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Climate change, scenarios and marine biodiversity conservation

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ABSTRACT

This paper explores the utility of qualitative scenario approaches to examine the potential impacts of climate change on marine biodiversity conservation on the east coast of Australia. This region is large and diverse, with considerable variation in marine biodiversity and, concomitantly, considerable diversity in the likely impacts from climate change. The results reinforce a number of key points. Engaging with stakeholders in scenario planning provides not only a focus to discuss the future in a disciplined way, but also provides ongoing reference points for contemporary decision making and planning. The paper illustrates how qualitative scenario planning provides opportunities to address the challenges of marine biodiversity conservation in a changing environment.

1. Introduction

Contemporary policy making is developed under conditions of uncertainty. Some policy arenas such as marine biodiversity conservation are particularly volatile given uncertainties over assessment of the state of the marine environment and impacts upon it. This paper explores the utility of qualitative scenario planning to examine the potential impacts of climate change on marine biodiversity conservation in east coast Australia.

This paper first provides a background to the use of qualitative scenarios and outlines the approach used to identify and explore plausible futures for marine biodiversity conservation in east coast Australia. It then describes the case study areas and outlines four generalised scenarios based on different levels of (i) climate change and variability; and (ii) development and use. The paper concludes with considering how such scenarios can guide opportunities to address the challenges of marine biodiversity conservation in a changing environment, given that decision makers have to make choices over decisions and policy 'investments' with imperfect knowledge of all consequences. This dilemma is at the core of contemporary strategy making and planning. While prediction and forecasting is difficult if not impossible, scenarios can support decision-makers to:

- consider what sort of future is desired (in consultation with stakeholders);
- test these ideas against what might plausibly happen in the future; and
- develop flexible strategies from this conversation which do not unnecessarily pre-empt future decisions.

2. Addressing the future: qualitative scenario development

Scenarios are narratives or stories about *plausible* futures (see [1–5] for more details on the history, principles and methods of scenario approaches to futures thinking). Scenario development provides opportunities to explore alternative options and offers a powerful tool to assist in developing understanding of a range of options, or plausible alternative futures. These opportunities arise because scenarios enable deep learning that results from understanding the structural dynamics (including system structure, causal relationships, driving forces and assumptions) of the system at issue and so avoidance of reactive responses [5]. Scenario approaches provide an opportunity to address uncertainties in marine biodiversity conservation through the engagement of stakeholders in the management process, and particularly in the building of scenarios, either qualitative or quantitative. Qualitative scenarios:

- promote strategic conversation;
- provide a risk management tool;

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- expose new challenges (look outwards) rather than prediction;
- release people from 'straight line extrapolations';
- provide potential for increased insight;
- validate current policy settings and guidance; and
- give 'front-end' input into strategic planning and policy development processes [15].

At the same time qualitative scenarios are constrained through:

- sensitivity in speculating about the future;
- inability to provide prescriptive solutions;
- limits in setting the context rather than guiding decisions; and
- expense in terms of time commitment [6].

Qualitative scenario planning follows systematic and recognisable phases, and is a highly iterative, intense and imaginative process [7]. There is no set ideal number of scenarios but problems arise if either too few or too many scenarios are developed. Richness can be lost, too, if a simple continuum of 'good, indifferent, bad' is used. The key to scenario development is to identify a key focusing issue or set of related issues. This can either be given by the need to focus on a particular problem or issue or be established by a focused discussion or 'brainstorming' exercise. Such discussions typically lead to a range of ideas, from which key issues that guide the development of narratives can be identified. The brainstorming exercise provides a number of alternatives as well as focusing issues. The narratives are written following consideration of the way in which options can be developed around the focusing issues. The narratives can be tested or 'wind tunnelled' to ensure that they are plausible [7], giving an opportunity to revise and clarify the scenarios. After the narratives have been tested, they can be used to develop policy or management options. This stage is critical, as often the development of the scenarios is seen as an end point, when in fact they are the starting point for further planning. The narratives can be used to evaluate challenges, identify opportunities and threats, and strengths and weaknesses of various options.

One of the outcomes of a scenario exercise is that, in exposing new challenges by encouraging participants to look outwards, it can be effective in breaking path dependency. In providing potential for increased insight, the process may also give validation to current policy settings and guidance and help strategic planning and policy development processes. It is important to include opportunities for thinking outside the square – in Steve Jobs's words to "stay foolish" [8].

At the same time there may be justifiable sensitivity in speculating about the future, and problems in dealing with wild cards or black swan events arising from the external environment. Wild cards and 'black swan' events [9] are previously unheard of or unconsidered events or impacts prior to an event or discovery, but once such a black swan event has occurred, decision-making automatically takes account of them.

Initial scenario development was undertaken through focused workshops in three case study regions (see Section 3 for description of these study areas). Workshop participants comprised technical advisors, management agency staff and stakeholders. The first section of each workshop involved brief discussions of, and orientations to, the case study regions. After this scene setting, workshop participants discussed the key underlying values of the marine and coastal environments of their region. Participants were then invited to consider the key issues likely to affect their region from 2012 to 2030. Along with key issues, discussion also identified the major drivers affecting the region and associated key uncertainties. The rationale behind the interest in critical drivers and uncertainties is that they provide information about the change dynamics of the system in question. Discussion of uncertainties affecting the area into the future included asking workshop participants to consider the possibility of wild cards or black swan events. Ranking of the issues and uncertainties provided a means of identifying critical or focussing issues. Identifying uncertainties, together with consideration of values, issues and drivers, helped workshop participants shape plausible 'regional scenario narratives' for each study area.

To provide for scalability of the findings from the case regions to other levels, from local to national, four generalised 'scenario spaces' were then developed from the regional scenarios. In this paper, we focus on these generalised scenarios, which were constructed using two parallel approaches. First, rankings of issues and uncertainties from each workshop were consolidated by the research team to identify two critical uncertainties (important drivers that have significant associated uncertainties) that are likely to have major consequences for marine biodiversity. These were 'climate change and variability' and 'development and use'. Second, the workshop drivers data were used to construct influence diagrams that showed relationships identified by the research team between the drivers for each region and important habitats for biodiversity. Thematic classification of these drivers revealed the same two critical influences on biodiversity outcomes. Generalised scenarios were therefore created by intersecting the two antipodes, climate variability and change and development and use of the marine and coastal environment. Antipodes express the extreme outcomes of key uncertainties and enable construction of four scenario narratives associated with combinations of high and low levels on each antipode.

3. Study areas: east coast Australia

The east coast of Australia (including the island state of Tasmania) stretches from Cape York at latitude 10.68° South, to South East Cape in Tasmania at latitude 43.39° South, giving a latitudinal distance of 3680 km, with the coastline length much longer. This span, from the tropics to cool temperate waters, includes significant marine biodiversity, and includes the Great Barrier Reef (GBR), the world's largest coral reef system, with over 2900 individual reefs and 900 islands. The east coast includes 16 meso-scale bioregions under the Integrated Marine and Coastal Regionalisation Australia (IMCRA v 4.0), "a spatial framework for classifying Australia's marine environment into bioregions that make sense ecologically and are at a scale useful for regional planning" [10]. More than 80% of Australia's population lives adjacent to these east coast marine environments. Major population centres include Australia's three largest cities, Sydney, Melbourne and Brisbane as well as extensive settlements in the Gold Coast (Queensland) and Newcastle (New South Wales), Australia's largest non-capital cities. The east coast also includes major centres of industry and infrastructure. Three of the 16 meso-scale marine bioregions within this vast domain were selected for analysis of the impact of climate change on marine biodiversity conservation. These study sites, the Whitsundays in North Queensland; the Tweed-Moreton (straddling the border of Queensland and New South Wales); and East Coast Tasmania, provide broad representation but also allow exploration of key issues, drivers and uncertainties at the meso-scale.

3.1. The Whitsundays

The Whitsundays marine area is principally valued for its ecological attributes (including continental islands and fringing reefs, coral reefs, seagrass habitat, coastal wetlands and marine fauna), tourist attractions, and fishing productivity. The ecological values of the Whitsundays include a calving ground for whales,