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Evaluating empirical decision rules for southern rock lobster fisheries: A South Australian example

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ABSTRACT

The fishery for rock lobsters in South Australia's southern zone has been in decline for several years. Previous harvest strategies included limit reference points, but did not specify explicit total allowable commercial catches (TACCs) when these reference points were breached. Two alternative catch-rate-based decision rules for setting TACCs for this fishery were proposed by stakeholder groups, including government scientists and the fishing industry. The two decision rules ("discrete" and "linear") set TACCs based on changes in catch-rates, with the general aim of achieving a constant exploitation rate. The two rules differed in terms of how TACCs are changed given changes in catch-rate. Management strategy evaluation is used to evaluate these decision rules. The "discrete" rule leads to greater variation in catches, but to somewhat lower risks. However, unlike the linear rule, the discrete rule cannot reduce [or increase] catches markedly. Based on the trade-offs between risk and catch, as well as the need for buy-in of impacted stakeholders, the discrete rule was selected as the basis for setting TACCs for the southern rock lobster fishery for the next 3–5 years.

1. Introduction

Crustaceans constitute some of the world's most valuable fisheries. Southern rock lobster (*Jasus edwardsii*) is South Australia's most valuable fishery resource, worth in excess of AU$100 million annually (Knight and Tsolos, 2009). The fishery 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) from the mouth of the Murray River to the Western Australian border (Fig. 1). Approximately 80% of the annual catch of rock lobsters off South Australia is taken in the SZ (Linnane and Crosthwaite, 2009), which comprises over 22,000 km^2 of relatively narrow (<30 km) continental shelf. Fishing methods have generally remained unchanged over time consisting of steel framed baited pots that are set individually overnight and hauled at first light.

The SZ has a long history of management that includes both input and output controls (Sloan and Crosthwaite, 2007). It has been a limited entry fishery since 1967, currently with a total of 181 licenses. The season extends from 1 October to 31 May of the following year. There is a minimum legal size (MLS) of 98.5 mm carapace length, CL, prohibition on the taking of berried females, and several sanctuaries within which lobster fishing is prohibited. The dimensions of lobster pots, including mesh and escape gap size, are also regulated. Fishers have to use between 40 and 100 of the total number of pots endorsed on their license at any one time to take lobster. In 1993, output controls in the form of total allowable commercial catches (TACCs) and individual transferable quotas (ITQs) were also implemented.

Despite these explicit regulations, the status of the SZ fishery has declined considerably in recent seasons (Linnane et al., 2010). Catch per unit effort (CPUE) has decreased from an historical high of 2.1 kg/potlift in 2002/2003 to just 0.6 kg/potlift in 2009/2010 (Fig. 2), the lowest on record. This decrease reflects declines in estimated legal size biomass from ~4800 tonnes to ~1800 tonnes and a doubling of exploitation rates from ~0.35 to ~0.7 over the same period (Linnane et al., 2011), and has resulted in substantial reductions to the TACC from 1900 tonnes in 2002/2003 to 1250 tonnes for the start of the 2010/2011 season. Importantly however,

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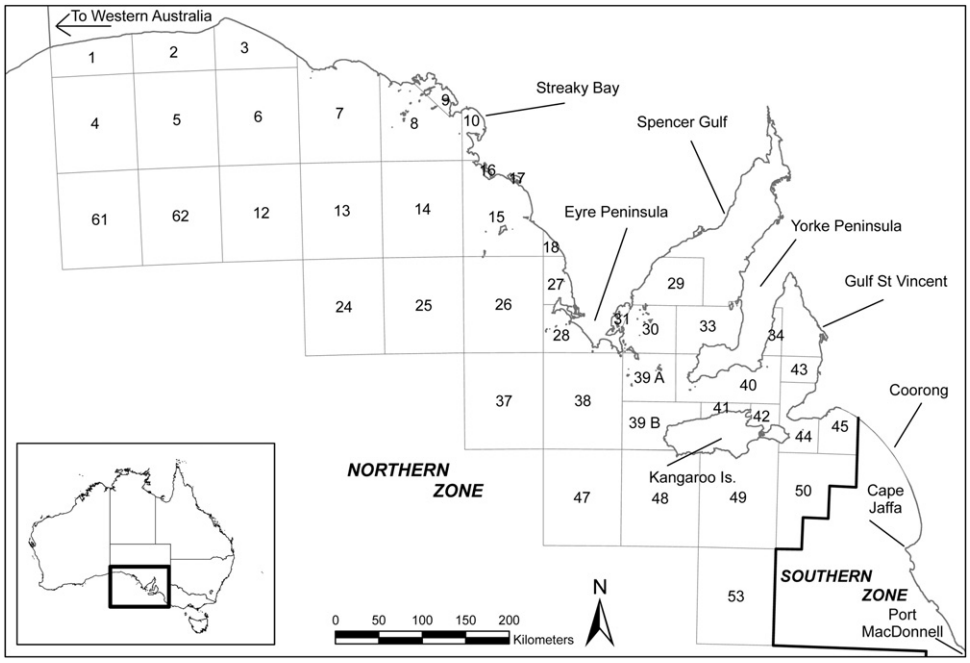

Fig. 1. Northern and southern zone rock lobster fisheries of South Australia. Numbers show the locations of the marine fishing areas which are used for statistical purposes.

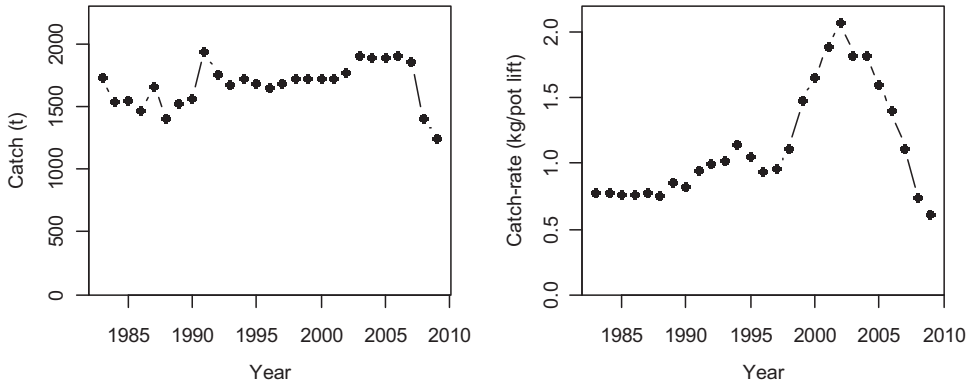

Fig. 2. Trends in commercial catches and catch-rates of SZ rock lobster.

reductions during this period were largely made in the absence of formal decision rules that advised on TACC levels.

The harvest strategy for the South Australian SZ rock lobster fishery was reviewed at the end of the 2009/2010 fishing season. At this time, there was clear agreement between industry sectors, resource managers and stock assessment scientists on the need for a rule-based system that provided explicit advice on appropriate TACC levels based on current fishery performance. With this common objective, two decision rules[1] (DRs) were proposed for evaluation, one by government scientists and the other by industry. Both of the DRs were based on the notion of maintaining a constant exploitation rate without explicitly attempting to estimate exploitation rate annually. Both DRs modified TACCs based on changes in catch-rates from one year to the next. However, it was unclear when they were proposed how well these DRs would achieve the conflicting goals of low probabilities of the resource dropping to undesirably small population sizes and high catches and catch-rates.

Management strategy evaluation (MSE; Smith et al., 1999; Butterworth, 2007; Rademeyer et al., 2007) has in the past been used to evaluate approaches for setting TACCs for rock lobster resources (e.g. Johnston and Butterworth, 2005; Punt and Hobday, 2009; Starr et al., 1997) and TACCs are set for New Zealand and South African rock lobster resources using approaches similar to the two decision rules proposed for use in the SZ rock lobster fishery. MSE provides a means to identify the trade-offs among alternative TACC-setting approaches given uncertainty regarding the true state of the system and future data prior to their use in practice, giving decision makers the opportunity to objectively select among the alternative candidate DRs and to have some reassurance of the likely impact of applying any selected DR. This paper therefore uses MSE to compare the two DRs proposed for the SZ rock lobster resource. Although it is common to consider a range of values for the parameters of DRs when applying MSE (e.g. De Oliveira and Butterworth, 2004; Plagányi et al., 2007), such results are not

[1] We use the term 'decision rule' here rather than the more conventional term 'harvest control rule' because harvest control rules usually only indicate how the results of assessments should be used to determine management actions and not how the assessment is to be conducted. The DRs of this paper in contrast are fully specified because they specify which data are to be used to apply them. As such the DRs are more similar to 'Operational Management procedures' (Johnston and Butterworth, 2005).