WAMSI Progress report to 30 June 2007 for WAMSI Node 3 Project 1 (WAMSI Code 3.1):

Deepwater Communities at Ningaloo Marine Park

Executive Summary

Site-specific studies of geophysical characterisation or mapping of near-shore benthic habitats are few and have only recently been developed to help guide managers in the appropriate placement of Marine Protected Areas (MPAs). The primary criteria identified for establishing MPAs are that they contain a comprehensive, adequate and representative (CAR) sample of marine biodiversity (Jordan et al. 2005). Comprehensive is the extent to which the full range of ecosystems and habitats are included in MPAs. Adequate refers to the degree to which the size, boundaries and location of MPAs are adequate to maintain biodiversity and ecological patterns and processes, especially in relation to the ability to manage impacting activities. Representative covers the extent to which MPAs reflect the range of biological diversity of communities within ecosystems and habitats (Jordan et al. 2005). Ideally the representative protection of marine biota in Australia would be based upon extensive knowledge of the distribution of biota and ecosystem components (Post 2006). In that sense, it is a critical aspect of marine biodiversity management in WA to ensure that we have relevant information on habitats and species diversity and abundance throughout the marine park. This information can be used to assess conservation significance and establish indicators for ecosystem health so that management strategies may be tailored to protect these systems over time and in the face of global issues such as climate change.

Choosing the most suitable mapping method from a suite of techniques, depends on the objective(s) of each project, particularly with respect to the scale and distribution of the sea floor features of interest, and the required resolution of the resulting maps (Diaz et al. 2004). The application of acoustic technologies to sea floor mapping has enabled effective collection of data on sea floor substrata and has led many mapping studies to equate benthic habitat with bottom sediment or substratum type (Ball et al. 2006).

Ningaloo Marine Park (NMP) is situated on the northern extremity of the Dirk Hartog Shelf of Western Australia and extends over 300 km west of Cape Range peninsula from Point Murat near North West Cape south to Red Bluff (21°50'S to 24°00'S) encompassing all of Ningaloo Reef (Carrigy and Fairbridge 1954; LeProvost Dames and Moore 2000; ref). The submarine shelf is gently sloping underlain by Pleistocene limestone with a veneer of marine sediments and interrupting this shelf, a fringing barrier reef system (Carrigy and Fairbridge 1954). One of the major features of NMP is the bathymetry which sees a very rapid drop-off in bottom depth in the northern part of the Marine Park in front of Cape Range (LeProvost Dames and Moore 2000). This results in a narrow shelf with its landward edge unusually close to the shore, i.e. between Point Cloates and Jurabi Point, depths of 100m occur within 6 km of the shore and 500 m within 15 km, which brings oceanic species like whales and pelagic fish to come relatively close to shore (LeProvost Dames and Moore 2000). At the southern part of NMP the shelf broadens to greater than 30 km near Red Bluff (LeProvost Dames and Moore 2000; ref). The location and morphology of the reef environments has a critical relationship with the oceanography within and surrounding the marine reserves and the complex intertidal and subtidal geomorphology of the reserves plays a significant role in the variety of marine habitat types and correspondingly high species diversity.

Previous studies suggest the substrate of the deeper waters of the northern NMP in general consists of a varying veneer of sand overlying limestone with a predominant sessile flora and fauna of algae and sponges with a diverse mobile crustacean and mollusc fauna (LeProvost Dames and Moore 2000). The

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Western Australian Museum (1988) discovered that the bottom fauna in waters >40 m is dominated by sponges; however, the sponge assemblages have never been systematically examined.

The aims of the project are to develop broadscale habitat maps of the deepwater component of NMP (offshore of the fringing reef), in the context of providing surrogate information for broadscale biodiversity assessments; undertake a broadscale characterisation of the biodiversity of the deepwater habitats of NMP based on historical information and that to be provided through deepwater broadscale habitat mapping;
characterise the diversity and abundance of filter feeding communities in NMP, especially in the deeper waters; characterise the surficial sediments and seabed geomorphology of the deeper waters of NMP; and characterise finfish diversity and abundance in the deeper waters of NMP and support the development of management targets for commercially and recreationally targeted species.

In April/May 2006 the Australian Institute of Marine Science (AIMS), in conjunction with Fugro Survey Pty Ltd (FUGRO), the Western Australian Museum and students from the University of Western Australia (UWA) and Curtin University of Technology (CUT), initiated surveys in the northern part of NMP to develop broadscale habitat maps of the deepwater component of the reserves (offshore of the fringing reef), identify the species present, and describe their basic patterns of distribution (Barnes et al. 2006).

Broadscale bathymetry of the continental shelf adjacent to the northern part of NMP was examined prior to the survey. The 2004 AIMS study (Rees et al. 2004) and Faircopy nautical charts supplied under licence by the Australian Hydrographic Office of the Royal Australian Navy (RAN) to the Applied Sedimentology and Marine Geoscience Group Department of Applied Geology Curtin University of Technology, and a fine scale multibeam hydro acoustic survey carried out by FUGRO on behalf of AIMS were the primary tools used prior to this survey to identify areas of bathymetric, topographical, benthic and piscatorial interest in areas with different levels of conservation protection. A singlebeam hydro acoustic survey carried out by the Centre of Marine Science and Technology (CMST) at CUT was used to gather data during the survey to identify areas of interest for sampling.

A towed video system, stereo baited underwater video systems (stereo-BRUVs) and a benthic sled were used to sample the biodiversity, diversity and abundance of filter feeding communities, finfish and invertebrate diversity and abundance. Single and multibeam acoustic surveys and sediment grabs were used to investigate and sample surficial sediments and seabed geomorphology of the deeper waters of NMP. No nautical charts for the southern part of the NMP exist so this approach will need to be modified for the 2007 survey.

Bathymetry and backscatter data from the multibeam was input into ESRI ArcGISTM software to form the base map layer for the area surveyed. This allowed for detailed visual analysis of the survey area. The singlebeam and multibeam acoustics achieved during the 2006 survey has provided detail of the seafloor in a limited area of NMP (Figure 3). Different habitats, based on bathymetry and geomorphology could be distinguished within this area. Sediment generation, transport and deposition patterns were evident, ridge systems could be identified and patches of previously unknown rubble mounds were evident. A considerable amount of spatial detail was gained. Acoustics combined with sedimentological and geomorphological data enabled us to categorise different habitats according to depth, topography, substrate stability, hardness and roughness, grain size and suitability to support significant biota, from the back of the reef slope (beyond the fringing reef) out to the edge of the continental shelf plateau.

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The continental shelf within the northern NMP is narrow and preliminary results show a clear zonation of habitats across the shelf. There is a strong association between geomorphology and benthic habitats with communities taking advantage of the availability of Last Interglacial substrates composed of fossilised limestone. Substrata in the shallow reef slope zone consist of a thin veneer of Holocene coralgal growth. In the 30-40 m zone hard corals rapidly disappear, gradually replaced by a mixed deep-water benthic community dominated by sponges, crinoids, turf algae and *Halimeda*, with some soft corals (gorgonians, sea whips), ascidians and sea pens. There is an extensive middle shelf sand plain where sediment thickness is variable overlying limestone pavement and low relief systems. Here communities of sponges, crinoids, sea pens, sea whips and hydroids are patchy with higher abundance associated with hard substrates. Bioturbation was evident from echinoderm feeding traces, polychaetes and burrowing fish and a diverse infauna have reworked the sediments to build mounds and burrows. Large ridges have been identified at various depths with an extensive system on the outer shelf (75-125 m). Exposed limestone substrates are dominated by sponge and gorgonian gardens, some of the sponges and gorgonian sampled from these gardens are likely to be new species. In the Cloates Sancturary Zone (SZ) fossil reefs support a diverse coralgal and sponge community. Here corals persist to greater depths (40-50 m) than those observed further north in the NMP.

Towed video allowed us to detect and target different benthic communities so species and functional groups could be identified and their distribution, abundance, biomass and size composition investigated. Analysis of towed video identified seven broad habitats, six substrata and sixteen different benthos categories. Further analysis will investigate percent cover of habitat, substrate and benthos for each tow, the relationship with water depth and the relationship between consolidated and non consolidated substrata and different benthos categories.

Preliminary identification (ID) of the dominant benthos (sponges and soft corals) has started at the West Australian Museum and further IDs will include digital photographs and analysis of dominant sponge spicule preparations, sponge and soft coral *in situ* and specimen ID digital photographs. These will be input into the ArcGIS software to create an interactive interface correlated to date, time, position and depth. Future analysis will also include biomass estimates of the dominant benthos using weight as a surrogate measure.

The Geographical Information System (GIS) layers generated include high resolution aerial mosaics, marine and shoreline habitat information and coastal outlines and marine fauna observations. From the April/May 2006 data survey, the acoustic data has been included as both point and raster (gridded) GIS datasets. Other layers include demersal fish assemblages surveyed and benthic habitat data using stereo-BRUVS and towed video. ArcGIS point shape file have been created for these with attributes including date, time, and operational code for each camera deployment. Video samples from each deployment have also been added as an attribute to utilise the hyperlink functionality of ArcMap. Point and line shape files showing the start/end point and track for each benthic sled tow and still images from samples acquired will be attached using the hyperlink technique. Sediment grab data included point shape file showing date, time, operational code and locations of each grab. Grain size will be displayed for each sample taken.

The Stereo-BRUVS survey identified 319 species of finfish from 54 families and analysis suggests the stereo-BRUVS have underestimated overall species richness for both commonly encountered and rare species. The same habitats at different depths were often associated with significantly different fish fauna. Coral reefs in 15-30 m supported a different fish assemblage to those in 30-50 m. Fish

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assemblages in rhodolith habitat in 30-50 m were significantly different to those at 50-70 m. Fish assemblages associated with sand habitat differed between all depth ranges with the exception of 30-50 and 50-70 m depths. Likewise, fish fauna found in sponge habitat at 90+ m were different to those found at both 50-70 and 70-90 m depths. Rhodolith habitat supported similar fish assemblages across all depth ranges with the exception of those found in the midshelf depths of 30-50-70 m. Sponge and sand habitat supported similar fish assemblages between 50-70-90 m depths. Further analysis of relative abundance and size frequency will be carried out using newly developed software.

Significant findings of this survey included diverse sponge and soft coral communities in the deeper waters of the continental shelf (50-110 m) with potentially high and unique biodiversity values, two large ridge systems parallel to the coastline supporting a vast array of species with diverse piscatorial associations, and several patches of previously unknown and unidentified rubble mounds. Low species diversity in the areas seaward of the back reef may be due to sediment transport and deposition, whereas, areas in deep water closer to the NMP seaward boundary with more stable sediments are inhabited by diverse benthic assemblages. Few hard corals were evident beyond 40-50 m during the survey. Large sand and rhodolith habitats were also evident.

These are only preliminary findings in the first year of a five year program.