CERF Marine Biodiversity Hub

Overview December 2007

The CERF Programme

The key aim of the Commonwealth Environment Research Facilities (CERF) programme is to provide sound advice to inform environmental public policy objectives and to better the management of Australia's unique environment. The research to be funded under CERF is to be collaborative – involving multiple institutions, and other research partners and end-users – and to incorporate multiple disciplines. CERF will specifically support national world-class environmental research that does not qualify for assistance under existing programmes.

The University of Tasmania, CSIRO, Geoscience Australia, Australian Institute of Marine Sciences and Museum Victoria received $6 million to create a CERF Hub for the Prediction and Management of Australia's Marine Biodiversity (Marine Biodiversity Hub). The 5 partners are contributing $12 million of their own funds to this initiative.

CERF Marine Biodiversity Hub

Evolutionary history and local environmental conditions predict the distribution of species and communities on land and this underpin landscape management. The Marine Biodiversity Hub's aim is to provide a similar predictive capacity for Australia's seascape. The Hub will build research capacity and collaboration between marine research agencies, and provide new tools to support the identification, assessment, conservation and sustainable use of Australia's marine assets, including enhancing the National Representative System of Marine Protected Areas (NRSMPA) and other ESD management applications. This will assist conservation agencies, resource management agencies, and users develop management approaches that provide comprehensive, adequate and representative conservation of Australia's seascape. Hub outputs will help agencies and stakeholders meet the requirements of the NRSMPA, Environmental Protection and Biodiversity Conservation Act, the Commonwealth Fisheries Act, and various State Fisheries and Conservation Management legislation.

Marine protected areas (MPAs) are key mechanisms of spatial management, and Australia's NRSMPA will be one of the most comprehensive in the world when it is completed by 2012. In Australia, the foundation of marine conservation management is a national "bioregionalisation" based on physical and biological data (Commonwealth of Australia 2005). The EEZ was divided into Provincial Bioregions based on the biogeography of demersal fish, with further subdivisions based on water depth and geomorphic units. These are the units that are being used to develop the NRSMPA, but to date the testing of the linkages between abiotic features and biota has been scattered, inconsistent and poorly understood.

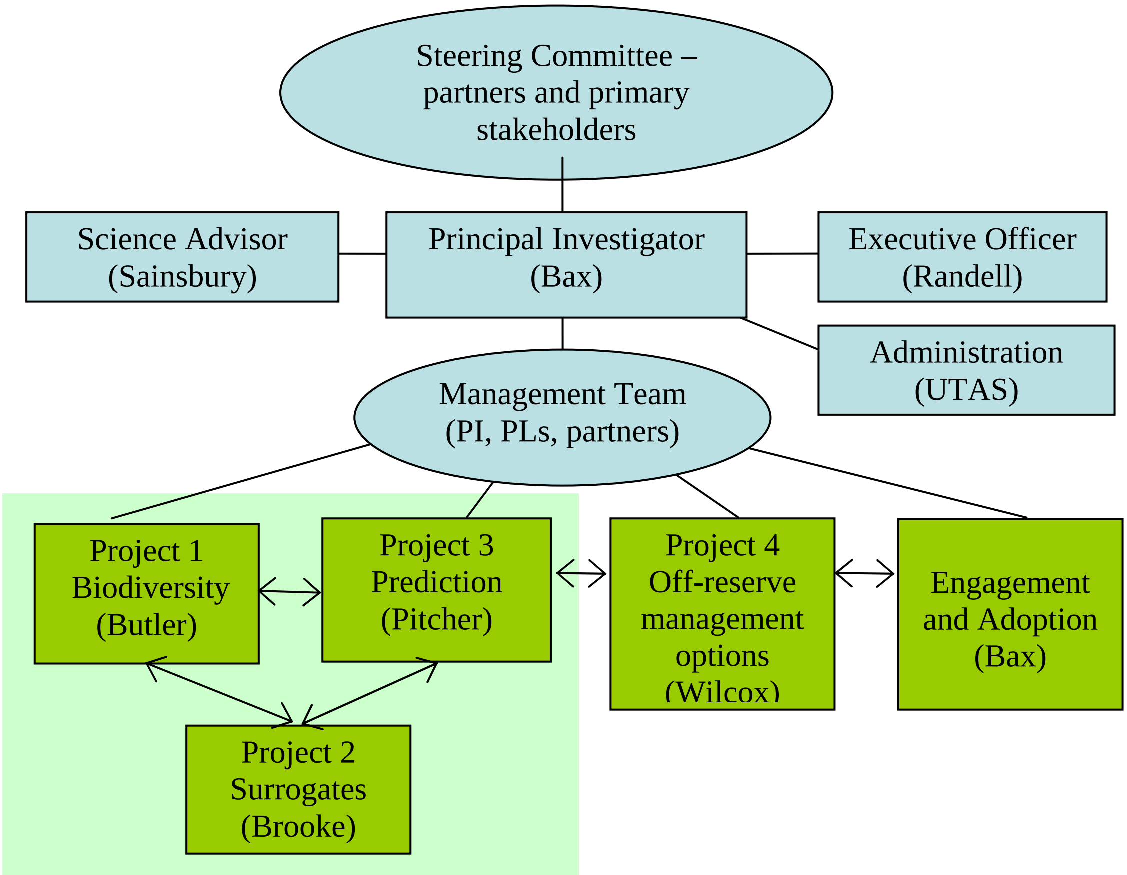
Comprehensive description of the biodiversity of the entire Australia marine jurisdiction is unattainable with current resources and technology. A main challenge faced by researchers and conservation managers is to predict biodiversity from the most useful surrogates. The Hub will build on existing research by investigating the degree to which biological surrogates and biophysical factors can be used to predict patterns in marine biodiversity.

Reserve systems by themselves will not provide comprehensive, adequate and representative protection of Australia's marine biodiversity. A combination of on-reserve and off-reserve conservation management methods, integrated with existing and new non-spatial methods, is required that together can deliver the required level of protection without restricting or stifling industry's innovative approaches to sustainable resource use. The Hub will develop qualitative and quantitative methods that can be used to compare how the different conservation management tools perform in isolation and in combination to conserve marine biodiversity in a multi-use environment.

Hub Framework

The Marine Biodiversity Hub is specifically organised to bring together partners with a proven history of bilateral cooperation into a single national collaboration that will combine resources, talents and knowledge of marine resources (biological and physical; static and dynamic) to deliver a common understanding and a common suite of spatial and non-spatial tools for the conservation management of marine resources.

There are four multidisciplinary collaborative projects in the Hub. Each project consists of a number of tasks (2-6) that vary in their level of inter-agency participation. Collaboration on all tasks is encouraged. Explicit links are made between tasks and projects.



Project 1: Biodiversity (Alan Butler)

This project will describe patterns in Australian marine biodiversity at continental, regional and local scales using a variety of taxonomic and recent genetic approaches. Historical changes in sea level, geomorphology, palaeocurrents and climate will be used to explain the origins of these patterns in biodiversity and be used to infer how contemporary biodiversity may respond to current environmental change. The smallest scale studied in this project is the scale of 10s of kilometres (seamount connectivity), and this is associated with modelling deepwater currents to establish potential connectivity between deep sea features. The largest scale is continental (and SW Pacific scale). This project will provide input and understanding to describing and categorising Australia's biodiversity – a crucial first step in its management.

Task 1 ***Update Shelf Bioregionalisation.*** Task updates 1996 national shelf bioregionalisation of Australian marine fauna, by including recent survey data and including depth as a structuring variable.

Task 2 ***Diversity, Distribution and History of Macrobenthos, especially Decapods off the WA continental margin.*** Determines whether bioregional patterns in invertebrate phyla on west coast Australia continental shelf and slope correspond to those of fish and incorporates broader Australian and SW Pacific data on two families of squat lobster to understand their evolution and radiation.

Task 3 ***Historical Biogeography – Derivation and Origin of Australia's Marine Biota*** Uses evolutionary biology and phylogeography on selected (informative) fish and invertebrate taxa to describe how Australia's provincial level bioregions came about and examine north-south and shallow-deep differences in endemicity. Provides data to predict possible changes and develop risk profiles for different species.

Task 4 ***Timing of Evolutionary Processes in Australia's Marine Biota.*** Uses molecular phylogenetics for selected fish and decapod species to evaluate synchronicity of historical physical processes and speciation that has given rise to Australia's high levels of endemism, especially in the south.

Task 5 ***Connectivity of Seamount Fauna.*** Assesses connectivity between seamounts of Southern Tasmania based on population genetics (2 corals, one decapod), spatial statistics and oceanography.

Project 2: Surrogates (Brendan Brooke)

The aim of the Surrogates Project is to improve our understanding of the ecological processes linking selected environmental variables and patterns in biodiversity, and hence their potential as surrogates. The emphasis will be on physical variables, although some biological variables (e.g. productivity) will be also be tested. The project will assemble the relevant physical datasets needed for both the Biophysical Relationships and Prediction Projects. This project will provide new tools for marine biodiversity research and management through developing more informed and robust surrogates for biodiversity.

There are 3 tasks that cover identifying and acquiring data, assessment and further development of physical surrogates and the development of disturbance surrogates for the shelf and slope.

Task 1 ***Surrogacy review, data quality assessment and data compilation.*** Identifies the range of useful biophysical datasets available for Hub research, including a description of their quality and location, and assessment of their potential utility as surrogates for marine habitats and biodiversity, supported with a literature review.

Task 2 ***Improvement of existing and development of new surrogacy relationships between physical variables and biodiversity patterns.*** Improves our understanding of the degree and form of processes linking physical variables and marine biodiversity. Includes development of new and improved surrogates, filed surveys for gap filling, and comparison of modelled geophysical and biological diversity.

Task 3 ***Influence of benthic disturbance on patterns of marine biodiversity.*** Identifies the range of physical disturbance regimes occurring on the Australian continental shelf and quantifies their geographic extents. (2) Develops disturbance indexes suitable for surrogacy applications that represent the energy level, delivery rate and peak-load of seabed stress. (3) Maps at a regional scale (where existing data sets permit) the areas on the shelf slope that are likely to be disturbed by seabed failure and associated down-slope mass movement and gravity currents. (4) Provides a regional ranking of the slope based on susceptibility.

Project 3: Prediction (Roland Pitcher)

The overall objective is to develop models that predict patterns of marine biodiversity, with specifiable precision from more broadly available physical surrogates, at regional and national scales around Australia. More specifically, the Prediction Project will:

- Examine the performance of a number of statistical/mathematical methods for modeling the relationships between biodiversity and the physical environment,
- Examine the extent to which selected taxa (such as fishes) are biological surrogates for other taxa (such as invertebrate groups) and other biodiversity measures (eg. species richness, diversity indices, evenness).
- As a first step, collate suitable biological data that provide that best available match to the broadest range of physical data output from the Surrogates Project.

Strong 3-way links are proposed between the Prediction project and the Surrogates project, and with the Biodiversity project, which will be maintained by cross-membership of key staff in each.

Task 1 ***Biological Data Audit and Acquisition.*** Scope available biological datasets, select suitable ones, acquire metadata, organise data in relational database, extract data in format suitable for surrogates and prediction analyses (0.01˚ grid).

Task 2 ***Predict Patterns of Continental Shelf Seabed Biodiversity from Physical Surrogates..*** Develop and test a number of statistical modelling methods at a range of end-user application spatial scales and as appropriate for the scale of the available surrogates, to predict functional assemblage patterns on the Continental shelf. Using data on multiple species derive biodiversity attributes/indices and test for relationship to predicted functional assemblage patterns.

Task 3 ***Predict Patterns of Continental Slope Biodiversity from Physical Surrogates.*** See task 2. Task uses existing slope data.

Task 4 ***Predict Patterns of Temperate Shallow Reefs from Physical Surrogates.*** See Task 2. Tasks uses existing wide-ranging shallow temperate reef visual censuses, supplemented with new physical data to develop predictive models.

Task 5 ***Predict Patterns of Tropical Coral Reefs from Physical Surrogates.*** See Task 2. Task will use existing wide-ranging shallow tropical reef visual censuses (Lord Howe, Coral Sea, NWS to the Abrolhos), supplemented with new physical data from the surrogates project.

Task 6 ***Predict Patterns of Marine Biodiversity from Biological Surrogates.*** Task aims to test prediction performance of biological surrogates, in particular whether assemblage patterns and biodiversity attributes for selected taxonomic groups can be predicted from other taxonomic groups at the meso/regional scale.

Project 4: Off-reserve spatial management and biodiversity offsets (Chris Wilcox)

The project will develop methods for evaluating management options that complement the National Representative System of Marine Protected Areas (NRSMPA) to achieve CAR biodiversity conservation in marine ecosystems that are subjected to commercial fishing and tourism (primarily recreational fishing). There are two primary foci, the use of incentives to influence the spatial overlap between biodiversity impacts and assets and the incorporation of biodiversity offsets to reduce the complexity of the spatial management problem.

The specific goals of the project are:

1) to deliver a system for evaluating triple bottom line outcomes of spatial management in the tuna fishery, and demonstrate its use in the evaluation of a limited number of scenarios and;

2) to explore a case study for bycatch offsets in the tuna fishery, providing background research including methods for accounting for the value of an offset and potentially demonstrating an implementation using marine turtles.

Task 1 ***Spatial Management of Marine Impacts Using Incentives.*** The task will develop methods for evaluating strategies for managing the impacts of fishing and other uses on biodiversity. Permanent MPAs in the NRSMPA will be taken as a given that we will complement with additional off-reserve management. Management options of particular interest will be spatial management and the use of spatial incentives. The project will use simulation modeling to predict the outcomes of management scenarios, and compare expected economic, social and biodiversity outcomes using performance relative to stakeholder identified criteria for each of these areas separately and in an integrated way using multi-criteria decision analysis.

Task 2 ***Biodiversity Offsets***. This sub-project will complement the spatial management investigation by developing the necessary tools to utilize biodiversity offsets firstly for threatened marine species and secondly exploring how they might be applied beyond TEPs to other bycatch species and impacted habitats. The primary focus of this project will be on the applications of offset programs to alleviate the effects of fisheries bycatch. By reducing the level of concern for bycatch species through offsets, the spatial constraints required to ensure that economic activities in the marine system do not cause unacceptable threats to biodiversity can potentially be eased. For instance, fisheries closures are a means of reducing residual bycatch which is not prevented by gear or fishing operation modifications. However, closures are a very expensive tool politically, socially and economically. Thus if closures can be avoided, and other more benign spatial incentives can be used to reduce other biodiversity concerns marine industries may be able to maintain their profitability while reducing their biodiversity impacts to or even below sustainable levels.