

Identifying viability thresholds for stochastic bio-economic systems managed with multiple objectives

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ABSTRACT

Management Strategy Evaluation (MSE) is a process that aims to evaluate trade-offs associated with alternative strategies for the management of dynamic resource systems, using a simulation framework and based on objectives which are usually specified by the stakeholders involved in managing these systems. It has been largely applied to marine fisheries, and is increasingly considered as a promising approach in the broader context of managing multiple ocean uses.

A key element of MSE involves turning broad conceptual objectives into quantifiable and measurable operational management objectives, against which the performance of management strategies can be assessed. The specification of operational management objectives requires three elements: a performance indicator that specifies the quantity of interest, a target for the performance indicator, and a measure of tolerance or acceptance that the indicator must achieve, usually specified as a probability. However, given the uncertainty typical of most renewable resource management problems, and the diversity of stakeholders usually encountered in resource management systems, identifying performance indicators, targets and tolerance levels often proves a challenge in itself. Stakeholders may find it difficult to select a particular set of indicators, thresholds and tolerance levels, or they may disagree with respect to all or some of these.

In this paper, we propose a formal approach to the selection of operational objectives for the evaluation of management strategies. The approach is applied to a spatial, multi-species coral reef fishery of which a simulation model was developed to examine the potential effects of management. The analysis focuses on Ningaloo Reef in Western Australia where a recreational fishery targets Spangled Emperor (*Lethrinus nebulosus*). The model integrates a broad range of physical, biological and socio-economic information and process understanding, and is used to assess the expected status of biomass, recreational catches and catch rates under different projected management strategies and future scenarios regarding the evolution of the fishery.

We use the notion of viable management strategies, as defined in recent applications of viability theory to the dynamic control of marine social-ecological systems, to examine the way in which operational management objectives can be set for the park. We define viable management strategies as those which allow performance criteria to be met at pre-agreed tolerance levels, and systematically explore the relations between the viability of management strategies and the performance targets used to assess the realization of broad management objectives. We also consider the trade-offs between performance targets under different management strategies, and identify those strategies which provide a greater scope to disagree about operational objectives.

Keywords: viability analysis, reef line fishery, recreational fishing, management strategy evaluation, Ningaloo Marine Park, Western Australia