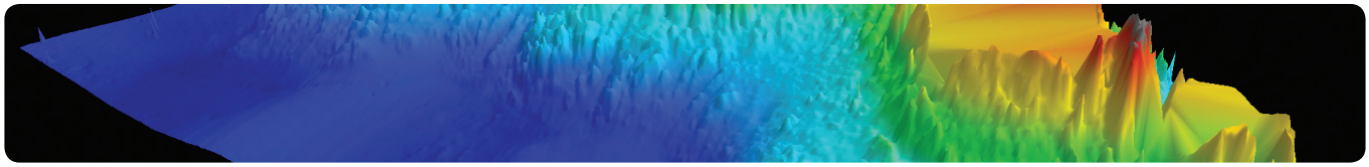
MARINE BIODIVERSITY RESEARCH

Prediction and Management of Australia's Marine Biodiversity

CERF MARINE BIODIVERSITY HUB



Ensuring a future for life in Australia's oceans

The Marine Biodiversity Hub is supporting the Department of the Environment, Water, Heritage and the Arts' (DEWHA) marine planning by providing national and regional maps of predicted patterns of marine biodiversity in Australia's oceans, and an increased range of options for its management.

This capability is crucial to conserving and managing Australia's marine biodiversity and will complement Australia's National Representative System of Marine Protected Areas (NRSMPA) due to be in place by 2012.

Together, the NRSMPA and off-reserve management provide the best option for long-term protection and sustainable use of marine biodiversity in light of competing demands on the marine environment.

Products

Bioregionalisation

The Interim Marine and Coastal Regionalisation for Australia (IMCRA 4.0) established patterns of marine biodiversity based on the ranges of 1500 fish species. This information is used in regional marine planning, including the number and placement of marine reserves. Marine Biodiversity Hub research has updated the bioregionalisation, increasing the number of fish species with distributional data to more than 5500, determined new depth-based delineations across the continental shelf, and showed that fish distribution patterns match those for decapods and six additional megabenthos groups at regional scales.

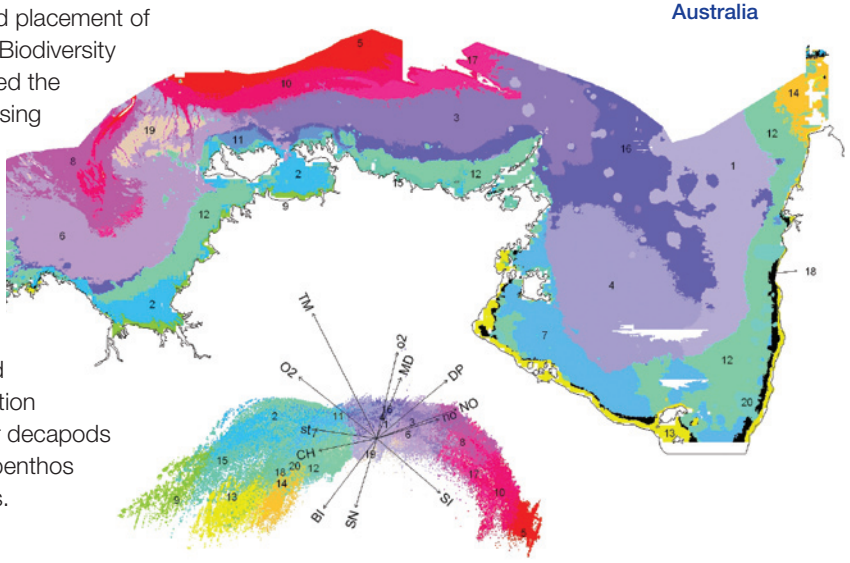
Predicting patterns in marine biodiversity

We rely on physical information layers to characterise marine biodiversity at a fine (1 km²) scale around Australia. A major goal of the Marine Biodiversity Hub is developing models of the relationships between biological survey data and the physical layers at regional scales. To achieve this, we have updated or developed 29 physical datasets, collated biological data from surveys from the past 50 years, and developed new statistical methods to re-interpret physical data in the context of its ecological use. The results and national maps from these analyses are being used by DEWHA to support regional marine planning, MPA selection and zoning, identifying threatened species distributions and habitats, and will support off-reserve management.

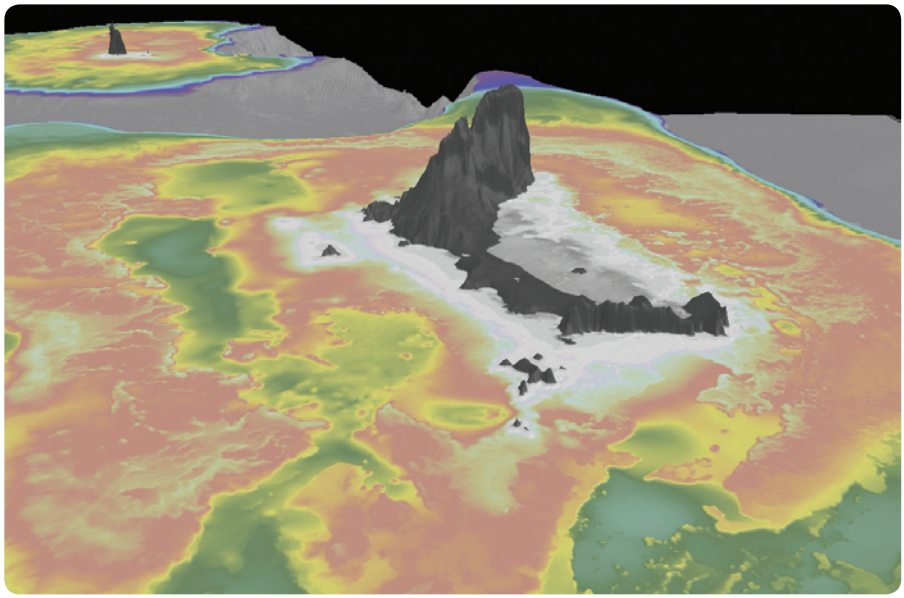
The Marine Biodiversity Hub was formed in 2007 to provide sound advice and improve management of Australia's unique marine environment. It is funded until June 2010 by a $6 million Commonwealth Environment Research Facilities Program (CERF) grant from the Department of the Environment, Water, Heritage and the Arts (DEWHA). An additional $12.4 million is being contributed by the five research partners: the University of Tasmania, CSIRO, Geoscience Australia, the Australian Institute of Marine Science, and Museum Victoria.

Stakeholder partners are the Australian Fisheries Management Authority, the Australian Petroleum Production and Exploration Association, the Commonwealth Fisheries Association, the Commonwealth departments of Agriculture, Fisheries and Forestry and Environment, Water, Heritage and the Arts, the Sustainable Tourism Cooperative Research Centre, and World Wildlife Fund Australia.

> Map and biplot of predicted seabed compositional biodiversity, northern Australia



BI: Benthic irradiance
CH: chlorophyll A (average)
DP: depth
MD: % mud
no: nitrate (std dev)
NO: nitrate (average)
o2: oxygen (std dev)
O2: oxygen (average)
SI: silicate (average)
SN: % sand
st: sea surface temperature (std dev)
TM: sea bed temperature (average)



> 3D view of Lord Howe Island and the surrounding shallow shelf viewed from the northeast. The island is surrounded by a relict (Holocene) reef that sits in 40 m – 20 m water depth (red-grey area) that is around 20 times larger than the modern fringing reef (dark grey on far side of island). The relict reef and old lagoon (green areas) support distinctive benthic communities.

Analysis of new high-resolution shelf data

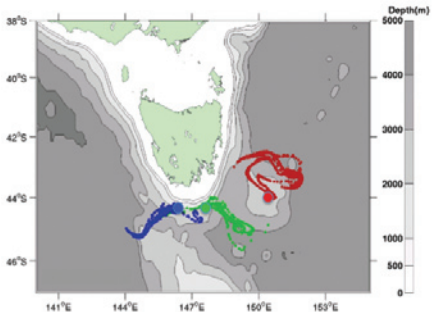
Hub researchers have completed intensive surveys relating geomorphic features and habitat types in four contrasting areas – Carnarvon Shelf, Lord Howe Island, South-East Tasmania and Jervis Bay. Relict reefs on the Lord Howe Island shelf form extensive coral and macro algal habitat, interspersed with mobile sand and encrusting algae. In contrast, relict shoreline features and drowned dunes at water depths to 50m on the Carnarvon shelf form rocky habitat with almost complete coral cover, interspersed with mixed habitats dominated by corals and sponges. At finer spatial scales, a range of physical variables has been tested as surrogates of infauna species distributions, with sediment sorting important in the soft sediment habitats at Lord Howe Island and Jervis Bay.

Connectivity

Genetic methods are being used by Hub scientists to determine how populations of deep sea corals and squat lobsters are connected (such as those on different seamounts). This is being compared to connectivity predicted from oceanographic models to assist in the design and management of marine reserve networks. Genetic methods also are being used in the comparative phylogeography of fishes and invertebrates to determine the origins of modern day biodiversity, the timing of major evolutionary processes that led to it, and implications for the future.

Off-reserve management

Hub researchers are investigating market-based instruments as options for off-reserve management to support the goals of the NRSMPA. We are exploring a range of options including: spatial incentives for managing the distribution of fishing effort in the commercial tuna fishery; environmental bonds and other approaches for providing incentives for marine industries to operate in an environmentally responsible manner; creating incentive mechanisms that can be used to assist the conservation of shared stocks such as sea turtles; and developing biodiversity offsets as a mechanism for ameliorating residual impacts. This research incorporates input from many disciplines including ecological models of species distributions, economic models of human decision making, and socio-economic research into values and objectives among stakeholders. Results and developed expertise are being used by DEWHA to support marine reserve design and implementation.



> Hydrodynamic models of larval dispersal in the deep sea are being used to predict connectivity among seamount populations and compare with genetic studies. Here we illustrate predicted winter dispersal with 30 day larval tracks from three seamounts in August 2003.

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