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A multi-model approach to engaging stakeholder and modellers in complex environmental problems

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ABSTRACT

Models are increasingly used to support decision-making in the management of natural resources. They can provide system understanding, learning, a platform for stakeholder engagement, projections of system behaviour and an environment for virtual testing of alternative management strategies. However, rarely is a single numerical model suitable for all these purposes. Our experience is that a suite of models of different size, complexity and scope can be more effective and can better address the needs of environmental management projects. Models of different complexity can address different needs, but can also be combined as a flexibly sculpted tool kit – as they require very different development effort they can be deployed at different stages during a project. Using rapidly deployed qualitative, or simple quantitative, models stakeholders can be exposed to models very early in the project, eliciting feedback on appropriate model content and familiarity with the modelling process without affecting the development of more complex, resource intensive, models aimed at answering core management questions. This early and continuous stakeholder exposure to models provides flexibility in addressing specific novel questions as they arise during project development, as well as an opportunity for developing skills and changing both modellers and stakeholders' attitudes, as is often needed when facing complex problems.

Using an example where we used five different model types in an effort to inform policy-making around regional multiple use management in north-western Australia, we describe (i) how each model type can be used, (ii) the different roles the models cover, and (iii) how they fit into a full decision making process and stakeholder engagement. We conclude by summarising the lessons we learnt.

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1. Introduction

This paper describes the use of several model types within a large research project aimed at integrating scientific information to support decision-making with the view of ensuring a sustainable future for the Ningaloo-Exmouth region in Western Australia (Fig. 1). The area has immense natural beauty (listed as a World Heritage Area in 2011), but is also currently the focus of rapid industrial development (e.g. around oil and gas extraction) with a highly diversified economy – including tourism, oil and gas, pastoralist and fisheries. There are many groups, with clashing objectives, interested in the region and the future development over the area will necessarily occur in a contested stakeholder environment.

The political tension surrounding the location saw a large research programme carried out in 2007–2011 to provide the information required for evidence based decision making about future management and development for the region.

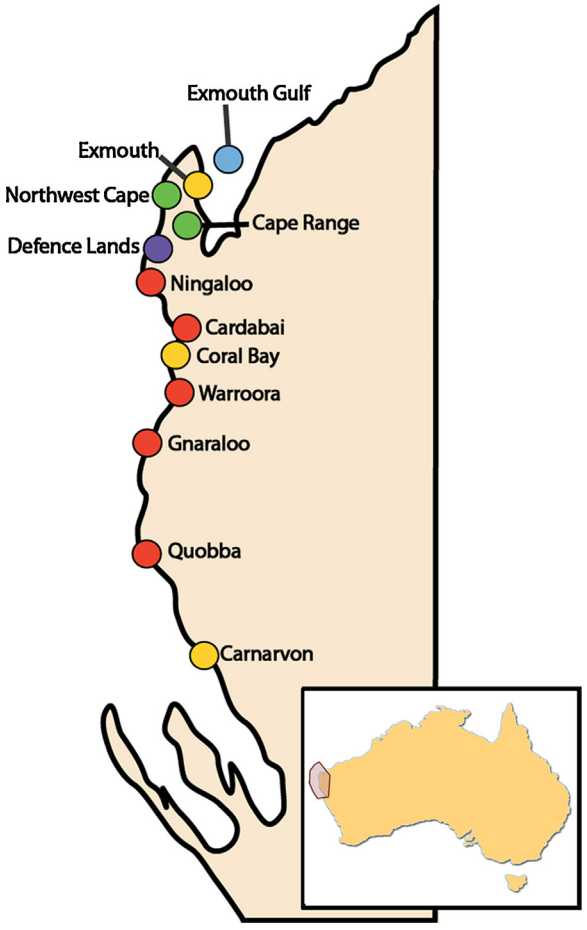

Fig. 1 – Ningaloo-Exmouth region of Western Australia, showing the major tourism nodes identified in the region – including the major settlements (yellow), pastoral stations (red), national parks (green) and other features (blue and purple). (For interpretation of the references to color in this text, the reader is referred to the web version of the article.)

Within this programme, our team was tasked with developing both targeted industry specific models and a fully integrated whole-of-system model of environmental, social and economic processes in the region. The goal of these models was to: (i) provide a means of integrating information collected by several other research activities within the larger project; (ii) explore the potential impact and effectiveness of various management options; and (iii) encourage stakeholder engagement. Our previous experience and much other research has shown the many benefits (e.g. utilitarian, social, ethical, political and uptake) of participatory co-management approaches when trying to find long lasting sustainable outcomes for common property resources, such as the marine and coastal estate (Bramwell and Sharman, 1999; Glasson and Marshall, 2007; Syme et al., 2012).

The original proposal for the modelling work was to use the Management Strategy Evaluation framework – which explicitly represents the resource, users and management feedbacks (de la Mare, 1998; Sainsbury et al., 2000) to model individual sectors as well as the overall system; with the intent of using industry specific models to address pressing industry specific questions for tourism and fisheries while field programs and the development of the whole-of-system model was underway. However, once the project began, it quickly became apparent that the different model types had complimentary science and engagement roles too and that more models were needed – simpler ones that could be used rapidly and in a highly interactive way.

An initial round of workshops eliciting questions for the modelling efforts and discussing key model content indicated that the models would need to address multiple processes and feedbacks across a range of spatial and temporal scales. It was evident that the complexity required to achieve this would lead to tools too unwieldy and slow running for use in interactive workshops. The models would be equally unsuited as tools for introducing and training potential users to modelling. Furthermore, we knew from previous experience that long development times for such complex models almost inevitably leads to a loss of interest and engagement, potentially leading to little subsequent uptake. This is because the modellers reticence to interact with busy people can lead to patchy or infrequent communication, which combines with rapidly shifting topics of interest and a fast turnover in the identity of representatives of local stakeholders and regulatory bodies, ultimately results in a loss of the key sense of participatory investment in the modelling process.

Sequentially defining, implementing and delivering a model may be the standard vision of modelling held by scientists and some managers (Fig. 2a), but a more iterative and adaptive approach (Fig. 2b) has been found to lead to greater engagement and uptake (Daniell, 2008; Fulton et al., 2011). This form of model development and stakeholder engagement leads to changes in model complexity and focus, as the problem becomes more defined and stakeholders appreciate what modelling can (and cannot) provide. Such an adaptive modelling process also more effectively accommodates different types (Joshi et al., 2007) and dimensions (Cross et al., 2001) of knowledge.

We addressed these modelling and engagement challenges by developing a suite of models each covering different roles