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Spatial differences in size of maturity and reproductive potential between inshore and offshore fisheries for southern rock lobster (*Jasus edwardsii*) in South Australia

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ABSTRACT

The fishery for southern rock lobster (*Jasus edwardsii*) is South Australia's most valuable marine resource. A feature of the fishery in recent years is the observed change in the spatial dynamics of the fishing fleet as a result of the quota introduction. Specifically, almost 80% of the annual catch comes from inshore grounds (<60 m) as fishers target small (<1 kg) "red" individuals favoured by export markets. As a result, data required to estimate the size at onset of maturity (SOM) and relative reproductive potential (RRP) are spatially limited. In 2007, a fishery independent research project provided a unique opportunity for the collection of biological data from offshore sites (>100 m) to allow for spatial comparisons of these parameters by depth. SOM, estimated as the size at which 50% of females reached sexual maturity (L_{50}) was lower offshore (68.4 mm carapace length (CL)) compared to inshore areas (103.3 mm CL). RRP, as a measure of egg production, was calculated for each size class from the product of fecundity, SOM and population length frequency. As with SOM, size classes contributing to RRP differed spatially. In the inshore grounds, 65% of RRP came from the 112.5–132.5 mm CL size classes. Maximum RRP (14%) was attributed to the 127.5 mm CL size class. In offshore areas, 54% of RRP came from the 92.5–102.5 mm CL size classes with maximum RRP (25%) coming from the 97.5 mm CL size class. Only 3% of total RRP came from rock lobsters below the minimum legal size (MLS) of 98.5 mm CL within inshore grounds whereas 46% of RRP came from below the MLS in offshore areas. We suggest that regional differences in lobster density may be one of the numerous factors contributing to observed results. Lobster density was consistently higher in offshore grounds compared with inshore areas. For example, the long-term average catch rate in depths of 0–30 m was 0.79 kg/potlift, compared to 1.77 kg/potlift observed in depths >90 m. Spatial variation in SOM and RRP are discussed in relation to observed differences in lobster density as a result of commercial fleet dynamics.

1. Introduction

The fishery for southern rock lobster (*Jasus edwardsii*) is South Australia's most valuable marine resource with annual exports exceeding AU$100 million (Knight et al., 2007). It is divided into two zones for management purposes: a southern zone (SZ) that extends from the Victorian border to the mouth of the Murray River and a northern zone (NZ) that runs from the mouth of the Murray River to the Western Australian border. The most productive area is the SZ (Fig. 1), due largely to the presence of ideal lobster habitat consisting of continuous limestone reefs (Lewis, 1981). In addition, the SZ is recognised for having high levels of primary productivity due to annual upwelling events that characterise the region (McClatchie et al., 2006). The SZ has a long history of management that includes a range of both input and output controls (Sloan and Crosthwaite, 2007). These include a single minimum legal size (MLS) of 98.5 mm carapace length (CL) across the entire zone and an annual total allowable commercial catch (TACC), which currently stands at 1770 tonnes. The majority of the TACC is taken in the four major marine fishing areas of 51, 55, 56 and 58 (Fig. 1).

A feature of the SZ fishery in recent seasons is the observed change in the spatial dynamics of the fishing fleet as a result of the TACC introduction (Linnane and Crosthwaite, in press). Stemming primarily from the need to maximise catch profit under the TACC system (rather than catch volume under input controls), the fleet almost exclusively targets inshore grounds that contain small (<1 kg) "red" coloured lobsters (Chandrapavan et al., in press). These particular individuals are in high demand throughout the year driven by the Chinese market that favours them for both size and colour (Woods et al., 2007). Offshore individuals are generally larger

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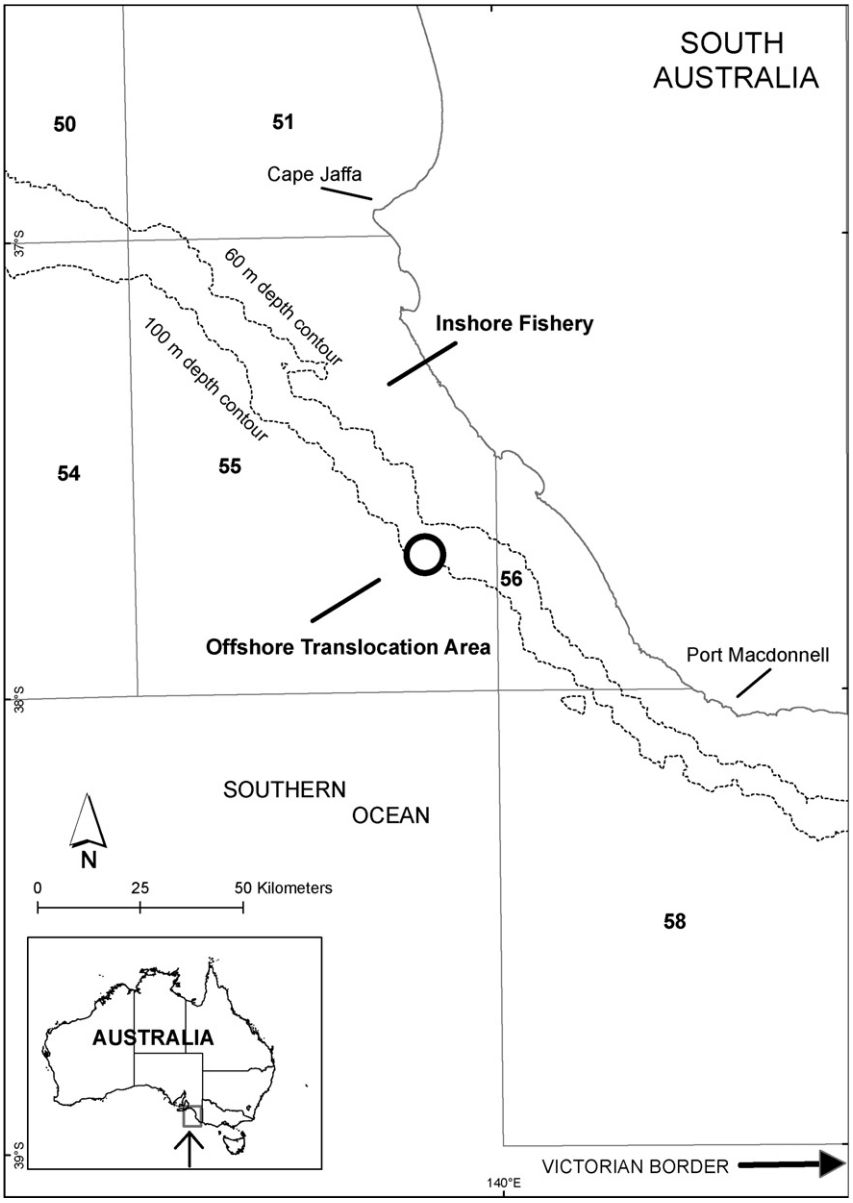

Fig. 1. Location of marine fishing area (MFA) 55 with offshore translocation site within the South Australian southern zone rock lobster fishery.

than 1 kg and tend to have a "speckled" or "white" colouration not favoured by buyers. Inshore lobsters therefore attract premium prices and as a result, approximately 80% of the annual TACC in the SZ is now taken within depths of <60 m while offshore grounds remain largely underexploited (Linnane and Crosthwaite, in press).

There is strong evidence from both fishery dependent and independent catch per unit effort (CPUE) data that the shift in fishing effort has lead to a disparity in lobster densities between inshore and offshore sites. Specifically, CPUE is 2–3 higher in deeper waters compared to shallow water sites (Linnane and Crosthwaite, in press). Preferred market traits have therefore lead to the rather unusual situation in terms of fishery management where high CPUE areas are avoided in favour of low catch rate grounds. In response, alternative management strategies are now being developed that aim to avoid localised lobster depletion within inshore grounds. One such strategy is lobster translocation where low-value deep-water speckled lobsters are translocated to inshore grounds to improve their subsequent market value. Recent small-scale studies in Tasmania indicate that *J. edwardsii* change to the favoured "red" colouration after a single moult when translocated inshore (Chandrapavan et al., in press).

Due to the contracted nature of the commercial fleet within inshore grounds, fishery dependent data on the reproductive biology of *J. edwardsi* in South Australia tends to be spatially limited. Two features that are important to the management of the resource, especially in terms of MLSs, are size at onset of sexual maturity (SOM) and the relative reproductive potential (RRP) of specific size classes within female lobsters. Both of these features are known to differ spatially across the range of *J. edwardsii* within South Australia (Linnane et al., 2008a), Victoria (Hobday and Ryan, 1997; Punt and Hobday, 2006), Tasmania (Punt and Kennedy, 1997; Gardner et al., 2006) and New Zealand (MacDiarmid, 1989). As a result, knowledge on regional differences in SOM and RRP can help to refine the use of MLS's as a management tool as well as improve spatial assessment of the resource.

In 2007, a translocation study in the SZ of South Australia provided a unique opportunity for the collection of biological data from offshore sites >100 m depth. Data from female individuals were