

WAMSI Biannual Progress Report to 30 May 2008

WAMSI Node 1 Project 2 (WAMSI Code 1.2): Coastal ecosystem characterisation, benthic ecology, connectivity and client delivery modules

Node Leader: John Keesing

Project Leader: John Keesing

Project duration: 1 July 2006 to 30 June 2011

Due date for current milestone report: 31 May 2008

Executive Summary

- 1. An assessment of the importance of physical forcing and ecological interactions among key functional groups in determining patterns of spatial mosaics in benthic habitats.**

Milestone 2.1.1: Development of cellular automaton gap model for investigation of habitat patch dynamics

A working cellular automaton model has been developed. At present the model represents the reef as a gridded rectangle, with a specific habitat type at each grid point. It uses relatively simple succession rules. When a habitat at a particular location expires, according to a life-span specification, it is either replaced by a neighbour's habitat or by the next type in the succession cycle. The model produces a graphical 2-d, time-varying depiction of the reef evolution, and summary time-series of patch sizes. This component of the work is now complete and the model can be used in the next stages of the project.

Milestone 2.1.2: Scale and proportion of habitat patches across a coastal gradient quantified

Sites for field work were identified across a coastal wave exposure gradient at Marmion lagoon. Sampling of large scale transects using towed video recordings was carried out in December for approximately half the sites, with the remainder completed in January – February of 2007. Characterisation by divers completed; canopy composition, substrate rugosity, and abundances of potentially important fauna quantified at 24 sites across the wave exposure gradient, consequently the field work for this project is ahead of schedule. The surveys have confirmed previous impressions that patch structure is an important and ubiquitous characteristic of Marmion Lagoon benthic communities, with strong implications for biodiversity and productivity.

Milestone 2.1.3: patch dynamics and invertebrate demography quantified

Surveys to obtain demographic data from massive sessile invertebrates have been completed at 24 sites along the Marmion reef trace. At each site the number and size of all sponges, ascidians and hard corals have been recorded along a 1 m x 25 m transect. Many of the sites surveyed to date have been found to consist of distinct patches, some dominated by the kelp *Ecklonia radiata* and other devoid of kelp. These bare patches often feature an abundance of filter feeders, sponges and hard corals. The persistence of hard coral colonies within these patches provides some

support to the theory that these patches persist for many years; and are thus functionally very important component of the system. Future work will obtain accurate demographic information for resident hard corals within these bare patches. At six offshore sites colonies of the hard coral genera *Plesiastrea* and *Cyphastrea* have been collected and are currently being prepared for x-ray and skeletal density analysis. Colonies will be sectioned, x-rayed and the seasonal density bands analysed for small changes in skeletal density to determine an accurate age for each colony. This work is scheduled to be completed in September 2008. These data will be combined with coral population structures collected in 2006-2007 enabling us to independently validate models of patch dynamics (including patch longevity) using estimated coral ages.

2. An assessment of ecosystem processes with particular relevance to contrasting fished and non-fished areas.

Milestone 2.2.1: Field data collection completed at all sites

Field data collection completed at inshore sites in Marmion, with abundance of consumers (predatory and herbivorous fish and invertebrates) obtained from reef, seagrass and sand habitats. Rates of growth and consumption of kelp also obtained from inshore reef habitats. Collections of selected invertebrate taxa were completed for stable isotope analyses that will elucidate important trophic pathways, and for obtaining biomass measurements that will be needed by ecological modelers. Fieldwork also completed at a number of sites at Rottnest Island, focusing on abundances of consumers and consumption of kelp on reef habitats. This work revealed useful insights into potentially important indicator characteristics of fish communities that reflect difference levels of exploitation. Differences in trophic structure such as those found at Rottnest Island may have important consequences for other ecosystem components at lower trophic levels.

Milestone 2.2.2: Field data collected at all sites. Draft MS on predator gradients in relation to spatial management regimes and size of management unit. Draft MS on variation in ecological processes in relation to spatial predator gradients.

In April 2008 field surveys were successfully completed at 12 sites in Jurien Bay, bringing the total number of sites surveyed across all three regions (Marmion Lagoon, Rottnest Island, Jurien Bay) to 28. Of these, 13 were located within marine sanctuaries – 6 sanctuaries were surveyed (2 in each region). At each site surveys included abundance of rock lobsters, abundance of fish, and abundance of large invertebrates. In addition, estimates of rates of grazing and predation have been conducted within each sanctuary area. Biomass production by *E. radiata* can be considerable and these data show that little of this production is grazed directly. This implies considerable export of kelp production that probably sustains fauna in other habitats. These insights point to the importance of ungrazed production in coastal food webs at spatial scales far greater than the reefs themselves.