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Pilot phase trial to quantify the extent and relevance of any deepwater puerulus settlement that may have taken place in the Western Rocklobster Fishery

(FRDC Project 2009/063)

FRDC FINAL REPORT

JUNE 2010

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DATE: June 2010

PUBLISHER: Western Rocklobster Council

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OBJECTIVES:

1. To establish whether a shift in post puerulus settlement is occurring from shallow to deeper water.

2. To establish a new technique for conducting future research into post puerulus settlement.

Non-technical Summary

OUTCOMES ACHIEVED TO DATE

This project successfully trialled modifications to commercial western rock lobster pots to sample a wide size range of lobsters with the assistance of commercial fishermen. Wide areas of the coast from the shallows to >30 fm were sampled over a ten day period in September 2009.

The second objective was to establish whether there has been a shift in post-puerulus settlement from shallow to deeper waters. Analysis showed that it is *unlikely* that there has been a major shift in the depths at which pueruli are settling. However, small lobsters were sampled in low numbers in the deep water categories in this survey and this therefore does not exclude the possibility that deep water settlement may be becoming more common than in past.

This study had two objectives. Firstly to trial modifications to commercial western rock lobster pots, so as to sample as wide a size range of lobsters on the grounds as possible. Sampling took place over a 10 day period between 13-24 September 2009, with seven commercial fishermen being responsible for collection of the data at different sampling locations (Mandurah, Fremantle, Lancelin, Dongara, Geraldton, Abrolhos and Kalbarri).

This arrangement proved to be successful in that a wide area of the coast was covered by the sampling regime and good quality catch composition data was achieved across the four depth zones (0-10 fm, 10-20 fm, 20-30 fm and >30 fm) that were sampled.

The different pot modifications that were trialled sampled a wide size range (25-144 mm CL), but mostly caught lobsters around the legal size limit (modal size, 80 mm CL). In three of the four areas where more than one pot type was used, there were significant differences ($p<0.01$) in the catch rates of one or more size classes between the various pot types.

The second objective was to establish whether there has been a shift in post-puerulus settlement from shallow to deeper waters. Analysis showed that depth was highly significant ($p<0.05$) in determining the catch rates of most size classes (≤50 mm CL; 51-65 mm CL; 66-76 mm CL; 77-105 mm CL and ≥105 mm CL). Generally, small size classes were sampled in the shallow depth categories and larger lobsters were sampled in the deeper depth categories, which would suggest that as in the past, recent puerulus settlement has been in shallow depths. Accordingly, it would seem reasonable to conclude that it is *unlikely* that there has been a major shift in the depths at which pueruli are settling. However, small lobsters were sampled in low numbers in the deep water categories in this survey and this therefore does not exclude the possibility that deep water settlement may be becoming more common than in past.

In terms of recommendations, more monitoring of post-puerulus/juvenile lobsters using modified commercial pots similar to those used in this study has the potential to provide inter-annual comparisons of the numbers of small size classes settling at different depths on the grounds. It is only with more data of this type over a longer time period, that it will be possible to show whether there is any indirect evidence of a shift in settlement to deeper water. Should this work continue into the future, it would be beneficial to standardize on a consistent type of modification to the commercial pots so that more reliable comparisons of the relative numbers of juvenile animals can be made between areas.

KEYWORDS: **western rocklobster, offshore juvenile settlement, puerulus, *Panulirus cygnus***

Acknowledgements

Thanks go to all the pilot phase trial participants for their significant in-kind contributions; Nils Stokke, Jarrad Groom, Ash Newton, Rocco Masiello, Roy McVeigh, Bob Stone, Mick Briguglio and Peter Burton. Deckhands included Joe Pittorini, Jim Ross, Rob Glass, Mark Ralph and the two gun deckies , Justin Golding and Shawn Lawson. Thanks also to the Department of Fisheries WA on board monitoring team who made themselves available at all hours to assist in data collation. Thanks to Adrian Thompson from the Department of Fisheries WA Research Division for his significant contributions, including input into the analysis of the data as well as liaison with trial participants.

1.0 Background

It is well known from previous research (Fitzpatrick *et al*. 1989), that pueruli generally settle in crevices amidst seagrass and macroalgae from sub-tidal depths to 20 m, with only very few pueruli being found deeper down to 30 m. Consequently, scientific puerulus collectors, which are used to provide annual settlement indices, are all moored in depths considerably shallower than 20 m (Chubb 1995). In recent years, puerulus settlement has been unusually low (Brown 2009; Brown *et al*. 2009), leading to speculation at a stakeholder risk assessment workshop held in April 2009 (Brown 2009), that the pueruli may have settled in deeper water than usual.

This project was initiated largely in response to the above hypothesis. The thought was that if more than usual numbers of pueruli had settled in the deep, that this would have resulted in an a distortion in the number of juvenile animals in the deep water. The focus was therefore to produce relative abundance measures of small lobsters (<60 mm CL) in a range of water depths in different areas of the commercial fishery.

The project was undertaken jointly by the Western Rock Lobster Council and the Department of Fisheries and has used the logistical support of a number of commercial fishers to sample in the different depths and areas of the fishery.

1.1 Need

The low puerulus risk assessment report suggests a 10-35% probability that the poor settlement on inshore collectors over the last three years could be caused by short-term environmental changes. There is a growing concern amongst industry that short term environmental changes may indeed be responsible for a shift in the pattern of settlement from shallow to the deeper water. At the recent Western Rocklobster Council Congress it was suggested that industry driven research be undertaken, in collaboration with Department of Fisheries researchers, aimed at collecting post-puerulus stage rocklobster in deep water to validate or refute anecdotal reports from fishermen of this phenomenon occurring in recent years.

It is envisaged that the findings of this study will assist in addressing the uncertainty around the suite of possible explanations for the poor puerulus settlement in the western rocklobster fishery over the past three years and will aid in developing management arrangements now and into the future.

1.2 Objectives

1. To establish whether a shift in post puerulus settlement is occurring from shallow to deeper water.

2. To establish a new technique for conducting future research into post puerulus settlement.

2.0 Methods

Seven fishers from ports throughout the fishery participated in this trial using modified pots to sample as wide a size range as possible of lobsters on the fishing grounds.

The trial was conducted over the period 14-24 September 2009, corresponding with the dark phase of the lunar cycle which is considered to be the optimal moon phase for maximising lobster catches. The fishers that participated in the trail were widely distributed over the commercial fishing grounds in order to provided good spatial coverage of the fishery (Figure 1).

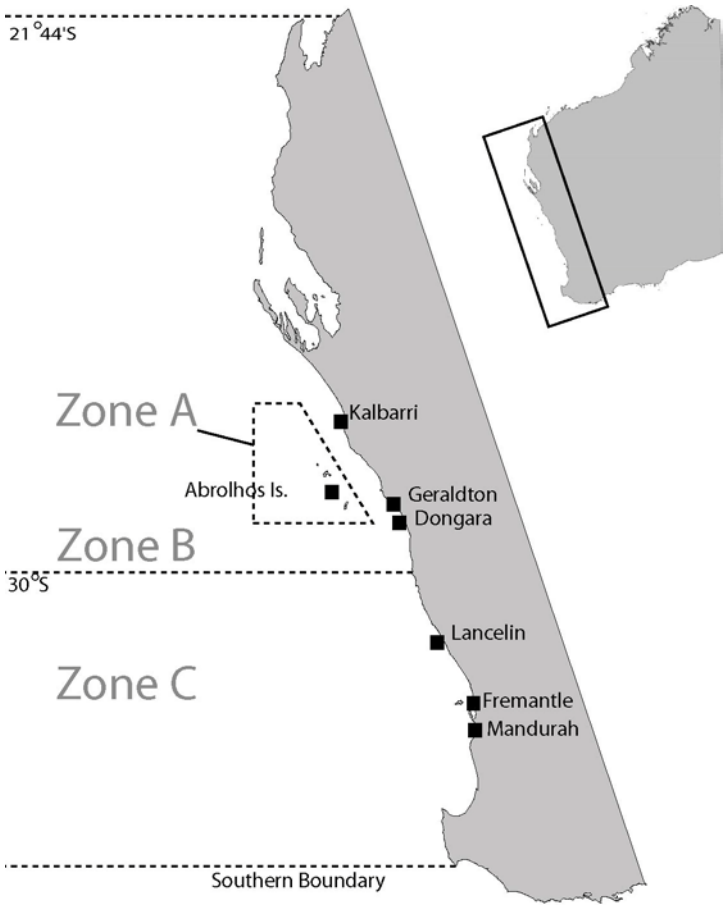

Figure 1: Squares indicating the ports and general locations sampled by the seven fishers who participated in the western rock lobster post-puerulus settlement trial conducted between 14 - 24 September 2009.

The seven fishermen that participated in the survey were required to set ten pots on potentially good lobster habitat, at each of four depth categories: 0-5 fm, 5-20 fm, 20-40 fm and >40 fm, which for practical purposes of this study can be considered to have been 0-10 m, 11-40 m, 41-60 m and >60 m.

Since the focus was on sampling a wide size range of lobsters, the pots were pulled prior to dawn so as to maximise the capture of small animals. The pots were pulled in an alternate order each fishing day, starting from shallow to deep depths on days 1, 3, 5, 7 and 9 and from deep to shallow depths on days 2, 4, 6, 8 and 10. They were reset on new areas of ground each day, at least 500 m from any previous pot sets during the survey so as to reduce any possibility of fishing induced change in localised abundance biasing the results.

For each pot pulled, the GPS location and bottom type was recorded, together with the carapace length (CL) of each lobster (measured with vernier callipers to the nearest 1 mm), its colour (white or red), sex (male or female) and the maturity status of each female (ovigerous, tar-spoted, or setose). In addition to data on the lobster catch, information was also recorded on any by-catch or damage to the pot (e.g. battens missing or broken). The sampling form used in the survey is shown in Appendix I.

At each location there was a predominant pot type used, with each fisher also being permitted to trial a second pot type (three pot types were used at Lancelin). All pots were batten or stick pots of the type commercially used in the fishery, but modified to retain small animals by having closed escape gaps and small mesh, more battens, or in the case of stick pots, more sticks covering the pot (Table 1; Appendix II).

Table 1 – Details of modifications made to standard commercial lobster pots used in this study. Pot type refers to variations of pot construction at particular localities and these pot type numbers are referred to in the results.

Port or general location of sampling	Pot type	Description of pot modification
Mandurah		40 stick pots with extra sticks used in the construction
Fremantle	1	32 batten pots with additional battens on the back
	2	8 batten pots with additional battens on the base
Lancelin	1	5 batten pots with additional battens
	2	5 stick pots with extra sticks used in the construction
	3	30 batten pots with a plastic mesh covering
Dongara		40 batten pots with a plastic mesh covering
Geraldton	1	8 batten pots with mesh and additional battens on the base
	2	32 batten pot with plastic mesh and additional battens on the back. The escape gaps were not covered by battens, but were covered by mesh
Kalbarri		40 batten pots with plastic mesh covering
Abrolhos	1	32 batten pots with steel mesh covering
	2	8 batten pots with no mesh covering

2.1 Analysis

Due to the variation in potlifts between depths and the differences in the experimental pot types, it was necessary to standardise the catch as catch rates to compare between pot types and depths. Within a location, the transformed catch rates (square root transformed) were compared through analysis of variance (ANOVA) for the factors depth, and pot type where multiple pot types were used. The data presented in the figures is the raw data to allow meaningful comparison of five different size classes of lobsters (≤50 mm CL; 51-65 mm CL; 66-76 mm CL; 77-105 mm CL and ≥105 mm CL), by sites and pot type.

3.0 Results

3.1 Pot Lifts (Effort)

There were a total of 2,244 pot lifts as part of this study, however, due to some lines of pots going over two depth categories, only 2,214 pot lifts could be used in the analysis. Due to environmental conditions and safety concerns, it was not possible to have effort evenly distributed across the four depth categories (Figure 2). As a result, data were presented as a catch rate (lobsters of a given size, per pot lift) to standardise for the uneven effort distribution.

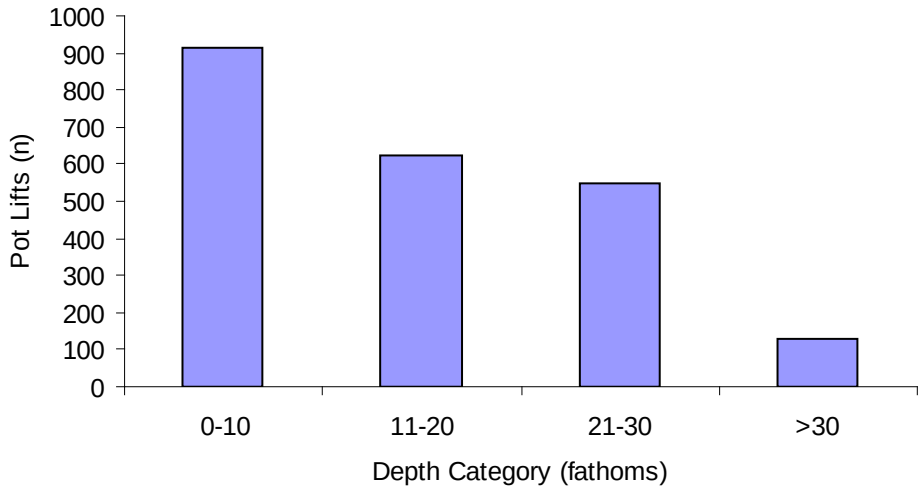

Figure 2: Distribution of effort (pot lifts) across the four depth categories which were sampled during the western rock lobster post-puerulus settlement trial undertaken between 14 - 24 September 2009.

3.2 Catch

A total of 19,731 western rock lobsters were measured as part of this study, ranging in size from 25 – 144 mm CL. The modal carapace length class captured was 80 mm, which is the first solely legal-sized size class of animals in the catch (Figure 3).

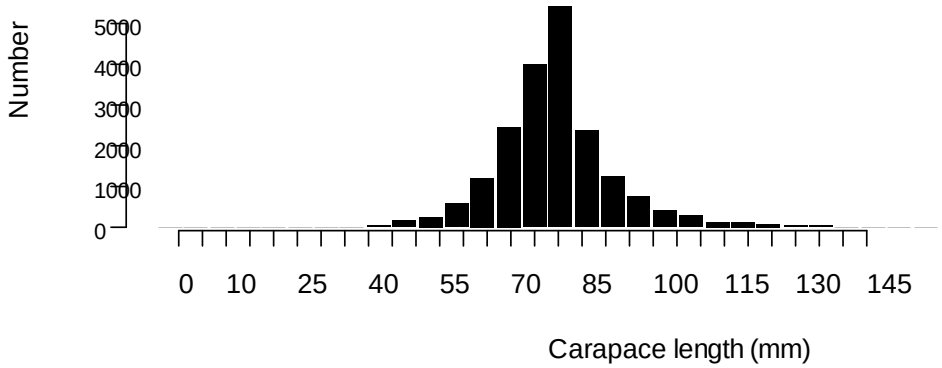

Figure 3: Size frequency distribution for 5 mm size classes of western rock lobsters captured during the western rock lobster post-puerulus settlement trial undertaken between 14 - 24 September 2009.

3.3 Catch Rates

Depth was a significant factor in the analysis of catch rates of lobsters of different size classes at the seven locations sampled (Table 2). Pot type was only significant for two locations (Geraldton and Abrolhos), and two size classes within those locations (Table 2).

Table 2: Significant ($p<0.05$; capital letters), or marginally significant ($p<0.1$; lower case letters) factors from ANOVAs of pot type (P), depth (D) and their interaction (I), for each size class at the seven locations reported on in this study.
* indicates locations where comparisons of pot type could be made

Size Class (mm CL)s	Mandurah	Fremantle *	Lancelin *	Dongara	Geraldton *	Abrolhos *	Kalbarri
≤50	D		d	D	D		
51-65	D	D	D	D	D	P	D
66-76	D	D	D	D	DPI	Di	D
77-105	D	D	D	D	DP	Pi	D
≥105	D	Dp					

3.3.1 Catch Rates ≤50 mm CL

Catch rates of western rock lobsters less than 50 mm CL were low, with only 153 captured throughout the study. Depth was a significant factor in the catch rates for Mandurah, Dongara and Geraldton, and marginally non-significant at Lancelin. These sites showed higher catch rates in the two shallower depth ranges than in depths greater than 20 fm (Figure 4). There were only 12 lobsters captured deeper than 20 fm, with none caught greater than 30 fm. The high variance in the catch rates makes it difficult to statistically differentiate catch rates between the two shallow depth ranges, however, nine of the 12 pot types had greater catch rates in ≤10 compared to the >10 to 20 fathom range.

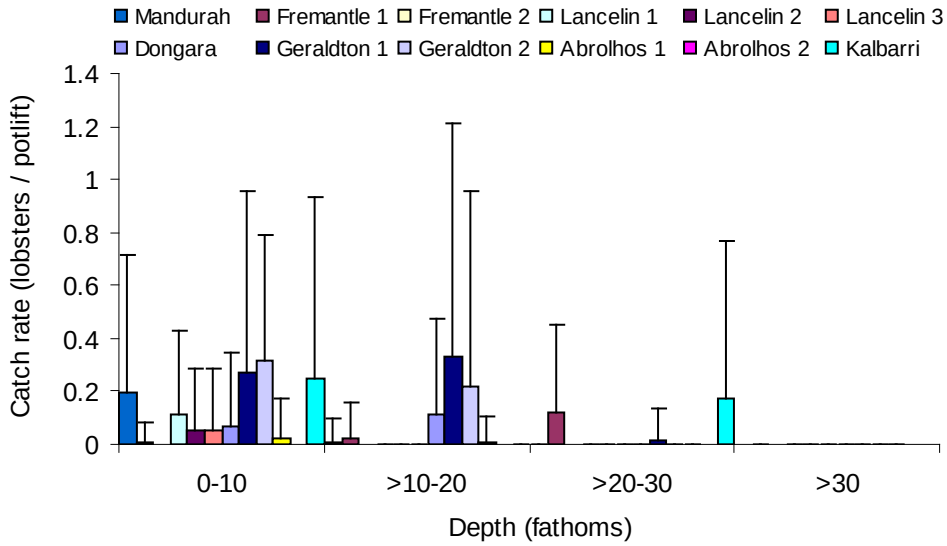

Figure 4: Average catch rates (+SE) of western rock lobster with a carapace length of ≤ 50 mm sampled during the western rock lobster post-puerulus settlement trial undertaken between 14 - 24 September 2009.

3.3.2 Catch Rates 51-65 mm CL

With the exception of the Abrolhos, all locations had a significant effect of depth on the catch rates of this size class of lobsters. This difference appears to be driven by different catch rates between the shallower (≤ 20 fm) and the deeper (> 20 fm) depth categories, with 2 of the 1,506 lobsters captured in greater than 30 fm (Figure 5). However, it should be noted that the catch rates for all but one of the pot types (Dongara), catch rates were higher in ≤10 fm compared to >10 to 20 fm.

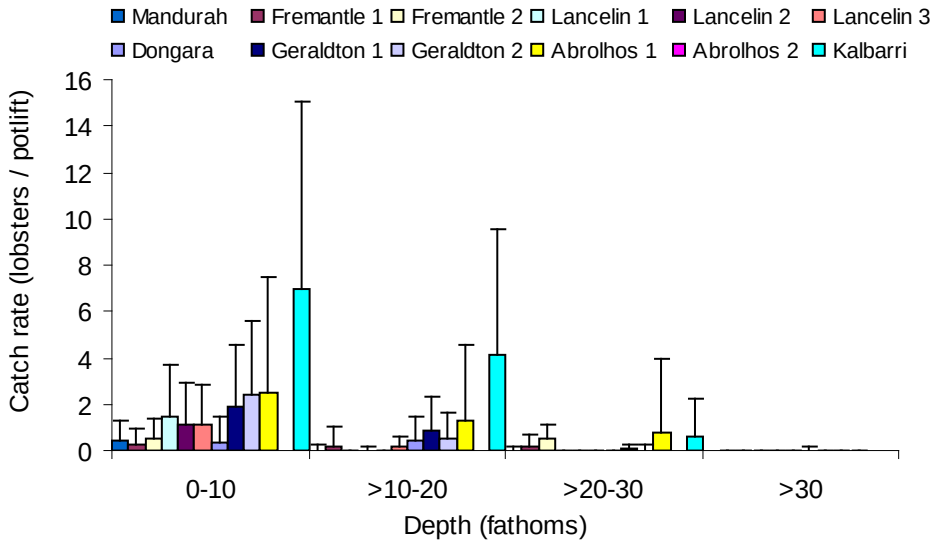

Figure 5: Average catch rates (+SE) of western rock lobster with a carapace length of >50 to 65 mm

There was a significant effect of pot type at the Abrolhos for this size class, with the Abrolhos 2nd pot failing to catch any lobsters in this size class from the 32 potlifts, compared to the Abrolhos 1st pot which caught 496 lobsters in this size class from 369 potlifts.

3.3.3 Catch Rates 66-76 mm CL

The catch rates of this size class were very similar to the two smaller size classes. For all locations, depth was a significant factor effecting catch rates, again driven by lower catch rates in depths of >20 fm. Similarly, all location with the exception of Kalbarri, had higher catch rates in ≤10 fm compared to >10 to 20 fm depth range. Only six of the 3,541 lobsters in this size range were caught in depths greater than 30 fm.

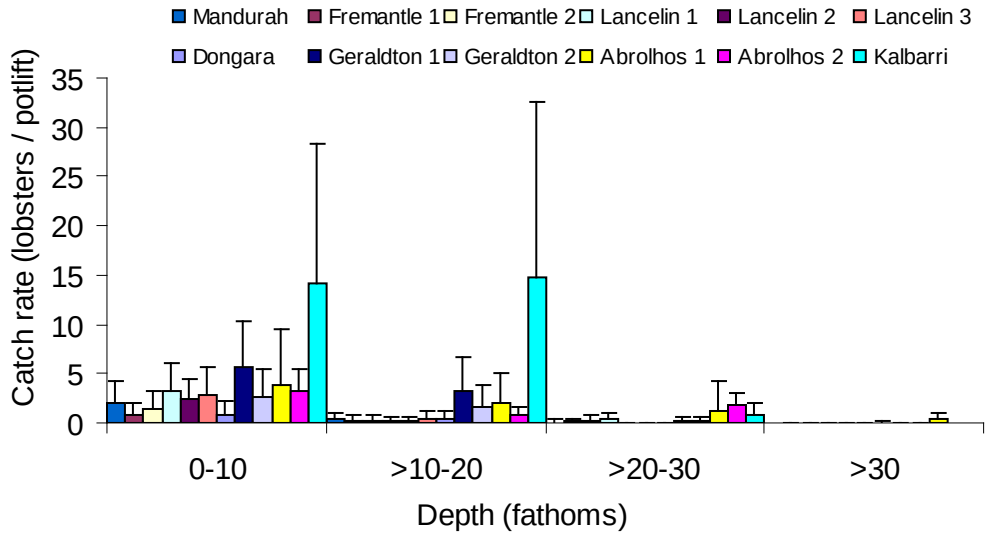

Figure 6: Average catch rates (+SE) of western rock lobster with a carapace length of >66 to 76 mm sampled during the western rock lobster post-puerulus settlement trial undertaken between 14 - 24 September 2009.

There was also a significant effect of pot type for the analysis of this size class in Geraldton. It was driven by the higher catch rates of the Geraldton 1st pot compared to the Geraldton 2nd pot (Figure 7).

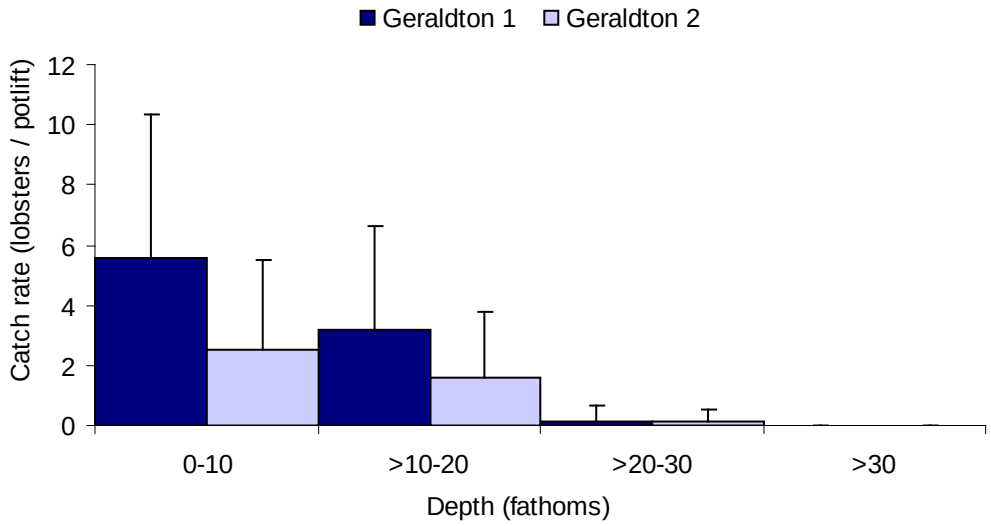

Figure 7: Average catch rates (+SE) of >66-76 mm western rocklobsters for the two pot types used in Geraldton during the post-puerulus settlement trial undertaken between 14 - 24 September 2009.

3.3.4 Catch Rates 77-105 mm CL

This category represents the first size class that is commercially exploitable. Depth was a significant factor for all locations other than the Abrolhos, where it, along with Geraldton, had pot type as a significant factor.

All locations, except Abrolhos 2, had higher catch rates in ≤10 fm and lowest in >30 fm. For 10 of the 12 pot types there were higher catch rates in the ≤10 fm compared with >10 – 20 fm, with only Fremantle 2 and Mandurah having marginally higher catch rates (≤0.06 lobsters / pot difference) in the >10 – 20 fathom depth range. Similarly, 10 of the 12 pot types had higher catch rates in >10 – 20 than >20 – 30 fm (Figure 8). The exceptions were Abrolhos 2, which showed increase in catch rates with increasing depth, and Lancelin 2, which had a slight increase in catch rates from >10-20 fm to >20-30 and >30 fm, though this result was based on the results of only two pot lifts.

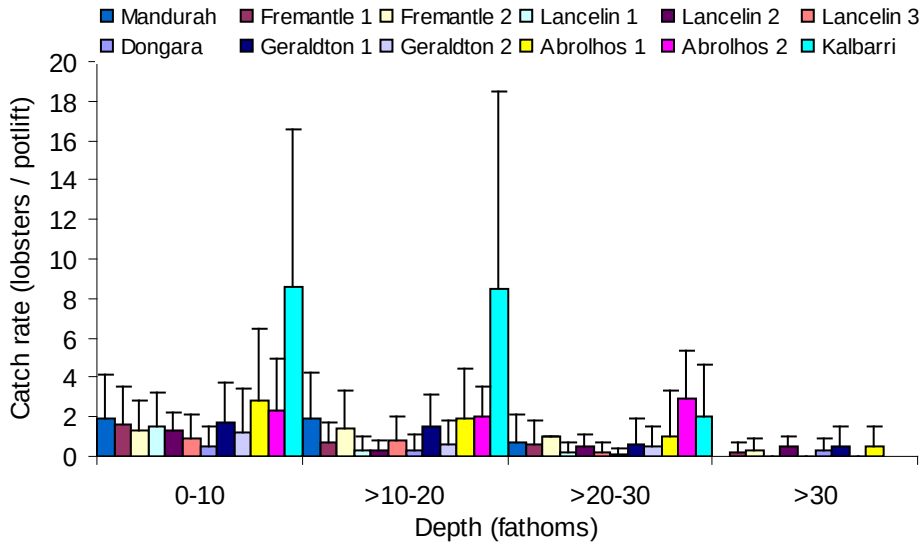

Figure 8: Average catch rates (+SE) of western rock lobster with a carapace length of >77 to 104 mm, sampled during the western rock lobster post-puerulus settlement trial undertaken between 14 - 24 September 2009.

Abrolhos and Geraldton were the two locations where there was a significant effect of pot type. In Geraldton as for the preceding size class, the Geraldton 1st pot catch rate was higher across all depths compared to the Geraldton 2nd pot (Figure 9). The differences in the catch rates for the Abrolhos pots were not as clear. As mentioned previously, the catch rates for the Abrolhos 2nd pot increased with depth in contrast to the Abrolhos 1st pot, which declined with increasing depth (Figure 9)

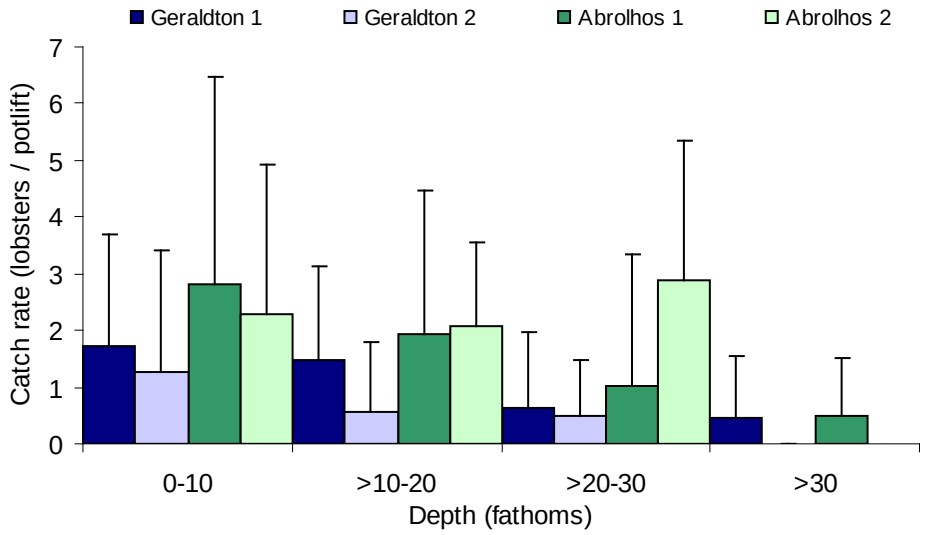

Figure 9: Average catch rates (+SE) of 77-105 mm western rocklobsters for the pot types used in Geraldton and Abrolhos during the post-puerulus settlement trial undertaken between 14 - 24 September 2009.

3.3.5 Catch Rates ≥105 mm CL

This size category show markedly different results from the previous size categories examined. Depth again was a significant factor in the analysis, though only for the two southern locations of Mandurah and Fremantle (Table 2). In this instance, the significant effect of depth was due to higher catch rates in the deeper water, with only one lobster greater than 105 mm CL being captured in less than 10 fm of water.

Both pot types used at Fremantle showed increasing catch rates with depth, while catch rates were highest in 10 – 20 fm in Mandurah and declined between 20 – 30 fm. There was no fishing greater than 30 fm in Mandurah (Figure 10).

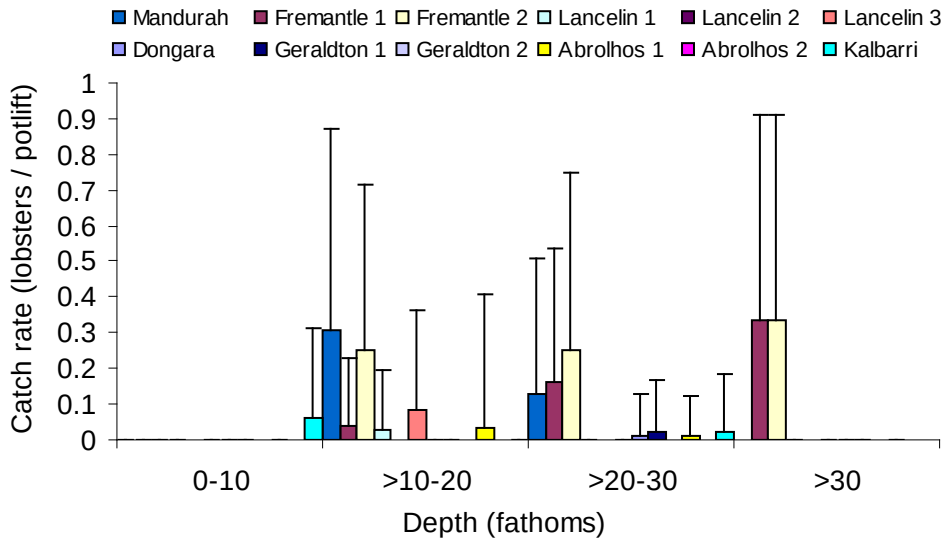

Figure 10: Average catch rates (+SE) of western rock lobster with a carapace length of ≥105 mm, sampled during the western rock lobster post-puerulus settlement trial undertaken between 14 - 24 September 2009.

4.0 Discussion

This pilot phase trial to quantify the extent and relevance of any deepwater puerulus settlement that may have taken place in the fishery has produced a quick and relatively inexpensive measure, of the relative abundance of a wide size range of lobsters on the fishing grounds.

The fact that this pre-season survey using pots modified to catch very small lobsters was the first of its kind in terms of its methodology, does not allow for comparisons across other years. However, the results from this survey conform with other available western rocklobster data in showing that the majority of small lobsters are in the shallows and that large animals are generally more common in deep water.

The fact that the results from this survey show generally similar patterns in terms of the depth distributions of the different size classes to what has been recorded in the past, would suggest that it is *unlikely* that there has been a major shift in the depths at which pueruli are settling. Certainly small lobsters were sampled in low numbers in deep water in this survey and this therefore does not exclude the possibility that deep water settlement may be becoming more common than in past.

The different types of pot used in this survey were all based on modifications to commercial pots. Even though the pots had modifications such as mesh and additional battens, they were not optimal tools for sampling lobsters below the legal minimum size because their size would have made if difficult for very small animals to enter and larger animals in the pot would have reduced the entry of small animals by their dominance of the food and space in the pot. These factors in part explain the relatively large size frequency distribution in the catch recorded over the duration of the survey (Figure 3). Despite the modified commercial pots not being ideal for catching small lobsters, the relative catch rates for the different size classes are comparable across depths within sampling locations.

It was notable that relatively few small individuals (<50 mm CL and 51 — 65 mm CL) were recorded in the pots at Kalbarri and the Abrolhos Islands. This was unexpected given that at both areas, but the Abrolhos in particular, the size composition of the catch is generally smaller than elsewhere in the fishery. There is no obvious explanation for this result, other than the possibility that the pot types used in these areas were less efficient at sampling small individuals than the pot types used at the other sampling sites (Fremantle, Mandurah, Lancelin, Dongara and Geraldton). This possibility is supported by the fact that in three of the four areas where more than one pot type was used there were significant differences in the catch rates of the different pot types. This suggests that several of the pot designs were particularly inefficient at catching small size classes of lobsters (Table 2 and Figures 7 and 9).

Depth was a significant factor in the catch rates of most, but not all size classes in the different sampling locations, with small size classes being prolific in the shallows and larger size classes in the deep. The exception to this general rule was the Abrolhos site, where only the 66-76 mm CL size class showed depth to be a significant factor. Changes in size structure with depth are well known as being less defined at the Abrolhos compared to the coast – for example high egg production from breeding females has historically been recorded in 0-20 m depths at the Abrolhos, whereas egg production is nearly zero at the coast because of the lack of any breeding animals in that same depth category (Melville-Smith *et al*. 2009). Catch rates of lobsters ≥105 mm CL were significantly related to depth at Mandurah and Fremantle, but not elsewhere because only low numbers of this size class were sampled at the other sites.

5.0 Benefits

The beneficiaries of this research project have been widespread across different stakeholder groups of the western rock lobster fishery, ranging from commercial fishermen, managers and researchers of the fishery and other groups with a less direct interest in fishery.

The project had very clear objectives in that it was attempting to establish whether there has been a shift in the pattern of western rocklobster puerulus settlement from shallow to deep water. The project has successfully addressed this question.

The project was also directed at developing modifications to commercial western rock lobster pots to enable them to sample a wide range of lobsters. It successfully addressed this question and in the process fostered close working relations with industry members who were instrumental in collecting the data that has been used in this report.

6.0 Further Development

This pilot phase trial has set in place baseline data monitoring post puerulus settlement levels using a relatively inexpensive method.

The modifications to commercial pots developed during this project to sample undersize catch have been incorporated into a season long trial conducted during the 2009/10 commercial season with industry and Department of Fisheries Research Division involvement.

More monitoring of post-puerulus/juvenile lobsters will provide the comparisons that are necessary to compare inter-annual differences in the numbers of these size classes settling at different depths on the grounds. It is only with more data of this type over a longer time period, that it will be possible to show whether there is any indirect evidence of a shift in settlement to deeper water. Should this work continue into the future, it would be beneficial to standardize on a consistent type of modification to the commercial pots so that more reliable comparisons of the relative numbers of juvenile animals can be made between areas.

5.0 Planned outcomes

At the time that funds were granted for this project there was concern that there might have been a shift in the pattern of puerulus settlement from shallow to deeper water. This project has addressed these concerns by showing that it is unlikely that there has been a major shift in the depths at which the pueruli are settling. A second outcome from the project has been the development of a number of different modifications to commercial western rock lobster pots to enable them to sample a wide range of lobsters and the development of close working relations with commercial fishermen who were instrumental in collecting the data that has been used in this report.

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7.0 APPENDICES

Appendix I : Datasheet used to recorded the sampling details and catch for each pot

Rock Lobster Length Frequency

Vessel name: _____ Reg. No: _____ Date: _____

Latitude: _____ Longitude: _____ Depth: _____

Was there evidence of Octopus? YES / NO

	Males		Females						Males		Females				
CL	Red	White	Red	White	Spawn	Tar spot	Setose	CL	Red	White	Red	White	Spawn	Tar spot	Setose
20								89							
21								90							
22								91							
23								92							
24								93							
25								94							
26								95							
27								96							
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Appendix II: Images of different pot types used in the trial

Abrolhos 1 pot type, a batten pot with an internal steel mesh covering

Fremantle 1 pot type, a batten pot with additional battens on the back

Geraldton 2 pot type, a batten pot with plastic mesh and additional battens on the back. The escape gaps were not covered by battens, but were covered by the plastic mesh

Mandurah and Lancelin 2 pot types, were stick pots with extra sticks used in the construction and with an external wire netting covering

Appendix III
INTELLECTUAL PROPERTY:

Appendix IV
STAFF:

Dr Andrew Winzer	Principal Investigator to November 2009
Dr Simon de Lestang	Co-investigator
Dr Roy Melville-Smith	Principal Investigator June 2010 onwards

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