Scenarios for community-based approaches to biodiversity conservation: A Case Study from the Wet Tropics, Queensland, Australia

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ABSTRACT

Natural resource management approaches that deliver biodiversity conservation remain elusive, with evidence of a persistent implementation gap between biodiversity science and conservation projects. Scenarios have been identified as potentially useful to address the complex issues underlying this implementation gap, but have been infrequently applied to biodiversity conservation. Our paper reports on action co-research to develop, apply and assess the efficacy of scenarios within a community-based natural resource management (CBNRM) approach to biodiversity conservation at Mission Beach, a key site within the globally significant Wet Tropics bioregion. We focused on scenarios’ capacity to address the issues of contested interests and uncertainty, specifically aiming to engage the community to build a cohesive vision. The scenarios’ headline messages included a projected substantial loss of habitat in coastal vegetation communities that are highly valued by all stakeholders. Our assessment identified that the use of scenarios fulfilled the intended aims, resulting in a vision for biodiversity conservation that has substantial community support. Three factors contributed to this efficacy of the scenarios: (1) the focus on threat; (2) biodiversity science integration; and (3) simplicity in presentation. Further investigation is recommended of the potential of scenarios as tools to overcome the implementation gap in biodiversity conservation.

KEY WORDS regional planning; conservation planning; participatory scenario development; CBNRM; stakeholders; land use; Mission Beach
Introduction

Scenarios are gaining recognition as important tools for environmental planning that can address multiple challenges including community engagement, knowledge integration, conflict resolution, and decision-making in the face of uncontrollable, irreducible uncertainty (Raskin et al. 2005; Shearer et al. 2006). Scenarios provide insights into drivers of change, reveal the implication of current trajectories, and can illuminate options for action through presentation of different and competing visions of the future with vivid, clear and striking differences (Carpenter et al. 2006). Scenarios that link social, economic and environmental values and issues, based on both quantitative modelling and qualitative narratives, have been applied to consider global trajectories and international policy options since the 1970s, and are increasingly used at continental, regional and local scales (Patel et al. 2007; Raskin et al. 2005). In this paper we report on the use of scenarios in local-scale community-based natural resource management (CBNRM) at Mission Beach, a key site of contested land use and high biodiversity values in the Wet Tropics bioregion of north-east Queensland.

Community-based approaches to NRM have been mandated in Australia since 2002 through a program which devolved responsibilities from national and state governments to organisations with community-based governance structures, reflecting global trends to decentralised management across natural resource sectors (Brooks et al. 2006; Robinson et al. 2009; Tacconi 2007). Community engagement methods that build capacity and integrate across institutions, strategies and knowledge systems, are required to achieve social and environmental outcomes within CBNRM in Australia (Auditor-General 2008; Measham 2007; Morrison et al. 2004). CBNRM requires co-design for specific communities and natural resources using participatory tools that ensure integration of science, local and Indigenous knowledge, and recognise the diversity of human values associated with the environment (Berkes et al. 2007; Hill et al. in review).
A rich body of literature exists on effective participatory tools for such integrated CBNRM, including visioning, scenarios, historical trends analysis, throw-away models, participatory mapping and problem co-analysis (Sayer & Campbell 2004; Sunderland et al. 2008). However, these tools are still infrequently applied in biodiversity conservation projects, where the implementation gap remains problematic. More than two-thirds of the biodiversity conservation assessments in the peer-reviewed scientific literature have not resulted in any conservation action (Knight et al. 2008; Sunderland et al. 2008). Scenarios are of particular interest because of their identified potential to address issues like uncertainty, contingency, reflexivity, and disparate conflictual interest groups, which typically plague biodiversity problems (Peterson et al. 2003). Scenarios have previously been applied and proven useful in the Wet Tropics for stimulating dialogue over sustainability in future landscapes, and building social capital for environmental planning broadly (Bohnet & Smith 2007). Our research sought to build on these outcomes through interrogating the identified potential of scenarios within a biodiversity conservation application at Mission Beach within the Wet Tropics bioregion (Hill et al. in review).

The Wet Tropics bioregion is characterised by its tropical climate, spectacular scenery, cultural values, economic productivity and biodiversity whose global significance is recognised through protection of some 900,000 hectares within the Wet Tropics World Heritage Area (WTWHA). Within the region, Mission Beach, the focus of this research, has been identified as a priority area for action on biodiversity conservation, reflecting its significance for a range of biota, and in particular the endangered southern cassowary (Casuarius casuarius johnsonii) (FNQ NRM Ltd and Rainforest CRC 2004; Latch 2007). The goal of our action co-research was to develop, apply and assess the efficacy of scenarios within a CBNRM approach to biodiversity conservation. The scenarios as a tool focused on the identified biodiversity conservation problems of disparate conflictual interest groups and
uncertainty, with two specific objectives: (1) to engage the community; and (2) assist in building a cohesive community vision (Peterson et al. 2003).

Our study is presented in the following sequence. Firstly the literature on scenarios, their history and relationship to CBNRM is reviewed. We then describe the study area, action co-research and assessment methods. The results section follows and includes a description of both the scenario development processes and the actual scenarios. We then discuss the insights in relation to threat, science integration, and simplicity that emerged from our assessment of efficacy. The paper concludes with a consideration of implications of this research for further development and application of scenarios for CBNRM approaches to biodiversity conservation.

Scenarios: history and relationship to CBNRM

The scenario method was first developed in response to problems in forecasting for challenging future issues including nuclear strategy and the impact of technology (Kahn & Wiener 1967; May 1996). Scenarios differ from forecasts by providing plausible sequence of future events, rather than predictions, based on identification and incorporation of key drivers of change (Shearer et al. 2006). Scenarios gained impetus in the 1970s for addressing growing global natural resource problems, characterised by uncertainty, multiple linkages to social, economic and cultural dimensions, including expanding human population and economies (Raskin et al. 2005). Scenario formulation techniques have developed in two main streams: deterministic, quantitative modelling, and qualitative descriptive analyses, with a more recent emphasis on participatory approaches in both (Rotmans et al. 2000). The recent Millennium Ecosystem Assessment (MEA) scenarios are at the forefront of integrated methods, using both rigorous modelling and rich, insightful narrative to address changes in ecosystem services and implications for human well-being (Carpenter et al. 2006).
The MEA was the first substantial exercise to address biodiversity issues through scenarios, and identified a high certainty of global species extinctions and loss of ecosystem services in all cases, with the highest rates of loss occurring in tropical forests and woodlands and warm mixed forest and savannas ecosystems (Peterson et al. 2003; Sala et al. 2005). This application triggered further interest in the development of both the technical biodiversity models (beyond species-area relationships) and the use of scenarios in participatory CBNRM approaches (Cumming 2007; Sunderland et al. 2008). The government-mandated arrangements for NRM in Australia rely on bringing disparate, adversarial interest groups and fragmented institutional arrangements within regional communities together to re-invigorate integrated action on urgent environmental problems (Lockwood et al. 2009; Robinson et al. 2009). A range of approaches are showing promise as tools for achieving this deliberative vision, including large-scale collaborative partnerships (Lane & Robinson 2009), web-based planning support tools (Nelson & Pettit 2004), community surveys (Measham 2007) and capacity-building measures (Robins 2008). Scenarios were identified as one of four key principles to link local communities into government NRM priorities in Indonesia (Wollenberg et al. 2009). Our study’s goal of assessing the efficacy of scenarios as a tool within a CBNRM approach to biodiversity conservation builds on these and other recent initiatives that are applying scenarios in participatory NRM settings (Castella et al. 2005; Enfors et al. 2008; Newton et al. 2009).

Methods

Case study: history and geography

Biodiversity conservation activities at Mission Beach are embedded within a complex planning system aimed at sustainable management of natural and cultural resources in the Wet Tropics bioregion. The formulation and implementation of the Sustaining the Wet Tropics Regional Plan for Natural Resource Management 2004-2008 (Regional NRM Plan)
achieved an unprecedented level of coordination between over a hundred pre-existing plans, while the recent *Far North Queensland Regional Plan 2009-2031* (FNQ 2031 Plan) establishes clear patterns for future urban, rural and residential land uses (FNQ NRM Ltd and Rainforest CRC 2004; Minister for Infrastructure and Planning 2009). Mission Beach is recognised in both plans as a hotspot for action in biodiversity conservation, and is identified as a key site in the Cassowary Recovery Plan (Latch 2007); and the FNQ 2010 Plan (FNQ RPAC 2000). While the 60% of Mission Beach habitat within WTWHA is relatively well-protected, the habitat outside the protected area estate has similar globally significant values, but is subject to ongoing loss, fragmentation and degradation, despite past efforts to reverse this decline. In 2006, a project was therefore initiated to create a new model and tools for a CBNRM approach to biodiversity conservation at Mission Beach (Weston 2006). The project was championed by Terrain NRM, the community-based organisation mandated by Australian government to deliver regional NRM (Robins & Dovers 2007).

The Mission Beach study area of some 24,000 hectares is located approximately 120 km south of Cairns, and is bounded by Maria Creek in the north, the Hull River to the south, the Walter Hill Range to the west and the Coral Sea to the east (Figure 1). Mission Beach now falls within the newly reformed Cassowary Coast Regional Council. It previously lay across the boundaries of the now amalgamated Johnstone and Cardwell Shires. Mission Beach consists of four smaller villages—Bingil Bay, North Mission Beach, South Mission Beach and Wongaling Beach—interspersed with coastal rainforest communities of conservation significance. Four topographic units dominate: lowland plains, coastal ranges, tidal flats and flood plains. Land uses within the area are primarily agricultural, conservation, residential and tourist.

Mission Beach, in common with much of coastal Australia, is currently experiencing development pressure associated with sea-change and tree-change human population
movements (Gurran et al. 2005). Coastal regions have experienced strong human population growth in recent decades, in part due to their aesthetic and environmental attributes, leading to an increase in coastal dwelling construction and economic activity. Demand for residential and tourism development is driven by institutional investors, second-home buyers, and retirees cashing in on high city property values, increasing the expense of low-cost housing (Gurran & Blakely 2007). At Mission Beach, this transformation process is threatening important biodiversity values—in an area less than 30,000 ha, our study site includes 36% of Australia’s bird species, 13% of remaining wet tropical lowland rainforest, and 5% of all Australian vascular plant species (Chenoweth EPLA 2007). It is a significant site for conservation of the endangered southern cassowary, which is threatened by habitat loss, fragmentation and degradation, roads and traffic, dog attacks, hand feeding, diseases and natural catastrophes particularly cyclones (Latch 2007). Cassowary habitat in the Wet Tropics has been extensively cleared with up to two thirds of all lowland habitat cleared across the region and more than 30% in the Mission Beach study area (Kemp et al. 2007; Williams et al. 2008). Approved and pending development applications in the Mission Beach study area continue to threaten cassowary habitat.

Figure 1: Location Mission Beach and surrounds study area

Action co-research

An action co-research approach was used for the study, combining real-world experimentation with bringing researchers and practitioners together in an equitable working relationship for co-generation of new knowledge (Greenwood & Levin 2007; Wilmsen et al. 2008). The term “co-research” signals our attention to situate our approach as collaborative
and empowering, responding to critiques of the diversity within the participatory action research field, and the opportunities to build discursive community practice for NRM (Kesby et al. 2007; Nelson & Pettit 2004). Our study of scenarios was embedded within a larger research project aimed at creating a place-based learning community and dialogic network to co-produce knowledge (Davidson & O’Flaherty 2007; Hill et al. in review). Our core co-research team included three people from Terrain NRM and three scientists. The Mission Beach Habitat Network Action Committee (hereafter committee) provided the forum for a wider dialogue with civil society, industry, scientific and government actors who had decision-making roles at local, regional and national scales.

Our initial scenario-development approach created sets of scenarios that were vivid and different, in keeping with the guidance in the scientific literature (Carpenter et al. 2006; Peterson et al. 2003; Rotmans et al. 2000). We considered a wide range of potential responses to projected possible future events by societies, economies, and ecosystems, aiming for rigour, consistency, transparency and imagination, while moving beyond “business-as usual” formulations. Data sources for scenario formulation and assessment of efficacy included biophysical and social data held by the core co-research team, policies, plans, media releases, annual reports, terms of reference, minutes of meetings, consultation reports, historical essays, and data held by researchers and others represented on the Committee. Participant observation was undertaken by a member of the core co-research team at the community workshop attended by approximately fifty people and in numerous smaller meetings with stakeholders (Evans 1988). The assessment of efficacy of the scenarios used a simple two-stage objective-oriented evaluation approach: (1) determining whether the objectives as originally set out were achieved; and (2) undertaking content analysis and theme identification of the documentary and participatory observation data to interrogate the factors behind the performance of the scenarios (Kumar 2005). Validity of the content
analysis and theme identification was established through convergent triangulation between multiple data sources and the co-research team’s regular conduct of critically reflexive reviews (Robinson 1998).

Results - Scenario development process

Preparing for the participatory scenario development

The scenario development process took place over an 18 month period (Figure 2) beginning with an institutional analysis. Key factors identified as hampering previous biodiversity conservation efforts included: divergent goals of local, State and Federal agencies; insufficient resources for responsible organisations and authorities; diverse aspirations of community groups, individuals, industries and others; gaps in current institutional arrangements; and a lack of coordination and collaboration between institutions (Hill et al. 2008). Stakeholders’ views ranged across a spectrum: (1) facilitating development while relying on existing national parks to protect habitat; (2) increasing regulatory protection for habitat within a clear threshold to limit development; and (3) imposing an immediate moratorium on any further development that impacts habitat. The Queensland government’s post-cyclone cassowary feeding and relocation program highlighted the controversies, with considerable media debate about the choice between ensuring cassowary survival through native habitat protection or through active feeding and management. A number of instruments were proposed to address these divisions: a local action committee, common community vision, values significance assessment, broad community engagement, institutional brokering and science partnerships (Hill et al. 2009).

Figure 2: Scenario development timeline
Development of a common vision between key stakeholders in NRM is recognised as a useful means of overcoming conflicting community perceptions, diverse aspirations and divergent goals (Moore et al. 1999). We considered a number of different approaches to engaging stakeholders in the formulation of such a vision: community-wide visioning, charette, future search conference, strategic perspectives analysis, scenarios and first-cut draft vision workshop (Dale & Lane 1994; Moore et al. 1999; Susskind et al. 1999). Scenarios were viewed as potentially highly salient to the Mission Beach context because of their power in stimulating people to evaluate and reassess their beliefs about the system, thereby encouraging reframing and movement from conflict to cohesion (Peterson et al. 2003; Rydin 2003). Early scoping of scenarios in Mission Beach identified their potential for also integrating biodiversity science associated with thresholds in traffic and other threatening processes.

**Local action committee and community engagement in the scenarios**

The local action committee was first brought together in May 2007 to oversee and guide the planning process, including the formulation of participatory scenarios. Our stakeholder analysis (Reed 2008) identified key actors from a range of sectors resulting in a committee including representatives from three industry, two local government, four state government, one national government, two research and five civil society groups, including one Traditional Owner organization. The committee’s voluntary governance role was to: facilitate community ownership of the process; provide a forum for dialogue between different interest groups; allow information sharing; ensure that there was a strong foundation for implementation partnerships and resourcing; and provide an opportunity for participation in the common aspiration of securing the natural and cultural values of Mission Beach.
Members undertook to liaise with their organisation and networks and subsequently provide advice on behalf of their organisations.

At its first meeting, the committee endorsed a proposal from the core co-research team acknowledging the benefits of a community-based and broadly supported vision, and asking the team to propose a relevant process. Four scenarios were proposed, each reflecting alternate futures that gave differential weighting to biodiversity, agriculture, and residential development options. However, the committee viewed this approach as overly complex and not focussing sufficiently on the key issue of habitat protection. Illustrative examples of comments from members included:

- ‘Too academic, too complicated to ask people to wear different hats for scenarios’;
- ‘just do the business as usual scenario and then ask what we want to do about it’;
- ‘one scenario could show what will happen in the next few years; needs to be simple; use scenarios to paint a picture’.

The committee reached consensus that the purpose of the scenarios should be to support a comprehensive community engagement strategy that would: (1) provide opportunities for people to say what they want and influence decisions; (2) ensure the wider community is informed about the planning exercise; and (3) develop a strong community vision that would attract wider interest and support. The option of participatory development of the scenarios with the community was rejected as time-wasting. Instead, the committee asked the team to develop a revised proposal for the formulation of two scenarios, one depicting the current situation, and one showing business-as-usual (BAU) in 2025. The revised proposal for two scenarios was presented in August 2007, and endorsed by the
committee for use in the workshop. Illustrative examples of comments from various members included:

- ‘Community-based vision very important’;
- ‘BAU scenario is a justification for working together’;
- ‘support just the one BAU scenario; current status is good to compare with BAU’;
- ‘vision should be the focus of the workshop’.

The meeting reached consensus around a simple poster format, including a qualitative statement, a map, relevant photographs, and sets of quantitative data. The core co-research team circulated to the committee members both drafts of the posters and revisions in response to the comments received. In parallel with the scenario development, studies were also undertaken to assess the significance of the identified community values associated with habitat, including Traditional Owner cultural values, aesthetic/lifestyle values, and biodiversity values (Chenoweth EPLA 2007; Falco-Mammone 2007; Hill et al. 2007; The Djiru Traditional Owners and Girringun Aboriginal Corporation 2007).

Selection of participants and structuring the community workshop process

The primary purpose of the community workshop was to initiate the process of developing an agreed vision. Selection of workshop participants aimed to engage key actors from sectors important to biodiversity conservation. The committee drove this selection process, with all members providing lists of possible attendee names, which were circulated for comments and additions, and a final list approved by consensus. Participation in the workshop was by invitation-only with no general public invitation. A post-workshop review by the committee identified that while the selection process had resulted in a good mix across civil society, industry, government, Traditional Owner and research communities, there was under-
representation of youth and women, which in part reflects the demographic profile of Mission Beach residents.

The scenarios were released publicly two weeks prior to the workshop, and received substantial interest from the local media, including a feature in the major regional newspaper. The workshop was carefully structured in two phases. In the first phase, the scenarios were presented along with information about the outcomes of the significance assessment of the identified community values associated with habitat. The workshop was then broken into seven small groups to address the following focus question:

Our goal is to develop a habitat network that is ecologically viable and protects the identified community values. Imagine that by 2025 we have achieved our goal. What does Mission Beach look like then? How does it differ from the BAU 2025 scenario?

In the second phase of the workshop, further information was presented regarding management issues highlighted by the BAU scenario, followed by small break-out groups to address the question:

Again imagine that by 2025 we have achieved our goal of an ecologically viable habitat network that protects the identified community values. What are the prime issues we need to address? What steps did we take to address these issues?

Several members of the committee acted as facilitators at the workshop, guided by a handbook co-produced between the researchers and the committee.

Workshop outcomes

Interrogation of the scenarios elicited a strong reaction from the workshop participants, identifying an overall vision for the future as one in which the BAU scenario does not eventuate. Comments included:
- ‘Nothing we want is connected with the BAU—we want conservation and sustainability with more cassowaries, more habitat corridors, and more production from new markets’;

- ‘BAU can not be realistic—we want a clean green image, with a clearly defined tourism market, common values around sustainability.’

Key themes that emerged in relation to the desired future vision included concepts of sanctuary, of an environmentally-focused way of life, and a strong community achieving sustainability. Detailed steps to achieve the vision were captured in relation to the management of traffic, tourism, residential and infrastructure development, agriculture, management by Traditional Owners, habitat protection and restoration actions, exotic species, institution building and ensuring economic viability. A report on the workshop outcomes was finalised together with the committee, and posted on the Terrain Ltd website in March 2008 (Hill & O'Malley 2008). This report synthesised an agreed Community Vision from the major themes at the workshop which was subsequently endorsed by the committee:

Mission Beach is a sanctuary for wildlife and habitat; its defining feature is a strong human community that acts to protect its special values. Mission Beach is an exemplar of sustainable living, both environmentally friendly and culturally diverse. Mission Beach has a tropical landscape character where urban, farming, and forest communities blend to maintain a harmonious setting with strong visual appeal.

Committee members undertook a review of the community workshop in March 2008. Both process and outcomes were identified as positive, based on feedback to the committee members from their networks, including both workshop participants and the wider community.
The Scenarios

The building of scenarios followed the first five stages of the process outlined by Peterson et al. (2003):

1. Identification of the focal issues
2. Assessment of the current system, key drivers of change/uncertainties, measures of effectiveness, potential thresholds for regime shifts;
3. Identification of possible alternatives;
4. Building of spatially-explicit scenarios; and
5. Analysis of scenarios and recommended policy choices

The key focal issue selected was the committee’s overall goal “to develop a network of natural habitat that is ecologically viable and protects identified community values”. Assessment of the current system identified key drivers of change, with associated measures of relevance to evaluating the impacts of different scenarios (Table 1). Cassowary conservation was recognised as a key indicator and relevant planning focus for consideration of natural and cultural values, and a collaborative focal species approach later emerged within the larger project in response to this recognition (Hill et al. in review).

The initial scenarios rejected as overly complex and academic by the committee are summarised in Table 2. The two scenarios finally developed and used in the workshop were:

1. A scenario reflecting current conditions (Current Scenario); and
2. A scenario modelling conditions in 2025 if current trends in land use and population continue without any specific policy interventions (2025 Business-as-Usual (BAU) scenario).
Table 3 shows how the drivers were measured, together with justification for the measurement approach, for these two scenarios. The original set of drivers was narrowed to focus on issues most salient to a BAU approach. The committee’s requirement for simplicity, clarity and a poster format underpinned the design of the scenario presentation (Figure 3).

Six sets of information were incorporated into an integrated poster layout:

1. A qualitative statement addressing the key drivers identified through the scoping study and exploratory phases of the planning exercise;
2. A set of quantitative data addressing these key drivers;
3. Spatial land-use data in five categories;
4. Analysis of conservation status in terms of (primarily) tenure-based institutional arrangements for protection and restoration;
5. Analysis of regional ecosystems biodiversity status; and
6. Photographic images to illustrate key messages.

Figure 3: Poster mock-ups representing the final two scenarios and format

Table 4 presents the qualitative and quantitative information captured within each scenario, and the spatial pattern of population and intensive land use are shown in Figures 4 and 5. The modelling of a continuation of current trends in population growth and land use change by 2025 identified a number of headline results which included:

- Mission Beach will have around 3,000 more people (a doubling of the current population, highlighted in Figure 5, primarily along the coast);
- An additional 528 more hectares of intensive land use will bring additional dogs, cats and traffic pressures on habitat and clearing of 397 ha of intact remnant vegetation;
• Loss of habitat through clearing will be concentrated on highly-valued coastal vegetation communities, including some 190 ha of already threatened regional ecosystems;

• Mission Beach in 2025 is likely to have more restored and protected habitat areas for its unique plants and wildlife; and

• The tourism industry will be the region’s largest employer, with the traditional industries of agriculture and fisheries declining.

*Figure 4: Current land use*

*Figure 5: Business as Usual (2025) scenario – land use*

The extent to which these changes will impact on biodiversity values was assessed through the analysis of the effect on ecosystem endangerment. Regional ecosystem mapping classifies vegetation communities as endangered, of-concern, and not-of-concern (EPA 2006). The projected land use requirement of residential and visitor populations to 2025 showed a loss of 19 ha of ‘endangered’ and 190 ha ‘of-concern’ regional ecosystems, some associated with road developments, but most attributed to new urban or rural residential developments along the coast. Furthermore, an estimated 858 ha of disturbed vegetation could be cleared through intensification of agricultural practices by 2025 (Williams et al. 2008). There was potential for revegetation of existing clearings in conservation areas (51 ha), but this was exceeded by new clearing for new roads or widening/realignment of existing roads (116 ha).

**Discussion**
Efficacy of the scenarios

The objective-oriented evaluation identified substantial evidence that the objectives as originally set out had been achieved. The community engagement was demonstrated by attendance and participation at the workshop, and positive feedback from stakeholder networks identified through the committee review process. A community vision was developed and endorsed by all the disparate interest groups on the committee and present at the workshop. However, the scenarios formed one relatively small part of a broader engagement strategy using numerous other tools including media releases, direct mail, web-based interaction, public launches and one-to-one meetings. The second part of the assessment therefore focused on analysing factors underlying the contribution of the scenarios to the achievement of these objectives. This analysis identified three factors of importance: (1) the focus on threat; (2) biodiversity science integration; and (3) simplicity in presentation.

Threat

The committee’s original direction to focus on the current and BAU scenarios was based on a perception that BAU would provide a justification for the disparate interest groups to start working together. This proved to be true, with a common strong negative reaction to the outcomes of BAU among all the interest groups present at the community workshop. Use of the BAU in this context has much in common with worst-case scenario planning, a popular approach to military planning (Edwards 1999). Worst-case scenario planning is considered appropriate when threats are urgent, i.e. climate change impacts and security implications (Edwards 1999). The underlying rationale is that an optimistic view of military threat could lead a nation to disaster. Threats are also recognised as a means of mobilising community cohesion. Communities are formed and shaped by opposition, engaging powerful rhetoric’s
of place and ‘home’ which inspire cohesion in resistance (Dalby & Mackenzie 1997). The efficacy of the BAU in highlighting threats to all interest groups was a key factor in its ability to promote the formulation of a cohesive community vision. Given the high threats to biodiversity identified in all global Millennium Ecosystem Assessment scenarios (Sala et al. 2005) and the evidence for an accelerating humanity-driven extinction crisis, further investigation of the application of worst-case scenario-planning in the field of biodiversity conservation is warranted (Bradshaw et al. 2009).

**Biodiversity science integration**

The action co-research approach resulted in the co-design of the scenarios between the committee and the scientists. While the practitioners’ involvement ensured the focus on threat, thereby enabling the scenarios’ contribution to building cohesion, the science contribution built confidence in the headline results from the scenarios. These headline results were widely reported in the media, stimulating considerable interest and providing the foundation for workshop participants to commonly perceive that the threat being faced was real. This common perception of threat reflects lowered community uncertainty about likely impacts of development on biodiversity.

**Simplicity**

The need to reduce complexity and present simple, transparent information was a consistent theme of the committee in relation to the scenarios, and indeed to all aspects of planning. This requirement for simplicity from practitioners intersects with the research community’s goals to integrate increasingly complex quantitative biodiversity and other models with rich qualitative narrative in scenarios (Cumming 2007; Newton et al. 2009). The key characteristics for scenarios sought by the practitioners in our case study—limited diversity,
extrapolations of current trends, unimaginative—are viewed as deficiencies in the scientific literature (Peterson et al. 2003; Rotmans et al. 2000). The importance of simple visual images, and the usefulness of simple forecasting processes in vision making has been previously identified in scenario research (Bohnet & Smith 2007; Patel et al. 2007). Social context clearly should be an important determinant of the balance between rigorous quantitative modelling and qualitative descriptive presentations in scenarios—approaches like the MEA that integrate the two will not always be necessary or beneficial.

Conclusion

Our application of scenarios as tool within a CBNRM approach biodiversity conservation confirmed their relevance and ability to address the uncertainty and contested interests that plague biodiversity problems. The scenarios performed well as a tool for galvanising community engagement and building a cohesive community vision. Two scenarios were developed which demonstrated to the community the implications of BAU trend continuing, including substantial impacts on biodiversity. This threat provoked a common and strongly negative reaction at the community workshop, bringing people together around a cohesive community vision. Science integration within the development of the scenarios built confidence that the threats faced were real.

A need to reduce the number and complexity of scenarios was identified early in the study through the action co-research approach, which resulted in the refinement of scenarios and the production of two simple scenarios. This required simplification highlights a gap between current guidelines about scenarios in the scientific literature, and the practical focus of practitioners. Interrogation of the social context for scenario application should occur
before identifying the balance of rigorous quantitative modelling and qualitative descriptive presentations in scenario formulation.

The scenario technique combined with the participation of stakeholders, proved to be a useful tool for reducing the contested interests which pose a barrier to implementation of biodiversity conservation. It enabled the community to envision a desired common 2025 future. Scenario building and visioning processes which engage community and integrate science can support effective consensus-building in CBNRM approaches to biodiversity conservation, which in turn helps overcome the implementation gap between conservation assessment and real-world conservation action. Further investigation of scenarios, including the use of threat-focused and worst-case approaches, is recommended as a means of building more effective tools for biodiversity conservation.

Acknowledgements

This work has been funded through the Australian Government’s Marine and Tropical Sciences Research Facility (MTSRF), via the Reef and Rainforest Research Centre Limited. This research was conducted in collaboration with the Terrain NRM biodiversity planning team. We would also like to thank Drs Leanne Cullen, Frederieke Kroon and Emma Jakku and Ms Liana Williams for their internal reviews of the manuscript. Thank you also to the Mission Beach community and Mission Beach Habitat Network Action Committee, and all those that attended workshops and meetings.

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Tables

TABLE 1. Primary key drivers of change, measures of these, methods and justification

TABLE 2. Original scenarios proposed to Mission Beach Habitat Network Action Committee (Hill et al. 2007)

TABLE 3. Current and Business-as-usual (BAU) scenarios
<table>
<thead>
<tr>
<th>Key Driver</th>
<th>Measure (final Current and BAU scenarios)</th>
<th>Methods/datasets</th>
</tr>
</thead>
</table>
| Population growth and infrastructure | • Residential population  
• Tourist population  
• Tourist establishments                                               | • *Current* 2006 ABS data; *BAU* modelled from adjusted 2001-06 change rates (Williams *et al.* 2008)  
• As above  
• Mission Beach Tourism (industry data) |
| Human settlement density         | Intensive and other land uses                                                                         | *Current* QLUMP 2004 data; *BAU* modelled from 1999-2004 trends                 |
| Key industries                   | Key employment                                                                                          | *Current* 2006 ABS data; *BAU* modelled from adjusted 2001-06 change rates       |
| Traffic and road management      | • Vehicles per day;  
• cassowary underpasses;  
roadkill hotspots                                                   | *Current* Department of Main Roads traffic data; EPA/QPWS data 1992-2006 on cassowary road deaths at MB; *BAU* modelled from these. |
| Dogs and other invasive species  | • Registered dogs  
• Qualitative statement on invasive species.                                                          | *Current* MB population-equivalent proportion of total dog registrations; *BAU* modelled on 3% growth rate. Qualitative based on development trends. |
<p>| Human interactions with cassowaries | Qualitative                                                                                           | Descriptions based on records of current behaviours (Latch 2007)                 |
| Conservation regulation and funding support | Qualitative and spatially-explicit quantitative                                                           | Qualitative based on current situation and trends in restoration and recovery plans and Djiru people’s aspirations. Table quantifies the areas protected by a variety regulatory/legal tenure (EPA 2006). |
| Natural disasters (e.g. cyclones) | Qualitative                                                                                           | Qualitative observations on effects of Cyclone Larry included                    |
| Conservation effort              | Spatially-explicit quantitative                                                                        | The effect of conservation effort on the biodiversity status of regional ecosystems is presented in a table. |</p>
<table>
<thead>
<tr>
<th>Key drivers</th>
<th>Current situation</th>
<th>Baseline scenario</th>
<th>Backyards and biodiversity</th>
<th>Noosa in the North</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population growth</td>
<td>Very high population growth</td>
<td>Very high population growth 3% continues</td>
<td>Growth levels slowed to 1%</td>
<td>Population tripled or more by 2025</td>
</tr>
<tr>
<td>Human settlement density</td>
<td>Low rise, unit development, strip development emerging.</td>
<td>Medium rise, unit development</td>
<td>Little changed</td>
<td>High density occupancy over all available cleared space</td>
</tr>
<tr>
<td>Key industries</td>
<td>Tourism, farming</td>
<td>Tensions between mass and nature-based tourism; farming declining</td>
<td>Stagnation both tourism and farming</td>
<td>Economy booming as mass tourism replaces nature-based tourism</td>
</tr>
<tr>
<td>Traffic and road management</td>
<td>One scenic road and one 2 lane road, both with cassowary calming</td>
<td>A 2 lane road and 4 lane highway with little or no traffic calming</td>
<td>Same roads but with network of cassowary safety measures.</td>
<td>One scenic road and one 2 lane road, both with network of cassowary safety measures</td>
</tr>
<tr>
<td>Dogs and other invasive species</td>
<td>Little regulation, some limits on dog numbers and licences.</td>
<td>Little changed</td>
<td>Impacts of pets and invasive species minimised through by-laws.</td>
<td>No controls on dogs, cats, weeds etc.</td>
</tr>
<tr>
<td>Human interactions with cassowaries</td>
<td>Frequent feeding of cassowaries.</td>
<td>Frequent feeding of cassowaries.</td>
<td>Heavy fines prevent cassowary feeding.</td>
<td>Frequent feeding of cassowaries.</td>
</tr>
<tr>
<td>Government regulation and funding</td>
<td>Fragmented with limited effectiveness.</td>
<td>Fragmented with limited effectiveness.</td>
<td>Comprehensive and effective with well-funded restoration efforts.</td>
<td>Government regulation remains in place but focus shifts to funding through the market</td>
</tr>
</tbody>
</table>

TABLE 2. Original scenarios proposed to Mission Beach Habitat Network Action Committee (Hill et al. 2007)
<table>
<thead>
<tr>
<th>Market-based instruments</th>
<th>Offsets started with some uptake</th>
<th>Offsets now being widely used in rampant development.</th>
<th>Some offsets but conservation still reliant on government funds.</th>
<th>Offsets now being widely used in rampant development, funded through carbon trading.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural disasters</td>
<td>Cyclone Larry devastated Mission Beach in 2006</td>
<td>A second category five cyclone 15 years after Larry</td>
<td>A second category five cyclone 15 years after Larry.</td>
<td>A second category five cyclone 15 years after Larry.</td>
</tr>
<tr>
<td>Conservation effort</td>
<td>Substantial regulatory but poor incentive-based conservation</td>
<td>Weak effort overall</td>
<td>Very strong regulatory but little incentive-based conservation.</td>
<td>Strong restoration funded through the market.</td>
</tr>
<tr>
<td>Community cohesion and conservation</td>
<td>Poor cohesion</td>
<td>Increased cynicism and division.</td>
<td>Conflict about over-regulation and economic stagnation.</td>
<td>Conflict over development impacts and loss of social fabric</td>
</tr>
<tr>
<td>Drivers</td>
<td>Current</td>
<td>Key qualitative</td>
<td>BAU 2025</td>
<td>Key qualitative</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>----------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Population growth and infrastructure</strong></td>
<td>Residents – 4103</td>
<td>The relaxed lifestyle is under threat from increasing development pressures from</td>
<td>6582</td>
<td>Moderate population growth (over 3%) continues within the faster growing parts of Mission Beach</td>
</tr>
<tr>
<td></td>
<td>Tourists – 1646</td>
<td>tourism and residential units</td>
<td>2541</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tourist establish - 73</td>
<td></td>
<td>129</td>
<td></td>
</tr>
<tr>
<td><strong>Human settlement density</strong></td>
<td>Intensive – 622 ha</td>
<td>Vying for space in the narrow coastal belt of habitat</td>
<td>Intensive - ha</td>
<td>Coastal strip dense sea-change residential location</td>
</tr>
<tr>
<td><strong>Key industries</strong></td>
<td>17% agriculture, forestry and fishing</td>
<td>Trends of declining employment in agriculture and increasing jobs in tourism and construction</td>
<td>5% agriculture, forestry and fishing</td>
<td>Tourism largest employer, construction strong, agricultural and fisheries weak</td>
</tr>
<tr>
<td></td>
<td>12% retail</td>
<td></td>
<td>12% retail</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11% accommodation, restaurants &amp; cafes</td>
<td></td>
<td>25% accommodation, restaurants &amp; cafes</td>
<td></td>
</tr>
<tr>
<td><strong>Traffic and roads</strong></td>
<td>3600 vehicles per day</td>
<td>Traffic calming devices and a faun underpass are being trialled</td>
<td>Additional 5789 cars per day</td>
<td>Higher levels of road traffic.</td>
</tr>
<tr>
<td><strong>Dogs and invasive species</strong></td>
<td>1957 registered dogs</td>
<td>Dogs, pigs and weeds perceived as a threat.</td>
<td>3400 registered dogs</td>
<td>Increasing numbers of dogs, pigs and weeds.</td>
</tr>
<tr>
<td><strong>Government regulation</strong></td>
<td>34% National Park</td>
<td>A significant is protected by legislated tenure conservation status</td>
<td>N/A</td>
<td>A large portion of coast vegetation cleared with more effective enforcement of laws protection some remnant on the coast</td>
</tr>
<tr>
<td></td>
<td>2% Reserves</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.7% Covenants/Nature Refuges</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Natural disasters</strong></td>
<td>Cyclone Larry - 2006</td>
<td>Cyclone related impacts including the death of 15 adult cassowaries in an 18-month period</td>
<td>N/A</td>
<td>Increased frequency of future natural disasters under climate change</td>
</tr>
<tr>
<td><strong>Conservation effort</strong></td>
<td>Regional Ecosystems outside conservation areas – 5618 ha</td>
<td>Restoration plans being formulated to connect isolated fragments of remnant vegetation and improve habitat connectivity,</td>
<td>Regional Ecosystems outside conservation areas – 4712 ha</td>
<td>Green corridors through the rural matrix. Fragmented coastal matrix of wetlands and mixed rainforest and open forest habitats.</td>
</tr>
</tbody>
</table>
FIGURE 1. Location of Mission Beach study area, within Wet Tropics World Heritage Area
FIGURE 2. Scenario development timeline
FIGURE 3. Poster mock-ups representing the two scenarios and format.
FIGURE 4. Current land use
FIGURE 5. Business as Usual scenario – 2025 land use
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