Ecological Interactions in Coastal Marine Ecosystems:
Rock Lobster

Progress Report to 30 November 2005

Lachlan MacArthur and Glenn A. Hyndes

Centre for Ecosystem Management, Edith Cowan University, 100 Joondalup Drive, Joondalup, WA 6027

CENTRE *for* ECOSYSTEM MANAGEMENT
EDITH COWAN UNIVERSITY

1. Executive Summary

The density and size structure of western rock lobster (*Panulirus cygnus*) populations within the Jurien Bay Marine Park have been determined from up to 15 sites stratified by depth, cross-shelf location and benthic habitat. Surveys have been conducted over four sampling periods, with a further two remaining. The results indicate that there are larger numbers of smaller lobster within the 40 - 60 mm carapace length range on shallow inshore reefs with high seagrass coverage. All sites have lobster within the 60 to 80 mm class, although densities are lower on the more offshore sites characterised by kelp pavement. However, a number of exposed sites have not been consistently sampled due to high swell conditions, and some seasons have not yet been repeated so any conclusions at this stage must be considered preliminary. In addition, gut samples and stable isotope samples have been collected from 193 lobster specimens obtained over two seasons from sites differing in surrounding benthic habitat. Early results indicate that articulated coralline algae, in particular, contributes the highest to overall diet in terms of volume consumed, and this holds true over all habitats. However, stable isotope analysis indicates that other food sources may contribute more to lobster production. Research into the movements of rock lobster is currently underway using acoustic transmitters and receivers. Results will emerge early next year and will help us understand home-range, foraging and migration patterns within coastal waters.

2. Research Activity

Lobster density and size-structure

Lobster density and population structure have been measured on coastal reefs during four sampling periods to date: November 2004, February /March 2005, August 2005 and November 2005. A further two trips remain (February /March 2006 and August 2006). The reefs surveyed are stratified by depth, distance from shore and major benthic habitat in order to determine how these factors may influence lobster density and population size-structure. In addition, some of these reefs are located within sanctuary zones and results will provide baseline data for examining the impact of these no-take zones on lobster populations. Reefs are sampled by SCUBA with the number of lobster and size estimates recorded over 4 replicate 30 x 5 m transects.

Results indicate that there is high between-reef variability in lobster densities within habitat categories (Fig. 1). Lobster densities in offshore kelp/ pavement dominated habitats appear to be generally low although this category was not sampled in the first season and was not sampled during August due to high swell conditions. For those sites sampled in all seasons, there appears to be a general decline in lobster densities from November 2004 to August 2005.

Length frequency histograms reveal that the carapace length (CL) of the majority of lobsters sampled fall between 45 and 80 mm (Fig. 2). For all habitat categories, except shallow inshore seagrass, the great majority of lobsters are between 60 and 80 mm CL. The shallow inshore seagrass dominated sites have a higher proportion of juvenile lobster between 45 and 60 mm CL.

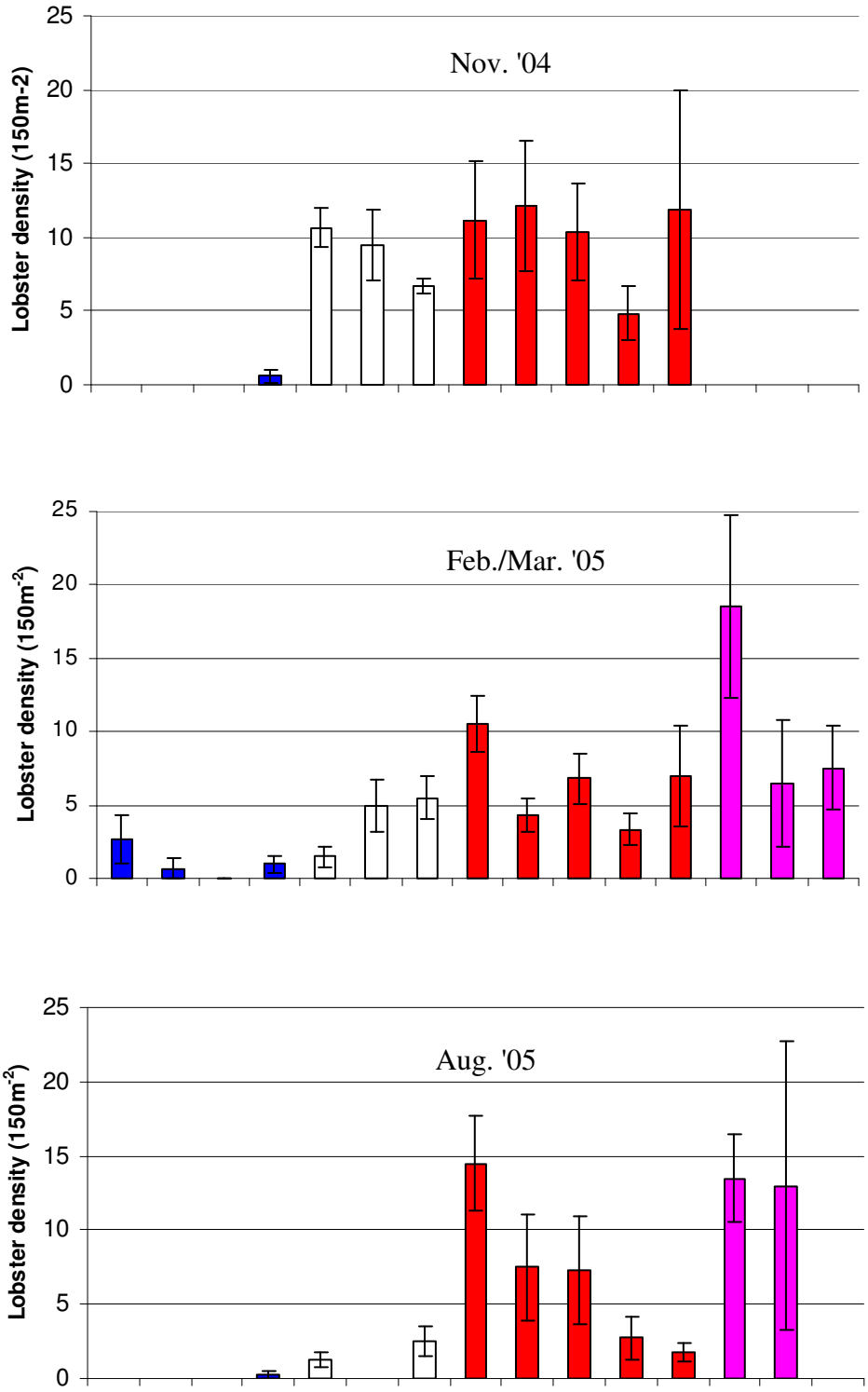

Figure 1. Density of lobster (± 1 se) surveyed from four habitats during November 2004, February/ March 2005 and August 2005. "*" indicates site not sampled.

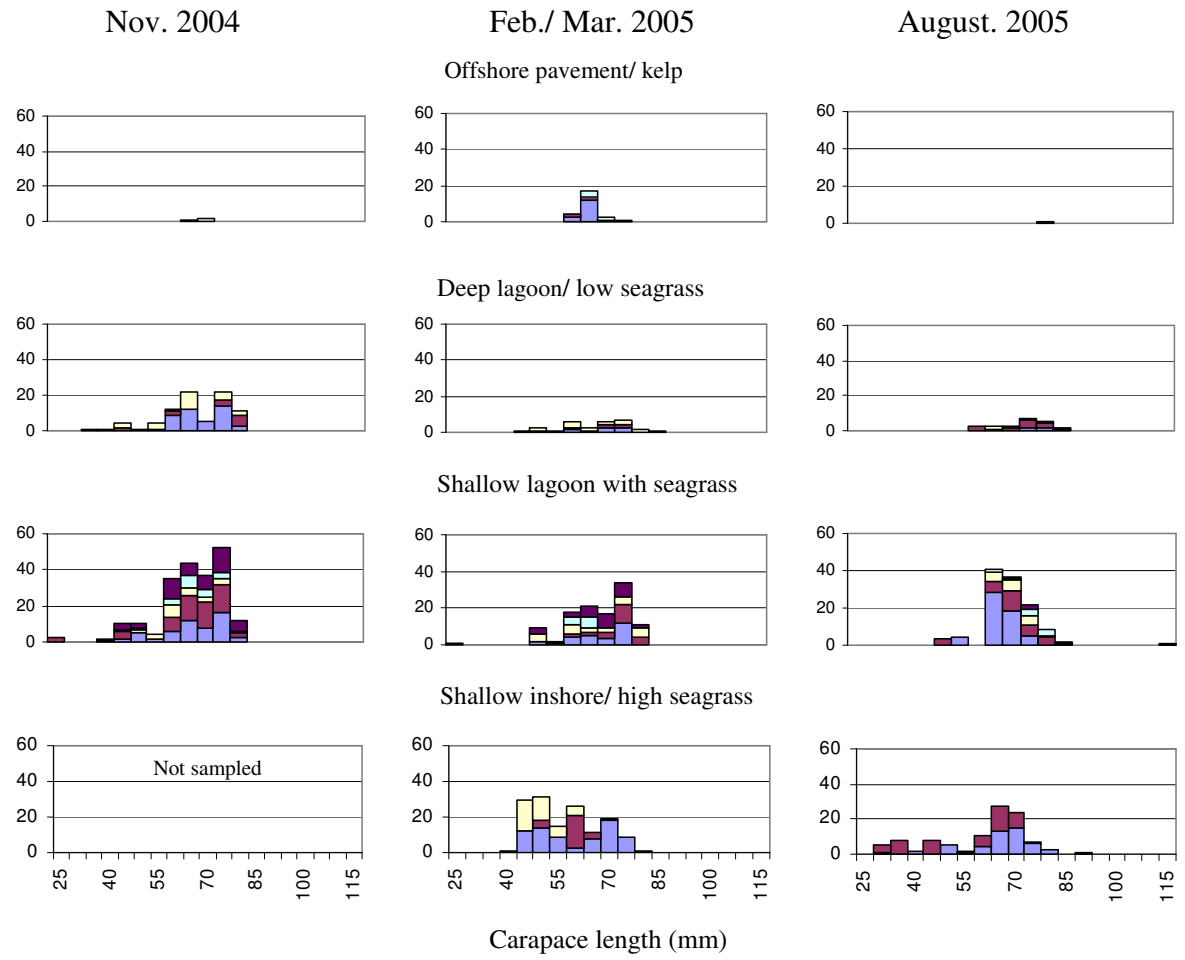

Figure 2. Carapace length frequency histograms of lobster collected from sites within four habitat categories during November 2004, February/ March 2005 and August 2005. Separate sites indicated by different bar colours.

<u>Lobster diet and trophic linkages</u>

To investigate the diet and trophic interactions of western rock lobster 193 gut and stable isotope samples have been collected. The number of samples belonging to each size class of lobster and the habitat from which they have been collected is shown in the table below:

April 2005								
	Habitat							
	Deep low seagrass		Shallow pavement/ Amphibolis		Posidonia sinuosa meadow		Amphibolis griffithii meadow	
	Site							
Carapace length size class (mm)	DC	DW	FN	FW	FS	OR	FE	BK
26-50	1	0	1	0	0	1	1	1
51-75	16	8	12	5	13	6	12	9
76-100	0	1	0	1	3	2	2	5
All sizes	17	9	13	6	16	9	15	15
October/ November 2005								
26-50	0	1	0	1	0	0	2	0
51-75	5	7	14	14	8	2	7	10
76-100	2	2	0	3	3	3	4	5
All sizes	7	10	14	18	11	5	13	15

Lobsters were collected within two hours of sunrise to minimise digestion of gut contents. Gut samples were then stored in 70% ethanol whilst flesh samples were frozen as soon as possible. To determine lobster diet, guts have been dissected and the volume of prey items contributing to each gut determined. This has been conducted for 50 of the guts collected to date.

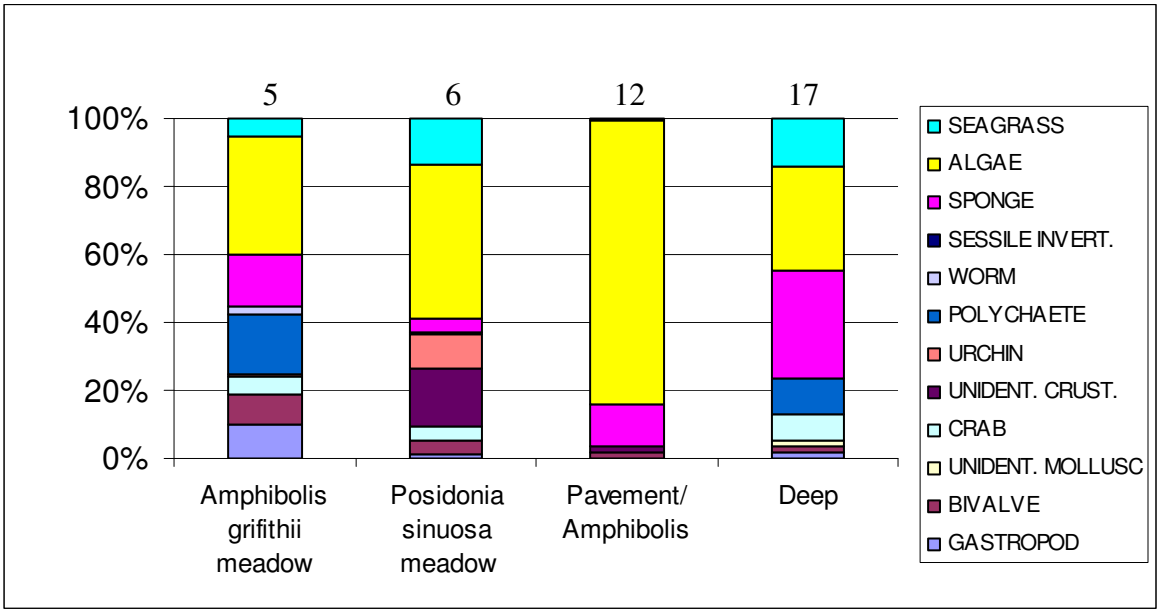

Figure 3. Major taxa contribution to total gut volume for lobster collected from four habitats during April 2005.

Preliminary results indicate that algae contribute greatly to overall gut volume for lobster from all habitat categories (Fig. 3). These algae comprise mainly articulated coralline algae such as *Haliptilon* and *Metagoniolithon* sp.. Seagrass, sponge and polychaetes also comprise a relatively large proportion of gut volume in general. These results, although preliminary, indicate that lobster collected from shallow pavement/ *Amphibolis* habitat have a greater contribution of algae to their diets when compared to lobsters from other habitats, and consume only relatively small quantities of other food sources.

Stable isotope analysis, to determine the levels of $\delta^{13}C$ and $\delta^{15}N$ in lobster flesh, has been completed for a subset (87) of samples from the April 2005 collection period. Samples collected from the October/ November period are yet to be analysed. In addition, samples of primary producers, e.g. algae and seagrass, and potential lobster prey, e.g. gastropods and crustaceans, have been collected concurrently from the same sites or sites adjacent to lobster collection sites. This will allow for the identification of primary producers and prey that are likely to contribute most to lobster production.

Results from April 2005 indicate that whilst coralline algae such as *Haliptilon* and *Metagoniolithon* contribute a large amount to gut volume, the average $\delta^{13}C$ for these prey items are quite separate from that of lobster tissue (Fig. 4). This may indicate that other food sources may contribute more to lobster production.

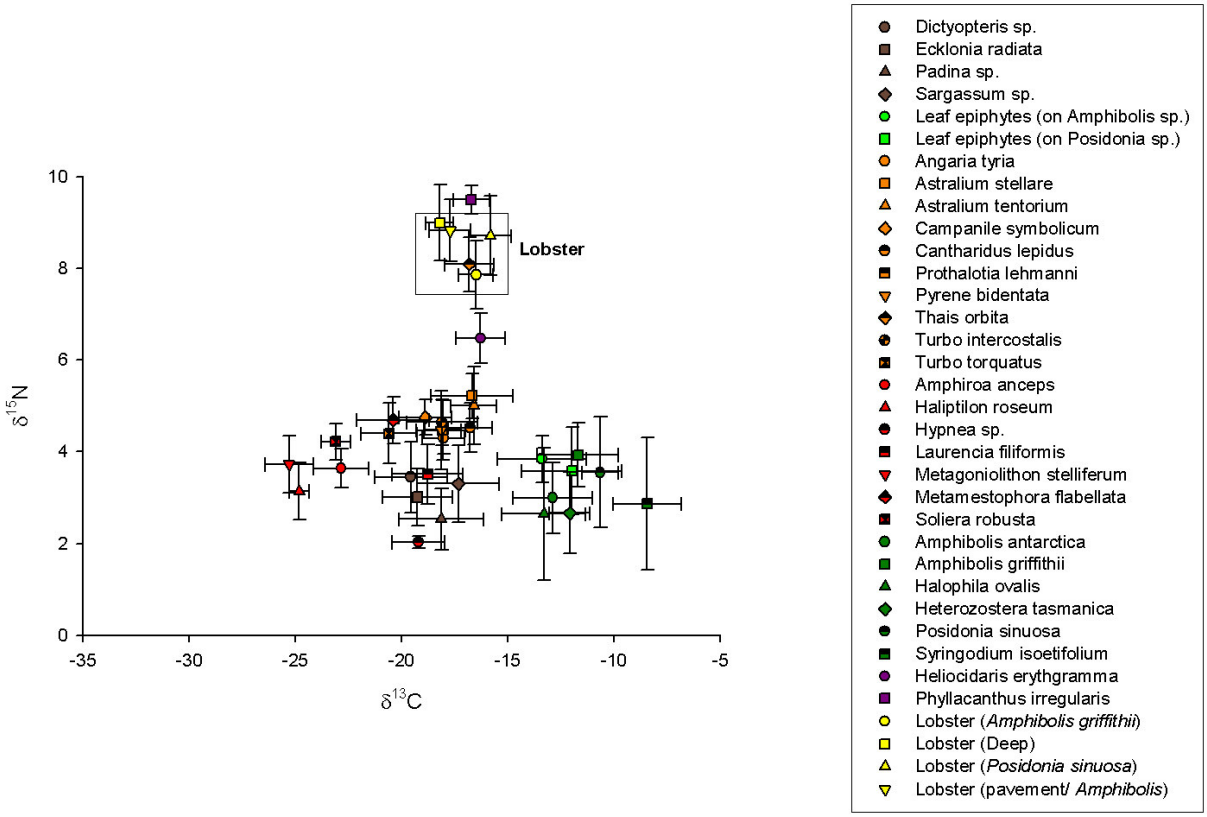

Figure 4. $\delta^{13}C$ and $\delta^{15}N$ signatures of lobster, primary producers and potential prey items collected from Jurien Bay during April 2005.

Lobster Movements

Lobsters are currently being tagged with acoustic transmitters in order to determine home-range size, foraging and migratory movements. Fixed receivers will be deployed within the next few weeks. This will allow for the study of home range size and possible migration movements over the December period when some lobster are believed to make a migration to deeper offshore waters. In addition, lobster will be tracked using a manual receiver to determine the distance of foraging excursions and also to determine which habitats are important for lobster foraging. This work will begin January 2006.

3. Dissemination

Methods and preliminary results from the Rock Lobster Project have been disseminated through a PhD research proposal seminar within the School of Natural Sciences entitled "Habitat use, movements and trophic linkages of the western rock lobster within the Jurien Bay Marine Park", delivered on the 17th December 2004.

A seminar of the same name was also given at the Australian Marine Sciences Association postgraduate student workshop held at Rottnest Island, 30 June - 1 July 2005.

4. Commercialisation

There are currently no commercial outputs or intellectual property associated with this research project.

5. Benefits to the State

This research will contribute towards a broader understanding of mid-west coastal ecosystems. *Panulirus cygnus*, as a large and abundant consumer within these ecosystems, are likely to play an important role in the flow of energy within them. This study will expand on past research and provide a more complete picture of the distribution of *P. cygnus* among coastal water habitats whilst highlighting important linkages between these habitats.

By providing information on the coastal habitats utilised by *P. cygnus* and the scale of movements between habitats this study will aid in the design of any future MPAs in terms of establishing boundaries that encompass these habitats and movements. Furthermore, this study will provide baseline monitoring of *Panulirus cygnus* inside and outside sanctuary zones thereby allowing Before After Control Impact (BACI) studies to be conducted in the future. One benefit of such a study is determining what the likely impacts of lobster fishing are on shallow water benthic ecosystems.

6. Appendices

None.