

# Multi-Year Research Plan

## Marine Biodiversity Hub

July 2011 – December 2014  
Version 0.2

## National Environmental Research Program (NERP)



**Australian Government**

**Department of Sustainability, Environment,  
Water, Population and Communities**



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**Multi-Year Research Plan  
National Environmental Research Program (NERP)  
Marine Biodiversity Hub**

**VERSION CONTROL REVISION HISTORY**

Version	Date revised	Section Revised	Revision Comments and Who
Plan V0.1	June 6, 2011		Submitted first draft
Plan V0.2	July 7, 2011	All	Modified following comments from DSEWPaC and approved by Steering Committee

**Multi-Year Research Plan  
NERP  
ACCEPTANCE AND RELEASE NOTICE**

This Multi-Year Research Plan Version 0.2 of the Marine Biodiversity Hub is authorised for release once all signature have been obtained.

Role	Name and Position title	Signature	Date
Hub Leader	Nic Bax, IMAS, UTAS		July 7, 2011
DSEWPaC	Geoff Richardson, ERIB		

## 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.*

NERP focuses on biodiversity research and delivering information that the Australian Government and other stakeholders need to better inform environmental management, policy and decision making, both in the short-term and into the future. This includes understanding how ecosystems function, monitoring their health, maintaining and building their resilience, using them sustainably and exploring how to better use markets to protect biodiversity.

The NERP seeks to achieve its objectives by supporting applied research that:

- Has a strong public-good focus and public-good outcome
- Is end-user focused and addresses the needs of the Australian Government and other stakeholders in developing evidence-based policy to improve management of the Australian environment
- Is highly innovative and aims to achieve world-class research
- Enhances Australia's environmental research capacity
- Is collaborative and builds critical mass by drawing on multiple disciplines from multiple research institutions to address challenging research questions
- Provides results accessible to government, industry and the community, and
- Includes a focus on synthesis and analysis of existing knowledge.

Five large multi-institutional research hubs have been established to examine biodiversity issues in terrestrial, freshwater and marine ecosystems across Australia. For further details see [www.environment.gov.au/nerp](http://www.environment.gov.au/nerp)

### **This Multi Year Research Plan (MYRP)**

This research plan has been developed for the Marine Biodiversity Hub. To check you have the most recent version of this document, please see the NERP website [www.environment.gov.au/nerp](http://www.environment.gov.au/nerp).

The purpose of the MYRP is to:

- Provide contextual information and a breakdown of research activities in the Hub
- Describe the research that the Hub will be undertaking under the NERP between 2011 and 2014
- Identify research priorities and links to Australian Government Environment Portfolio policies and programs
- Outline the relationship of the research to the Australian Government Environment Portfolio and other key end users, and
- Provide a framework for monitoring and evaluating the Hub activities, as part of the NERP.

The primary audience for the MYRP is the Minister for Sustainability, Environment, Water, Population and Communities, environment portfolio agencies, particularly the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) and the Hub with its researchers. Other interested stakeholders include non-hub researchers, government and non-government organisations and the general public.

This research plan was prepared by Hub Director Professor Nic Bax in consultation with Hub partners, DSEWPaC and other stakeholders.

This Multi-Year Research Plan broadly describes the scope of the Hub's research work program over the period 2011 to 2014. It will be accompanied by several Annual Work Plans (AWPs), which will define details of the scheduled activities on an annual basis.

# 1.0 The Research Hub

## 1.1 Introduction/Background

**Hub Director:** *Prof Nic Bax, Institute for Marine and Antarctic Science, University of Tasmania*

The Marine Biodiversity Hub will be a national program reflecting DSEWPaC's national responsibilities. The five partners of the CERF Marine Biodiversity Hub – UTAS, CSIRO, GA, AIMS and MV – and new partners UWA, and CDU will work with the Department to improve their capacity for evidence-based decision making in the marine environment. One key outcome of the CERF Marine Biodiversity Hub was new national maps of marine biodiversity that were used by the Department in marine bioregional planning. A second key outcome was new options for managing biodiversity that were used to inform structural adjustment. These and other products provide the basis for our continued research to support DSEWPaC.

Our overall objective is to provide scientific information and advice that will support the Department in decision making in the marine environment, specifically in implementing and monitoring its marine bioregional plans, managing the NRSMPA, supporting the information needs of ERIN and AWD, and providing key baseline information for the Heritage Division. This will be accomplished through four tightly integrated national themes, which will include the engagement of Departmental staff in program development prior to any research commencing. Our scope is national. It matches DSEWPaC's responsibilities and will allow us to provide consistent scientific data, information and advice to the Commonwealth, States and NT. New survey activity will be focussed off Northern Australia (North to Coral Sea), in recognition of its global marine biodiversity significance, the rapidly increasing pressures facing this region and the paucity of current information. The four research themes are:

**1. National Monitoring, Evaluation and Reporting**, will contribute towards two blue-prints: first, for a sustained national environmental monitoring strategy designed to evaluate marine ecosystem health, and: second, for a sustained monitoring strategy to help manage the Commonwealth Marine Reserve Network (focussing on the Southeast Marine Region). It will facilitate closer liaison between federal agencies such as DSEWPAC, 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.

**2. Supporting Management of Marine Biodiversity**, 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.

**3. National Ecosystems Knowledge**, 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 (eg. CMRs), and provide the long-term perspective on biodiversity dynamics to inform future management under climate change. 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.

**4. Regional Biodiversity Discovery to Support Marine Bioregional Plans**, will address regional knowledge gaps in Northern Australia, 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, Geosciences Australia, Museum Victoria, and the University of Western Australia using a diverse set of data collecting methods.

## 1.2 Hub Mission

Draft NERP Mission: Deliver an efficient public good environmental research program which addresses the Environment Portfolio's priorities.

Draft MBHub Mission: A national collaboration to support DSEWPaC and other marine stakeholders in improving the evidence-base for decision making for marine biodiversity management through providing a common scientific understanding and approach in this multi-jurisdiction and multi-sector environment. More generally: to assist DSEWPaC implement marine bioregional plans; evaluate and report ecosystem health (MERF); manage the NRSMPA; improve knowledge of the biodiversity of poorly known areas; apply landscape level approaches to managing listed species; assess potential natural Heritage areas; and manage new infrastructure developments.

## 1.3 Hub Strategic Goals

Draft NERP Goals:

Goal 1 : Contributing to Research Priorities Contribute to meeting the policy and program research priorities/requirements of the Environment Portfolio.

Goal 2: Promoting Excellence in Research Promote excellence in research through funding world class, innovative, multi-disciplinary research that supports the conservation and management of Australia's biodiversity and ecosystems.

Goal 3 : Supporting Evidence Based Policies and Decisions Enable evidence based policy decision making by increasing the capacity of Environment Portfolio decision makers.

Goal 4: Delivering an Effective and Efficient Program Improve program performance by ensuring the National Environmental Research Program (NERP) has a strong governance framework supported by effective systems and processes.

Draft MBHub Goals: The overall goal of the Marine Biodiversity Hub is to support DSEWPaC (primarily Marine Division but also AAD, AWD, ERIN, Heritage and potentially others) in accessing timely and relevant information to support evidence-based management. This will provide DSEWPaC and other stakeholders an opportunity (and hopefully a stimulus) to develop common approaches to managing marine natural resources that promote increased effectiveness and greater efficiency.

## 1.4 Expected Outcomes

An improved evidence-base for decision making through:

- 1) improved access to and sharing of information held nationally;
- 2) additional options for identifying and valuing biodiversity;
- 3) an improved understanding of cumulative threats and impacts;
- 4) an evaluation of options for achieving DSEWPaC objectives

DSEWPaC objectives of particular relevance are:

- 1) implementing Marine Bioregional Plans (addressing regional priorities and strategies);
- 2) managing the Commonwealth Marine Reserve Network;
- 3) implementing a landscape approach to species management and recovery plans (including cost effective approaches for implementing recovery plans for multiple species);
- 4) evaluating and reporting ecosystem health (MERF) including for input to the 2016 SoE report;
- 5) providing new information and options to support approval and permitting for new infrastructure development.

We will concentrate research efforts on areas identified by DSEWPaC as being of current focus: Northwest Australia, North Australia, the Coral Sea and Southeast Australia. Much of our work will be relevant to the Australian Antarctic Territories and we will collaborate with AAD to generate research synergies.

We will work towards increased effectiveness and efficiency in providing scientific support for decision making by DSEWPaC and other marine stakeholders (especially the fishing and oil and gas industries) by taking an integrated approach to data discovery, developing performance measures for objectives and evaluating management options.

## **1.5 Expected Outputs**

Outputs will be delivered directly to DSEWPaC and additionally to the States and NT through established relationships and a collaborator network. We will develop focussed workshops with our Departmental knowledge broker to maximise understanding and uptake. Data products will be available through established relationships with IMOS/AODN, ALA and new links with the NPEI. Identified outputs at this stage are:

- Survey design and trials of sustained observing systems for KEF and CMR processes;
- Recommendations for future sustained observation, evaluation and reporting of national ecosystem health indicators and CMR monitoring;
- A process to value biodiversity that will support decision making where biodiversity and economic interests coincide;
- New scientific tools that integrate threats, assets and cumulative impacts, to assess benefits and tradeoffs of cross-jurisdictional and cross-sectoral management arrangements and support implementation of marine bioregional plans;
- New scientific approaches and management options at the landscape level to support the Department's implementation of the EPBC Act in reference to three current issues – deepwater sharks, benthic biodiversity, euryhaline sawfish. Each of these issues is a test case for a larger group of issues facing the Department, and will provide options that extend well beyond the test case;
- New datasets, maps and improved interpretations leading to a national classification of unsampled canyons and outer shelf reefs, identified as important features in marine bioregional plans, and assisting decision making concerning impacts of marine industries in particular fisheries and oil and gas;
- Knowledge of biodiversity source-sink dynamics (particularly how they influence existing KEFs and new CMRs) to improve understanding of connectivity in the Commonwealth Marine Reserve Network;
- A description of the origins and regional significance of Australia's marine biodiversity to identify local areas of high endemism that may have low resilience to a changing climate;
- Significant new biological and physical datasets for strategically important but largely unknown KEFs, CMRs and ecosystems especially in Northern Australia/Coral Sea to support implementation of marine bioregional plans;
- Further development scientific monitoring approaches that will support development of a cost-effective routine national marine monitoring capacity;
- Technical and high impact journal publications, conference presentations and keynotes.

## 1.6 Research Relevance

The research themes proposed above and the capability offered by the six Hub partners deliver directly on most of the NERP research questions (Table 1).

**Table 1. List of individual projects which address NERP research questions in each of the 4 themes**

NERP Research Questions	1	2	3	4	5
<b>1. National Monitoring</b>		2.1,2.2		4.2,4.4	
<b>2. Supporting Management</b>	1.1, 1.2, 1.3, 1.4, (1.6)	2.1,2.2,2.3	3.1,3.4,3.7, (3.8), 3.9	4.1,4.2,4.4	5.1,5.2,5.3,5.4, 5.5, 5.6
<b>3. Ecosystem Understanding</b>		2.1,2.3,2.4	3.1,3.2,3.3, 3.4, 3.7	4.1,4.2,4.4	5.3,5.5
<b>4. Regional Biodiversity</b>		2.3,2.4	3.1,3.7	4.4	
<b>Not covered</b>	1.5		3.5,3.6,(3.8)	4.3	

The large and diverse capability the partners bring to this Hub bid provides a huge opportunity for the Department to access the best marine researchers in Australia (plus links to the wider international community). The partners offer a co-investment of more than 60% (which based on our track record in the CERF Marine Biodiversity Hub we will greatly exceed in practice) indicating our understanding that answering the NERP research questions (made even more difficult in the marine environment due to logistical complexities) will require world-class strategic research and will continue to place Australia as a world leader in the way that we manage our oceans. The depth of our capability provides the research partners with significant flexibility in working with the Department to provide outputs that will not only support the Department's management interests, but also meet the partners' need to engage in strategic, world-leading science.

Each Hub theme is focussed at responding to specific data or knowledge gaps that restrict DSEWPaC's capacity to manage marine biodiversity. Specifically, the research addresses the following biodiversity policy questions identified by the Department in 2010:

### **Q1. Values: understanding the major drivers for maintaining biodiversity**

A major project under **Supporting Management** is to develop an approach for the socio-economic valuation of marine assets to support the implementation of marine bioregional plans especially decisions on economic activities in off-reserve areas. While the focus will be on developing a set of approaches that can be used over the long-term, developing and testing these tools will provide early results of immediate relevance eg. through supporting management of activities in multiple use areas of the Commonwealth Marine Reserve Network. We have a strong team of social scientists, socio-economists and resource economists from CSIRO, UTAS and UWA. An early emphasis will be on working with the Department to refine objectives and values with the aim of providing quantifiable measures that can be used to compare the efficacy and cost of different options for managing marine biodiversity in a multi-jurisdictional and multi-sectoral environment.

A major multi-agency project under Supporting Management is to assist the development of quantitative management goals, reference points and scientific monitoring methods that can be applied at the landscape level to manage rare listed species including Australian sea lions, dugongs, marine turtles, and numerous elasmobranchs. Euryhaline sharks will be used as a test case. This species group is a high priority group in North Australia and this project will be directed at answering the needs of the recent DSEWPaC workshop on this group. We will address questions on how to determine a sustainable population (or habitat), how to cost-effectively monitor population status, how to assess and manage cumulative impacts, and when no further action is warranted.

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

Our ability to identify and report on indicators of environmental change, and manage valued ecosystems, depends on our ability to understand the way in which these systems respond to multiple simultaneous pressures. Our understanding of these systems is reflected in model-based (conceptual or otherwise) management decisions. This understanding can only be scientifically tested and improved by making falsifiable predictions about the manner in which these systems will respond to anthropogenic pressures and management intervention. Reliable, cost-effective observation systems are essential to continually test and

improve both our understanding of these systems and our ability to manage and monitor them effectively. The **National Monitoring Theme** will examine the extent to which existing national and regional datasets, together with new and existing observation methods, can provide a basis for sustained (decadal) observation, evaluation and reporting of the nation's highest priority marine assets, namely KEFs and CMRs. The research will provide recommendations and pointers towards the development of a national monitoring, evaluation and reporting system for marine ecosystem health and a monitoring system to support implementing the management plan for the Southeast Commonwealth Marine Reserve network. These systems will rely on, and contribute to, existing observation initiatives such as IMOS and the Reef Life Survey. The National Monitoring Theme also builds on, and is designed to serve the needs of the Department's existing management initiatives such as the Marine Environmental Reporting Framework, State of the Environment (SoE) reporting, the MACC Common Assessment and Reporting Framework (CARF) and CMR design criteria.

The physical environment is a major determinant of marine biodiversity. National physical datasets relevant to marine biodiversity were improved by a major effort in this area by the CERF Marine Biodiversity Hub. This led to detailed biodiversity predictions that were provided and used in marine bioregional planning at the provincial scale, across depth and at the 1 km<sup>2</sup> scale. The importance to biodiversity of large physical features (eg. canyon, shelf-edge reefs, shoals) was not part of this work and the need for this information was emphasized by DSEWPaC in developing marine bioregional plans. The **Ecosystem Understanding Theme** will use newly available data (eg. national swath mapping), and ecological data to determine how these large-scale features drive local biodiversity, categorise them based on predicted importance and determine interactions with the physical oceanographic environment. These areas are often also focal areas for the fishing industry and other economic activities so this information will feed directly into the **Supporting Management Theme** to support implementing marine bioregional plans in a cross-sectoral environment.

The use of physical surrogates in biodiversity management needs to be supported by rigorous science. The CERF Marine Biodiversity Hub developed new statistically robust approaches for physical surrogates which were adopted by marine planners from DSEWPaC, the States and conservation NGOs. These new approaches accounted for prediction uncertainty and developed probabilistic measures of biodiversity that may fundamentally change the way biodiversity is valued and managed – by reducing the assumption of irreplaceability. An important component of the **Ecosystems Understanding Theme** is to increase our understanding of how to describe and map biodiversity. This information will be another key data layer in valuing marine biodiversity and will assist decision making for off-reserve areas.

Our understanding of marine biodiversity is particularly poor off Northern Australia (from the NW to the Coral Sea). The Regional **Biodiversity Theme** will work with the Department to identify and survey areas of particular importance to regional marine biodiversity. In addition, the program will be testing the importance of large topographic features for marine biodiversity (link to **Ecosystems Knowledge Theme**). Finally, through this and other work, the Hub will be working with the Marine National Facility and other research providers to establish a dedicated program of biodiversity discovery and surveying that supports implementation of marine bioregional plans nationally (eg. gap filling and monitoring).

### **Q3. Threats: maintaining/building resilience for future changing threats**

Managing our national marine assets requires us to identify and value them, determine the threats, and finally evaluate management options that meet the needs of relevant jurisdictions and sectors. The **Supporting Management theme** delivers on the latter three of these needs. It is closely linked to Themes 3 and 4 that identify marine assets and closely linked to Theme 1 as management approaches need robust informative monitoring. The first deliverable from this Theme will be a comprehensive database of the distribution and intensity of marine threatening processes, concentrating on Australia but in a regional context. This deliverable builds on previous work by CSIRO for the Marine Division and will provide a queryable ("Google-type") database of ~100 processes that have the potential to threaten biodiversity, their spatial patterns and intensity, and including things like fishing, shipping, seismic surveys, to name a few. Subsequent work will be spent on predicting cumulative impacts.

While individual features (or CMRs) are important in marine planning, planning at the bioregional level requires information on how they are connected and work together as a system. The **Ecosystem Understanding Theme** will deliver comprehensive national map(s) of connectivity at various scales and time periods, validated by genetic analyses, to support the developing NRSMPA and its integration with off-reserve management. We are also proposing to examine how connectivity and important oceanographic features may change in a warming ocean, and determine how range-limited endemic marine species developed (through speciation) over previous periods of rapid climate change. Analyses of the past and potential future dynamic properties of Australia's marine biodiversity (and the physical environment



supporting it) will highlight the regional affinities of our marine biodiversity and identify areas of high species turnover and phylogenetic endemism. This will inform interpretation and valuation of contemporary patterns in marine biodiversity and illustrate its historic and potential future resilience. Results will be used in the **Supporting Management Theme**.

#### **Q4. Sustainable use of biodiversity and ecosystems**

The **Supporting Management Theme** will provide approaches and options to support implementing marine bioregional marine plans in a multi-sectoral, multi-jurisdictional environment. This will require close collaboration with the Department and other stakeholders to provide performance measures for individual objectives, and develop scientific spatial analysis tools that can be used to examine the trade-offs and complementarities of different management approaches – including on- and off-reserve zoning, fishery spatial closures, incentives, etc. The goal is to provide the information to support management of biodiversity and marine resources in a multi-sectoral and multi-jurisdictional environment. While we can make progress on some aspects of this independently, if this approach is to be effective it will require the active engagement of the relevant management agencies.

#### **Q5. Biodiversity markets**

The CERF Marine Biodiversity Hub developed market-based instruments for marine management with the Department, AFMA, the fishing industry and conservation NGOs. This resulted in high-profile (and controversial) publications in the international conservation literature. Components of this research were used by the Marine Division to support marine reserve planning and to assist in considering options for structural adjustment. At the same time conventional biodiversity markets will often be of limited value in the marine environment where biodiversity assets are typically publically owned. Recognising this, the **Supporting Management Theme** will identify where management incentives can be used to support rather than replace spatial management. This work will be informed by the socio-economic valuation of biodiversity assets and provide additional options to managing and monitoring use of the marine environment both on- and off-reserve.

## **1.7 Partner/collaborative organisations**

**Table 2. NERP funding and partner contributions**

Hub Activity (exc GST)		2010-11	2011-12	2012-13	2013-14	2014-15	Total program budget
<b>Research Projects</b>	NERP	-	3,395,207	3,362,824	2,613,648	216,182	9,587,862
	CASH/IN-KIND	-	4,904,365	4,732,715	4,129,589	453,618	14,220,286
	<b>TOTAL</b>	-	<b>8,299,572</b>	<b>8,095,539</b>	<b>6,743,238</b>	<b>669,800</b>	<b>23,808,148</b>
<b>Knowledge Brokering and Communication</b>	NERP	-	257,321	369,398	384,531	400,889	1,412,138
	CASH/IN-KIND	-	201,452	438,720	470,100	495,324	1,605,596
	<b>TOTAL</b>	-	<b>458,772</b>	<b>808,118</b>	<b>854,631</b>	<b>896,213</b>	<b>3,017,735</b>
<b>Administration</b>	NERP	-	-	-	-	-	-
	CASH/IN-KIND*	-	497,446	723,033	747,176	773,463	2,741,118
	<b>TOTAL</b>	-	<b>497,446</b>	<b>723,033</b>	<b>747,176</b>	<b>773,463</b>	<b>2,741,118</b>
<b>Total Funding (excl. GST)</b>	NERP	2,000,000	2,500,000	2,600,000	2,600,000	1,300,000	11,000,000
	CASH/IN-KIND	-	4,755,790	7,026,690	5,745,045	1,039,476	18,567,001
	<b>TOTAL</b>	<b>2,000,000</b>	<b>7,255,790</b>	<b>9,626,690</b>	<b>8,345,045</b>	<b>2,339,476</b>	<b>29,567,001</b>

\* Administration "Cash/In-kind" includes scholarships.

## **1.8 Links to other research programs**

During the course of preparing this research plan we have had discussions with the other NERP Hubs. We have identified synergies with other Hubs and have scientists working across the Marine Biodiversity Hub, NABH and the GBRTS Hub and a shared postdoctoral student with the NABH, with whom we will also share infrastructure and develop complementary sampling programs. We recognise the potential gains to be made from closer cooperation across Hubs and early discussions between Hub directors suggest that additional links and communication channels with the Department will develop over time.

Many of the Marine Biodiversity Hub products and approaches will be of relevance to management of Antarctic resources and we anticipate strong collaborations with research programs operated through the AAD.

An Outside Collaborator Network will be established and chaired by the Hub director. We have already identified NT Fisheries and NSW DECC as State-based departments with whom we will be collaborating on joint field-based research. Outside collaborators will be invited to the annual Hub science workshop and to other Hub-led meetings as appropriate.

Strategic discussions will be held with stakeholders including the Integrated Marine Observing System (IMOS), the Australian Fisheries Management Authority (AFMA) and the Australian Petroleum Production and Exploration Association (APPEA), with the aim of identifying additional research opportunities or complementary studies that would enhance Hub outputs and impact.

Many of the Hub partners will use this core funding to leverage additional projects through their own agency and this research will feed into the Hub, increasing its research outputs and application.

## **1.9 Communication, knowledge brokering, synthesis and analysis**

A goal of the Marine Biodiversity Hub is to provide the information and options to support biodiversity and marine resource management in a cross-jurisdictional and cross-sectoral environment. One strength of our collaboration is our existing connections with many States/Territory and with other government agencies. The Marine Biodiversity Hub would have partners on the MACC (or its replacement) and OPSAG and reports regularly to the Biodiversity, Research and Development and National MPA working groups. The Director and Supporting Management Theme Leader have a long-history of working with AFMA, DAFF and the fishing industry the latter leading the team that produced the information for AFMA's new harvest policy and ecological risk assessment. This research plan has presented at the AFMA Board meeting and at a meeting of APPEA environmental managers. This supports the Hub's goals of informing a whole of government approach to marine management, especially off-reserve management.

Knowledge brokering is not a one-way process, so following early discussions with the Marine Division we are proposing that we develop the opportunity for partners in the Marine Biodiversity Hub to second staff to work inside the DSEWPaC. The objectives of these secondments would be to support periodic short-term information needs of the Department, contribute to expanding and maintaining a high level of current scientific knowledge by staff, and further developing communication between the Department and the scientific community.

An important component of knowledge brokering has been to develop and support targeted workshops with DSEWPaC, other national management agencies and scientists from inside and outside the Hub. This is not as straightforward as it seems as it takes a high level of trust to discuss challenging issues with outside "experts". We will continue to develop targeted workshops with the Department through, see this as important deliverable of knowledge brokering, and critical to achieving progress in the National Monitoring and Supporting Management themes.

Information products – data, metadata, reports, papers, media releases, imagery – would be provided to DSEWPaC and indexed on the Hub website ([marinehub.org.au](http://marinehub.org.au)) now running at over 1,000 visits per month. This website has been updated to a new database structure that supports information searches of Hub products in a variety of formats to meet a broad range of user needs. Metadata and data will be held in distributed databases and/or on Australian Oceans Data Network (AODN). AODN will be a central facility to discover and archive all Hub metadata and data. Discussions will be held with ERIN to ensure that data delivery meets the Department's information needs. This data structure and delivery (excluding the website) does not depend on the host organisation (UTAS) or the continuation of the Hub. Data and access will be maintained in perpetuity by the partners and AODN.

While AODN will be the central facility to access Hub-derived data, we will also be ensuring that our data become available through more specialist facilities. Funding has been set aside to involve Australian museums (in addition to Hub Partner – Museum Victoria) in biodiversity discovery. This will ensure that collected samples are curated and the data made nationally and internationally available through OZCAM and OBIS. We have made biodiversity mapping products and methods available through the Atlas of Living Australia, and internationally through groups including the Global Oceans Biodiversity Initiative.

A communication plan will be developed and approved by the Steering Committee by Milestone 4, November 1, 2011. This will extend the successful Communication Plan of the CERF Marine Biodiversity Hub to match the NERP communication protocol.

### ***1.10 Measuring success***

To be developed as Milestone 4 (November 1, 2011)

## 2.0 Research Themes

### 2.1 Theme 1 - National Monitoring, Evaluation and Reporting

#### 2.1.1 Theme Description

**Theme Leader:** *Dr Keith Hayes, CSIRO Mathematics and Information Science*

This theme will contribute towards two blue-prints: first, for a sustained national environmental monitoring strategy designed to evaluate marine ecosystem health, and: second, for a sustained monitoring strategy to help manage the Commonwealth Marine Reserve Network (focussing on the Southeast Marine Region). This research aligns broad strategies in the Draft Marine Bioregional Plan for the South West Marine Region and with a number of research priorities identified by the Marine Division of DSEWPAC. It will facilitate closer liaison between federal agencies such as DSEWPAC, 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.

Five outputs of this theme will be:

1. An analysis of alternative approaches for monitoring biodiversity in Commonwealth waters based on scientific, economic, and logistical considerations (this is a joint output with Theme 2 Project 1).
2. Identification of the evidence-base/data requirements for managing the Southeast network of Commonwealth Marine Reserves and by extension networks in other bioregions
3. Identification of the evidence-base/data requirements to evaluate and report on national marine ecosystem health
4. Data analysis (within limits of existing data) to inform national-scale marine ecosystem health input to the 2016 SoE report
5. 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.

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.

Three outcomes of this theme will be:

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)
3. Access to the relevant data analyses (within limits of existing data) to report on national-scale marine ecosystem health for input to the 2016 SoE report

There are two projects in this Theme:

1. Collation and analysis of existing data sets
2. Analysis of approaches for monitoring biodiversity in Commonwealth waters

#### 2.1.2 Theme Activities

Attachment A provides detailed information about each theme in the Hub over the life of the program. It describes expected outcomes, outputs (including services and products), performance indicators, timelines and links to end user requirements.

## 2.1.3 Theme Approach and Methods

### Theme 1 Project 1: Collation and analysis of existing data sets

Participating agencies: *CSIRO, UTAS, UWA, AIMS, GA*

NERP\$ \$1,194,184; Total in-kind \$1,582,952; 1.5 Postdocs

The project will source and analyse available relevant data sources to validate predictions associated with KEF indicators for national-scale marine ecosystem health. The project will also develop new techniques analyse time series data for seasonality, change point and trend detection. This project will also 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.

The project will 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.

### Theme 1 Project 2: Analysis of approaches for monitoring biodiversity in Commonwealth waters

Participating agencies: *CSIRO, UTAS, UWA, GA*

NERP\$ \$1,744,224; Total in-kind \$2,345,935; 1.5 Postdocs

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 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. The project will 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)

The project will 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.

## 2.2 Theme 2 - Supporting Management of Marine Biodiversity

### 2.2.1 Theme Description

**Theme Leader:** *Dr Tony Smith AM, CSIRO Marine and Atmospheric Research*

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 will be 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. An increased emphasis on performance based management will assist development of a shared understanding.

Ten outputs of this theme will be:

1. An analysis of alternative approaches for monitoring biodiversity in Commonwealth waters based on scientific, economic, and logistical considerations (this is a joint output with Theme 1 Project 2).
2. Recommended performance indicators in the Commonwealth South East Marine Reserve Network;
3. Recommended options for using incentives to increase stewardship of CMRs, especially in support of monitoring and compliance in multiple-use zones;
4. Analysis of economic values of different stakeholders for marine biodiversity and habitats, at different scales to support decisions on approvals and other decision making.
5. National maps/GIS layers of cumulative threat and impact and recommended methods to quantify cumulative threats and impacts to update maps
6. Recommendations for integrating information and data on values, assets, threats and impacts to support decision making
7. Analysis of strategies for management of chondrichthyans and benthic biodiversity
8. Recommendations for improved guidelines for managing high conservation priority species on and off reserve and including identification of complementary arrangements between conservation and resource management agencies, particularly fisheries
9. Analysis and recommendations on the application of new genetic techniques that have the potential to make it possible to assess rare and listed species more effectively and at a radically reduced cost
10. Recommendations for management of freshwater sawfish in the Northern Australia supported by analyses to assess population status and distribution

Outputs from this theme depend critically on and are contingent upon, results from existing research in the South East Marine region, and results from new research on improved understanding of biodiversity assets from Theme 3 and analysis of approaches to monitoring biodiversity in Theme 1, Project 2. Outputs also feed directly into developing a blue-print for a sustained monitoring strategy to help manage the Commonwealth Marine Reserve Network being developed under Theme 1.

Three outcomes of this theme will be:

1. A considered understanding of the evidence base for managing a network of Commonwealth Marine Reserves including options for building stewardship
2. A considered understanding of the national evidence-base on cumulative threats and impacts
3. A considered understanding of more efficient and cost effective approaches to managing EPBC Act listed species and other conservation values.

There are four projects in this Theme:

1. Integrating social, economic and environmental values
2. Integrating threats, values and assets for management
3. Landscape approaches to managing high priority conservation values, and
4. Supporting management of listed and rare species

## 2.2.2 Theme Activities

Attachment A provides detailed information about each theme in the Hub over the life of the program. It describes expected outcomes, outputs (including services and products), performance indicators, timelines and links to end user requirements.

## 2.2.3 Theme Approach and Methods

### Theme 2 Project 1: Integrating social, economic and environmental values

Participating agencies: CSIRO, UTAS, UWA

NERP\$ \$814,506; Total in-kind \$1,177,693; 1.5 Postdocs

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 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 this network, and this project will be developed jointly with the Marine Division and Theme 1 Project 1.

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 (eg. 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.

### Theme 2 Project 2: Integrating threats, values and assets for management

Participating agencies: CSIRO

NERP\$ \$411,957; Total in-kind \$411,957

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, DSEWPaC Marine Bioregional Planning, DSEWPaC/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. Finally, 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.

### Theme 2 Project 3: Landscape approaches to managing high priority conservation values

Participating agencies: CSIRO/UWA  
NERP\$ \$318,350; Total in-kind \$446,984

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: 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.

### Theme 2 Project 4: Supporting management of listed and rare species

Participating agencies: CDU, NT Fish, CSIRO  
NERP\$ \$954,399; Total in-kind \$1,331,878

This project focuses on landscape-level integrated management solutions for supporting management of rare and listed species, using euryhaline elasmobranchs a key threatened group in Northern Australia as a test case. The new genetic techniques that will be modified and applied in this task have the potential to make it possible to assess rare and listed species more effectively and at a radically reduced cost. The management options developed in this project will have wide applicability to other listed and data poor species providing for a more effective and efficient management of this very diverse group. A key output of this project will be an assessment of the effectiveness of this approach for other listed and rare species.



Australian populations of sawfish have undergone substantial albeit unquantified declines in abundance, accompanied by fragmentation and range contraction. The species continue to be at risk from overfishing (commercial, recreational, and domestic/international IUU) and habitat modification. There has been no systematic monitoring of abundance, and therefore no way of demonstrating the extent of decline, or the current population trajectories. The high spatial structuring of this species requires a landscape approach to their management. We will develop a novel and modern assessment and monitoring strategy for freshwater sawfish in the Northern Australia to assess population status, distribution and assess current management effectiveness. Biological information will be collected on additional listed species as they are captured. The problems above are shared by many other high-profile listed species such as Australian sea lions, dugongs, marine turtles, and numerous other elasmobranchs. The techniques developed in this project will find application to these other species in the future, although the specifics will differ from species to species. In particular, the methods to address conservation issues for rare and data poor species should see wide application.

## 2.3 Theme 3 - National Ecosystems Knowledge

### 2.3.1 Theme Description

**Theme Leader:** *Dr Brendan Brooke, Geoscience Australia*

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 (eg. CMRs), and provide the long-term perspective on biodiversity dynamics to inform future management under climate change.

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 project 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).

Six outputs of this theme will be:

1. Maps/GIS layers incorporating the best available existing data, that describe the physical features, processes and patterns of biodiversity in targeted areas of the continental shelf in Northern Australia
2. Models (conceptual, qualitative & quantitative) that describe how the morphology and local oceanography of large-scale physical features influences their value to biodiversity
3. Recommend an analytical template for characterising and assessing the significance for biodiversity of key physical and ecological features throughout the Australian Marine Estate, especially those that have not been well-sampled
4. An atlas illustrating major patterns of species and genetic biodiversity of three major faunal groups across Australia's marine domain.
5. National maps/GIS layers of hotspots of biological and genetic diversity,
6. Exploration of the possible causes and management implications of major biodiversity patterns.

Outputs from this theme will be used in Theme 2 Project 1 to value marine biodiversity and may influence monitoring decisions in Theme 1.

Three outcomes of this theme will be:

1. A considered understanding of the importance of the physical environment of seafloor features for their value to biodiversity, including connectivity between areas of management interest (eg. KEFs and CMRs)
2. Increased capacity for understanding patterns of biodiversity through further building the national evidence-base
3. Increased capacity for managing off-reserve activities at the spatial scales representing patterns in biodiversity

There are two projects in Theme 3.

1. Shelf and Canyon Ecosystems - functions and processes, and
2. National Maps of Connectivity and Biodiversity

### 2.3.2 Theme Activities

[Attachment A](#) provides detailed information about each theme in the Hub over the life of the program. It describes expected outcomes, outputs (including services and products), performance indicators, timelines and links to end user requirements.

### 2.3.3 Theme Approach and Methods

#### Theme 3 Project 1: Shelf and Canyon Ecosystems - functions and processes

Participating agencies: *GA, UWA, AIMS, CSIRO*

NERP\$ \$1,508,743; Total in-kind \$2,734,824; 3.5 Postdocs

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 inform subsequent management decisions. Ecologically important physical processes that operate within and between shelf and canyon ecosystems determine their value as biodiversity hotspots, eg. 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 DSEWPaC. 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.

### Theme 3 Project 2: National Maps of Biodiversity and Connectivity

Participating agencies: *Museum Victoria, AIMS, CSIRO*

NERP\$1,203,893; Total in-kind \$2,088,808; 2 Postdocs

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.

Task 1: 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 accumulate comprehensive datasets for 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 mix of genetics, 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 of interest to Marine Heritage (eg Coral Sea, Cape York, Kimberley). An atlas will summarise and interpolate existing knowledge for two large faunal groups. 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: National biodiversity datasets for 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 include datasets and maps summarising distributions and conservation values of sharks, rays and selected teleosts, incorporating hotspots of distribution and endemism. This project will provide data products and maps that will improve DSEWPac 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.

## 2.4 Theme 4 - Regional Biodiversity Discovery to Support Marine Bioregional Plans

### 2.4.1 Theme Description

**Theme Leader:** *Dr Julian Caley, Australian Institute of Marine Science*

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 Victoria, 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.

Three outputs of this theme will be:

1. Physical and biological samples and data to fill major knowledge gaps for specific data poor KEFs and CMRs in Northern Australia and/or the Coral Sea
2. Analyses to understand patterns of community assembly and associated physical drivers of marine biodiversity including connectivity in these poorly studied marine realms
3. Increased opportunities for using national mapping and survey capacity to support further understanding of biodiversity in data poor regions of Australia

Outputs from this Theme will be key inputs of data and samples to Theme 3 and will also provide opportunities for testing and extending the work in Themes 1 and 2 particularly the proposed regionally focussed work to support marine management.

The outcome of this theme will be:

1. Increased capacity for understanding biodiversity in a data poor region of Australia's marine environment.

The one Project in this Theme is supported by a 21-day survey on RV Solander

### 2.4.2 Theme Activities

Attachment A provides detailed information about each theme in the Hub over the life of the program. It describes expected outcomes, outputs (including services and products), performance indicators, timelines and links to end user requirements.

### 2.4.3 Theme Approach and Methods

#### Theme 4 Project 1: 21-day RV Solander Survey

Participating agencies: *AIMS, GA, Museum Victoria, UWA*

NERP\$ \$1,437,606; Total in-kind \$2,099,258; 0.5 NERP-funded Postdoc

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. This will also address the interests of Natural and Indigenous Heritage in biodiversity mapping in the Coral Sea and Cape York. The survey will have the potential to extend from shallow to deep habitats (~2000m); however the precise location and focus will be determined in consultation with DSEWPaC and with the aim of directly enhancing outputs from other projects in the Hub. We plan to determine the area and conduct the survey in the first year of the NERP Hub, so that samples can be worked up and available to other Hub projects in a timely fashion.

These data will be used to fill 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 capitalising on recent marine infrastructure investments. 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.

## 3.0 Research Projects

### 3.1 Project Activities

Attachment B provides detailed information about each project in a theme over the life of the project. This information provides key information about each project including expected outcomes, outputs, links to research questions, polices and programs, indicative budget and timelines.

## 4.0 Research Hub Administration

### 4.1 Leadership and Governance

The Steering Committee will consist of major stakeholders (DSEWPaC, AFMA, APPEA, IMOS, WWF-Australia have been invited to join), a member of the NERP Secretariat, an independent chairman elected by the committee, and senior representatives of major partners. The Hub Director will report to this committee, which will meet twice a year to oversee Hub progress and reporting, and hold an annual strategic review of the Hub. The Steering Committee approved reports to be provided to the NERP Secretariat.

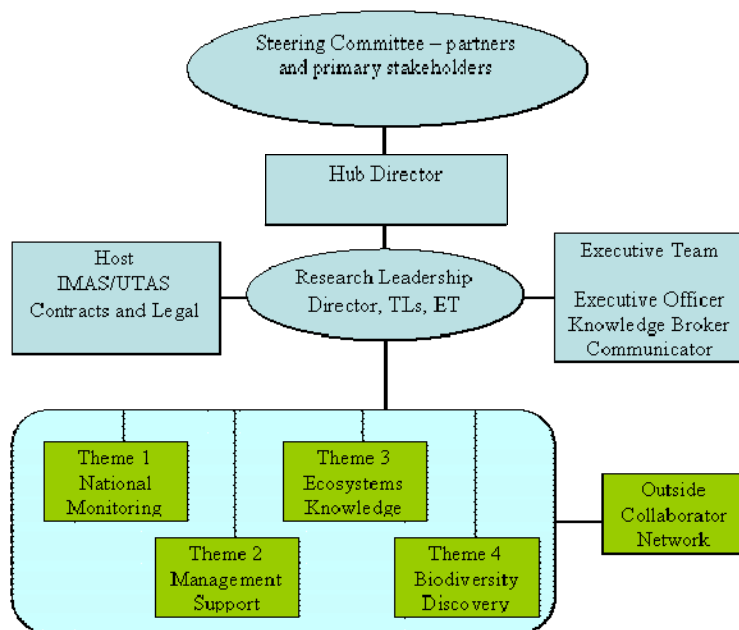
The Research Leadership Team will consist of Theme Leaders, additional partners (optional), the Director and the Executive Officer. The Theme Leaders and Executive Team report to the Management Team, which will meet:

- Monthly teleconferences for administrative matters and progress updates
- Twice a year for review, reporting and planning

The Research Leadership Team prepares reports for Steering Committee approval.

Themes will be managed through a Theme Leadership Team consisting of all project leaders. They will meet monthly to exchange information and quarterly to review progress and report to the Research Leadership Team. Theme Leaders will sit on the quarterly review of other Themes on a rotational basis. Data streams (new and old) and analytical tools will be distributed across Themes.

The roles and responsibilities of the Steering Committee, Research Leadership Team, Director, Theme Leaders, Project Leaders, Knowledge Broker and Communicator will be identified based on a review of the performance of these roles in the CERF Marine Biodiversity Hub. The Director's approach in leading this NERP Hub is twofold: first, to work with DSEWPaC and the Steering Committee to develop the strategic approach that the Hub will take, and; second to work with Hub partners to deliver high quality science to meet these strategic goals, while at the same time increasing the capability of all partners (and collaborators) to individually and jointly deliver research that supports continued improvement in the management of Australia's marine biodiversity.



## 4.2 Reporting requirements

Progress reports will be provided to DSEWPaC twice a year according to the following schedule:

Report Due	Reporting period
1 April	1 July – 31 December
1 October	1 January – 30 June

A final report will be provided on or before 1 April 2015.

Financial statements will be provided with each Progress Report and the Final Report. Audited financial statements will be provided annually for each preceding calendar year on April 1, and within 60 days of the end of the Hub.

## 4.3 Risk Management

Key risks for Themes are identified in MYRP Attachment A, and for Projects in MYRP Attachment B.

Key risks for the Marine Biodiversity Hub are identified in the following table.

Possible risks	Proposed 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.
Loss of data during or after funding period	Ensure ANZLIC metadata requirements are met; data or metadata delivered to ERIN and/or AODN; data archived by larger partners or AODN
Data and reports cannot be accessed in timely fashion	All Hub outputs indexed and available on Hub website through multi-contextual search engine. Data manager identified as part of Executive Team.
Hub outputs not recognised or used by DSEWPaC and other stakeholders. Lack of engagement.	Knowledge broker (ideally seconded from DSEWPaC) working closely with the Department and senior researchers. Key stakeholders on Steering Committee. Key Departmental representative identified for each project with reporting schedule to be developed. Ten percent of NERP funding set aside for communications.



IP issues reduce collaboration between partners	All Hub data to be publically available. Guidelines for collaboration established. All publications approved by Hub director
Financial probity not met	Annual accounts audited
EO and Health and Safety Issues	All partners are recognised agencies with established EO and Health and Safety procedures and are contractually obligated to meet recognised national standards.

# **Marine Biodiversity Hub**

## **Attachment A**

### **Multi-Year Research Plan Theme Descriptions (2011 – 2014)**

## **Theme 1:**

### **National Monitoring, Evaluation and Reporting**

Theme Leader: Keith Hayes (CSIRO)

Total budget (excl. GST): \$6,867,295

### **Key Expected Outcomes**

In the short-term the key expected outcomes for the National Monitoring, Evaluation and Reporting theme are a greater understanding of the logistical and statistical issues associated with the deployment and analysis of data generated by non-extractive survey methods for understanding KEFs (landscape features that SEWPAC intend to use to evaluate marine ecosystem health) and managing CMRs in the south east marine planning region (and by extension) the CMR estate; and catalogue new and existing data sources that could be relevant to the indicators identified for the KEFs in the National Indicators project and the objectives of the Commonwealth Marine Reserves in the SE planning region.

In the Medium-term the key expected outcomes for the National Monitoring, Evaluation and Reporting theme are: Survey design recommendations and data analysis methods for a complementary suite of non-extractive monitoring and survey methods, together with commentary on their suitability for sustained national environmental monitoring; Development and application of new and existing time series analysis methods to validate ecosystem health indicators for as many KEFs and CMRs in the south east marine planning region as is possible within the resource constraints of the project.

In the Long-term the key expected outcomes for the National Monitoring, Evaluation and Reporting theme are: Contribute towards a blue-print for a sustained national environmental monitoring strategy designed to evaluate marine ecosystem health and manage the Commonwealth Marine Reserve Estate; and greater alignment between marine-focused agencies such as SEWPAC, BOM and DIISR to meet the needs of a sustained national monitoring programme that supports State of the Environment reporting and National accounts reporting for the marine environment.

### **Key Expected Outputs**

The key expected outputs of the National Monitoring, Evaluation and Reporting theme for services are: Trial and testing of new video and nitrogen-isotope monitoring methods to gauge their potential role in a sustained national marine monitoring strategy; Additional survey and analysis of the communities and habitats of the Flinders CMR, Houtman-Abrolhos and Solitary islands KEFs. The outputs for products are: Statistical models for understanding the bias and variance associated with new video and nitrogen-isotope monitoring methods, including deep water BRUVs for Services: collation and analysis of time series data relevant to the development and implementation of the SEWPAC objectives for the CMRs in the South East marine planning region, the MERF framework and the national framework developed for the identification of marine indicators. Provision of analysis

for the 2016 State of the Environment report contingent on extant data products. New multivariate state-space modelling techniques to identify trends within, and relationships between, time series observations of the components and processes of KEFs and CMRs. Where possible (contingent on existing resources and data) validation of indicators for KEFs nationally and CMRs in the South East marine planning region, and where appropriate amended models and predictions of KEF response to threatening processes. Status and trend reporting for SoE 2016 for relevant extant datasets.

### **Key Risks**

Injury and/or loss of equipment at sea leading to failure of one or more field programmes. Insufficient power to detect trends and/or changes in ecological indicators due to high variance and insufficient spatial and/or temporal replication. Unable to test event-based sampling strategy due to inclement weather or absence of event trigger during the project period would prevent equipment trials. Loss of support from key collaborators such as NSW Department of Primary Industries and IMOS would compromise project objectives and deliverables. Very few of the available data sets overlap with current KEFs or CMRs leaving the project unable to validate indicator predictions. Lack of senior executive support for greater alignment between the information priorities and strategies of government agencies will undermine attempts to create synergy necessary for sustained national environmental monitoring of Australia's EEZ.

### **Research Questions (Environment Portfolio)**

Research questions from the environment portfolio relevant to theme 1 are:

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

Relevant Policies and Programs for theme 1 identified in recent NERP and NPEI information gathering exercises from across the portfolio 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.

### **Key Events and Dates to Influence Policies and Programs**

The following key events and dates are planned to influence department Policies and Programs: IMOS ecosystem monitoring workshop, date to be confirmed; finalisation of IMOS national strategy and decadal strategy, August 2011; meetings with SEWPAC to develop draft science plans, July 2011; management planning workshops for new CMRs or for existing CMR networks such as the south-

east CMR network; finalisation of NERP science plans, including development of preliminary and detailed field plan for theme 1 project 1, August 2011 and; State of the Environment report 2016.

### **End Users**

The following department staff have been identified as potential research users:

Andrew Read, Director, Marine Protected Area Operations Section (MD);  
Martin Riddle & Andrew Constable, (AAD);  
Jeff Tranter, (ERIN); and  
TBD State of the Environment (IMD)

### **Links and Dependencies to other Hubs and projects**

Theme 1 will link to Theme 3 canyon surveys, Theme 2 pressure mapping and analysis and Theme 2 CMR objective.

## **Theme 2 :**

### **Supporting Management of Marine Biodiversity**

Theme Leader: Dr Tony Smith (CSIRO)

Total Budget (excl GST): \$5,867,724

### **Key Expected Outcomes**

The main high level (longer term) expected outcome for the supporting management of marine biodiversity theme is improved management of marine biodiversity arising from improved options for management arrangements across various sectors operating in the marine environment. For example, improved management of environmental assets arising from coordinated on and off reserve management between SEWPaC and AFMA.

### **Key Expected Outputs**

Outputs for the supporting management of marine biodiversity theme will take the form of various scientific products - maps, risk assessments, economic valuations, evaluation of alternative management options, guidelines – that will support evidence-based decision making by managers. Specific outputs will feed into ongoing decision points related to management of high priority biodiversity assets including species and habitats.

### **Key Risks**

Since some management options depend on co-ordinating activities across sectors, a key risk of theme 2 is failure to agree across portfolios and among ocean users. This risk will be managed by early and judicious involvement of key portfolios and stakeholders at a variety of levels from steering groups through to detailed workshops.

## Research Questions (Environment Portfolio)

Research questions from the environment portfolio relevant to theme 2 are:

- 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?
- 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,
- 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?
- 2.3: What are the advantages and disadvantages for biodiversity of an ecosystem management approach?
- 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?
- 4.1 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?
- 5.1: How can Australia's marine environment be best managed to maximise ecosystem health, ecosystem resilience, and ecosystem goods and services?
- 5.2: What are the comparative costs and benefits for different market models, and how successful have they been in Australia to date?
- 5.3: How can biodiversity markets best operate at the larger scale, ie, landscapes/bioregions?
- 5.4: How can a system of innovation, evaluation and improvement be best established?
- 5.5: Given the limited data currently available about many elements of biodiversity, what cost-effective mechanisms can be used to assign market values to biodiversity, particularly in areas of urban development pressure?
- 5.6 : How can biodiversity markets integrate with markets for other ecosystem services, such as water provision and carbon capture and storage?

## **Policies and Programs**

Relevant Policies and Programs for theme 2 identified in recent NERP and NPEI information gathering exercises from across the portfolio are: 1A Biodiversity Conservation; 1B Protection of Threatened Species and Communities; 1E Maintaining/building a Marine reserve system and protected areas; B1 Environmental Regulation; B2 Sustainable Management of Natural Resources and the Environment; B3 Protection and Management of Heritage Values; C1 Antarctic Science and Environmental Management.

## **Key Events and Dates to Influence Policies and Programs**

This theme will be initiated with a meeting with relevant departmental staff to determine priorities and focus. A series of ongoing meetings is planned as this theme will need to interact closely with SEWPaC staff.

## **End Users**

The following department staff have been identified as potential Theme 2 research users:

Ian Snape, Martin Riddle & Andrew Constable, (AAD);  
Michael Ward, Ports and Marine, (AWD);  
Andrew Read, Director, MPA OPs, (MD);  
Lesley Gidding, Director, Species Conservation (MD);  
Nathan Hanna, Director Sustainable Fisheries (MD); and  
Jeff Tranter, (ERIN)

## **Links and Dependencies to other Hubs and projects**

Although there are no critical dependencies identified at this stage, projects in this theme are likely to draw on outputs from several other projects in the Hub, particularly in the later stages of the work.

## **Theme 3:**

### **National Ecosystems Knowledge**

Theme Leader: Brendan Brooke (GA)

Total Budget (excl GST): \$7,536,266

### **Key Expected Outcomes**

Key expected outcomes for the National Ecosystem Knowledge theme are considered understanding of the importance of the physical environment associated with seafloor features for biodiversity value, including connectivity between management areas (CMRs, KEFS) and; improved capacity for

understanding patterns of biodiversity and for managing off-reserve activities at spatial scales that represent biodiversity patterns.

### **Key Expected Outputs**

Key expected outputs for the National Ecosystems Knowledge theme are: maps/GIS layers representing physical features, processes and patterns of biodiversity for targeted areas of the continental shelf in Northern Australia; models (conceptual, qualitative, quantitative) that describe how large-scale physical features influence biodiversity values; an analytical template for characterising and assessing biodiversity of key shelf physical and ecological features throughout the Australian Marine Estate; an atlas of species and genetic biodiversity for three major faunal groups across Australia's marine domain; national maps/GIS layers of hotspots of biological and genetic diversity and; exploration of possible causes and management implications of major biodiversity patterns.

### **Key Risks**

Delays in discovery and acquisition of datasets have been identified as key risks. Delays in recruitment of postdoctoral researchers and loss of key staff are also key risks to theme 3.

### **Research Questions (Environment Portfolio)**

Research questions from the environment portfolio relevant to theme 3 are:

- Q2. Ecosystems: understanding ecosystem function/monitoring ecosystem health;
- 2.1 How can we improve our capacity to understand, monitor and evaluate ecosystem function/health, including by using predictive models/tools;
- 2.3 What are the advantages and disadvantages for biodiversity of an ecosystem management approach?
- 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? Also provides underlying data for;
- 1.1 Are all threatened species equally valuable in a genetic and ecological context? and;
- 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?

### **Policies and Programs**

Relevant Policies and Programs for theme 3 identified in recent NERP and NPEI information gathering exercises from across the portfolio: 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; C1 Antarctic science and environmental management.

### **Key Events and Dates to Influence Policies and Programs**

Theme 3 will be initiated with a meeting with relevant departmental staff to determine the priorities and focus, including geographic areas of interest.



## **End Users**

The following department staff have been identified as potential research users of theme 3 research:

Ian Snape, Martin Riddle & Andrew Constable, (AAD);

Rowan Wylie, Director North-West, (MD)

Andrew Read, Director MPA Ops (MD);

Michael Ward, Ports and Marine, (AWD); and

Jeff Tranter, (ERIN)

## **Links and Dependencies to other Hubs and projects**

Theme 3 will link with Theme 1 as a source of expertise and information on shelf physical features, processes and biodiversity; Theme 2 in respect of socioeconomic research focus on sharks, and: Theme 4 as a source of new data collected on marine surveys and in respect of critical habitats for sharks and rays.

## **Theme 4:**

### **Regional Biodiversity Discovery to Support Marine Bioregional Plans**

Theme Leader: Julian Caley (AIMS)

Total budget (excl GST): \$3,536,863

### **Key Expected Outcomes**

Key expected outcomes from theme 4, Regional Biodiversity Discovery to Support Marine Bioregional Plans are 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. Theme 4 will support implementation of marine bioregional plans and a more effective management of Australia's marine estate. In addition the Marine Biodiversity Hub will promote development of a national mapping and survey capacity capitalising on recent marine infrastructure investments.

### **Key Expected Outputs**

Key expected outputs of theme 4, Regional Biodiversity Discovery to Support Marine Bioregional Plans will be new physical and biological descriptions of very poorly known Australian marine ecosystems; supply of key samples both physical and biological to support analysis and synthesis for better understanding of the patterns and processes structuring Australian marine biodiversity in linked themes 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 and; 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 will also be an output.

### **Key Risks**

The key risks for theme 4 will be: 1) Bad weather delaying or interrupting cruise schedule with less work getting done than planned, 2) Loss of key staff leading to loss of capacity and delays as new staff are recruited; 3) breakdown of ship and/or equipment on board or loss of equipment leading to loss of capacity to do planned work; 4) significant work injury leading to significant cruise disruption and: 5) unrealistic expectations of what can be achieved by a single survey.

### **Research Questions (Environment Portfolio)**

Research questions from the environment portfolio relevant to theme 4 are:

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**

Relevant Policies and Programs for theme 4 identified in recent NERP and NPEI information gathering exercises from across the portfolio: 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 and; 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 to Influence Policies and Programs**

Theme 4 will be initiated with a meeting with relevant departmental staff to determine the survey's scope and geographical focus

## **End Users**

The following department staff have been identified as potential research users:

Rowan Wylie, Director North-West (MD); Ilse Kiessling, Director North, (MD); Belinda Jago, Director East (MD); Andrew Read, Director MPA OPs, (MD);  
Michael Ward, Ports and Marine, (AWD);  
Jeff Tranter, (ERIN);  
Belinda Brown, Parks and Biodiversity Science Branch, (Parks Australia)

## **Links and Dependencies to other Hubs and projects**

This theme links to themes 1, 2 and 3 by providing critical new data sets that will facilitate new analyses across local, regional and national scales. A link to the tropical Hub or Northern Hubs could eventuate depending on the location of the survey.

# **Marine Biodiversity Hub**

## **Attachment B**

### **Multi-Year Research Plan Project Descriptions (2011 - 2014)**

## **Theme 1: National Monitoring, Evaluation and Reporting**

### ***Project 1.1***

#### **Collation and analysis of existing data sets**

Project Leader: Keith Hayes (CSIRO)

Total budget: NERP\$ \$1,194,184; Total in-kind \$1,582,952

#### **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 1.2 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.

#### **Key Expected Outcomes**

The key expected outcomes of project 1.1 Collation and analysis of existing data sets is a catalogue of new and existing data sources that could be relevant to the indicators identified for the KEFs in the National Indicators project and the objectives for Commonwealth Marine Reserves in the South East marine planning region. The long-term key expected outcome is a greater alignment between marine-focused agencies such as SEWPAC, BOM and DIISR to meet the needs of a sustained national monitoring programme that supports State of the Environment reporting and National accounts reporting for the marine environment.

#### **Key Expected Outputs**

The key expected outputs are the development and application of new and existing time series analysis methods to validate ecosystem health indicators for as many KEFs and CMRs in the south east marine planning region as is possible within the resource constraints of the project.

The key expected services outputs is a collation and analysis of time series data relevant to the development and implementation of the SEWPAC objectives for the CMR estate, the MERF framework and the national framework developed for the identification of marine indicators.

The key expected products outputs is new multivariate state-space modelling techniques to identify trends within, and relationships between, time series observations of the components and processes of KEFs and CMRs in the South East marine planning region.

Other expected outputs is the prioritisation of future infrastructure needs to meet the objectives of a sustained national environmental monitoring strategy for the Commonwealth Marine Reserve Estate and ecosystem health assessment of Australia's EEZ; Statistical and logistical foundation for

the first assessment of marine ecosystem health of Australia's EEZ and ;Status and trend reporting for SoE 2016 for relevant extant datasets.

### **Key Risks Assessment**

The following have been identified as key risks: Loss of support from key collaborators compromising the ability to access data sets and/or develop new multivariate state space models; Very few of the available data sets overlap with current KEFs or CMRs in the south east marine planning region leaving the project unable to validate indicator predictions and; Lack of senior executive support for greater alignment between the information priorities and strategies of government agencies undermining attempts to create synergy necessary for sustained national environmental monitoring of Australia's EEZ.

### **Research Questions Environment Portfolio**

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

Q 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?

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

Q 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**

This project is relevant to the following department 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; and

C1 Antarctic Science and Environmental Management.

### **Key Events and Dates to Influence Policies and Programs**

The following are key events to influence policies and programs:

IMOS ecosystem monitoring workshop, date to be confirmed;

Finalisation of IMOS national strategy and decadal strategy, August 2011;

Meetings with SEWPAC to develop draft science plans, July 2011;

Finalisation of NERP science plans, including development of preliminary and detailed field plan for theme 1 project 1, August 2011; and

State of the Environment report 2016.

## **End Users**

The following department staff have been identified as potential research users:

Andrew Read, Director, Marine Protected Area Operations Section;

Martin Riddle & Andrew Constable, AAD; and

Jeff Tranter, ERIN.

## **Links and Dependencies to other Hubs and projects**

Theme 1 project 1.1 will link to theme 2 pressure mapping and analysis.

## ***Project 1.2***

### **Analysis of approaches for monitoring biodiversity in Commonwealth waters**

Project leader: Keith Hayes (CSRO)

Total budget: NERP \$ \$1,744,224; Total in-kind \$2,345,935

#### **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 1.2 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.

#### **Key Expected Outcomes**

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.

Long-term: Contribute towards a blue-print for a sustained national environmental monitoring strategy designed to evaluate marine ecosystem health and manage the Commonwealth Marine Reserve Estate.

Closer liaison between federal agencies such as SEWPAC, BOM, and DIISR, and state agencies responsible for the management of Marine Protected Areas (MPAs), to identify the infrastructure requirements and logistical/statistical constraints of a sustained national marine monitoring strategy, and help inform off-reserve management of CMR assets.

#### **Key Expected Outputs**

Medium-term: survey design recommendations and data analysis methods for a complementary suite of non-extractive monitoring and survey methods, together with commentary on their suitability for sustained national environmental monitoring.

Services: Trial and testing of new video and nitrogen-isotope monitoring methods to gauge their potential role in a sustained national marine monitoring strategy. Additional survey and analysis of the communities and habitats of the Flinders CMR, Houtman-Abrolhos and Solitary islands KEFs.

Products: Statistical models for understanding the bias and variance associated with new video and nitrogen-isotope monitoring methods, including deep water BRUVs. Habitat maps and community catalogues for Flinders CMR, Houtman-Abrolhos and Solitary islands KEFs.

Expected benefits: greater understanding of the logistical and statistical issues associated with survey design, survey implementation and data analysis for underwater video-based and isotope-



based monitoring methods, leading to a blue-print for how to integrate these methods into other new and existing survey methods for cost-effective monitoring and survey of KEFs and CMRs.

### **Key Risks Assessment**

Injury and/or loss of equipment at sea leading to failure of one or more field programmes;

Insufficient power to detect trends and/or changes in ecological indicators due to high variance and insufficient spatial and/or temporal replication;

Unable to test event-based sampling strategy due to inclement weather or absence of event trigger during the project period would prevent equipment trials; and

Loss of support from key collaborators such as NSW Department of Primary Industries and IMOS would compromise project objectives and deliverables.

### **Research Questions (Environment Portfolio)**

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

Q 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?

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

Q 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**

This project is relevant to the following department 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; and

C1 Antarctic Science and Environmental Management.

### **Key Events and Dates to Influence Policies and Programs**

IMOS ecosystem monitoring workshop, date to be confirmed;

Finalisation of IMOS national strategy and decadal strategy, August 2011;

Meetings with SEWPAC to develop draft science plans, July 2011;

Management planning workshops for new CMRs or for existing CMR networks such as the south-east CMR network;

Finalisation of NERP science plans, including development of preliminary and detailed field plan for theme 1 project 1, August 2011; and

State of the Environment report 2016.

**End Users (name, title and section)**

Andrew Read, Director, Marine Protected Area Operations Section; and  
Jeff Tranter, ERIN

**Links and Dependencies to other Hubs and projects**

Project 1.2 links to theme 3 canyon surveys, theme 2 pressure mapping and analysis and theme 2 CMR objectives.

## **Theme 2: Supporting Management of Marine Biodiversity**

### ***Project 2.1***

#### **Integrating social, economic and environmental values**

Project Leader: Sarah Jennings (UTAS)

Total budget (exc GST): NERP funding \$ \$814,506; Total in-kind \$1,177,693;

#### **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.

#### **Key Expected 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).

#### **Key Expected Outputs**

The different components of the project will produce different, but linked, outputs. The first stage of the project will produce an explicit set of objectives and priorities for marine biodiversity conservation that can be used to guide monitoring and reserve management; 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 ; and the final component of the project will be to derive and compare economic values for marine biodiversity and habitats, at different scales (eg. 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 Risks Assessment**

The key risk identified is that there may be difficulty gaining access to appropriate SEWPaC staff for involvement in the first participatory stage of the project (risk) due to their other work commitments (source) which may result in a distorted picture of the current implicit objectives and priorities (consequence). This risk will be managed through early discussions with SEWPaC about identifying the key individuals to be involved and planning the participatory workshops at times that are most suitable.

Where possible variability will be reduced by looking for sub-groups with common preference sets and attempting to determine what characterises these different groups. There may be difficulty in getting postdoctoral staff (risk) due to a shortage in relevant PhDs in Australia (cause) which may cause some delays in some components of the project (consequence). The project has been scheduled to minimise the potential impact of this risk.

### **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**

This project is relevant to the following department policies and programs:

- 1A Biodiversity Conservation;
- 1B Protection of Threatened Species and Communities;
- 1E Maintaining/building a Marine reserve system and protected areas;
- B1 Environmental Regulation;
- B2 Sustainable Management of Natural Resources and the Environment;
- B3 Protection and Management of Heritage Values; and
- C1 Antarctic Science and Environmental Management.

### **Key Events and Dates to Influence Policies and Programs**

This project will be initiated with a meeting with relevant departmental staff to determine the project priorities and focus. A series of ongoing meetings is planned as this project will need to interact closely with SEWPaC staff.

### **End Users (name, title and section)**

Ian Snape, Martin Riddle & Andrew Constable, (AAD);

Michael Ward, Ports and Marine, (AWD);  
Andrew Read, Director, MPA OPs, (MD);  
Lesley Gidding, Director, Species Conservation (MD);  
Nathan Hanna, Director Sustainable Fisheries (MD); and  
Jeff Tranter, (ERIN)

### **Links and Dependencies to other Hubs and projects**

The project is not dependent on other projects for its success; but will help inform project 3 in this theme. Improved understanding of ecosystem processes, biodiversity mapping, and regional biodiversity discovery could add value or further focus for this project.

## ***Project 2.2***

### **Integrating threats, values and assets for management**

Project Leader: Piers Dunstan (CSIRO)

Total budget (exc GST): NERP\$ \$411,957; Total in-kind \$411,957

### **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 values will influence how those threats are considered.

### **Key Expected Outcomes**

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

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

Long term: SEWPaC 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.

### **Key Expected Outputs**

Tools and approaches to enhance SEWPaCs and Australia's understanding of the links between threats and biodiversity assets. Improved maps of the distribution of known threats to biodiversity and the overlap between threats and assets. Tools to understand the estimate cumulative impacts of threats to biodiversity. Tools to integrate the known threats, assets and biodiversity values so

that management responses allow tradeoffs between different sectors and meet the needs of multiple use management.

### **Key Risks Assessment**

Insufficient communication with other themes and SEWPaC caused by poor links leading to the project goals poorly specified. Inability to link threats to biodiversity caused by poor data leading to inability to compile cumulative risk.

### **Research Questions Environment Portfolio**

Q1.3 What is the fairest and most cost-effective mix of policy tools to conserve recognised biodiversity values?

Q2.1 How can we improve our capacity to understand, monitor and evaluate ecosystem function/health, including by using predictive models/tools?

Q2.2 How can we improve our capacity to understand, monitor and evaluate ecosystem function/health, including by using predictive models/tools?

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

Q2.4 What can we do to strengthen and validate the use of surrogates for identifying biodiversity for protection?

Q3.7 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?

Q3.9 How can the different threats to biodiversity be prioritised for management and investment purposes, and how can cumulative threats be assessed?

Q4.4 How can Australia's marine environment be best managed to maximise ecosystem health, ecosystem resilience, and ecosystem goods and services?

### **Policies and Programs**

This project is relevant to the following department policies and programs:

1A Biodiversity Conservation;

1B Protection of Threatened Species and Communities; 1E Maintaining/building a Marine reserve system and protected areas;

B1 Environmental Regulation;

B2 Sustainable Management of Natural Resources and the Environment;

B3 Protection and Management of Heritage Values; and

C1 Antarctic Science and Environmental Management.

### **Key Events and Dates to Influence Policies and Programs**

This project will be initiated with a meeting with relevant departmental staff to determine the project priorities and focus. A series of ongoing meetings is planned as this project will need to interact closely with SEWPaC staff, especially as this moves to the second stage of this project.

### **End Users (name, title and section)**

Ian Snape, Martin Riddle & Andrew Constable, (AAD);

Michael Ward, Ports and Marine, (AWD);

Andrew Read, Director, MPA OPs, (MD);

Lesley Gidding, Director, Species Conservation (MD);

Nathan Hanna, Director Sustainable Fisheries (MD); and

Jeff Tranter, (ERIN)

### **Links and Dependencies to other Hubs and projects**

This project will be tightly linked with theme 1 to ensure that monitoring and threats align. The project will also use outputs from theme 2 project 2 to obtain biodiversity values. This project will continue and extend some of the work from the CSIRO threat mapping project.

## ***Project 2.3***

### **Landscape approaches to managing high priority conservation values**

Total budget: NERP\$ \$318,350; Total in-kind \$446,984

### **TASK 1 Supporting management of high conservation priority species.**

Task leader: Tony Smith (CSIRO), other staff Ross Daley and Penny Johnson.

### **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 can not 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?

### **Key Expected Outcomes**

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

### **Key Expected Outputs**

Compilation of existing information on threats to sharks and rays. Compilation of existing strategies for managing threats to sharks and rays. Evaluation of integrated management solutions for sharks and rays in general, and for specific high priority species (to be discussed with SEWPaC - e.g. sawfish, rays, deepwater species). 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.

### **Key Risks Assessment**

That existing data and information may not be available (risk) from AFMA (source) due to failure to establish a cross-agency work plan. This risk can be mitigated by establishing an agreement between agencies.

### **Research Questions (Environment Portfolio)**

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?

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**

This project is relevant to the following department policies and programs: 1B Protection of Threatened Species and Communities; B1 Environmental Regulation; B2 Sustainable Management of Natural Resources and the Environment.

### **Key Events and Dates to Influence Policies and Programs**

This project will be initiated with a meeting with relevant departmental staff to determine the project priorities and focus.

### **End Users (name, title and section)**

Lesley Gidding, Director, Species Conservation Section;

Nathan Hanna, Director Sustainable Fisheries Section;

Ian Snape, Martin Riddle & Andrew Constable, AAD;

Ports and Marine, AWD (Michael Ward); and

Jeff Tranter, ERIN

### **Links and Dependencies to other Hubs and projects**

This project links to shark work undertaken in Theme 3 and draws on previous research on ecological risk assessment undertaken by AFMA.



## **2.3**

### ***Landscape approaches to managing high priority conservation values***

#### **TASK 2 Supporting management of marine benthic biodiversity**

Task Leader: Roland Pitcher (CSIRO)

##### **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.

Available resources will permit this task to focus on one region - the SEMR - and primarily on fishing impact and its management and the interaction with conservation planning and management.

##### **Key Expected Outcomes**

- \* integrated approach to the protection of benthic biodiversity and management of human uses that interact with the seabed
- \* an evidence-based regulatory environment for ocean users
- \* effective off-reserve management and accounting of reserve and off-reserve management in assessing overall sustainability risk

##### **Key Expected Outputs**

- \* maps of human uses and intensity, where available
- \* refined empirical maps of hard ground in SEMR, combined with predicted habitat distributions
- \* maps of threats and risks to benthic biodiversity, and maps of cumulative risks
- \* models and methods to assess risk and evaluate management options
- \* evaluations of integrated management options for uses that interact with benthic biodiversity, for the SEMR region where adequate data are available

##### **Key Risks Assessment**

Dependency on products from other tasks is a risk. Responsibility and resource needs for some outputs, and their timelines, has been identified and considered, but details remain to be finalised.

##### **Research Questions (Environment Portfolio)**

Q2.1.2: threats to biodiversity values can be detected

Q2.1.3: trends can be modelled and predicted

Q2.1.4: which management actions are effective and can be evaluated

Q3.7 How can off-reserve areas be managed to ensure values of biodiversity, and MPAs, are not compromised by regional & external threats?

Q3.9 How can the different threats to biodiversity be prioritised for management and investment purposes, and how can cumulative threats be assessed?

Q4.inform decisions related to sustainable use by managers having access to integrated assessments of cumulative effects of uses

Q4.1 How do productive marine uses impact on biodiversity?

Q4.4 How can Australia's marine environment be best managed to maximise ecosystem health, ecosystem resilience, and ecosystem goods and services?

### **Key Events and Dates to Influence Policies and Programs**

1A Biodiversity Conservation;

1B Protection of Threatened Species and Communities;

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

B1 Environmental Regulation;

B2 Sustainable Management of Natural Resources and the Environment;

B3 Protection and Management of Heritage Values; and

C1 Antarctic Science and Environmental Management.

### **Key Events and Dates to Influence Policies and Programs**

The project will be initiated with a meeting with relevant departmental staff to determine the project priorities and focus.

### **End Users (name, title and section)**

Lesley Gidding, Director, Species Conservation Section;

Nathan Hanna, Director Sustainable Fisheries Section;

Ian Snape, Martin Riddle & Andrew Constable, AAD;

Ports and Marine, AWD (Michael Ward); and

Jeff Tranter, ERIN

### **Links and Dependencies to other Hubs and projects**

\* benthic biodiversity maps from MBH1 (to be finalised).

\* predicted maps of specific habitat types

\* empirical maps of hard ground in SEMR from previous research

\* benthic impact & recovery knowledge from a range of completed projects

\* benthic impact/recovery and human use management scenario models from completed projects

\* spatial data and maps of human use intensity affecting the seabed from management agencies.

## **Project 2.4**

### **Supporting management of listed and rare species**

Project Leader: Karen Edyvane (CDU) Co-Leaders: Richard Pillans (CSIRO), Thor Saunders (NT Fisheries)

Total budget (exc GST): NERP\$ \$954,399; Total in-kind \$1,331,878

### **Problem Statement**

This project focuses on landscape-level integrated management solutions for supporting management of rare and listed species, using euryhaline elasmobranchs a key threatened group in Northern Australia as a test case. The new genetic techniques that will be modified and applied in this task have the potential to make it possible to assess rare and listed species more effectively and at a radically reduced cost. Northern Australia is a global stronghold for populations of euryhaline and coastal elasmobranchs, particularly TEP species, such as the genus *Pristis* (sawfishes) and *Glyphis* (river sharks).

Many euryhaline and coastal elasmobranch species continue to be at risk from overfishing (commercial, recreational, and domestic/international IUU), as well as habitat modification. Some species, such as the Freshwater Sawfish, have undergone substantial (albeit unquantified) declines in abundance, accompanied by fragmentation and range contraction. Effective conservation and management is currently compromised by an acute lack of data, particularly in the inshore waters of the Northern Territory (NT). Systematic monitoring of abundance and distribution, and also, improved understanding of biology, connectivity, habitat requirements, population genetic structure and key threats, is essential to inform population status, assessment and trajectories. Innovative methods and tools to assist long-term population monitoring, assessment and management of data-poor, rarely encountered TEPs species are also urgently required.

### **Key Expected Outcomes**

The project will improve understanding and management of data-poor, TEPs and targeted, priority euryhaline and coastal elasmobranch species (particularly threatened sawfishes) in northern Australia, initially focusing on selected inshore locations in the Northern Territory (eg. West Alligator, Roper River, Darwin Harbour). This will be achieved through:

- (1) Developing innovative long-term monitoring methods (ie. abundance and mortality, movement, population genetics), for evaluating the population status of rare and data-poor, TEP euryhaline and coastal elasmobranchs in the NT (and northern Australia), with Freshwater Sawfish, initially, as a focal species.
- (2) Developing an assessment framework to assess the population status (including assessment of proposed harvests) of data-poor, rarely encountered TEP elasmobranch species.
- (3) Improving understanding of the distribution and range, abundance, and life history of priority euryhaline and coastal elasmobranchs (particularly *Pristis*, *Glyphis*), in northern Australia (and particularly the NT).

- (4) Improving understanding of habitat utilisation, long-term movement patterns and connectivity (inshore-offshore, freshwater-estuarine-marine) of threatened sawfishes and selected priority elasmobranch populations in the NT.
- (5) Determination of the population genetic structure of selected priority elasmobranchs in the NT (including Freshwater Sawfish).
- (6) Improving understanding of the threats facing threatened sawfishes, TEPs and priority elasmobranchs in the NT, including fishing mortality and levels of indigenous harvest.
- (7) Developing population estimates and trajectories of priority TEP coastal elasmobranchs (particularly Freshwater Sawfish), in the NT and also, across northern Australia.
- (8) Improving industry and public awareness and understanding of the threats facing threatened sawfishes, TEPs and priority euryhaline and coastal elasmobranchs in the NT.
- (9) Assisting Indigenous participation in the monitoring and management of threatened sawfishes and priority elasmobranchs in the NT.
- (10) Develop capability and partnerships in the NT in the monitoring and assessment and management of data-poor, priority euryhaline and coastal elasmobranchs.

### **Key Expected Outputs**

The management options developed in this project will have wide applicability to other listed and data poor species providing for a more effective and efficient management of this very diverse group. A key output of this project will be an assessment of the effectiveness of this approach for other listed and rare species. The project will deliver improved biological understanding and significantly, methods, population monitoring and assessment tools, for the management of threatened sawfishes and other, data-poor, TEPs and priority euryhaline and coastal elasmobranch species in the NT, through:

- (1) Development of a landscape approach to assess the population status of data-poor, rarely encountered TEP elasmobranch species (particularly sawfishes), including tools to assess the effectiveness of current management of populations in northern Australia (eg. quantitatively assessing the effectiveness of management initiatives or proposed harvests against EPBC and IUCN criteria).
- (2) Development of novel and innovative population monitoring methods (using a combination of acoustic telemetry, mark recapture and close-kin genetics) for evaluating the population status of sawfishes and other rare and data-poor, TEP euryhaline and coastal elasmobranchs in the NT and northern Australia (eg. Glyphis, Bull Shark).
- (3) Design and implementation of a strategic, intensive field netting and monitoring program in the NT in 2-3 selected coastal systems (ie. rivers, estuaries and coastal areas), to gather baseline data on the distribution, range, abundance, and life history of sawfishes (and other priority euryhaline and coastal elasmobranchs).
- (4) Design and implementation of an intensive acoustic tagging program and a recreational fish tag-release program, in a selected location in the NT, to improve understanding of habitat utilisation, long-term movement patterns and connectivity (ie. inshore-offshore, freshwater-

estuarine-marine) of selected populations of sawfishes (and other priority euryhaline and coastal elasmobranchs).

(5) Determination of the population genetic structure of selected priority and TEP elasmobranch species and populations in the NT, utilising mitochondrial and nuclear DNA to obtain estimates of population structure, phylogeographic structure and genetic diversity - including an examination of close-kin relationships in Freshwater Sawfish individuals.

(6) Estimates of fishing mortality and abundance of priority and TEP elasmobranchs in selected locations in the NT, through fishery and fishery-independent monitoring and improved 'by-catch' identification, monitoring and reporting.

(7) Improved public awareness and understanding of the threats facing TEPs and priority euryhaline and coastal elasmobranchs in the NT, through commercial and recreational and community-based reporting programs and a national, sawfishes (and TEP and priority euryhaline and coastal elasmobranch) website.

(8) Population estimates (ie. population abundance and long-term projections) of sawfish populations in the NT and application across northern Australia and other priority TEPs and coastal elasmobranchs species (ie. *Glypis*). Population estimates based on time series of acoustic telemetry, juvenile counts and close-kin genetics (ie. to estimate juvenile and adult survival, adult abundance and age-fecundity relationships).

(9) Increased Indigenous participation in the monitoring and management of sawfishes and selected priority elasmobranchs in the NT, through accessing Indigenous ecological knowledge, improving estimates of Indigenous harvest, and developing Indigenous sea-ranger partnerships in the long-term monitoring of euryhaline and coastal elasmobranchs (and entanglements) in remote areas.

(10) Development of capability in the NT through partnerships (university, government, industry, indigenous) in the monitoring and assessment of data-poor, priority euryhaline and coastal elasmobranchs, particularly in genetic mark-recapture, close-kin genetics, acoustic tagging and systematic population monitoring and assessment tools.

### **Key Risks Assessment**

(1) Lack of baseline knowledge of distribution and abundance for many species of rare, TEP euryhaline and coastal elasmobranchs in the NT (risk), may compromise population modelling and assessment (consequence) - due largely to a remote and largely, inaccessible coastline (source). Current program will develop an information base for 2-3 coastal regions.

(2) Low number of adult sawfishes taken by NT Fisheries (source) - hence, limited information on adult distribution (risk) - may compromise population assessments (consequence). The distribution of sawfish species will be addressed by grossly defining the habitats of freshwater (and other) sawfish by identifying the rivers in which juveniles occur.

(3) "Recaptures" required for close kin genetic approach for looking at sawfish likely to be small (risk), ie. likely to be lack of information from the parental set (consequence) (due to the low number of adult sawfish taken in NT Fisheries) (source). To confirm the utility of the method, project includes the Darwin Harbour region (greater fishing effort) and also, a range of potential

sawfish species (recaptures likely greater for some more dominant sawfish species, ie. *Anoxypristis*). Project will target genetically and conventionally tagging juvenile sawfish (the easiest life history stage of sawfish of all species to capture) - and genetically sample as many as possible of those that do not survive capture. New close-kin techniques will be developed that do not depend on obtaining adult samples. Synergies with existing conventional/genetic tagging program for elasmobranchs in the Offshore Net and Line Fishery in the NT will also be explored (ie. NT Fisheries has a bank of tissue from ~ 3000 elasmobranchs tagged over the last 4 years, which includes *Anoxypristis*).

(4) There may be difficulty in coordinating elasmobranch experts and managers across northern Australia (NT, Qld, WA) and gaining access to appropriate SEWPaC staff for involvement in the first participatory stage of the project (risk) due to their other work commitments (source) which may result in a distorted picture of the current implicit objectives and priorities (consequence). This risk will be managed through early discussions with SEWPaC about identifying the key individuals to be involved and planning the participatory workshops at times that are most suitable.

(5) There may be difficulties in finding appropriate Australian postdoctoral research staff (risk) given the limited number of PhDs being undertaken in these areas in Australia (source), which may cause some delays in the activities they are involved in if overseas recruitment is necessary (consequence). To allow for this, activities where postdoctoral research staff (genetics, field program) will be most required have been scheduled for a later start in the project (but if appropriate staff are found then these could be started earlier).

### **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?

1.3 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?

1.6 How can the management of biodiversity values of the Indigenous estate by Indigenous custodians be improved upon, and what incentives/resources, information and support are needed to achieve this?

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

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; 1B Protection of Threatened Species and Communities; B2 Sustainable Management of Natural Resources and the Environment.

## **Key Events and Dates to Influence Policies and Programs**

This project will be initiated with a meeting with relevant departmental staff to determine the project priorities and focus.

## **End Users (name, title and section)**

Lesley Gidding, Director, Species Conservation Section;

Nathan Hanna, Director Sustainable Fisheries Section;

Ports and Marine, AWD (Michael Ward); and

Jeff Tranter, ERIN

## **Links and Dependencies to other Hubs and projects**

This project links 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 other euryhaline elasmobranchs, 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 would co-invest, 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 3 - Understanding critical habitats; Links to Theme 4, Project 1 - Biodiversity Discovery; Links to Project 2 - Socioeconomic on sharks.

## **Theme 3: National Ecosystems Knowledge**

### ***Project 3.1***

#### ***Shelf and Canyon Ecosystems- functions and processes.***

Project Leader: Brendan Brooke (GA)

Total budget: NERP\$ \$1,508,743; Total in-kind \$2,734,824

#### **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.

## **Key Expected Outcomes**

Considered understanding of the importance of the physical environment associated with seafloor features for biodiversity value, including connectivity between management areas (CMRs, KEFS). Improved capacity for understanding patterns of biodiversity and for managing off-reserve activities at spatial scales that represent biodiversity patterns.

## **Key Expected Outputs**

Maps/GIS layers representing physical features, processes and patterns of biodiversity for targeted areas of the continental shelf in Northern Australia; Models (conceptual, qualitative, quantitative) that describe how large-scale physical features influence biodiversity values; An analytical template for characterising and assessing biodiversity of key shelf physical and ecological features throughout the Australian Marine Estate

## **Key Risks Assessment**

Delay in meeting with SEWPaC staff to establish theme priorities & focus; delays in discovery and acquisition of datasets; delays in recruitment of postdoctoral researchers; loss of key staff.

## **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; and

B3 Protection and management of heritage values.

## **Key Events and Dates to Influence Policies and Programs**

This project will be initiated with a meeting with relevant departmental staff to determine the themes priorities and focus, including geographic areas of interest.

## **End Users (name, title and section)**

Ian Snape, Martin Riddle & Andrew Constable, (AAD);



Rowan Wylie, Director North-West, (MD) Andrew Read, Director MPA Ops (MD);  
Michael Ward, Ports and Marine, (AWD); and  
Jeff Tranter, (ERIN)

### **Links and Dependencies to other Hubs and projects**

This project will link to Theme 1 as a source of expertise and information on shelf physical features, processes and biodiversity; Theme 4 as a source of new data collected on marine surveys.

## ***Project 3.2***

### ***National Maps of Biodiversity and Connectivity***

Project Leader: Tim O'Hara (MV)

Total budget: NERP\$1,203,893; Total in-kind \$2,088,808

### **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.

### **Key Expected 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.

### **Key Expected Outputs**

An atlas illustrating major patterns of species and genetic biodiversity of three major faunal groups across Australia's marine domain; National maps/GIS layers of hotspots of biological and genetic diversity, including for sharks, rays and select teleosts; Exploration of the possible causes and management implications of major biodiversity patterns.

### **Key Risks Assessment**

Few risks with data acquisition as already identified or acquired in the CERF MBH. Otherwise, risks with ability to extract molecular data from museum specimens; delays in recruitment of postdoctoral researchers; loss of key staff.

## **Research Questions (Environment Portfolio)**

Q2. Ecosystems: understanding ecosystem function/monitoring ecosystem health. Including Q2.4. It also provides underlying data for Q1.1, Q2.1, Q2.3 and Q3.7.

## **Policies and Programs**

1E Maintaining/building a marine reserve system & protected areas;

1G Biodiversity research;

B3 Protection & management of heritage values; and

C1 Antarctic science and environmental management.

## **Key Events and Dates to Influence Policies and Programs**

This project will be initiated with a meeting with relevant departmental staff to determine the themes priorities and focus.

## **End Users (name, title and section)**

Ian Snape, Martin Riddle & Andrew Constable, (AAD);

Andrew Read, Director MPA Ops (MD);

Michael Ward, Ports and Marine, (AWD); and

Jeff Tranter, (ERIN)

## **Links and Dependencies to other Hubs and projects**

Links to Theme 1 in terms of MPA monitoring designs, Theme 2 in regard to management of sharks and rays, and to Theme 4 as a source of new genetic material collected during the marine survey.

## **Theme 4 - Regional Biodiversity Discovery to Support Marine Bioregional Plans**

### ***Project 4.1***

#### ***Voyage of Discovery***

Project Leader: Julian Caley (AIMS)

Total budget: NERP\$ \$1,437,606; Total in-kind \$2,099,258

#### **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 MBH

### **Key Expected 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.

### **Key Expected Outputs**

New physical and biological descriptions of very poorly known Australian marine ecosystems; supply of key samples both physical and biological 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.

### **Key Risks Assessment**

- 1) Bad weather delaying or interrupting cruise schedule with less work getting done than planned.
- 2) Loss of key staff leading to loss of capacity and delays as new staff are recruited
- 3) breakdown of ship and/or equipment on board or loss of equipment leading to loss of capacity to do planned work
- 4) significant work injury leading to significant cruise disruption
- 5) Unrealistic expectations of what can be achieved by a single survey.

### **Research Questions (Environment Portfolio)**

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

Q 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?

Q 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?

Q 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?

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

Q 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 to Influence Policies and Programs**

This project will be initiated with a meeting with relevant departmental staff to determine the survey's scope and geographical focus

**End Users (name, title and section)**

Rowan Wylie, Director Tropical North-West Marine Conservation Section;

Ilse Kiessling, Director Tropical North Conservation Section;

Belinda Jago , Director Temperate East Marine Region;

Andrew Read, Director Marine Protected Area Operations Section;

Ports and Marine, AWD (Michael Ward); and

Jeff Tranter, ERIN

**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