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Research Paper

Building systems-based scenario narratives for novel biodiversity futures in an agricultural landscape

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HIGHLIGHTS

- Systems-based scenario planning helps stakeholders rethink biodiversity futures.
- Building scenario narratives using a systems structure enabled expert input.
- The scenarios helped challenge assumptions and reveal new opportunities.
- Future conservation will need to prioritise new locations and strategies.
- Novel ecosystems are a key biodiversity conservation strategy under climate change.

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ABSTRACT

Improving biodiversity futures requires a systems-based appreciation of the dynamic human and biophysical interactions shaping landscapes. By combining a structured approach to identifying key drivers of change on biodiversity with a collaborative approach to scenario planning, biodiversity planners and managers can work with stakeholders to identify a range of possible futures and explore their implications. This paper presents an approach to developing scenario narratives constructed against key drivers of change identified through a social–ecological systems analysis. The approach facilitated the integration of stakeholder and expert input to inform system dynamics affecting biodiversity outcomes, helping to direct and discipline the collective imagination, and to challenge assumptions and reveal new opportunities and strategies. Examples are provided to show how conventional notions about preserving biodiversity remnants "as is" were not a good fit for the diverse range of futures imagined, and that restoration ecology would have to expand to incorporate ideas of landscape fluidity and novel ecosystems. Aspects of the scenario narratives highlighted the need for new conservation strategies for the endangered native grassland ecological community within the Tasmanian Midlands case study, and a re-focusing on new locations across that landscape.

1. Introduction

Creating scenarios to explore and imagine the future is a widely used tool in landscape planning (Xiang & Clarke, 2003). The use of scenarios in planning processes is recommended for contexts of high uncertainty and low controllability (Peterson, Cumming, & Carpenter, 2003), and to open up constrained thinking to new possibilities (Chermack, 2004). In this journal alone, there are accounts of scenarios being used to initiate discussion about future constraints and opportunities for rural development (Van Berkel, Carvalho-Ribeiro, Verburg, & Lovett, 2011), to develop visual aids that enhance learning about climate change impacts and/or development trajectories (Albert, Zimmermann, Knieling, & von Haaren, 2012; Lamarque et al., 2013; Norman, Feller, & Villarreal, 2012), and to explore policy options for alternative futures (Pearson, Park, Harman, & Heyenga, 2010; Southern, Lovett, O'Riordan, & Watkinson, 2011).

Landscapes are social constructs that evolve out of the systemic interactions between humans and their environment (Greider & Garkovich, 1994; Tress & Tress, 2001). Participatory tools that help stakeholders analyse complex social–ecological system (SES) interactions in a holistic way are therefore required (Hanspach et al., 2014), especially when planning for future landscapes under climate change (Bohnet & Smith, 2007). While it is a characteristic of

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both social and ecological systems to self-organise as they adapt to change, a particular feature of social systems is human agency associated with an ability to anticipate, imagine, and potentially influence the future (Davidson, 2010). Scenarios can help capture that imagination, and direct it for the benefit of planning and decision-making (Chermack, 2007).

The future for biodiversity in landscapes predominantly used for agriculture is a case in point. In landscapes with a long history of agriculture, biodiversity has become entwined with traditional land management practices, and reviving this traditional ecological knowledge has been posited as one strategy for conserving future biodiversity (Barthel, Crumley, & Svedin, 2013). For landscapes with a more recent history of agriculture, such as in Australia, the discourse underpinning conservation strategies is more often directed at protecting individual species and preserving the few remaining remnants of native vegetation. Yet preserving biodiversity "as is" will no longer be feasible under climate change (Dunlop, Parris, Ryan, & Kroon, 2013). As a result, biodiversity planners are facing high uncertainty and low controllability, while also needing to change their way of thinking. The use of scenarios is therefore apt.

In particular, scenario planning could assist restoration ecologists identify and plan for the management of novel ecosystems (Hobbs et al., 2014; Hobbs, Higgs, & Harris, 2009; Seabrook, McAlpine, & Bowen, 2011). This may involve biodiversity managers exploring how to provide valued ecosystem attributes in alternative places or under alternative configurations, and managing for (novel) species composition and function (Hobbs et al., 2014). A systems-based approach to scenario planning can assist in matching that need for imaginative reconceptualisation with the expertise of climate change modelled projections, and an appreciation of the dynamics of landscapes (Manning et al., 2009) and their connectivity (Worboys, Francis, & Lockwood, 2010).

Scenarios are developed for predictive (What will happen?), normative (What should happen?) and/or exploratory purposes (What could happen?), representing probable, preferred or possible futures (Börjeson, Höjer, Dreborg, Ekvall, & Finnveden, 2006; Rickards, Wiseman, Edwards, & Biggs, 2014; Rounsevell & Metzger, 2010). While species distribution modelling can offer an element of future prediction for biodiversity, a key challenge for biodiversity planning is to explore potential futures and new possibilities. The range of possible futures can be restricted to those deemed more plausible or opened up depending on the extent that scenarios are being used for decision support or for stimulating wider debate about possible futures (Volkery & Ribeiro, 2009). While restricting the range of scenarios helps reduce complexity overload, it can also undermine the potential of opening up the minds of those involved to new possibilities (van Drunen, van't Klooster, & Berkhout, 2011). Indeed, credentials for a good set of scenarios include that they are both plausible and surprising, are provoking as well as proximate, and that they enable mind stretching without overload (Xiang & Clarke, 2003).

A commonly used systems-based strategy for developing diverse plausible future scenarios involves identifying two critical uncertainties from among key drivers of change on system dynamics, and then creating a quadrant matrix of scenarios comprising the four possible combinations at the end points of these critical uncertainties (Rickards et al., 2014). This matrix approach was used by the UK Climate Impacts Programme, adopting characteristics associated with governance and social and political values as the two axes forming the matrix (Berkhout, Hertin, & Jordan, 2002). In the context of marine biodiversity, best case and worst case trends for climate change have been adopted as the critically uncertain extremes by Evans, Hicks, Fidelman, Tobin, and Perry (2013), who intersected these end points with limited versus ideal adaptation pathways to create four scenarios, and by Haward et al. (2013), who intersected these with high versus low level of development affecting marine areas. In an agricultural landscape facing rural decline, community stakeholders developed a matrix of scenarios representing combinations of a declining versus an improving environment intersecting with the possibility of new markets versus a continuation of rural economic decline (O'Connor, McFarlane, Fisher, MacRae, & Lefroy, 2005). In terms of governance characteristics, other studies have characterised scenarios in terms of extremes of autonomy and interdependence (Dockerty, Lovett, Appleton, Bone, & Sünnenberg, 2006); level of centralisation and autonomy (Daconto & Sherpa, 2010); and laissez-faire and proactive approaches (Carter & White, 2012).

Construction of scenario narratives as descriptive storyline texts is often adopted as part of participatory approaches to scenario planning (e.g. Foran, Ward, Kemp-Benedict, & Smajgl, 2013; Kok, van Vliet, Bärlund, Dubel, & Sendzimir, 2011). In such cases, participants are usually given control over the production of the narrative texts, which requires a considerable time commitment. For example, Kok et al. (2011) describe a writing process involving two consecutive 3-day workshops followed by a 30-day period to finalise the narrative texts online. These narrative techniques are often combined with simulations to assist in evaluating the implications of the scenarios for policy and planning (e.g. Kok et al., 2011; Volkery, Ribeiro, Henrichs, & Hoogeveen, 2008). However, in most cases, the scenario logic is pre-determined, often as a matrix combining a global-local axis with an axis ranging from economic self-interest to an environmental and equity orientated approach (Kok et al., 2011; Rounsevell, Berry, & Harrison, 2006). The challenge, as highlighted by Rounsevell and Metzger (2010), is to enhance the saliency and legitimacy provided through these participatory methods with approaches that also enhance their credibility. Credibility can be undermined by "a potential lack of diversity" among participants, and because participants may not always have "a complete mental model of the system" being analysed (Rounsevell & Metzger, 2010, p. 610). Vervoort, Kok, Beers, Van Lammeren, and Janssen (2012) explored an approach that combined a systems-based analytic approach with an experiential technique, but this involved a series of individual participant narratives rather than a group-level narrative.

This paper reports on a systems-based exploratory scenario development exercise to support landscape-scale biodiversity planning in the Tasmanian Midlands, an agricultural landscape identified by the Australian government as a biodiversity hotspot. Scenarios were developed by stakeholders using the above quadrant matrix process, building on a prior SES analysis of dynamics affecting native grasslands which are the key biodiversity feature of this landscape. This ensured that stakeholders were given greater control over the initial design of the scenarios, leaving the more time-consuming process of refining scenario narratives to the research team. These scenario narratives were developed in consultation with relevant scientific experts from initial dot point prompts provided by stakeholders. The process used mirrors that adopted for a parallel case study involving the Australian Alps (Mitchell, Lockwood, Moore, & Clement, 2015b).

The paper's first aim is to present the approach used to develop scenario narratives that enabled expert input into how the key drivers of change might affect system dynamics under each of the future scenarios. A detailed examination of the key drivers of change is vital for complex issues such as biodiversity conservation on predominantly privately managed agricultural land. As Spangenberg (2007, p. 348) has noted: "Only if the driving forces are adequately reflected in the scenario dynamics, allowing projections into the future and the analysis of unsustainable trends, is it possible to compare different scenarios regarding their expected impacts on biodiversity, and to derive suitable priorities for strategic policy action."