessment of CMRs, especially multiple-use zones, and how alternative approaches to involving marine users affects their support, stewardship and compliance. This research has the potential to be extended to also inform how existing users of the marine environment would respond to management options likely to be considered in implementing marine bioregional plans more generally. A focus for this extension will be determined in consultation with the Department.

The third component will be to derive and compare economic values for marine biodiversity and habitats, at different scales (e.g. local and regional) and to different stakeholders. This will support development of monitoring plans, the comparison of alternative management options, and decisions associated with the approval and permitting of new marine developments, particularly in the oil and gas industry. Early discussions will be held with the Department to provide a geographic focus for this research.

Key researchers

1. Sean Pascoe (CSIRO) — social and economics
2. Michael Burton (UWA) — social and economics
3. Dave Pannell (UWA) — socio-economics
4. Abbie Rogers (UWA) — Post doctoral researcher, socio-economics
5. Satoshi Yamazaki (UTAS) — social and economics
6. Sarah Jennings (UTAS) — social and economics
7. James Innes (CSIRO) — economics
8. Samantha Paredes (Masters student, QUT) and Jean-Baptiste Marre (PhD student, QUT) are also contributing to project outputs.

Problem statement

The key research questions to be addressed are how to value and monitor biodiversity in a quantitative fashion that will support managers in including implementing marine bioregional plans and permitting new developments.

Outcomes

This project will develop socio-economic approaches to valuing biodiversity to support implementation of management objectives in the CMR network management plan, and approval and permitting of new infrastructure developments. The project will have three main components: 1) to assist development of performance indicators in the Commonwealth Southeast Marine Reserve Network; 2) to develop options for using

incentives to increase stewardship of CMRs, especially in support of monitoring and compliance in multiple-use zones; and 3) provide biodiversity valuations to support decisions on new approvals (in areas to be determined in consultation with the Department).

Additional specification of outcomes based on subsequent discussions with DOTE:

- The consistent and effective monitoring of CMR networks in Australia leading to improved allocation of monitoring effort spatially and temporally (Component 1).

- Improved resource allocation and management due to a more comprehensive knowledge of how incentives can be used to promote the achievement of marine conservation goals (Component 2a).

- A set of guidelines for applying offsets in the marine environment, particularly where broad environmental and ecosystem effects are anticipated, which reflects current best practice national and international evidence/experience, is based on sound economic principles and has social license (Component 2b)

- Improved resource allocation and management due to a more comprehensive knowledge of individual and social values at a variety of scales for marine biodiversity and other conservation outcomes, and better understanding of how these values are formed and of how information is used by decision makers (Component 3).

Outputs (products and services) in 2014

Activity 1: project team members will work with DOTE and Theme 1 to develop and apply a framework and set of guiding principles for identifying pressures, objectives and performance indicators in marine reserve networks, and for allocating monitoring resources and for triggering appropriate management responses:

- Paper mapping possible social, economic and ecological indicators to offshore marine reserve objectives, and developing a methodology for prioritising these in a cost-effective manner.

Activity 2a: Identification of the current set of incentives created under existing conservation legislation relating to the extractive industries; identification of possible incentive based mechanisms that may foster marine stewardship by these industries and the broader community:

- Overview paper on use of market-based instruments to promote sustainability and stewardship both on and off reserve, and across a range of activities.

- Paper detailing the potential for market-based incentives to improve environmental performance in the marine mining and dredging sector.

Activity 2b: two case studies illustrating the application of the marine offset framework in seagrass and migratory shorebird habitats, and a non-market valuation study to explore a range of potential issues associated with social licence in the use of offsets, including where the offset occurs (local, national, international) and whether the offset is associated with, for example, a purposeful change caused by industry development or as a contingency to the possibility of accidental damage:

33

- Conference paper on the economics of offsets.

- Report synthesising outcomes of workshop on best practice in offsets design and valuation (run in association with AARES 2013).

- Report on each of the case studies on offsets in seagrass and migratory shorebird habitats, considering issues and constraints of potential approaches to offsets

- Synthesis report on issues, constraints and potential approaches to offsets in the marine environment

Activity 3: a series of non-market valuation studies, each of which will describe scenarios in ecologically relevant ways and which will provide information that is meaningful for policy development and/or implementation. The suite of projects will be designed to allow comparison of values for marine biodiversity and habitats, at different scales (e.g. local and regional) and to different stakeholders. One of the non-market valuation studies will support Activity 2 by exploring issues related to social licence and marine offsets. Another component will explore the way in which decision-makers use various types of information about marine and coastal values:

- Draft report describing the results of the pilot study investigating public values associated with alternative marine offset mechanisms.

- Draft report on primary offset social licence case studies.

- Draft report on the use and influence of economic valuation applied to coastal and marine ecosystems in decision-making.

Activities and Milestones in 2014

Date	Activity	Milestone	Department contact	Project contact
September 2013		Conference paper on economics of offsets		Sean Pascoe
September 2013		Report based on offsets workshop and other desktop work to date		Sarah Jennings/ Satoshi Yamazaki
September 2013	Workshop on application of offsets framework to case studies in seagrass and migratory shorebird habitats	Workshop report		Sarah Jennings/ Michael Burton/ Sean Pascoe
December 2013		Draft case study report: offsets in seagrass habitats Draft case study report; offsets for migratory shorebirds		Michael Burton Sean Pascoe

Date	Activity	Milestone	Department contact	Project contact
December 2013		Submit paper on market-based instruments overview		Sean Pascoe
30 December 2013		Draft report for pilot offset valuation case studies		Michael Burton/ Abbie Rogers
February 2014		Draft synthesis report: offsets in the marine environment		Sarah Jennings
February – October 2014	Analysis of primary offset valuation survey data			Michael Burton/ Abbie Rogers
March 2014	Use of economic valuation in coastal and marine environments by decision-makers	Draft report on use of economic valuation by decision-makers		Jean-Baptiste Marre
31 December 2014		Draft report for primary offset valuation case study		Michael Burton/ Dave Pannell/ Abbie Rogers
31 December 2014	Final report	Contributions to Hub final report provided on agreed template		Sarah Jennings

Expected benefits

The key benefits of this project will be a strengthened knowledge set upon which to base the implementation of marine offsets, particularly where activities involve complex ecosystem and environmental effects on market and non-market marine values; general and activity-specific information and guidance about the use of incentives in achieving marine resource stewardship and sustainability; identification of objectives and priorities related to offshore marine reserves, and clear guidance as to the selection of social, economic and ecosystem indicators.

Key risks in 2014 and risk management strategy

The key risks to the project in 2014 stem from issues encountered in 2013:

1. The loss of a key project member (Olivier Thebaud)

2. Delay to the start of the project because of uncertainty within DOTE about the questions to be answered

3. The election in September 2013 which may alter the policy landscape in DOTE.

While Dr Thebaud has relocated to France, he continues to be associated with the project and his place in the team has been taken in Australia by Michael Burton, who assumes leadership of the case study, and James Innes and Fabio Buschetti, who will contribute expertise on the project.

Clear and specific terms of reference for project 2b were agreed with DOTE in June 2013. There appear to be few risks to fulfilling those terms of reference other than the potential for a change of government in September 2013, and consequent uncertainty about future policy on offsets. There is little the project team can do to mitigate those risks. Nevertheless, the team maintains close contact with the department to keep abreast of events.

Research questions (Environment portfolio)

The project specifically addresses Question 1. Values: understanding the major drivers for maintaining biodiversity and Question 5. Biodiversity markets and the role of conservation incentives.

Policies and programs

1A Biodiversity Conservation – Environmental Stewardship Program – development of a metric for conservation value

1E Maintaining/building a Marine reserve systems and protected areas – Understand the values, perception and attitudes of the community and stakeholders to the establishment and management of the Commonwealth marine reserve estate to determine appropriate levels of resource allocation/engagement regarding compliance, enforcement and education;

B1 Environmental Regulation – promote a cooperative approach to protect and manage the environment; EPBC statutory and regulatory decision making in marine areas; Use of Environmental Offsets under the EPBC Act

Key events and dates in 2013–14

- Offsets workshop late 2013: workshop with departmental staff and invited experts
- Project meeting in February 2014 to synthesise findings and develop the final project report
- Presentation to DOTE late 2014

End users

- Activity 1: Travis Bover, Barbara Musso, Belinda Jago, Rod Atkins, DOTE
- Activity 2: Travis Bover, James Tresize, Felicity McLean, DOTE

Links and dependencies to other Hubs and projects

This project is developing links with projects 2 and 3 within the Theme. These are bilateral: advice is being drawn on attribute definition for the valuation exercises, and values derived from these projects may be integrated with the outcomes of those projects.

The monitoring component will also link with Theme 1, to include additional ecological scope. There are no anticipated limiting dependencies.

Start date and duration (in months)

July 2011, 42 months

Project 2.2 - Integrating threats, values and assets for management

Continuing project

Project Leader: Piers Dunstan

Organisation: CSIRO

Total NERP Budget (ex GST): $411,957

2014 NERP Budget (ex GST): $13,845

Total Non-NERP Cash/In-Kind Budget (ex GST): $411,960

2014 Non-NERP Cash/In-Kind Budget (ex GST): $13,845

Project Description

The first component of this project is to identify the relevant risks and impacts from human activities and map their spatial distribution at the national scale. A significant amount of work has already been done to identify individual threats. The project will bring together existing data and information on key threats to marine biodiversity – CERF Marine Biodiversity Hub, DOTE Marine Bioregional Planning, DOTE/CSIRO Marine Indicators Threat Mapping Project, fisheries risk assessment, NPEI, IMOS and NOIS – to provide a threat assessment that can be prioritised to meet the Department's needs in implementing marine bioregional plans. Additional important threats including SST anomalies, marine debris and invasive species need quantification. There is no agreed method to quantify cumulative threats and impacts and this project will explore several methods, testing them against independent data to support the Department's management of cumulative threats to marine biodiversity. Improved methods for mapping cumulative threats will be used to provide threat and impact layers nationally.

The information from threats and impacts will be integrated with improved knowledge on socio-economic values from Project 1 and improved understanding of biodiversity assets from Theme 3 to support implementation of marine bioregional plans. The project will identify interactions between threats, biodiversity values and biodiversity assets and develop a geographic focus based on the Marine Bioregional Plans and in discussion with the Department. It will result in an improved understanding how information and analyses from a variety of sources (including other projects and themes in this Hub) can be integrated to support their decision making. A key priority for the task is to assemble the expertise in EBM, EBFM and spatial planning within the Hub and CSIRO to formulate options and opportunities that build on existing work.

Additional Information:
The project is also responsible for developing the Data management plan for the Hub. Data generated by the Hub will be made available through AODN to enable easy use by DOTE and researchers in other Hubs. A workflow will be developed to enable hub researchers to easily make data available on AODN. The project will identify tools for metadata authoring and identify the barriers for data management for researchers.

Key Researchers

1. Piers Dunstan, CSIRO Marine and Atmospheric Research – Mathematical ecologist
2. Scott Foster, CSIRO Mathematic and Information Services - Statistician

Problem Statement

The Department needs to be able to manage threats to biodiversity within Australia's EEZ. To achieve this requires an understanding of specific threats to biodiversity assets and the cumulative impact of those threats on biodiversity. Different social-economic values will influence how those threats are considered.

Outcomes

1. Short term: A clear understanding of DOTE's needs for cumulative threat analysis and an understanding of how threats, values and assets are linked. DOTE will have enhanced threat maps that will map currently missing threats including climate change, marine debris and invasive species.

2. Medium term: DOTE will be able to better assess the treats to marine biodiversity and the impacts of cumulative activities. The department will have improved information to make decisions on biodiversity management.

3. Long term: DOTE will be better able to assess threats to marine biodiversity. There will be an improved understanding of cumulative impacts across sectors. The department will be able to assess the interaction between threats, biodiversity values and biodiversity assets.

Outputs (products and services) in 2014

1. Tools and approaches to enhance DOTEs and Australia's understanding of the links between threats and biodiversity assets.

2. Improved maps of the distribution of known threats to biodiversity and the overlap between threats and assets. Tools to understand the cumulative impacts of multiple threats to biodiversity.

3. Improved data management allowing DOTE rapid and increased access to Hub data and Research.

Activities and Milestones in 2013

Milestone 1: Pressure Layers available on the Australian Ocean data network for key pressure to the Australian Marine Environment (February 2014).

Milestone 2: Data management framework and metadata tools actively used by Hub researchers (June 2014);

Milestone 3: Framework for the assessment of cumulative risk and impacts including a regional example. (June 2014) developed in collaboration with Theme 1 project 1.

New Milestone 4: Project summary provided for Hub final report on agreed template (December 2014).

Expected Benefits

This project will provide:

- an improved understanding of the links between threats, values and biodiversity.
- improved tools for understanding cumulative threats and how these threats overlap biodiversity assets.
- improved tools for assessing multiple use objectives.
- improved data management for the Hub

Key Risks in 2014 and Risk Management Strategy

1. Insufficient communication with other themes and DOTE caused by poor links leading to the project goals being inadequately specified or resourced. The Hub Director and Deputy Director have agreed with the Marine Division SES to meet three times a year to help keep projects and their inputs timely and relevant to alleviate this risk.

2. Inability to link threats to biodiversity caused by poor data leading to inability to compile cumulative risk. To alleviate this risk an initial scoping will be used to identify examples with sufficient data.

Research Questions (Environment Portfolio)

1.3 What is the fairest and most cost-effective mix of policy tools to conserve recognised biodiversity values (e.g. land acquisition, covenants, stewardship payments, regulation, education) at both national and regional scales?

2.1 How can we improve our capacity to understand, monitor and evaluate ecosystem function/health, including by using predictive models/tools, to ensure:

- key ecosystem functions can be understood and maintained through effective management

- threats to values, such as biodiversity or important ecosystem functions, can be detected

- trends can be monitored and tipping points/thresholds, that indicate species, population or ecosystem collapse, can be predicted, and

- which management actions are effective and timely, can their success be measured over time, and how can their relevance/effectiveness be evaluated as the environment changes (i.e. use of adaptive management systems)?

2.2 What are practical models for incorporating complex ecosystem science into management, e.g. through managing key drivers such as keystone species, core processes and human activities?

What are the minimum data needed to determine the health of an ecosystem?

2.3 What are the advantages and disadvantages for biodiversity of an ecosystem management approach? How can emerging genetic technologies and analysis of past management practices assist our understanding of ecosystems?

2.4 In environments such as marine areas, where comparatively little is known about biodiversity and ecosystem processes, what can we do to strengthen and validate the use of surrogates for identifying biodiversity for protection?

3.7 How can we best manage those parts of the Commonwealth Marine Area outside Marine Protected Areas (MPAs) to ensure values of MPAs are not compromised by external threats?

3.9 How can the different threats to biodiversity be prioritised for management and investment purposes, and how can cumulative threats be assessed?

4.4 How can Australia's marine environment be best managed to maximise ecosystem health, ecosystem resilience, and ecosystem goods and services?

Policies and Programs

1A Biodiversity conservation;

1B Protection of threatened species & communities;

1E Maintaining a marine reserve system;

1G Biodiversity research;

B1 Environmental regulation;

B3 Protection and management of heritage values.

Key Events and Dates in 2014

Meeting with DOTE (late 2014)

Hub Meeting (late 2014)

End Users

- Travis Bover, Regional Domestic Marine Policy, WH&M, DOTE
- Barbara Musso, CMR Policies and Programs, PA, DOTE
- Belinda Jago, Coral Sea and North Network Management, PA, DOTE
- Andrew Read, Temperate East and South-east Network Management, PA, DOTE
- Rod Atkins, South-west and North-west Network Management, PA, DOTE

41

- Felicity McClean, Offshore Petroleum, EACD, DOTE
- David Holt, Mike Maslen, ERIN, DOTE
- Ian Snape, Martin Riddle and Andrew Constable, AAD, DOTE
- Roger Proctor, Director AODN

Links and Dependencies to other Hubs and projects

- Collaboration with Theme 3 project 2 on national biodiversity maps & threats
- Collaboration with Theme 2 project 1 using identified biodiversity values
- Collaboration with Theme 1 project1 developing data management tools, shared datasets and methods of analysis.
- Collaboration with Tropical Hub, Theme 2 program 5, Cumulative impacts on benthic biodiversity

Start Date and Duration (in months)

July 2011, 42 months

Project 2.3 – Task 1 - Landscape approaches to managing high conservation priority species

Continuing project

Project Leader: Tony Smith

Organisation: CSIRO

Total NERP Budget (ex GST): $318,350 (Tasks 1 and 2)

2014 NERP Budget (ex GST): $10,845 (Tasks 1 and 2)

Total Non-NERP Cash/In-Kind Budget (ex GST): $446,984 (Tasks 1 and 2)

2014 Non-NERP Cash/In-Kind Budget (ex GST): $10,845 (Tasks 1 and 2)

Project Description

This project focuses on integrated management solutions to key threatened groups and habitats, including on and off reserve management. It comprises 2 tasks focused at a range of landscape scales to deliver improved management arrangements to address high priority conservation values identified under the EPBC Act.

Task 1: Supporting management of high conservation priority species: This task will develop new approaches to manage high conservation priority species at a landscape scale in a multi-jurisdictional and multi-sectoral environment. A significant fraction of Australia's chondrichthyan fauna is at risk from a variety of human uses, particularly fishing. The group contains many slow-growing vulnerable species, including some of high concern to the Marine Division, so this group provides a good test case for developing these methods. Landscape approaches to management have been identified as a primary tool for protection, but chondrichthyans are widely distributed and cannot be fully protected in all parts of their range. The task will identify and test strategies for supporting management of chondrichthyans both on and off reserve. What combination of spatial and other management strategies can best protect this group, including more mobile species, while maintaining access for ocean users? This issue will be addressed at national and regional scales. Delivery outputs will include recommendations for improved guidelines for managing high conservation priority species on and off reserve and will seek to identify complementary arrangements between conservation and resource management agencies, particularly fisheries.

Task 2: see following project report (Roland Pitcher)

Key Researchers

1. Ross Daley, CSIRO – shark and ray expert
2. Penny Johnson, CSIRO – Atlantis ecosystem modelling
3. Tony Smith, CSIRO – project leader
4. Helen Webb, CSIRO – ecological risk assessment

43

Problem Statement

This task will develop new approaches to manage high conservation priority species at a landscape scale in a multi-jurisdictional and multi-sectoral environment. A significant fraction of Australia's chondrichthyan fauna has been identified as being at risk from a variety of human uses, particularly fishing. Spatial management has been identified as a primary tool for protection, but sharks and rays are widely distributed and cannot be fully protected in all parts of their range. What combination of spatial and other management strategies can best protect this group while maintaining access for ocean users?

Additional information:
The premise underlying this project is that conservation values are not distributed uniformly across the EEZ, but that high conservation value species and habitats tend to be aggregated in "hot spots". This project aims to develop improved understanding of the location of such areas and the conservation values they contain.

Outcomes

1. New Short term: improved understanding of the location of high conservation value areas and the conservation values they contain – for this project, focusing on selected demersal shark and ray species from SE Australia.

2. New Short term: improved information to assist Marine Division work on Biologically Important Areas for listed species, (as defined in Marine Bioregional Plans) priority EPBC nominated species and CITES listed species.

3. New Medium term: identification and analysis of management options to improve conservation outcomes for sharks and rays in SE Australia – both on reserve and off reserve

4. New Medium term: improved information to assist EACD for assessing risk and evaluating potential offsets

5. New Long term: improved protection for the chondrichthyan fauna in SE Australia

6. Existing Long term: A more efficient regulatory environment for ocean users and better protection for key species. Better links with key management agencies such as AFMA.

Outputs (products and services) in 2013/14

1. Workshop 2 report and species mapping data table available

2. Refined species distribution maps for sharks and rays in SE Australia

3. Locations of biodiversity hot spots for sharks and rays in SE Australia

4. Nursery, foraging and corridor areas for selected key species

5. Preliminary exploration of options for on and off reserve management of sharks and rays in SE Australia

44

Activities and Milestones in 2013/2014

Milestone 1: Summary of species distributions completed including incorporation of new data (June 2013);

Milestone 2: Report list of proposed publications and authors (June 2013).

Milestone 2: Report on preliminary investigation of on and off reserve management options using Atlantis (October 2013)

Milestone 3: Methods for mapping nursery, foraging and corridor locations completed; example plots of species-specific maps of key areas (December 2013)

Milestone 4: Application of new methods to a range of temperate demersal shark and ray species (June 2014)

Milestone 5: Provide project summary results for Hub final report on agreed template (December 2014)

Expected Benefits

- Benefits will include easier access to existing information to help make decisions about protecting sharks and rays that take into account existing and new management arrangements.

- Additional information: Activities and outputs in 2013 should lay the foundation for the more specific advice on management options to be delivered in June 2014.

Key Risks in 2013 and Risk Management Strategy

This project aims to improve understanding of the distribution of the temperate chondrichthyan fauna of SE Australia, and to provide more precise information on area and habitat use for selected species. Analyses will be based on existing biological and environmental data.

Risk 1: existing data are inadequate to improve the predictions of species distributions. This data risk is being managed by supplementing existing data with expert knowledge gathered from chondrichthyan experts at two workshops. The first identified the key knowledge gaps. The second compiled existing knowledge and identified new data sets.

Risk 2: methods to improve predictions of area use by selected species have not yet been developed. Ross Daley is exploring generalised linear models to standardise catch and effort data from data rich areas so that maps can be extrapolated into data rich areas. Predictive models are under development to analyse the effects of environmental variables (temperature, wind, current) on distribution.

Research Questions (Environment Portfolio)

1.1 Are all threatened species equally valuable in a genetic and ecological context?

1.2 When is it too late to recover a species?

1.4 What are the best mechanisms for sharing the costs of management between the various beneficiaries?

2.1 How can we improve our capacity to understand, monitor and evaluate ecosystem function/health, including by using predictive models/tools, to ensure:

- key ecosystem functions can be understood and maintained through effective management

- threats to values, such as biodiversity or important ecosystem functions, can be detected

- trends can be monitored and tipping points/thresholds, that indicate species, population or ecosystem collapse, can be predicted, and

- which management actions are effective and timely, can their success be measured over time, and how can their relevance/effectiveness be evaluated as the environment changes (i.e. use of adaptive management systems)?

2.2 What are practical models for incorporating complex ecosystem science into management, e.g. through managing key drivers such as keystone species, core processes and human activities?

- What are the minimum data needed to determine the health of an ecosystem?

2.3 What are the advantages and disadvantages for biodiversity of an ecosystem management approach? How can emerging genetic technologies and analysis of past management practices assist our understanding of ecosystems?

3.1 How do we manage ecosystems and regions for ecological resilience: how is resilience maintained, restored and monitored?

3.4 How can the biodiversity value of protected areas be improved through a system of establishing adjacent buffering areas?

3.7 How can we best manage those parts of the Commonwealth Marine Area outside Marine Protected Areas (MPAs) to ensure values of MPAs are not compromised by external threats?

3.9 How can the different threats to biodiversity be prioritised for management and investment purposes, and how can cumulative threats be assessed?

4.2 As land and marine use intensifies, how can we improve approaches to strategic environmental assessments of nationally important areas and regions?

4.4 How can Australia's marine environment be best managed to maximise ecosystem health, ecosystem resilience, and ecosystem goods and services?

Policies and Programs

2.1.2:   Threats to biodiversity values can be detected

2.1.3:   Trends can be modelled and predicted

2.1.4:   Which management actions are effective and can be evaluated

3.7:   How can off-reserve areas be managed to ensure values of biodiversity, and MPAs, are not compromised by regional & external threats?""

3.9   How can the different threats to biodiversity be prioritised for management and investment purposes, and how can cumulative threats be assessed?

4:      Inform decisions related to sustainable use by managers having access to integrated assessments of cumulative effects of uses

4.1   How do productive marine uses impact on biodiversity?

4.4   How can Australia's marine environment be best managed to maximise ecosystem health, ecosystem resilience, and ecosystem goods and services?"

Key Events and Dates in 2014

- Joint Project Meeting with DOTE and AFMA (mid 2014)
- Hub Meeting (late 2014)

End Users

- Travis Bover, Regional Domestic Marine Policy, WH&M DOTE
- Paul Murphy, Wildlife Trade and Biosecurity, WH&M DOTE
- Felicity McLean, Offshore Petroleum Section, EACD, DOTE
- Lesley Gidding, Marine and Freshwater Species Conservation, WH&M, DOTE
- Beth Gibson, AFMA
- Nick Rayns, AFMA

Links and Dependencies to other Hubs and projects

There will be important links between this Project and Project 2.3.2 that is focusing on benthic biodiversity in the same region (SEMR). Potentially the improved understanding of benthic habitats from the latter project can help inform species distribution and habitat use for sharks and rays. There will be links to Project 2.2 for data provision (human use) and also data management (storage of and access to map products). Outputs from Project 2.3.1 can also inform monitoring strategies for the SE MRN (Project 2.1).

Start Date and Duration (in months)

July 2011, 36 months

Project 2.3 - Task 2 - Landscape approaches to managing high priority conservation values: supporting management of marine benthic biodiversity

Continuing project

Project Leader: Roland Pitcher

Organisation: CSIRO

Total NERP Budget (ex GST): $318,350 (Tasks 1 and 2)

2014 NERP Budget (ex GST): $10,845 (Tasks 1 and 2)

Total Non-NERP Cash/In-Kind Budget (ex GST): $446,984 (Tasks 1 and 2)

2014 Non-NERP Cash/In-Kind Budget (ex GST): $10,845 (Tasks 1 and 2)

Project Description

This project focuses on integrated management solutions to key threatened groups and habitats, including on and off reserve management. It comprises 2 tasks focused at a range of landscape scales to deliver improved management arrangements to address high priority conservation values identified under the EPBC Act. *(See Task 1 project report in previous section – Tony Smith.)*

Task 2: Supporting management of marine benthic biodiversity: Considerable information has now accumulated on benthic biodiversity and human uses that interact with the seabed, including detailed maps in some regions. It is known that some uses are a potential threat to benthic biodiversity, but it is not known how these threats may interact. What combination of spatial and other management strategies can protect benthic biodiversity while maintaining access for ocean users now and in the future? This task has strong links to biodiversity valuation in Project 1 of this theme, and monitoring in Theme 1. The landscape approach being taken will also lead to complementary and competing management options with Task 1 that will need to be resolved as part of these tasks.

Additional Information:
Given the resources available, this task will focus in the SEMR. To progress meaningfully beyond existing benthic assessments in the SEMR, the approach must collate all relevant existing data, be quantitative and at finer spatial resolution, as well as be relevant to stakeholders and publishable in peer reviewed literature. The proposed scope is to acquire, collate and analyse underpinning benthic information and data to provide integrated input into a spatial dynamic model of trawl effort & impacts and benthic recovery, to evaluate alternative management options (MSE) across sectors. The model will be based on a trawl MSE model originally developed in 1999 for evaluating management of the effects of trawling in the GBR, and subsequently applied successfully in the GBR, the Torres Strait and in the NPF. The model will be re-configured for application in the SEMR, to model cumulative effects (if possible, including bottom set long-line) of direct impacts (in future projects, developments may include indirect effects) and will be used to evaluate outcomes for benthos of recent management interventions in the SEMR (e.g. SE RMP; SESSF structural adjustment and fishery spatial closures; possibly petroleum leases if

48

information becomes readily available). These outcomes will be cross-referenced with fishing industry bio-economic outcomes under the same management interventions, if and as available from the existing fishery assessments for the SESF. This integrated approach will demonstrate potential utility for application to future on- and off-reserve management options that may be suggested by stakeholders.

Key Researchers

1. Roland Pitcher, project leader, CSIRO - impact & recovery data, analysis & prediction, reporting
2. Alan Williams, co-project leader, CSIRO - SEMR benthic biological and fishery information, reporting
3. Nick Ellis, CSIRO - trawl modelling and scenario evaluation, reporting
4. Franzis Althaus, CSIRO - SEMR benthic biological data management, fishery data, reporting
5. Additional supporting staff include: Ian Mcleod, CSIRO (regional environmental datasets) and Sharon Tickell (scientific programming).

Problem Statement

Considerable information has now accumulated on benthic biodiversity and human uses that interact with the seabed, including detailed maps in some regions. It is known that some uses are a potential threat to benthic biodiversity, but it is not known how these threats may interact, or what combination of spatial and other management strategies can protect benthic biodiversity while maintaining access for ocean users.

Additional Information:
In order to understand the potential cumulative threats of human uses to benthic biodiversity, and which spatial and other management strategies provide the best outcomes for benthic biodiversity and for ocean users, the approach will be evidence-based and will require new integration of disparate datasets. The required data to be acquired and analysed include: maps of benthic biodiversity characterisation; distributions of sessile epibenthos morphotypes and other species from surveys in the SEMR; impact and recovery rates of sessile morphotypes and species; recent management interventions and spatial planning; spatial and temporal fishing effort; historical fishing intensity and distribution; and bio-economic information for industry indicators.

Outcomes

1. integration and understanding of sessile benthos distribution and vulnerability in the SEMR;

2. integration and understanding of the benthic biodiversity benefits of recent management interventions in the SEMR;

3. integrated approach to the protection of benthic biodiversity and management of human uses that interact with the seabed;

4. an evidence-based regulatory environment for ocean users;

5. effective off-reserve management and accounting of reserve and off-reserve management in assessing overall sustainability risk.

Outputs (products and services) in 2013/14

1. catalogue of relevant datasets and sources for benthos biodiversity, human use (with priority on fishing), and management regimes, for the SEMR (2013 completed).

2. maps of human uses and intensity that interact with the seabed in the SEMR, where data available (2013 completed).

3. map of predicted distribution of benthic biodiversity composition for the SEMR (2013 completed)

4. a model capable of assessing risk and evaluating alternative management in the SEMR (2013 completed).

5. refined empirical maps of hard ground habitats in the SEMR (2013 in progress),

6. integrated evaluations of management interventions for uses that interact with benthic biodiversity, for the SEMR, where adequate data are available (2014).

Activities and Milestones in 2013/14

<u>2012-2013</u>

Milestone 1: relevant datasets and sources for benthos biodiversity, human use (with priority on fishing), and management regimes, identified for the SEMR (completed);

Milestone 2: acquisition & collation of information & data completed (completed except as noted):

*   benthic habitat, biodiversity characterisation & distribution
*   occurrence of epibenthos morphotypes from surveys in SEMR
*   occurrence of other key benthic species, if possible
*   impact and recovery rates of vulnerable benthic fauna
*   fishing effort data (particularly trawling) spatial by year; recent and historical
*   past management interventions and spatial planning in the SEMR
*   bio-economic information for essential industry indicators (in progress).

Milestone 3: maps of distributions of fishing activities that interact with the seabed completed (completed);

Milestone 4: refined empirical maps of hard ground habitats in the SEMR (in progress);

Milestone 5: map of benthic biodiversity characterisation and additionally, cross-tabulate exposure of biodiversity distributions to fishing footprints and protection in fishery closures and CMRs (completed);

Milestone 6: re-configuration of trawl MSE model to SEMR (completed); and

50

Milestone 7: list of proposed publications and authors (completed).

Milestone 8: Complete maps of predicted distributions & abundance of epibenthos morphotypes (in progress Dec 2013)

2014
Milestone 9: maps of distributions of activities other than fishing that interact with the seabed depending on their availability (June 2014)

Milestone 10: Complete evaluation of cumulative effects and recent management in the SEMR (June 2014)

Milestone 11: Complete demonstration of MSE utility for application to future management options (June 2014)

Milestone 12: Provide project summary for Hub final report in agreed template (December 2014)

Expected Benefits

More effective conservation of benthic biodiversity, with management arrangements able to provide downstream benefits for ecosystem processes.

Additional information:
Improved understanding of sessile biodiversity distribution and vulnerability in the SEMR, and of the benefits of recent management interventions in the SEMR; and ability to evaluate future alternative strategies for on and off reserve management with respect to sustainability risk and industry performance — leading to an effective integrated evidence-based approach to planning, management and regulation for conservation and sustainable multiple use of the seabed environment.

Key Risks in 2014 and Risk Management Strategy

1. Data acquisition:

- impact and recovery rates of vulnerable benthic fauna:
    - little empirical rate data are available for trawling in the SEMR. A range of suitable values will be obtained from other regions including tropical Australia, and temperate northern hemisphere.

    - impact for devices other than trawl is largely anecdotal. Some new quantitative data are expected to become available for longline and access will be requested.

- fishery effort data:
    - access to State data is uncertain. Commonwealth fisheries data are available and these sectors can be assessed; State fisheries data will be accessed where available.

- historical fishing effort data:

51

- pre-1985 data are qualitative. Spatial & temporal mapping of effort pre-1985 will be based on interpolation.

- bio-economic indicators for fisheries:
  - the management alternatives that have been evaluated for fisheries economics (by other projects) may not be a direct match for those relevant to sustainability assessment of benthos. Relevant benthic evaluations will be made, and where possible, compared with fisheries indicators for the best available matching evaluations.

2. Distributions of fishing activities that interact with the seabed:

- access agreements may not permit 'publication' of industry maps. It is expected at least that permissions to use data as inputs to assessments will be available.

3. Refinement of empirical maps of hard ground habitats:

- the level of detail of the update is dependent on industry cooperation. Nevertheless, maps do already exist and some level of refinement will be achievable.

4. Predict and map distributions & abundance of epibenthos morphotypes:

- relatively few benthos types may be predictable with sufficient certainty across the entire SEMR. Responses may involve simplifying to fewer benthos types and/or restricting applications to sub-regions within the SEMR. Further, benthos morphotypes are not true species and the actual species composition of any given type is likely to vary across the SEMR. Results will be presented with appropriate qualifiers and recommendations for gap filling.

5. Re-configure existing trawl MSE model to SEMR:

- potential for further software incompatibilities with current operating systems. 5%FTE of suitably skilled scientific programmer has been assigned and already resolved some issues and will be available to assist with further issues.

Research Questions (Environment Portfolio)

2.1.2:   Threats to biodiversity values can be detected

2.1.3:   Trends can be modelled and predicted

2.1.4:   Which management actions are effective and can be evaluated?

3.7   How can off-reserve areas be managed to ensure values of biodiversity, and MPAs, are not compromised by regional & external threats?

3.9   How can the different threats to biodiversity be prioritised for management and investment purposes, and how can cumulative threats be assessed?

4   Inform decisions related to sustainable use by managers having access to integrated assessments of cumulative effects of uses

4.1   How do productive marine uses impact on biodiversity?

4.4   How can Australia's marine environment be best managed to maximise ecosystem health, ecosystem resilience, and ecosystem goods and services?

Policies and Programs

1.1   Are all threatened species equally valuable in a genetic and ecological context?

1.2   When is it too late to recover a species?

1.4   What are the best mechanisms for sharing the costs of management between the various beneficiaries?

2.1   How can we improve our capacity to understand, monitor and evaluate ecosystem function/health, including by using predictive models/tools, to ensure:

  o   key ecosystem functions can be understood and maintained through effective management

  o   threats to values, such as biodiversity or important ecosystem functions, can be detected

  o   trends can be monitored and tipping points/thresholds, that indicate species, population or ecosystem collapse, can be predicted, and

  o   which management actions are effective and timely, can their success be measured over time, and how can their relevance/effectiveness be evaluated as the environment changes (i.e. use of adaptive management systems)?

2.2   What are practical models for incorporating complex ecosystem science into management, e.g. through managing key drivers such as keystone species, core processes and human activities?

  o   What are the minimum data needed to determine the health of an ecosystem?

2.3   What are the advantages and disadvantages for biodiversity of an ecosystem management approach? How can emerging genetic technologies and analysis of past management practices assist our understanding of ecosystems?

2.4   In environments such as marine areas, where comparatively little is known about biodiversity and ecosystem processes, what can we do to strengthen and validate the use of surrogates for identifying biodiversity for protection?

3.1   How do we manage ecosystems and regions for ecological resilience: how is resilience maintained, restored and monitored?

3.4   How can the biodiversity value of protected areas be improved through a system of establishing adjacent buffering areas?

3.7   How can we best manage those parts of the Commonwealth Marine Area outside Marine Protected Areas (MPAs) to ensure values of MPAs are not compromised by external threats?

3.9   How can the different threats to biodiversity be prioritised for management and investment purposes, and how can cumulative threats be assessed?

4.2   As land and marine use intensifies, how can we improve approaches to strategic environmental assessments of nationally important areas and regions?

4.4   How can Australia's marine environment be best managed to maximise ecosystem health, ecosystem resilience, and ecosystem goods and services?

Key Events and Dates in 2014

- Joint Project Meeting with DOTE and AFMA (mid 2014)
- Hub Meeting (late 2014)

End Users

- Travis Bover, Regional Domestic Marine Policy, WH&M, DOTE
- Paul Murphy, Wildlife Trade and Biosecurity, WH&M, DOTE
- Felicity McLean, Offshore Petroleum Section, EACD, DOTE
- Beth Gibson, AFMA
- Nick Rayns, AFMA

Links and Dependencies to other Hubs and projects

This project links to other projects in Theme 2 (Projects 2.2 and 2.3.1) due to shared concepts and contribution of ideas and skills. Nevertheless, there is no duplication and no dependencies. Similarly, there are links with Themes 1 and 3. CMR monitoring fieldwork conducted early in Theme 1 may be able to contribute data to this project if video analyses are completed within the current year. Dependencies are to projects outside the Marine Hub as outlined in the risk assessment section.

Start Date and Duration (in months)

July 2011, 42 months

Project 2.4 - Supporting management of listed and rare species

Continuing project

Project Leader: Peter Kyne

Organisation: Charles Darwin University

Total NERP Budget (ex GST): $954,399

2014 NERP Budget (ex GST): $0

Total Non-NERP Cash/In-Kind Budget (ex GST): $1,331,878

2014 Non-NERP Cash/In-Kind Budget (ex GST): $70,844

Project Description

Reliable and cost-effective assessment and monitoring tools are urgently required for the conservation and management of data-poor, low abundance, rarely-encountered threatened species in Australia, including euryhaline and estuarine elasmobranchs of northern Australia. Management of globally-significant populations of priority species, particularly sawfishes (*Pristis* species) and river sharks (*Glyphis* species), is currently compromised by an acute lack of data and knowledge, including in the river and estuarine waters of the Northern Territory (NT). Essential baseline data and an understanding of distribution, abundance, biology, patterns of connectivity, critical habitat requirements and population genetic structure are needed. While *Pristis* and *Glyphis* species are protected under the *EPBC Act* as well as Commonwealth and State/Territory fisheries regulations, current reporting from fisheries is inadequate to quantitatively determine population status. Subsequently, this limits the assessment of the effectiveness of current management initiatives (such as retention bans, fishing effort reduction, gear regulations, seasonal closures, spatial closures etc.). Population monitoring methods, population modelling and integrated assessment strategies are urgently needed to estimate population status, undertake population assessments, and predict population trajectories, as well as to assess management effectiveness. Research tools encompassing field surveys, tagging and acoustic telemetry, and novel genetic techniques can be integrated in order to meet these needs, resulting in the assessment of the status of rare and threatened species more effectively and at a radically reduced cost. Integrated assessment strategies developed for euryhaline and estuarine elasmobranchs are potentially transferable to other data-poor, low abundance, rarely-encountered and/or threatened marine and aquatic species across a variety of taxa (fishes, reptiles, mammals). This project will be undertaken in several key river systems of the NT, including the Daly, East Alligator, South Alligator, Adelaide and Victoria Rivers.

Key Researchers

1. Peter Kyne (CDU; Project Leader/Field Research Team);
2. Richard Pillans (CSIRO; Project Co-leader/Field Research Team);
3. Thor Saunders (NT Fisheries; Project Co-leader);
4. Grant Johnson (NT Fisheries; Field Research Team);

5. Pierre Feutry (CDU; Genetics Research Team/Population Assessment and Modelling Team);
6. Mark Bravington (CSIRO; Genetics Research Team/Population Assessment and Modelling Team);
7. Peter Grewe (CSIRO; Genetics Research Team/Population Assessment and Modelling Team); and,
8. Russ Bradford (CSIRO; Field Research Team).

Problem Statement

This project will develop innovative methods to assess the population status of data-poor, low abundance, rarely-encountered, threatened euryhaline and estuarine elasmobranchs in order to inform conservation and management of these species.

Outcomes

1. Quantitative estimates of population trend and/or population size for at least one threatened euryhaline or estuarine elasmobranch species which will act as a baseline level to assess the population status and effectiveness of current management measures;

2. Improved ecological understanding of habitat utilization and requirements, short and long-term movements, connectivity and spatial dynamics of priority species;

3. Improved understanding of the seasonal occurrence, species richness and abundance of priority species;

4. Improved management of priority species in northern Australia;

5. Improved public awareness and understanding of the threats facing threatened euryhaline and coastal elasmobranchs in northern Australia; and,

6. Improved engagement with Indigenous communities to further understanding and management of threatened sawfishes and priority elasmobranchs in the NT.

Additional Outcome requested by DOTE

7. Improved monitoring of potential impacts on Largetooth Sawfish and other threatened euryhaline and estuarine elasmobranch species for referred actions or fisheries assessments.

Outputs (products and services) in 2014

1. Manuscript on the population structure of Speartooth Shark;

2. Manuscript on mitogenomic diversity in Largetooth Sawfish and Speartooth Shark;

3. Development of management options for data-poor, low abundance, rarely-encountered threatened species;

4. Manuscript on sawfish representation in Australia's protected area system;

5. Manuscript on population ecology of river sharks in the South Alligator River;

56

6. Guide to the sharks of Kakadu's rivers (prepared in collaboration with Kakadu National Park);

7. Project website including species accounts for each priority species (ongoing); and,

8. A manual providing protocols for monitoring Largetooth Sawfish for use by EACD when addressing referred actions and assessment of fisheries.

Activities and Milestones in 2014

1. Finalise the development of close-kin tools through ongoing molecular and statistical research (including the discovery of genetic markers) (June 2014);

2. Continue field sampling for Largetooth Sawfish and river sharks in key NT river systems (ongoing);

3. Finalise small-scale movement studies to determine habitat utilisation and movement patterns of selected euryhaline species (December 2014);

4. Maintain existing acoustic receiver array systems in key NT river systems (ongoing);

5. Undertake an expert workshop on the development of management options for data-poor, low abundance, rarely-encountered threatened species (June 2014);

6. Engage Indigenous communities in research activities, including in the Daly and Alligator Rivers regions (ongoing);

7. Examine importance of relevant commercial and recreational fisheries regarding interactions with priority species (ongoing); and,

8. Maintain project website (conservation and management of data-poor, low abundance, rarely-encountered threatened species) (ongoing).

Expected Benefits

DOTE will have improved information upon which to base management decisions for data-poor, low abundance, rarely-encountered threatened species in Australia, which a focus on northern Australian threatened euryhaline elasmobranchs (benefits also potentially transferable to other data-poor, low abundance, rarely-encountered and/or threatened marine and aquatic species across a variety of taxa i.e. fishes, reptiles, mammals).

Key Risks in 2014 and Risk Management Strategy

1. Lack of baseline knowledge of distribution and abundance for many species of data-poor, low abundance, rarely-encountered threatened elasmobranchs in the NT (risk), due to their rarity and/or largely inaccessible habitat (source), may compromise population modelling and assessment (consequence). Current program will develop an information base for 3-5 key riverine systems.

2. Small population size of adult Largetooth Sawfish (risk), due to reductions in population, subsequent rarity, large adult size (up to 7 m long, making sampling

57

difficult), and occurrence in expansive marine environments (source), which limits a population assessment of mature animals (consequence). Juvenile Largetooth Sawfish will instead be the focus as these occur in riverine environments and are therefore more accessible than adults. The close-kin method enables the estimation of adult population size through an examination of the relatedness of juveniles within and between rivers, therefore not relying on obtaining adult samples.

3. Small population size of juvenile Largetooth Sawfish (risk), due to rarity, inaccessibility of some freshwater habitat, or possibly due to poor recruitment years during the course of the project (source), which results in insufficient samples for the close-kin genetic approach (consequence), and insufficient fish available to be acoustically tagged in order to monitor movement and derive estimates of mortality required for population estimates. Surveying by the Field Research Team has found this to be the case, and the project expanded in 2013 to include Speartooth Shark, another listed euryhaline species, with decent numbers obtained in 2013 from various rivers (including expanding the project to sample the Cape York Peninsula population).

4. Some acoustic receivers positioned in river systems may be lost (risk), due to the large discharge in the wet season (source), reducing data available for movement studies and mortality estimates (consequence).

5. A limited number of independent mitochondrial or nuclear loci may be found (risk), due to recent bottle-neck events or small effective population size (the less unrelated the individuals are, the less recombination events have happened) (source), limiting our capacity to infer relationships between individuals, population structure and sex-biased dispersal (consequence).

Research Questions (Environment Portfolio) (reduced to key questions addressed)

1.1   Are all threatened species equally valuable in a genetic and ecological context?

1.2   When is it too late to recover a species?

1.3   What is the fairest and most cost-effective mix of policy tools to conserve recognised biodiversity values?

1.4   What are the best mechanisms for sharing the costs of management between the various beneficiaries?

Policies and Programs

1A Biodiversity Conservation;

1B Protection of Threatened Species and Communities;

B2 Sustainable Management of Natural Resources and the Environment.

Key Events and Dates in 2014

January to October: key field season.

Management options workshop – early 2014

Meeting with DOTE – mid 2014

Hub annual meeting – late 2014

End Users

- Lesley Gidding, Marine and Freshwater Species Conservation, WH&M, DOTE;

- Nathan Hanna, Sustainable Fisheries, WH&M, DOTE;

- Director Kakadu National Park, DOTE

- Veronica Blazely, National Natural Heritage, DOTE

Links and Dependencies to other Hubs and projects

This project inks to the NERP Northern Australia Hub. That Hub will be examining the interdependencies between riverine and coastal systems, including a focus on biodiversity and connectivity. With the Marine Hub examining inshore-offshore marine environments, a linkage between the two will provide a more complete picture of cross-system use, resulting in filling critical knowledge gaps regarding connectivity between systems. Sawfish and river sharks are reliant on environments spanning the interests of both Hubs, moving across the catchment-coastal-offshore interface, and therefore representing a cross-system linkage. The Northern Australia Hub has co-invested, providing 50% of a postdoctoral salary and contributing to operating costs. This will result in significant value adding, and complimentary expertise and leadership from the riverine-estuarine perspective. Links to Project 2.3 (task 1) - Landscape approaches to managing high priority conservation values. Links to Project 2.5 – New tools to assess the recovery of white sharks.

Start Date and Duration (in months)

Start date: October 2011; Duration: 39 months.

Project 2.5 – White shark population and abundance trends

Project Leader: Barry Bruce

Organisation: CSIRO

Total NERP Budget (ex GST): $500,000

2014 NERP Budget (ex GST): $200,000

Total Non-NERP Cash/In-Kind Budget (ex GST): $370,876

2014 Non-NERP Cash/In-Kind Budget (ex GST): $148,350

Project Description

This project develops techniques to undertake a population assessment for white sharks in Australian waters. An assessment is necessary to understand whether the species is recovering and hence whether conservation actions under the National Recovery Plan for the species are producing tangible benefit. This project will combine novel genetic and electronic tagging techniques to develop initial estimates of the abundance and population trends of white sharks in eastern Australian waters. It will also establish protocols for developing national estimates of abundance and an on-going monitoring strategy for the species. The tools developed will provide a framework for similarly assessing the population status of other EPBC Act listed marine species, such as grey nurse shark, sawfish and spear-tooth shark species. The overall program comprises seven sub-projects staged through the 2013 and 2014. The project will consolidate existing information on the demographic parameters, develop novel methods for determining juvenile and adult survival and provide initial estimates of abundance based on nursery area surveys. These data will be used to develop strategies for long-term population monitoring and for assessing population trends. Research will initially focus in eastern Australia while building further knowledge and reviewing on data available for white sharks west of Bass Strait. Once the techniques have been developed on the east coast, they will be transferrable to white sharks on the west coast, as the movement patterns, spatial footprint and key habitats of the western population are identified.

Key Researchers

1. Barry Bruce (CMAR Project Leader)
2. Toby Patterson (CMAR Project Co-leader - Estimating juvenile abundance)
3. Peter Grewe (CMAR Project Co-leader - Estimating adult survival)
4. Mark Bravington (CMIS Project Co-leader - Estimating adult abundance)
5. Rich Hillary (CMAR Project Co-leader - Data integration and modeling)
6. Russ Bradford (CMAR Project Co-leader – Western white shark population)

Problem Statement

The white shark is currently listed as 'Vulnerable' under the EPBC Act. A National Recovery Plan for the white shark was initiated in 2002 and a review of the recovery plan, undertaken in 2008, supported the current listing. The review, however, concluded that although progress has been made on a number of listed actions, there was still no effective way to estimate population size or population trends in Australian

60

waters and thus no effective way of determining if current Recovery Plan actions (including the initial instigation of protective legislation) were having any tangible beneficial effect. Thus it was not possible to assess progress against the primary goal of the Recovery Plan.

Recent public and political debate, particularly in Western Australia, due to a series of fatal shark attacks, has highlighted an urgent 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. Establishing current status and trends in populations generally requires long-term historical data sets of catch or other suitable indices of abundance, analytical tools to interpret and standardise these data and protocols for implementing a cost effective way of on-going monitoring. These are not always available or well defined for marine TEP species, like the white shark, and are thus not trivial tasks to achieve.

Outcomes

The project will 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. The project will provide information that will assist in the implementation of marine bioregional plans; development and implementation of policies to support the ecologically sustainable management of the marine environment; and advising on the status of and threats to marine matters of national environmental significance and fulfil obligations under the National Plan of Action (Sharks).

The project will contribute to:

1. Priorities identified in the department's Annual Operational Plan 2012-2013 and Strategic Plan 2012-2016 by advancing efforts to halt the decline of marine biodiversity;

2. Response to a recent emerging issue of public interest but furthering a national research strategy agreed to by WA, Commonwealth and other leading Australian shark experts;

3. A research need identified in SOE2011, specifically the uncertainty around the reported continuing decline in east coast white shark populations;

4. Inform efficient and effective biodiversity data, information and knowledge systems, through its collaborative approach and integrating existing expertise and data; and uses innovative technology to establish well-informed conservation management through recovery planning, using a mix of acoustic tagging, aerial surveys and close-kin genetics;

Outputs (products and services) in 2014

1. Manuscript on preliminary trials of aerial surveys of juvenile nursery areas

61

2. Manuscript examining long term (14 year) correlations between white shark distribution and movements in southern Australia and environmental variables (including sea level)

3. Manuscript on distribution and migration patterns of juvenile white sharks in eastern Australia using acoustic tracking and satellite telemetry data

4. Manuscript on aging of Australian white sharks

5. Updated public extension display featuring project activities at the Melbourne aquarium

Activities and Milestones in 2014

1. Commence tagging program SE Victoria (June 2014)

2. Development and application of close-kin tools through ongoing molecular and statistical research, including the discovery of genetic markers (Dec 2014).

3. Complete tagging program (Port Stephens) (Dec 2014)

4. Complete aerial survey program (Port Stephens) (Dec 2014)

5. Continue public extension displays - Melbourne Aquarium and partner oceanariums (Dec 2014)

6. Provision of Progress Reports June 2014/Dec 2014

7. Provide project summary for Hub final report in approved template (Dec 2014)

Expected Benefits

The project will 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. The project will provide information that will assist in the implementation of marine bioregional plans; development and implementation of policies to support the ecologically sustainable management of the marine environment; and advising on the status of and threats to marine matters of national environmental significance and fulfil obligations under the National Plan of Action (Sharks).

Key Risks in 2014 and Risk Management Strategy

Risk	Analysis – Likelihood and consequence	Rating – see table below	Treatment
Availability of experts	Possible; Major	High	Project team is well established and allocated to the project. Sub-project leaders have been allocated tasks and meeting schedules determined
Reluctance of some parties to cooperate and share information	Possible; Moderate	low	Involve all stakeholders in process to incorporate their views and get them on board with the benefits of the project.
Timelines not aligned to DOTE needs	Unlikely; Major	High	Key dates and deliverables have been discussed and agreed with DOTE listed species section.
Linkages and synergies with other NERP projects not fully explored/implemented	Unlikely; Moderate	Moderate	Internal meetings with linked projects regularly held and representatives from projects consulted prior to or participate in meetings. Shared project staff between this project and other projects.
Unusual weather prevents field work	Possible, Moderate	Moderate	Close liaison with State colleagues will identify suitable windows and improve equipment availability.
White shark population much larger than expected	Rare, Catastrophic	Moderate	Moderate risk to project, but overall a good outcome for the department and the conservation of this species. Statistical analyses will help resolve this question.

		Likelihood				
		Rare	Unlikely	Possible	Likely	Almost certain
Consequence	Insignificant	Low	Low	Low	Low	Low
	Minor	Low	Low	Moderate	Moderate	Moderate
	Moderate	Low	Moderate	Moderate	High	High
	Major	Moderate	High	High	Very high	Very High
	Catastrophic	Moderate	High	Very High	Very High	Very High

Research Questions (Environment Portfolio) (reduced to key questions addressed)

What is the current population status of white sharks in Australian waters?

How can populations of such non-commercial threatened marine species be adequately assessed and monitored to provide robust policy advice?

Policies and Programs

1A Biodiversity Conservation;

1B Protection of Threatened Species and Communities;

B2 Sustainable Management of Natural Resources and the Environment.

Key Events and Dates in 2014

January to March – key fieldwork period (SE Vic)

August to December – key fieldwork period (NSW)

Meeting with DOTE – mid 2014

Hub annual meeting – late 2014

End Users

- Lesley Gidding, Marine and Freshwater Species Conservation, WH&M, DOTE;
- Nathan Hanna, Sustainable Fisheries, WH&M, DOTE;
- Additional key stakeholders are DOTE, the National Shark Recovery Team, the engaged group of experts, Fisheries and Environment Departments of the States of WA, NSW, Victoria, SA, and TAS, IMOS.

Links and Dependencies to other Hubs and projects

This project builds on techniques developed in the FRDC/CSIRO southern bluefin tuna population estimation project – a multi-year, multi-million dollar project. This project will use and further refine the statistical and genetic approaches developed in that project.

This project extends the NERP Marine Biodiversity Hub Euryhaline Elasmobranch project led by CDU with input from CSIRO and NT Fisheries. There will be exchange between the projects to improve the technical expertise available to both, including in genetics, close-kin analysis and the analysis and interpretation of acoustic data.

Start Date and Duration (in months)

June 2013   18 months: (Final report due Dec 2014)

64

Theme 3: National Ecosystems Knowledge

This theme will provide a better understanding of linkages between seabed physical features and ecological processes that sustain important areas for marine biodiversity including Key Ecological Features (KEFs), estimate and test connectivity between these important areas and those areas being actively managed for biodiversity conservation (e.g. CMRs), and provide the long-term perspective on biodiversity dynamics to inform future management under climate change.

Additional information: The research will support implementation of Marine Bioregional Plans by providing new data, maps and interpretations (e.g. inputs to Marine Conservation Atlas) to inform assessments under the EPBC Act, such as those for commercial fisheries or assessment of activities associated with oil and gas exploration and production. This theme will also contribute to the strategic longer-term need to progressively develop our capacity to understand and communicate national patterns of marine biodiversity (e.g. through future iterations of the Integrated Marine and Coastal Regionalisation of Australia that may be required in the longer-term).

Theme Leader: Dr Scott Nichol

Organisation: Geoscience Australia

Total NERP Budget (ex GST): $2,712,636
2014 NERP Budget (ex GST): $57,122

Total Non-NERP Cash/In-Kind Budget (ex GST): $4,823,632
2014 Non-NERP Cash/In-Kind Budget (ex GST): $147,568

Project 3.1 – Shelf and canyon ecosystems – functions and processes

Continuing project

Project Leader: Dr Scott Nichol

Organisation: Geoscience Australia

Total NERP Budget (ex GST): $1,508,743

2014 NERP Budget (ex GST): $49,215

Total Non-NERP Cash/In-Kind Budget (ex GST): $2,734,824

2014 Non-NERP Cash/In-Kind Budget (ex GST): $55,099

Project Description

This project will provide a better understanding of the spatial linkages between seabed physical features and patterns of biodiversity for targeted areas in Northern Australia through integrated analysis and modelling of available physical and biological datasets.

Project 1 focuses on shelf and canyon features as these were identified as important areas for biodiversity in marine bioregional plans. Improved information on the importance of individual features to biodiversity values and the relative biodiversity value of nearby features will assist assessments of the impacts of marine use and

65

inform subsequent management decisions. Ecologically important physical processes that operate within and between shelf and canyon ecosystems determine their value as biodiversity hotspots, e.g. for locally rich benthic biodiversity, high productivity, or local abundances of listed species. This project will improve knowledge of the importance of large-scale shelf features that support biodiversity values for areas of management interest in Northern Australia, selected in consultation with DOTE. The project will harvest the best available existing data (bathymetry, oceanography, sediments, habitats, species), incorporate new data from strategically selected sites (in collaboration with Themes 1 and 4) and employ advanced spatial analysis methods (in collaboration with Project 2 and Theme 1). Importantly, this project will develop an analytical template for characterising and assessing the significance for biodiversity of key physical and ecological features throughout the Australian Marine Estate. This will assist managers evaluating options for biodiversity management of the many canyons and outer shelf features (especially outside the Commonwealth Marine Reserve Network) where no biological surveys have occurred. The project comprises two tasks:

Task 1: Data Discovery for Areas of Management Interest. Data that describe physical features, processes and patterns of biodiversity on the continental shelf in areas of management interest of Northern Australia will be identified, harvested and formatted for analysis. The key outputs will be GIS products and supporting documentation that describe and integrate these datasets for these areas, as well as the provision of sustainable management and online discoverability of the data.

Task 2: Data Analysis & Synthesis for Areas of Management Interest. The role of large-scale physical features on the shelf (banks, canyons, reefs) in influencing patterns of marine biodiversity will be analysed for these identified areas. Key objectives of the analysis are: (i) Providing quantitative descriptions of the morphology of large-scale physical features that can be used to predict their likely influence on key ecological processes (exposed substrate and increased productivity); (ii) Characterising physical and biological oceanography both on and off these large-scale physical features (e.g. upwelling zones); (iii) Mapping the distribution, abundance and behaviour of selected taxa (e.g. large sharks and fishes); (iv) Assessing the role of physical processes and ecology in the distribution of biodiversity. The key outputs will be new models (conceptual, qualitative & quantitative) that describe how the morphology and local oceanography of large-scale physical features influences their value to biodiversity. These models can then be used to predict the biodiversity value of other large-scale physical features that have not been sampled for their biodiversity. This information will assist assessing and managing impacts of marine industries including fisheries and oil and gas development.

Key Researchers

1. Julian Caley, AIMS - Ecologist
2. Camille Mellin, AIMS - Benthic ecologist
3. Brendan Brooke, GA - Geomorphologist
4. Peter Harris, GA - Sedimentologist
5. Zhi Huang, GA - Spatial analyst
6. Johnathan Kool, GA - Marine ecologist
7. Jin Li, GA - Ecological modeller
8. Scott Nichol, GA - Geomorphologist
9. Kim Picard, GA - Geoscientist

10. Rachel Przeslawski, GA - Marine ecologist
11. Lynda Radke, GA - Geochemist
12. Justy Siwabessy, GA - Acoustician
13. Gordon Keith, CSIRO - Seabed acoustician
14. Rudy Kloser, CSIRO - Seabed acoustician
15. Alan Williams, CSIRO - Marine ecologist
16. Phillipe Bouchet, UWA - Ecologist
17. Tom Letessier, UWA - Ecologist
18. Jessica Meeuwig, UWA - Quantitative ecologist
19. Anya Waite, UWA - Biological oceanographer

Problem Statement

Physical features on the shelf and in canyons were identified as important areas for biodiversity in marine regional plans. However, we lack a detailed understanding of the influence of physical features and processes on patterns of biodiversity across the continental shelf and upper slope. This project will improve our knowledge of the importance of large-scale shelf features (e.g. reefs, canyons) that support biodiversity values for areas of management interest in Northern Australia.

Examples of hypotheses to be tested:
 "*Assemblages of benthic community x vary in distribution across space as a function of the distribution of seabed features 1, 2, 3*" and; "*Key ecological processes vary across the continental shelf in association with the distribution of large scale geomorphic features (e.g. banks, shoals, valleys)*"

Outcomes

Short term outcomes include a considered understanding of the importance of the physical environment associated with seafloor features for biodiversity value, including connectivity between management areas (CMRs, KEFS). This will lead to the medium to long term outcome of an improved capacity for understanding and monitoring patterns of biodiversity at inter-annual to decadal time scales and for managing off-reserve activities at spatial scales that represent biodiversity patterns.

Outputs (products and services) in 2014

Fact sheets, data, metadata, maps, models/animations and papers describing and interpreting shelf and canyon processes at national and regional (CMR, KEF) scales.

The following products are planned for 2014:

1.	Science for Policy Makers Fact Sheet	*Submarine canyons on the Australian margin: Summary of key physical features, regional patterns & significance for biodiversity*
	Authors:	Huang, Nichol, Harris, Kloser and others
	Synopsis:	Factual summary of the number, type and distribution submarine canyons on the Australian margin, with supporting maps and charts. Presented in the context of the Commonwealth Marine Reserve network and related to oceanographic information.

	Due date:	March 2014 (draft)

2.	Science for Policy Makers Fact Sheet	*A continental-scale ocean connectivity model for marine ecosystems in Australia*
	Authors:	Kool and others
	Synopsis:	Description of the ocean connectivity model and how it can be used to better understand the spatial linkages within and between Commonwealth Marine Reserves and Key Ecological Features across the marine estate. To include an example from the North and North-West Marine Regions.
	Due date:	March 2014 (draft)

3.	Science for Policy Makers Fact Sheet	*Relationship between seabed structure and pelagic marine biodiversity at a continental scale*
	Authors:	Bouchet, Letessier, Huang and others
	Synopsis:	Factual summary of large-scale relationships between the diversity and distribution of pelagic species against a range of environmental variables including seabed geomorphology and sea surface properties.
	Due date:	March 2014 (draft)

4.	Metadata for Project Datasets	*a) National Submarine Canyon Dataset*
		b) National Larval Dispersal and Connectivity Dataset
	Authors:	Huang, Kool and others
	Synopsis:	a) Metadata describing the metrics derived for all mapped canyons on the Australian margin; published on AODN using Marine Community Profile for metadata.
		b) Metadata describing the metrics and derived products available from the dispersal model; published on AODN using Marine Community Profile for metadata.
	Due date:	February 2014

5.	Maps	*a) Maps & explanations representing potential connectivity and activity within and between KEFS and CMRs for the North and Northwest Marine Regions*
		b) Maps & explanations representing potential connectivity between submarine canyons for selected areas in the Northwest, Southwest and Southeast Marine Regions.

68

	Authors:	Huang, Kool, Nichol and others
	Due date:	July 2014 (draft)
6.	**Models**	**Online model of larval dispersal and connectivity for the Australian EEZ (open source with graphical user interface).**
	Authors:	Kool
	Due date:	July 2014
7.	**Posters**	Submarine Canyons of the Australian margin
	Authors:	Huang, Nichol and others
	Due date:	May 2014
8.	**Audio-Visuals**	*a) Flythrough movie of seabed habitats in the Oceanic Shoals Commonwealth Marine Reserve.* *b) Animation of 3D dispersal and mixing patterns in submarine canyons of the Northwest Marine Region.*
	Authors:	Nichol, Kool and others
	Due date:	April 2014

The following journal publications are proposed:

1.	**Working title:**	*Seabed geomorphology, processes and biodiversity of the Oceanic Shoals Commonwealth Marine Reserve (Timor Sea)*
	Authors:	Nichol, Picard, Siwabessy, Bouchet, Radke and others
	Synopsis:	Integrated interpretation of seabed form and physical processes within the Oceanic Shoals CMR, including an analysis of fine scale bathymetry scaled-up to a generalised model for the carbonate terraces KEF.
	Draft due:	December 2014

69

2.	Working title:	*Using new knowledge of marine ecosystems processes to support management and monitoring of marine reserves*
	Authors:	Nichol, Meeuwig, Caley and others
	Synopsis:	Demonstration of how new knowledge of the spatial relationships between seabed features and biodiversity patterns can be used to guide marine reserve management (Case studies of KEF's to be included).
	Draft due:	October 2014
3.	Working title:	*Potential connectivity between submarine canyons: a regional scale analysis*
	Authors:	Kool, Huang and others
	Synopsis:	Analysis of the potential for biological connectivity between canyons based on the larval dispersal model and national canyon dataset (focus on canyons in Northwest, Southwest & Southeast Marine Regions).
	Draft due:	October 2014
4.	Working title:	*Spatial and temporal variability of the Leeuwin Current and East Australian Current as modelled from sea surface satellite data (MODIS)*
	Authors:	Huang and others
	Synopsis:	Analysis of the Leeuwin Current and East Australian Current for the period 2002-2013 incorporating an 'environmental condition' assessment of the CMR network for the Northwest, Southwest, Temperate East and Southeast Marine Regions.
	Draft due:	July 2014
5.	Working title:	*Sponge biodiversity and ecology of the Van Diemen Rise and eastern Joseph Bonaparte Gulf, northern Australia*
	Authors:	Przeslawski, Alvarez, Battershill and others
	Synopsis:	Integrated analysis of sponge biodiversity patterns across the Oceanic Shoals CMR, using samples and data collected on three surveys (2009, 2010, 2012)
	Draft due:	July 2014 (published)
6.	Working title:	*The effects of multiple stressors on marine embryos and larvae*
	Authors:	Przeslawski, Byrne, Mellin

	Synopsis:	A review of literature on the effects of multiple stressors (climate change, ocean acidification) on early life stages of marine organisms. To include a meta-analysis of published results to identify knowledge, determine interaction type and strength, and identify key organisms that may be particularly robust or sensitive to conditions associated with stressors.
	Draft due:	July 2014
7.	Working title:	*Comparison of sampling methods to assess marine habitats and biodiversity patterns*
	Authors:	Przeslawski, Flannery
	Synopsis:	Analysis of the consistency of ecological relationships and biodiversity patterns across gear types (to be published as a Geoscience Australia Record)
	Draft due:	October 2014
8.	Working title:	*Using acoustics methods for ecological applications*
	Authors:	Przeslawski, Picard, Carroll and others
	Synopsis:	This review will summarise and assess the ways in which acoustics technology is being used in marine ecological research, including both widespread uses such as habitat mapping and lesser known uses such as quantifying behaviour.
	Draft due:	December 2014
9.	Working title:	*Novel methods for predicting biological invasions in warming oceans*
	Authors:	Mellin, Fordham, Bax, Bradshaw, Przeslawski, and Caley
	Synopsis:	
	Draft due:	January 2014
10	Working title:	An inventory of the submarine canyons incising Australia's continental margin and their habitat potential
	Authors:	Kloser, Williams, Keith, Althaus
	Synopsis:	Based on high resolution multi-beam data and available video data characterise the habitat of defined shelf incising canyons around the Australian continental margin. Test epifauna functional group predictive capability of the multi-beam backscatter and bathymetry data.
	Draft due:	February 2014

71

11	**Working title:**	Submarine canyons as a feature-scale surrogate for marine planning: a test of the false environmental heterogeneity hypothesis
	Authors:	Williams, Kloser, Althaus and Keithl
	Synopsis:	• hypothesis suggests there is inadequate characterisation of environment using abiotic surrogates, feature scale surrogates (Level 3) are too coarse, and are misunderstood/misused (Williams et al. 2009) • image and catch data enable first attempt to define fine scale habitat heterogeneity and species patterns • take account of fishing impacts – and could potentially include something about vulnerability • conclusions identify the need for 'sub-structure' (Level 4) to be understood for marine planning and point to the need for process studies or observational studies to underpin effective management
	Draft due:	June 2014

Activities and Milestones in 2014

Activity 1: Ongoing consultation with Wildlife, Heritage and Marine Division on progress with project research, with a focus on tailoring outputs to DOTE strategic needs.

Activity 2: Data Analysis and Synthesis will be completed this year, with a focus on ecosystem processes and Key Ecological Features of the North and Northwest Marine Regions. The analysis will also extend to datasets for the Temperate East and Southeast as part of the national canyon classification research.

New Milestone 1: May 2014 - Presentation of research at GeoHab 2014. GeoHab is the annual international conference on seabed habitat mapping and will be held in Australia this year. Project researchers will attend to present papers on the national canyon classification/analysis, connectivity modelling and biodiversity patterns in the North and Northwest Marine Regions.

New Milestone 2: December 2014. Shelf Physical Feature & Biodiversity Analysis - Analysis and modelling of relationships with biodiversity patterns completed for the North and Northwest marine regions, incorporating data from Theme 4 Oceanic Shoals Voyage of Discovery and outputs from larval dispersal modelling.

New Milestone 3: December 2014. Contributions from Project 3.1 to the Marine Biodiversity Hub Final Report are underway.

Expected Benefits

Activity 1: This work will identify the relative importance for biodiversity of physical features/KEFs, as identified in Bioregional Summaries.

Key Risks in 2014 and Risk Management Strategy

- DOTE not fully informed of project progress. Management strategy – maintain monthly reporting through the Marine Hub Research Leaders meeting.

- Progress with analysis of project data delayed. Management strategy – regular (fortnightly to monthly) communications between project partners on progress with data assembly and on start-up of analysis. Communications via phone hook-ups and a workshop planned for mid-year.

Research Questions (Environment Portfolio)

Q2.   Ecosystems: understanding ecosystem function/monitoring ecosystem health.

Q2.1   How can we improve our capacity to understand, monitor and evaluate ecosystem function/health?

Q2.3   What are the advantages and disadvantages for biodiversity of an ecosystem management approach?

Q2.4.   In environments such as marine areas, where comparatively little is known about biodiversity and ecosystem processes, what can we do to strengthen and validate the use of surrogates for identifying biodiversity for protection?

Policies and Programs

1A Biodiversity conservation;

1B Protection of threatened species & communities;

1E Maintaining a marine reserve system;

1G Biodiversity research;

B1 Environmental regulation;

B3 Protection and management of heritage values.

Key Events and Dates in 2014

- GeoHab 2014 International Conference being held in Australia in May (Lorne, Victoria). Researchers from Project 3.1 will attend and present key findings in a series of oral and poster papers.

- Project workshop planned for mid-2014 to bring researchers together to progress write up of results.

End Users

- Barbara Musso, Belinda Jago, Rod Atkins, Parks Australia, DOTE

- Travis Bover, Regional Domestic Marine Policy, DOTE

- Veronica Blazely, National Natural Heritage, DOTE

Links and Dependencies to other Hubs and projects

This project links to Theme 1 Project 2 – Analysis and approaches for monitoring biodiversity - as a source of expertise and information on shelf physical features, processes and biodiversity. Several researchers from Geoscience Australia (Nichol, Kool, Huang) and CSIRO (Williams) are involved in both projects.

The project also links to and is partly dependent on Theme 4 – Regional Biodiversity Discovery to Support Marine Bioregional Plans, as a source of new data for the Northern Marine Region. However, this project is not fully dependent on Theme 4 and has commenced ahead of the marine survey.

Start Date and Duration (in months)

Activity 1: DOTE Consultation – Commenced Nov 2011, Ongoing

Activity 2: Data Analysis & Synthesis – Commenced October 2012, Ongoing

Project 3.2 – National maps of connectivity and biodiversity

Continuing project

Project Leader: Dr Tim O'Hara

Organisation: Museum Victoria

Total NERP Budget (ex GST): $1,203,893

2014 NERP Budget (ex GST): $7,908

Total Non-NERP Cash/In-Kind Budget (ex GST): $2,088,808
2014 Non-NERP Cash/In-Kind Budget (ex GST): $92,468

Project Description

This project will take advantage of recently developed and upgraded biodiversity databases, supplemented with new genetic information, to compare and contrast alternative attributes of Australian marine biodiversity. It will compare the distribution of species richness of local endemics with those for all species, or with areas identified to be important in speciation or climate refuge. It will use a process-based approach to identify common biodiversity patterns that will inform conservation management at medium to large scales.

Task 1 (2012-2014): National maps of biodiversity and connectivity. There are few national maps of biodiversity and connectivity for the Australian marine environment. The aim of this task is to begin accumulating comprehensive datasets for selected biota across the entire Australian EEZ, including Antarctica (from 0-2000 m), map hotspots of biological and genetic diversity, and explore potential changes to faunal composition under various climate-change scenarios. This task will employ an innovative combination of phylogenetics and modelling to map patterns of connectivity of data-rich biota at national and regional scales. Outputs will be national maps of species and genetic biodiversity supported by datasets at sub-regional scale to assist decision makers. At present we have little data for many places identified as being of interest to Marine Heritage (eg Coral Sea, Cape York, Kimberley). An atlas will summarise and interpolate existing knowledge for two large faunal groups nationally. National maps of biodiversity will assist understanding of the role of networks of CMRs and other management measures in achieving the objectives of marine bioregional plans. Output from this task will be used in Theme 2 Project 1 to value marine biodiversity and may influence monitoring decisions in Theme 1.

Task 2 (2013-2014): National biodiversity datasets for squat lobsters, sharks, rays and selected teleosts. This task will utilise the key conservation values, vulnerability and extensive data holdings for Australian sharks, rays and selected teleosts to identify areas of key importance to threatened species, endemics, and both ancient and recently evolved elements of the fauna within marine provinces and their bathomes. Outputs will combine existing datasets and maps summarising distributions with conservation values of sharks, rays and selected teleosts, incorporating hotspots of distribution and endemicity. This project will provide data products and maps that will improve DOTE capacity to recognise, interpret and identify options to manage potential intersections between users of the marine environment and biodiversity values in identified hotspots, and provide improved information on which to base recovery plans if required.

75

Key Researchers

1. Tim O'Hara, Museum Victoria - Biogeographer & invertebrate taxonomist
2. Adnan Moussalli, Museum Victoria - Molecular analyst
3. Andrew Hugall, Museum Victoria - Post-doc
4. Skipton Woolley, Museum Victoria - PhD Student
5. Julian Caley, AIMS - Ecologist
6. Nikos Andreakis, AIMS - molecular phylogeneticist
7. Peter Last, CSIRO - Fish biogeographer & taxonomist
8. Daniel Gledhill, CSIRO - Fish biogeographer
9. William White, CSIRO - Fish biogeographer & taxonomist

Problem Statement

There are few national maps of biodiversity and connectivity for the Australian marine environment. Consequently, biological assessments of MPAs, KEFS and areas of economic interest have to be conducted without comparable data from other regions. This project will accumulate comprehensive datasets for the Australian EEZ that can be used to map hotspots of biological and genetic diversity, explore potential changes to faunal compositions under climate change and assign relative values to marine assets.

Outcomes

Increased capacity for understanding patterns of biodiversity and connectivity between management areas (CMRs, KEFS) through further building the national evidence database. Improved capacity for understanding patterns of biodiversity and for managing off-reserve activities at spatial scales that represent biodiversity patterns.

Outputs (products and services) in 2014

1. Mapping of seafloor phylogenetic endemism by December 2014.

2. Mapping of seafloor species richness and beta diversity (species turnover) across Australia's marine domain for the two invertebrate groups by July 2014.

3. Preparation of the national atlas of connectivity and biodiversity for Australia's seafloor life by December 2014.

4. Database consisting of datasets and maps summarising the distributions and key conservation values of Australian sharks, rays and selected teleosts within each demersal bathome. These will depict hotspots of distribution and endemicity and will provide insight into the origin and derivation of these species.

5. A series of scientific papers is expected, including:

1.	**Working title:**	*The distribution of phylogenetic endemism of seafloor fauna for the Australian region*
	Authors:	T O'Hara, A Hugall, S Woolley.
	Synopsis:	Paper summarising the distribution of phylogenetically rare species across the Australian EEZ.
	Draft due:	December 2014

2.	**Working title:**	*Global maps of seafloor species richness*
	Authors:	S Woolley, T O'Hara, A McCallum
	Synopsis:	Paper summarising species richness of two target faunal groups across the globe with a special emphasis on the Australian region.
	Draft due:	September 2014

3.	**Working title:**	*Global maps of seafloor biodiversity*
	Authors:	T O'Hara, A McCallum, S Woolley
	Synopsis:	Paper summarising biodiversity patterns of two target faunal groups across the globe with a special emphasis on the Australian region.
	Draft due:	June 2014

77

4.	Working title:	*Microsatellite marker development in the commercially exploited fish Rexea solandri.*
	Authors:	S Appleyard, N Andreakis, D Gledhill, J Morrongiello, N Bax
	Synopsis:	Development of molecular tools to investigate population structure in Gemfish.
	Draft due:	December 2014
5.	Working title:	*Demographic fluctuations of stock populations of Rexea solandri from southern Australia over the last 30 years of overexploitation and climate change.*
	Authors:	N Andreakis, S Appleyard, D Gledhill, J Morrongiello, N Bax
	Synopsis:	Demographic fluctuations of stock populations of Eastern Gemfish from southern Australia over the last 30 years of overexploitation and climate change.
	Draft due:	December 2014
6.	Working title:	*Phylogenomic approach to examine evolutionary diversity and distribution of the fish families Bothidae, Triglidae and Cynoglossidae in the Indo-pacific*
	Authors:	N Andreakis, W White, N Bax, P last
	Synopsis:	Phylogenomic approach to examine evolutionary diversity and distribution of the fish families Bothidae, Triglidae and Cynoglossidae in the Indo-pacific.
	Draft due:	December 2014

Activities and Milestones in 2014

Activity 4. Preparation of the National Atlas of Connectivity and Biodiversity for Australia's Seafloor Life.

New Milestone 4 (January 2014): Draft list of maps and explanatory text to be included in the Atlas for discussion with DOTE.

New Milestone 5 (April 2014): Agreement of final content of the Atlas.

New Milestone 5 (November 2014): Production of the Atlas.

New Milestone 6 (December 2014): Contribution to Hub final report in agreed template.

Expected Benefits

Data discovery and maps of species richness, and the distribution of rare and endemic species of benthic fauna (especially the often vulnerable sharks and rays) will assist the Department in refining values of Biologically Important areas and assessing future activities. Maps of evolutionary diversity will identify hotspots for speciation and evolutionary dead-ends that may influence future management of marine biodiversity.

Key Risks in 2014 and Risk Management Strategy

Activity 4: No major risks

Research Questions (Environment Portfolio)

Q1.1   Are all threatened species equally valuable in a genetic and ecological context?

Q2.   Ecosystems: understanding ecosystem function/monitoring ecosystem health.

Q2.1   How can we improve our capacity to understand, monitor and evaluate ecosystem function/health?

Q2.3   What are the advantages and disadvantages for biodiversity of an ecosystem management approach?

Q2.4.   In environments such as marine areas, where comparatively little is known about biodiversity and ecosystem processes, what can we do to strengthen and validate the use of surrogates for identifying biodiversity for protection?

Q3.1   How do we manage ecosystems and regions for ecological resilience: how is resilience maintained, restored and monitored?

Q3.2   How do we best manage important ecological features, such as climatic refugia, that could prevent decline in ecosystem function or improve species management?

Q3.7   How can we best manage those parts of the Commonwealth Marine Area outside MPAs to ensure values of MPAs are not compromised by external threats?

Policies and Programs

1E Maintaining a marine reserve system;

1G Biodiversity research;

B3 Protection and management of heritage values;

C1 Antarctic science and environmental management.

Key Events and Dates in 2014

Presentation of draft Atlas to DOTE and project update (January 2014)

Hub workshop (late 2014)

End Users

- Travis Bover, Regional Domestic Marine Policy, WH&M, DOTE
- Barbara Musso, CMR Policies and Programs Coordination, PA, DOTE
- Veronica Blazely, National Natural Heritage, DOTE
- Ian Snape, Martin Riddle and Andrew Constable, AAD

Links and Dependencies to other Hubs and projects

The Atlas will include data obtained from the Oceanic Shoals surveys (theme 4).

Start Date and Duration (in months)

Activity 4: January to December 2014.

Theme 4: Regional biodiversity discovery to support marine bioregional plans

Regional knowledge gaps in Northern Australia have been identified as a Departmental priority in recognition of the global marine biodiversity significance of these regions, and the rapidly increasing pressures facing them. A broad suite of physical and biological data will be collected by an interdisciplinary team from AIMS, Geoscience Australia, Museum and Art Gallery of the Northern Territory, and the University of Western Australia using a diverse set of data collecting methods. The two surveys proposed for this theme have now been reduced to one, but opportunities will be sought to mount a second survey through co-investment from other sources including the Marine National Facility.

Theme Leader: *Dr Julian Caley*

Organisation: *Australian Institute of Marine Science*

Total NERP Budget (ex GST): $1,437,606

2014 NERP Budget (ex GST): $54,130

Total Non-NERP Cash/In-Kind Budget (ex GST): $2,099,258

2014 Non-NERP Cash/In-Kind Budget (ex GST): $75,368

Project 4.1 – Twenty-one day *RV Solander* survey

Continuing project

Project Leader: Andrew Heyward (acting Julian Caley)

Organisation: Australian Institute of Marine Science

Total NERP Budget (ex GST): $1,437,606
2014 NERP Budget (ex GST): $54,130

Total Non-NERP Cash/In-Kind Budget (ex GST): $2,099,258

2014 Non-NERP Cash/In-Kind Budget (ex GST): 75,368

Project Description

We will use ship-based sampling to "develop a better understanding of the marine biodiversity and major drivers for maintaining biodiversity" (Marine Division) by filling major knowledge gaps for specific data poor KEFs and CMRs in Northern Australia and/or the Coral Sea. The initial cruise will survey key features including shoals and pinnacles that may be areas of high species richness on the continental shelf to the western side of Joseph Bonaparte Gulf. This survey location in the Oceanic Shoals CMR was chosen in consultation with DOTE and aims to directly enhance outputs from other projects in the Hub. The survey has now been completed.

Data from this survey will be used to address nationally recognised gaps in biodiversity knowledge and to understand patterns of community assembly, associated physical drivers of marine biodiversity in these poorly studied marine realms, and provide a regional context to these patterns and processes. This sampling will also support further development of a national mapping and survey capacity. This theme will provide key inputs of data and samples to Theme 3. These data will also provide opportunities for testing and extending the work in Themes 1 and 2 particularly the proposed regionally focussed work supporting marine management.

Key Researchers

1. Julian Caley, AIMS - Theme leader
2. Andrew Heyward. AIMS - Project leader (acting Julian Caley)
3. Scott Nichol, Geosciences Australia - project leader
4. Jessica Meeuwig. UWA - project leader)

Problem Statement

Difficulties understanding patterns and processes in marine biodiversity stem from significant knowledge gaps particularly for KEFs and MPAs in Northern Australia. This lack of knowledge reduces the capacity of science to support implementation of regional marine plans. This project will provide new biological and physical data to support greater understanding of marine biodiversity and support question driven research in the other themes in the Marine Biodiversity Hub.

Outcomes

Better understanding of patterns and processes structuring Australia's marine biodiversity; improved prediction of biodiversity and connectivity in Northern Australia; increased awareness of the origins and regional significance of Australia's marine biodiversity. This will support implementation of marine bioregional plans and a more effective management of Australia's marine estate. In addition we will promote development of a national mapping and survey capacity capitalising on recent marine infrastructure investments.

Outputs (products and services) in 2014

New physical and biological descriptions of very poorly known Australian marine ecosystems; supply of key physical and biological samples to support analysis and synthesis for better understanding of the patterns and processes structuring Australian marine biodiversity in linked programs within the NERP MBH; key knowledge gained for particular sites and habitats and the regional context of these sites to provide a more complete understanding of Australia's marine estate; new datasets and improved maps that identify key physical features, biodiversity and connectivity (physical and genetic). Communication products to raise awareness of Australia's marine biodiversity.

Activities and Milestones in 2014

Milestone 1: Baseline Characterisation of Oceanic Shoals CMR (June 2014)

Milestone 2: Biological and physical data **for** Oceanic Shoals CMR/Pinnacles KEF **survey area** made accessible via AODN (June 2014)

Milestone 3: Metadata records for biological and physical data collected in Oceanic Shoals CMR survey area published on AODN using Marine Community Profile (Feb 2014)

Milestone 4: Project final report provided for Hub final report (Dec 2014)

Expected Benefits

The field surveys will provide baseline information of shoal and off shoal environments and biodiversity in the western Joseph Bonaparte Gulf and enable comparison with datasets for other areas.

This work will provide improved characterisation of the bioregion, the first elaboration of variability at the regional scale in the submerged shoals and the probable extent of key habitats associated with high conservation values.

Key Risks in 2014 and Risk Management Strategy

Completion of final milestones and data transfer delayed by loss or re-allocation of key staff. Identify labour shortages as early as possible.

Unrealistic expectations of what can be achieved by a single survey. Early communication with DOTE staff. Integrate with results from existing surveys in similar areas to extend regional coverage.

Research Questions (Environment Portfolio)

2.3   What are the advantages and disadvantages for biodiversity of an ecosystem management approach? How can emerging genetic technologies and analysis of past management practices assist our understanding of ecosystems?

2.4   In environments such as marine areas, where comparatively little is known about biodiversity and ecosystem processes, what can we do to strengthen and validate the use of surrogates for identifying biodiversity for protection?

3.7   How can we best manage those parts of the Commonwealth Marine Area outside Marine Protected Areas (MPAs) to ensure values of MPAs are not compromised by external threats?

4.1   How do productive land and marine uses impact on biodiversity values and ecosystem function in different ecosystems or landscapes, and how might this change with future climate variability?

4.2   As land and marine use intensifies, how can we improve approaches to strategic environmental assessments of nationally important areas and regions?

4.4   How can Australia's marine environment be best managed to maximise ecosystem health, ecosystem resilience, and ecosystem goods and services?

Policies and Programs

- Natural and Indigenous Heritage

- Marine research to inform marine conservation management and marine protected area planning in the Indian Ocean Territories (IOT)

- Develop a better understanding of the marine biodiversity and major drivers for maintaining biodiversity in the North and North-west Marine Regions and Coral Sea

- Understand the ecological features and processes that influence the landscape-scale dispersal and recruitment of marine life that is necessary to maintain the biodiversity and productivity of marine ecosystems

- Understand the characteristics of marine ecosystems and biodiversity that help make them resilient to impacts of environmental change and human activities

Key Events and Dates in 2014

- Update DOTE on survey outcomes (February 2014)

- Finalisation of analyses and publications associated with these data but done from within Themes 1 and 3. (throughout 2014)

- Hub workshop (May 2013)

End Users

- Barbara Musso, CMR Policies and Program Coordination, DOTE

- Rod Atkins, South-west and North-west Network Management, PA, DOTE

- Travis Bover, Regional Domestic Marine Policy, WH&M, DOTE

- Felicity McClean, A/g Director, Offshore Petroleum, EACD, DOTE

- David Holt, Mike Maslen, ERIN, DOTE

Links and Dependencies to other Hubs and projects

This theme links to Themes 1 and 3 by providing critical new data sets that will facilitate new analyses across local, regional, and national scales

Start Date and Duration (in months)

January 2011, 48 months

84

Theme 5: Science and policy initiatives

This theme supports research and initiatives that require intensive collaboration between researchers and managers/policy makers. The first project, completed in 2013, provided practical guidance to establish a framework for standardised and integrated ecological, social and economic monitoring in coastal and marine areas. The guidance was applied to the Great Barrier Reef to establish an integrated monitoring framework for the Great Barrier Reef World Heritage Area.

Theme Leader: Dr Nic Bax

Organisation: University of Tasmania

Total NERP Budget (ex GST): 500,000

2014 NERP Budget (ex GST): nil

Total Non-NERP Cash/In-Kind Budget (ex GST): nil

2014 Non-NERP Cash/In-Kind Budget (ex GST): nil

Project 5.1 – Great Barrier Reef World Heritage Area Integrated Monitoring Framework

Project completed in 2013.

Surplus funds ($50,383) to be held by UTas and will be utilised in accordance with Project's Steering Committee advice.

Part D – Attachments incl Staff, Income and Expenditure Tables

Attachment 1 – Risk

The following describes the DOTE process to identify risk. Additional steps are required to analyse, assess and review risk. This method should be used for risk management across the Hub, themes and project activities. Risk management should be an iterative process throughout the life of the activity and is thus incorporated into the Progress Reports.

DSEWPaC requires all program and projects managers to identify and analyse and assess their project risks and to maintain a Risk Treatment Plan. The Corporate Risk Management Guidelines align with the International Standards Organisation (ISO) Guide 73:2009.

Risk management integrates a systematic and rigorous approach to what most people do on a daily basis. It is not complex, nor does it require specialised skills. It is about creating opportunities, understanding the risks and managing them to achieve desired outcomes. Potential problems are minimised by identifying, analysing, and planning a response to potential threats or uncertainty via Risk Management. Once a risk is realised it becomes an issue to be resolved.

The first step in risk management is to identify the risk. A risk is described by:

Risk + Source + Consequence = Description of Risk

To assist in identifying risks managers need to:

Consult and communicate

When considering a new process or implementing a decision it is important to identify key stakeholders and their needs, to ensure you are well informed about all areas of the activity you are undertaking. This is an important part of the process that should be considered at every step of risk management.

Establish context

Establishing the context is one of the most critical aspects of risk management. As risk is the effect of uncertainty on objectives, a clear understanding of the objectives for which you are assessing the risk, is critical. The context includes the organisation's internal and external environment and the purpose of the risk management activity. The context defines the scope for the rest of the risk management process. The context of the risk assessment will vary depending on the level within the organisation the risk assessment is being conducted. It may be necessary to re-do the risk assessment at each level (project, program, division, department) as different contexts will impact on the results of the assessment. For example a risk identified as HIGH at a project level (e.g. a consultant failing to meet a milestone), may not equate to a high risk for the division or department.

A poorly defined context can lead to a risk assessment which only focuses on the risk of achieving a process or output but does not consider the impact of this process on the project or organisational objectives.

Identify risks

It is important to identify the possible risks to be managed i.e. what can happen and how it can happen? Identification should also include risks whether or not they are under the control of the organisation.

Step 3 can be enhanced by exposure to an educated group which will result in a more comprehensive set of risks for consideration. The following may assist you with this step:

- Brainstorm to identify potential risks to identify issues that could hinder or prevent the achievement of the objective. Some examples of areas of risk that you might like to consider are:
  - policy implications

  - operational requirements

  - time

  - budget

  - climate change and environmental impacts

  - resources including people management and employee compliance

  - scoping issues

  - political impacts

- Review the list of identified potential risks and group similar risks; you are likely to find that many are actually sources (how can the risk occur?) of other risks.

- Identify the potential source/s or causes of each risk

- Identify the potential impacts of the risk if a risk event happens (consequences)

- You should also consider the life of the risks. i.e. will the risks outlive the term of the program or project?

- Review and finalise risks.

Examples of risk:

- That it may rain earlier than expected (**Risk**), caused by unseasonable weather (**Source**) which may delay undertaking the fauna survey (**Consequence**).

- The completion of a project might be delayed (**Risk**), caused by the consultant not delivering a report (**Source**) which may mean that we do not expend all of our budget in this financial year (**Consequence**).

87

- Greater than expected visitor numbers (**Risk**), caused by Australia's weak dollar (**Source**) will cause deterioration of the park's natural assets (**Consequence**).

- A serious accident (**Risk**), caused by unsafe working conditions (Source) will cause the department to face litigation (**Consequence**).

- Increasing severity of coral bleaching events (**Risk**), caused by sea surface temperature increases (**Source**), will lead to degraded reef habitat quality and biodiversity loss (**Consequence**).

Attachment 2 – Monitoring and Evaluation Plan

See separate file:

Marine Hub ME Plan Final July 2012.docx

Attachment 3 – Communications Plan

See separate file:

Marine Hub Science Communication Plan June 2013.docx

Attachment 4 – Staff, Income and Expenditure Tables

See separate file:

Marine Hub AWP 2014 Part D – Staff Income Expenditure tables.xlsx