Changing Currents in Marine Biodiversity Governance and Management: Responding to Climate Change

Final Report

Michael Lockwood, Julie Davidson, Marcus Haward, Marc Hockings, Lorne Kriwoken

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October 2013

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ATTACHMENTS

Attachment 1. Project Report #1 on requirements

Lockwood, M., Davidson, J., Hockings, M., Haward, M., Kriwoken, L., Allchin, R. (2011) *Requirements for marine biodiversity conservation governance and management in a changing climate*. Report #1 to the Fisheries Research and Development Corporation. School of Geography and Environmental Studies, University of Tasmania, Hobart.

Attachment 2. Journal Article #1 on requirements

Lockwood, M., Davidson, J., Hockings, M., Haward, M., Kriwoken, L. (2012) Marine biodiversity conservation governance and management: regime requirements for global environmental change. *Ocean and Coastal Management* 69: 160-172.

Attachment 3. Project Report #2 on scenarios

Haward, M., Davidson, J., Lockwood, M., .Hockings, M., Allchin, R., Kriwoken, L. (2012) *Scenarios for marine environments in Eastern Australia and implications for biodiversity*. Report # 2 to the Fisheries Research and Development Corporation. School of Geography and Environmental Studies, University of Tasmania, Hobart.

Attachment 4. Journal Article #2 on scenarios

Haward, M., Davidson, J., Lockwood, M., Hockings, M., Kriwoken, L. (2013) Climate change, scenarios and marine biodiversity conservation. *Marine Policy* 38: 438-446.

Attachment 5. Project Report #3 on reform proposals

Davidson, J., Lockwood, M., Haward, M., Kriwoken, L., Hockings, M., Allchin, R. (2013) *Improving marine biodiversity governance in the context of environmental change: three Australian case studies*. Report # 3 to the Fisheries Research and Development Corporation. School of Geography and Environmental Studies, University of Tasmania, Hobart.

Attachment 6. Journal Article #3 on reform proposals

Lockwood, M., Davidson, J., Haward, M., Hockings, M., Kriwoken, L. (submitted) Governance challenges for marine biodiversity conservation: adapting to environmental change in the Whitsundays, Australia. *Journal of Environmental Management*.

Attachment 7. Summary for policymakers – Whitsundays

Attachment 8. Summary for policymakers – Tweed

Attachment 9. Summary for policymakers – East Coast Tasmania

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1. NON TECHNICAL SUMMARY

2010/532	Changing Currents in Marine Biodiversity Governance and Management: Responding to Climate Change

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Keywords: governance; adaptation; marine biodiversity; climate change.

1.1 Objectives

1. To identify the requirements for adaptive marine biodiversity conservation governance and management in the context of climate change.
2. To assess how well current regimes, with a particular focus on marine protected areas, meet these requirements, and determine any necessary changes.
3. To identify alternatives to current regimes likely to enhance adaptivity and assess their governance and management effectiveness.
4. To offer advice to governance and management authorities on how regime improvements might be achieved.

1.2 Outcomes achieved to date

There is limited capacity in this type of project to generate immediate and demonstrable outcomes. We can only identify influences on ongoing processes as indicators of potential future outcomes.

We identified requirements for adaptive marine biodiversity conservation governance in the context of climate change. These requirements have influenced how governing agency personnel think about governance design. Developing 'best practice' adaptive governance requirements has provided a benchmark that can be used to assess current arrangements and support their reform.

The NSW Marine Estate process and Tasmania's Draft Natural Heritage Strategy have drawn on the project's research workshops and reports.

Proposals for changes to current arrangements have been judged by government agency staff as likely to enhance adaptive capacity, and thereby enhance marine biodiversity conservation outcomes.

We have received positive responses to our academic publications arising from the research, with several colleagues indicating that our work has influenced their thinking about adaptive governance and governance assessment methods.

We expect the influence of our work will continue to be evident, particularly as windows of opportunity for adopting our proposals arise, and as our findings are communicated through our recently-prepared policy advisory notes.

1.3 Need

Australia's marine systems and biota are known to be exposed to a range of likely impacts from human-induced climate change: ocean acidification, warming sea surface temperatures, rise in sea level, increases in cyclone intensities, changes in rainfall and run-off of land-based pollutants and sediments. While some responses of marine species and ecosystems to climate change impacts will necessitate straightforward improvements in current governance and management arrangements, others will pose a challenge and demand a significant rethink. As the implications of a changing climate have not been considered in the design of current arrangements, they are likely to be deficient in essential capacities for supporting and enabling change management. Consequently, research into the form and content of current and potential alternative regimes is critical to securing marine biota and associated dependent values. This research was a response to the need for adaptive governance of marine biodiversity in the context of climate change.

1.4 Results

Adaptive governance requirements

Through an iterative Delphi (expert) process supplemented by scholarly literature, thirty-six requirements for adaptive governance were identified, under seven broad themes. These requirements were used as standards in the assessment of current marine conservation governance performance in the three case study regions – Whitsundays, Tweed and East Coast Tasmania. We found a significant degree of divergence among the three regions (Table S1), with Whitsundays governance significantly more adaptive than the other two cases, and East Coast Tasmania the least adaptive of the three. Key distinguishing elements of the Whitsunday adaptive approach include the depth of knowledge of the social-ecological system; a level of sophisticated leadership demonstrated by achievements on securing political and community support and resources for initiatives to improve reef water quality; establishment of a range of collaborative, inclusive and trusted engagement and advisory processes that contribute to legitimacy of reef management; formal arrangements to secure cross-government coordination; a strong legislative base for the Great Barrier Reef Marine Park Authority that clearly articulates goals and objectives; and processes, such as the Reef Protection Plan, that support the primacy of higher-level biodiversity objectives.

Governance challenges

Governance challenges or deficiencies were identified from the assessments of adaptive capacity. While individual cases have their own specific challenges, mostly related to the level of maturity of current institutional arrangements, we found a degree of overlap among them. Common challenges were: improving knowledge of the social-ecological system; stakeholder communication and information; improving capacity to deal with uncertainty and complexity; preparedness for change; lack of broad public and political support for the values of marine biodiversity; and integration and coordination gaps amongst and across governance levels and agencies. As a response to these challenges, draft governance proposals were developed for each case study.

Drivers of biodiversity outcomes, development of scenarios and effects of our proposals

For each study area, we developed four scenarios for 2030 based on key drivers and critical uncertainties associated with development and climate change. Stakeholder and advisor assessments of the likely effects of our draft proposals on drivers and biodiversity outcomes ranged from strongly positive (e.g., effects on community values and attitudes, runoff from catchments, and tourism impacts), to little or no effect (e.g., climate change impacts, population growth, and tourism demand).

Table S1. Assessment of current governance performance

	Performance		
Requirements theme	**Whitsundays**	**Tweed**	**East Coast Tasmania**
Systems understanding, networks and learning	Good	Neutral	Poor
Values and works views	Neutral	Good	Poor
Institutional forms	Neutral	Neutral	Poor
Leadership and resources	Good	Neutral	Poor
Engagement and decision-making	Good	Good	Poor
Cohesion and direction	Neutral	Neutral	Poor
Governance quality	Good	Good	Poor

Likely effects of reforms on key biodiversity features

Assessments of the likely effects of the proposals on the area and condition of key biodiversity features showed improvements for most biodiversity features of the Whitsundays and Tweed regions. These improvements were evident across scenarios of [high climate change - high development and use of marine and adjacent terrestrial areas]; [high climate change - low development/use]; [low climate change - high development/use]; and [low climate change - low development/use]. The results supported the value of the proposals for improving marine biodiversity outcomes.

Governance pathways
Based on the predicted favourable influences of our draft proposals on marine biodiversity drivers and biodiversity outcomes, as well as the responses of our advisors, final governance pathways and specific recommendations were prepared for each study area, as summarized in Table S2. Although some of our recommendations run contrary to current policy directions, we have endeavoured to identify workable pathways by acknowledging these limitations and restricting proposals to small or medium adjustments to existing arrangements. Nevertheless, we are also aware that adoption of some pathways will be dependent on the emergence of 'windows of opportunity', which in turn will be reliant on champions, sympathetic leadership, political change or crises which function to change mental models and free up resources.

1.5 Conclusions

In the Whitsundays, current governance arrangements exhibit good adaptive capacity in many respects, but attention needs to be given to: knowledge of social drivers; capacity to deal with uncertainty and account for complexity; attitudes that are supportive of marine conservation; coordination between marine and terrestrial planning processes; and integration of conservation and fisheries management. Our proposals address these challenges in terms of institutional forms, leadership and resources, engagement, and cohesion and direction. Our principal concern in the Whitsundays is the enhancement of existing structures and arrangements through selected changes that address these key governance requirements. In particular, the declining condition of key reef ecosystems is a potential crisis that demands an overarching and integrated model of coastal/terrestrial and marine governance.

The Tweed region will experience further changes in marine ecosystems over the coming years in response to climate change and other drivers. These changes can be addressed through ongoing development and implementation of the proposed Marine Estate Management Strategy. Our principal concern in the provision of guidance for Tweed marine biodiversity governance is the enhancement of the new structures and arrangements through measures that improve capacity to deal with uncertainty and account for complexity; build leadership capacities for critical reflection and learning; secure political support and resources; improve stakeholder engagement to overcome public distrust of the marine parks system; and further integrate the work of relevant agencies, especially between conservation and fisheries and between marine and terrestrial planning processes.

Current governance for East Coast Tasmania is sectorally-oriented. Building on linkages within existing legislative responsibilities provides a workable pathway for improvement in inter-agency collaboration. Resourcing a more integrative governance approach will be a challenge, as will be establishing processes, support and funding for environmental monitoring and policy review. In our proposals, we focus on institutional forms and processes, leadership and resources, engagement and decision-making, and cohesion and direction. We argue that the government resource management and environmental agency needs to play a lead role in ensuring commitments to adaptive management are incorporated into key policies, plans support implementation of adaptive management, and processes and resources are targeted to completing the adaptive cycle.

1.6 Need for further work

We recommend:

- ongoing research into the knowledge gap that exists around the influence of governance arrangements on marine biodiversity outcomes, including monitoring the implementation of the new NSW marine estate management regime for lessons in integrated marine management that can be applied in other regions;
- further research into the design of institutional forms for integrated marine governance in the context of environmental change, particularly improving understanding of the most suitable institutional forms for particular governance levels and stages of maturity; and
- further work on identifying the most effective policy intervention points relevant to specific key drivers of biodiversity outcomes.

Table S2. Summary of governance proposals

Requirement theme	Pathway	Specific changes to arrangements	
Institutional forms and processes	Strengthen the existing intergovernmental and governance framework	Strengthen the Great Barrier Reef Intergovernmental Agreement between the Commonwealth and Queensland Governments and in particular, the Ministerial Forum, by requiring that it meets more frequently and by increasing its responsibilities so that it is required to present the Outlook Report directly to the Australian Parliament	Whitsundays
		Require that Outlook Reports include recommended actions and that subsequent reports give an account of the progress and effectiveness of their implementation	
		Strengthen provisions of the Intergovernmental Agreement to ensure collaborative conservation and fisheries management and establish relevant collaborative structures and processes	
Leadership and resources	Strengthen commitment from state government to the existing governance model	Maintain and enhance legislative support for, and political commitment to, existing collaborative programs aimed at building resilience through a strong NGO-led coalition of scientists and conservation stakeholders	
Engagement and decision-making	Improve engagement of local government, natural resource management (NRM) and local advisory bodies	Enact State legislation to encourage the development of collaborative and inclusive local and regional level institutions for integrated terrestrial and marine planning and management	
Cohesion and direction	Improve integration of marine and terrestrial governance, planning and management	Activate provisions of the Sustainable Planning Act 2009 that provide for regions to be designated over local government areas and over Queensland waters adjacent to local government areas	
		Reinstitute a regional planning framework that ensures alignment of land use and coastal planning with NRM planning and the activities of regional organizations	
Systems understanding	Build better understanding of land-sea dynamics and of the drivers of change	Charge the new Independent Scientific Panel with leading investigations into the connections between terrestrial and marine environments in the context of increasing understanding of social-ecological systems	Tweed
Leadership and resources	Provide leadership and resources to realize the proposed integrated approach to marine management	Build a broad consensus around the intrinsic value of marine biodiversity and the importance of marine protected areas to climate change adaptation by expanding engagement through marine advisory committees to include all marine stakeholder groups – commercial/recreational fishers, marine tourism operators, and conservation NGOs	
Engagement and decision-making	Build the capacity of stakeholders through collaborative engagement	Expand collaborative engagement of local communities beyond local marine park advisory committees to involve marine stakeholders such as commercial/recreational fishers, marine tourism operators, conservation NGOs	
Cohesion and direction	Improve integration of marine and terrestrial governance, planning and management	Reinstate regional catchment-based arrangements for NRM and foster integrated planning and management of landscapes and seascapes at the regional scale	
		Work towards the longer-term objective of establishing an integrated coastal and marine management authority with powers to work with CMAs, terrestrial and marine park authorities, and local government	
	Develop a bilateral discourse between Queensland and NSW governance authorities	Establish an informal cross-boundary cooperative group composed of agency personnel, scientists, policy-makers, representatives of organizations such as SEQ Healthy Waterways Partnership, local governments and NRM authorities and charge the group with keeping a watching brief on marine biodiversity developments	
Institutional forms and processes	Build improved integration of agency functions	Build on existing relationships between management agencies and work with NGOs and NRM bodies to increase engagement with and between agencies and industry sectoral groups and peak bodies	East Coast Tasmania
Leadership and resources	State Government to establish a framework to support adaptive management	Empower DPIPWE with a lead role in ensuring that commitments to adaptive management are incorporated into key policies and plans in a manner that supports implementation of the adaptive cycle	
Engagement and decision-making	Maintain and strengthen commitment to adaptive management	Make explicit provision for adaptive management in key policy documents and guidance, including regular reporting and review of achievements (and challenges)	
Cohesion and direction	Focus on integrating marine and terrestrial governance, planning and management	Develop an integrated terrestrial coastal and marine plan that incorporates provisions for sustainability of the coast and protection of biodiversity in coastal habitats in current policy and planning documents	

2. BACKGROUND AND NEED

Australia's marine systems and biota are known to be exposed to a range of likely impacts from human-induced climate change: ocean acidification, warming sea surface temperatures, rise in sea level, increases in cyclone intensities, changes in rainfall and run-off of land-based pollutants and sediments, and modified El Niño Southern Oscillation regimes (Poloczanska et al. 2007). These changes are already having observed impacts, for example, in an increased number of significant coral bleaching events and the poleward shift of some marine species as they adapt to warming sea surface temperatures. Range shifting of species is being observed off south eastern Australia as a result of the southward extension of the East Australian Current (Last et al. 2010).

While some suggested responses of marine species and ecosystems to climate change impacts will necessitate straightforward improvements in implementation of current governance and management arrangements, others will pose a challenge to current conservation norms and demand a significant rethink. As the implications of a changing climate have not been considered in the design of current marine conservation arrangements, they are likely to be deficient in essential capacities for supporting and enabling change management. Consequently, research into the form and content of current and potential alternative conservation regimes is critical to securing marine biota and associated dependent values. This proposal is a response to the need for adaptive governance and management responses to climate change-induced shifts in the structure and composition of marine ecosystems and habitats (Dietz et al. 2003, Hughes et al. 2005, Folke 2007, Young et al. 2007, Ruckelshaus et al. 2008, Mahon et al. 2009).

This project addresses the significant need identified in the NARP to review agility of conservation governance and management. The likely effects of human-induced climate change on marine biodiversity raise questions about the adaptive capacity of current governance and management systems and their ability to support the resilience of marine biota. Governance directly influences whether resilience is undermined, preserved or strengthened (McCook et al. 2007). As noted in a 2009 House of Representatives Standing Committee report: "Given the projected severe impacts on the coastal zone from climate change … and the urgent need for adaptation strategies and resilience building, any hesitation in addressing the issues concerning governance arrangements for the coastal zone could have severe consequences".

Furthermore, the "cornerstone of future success is an adaptive governance structure in which ecosystem management understanding is operationalized in day-to-day activities" (Barnes & McFadden 2008, p. 391). These conclusions point to a need for coherent and adaptive systems of marine biodiversity governance, planning and management. By providing understandings and strategies for this 'future success', we answered the priority NARP question: How will governance for the conservation of marine biodiversity need to change to adapt to climate change impacts? In particular, we developed adaptive governance options for three case study areas – Whitsundays, Tweed and East Coast Tasmania.

3. OBJECTIVES

The objectives of the project were to:

1. identify the requirements for adaptive marine biodiversity conservation governance and management in the context of climate change;
2. assess how well current regimes, with a particular focus on marine protected areas, meet these requirements, and determine any necessary changes;
3. identify alternatives to current regimes that are likely to enhance adaptivity and assess their governance and management effectiveness; and
4. offer advice to governance and management authorities on how regime reform might be achieved.

4. CASE STUDIES AND METHODS

The research focused on three contrasting study areas: the Whitsundays region of the Great Barrier Reef (Figure 1), the Tweed region in northern NSW (Figure 2), and East Coast Tasmania (Figure 3). The process that we used to assess the current governance of marine biodiversity in our three study areas, and to identify pathways to more adaptive arrangements, is summarised in Figure 4. The sequence of these steps was:

1. identification of general requirements for adaptive governance using an expert panel and analysis of the literature;
2. development of social-ecological systems models for each case study region with the help of stakeholder/advisor workshops and analysis of the literature;
3. assessment of current governance arrangements against adaptive governance requirements in stakeholder/advisor workshops;
4. specification of four plausible futures for 2030 using scenario planning, with input from stakeholders and advisors;
5. identification of governance challenges from the assessments in Steps 3 and 4;
6. development of a first version of governance proposals in response to the identified challenges;
7. in stakeholder/advisor workshops, assessments of the acceptability and feasibility of the Version 1 proposals, as well as their likely impacts on:
    a. system drivers and scenarios for 2030; and
    b. marine biodiversity outcomes for 2030;
8. development of Version 2 proposals as a result of the assessment process;
9. assessments of the Version 2 proposals by advisors;
10. analysis of potential system outcomes using Bayesian Belief Networks;
11. analysis of system dynamics using the concept of an adaptive cycle; and
12. a final set of proposals.

Step 1 was completed using an expert panel and analysis of the literature. Steps 2, 3, 4, 7 and 9 were conducted through an iterative sequence of workshops, engagements with scientific and agency advisors and the research team. Steps 5, 6 and 8 were undertaken by the research team.

In Step 7, these Version 1 proposals were subjected to three tests:

1. Comments and critiques of the proposals themselves were sought from stakeholders and advisors in each of the three study areas.
2. The potential effects of the proposals on the plausible scenarios for 2030, and the drivers that shaped these scenarios, were examined with the assistance of stakeholder input.
3. The potential effects of the proposals on biodiversity outcomes under each scenario were identified again with the assistance of stakeholder input.

The second and third tests involved a comparison between the effects of current governance arrangements and the draft proposals. This analysis provided a way of identifying whether our proposals could be expected to make any difference to plausible futures and associated biodiversity outcomes. Clearly there would be no point in pursuing proposals that did not lead to improved outcomes. The second and third tests were therefore used as a filter to test whether it was worth investigating and further developing the proposals. The first test was conducted for all three study areas. As the East Coast Tasmania proposal was largely rejected by stakeholders, we did not progress tests two and three for this study area. All three tests were undertaken for the Whitsundays and Tweed study areas.

Figure 1. Whitsundays study area

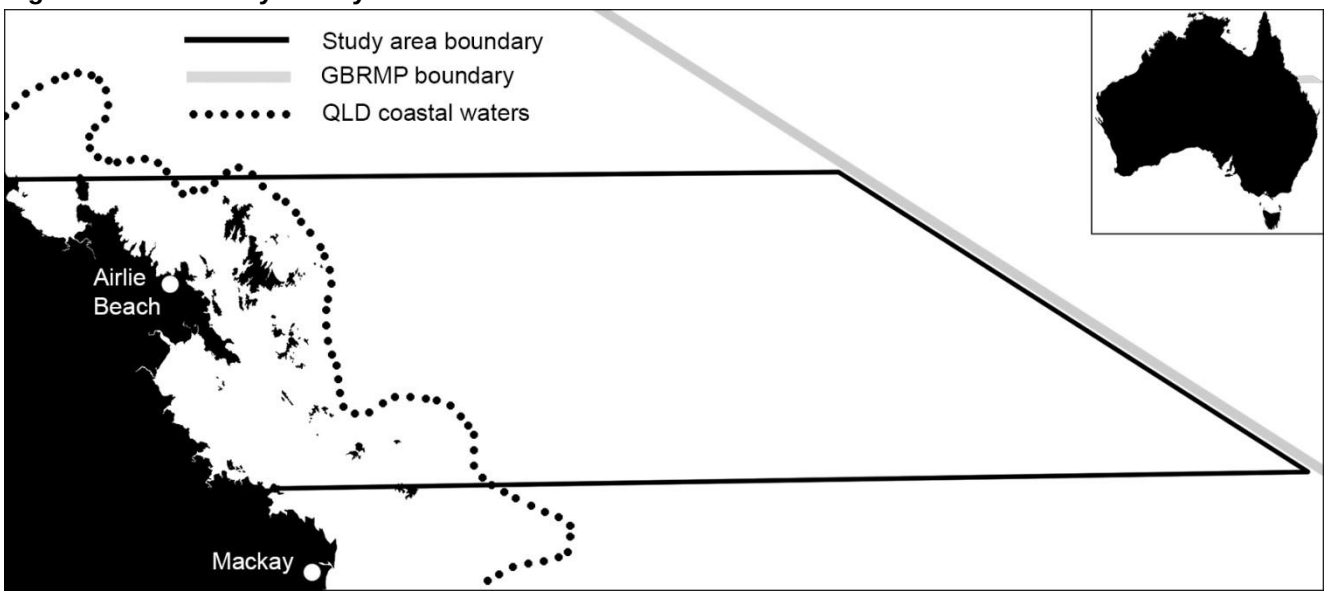


Figure 2. Tweed study area

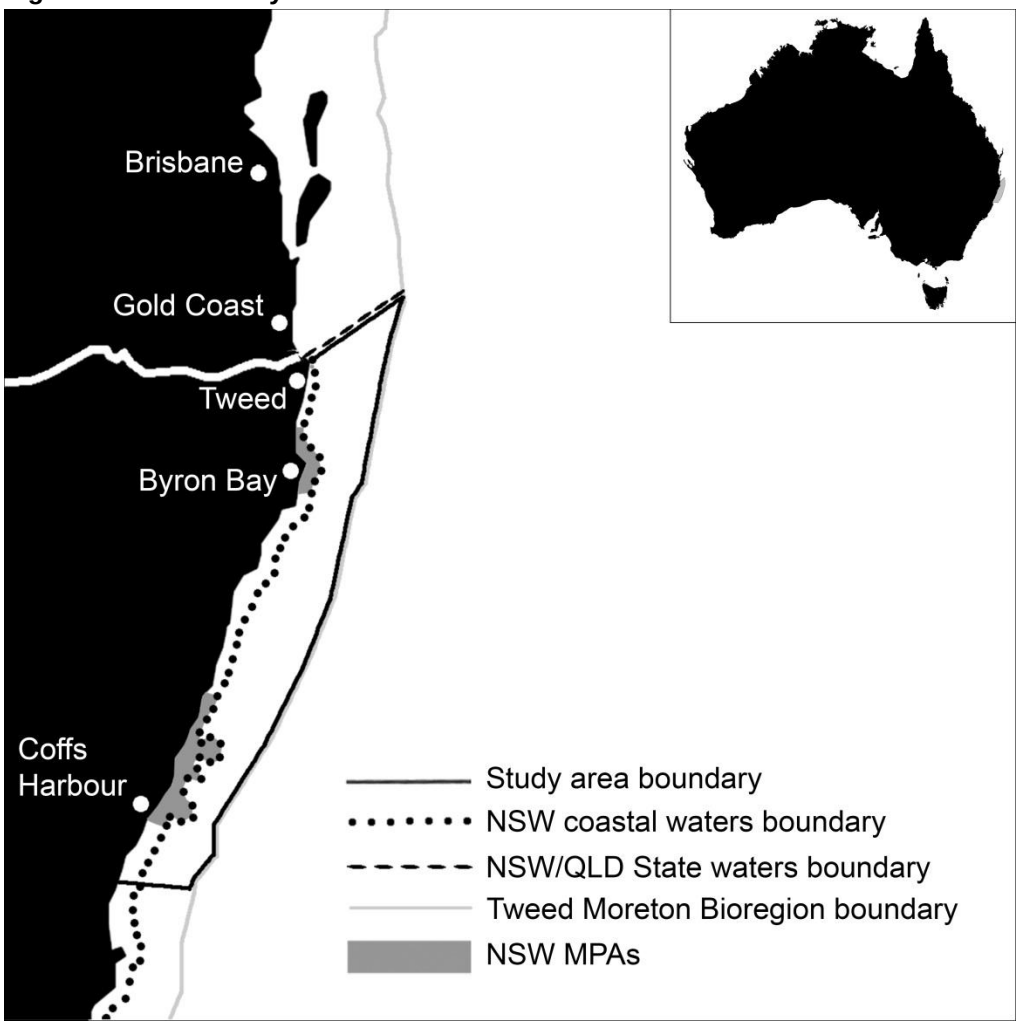


Figure 3. East Coast Tasmania study area

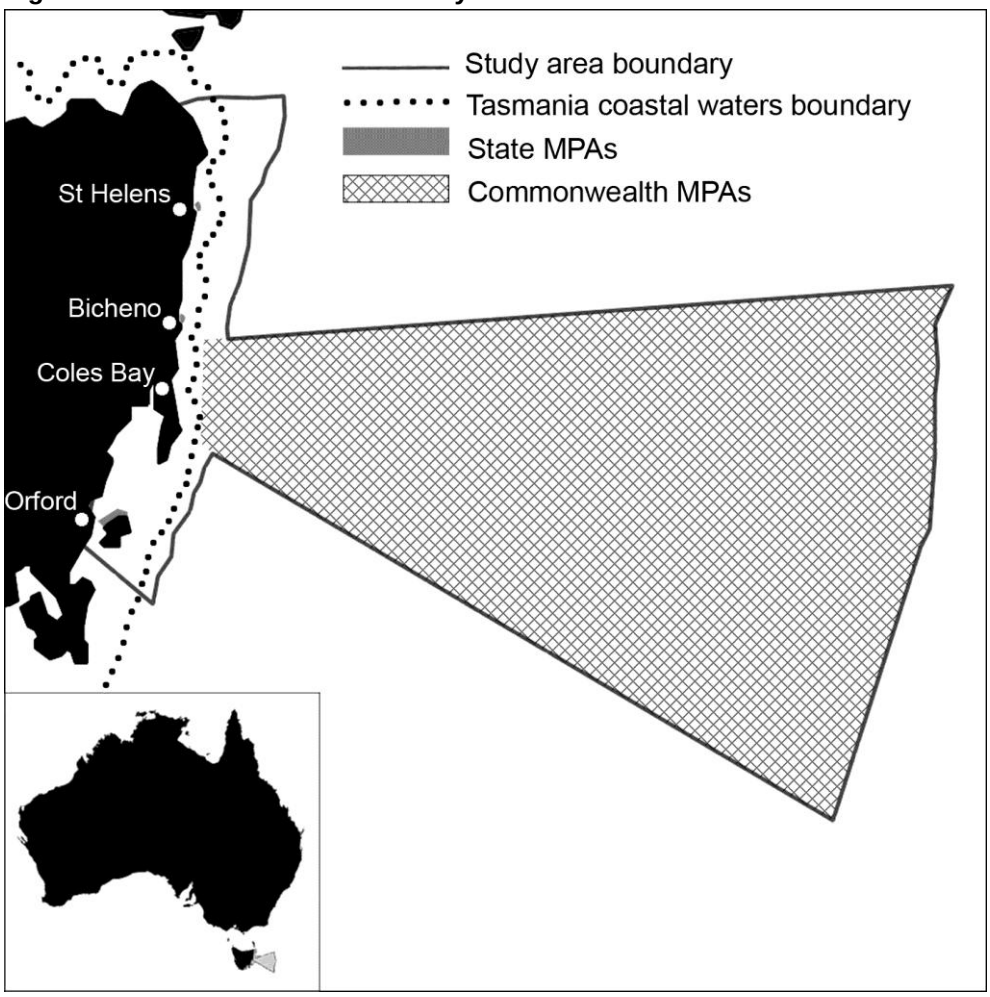
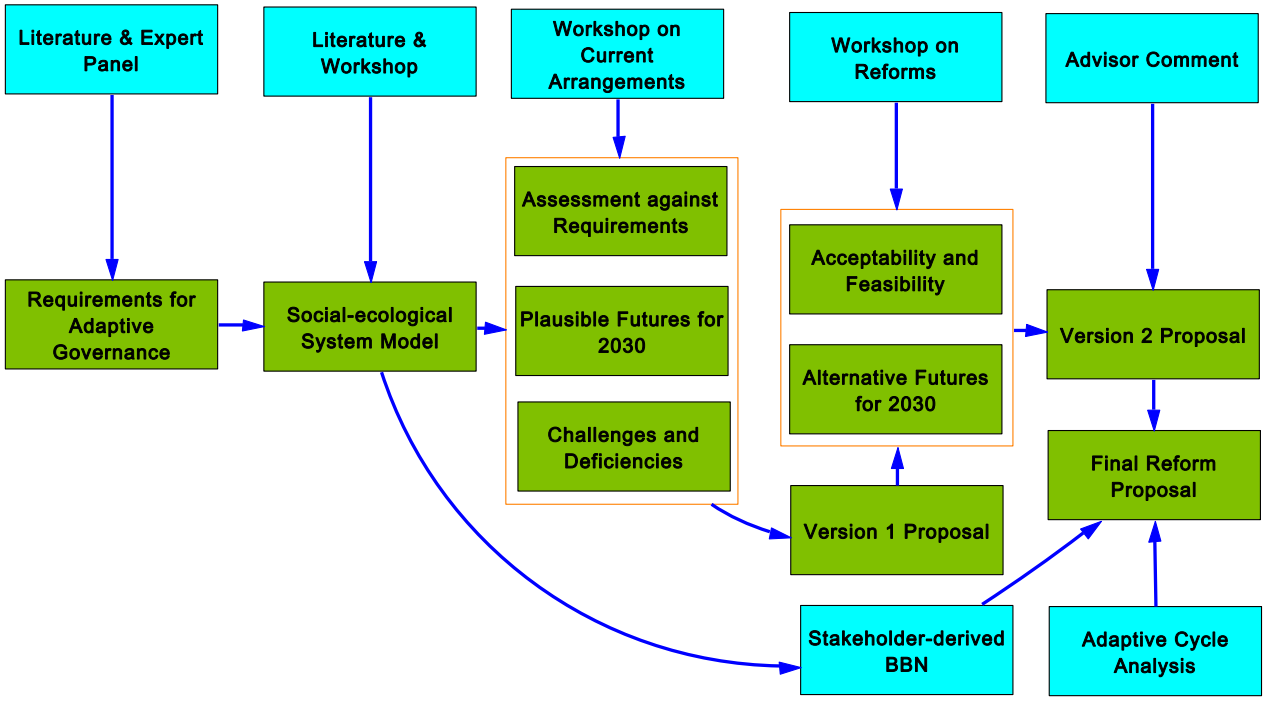


Figure 4. Steps in the process for assessing current governance arrangements and recommending improvements



The analysis of governance models and results from the tests of the Version 1 proposals were used to develop a second set of draft proposals for the three study areas (Step 8). These Version 2 proposals were presented to the project's advisory panels (Step 9). Again, given the response to the Version 1 proposal for East Coast Tasmania, the research team did not present a specific Version 2 proposal to advisors, but engaged in a series of informal conversations with key informants to assist development of the final proposals.

As a complement to the literature and workshop processes, we also:

- operationalised the social-ecological systems models for the Whitsundays and East Coast Tasmania study areas as Bayesian Belief Networks, with probabilities derived from surveys of advisors (Step 10); and
- analysed system dynamics using the heuristic of the adaptive cycle as per Holling (2001) (Step 11).

Undertaking these two additional analyses provided a means of further developing and validating our final set of proposals. These analyses, together with advisors' comments on the Version 2 proposals, were used to formulate a final set of proposals (Step 12).

Our research approach was based in large part on expert opinion, including that elicited through Delphi expert panels, stakeholder workshops, and key informant interviews. The use of expert opinion from scientists, agency managers and experienced stakeholders allowed the team to develop a depth of understanding about emerging issues relating to marine biodiversity and especially those surrounding the complex drivers of environmental change impacts on marine biodiversity. We also subjected our research outputs - adaptive governance requirements, social-ecological systems models, scenarios and reports - to expert/stakeholder scrutiny, thus helping to ensure their reliability.

Expert opinion is often the best information available in complex and emerging areas of investigation. Such opinions can be legitimately considered to be 'data' when they are collected in a quality-controlled manner using one or more of the standard techniques of qualitative research – such as key informant interviews, expert panels and focus groups or workshops (Denzin & Lincoln 2000). For example, the timely input of expert professionals can be used to "inform policy before conclusive scientific evidence becomes available, and to serve as a basis for action when problems are too urgent or stakes too high to postpone measures until more complete knowledge is available" (Krueger et al. 2012, p. 10). The benefits of expert engagement do not only accrue to researchers since prolonged engagement of stakeholders with the research process may also contribute to participants' understanding.

5. RESULTS

5.1 Requirements for adaptive governance

Combining requirements gleaned from the literature and confirmed by the expert panel with the addition panellists' requirements noted above that were not evident in the literature, lead to a set of requirements, organized into seven themes (Table 1). The key elements of these requirements, summarised according to the themes, are as follows. More details are given in Attachments 1 and 2.

Systems understanding, networks and learning

The complexities of ecosystem-based management demand the integration of scientific, social, economic and cultural knowledge. Systems understanding can enhance capacity for collaboration, shared decision making and more effective management planning and implementation. The formation of networks to share information is an appropriate response to dealing with the complexities of unsustainable resource use. Building shared understanding at the science–policy interface is a particular concern in the context of environmental change. Networks affect social processes associated with resource governance such as knowledge transfer, information sharing, consensus building and power relations. Learning is a key component of adaptation, which is one element of managing system resilience. Such learning involves experimentation and innovation to develop and test knowledge and understanding for coping with change and uncertainty.

Values and world views

Individuals' broad attitudes and values shape how actors make and respond to environmental policy options and decisions. Underlying environmental responses are a fundamental set of values and associated attitudes. Collections of attitudes and values are sometimes referred to as 'world views'. World views supportive of an adaptive approach to biodiversity conservation require decision makers and stakeholders to be open to change and new ideas. Decision makers need to be prepared to explore and trial new and innovative processes and methods, and stakeholders in marine biodiversity need to be willing to allow such experimentation to occur.

Institutional forms

Marine biodiversity governance requires an institutional ability to adapt forms and processes in response to new understandings about change drives and their consequences. Institutional adaptability demands that a governing body is intentional in its management of change and can rearrange internal processes and procedures in response to changing internal or external conditions. An organization that is strategic, anticipatory, forward-looking and innovative in approach is in a better position to read the external environment, reduce unexpectedness and surprises, respond to and cope with change, and adapt to changing community needs. Informal 'shadow networks' of nongovernment actors that work outside mainstream processes can play a key role in preparing a system for change. Redundancy and modularity in systems provide buffering or backup capacity in the event of rapid change. Recent trends towards decentralized, polycentric arrangements, where responsible authorities are distributed across multiple scales, exemplify these characteristics.

Leadership and resources

The leadership of key persons is a critical element of adaptive governance. Effective leadership is central to the collaboration among individuals, organizations and government authorities required to address the complex problems of global change and environmental protection. Leadership has a major role in building trust, developing and communicating visions, managing conflict, linking different actors, societal levels and knowledge systems, initiating partnerships, compiling and generating knowledge, and mobilizing support for change. Capacity in the form of human, finance, infrastructure, and knowledge resources is a major component of governing and managing environmental change processes.

Engagement and decision making

Engagement and decision making are central to considering the requirements for adaptive marine biodiversity governance. Inclusiveness is an ethical requirement that all stakeholders have opportunities to participate in and influence decision making processes and actions. Effective participation will advance justice and fairness, thereby fostering legitimacy in decisions. Even without the threat of climate change, marine biodiversity conservation governance and management can be fraught with conflict due to sharp differences in power and values across interested parties. Dealing with conflict is a key requirement for robust governance. Because of the emphases on linking for trust-building, learning and the dynamics of power, adaptive co-management has been proposed as a process for mediating conflict.

Cohesion and direction

Challenges associated with marine biodiversity conservation bridge governance scales (international, national, state, local), sectors (nature conservation, tourism, commercial and recreational fisheries, oil and gas, shipping) and geographic areas (coastal zones, marine bioregions, species' spatial distributions). Institutional fragmentation is a key issue in managing coastal and marine resources. Alignment between organizations and across boundaries (jurisdictional, sectoral and geographic) is required for system coherence in purpose, strategy and action. Coordinating governance structures and management systems at a scale consistent with ecosystem characteristics is a key element in achieving biodiversity conservation objectives. The governability of many marine regions depends in large part on what happens outside their borders, so that interactions and relationships between marine and land-based management authorities are critical for effective management outcomes. Policy networks and partnerships are needed to coordinate policy direction, conservation planning and transboundary management. Broad alignment of goals provides a platform for effective cross-sectoral and cross-jurisdictional management.

Governance quality

Legitimacy is a key element of the ethical and social acceptability of a governance regime. In liberal democratic systems, decisions and actions of governments are typically legitimized through electoral processes, and decisions given weight by legislation, regulation and policy. An organization can also earn legitimacy for more specific responsibilities and actions by gaining approval directly from those affected. Governance bodies may earn legitimacy through their leadership efforts in addressing environmental change, by generating consensus around a vision for marine biodiversity conservation, or through demonstrating effectiveness at producing conservation outcomes. Good governance also requires that authorities exercise powers and fulfil responsibilities in a transparent manner, and that they are accountable for their actions and performance.

Table 1. Requirements for adaptive governance and management of marine biodiversity

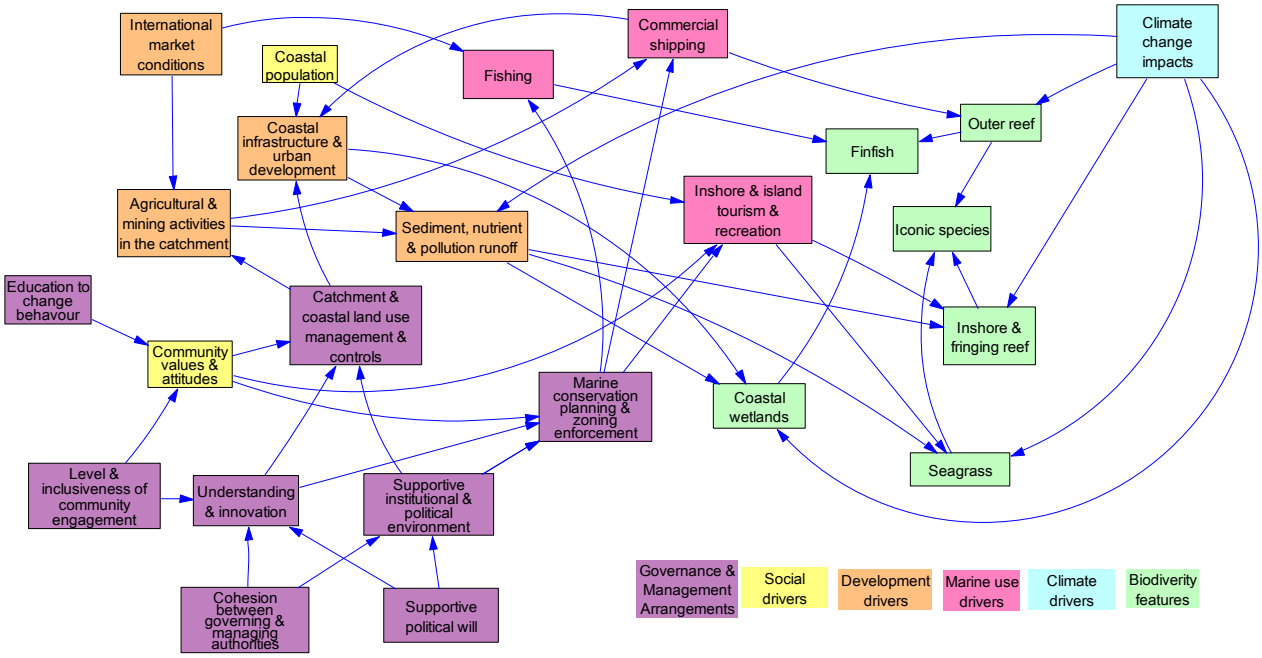
Themes	Requirements
Systems understanding, networks and learning	Actors who understand and work with the structures, functions and values of relevant social-ecological systems
	Decision makers who understand and respond to the possibility of nonlinear or abrupt change and where necessary the need for transformation
	Decision makers who integrate and deploy quality spatial and temporal information (biophysical, social, economic, legal, operational)
	Decision makers who identify, deploy and communicate different sources and forms of information and knowledge
	Trusted systems and processes that provide open access to, and exchange of, information
	Systems and processes through which information and knowledge are rigorously tested
	Systems and processes that enable continuous testing of assumptions, management experiments, and adjustment of interventions
Values and world views	Actors at all levels who are willing to challenge orthodox ways of thinking and doing
	Actors at all levels who are open to change and new ideas
	Decision makers who accept and are able to take account of diversity, complexity and uncertainty
	Decision makers who respect different perspectives, opinions and objectives
	Actors at all levels who value and respect different sources and forms of information and knowledge, including science
Institutional forms	Institutions, systems and processes that are flexible and readily amenable to change
	Levels of redundancy and modularity in institutions, systems and processes, so that system collapse is avoided if one part collapses
	Latent system capacity in the existence of 'shadow networks' that work out of the mainstream and help prepare a system for change through exploration of alternative futures
Leadership and resources	Leaders who encourage innovation and experimentation
	Leaders who recognize, create and take advantage of opportunities provided by change
	Leaders who are committed to critical reflection and learning
	Leaders who work to secure wide political and community support for objectives and actions
	Leaders who work to secure the funds and human resources needed to achieve objectives
Engagement and decision making	Engagement and decision making processes that are inclusive and trusted
	Decision makers and managers who draw on multiple instruments and methods that can plausibly achieve objectives
	Systems and processes that support networks, collaboration and dialogue between actors at all levels
	Actors at all levels who constructively deal with conflict
	Governance and management processes that require consistent and unbiased decision making, recognize human rights and the intrinsic value of nature, and consider intra- and inter-generational distributions of costs and benefits
Cohesion and direction	Systems and processes that align purpose across governance levels and between agencies and sectors (while allowing for variation and diversity)
	Systems and processes that coordinate action across governance levels and jurisdictions and between agencies, sectors and stakeholders
	Systems and processes that support primacy of legitimate higher level objectives over local/sectoral objectives when these are in conflict (with the caveat that this primacy is consistent with fair process)
	Systems and processes that have continuity through retention of institutional memory
	Governors and managers who are committed to achieve long-term purposes
Governance quality	Governors who have formally identified powers that are accepted by actors at all levels
	Systems and processes that recognize multiple sources of legitimacy and provide means to negotiate resolution of conflicts between them
	Governors who are genuinely committed to, and act on, their mandated responsibilities, including where relevant, enforcing compliance with regulations
	Governors and decision makers who act with integrity
	Governance and management purposes, systems, processes, decisions and outcomes that are clear and transparent
	Governors and managers who have clear goals, responsibilities and accountabilities

5.2 Social-ecological system models

Collaboratively developed conceptual social-ecological system models of the study areas provided an understanding of the drivers and influences on the key biodiversity features identified by our scientific advisors. Draft models were developed by the research team from the literature, refined in stakeholder workshops, and each element and relationship validated against published evidence. These conceptualisations underpinned the scenario development process (Section 5.4), as well as the Bayesian Belief Network models developed for Whitsundays and East Coast Tasmania (Section 5.8). Drivers included social, development, marine use and climate-related sources of environmental change.

Across the three cases, stakeholders and advisors rated climate change impacts as a highly important driver of marine biodiversity outcomes and a key uncertainty. Over 80% of Whitsundays and East Coast Tasmania and 40% of Tweed workshop participants gave this rating. Other non-climate drivers rated as highly important included coastal and port development, coastal population growth, impacts of terrestrial activities on water quality, community attitudes and values towards the marine environment, and political climate (see Section 5.1 of Attachment 3). Important governance and management influences on these drivers were also identified. Given our focus on governance matters, the specification of this dimension of the model is more detailed than in previous conceptualisations of social-ecological systems. The structure of the models is exemplified by the Whitsundays model given in Figure 5.

Figure 5. Whitsundays social-ecological system model



5.3 Assessment of current performance against adaptive governance requirements

In this section, we give a comparative overview of how the governance in each case study region performed in relation to the adaptive governance requirements summarised in Section 5.1. Advisors' average ratings of current marine biodiversity performance are given in Table 2. The results show that marine biodiversity governance in the Whitsundays region is significantly more adaptive than the two other cases and that East Coast Tasmania marine biodiversity governance is significantly less adaptive than either of the other cases. While individual regions have their own specific challenges mostly related to the level of maturity of conservation governance, we found a degree of overlap among the regions – challenges around improving knowledge of the social-ecological system; communication and information; improving capacity to deal with uncertainty and complexity and preparedness for change; issues around the lack of broad public and political support for the values of marine biodiversity; and integration/coordination gaps among governance levels.

Table 2. Summary of current performance on adaptive governance requirements

Theme	Responsible actor	Adaptive governance capacities	WS	TW	ECT
Systems understanding, networks and learning	Decision makers	*Knowledge of marine social-ecological systems*	Good	Neutral	Neutral
		Test, use and communicate different sources/forms of information	Good	Poor	Poor
		Continuously adjust or transform interventions	Good	Poor	Poor
Values and works views	Decision makers	*Challenge orthodoxy and are open to new ideas*	Good	Neutral	Poor
		Take account of complexity and uncertainty	Poor	Good	Poor
		Respect different perspectives	Good	Very Good	Poor
Institutional forms	Institutions, systems and processes	*Are flexible and readily amenable to change*	Neutral	Good	Poor
		Have capacity to avoid system collapse if one part collapses	Neutral	Poor	Poor
		Possess latent components that can drive change	Good	Neutral	Poor
Leadership and resources	Leaders	*Take advantage of opportunities provided by change and encourage experimentation*	Good	Poor	Poor
		Are committed to critical reflection and learning	Neutral	Good	Poor
		Work to secure political/community support and needed resources	Neutral	Good	Neutral
Engagement and decision-making	Leaders	*Establish collaborative, inclusive and trusted engagement processes*	Good	Good	Neutral
		Effectively integrate multiple instruments and methods	Good	Very Good	Poor
		Ensure fair decision making	Good	Good	Poor
Cohesion and direction	Systems and processes	*Align and coordinate action across and within governance levels and jurisdictions*	Good	Poor	Poor
		Support primacy of legitimate higher level objectives over local/sectoral objectives	Poor	Neutral	Poor
		Support achievement of long-term purposes and retention of institutional memory	Poor	Poor	Poor
Governance quality	Governors	*Have formally identified powers that are accepted by actors at all levels*	Good	Good	Neutral
		Are committed to their mandated responsibilities and act with integrity	Good	Good	Neutral
		Have clear goals, responsibilities and accountabilities	Poor	Good	Poor
Governance processes		*Are transparent*	Good	Good	Neutral
No. "Very Poor" or Poor" ratings			**4**	**6**	**17**
No. "Neutral" ratings			**4**	**5**	**5**
No. "Good" or "Very Good" ratings			**14**	**11**	**0**

WS = Whitsundays, TW = Tweed, ECT = East Coast Tasmania

Initial data analysis was based on averages of advisory panel members' assessments on a scale of:

-2 = Strongly disagree that the requirement is met, -1 = Disagree that the requirement is met, 0 = Neither agree or disagree that the requirement is met, 1 = Agree that the requirement is met, 2 = Strongly agree that the requirement is met, assessments.

The averages were converted to qualitative performance judgements as follows:

less than -1.3 = "Very Poor", -1.3 or more and less than -0.3 = "Poor", -0.3 or more and less than 0.3 = "Neutral", 0.3 or more and less than 1.3 = "Good", 1.3 or more -= "Very Good".

5.4 Plausible futures for 2030

Step 4 of our research process involved identification of four plausible futures for the each study area out to 2030. These scenarios were used as the basis for the stakeholder assessments of the likely impacts of our first draft reform proposals on the drivers of marine biodiversity and on the focal marine biodiversity features. Four scenario spaces were constructed based on two critical uncertainties identified via stakeholder workshops: climate change and development (Figure 6).

Figure 6. Four scenario spaces based on uncertainty in climate change and development

		DEVELOPMENT & USE	
		High	Low
CLIMATE VARIABILITY AND CHANGE	High end of projections	Scenario 1	Scenario 2
	Low end of projections	Scenario 3	Scenario 4

Table 3 summarizes the implications for biodiversity outcomes under current arrangements for each scenario. More detail on the scenarios, and their implications for biodiversity outcomes under current arrangements, are given in Attachments 3 and 4. As an illustration of the scenario narratives, the main characteristics of each 2030 scenario for the Whitsundays were as follows.

High Development, High Climate Change (Scenario1)

This scenario is marked by advanced development and use with climate change and variability tracking at the higher level. Expanded port facilities and allied infrastructure are impacting on coastal areas. Expansion of shore based infrastructure, road and rail services, and development of coastal centres and population hubs for both coastal industry and activities have occurred. The pace of this development has outstripped the capacity of regional infrastructure to control sediment and pollution loads reaching the marine environment. Recreation and tourism developments in coastal areas have proliferated, with marine based tourism in part due to the attractiveness of the coast to 'fly in – fly out' workers in areas adjacent to mining developments. With temperature and sea level rise tracking at the upper end of predictions, warming waters, increasing freshwater runoff and extreme climatic events, such as storms and surges, are impacting on marine biodiversity. Major changes have been observed in range, spread and density of marine flora and fauna while coral reefs have been degraded by bleaching, changes in ocean chemistry, and destructive storm events. Introduced or migrant species are more common, with some fishing operators taking the opportunity to commercialize these introductions. Changes in habitats associated with expansion of coastal development, together with increasing climate variability and change have rendered ineffective the traditional tools and approaches to marine biodiversity conservation.

Low Development, High Climate Change (Scenario 2)

This scenario is distinguished by lower to moderate levels of development and use of marine and coastal environments, but higher levels of climate variability and change. The damaging impacts of climate change and weather extremes have resulted in reductions in economic activity. Rising costs and scarcity of fossil fuels weakens the cruise ship market reducing the likelihood of ship groundings and oil spills in vulnerable areas. However, tourism remains a significant industry, with increasing interest in nature-based tourism. The slow pace of development has meant that regional infrastructure is able to effectively control sediment and pollution loads reaching the marine environment. Improvements in agricultural practices have reduced pollutant loads and improved water quality. Extreme events such as storm and rain events, warming waters, and increasing freshwater runoff have had major impacts on coastal margins with significant impacts on marine biodiversity. Major changes have been observed in range, spread and density of species of marine flora and fauna.

High Development, Low Climate Change (Scenario 3)

This scenario is characterized by high levels of development and use of marine and coastal areas but relatively low levels of climate variability and change. Alongside the 'sea-change' phenomenon, coastal development and infrastructure continues to expand with increases in ports and allied infrastructure, shore based infrastructure, road and rail services, and size of coastal centres and population hubs to service coastal industries and inland activities. Recreation and tourism in coastal areas have grown substantially, with marine- based tourism particularly popular, resulting in ongoing demands for infrastructure. There is growing pressure to intensify agriculture in drier areas by building dams to drought-proof farms. This has resulted in increased pollutant inputs and reductions in freshwater inputs to adjacent estuaries. These developments have major impacts on the proximate coastal and marine environment. Climate change results in some loss of coral and seagrass, but adaptation responses are minimising impacts on other communities. The fishing industry develops new markets and products to take advantage of range extending species.

Low Development, Low Climate Change (Scenario 4)

This scenario is characterised by relatively low to moderate development and use of the marine environment and adjacent coastal region and by a relatively low to moderate level of climate variability and change. There have been some positive changes in the pollutant load affecting inshore water quality. Coastal towns continue to grow and tourism is a major industry although in tropical waters increases in wind speed change the character of nature-based tourism from smaller vessels to larger cruise ships. Commercial and recreational fishing are important and the idea that sustainable fishing is necessary for food security becomes widespread. Although coastal infrastructures are placing stress on natural values, some areas are buffered by adjoining terrestrial and marine parks and the application of regional and integrated coastal planning strategies leads to more effective controls over coastal development and better protection of coastal habitats, especially saltmarsh, mangrove and seagrass. Along significant parts of the coast, sea level rise has been slow enough to allow wetlands to adapt without being impeded by coastal infrastructure. A shift to more localised scales of development has meant an improvement in social cohesion, important in supporting communities in coping with higher levels of climate unpredictability. There are challenges of ensuring effective implementation of sustainable development initiatives.

Table 3. Summary of biodiversity outcomes for each case study area under each scenario

Development		**Low**	**High**	**Low**	**High**
Climate Change		**Low**	**Low**	**High**	**High**
		Whitsundays			
Coastal Wetlands	Extent	Stable	Small Decline	Small Decline	Moderate Decline
	Condition	Good	Moderate	Good	Moderate
Seagrass	Extent	Small Decline	Severe Decline	Moderate Decline	Near Total Loss
	Condition	Good	Poor	Good	Very Poor
Inshore Reefs	Extent	Moderate Decline	Severe Decline	Severe Decline	Catastrophic Decline
	Condition	Poor	Very Poor	Very Poor	Very Poor
Offshore Reefs	Extent	Moderate Decline	Moderate Decline	Severe Decline	Severe Decline
	Condition	Good	Moderate	Poor	Very Poor
Marine Mammals	Extent	Stabilized	Local Extinctions	Declining	Local Extinctions
	Condition	Vulnerable	Endangered	Threatened	Endangered
		Tweed			
Coastal Wetlands	Extent	Small Decline	Moderate Decline	Moderate Decline	Extensive/Moderate Decline
	Condition	Good/Moderate	Moderate	Moderate/Poor	Poor
Seagrass	Extent	Small Decline	Moderate Decline	Moderate Decline	Extensive/Moderate Decline
	Condition	Good/Moderate	Moderate	Moderate/Poor	Poor
Coral Habitats	Extent	Small Decline	Moderate Decline	Moderate Decline	Extensive/Moderate Decline
	Condition	Good/Moderate	Moderate	Moderate/Poor	Poor
Nearshore Reefs	Extent	Small Decline	Moderate Decline	Moderate Decline	Extensive/Moderate Decline
	Condition	Good/Moderate	Moderate	Moderate/Poor	Poor
Rocky-Intertidal habitat	Extent	Small Decline	Moderate Decline	Moderate Decline	Extensive/Moderate Decline
	Condition	Good/Moderate	Moderate	Moderate/Poor	Poor
		East Coast Tasmania			
Wetlands	Extent	Small Decline	Moderate Decline	Moderate Decline	Extensive/Moderate Decline
	Condition	Good/Moderate	Moderate	Moderate/Poor	Poor
Giant Kelp Forest & Rocky Reefs	Extent	Small/Moderate Decline	Small/Moderate Decline	Severe Decline	Severe Decline
	Condition	Moderate	Moderate	Poor	Poor
Seagrass	Extent	Small/Moderate Decline	Small/Moderate Decline	Severe Decline	Severe Decline
	Condition	Moderate	Moderate	Poor	Poor
Finfish	Extent	Small/Moderate Decline	Small/Moderate Decline	Severe Decline	Severe Decline
	Condition	Moderate	Moderate	Poor	Poor
Iconic species	Extent	Stable	Stable	Variable	Severe declines
	Condition	Declining	Some declines	Declining	Variable

5.5 Governance challenges

In Table 4 we compare the marine biodiversity governance challenges faced by the three case study areas, as identified by the research team, based on qualitative assessments made by workshop participants in relation to the adaptive governance requirements.

As a Great Barrier Reef region, the Whitsundays has had the advantages of being managed by the Great Barrier Reef Marine Park Authority (GBRMPA), which demonstrates “effective” practice in the areas of stakeholder engagement, communication, integration of science into policy decisions, and adaptive management (Day & Dobbs 2013). Although the Authority utilizes a variety of information sources in its decision-making, there are still some gaps in knowledge of the social-ecological system and it could usefully look to incorporating stakeholders in the co-production of knowledge to improve its decisions and their understanding and acceptance among stakeholders. To build a governance system that is supportive of innovation and accepting of change will require integration of local, State and Commonwealth arrangements for land use, coastal and marine planning around issues such as port and coastal development. Expanding the scope of the Intergovernmental Agreement to include bilateral or trilateral agreement across jurisdictions and a commitment to integrated coastal planning and management will be required. Although there is extensive collaboration between State and Commonwealth spheres, significant challenges remain in aligning national and state objectives for the Great Barrier Reef. Some of these challenges were evidenced by changes to the State Coastal Planning Regulatory Provisions in Queensland in 2012 that are regarded by many as likely to negatively affect integrated coastal and marine planning.

The Tweed region is less mature than the Whitsundays in its adaptive governance journey and so faces a greater level of challenge in similar areas. It has significantly greater challenges in reconciling public attitudes to the legitimacy of marine conservation especially among some stakeholder groups. Research has established that opposition to marine conservation in NSW by minority groups is largely related to social rather than economic motivations, including perceived negative impacts of MPAs on family traditions, cultural heritage or social values (Voyer et al. 2012). The intense polarization that has emerged may also be related to competition for resources and a desire to maintain a seat at the political bargaining table. In addition, we noted challenges in improving integration and coordination between relevant agencies, and between government levels (especially, integration of conservation and fisheries management and coordination between marine and terrestrial planning processes). At the time of writing, some of the components required for the promotion of marine biodiversity conservation governance are yet to be established, including the leadership and communication programs, and a shift to an adaptive management regime. We note, however, that recent policy changes and establishment of a Marine Estate Management Authority should overcome some of these concerns (NSW Government 2013).

Biodiversity conservation in the East Coast Tasmania context has even further to go on its adaptive governance journey. Since the idea of marine reserves was first mooted around 1990, establishing such reserves has involved a struggle between fishing and conservation interests so that reserves are few and generally small, with only 1.1% of Tasmania’s immediate coastal waters (excluding Macquarie Island) in no-take areas. It should be noted that Tasmania has more coastline per unit area than any other state. More recently, a plan to protect the waters of the Bruny Bioregion in the south-east ran into extreme opposition and was abandoned. This situation can largely be attributed to the lack of cohesion between marine resource and conservation agencies, shortcomings in understanding the social and economic dimensions of marine systems, conservatism of marine managers, lack of resources and personnel in the conservation agency, lack of political and public support for marine conservation objectives, lack of public trust in the marine parks system with conflicts with fishers (especially with recreational fishers) over resource allocation, and a lack of constructive stakeholder engagement in marine reserves processes. The essential steps to enable the adaptive governance journey include overcoming the polarization of values within the state and the region, building public trust in the marine parks system (a political leadership issue), overcoming capacity problems in the parks sector, creating cohesion between marine resource and conservation agencies, and adoption of an adaptive management regime.

Table 4. Comparison of governance challenges among case study regions

Requirements	Whitsundays	Tweed	East Coast Tasmania
Systems understanding, networks and learning	Improve knowledge of the social-ecological system: • knowledge of less well-understood ecosystem features, such as seagrasses; • knowledge about the social components of the SES Improve information dissemination and establish mechanisms for the co-production of knowledge	Improve knowledge of: • social components of the SES; • mechanisms to integrate social and ecological knowledge Improve communication to stakeholders and use a diversity of information sources in planning and management Adopt adaptive management approaches	Improve knowledge of: • the social and economic components of the SES; • mechanisms to integrate social and ecological knowledge Use a diversity of information sources Adopt adaptive management approaches
World views and attitudes	Foster world views and attitudes that are supportive of marine conservation Improve capacity for flexibility and innovation within the SES Improve capacity to deal with uncertainty and account for complexity	Foster world views and attitudes that are supportive of marine conservation Improve capacity for innovation within the SES Improve capacity to deal with uncertainty and account for complexity (adopt a resilience approach)	Overcome polarization of values Overcome conservatism of marine managers Improve capacity to deal with uncertainty and account for complexity (Resilience approach) – overcome tendency to use uncertainty as an excuse for inaction
Institutions and forms	Overcome rigidities in the system (e.g., in legislation) unsupportive of preparedness for system change Improve response capacity to future change by building safeguards (i.e., redundancy and latency) into the SES	Build preparedness for change Improve response capacity to future change by building safeguards (i.e., redundancy and latency) into the SES	Improve preparedness for change – overcome lack of flexibility, agency silos, too few personnel, limited capacity in MPA sector Improve response capacity by building redundancy and latency into the SES
Leadership and resources		Build leadership capacities for – experimentation, critical reflection and learning, securing political support and resources	Build leadership capacities for – experimentation, critical reflection and learning, securing political support and resources
Engagement and decision-making	Improve 'fairness' and 'transparency' in governance	Improve stakeholder engagement and overcome public distrust of the marine parks system	Improve stakeholder engagement and build public trust in the marine parks system
Cohesion and direction	Further improve integration and coordination between agencies, and between government levels (especially, integration of conservation and fisheries management; coordination between marine and terrestrial planning processes; alignment in interpretation of legislation) Improve retention of institutional knowledge	Further improve integration and coordination between relevant agencies, and between government levels (especially, integration of conservation and fisheries management; coordination between marine and terrestrial planning processes)	Further improve integration and coordination between relevant agencies, and between government levels
Governance quality		Overcome non-acceptance of the legitimacy of marine conservation and address confusion over governments' roles and the rights and responsibilities of citizens Improve transparency in governance and research	Improve legitimacy of higher level biodiversity objectives Overcome the lack of clear goals for biodiversity conservation Improve transparency of reserves processes

5.6 Assessment of Version 1 proposals

Version 1 proposals were developed for each study area as a response to the challenges identified in Section 5.5. These proposals were assessed in terms of stakeholder views on their acceptability and feasibility; anticipated effects on the social-ecological system drivers; and implications for biodiversity outcomes. Details of these proposals and results are given in Sections 4.3 and 4.4 (Whitsundays), 5.3 and 5.4 (Tweed) and 6.3 and 6.4 East Coast Tasmania) of Attachment 5. As an indication of the findings, the proposals and assessment for the Whitsundays study area were as follows.

Whitsundays Version 1 proposals

A. Better integrate marine and coastal planning, including land use and catchment planning with marine planning.

1. Amend the provisions of the Great Barrier Reef Intergovernmental Agreement 2009 to include bilateral commitments to integrated marine and coastal planning.
2. Task the Great Barrier Reef Ministerial Forum with identifying mechanisms to address competing uses of Marine Park resources and consider onshore and off- shore issues that have national and cross-jurisdictional implications (as a means of implementing the recommendations of the 2006 review of the *GBRMPA Act 1975*, which found that managing pressures on marine resources and ecosystems external to the Marine Park cannot be achieved solely through the *Act* and the Authority).
3. Generate a policy platform and associated political will through existing collaborative arrangements such as those offered by the Healthy Waterways Alliance Mackay Whitsunday (which is headed by a panel of senior decision makers from Commonwealth Government, State Government, local government, natural resource management, tourism and industry, and James Cook University scientists).
4. Collaboratively undertake a detailed study of coastal and marine linkages and the potential cumulative impacts of historical land use change in the Pioneer and O'Connell catchments to:
    - identify any important coastal processes and linkages that may require restoration;
    - establish an agreed baseline against which to monitor future change; 9
    - agree on a relevant monitoring program for indicators of the health of coastal and marine systems and preliminary thresholds for action; and
    - guide land use planning in the future.
5. Review provisions of the Mackay, Isaac and Whitsunday Regional Plan and assess their relevance to governance and climate change mitigation and adaptation.

B. Strengthen the processes of, and commitments to, active adaptive management.

1. Embed inclusive and fair stakeholder engagement throughout the adaptive cycle – that is, research and information acquisition, goal setting, strategy development, monitoring and review. This may be fostered through, for example, an expanded role for the Whitsunday Local Marine Advisory Committee (LMAC).
2. Strengthen a learning culture amongst Great Barrier Reef authorities and stakeholders, through an annual Whitsunday coastal management forum to review the results of monitoring, research, planning and development in the region.

C. Further improve integration and coordination between conservation and fisheries management authorities.

1. Amend the provisions of the *Great Barrier Reef Intergovernmental Agreement 2009* to include bilateral commitments to collaborative conservation and fisheries management.
2. Pilot implementation of the expanded agreement in the Whitsundays, with the Great Barrier Reef Ministerial Forum taking a lead role in establishing the necessary collaborative

structures at the regional level (as a means of addressing a finding of the 2006 review of the *GBRMPA Act 1975* that 'The current suite of agreements between governments covering the Great Barrier Reef are high level, fragmented, limited in scope and detail and do not provide an adequate overarching framework for the future').

Whitsundays stakeholder comments on Version 1 proposals

Stakeholders' responses centred on strengthening the Intergovernmental Agreement, principally by recognizing the important role that local government plays in land use planning and coastal management and bolstering the standing and influence of the Ministerial Forum by having it meet more frequently and report directly to the Australian Parliament. Also emphasized were: integrated approaches to coastal and marine planning and management with coordination among and alignment of local government, NRM, the Whitsunday Hinterland and Mackay Bowen Regional Organization of Councils, and the Whitsunday LMAC; the importance of routine system condition and monitoring, especially to generate appropriate data flows, baselines and assessments of investment performance and effectiveness; and promotion of learning through stakeholder participation and co-production of knowledge.

Concern was expressed for the level of influence that recreational fishers exert at the political level and the lack of regulation enjoyed by this sector in contrast to commercial fishing which is perceived to be well-regulated. Because of their influence, it was suggested that recreational fishers could prove a significant impediment to generating the political will necessary to adopt the kinds of reforms being proposed. The overall consensus was that the proposals were likely to improve the marine condition but the importance of ongoing revision and review of the arrangements was strongly emphasized.

Whitsundays effects of Version 1 proposals on drivers and biodiversity outcomes

The likely influences of the proposals on particular social-ecological system drivers from Figure 5, as judged by workshop participants, are shown in Table 5. Table 6 presents an analysis of the effects of Version 1 proposals on the area and condition of significant biodiversity features. The table summarises the differences between current arrangements and the proposals for each scenario (Figure 6). The biodiversity features were identified in the stakeholder workshops. The likely extent and condition of each biodiversity feature in 2030 was assessed under current arrangements, and under the Version 1 proposals.

Table 5. Effects of reforms on the drivers of biodiversity outcomes

Strong positive influence	Some influence	Little or no influence
Sediment, nutrient & pollution runoff	Commercial fishing	Climate change
Agricultural activities in the catchment	Commercial shipping (associated infrastructure)	Commercial shipping (risk from oils spills & groundings)
Coastal infrastructure & urban development	Island tourism & recreation (including cruise ships)	Inshore tourism
Community values & attitudes	Political will	Recreational fishing
		Mining
		Coastal population

Table 6. Effects of proposals on key Whitsundays biodiversity features for each scenario

Climate Change		High	High	Low	Low
Development		High	Low	High	Low
Coastal wetlands	*Area*	⇧	⇧	⇧	⇧
	Condition	⇧	⇧	⇧	⇧
Seagrass	*Area*	⇧	⇧	⇧	⬮
	Condition	⇧	⇧	⇧	⇧
Inshore reef	*Area*	⇧	⇧	⬮	⬮
	Condition	⇧	⇧	⬮	⬮
Outer reef	*Area*	⇔	⇔	⇔	⇧
	Condition	⇧	⇧	⇧	⇧
Finfish	*Population*	⬮	⬮	⬮	⬮
	Health	⬮	⬮	⬮	⬮
Iconic species	*Population*	⬮	⇧	⬮	⬮
	Health	⇧	⇧	⇧	⇧

Key: 0.00 to 0.19 □; 0.20 to 0.99 □; 1.00 and above □.
Based on average judgements of 7 advisors and stakeholders using the following scales:
Area: -2 Large Decline, -1 Small Decline, 0 Stable, 1 Small Increase, 2 Large Increase
Condition: -2 Very Poor, -1 Poor, 0 Moderate, 1 Good, 2 Very Good

Stakeholders considered that the Version 1 proposals would improve the area and condition of coastal wetlands, seagrass and inshore reef across all scenarios. Inshore reef condition and area would be particularly benefitted under the [low climate change - low development] and [low climate change - high development] scenarios. Under version 1 proposals, the health and populations of finfish were judged to be substantially improved under all scenarios. The health and in particular population outcomes for iconic species would also improve under the proposals, with one slightly anomalous result for the [high climate change - low development] scenario. Outer reef outcomes were judged to be little affected by the proposals, with no effect on area and a small improvement to condition under all scenarios. Overall, these results support the utility of the Version 1 proposals for improving biodiversity outcomes.

5.7 Version 2 proposals

In responding to stakeholder assessments of the Version 1 proposal for the Whitsundays, a key focus of the research team was to build on the existing intergovernmental and governance framework; strengthen the Ministerial Forum and associated officials committees; improve and strengthen state government commitment to the existing governance model; and improve integration of local government, NRM organizations and LMACs into this approach. These Version 2 proposals are elaborated in Sections 4.5.1 to 4.5.3 of Attachment 5 and a more detailed account of stakeholder feedback on the Version 2 proposals is given Appendix 6 of Attachment 5.

For the Tweed, our responses to stakeholder assessments of the Version 1 proposal proposals for marine biodiversity governance assessment sought to address mainly issues of deficiencies in intergovernmental arrangements and integrated planning and management. We note the potential to

integrate the terrestrial with the marine by building on existing local engagement through NRM bodies, but concern was expressed that too much is expected of them. Development pressures on local government are increasing, and the existing planning system is unlikely to be able to address non-development issues. Our Version 2 proposals are elaborated in Sections 5.5.1 to 5.5.3 of Attachment 5 and a more detailed account of stakeholder feedback on the Version 2 proposals is given Appendix 6 of Attachment 5.

As with the other two study areas, for East Coast Tasmania it was our intention to have stakeholders identify plausible changes to drivers and associated scenarios, and the consequential changes to biodiversity outcomes, contingent on successful implementation of the proposals. However, the potential value of the proposals themselves were strongly contested by workshop stakeholders, such that data relating to changes to drivers, scenarios and biodiversity outcomes were not useful. We therefore confined our assessment to the general comments made by workshop participants.

At the East Coast Tasmania workshop, stakeholders from different sectors differed in their perception of the problem and, indeed, some questioned whether there was a problem at all. Fisheries representatives did not perceive a problem, possibly because marine resource interests dominate the political agenda. Nor were fisheries representatives convinced about the need for an integrated adaptive management framework, arguing that fisheries regulation already allowed for flexibility. Fisheries managers clearly do not feel any imperative to change and, indeed, intimated that the problem was being manufactured. On the other hand, local government and parks representatives did perceive a problem, but argued that adding ‘another layer of bureaucracy’ was not the solution.

Despite the lack of consensus, several participants suggested that, because of the high level of uncertainty about the impacts of climate change on productivity along the East Coast, further flexibility had to be built into management arrangements. It was suggested that it was important to allow experimentation and innovation, while carefully monitoring progress so that changes could be made if outcomes proved adverse. The importance of finding better ways to align policy and research as part of integrating the best information into an adaptive management framework was also discussed.

From the responses to the Version 1 East Coast Tasmania proposals, it was apparent that there are considerable challenges confronting the development of an adaptive governance regime. There is a need for integration capacity that brings together conservation and resource agencies and gets their managers talking to each other. Until this capacity is developed, nothing will change. We investigated the possibility of an existing entity taking on this integrating role, but found that no such entity exists. Issues of development (and climate change) drivers are important at local government level, with queries around local capacity to address these issues. Integration between Commonwealth and State levels is limited or non-existent. There was recognition that any reform model needs to recognize State agencies’ responsibilities and legislative mandates, while any nexus with NRM bodies would be difficult because they are largely focused on actions and capacity building and lack the benefits of a statutory base. Given these difficulties, we did not develop Version 2 proposals for East Coast Tasmania, but reconsidered our approach (see Section 5.10) based on the stakeholder criticisms and the analyses described in Sections 5.8 and 5.9.

5.8 Bayesian Belief Networks

Bayesian Belief Networks (BBNs) were developed for the Whitsundays and East Coast Tasmania study areas. Given the limited resources available to the project, it was decided not to develop a model for the Tweed study area.

The starting points were the social-ecological systems models developed through integration of current understandings from the literature with stakeholder workshops. The research team used the rationalised set of drivers and influences to develop a matrix showing all possible relationships. Those relationships that were both strongly supported by at least two of the three workshop models, and/or strongly supported in the literature, were selected. To make the Bayesian Belief Networks tractable, the research team simplified the models so that there was a maximum of three ‘parent’ nodes for each ‘child’ node. A definition was developed for each node, and two or three possible states were identified for each node, with associated definitions. A fifth stage, involving a mail survey of workshop

participants was undertaken to estimate conditional probabilities for selected states in each 'parent-child' relationship. Full conditional probability tables were calculated using CPT calculator software. The resulting BBNs were operationalized using Netica software.

As an illustration of the results, Figure 7 is a depiction of the East Coast Tasmania model, and Figure 8 shows the pathways with highest sensitivities for one of the biodiversity features, coastal wetlands. Table 7 gives the outcome probabilities for all the focal biodiversity features assuming the 'business as usual' probabilities for each of the nodes. Table 8 indicates how the outcome probabilities change assuming the 'best case' probabilities for several influential nodes. There are substantial increases in the probability that a biodiversity feature is in 'good condition', with these increases ranging from 42.7% for coastal wetlands, to 22.4% for iconic species. Synergistic effects are evident between 'climate change', 'runoff', 'coastal development', 'urchins' and 'fishing', in that the total independent contribution of each is less than their total contribution when they are considered simultaneously.

Table 7. Probabilities that East Coast Tasmania biodiversity features are in poor, moderate or good condition assuming 'business as usual'

Focal biodiversity feature	Poor	Moderate	Good
Coastal Wetlands	42.0	39.7	18.3
Seagrass	27.8	44.0	28.1
Reef & Kelp	48.6	35.6	15.8
Rock lobster & abalone	46.8	44.6	8.6
Iconic Species	27.3	38.5	34.2
Finfish	47.0	30.4	22.7

Table 8. Probabilities that East Coast Tasmania biodiversity features are in poor, moderate or good condition assuming the 'best case' probabilities for several influential nodes

Improvement *with best case 'Runoff', 'Coastal Development', Climate change, 'Fishing and 'Urchins' (%)*					
Focal feature	**Poor**	**Moderate**	**Good**		
			Joint	Independent	Synergy
Coastal Wetlands	-33.0	-9.7	42.7	31.3	11.4
Seagrass	-18.8	-23.0	41.9	27.4	14.5
Reef & Kelp	-36.6	-1.6	38.2	19.3	18.9
Rock lobster & abalone	-29.3	-5.0	34.2	14.5	19.7
Iconic Species	-13.0	-9.4	22.4	15.2	7.2
Finfish	-27.9	2.5	25.3	19.5	5.8

The research team intends to complete the BBN analysis over the next few months. Our preliminary conclusions are as follows. For both study areas, these conclusions are consistent with the findings from the stakeholder assessments of biodiversity outcomes (Section 5.6), and support the pathways and recommendations given in Section 5.10.

Preliminary conclusions from the Whitsundays BBN are that:

- the most important controllable variable is 'runoff';
- stronger catchment and land use controls are expected to lead to significant improvement in coastal wetlands, seagrass and inshore reef over 'business as usual';
- climate change is a significant influence on all focal features;
- if global action can constrain climate change to the lower end of projections, significant improvements are expected for all focal features compared with 'business as usual'; and
- improvements to education, level and inclusiveness of engagement, understanding and innovation, cohesion between authorities and political will are expected to lead, via stronger marine conservation planning and better management of recreation/tourism and fishing, to small-moderate improvements in seagrass, inshore reef, iconic species and finfish.

Figure 7. East Coast Tasmania BBN model

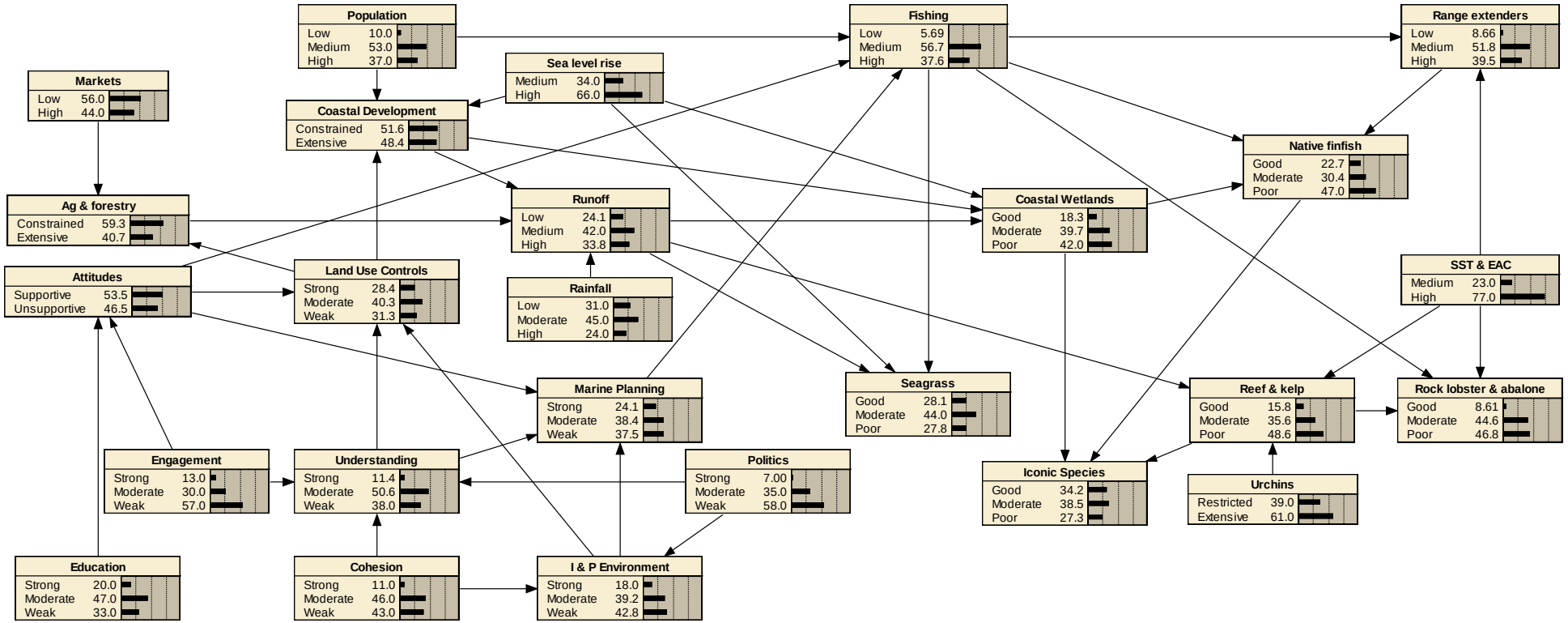
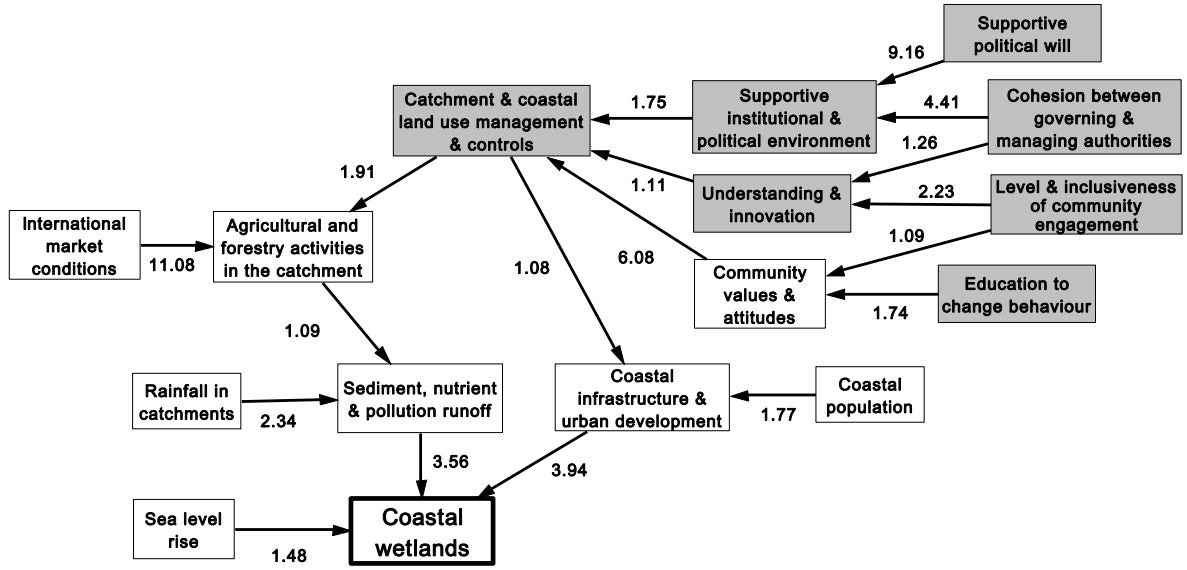


Figure 8. Pathways with highest sensitivities (% entropy reduction) for coastal, wetlands, East Coast Tasmania BBN model (governance influences in grey)



Preliminary conclusions from the East Coast Tasmania BBN are that:

- the most important controllable variable for coastal wetlands and seagrass is ‘runoff’, with coastal development also important for coastal wetlands;
- the most important controllable variable for reef & kelp is ‘urchins’, with ‘sea surface temperature’ and ‘East Australian Current’ also important;
- the most important controllable variable for rock lobster and abalone is ‘fishing’, with the condition of reef and kelp also significant;
- the most important controllable variable for iconic species is the condition of reef and kelp;
- the most important controllable variable for finfish is ‘fishing’;
- stronger catchment and land use controls are expected to lead to significant improvement in coastal wetlands and seagrass over ‘business as usual’;
- strong measures to combat urchins are expected to lead to significant positive outcomes for reef and kelp and associated iconic species;
- strong measures to control fishing are expected to lead to significant positive outcomes for rock lobster, abalone and finfish;
- climate change is a significant influence on coastal wetlands, seagrass and reef and kelp;
- if global action can constrain climate change to the lower end of projections, significant improvements are expected for coastal wetlands, seagrass and reef & kelp compared with ‘business as usual’;
- improvements to education, level and inclusiveness of engagement, understanding and innovation, cohesion between authorities and political will are expected to lead, via more supportive community attitudes and stronger coastal catchment and land use controls and limiting the impact of coastal development, to substantial improvements in coastal wetlands and seagrass over ‘business as usual’; and
- improvements to education, level and inclusiveness of engagement, understanding and innovation, cohesion between authorities and political will are expected to lead, via supportive community attitudes, stronger marine conservation planning and sound management of commercial and recreational fishing, to small improvements in iconic species, finfish and lobster & abalone over ‘business as usual’.

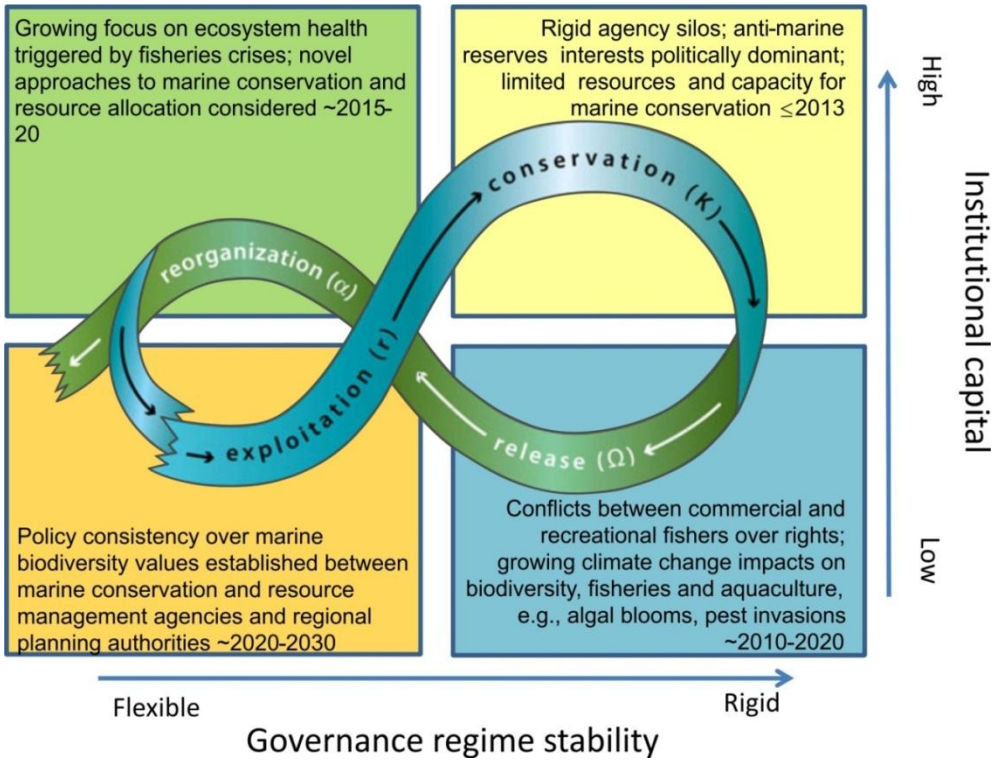
5.9 Assessments of system dynamics

To assist the formulation of pathways to governance improvements, a key concept of resilience thinking, the adaptive cycle, was utilized. The adaptive cycle is a useful heuristic for framing processes of governance regime change, and especially for highlighting the triggers of and barriers to such change. Our main aim in using this conceptual tool is to promote governing approaches that proactively seek to enhance system resilience or, in other words, those approaches that prepare social-ecological systems to respond to unpredictable drivers of change.

An adaptive cycle has three main properties - potential, connectedness and resilience. Potential or wealth sets limits for what is possible. Connectedness determines the degree to which a system can control its own destiny. Resilience determines how vulnerable the system is to disturbances and surprises that can exceed or break that control. As the fundamental unit of adaptive change, the adaptive cycle traces the passage of systems along a front loop of exploitation or growth to consolidation and conservation of resources, then along a back loop of collapse and release of assets followed by their reorganization into new and novel components. The trajectory alternates between long periods of slow accumulation and transformation of resources or wealth (from exploitation to conservation), with shorter periods that create opportunities for innovation (from release to reorganization). During the slow sequence from exploitation to conservation, connectedness and stability increase and capital (wealth) is accumulated. As the system's connectedness increases, it eventually becomes over-connected and increasingly rigid in its control, and therefore vulnerable to disturbance. Such disturbance can trigger disintegration and the release of assets, which are then available to be rapidly reorganized into novel combinations. The reorganization phase can unexpectedly create opportunities for experiments that lead to innovations in the next cycle.

Our analyses of the Whitsundays and Tweed study areas in the context of the adaptive cycle are given in Sections 4.7 and 5.7 of Attachment 5. Here we précis our analysis for East Coast Tasmania from Section 6.5 of Attachment 5. From the perspective of the adaptive cycle model (Figure 9), the trajectory of the current regime is readily represented as a governance regime that is currently anchored in the K or conservation phase with rigid silos between conservation and resource management agencies, marine resource extraction interests having a strong influence on policy, and limited resource allocation and capacity for marine biodiversity protection.

Figure 9. An adaptive cycle for East Coast Tasmania marine biodiversity governance to 2030



Already crises are emerging driven by climate change and development drivers and pressures. Development in East Coast Tasmania is likely to continue with new agriculture activities and increasing viticulture already evident along with continued settlement expansion, but at a lower scale than in Queensland or New South Wales. At the same time, it is important to recognise the potentially strong climate change signal affecting East Coast Tasmania, the role of the EAC in warming ocean waters, impacts of new species (e.g., the long-spined sea urchin *Centrostephanus rodgersii*) and reduced level and extent of colder upwelling that may bring significant changes to marine biodiversity, in addition to the potential of climate enhanced impacts such as algal blooms to affect water quality, seafood safety and economic returns. These trends present a significant challenge for the current marine management model and are likely to result in growing crises in fisheries, with associated conflict between commercial and recreational fishers in the Ω or release phase.

However, these crises are also likely to provide the opportunity for a growing focus on ecosystem health and reconsideration of the sectorally–oriented agencies model in the reorganization or α phase. While climate change impacts are also likely to be significant, much can be done to mitigate and adapt. Addressing ecological threats posed by the long-spined sea urchin by reducing catches of rock lobster (an urchin predator) is expected to reduce the rate and scale of urchin barrens formation. Monitoring of fisheries and aquaculture operations to mitigate impacts of algal blooms could strengthen coordination between sectorally–oriented agencies and increase support for institutionalising integrative processes. In the new r phase, this coordination will be facilitated by development of a policy framework for marine biodiversity conservation; establishing formal commitments; setting high level principles; and formalising key elements of governance. At the same time, this approach will extend and facilitate linkages with local government, and with the Australian government as well as engagement with NRM bodies and community. These developments will establish the foundations for a more integrated and adaptive marine biodiversity governance regime.

Current governance for East Coast Tasmania is sectorally-oriented. Existing strong sectoral management can be seen as both a negative and a positive challenge. Building on linkages within existing legislative responsibilities and ‘mandates’ could provide a workable adaptive governance pathway. Intergovernmental linkages will always be a consideration, particularly in the integration of policy and practices from state waters to Australian Government jurisdiction. Resourcing a more integrative governance approach will always be a challenge, as will be establishing processes, support and funding for environmental monitoring and policy review. Building linkages with land use management policy and practice is crucial to address emergent issues, including catchment land use changes such as more intensive agriculture, grazing and viticulture or housing or industrial development.

5.10 Final proposals

Our final proposals for each of the case study regions are summarized in Table 9, and detailed in Sections 4.7, 5.7 and 6.5 of Attachment 5. Table 9 is organized according to broad themes related to requirements for adaptive governance. Evaluation of the effects of the proposals on biodiversity outcomes indicated:

(i) small but significant improvements in marine condition over the next decade and a half;
(ii) practical constraints such as level of system knowledge, available resources, lack of political support, and existing institutional settings are likely to impose substantial limitations on capacity to adopt more adaptive models of governance; and
(iii) currently available institutional models exhibit varying capacities to support adaptive governance and all require varying degrees of modification to better meet the expected challenges of marine biodiversity conservation out to 2030.

These proposals are directed towards the most important drivers in the SES model presented in Section 5.2. The pathways to adaptive governance summarised in Table 9 address the key drivers in the model. By way of a few examples, for the Whitsundays, improving integration of marine and terrestrial governance, planning and management links to coastal development and population growth drivers, while strengthening commitment from the Queensland Government to the existing governance model links to provision of a supportive political climate and leadership. For the Tweed

region, the importance of leadership and resources in building a broad consensus around the intrinsic value of marine biodiversity and the importance of marine protected areas links to supportive community attitudes as a driver of biodiversity outcomes. For East Coast Tasmania, improved integration of resource and conservation agency functions and a focus on integrating marine and terrestrial governance, planning and management will help with more effective management of the impacts of land-based activities and coastal development on the marine environment.

We acknowledge that some of our recommendations are contrary to current policy directions, and their adoption will be dependent on the emergence of future 'windows of opportunity', which in turn will be reliant on drivers such as champions, sympathetic leadership, political change or crises that function to change mental models and free up resources. For instance, in the East Coast Tasmania case, where the current governance arrangements are seemingly resistant to change, the sectoral marine management model is likely to be challenged by the climate-induced impacts of pest incursions and toxic algal blooms on economically important fisheries and aquaculture. These crises are likely to provide the opportunity for a growing focus on ecosystem health and reconsideration of the sectorally–oriented governance model, showing the need to strengthen coordination between agencies and increasing support for institutionalization of integrative processes.

Although we categorize the current governance regime for the East Coast Tasmania as immature, building on linkages within existing legislative responsibilities and mandates provides a workable pathway to a more integrated and adaptive governance regime. Building linkages with land use management policy and practice will be crucial to address emergent issues, including catchment land use changes such as more intensive agriculture, horticulture, residential or industrial development. Fisheries interests dominate discussion on marine biodiversity in East Coast Tasmania. A transition strategy of a pathway to address marine biodiversity governance must recognize that constraints in resourcing and limited political will currently prevent adoption of the NSW or Whitsunday approaches. A related limitation is that marine biodiversity conservation is framed from a fisheries perspective, and managed within fisheries legislative and administrative frameworks. Responses from agencies and interests focusing on biodiversity conservation suggest that marine biodiversity problems and issues are not adequately recognized. Decline in the region's rock lobster stocks has led to acceptance of radical change, such as cuts in catches to rebuild stock biomass and reduce impacts of long-spined sea urchins, and this may be a harbinger for broader policy change. Positive developments include work on the draft Coastal Policy Framework and draft Natural Heritage framework that include commitments to integrated management and to sustainable use of coastal and marine regions.

Pathways to improved biodiversity governance need to be built in a 'no–frills', bottom-up manner from existing interdepartmental processes, but supported by a new degree of high-level political commitment, such as from Cabinet. Existing Tasmanian government 'crisis' and emergency management models provide a key model here with inter-agency collaboration leading to agreed decision rules and actions. Recent examples include:

- the bushfires response on Tasman Peninsula in 2013 that involved high-level interagency coordination;
- flooding in Georges Bay that resulted in an integrated response to rainfall and pollution impacts on fishing and oyster operations; and
- management of toxic algal blooms for their impacts on shellfish and aquaculture production.

While drivers for crisis management models – urgency, human safety, human health – are not the same as those for marine biodiversity, focusing on positives and gains from such approaches (for example, improved decision-making and engagement processes) shows a practical and potentially effective way forward.

In the Whitsundays, recent achievements in improving water quality could be threatened by a new State policy direction that supports expansion of port infrastructure, dredging and shipping, expanded coastal development, and a shift away from integrated regional planning. Although these developments threaten what has proven to be an effective governance model, the potential listing of the Great Barrier Reef on the List of World Heritage in Danger could present previously unavailable

opportunities to go beyond the present focus on catchment-based water quality impacts and facilitate consideration of an overarching and integrated model of coastal/terrestrial and marine governance.

The strategic assessment that is currently being completed for the Great Barrier Reef World Heritage Area by the Australian and Queensland Governments may provide a means to promote the governance reforms proposed here. The fact that the Strategic Assessment is being developed in two parts (one prepared by the Queensland Government for the coastal zone and the other being prepare by GBRMPA for the Marine Park) is perhaps illustrative of the need for these reforms. While jurisdictional boundaries will remain, a trilateral commitment to integrated planning across local, State and Commonwealth jurisdictions would strengthen marine governance arrangements. Policy pressure that might arise from the World Heritage Committee consideration of the results of the strategic assessment and consideration of possible World Heritage in Danger listing might provide the political impetus that will be needed to pursue these reforms.

Reforms currently being undertaken in NSW have the potential to make significant progress in the direction of an adaptive governance regime for conservation of marine biodiversity in the Tweed region. Our preferred trajectory for the new regime is an establishment pathway based on developing a better understanding of land-sea dynamics, provision of sufficient resources and leadership, developing institutions for collaborative engagement, and improving the alignment between marine and terrestrial governance. Ideally, this trajectory would ultimately lead to an integrated coastal, catchment and marine management authority.

Table 9. Summary of governance proposals

Requirement theme	Pathway	Specific changes to arrangements	
Institutional forms and processes	Strengthen the existing intergovernmental and governance framework	Strengthen the Great Barrier Reef Intergovernmental Agreement between the Commonwealth and Queensland Governments and in particular, the Ministerial Forum, by requiring that it meets more frequently and by increasing its responsibilities so that it is required to present the Outlook Report directly to the Australian Parliament	Whitsundays
		Require that Outlook Reports include recommended actions and that subsequent reports give an account of the progress and effectiveness of their implementation	
		Strengthen provisions of the Intergovernmental Agreement to ensure collaborative conservation and fisheries management and establish relevant collaborative structures and processes	
Leadership and resources	Strengthen commitment from state government to the existing governance model	Maintain and enhance legislative support for, and political commitment to, existing collaborative programs aimed at building resilience through a strong NGO-led coalition of scientists and conservation stakeholders	
Engagement and decision-making	Improve engagement of local government, natural resource management (NRM) and local advisory bodies	Enact State legislation to encourage the development of collaborative and inclusive local and regional level institutions for integrated terrestrial and marine planning and management	
Cohesion and direction	Improve integration of marine and terrestrial governance, planning and management	Activate provisions of the Sustainable Planning Act 2009 that provide for regions to be designated over local government areas and over Queensland waters adjacent to local government areas	
		Reinstitute a regional planning framework that ensures alignment of land use and coastal planning with NRM planning and the activities of regional organizations	
Systems understanding	Build better understanding of land-sea dynamics and of the drivers of change	Charge the new Independent Scientific Panel with leading investigations into the connections between terrestrial and marine environments in the context of increasing understanding of social-ecological systems	Tweed
Leadership and resources	Provide leadership and resources to realize the proposed integrated approach to marine management	Build a broad consensus around the intrinsic value of marine biodiversity and the importance of marine protected areas to climate change adaptation by expanding engagement through marine advisory committees to include all marine stakeholder groups – commercial/recreational fishers, marine tourism operators, and conservation NGOs	
Engagement and decision-making	Build the capacity of stakeholders through collaborative engagement	Expand collaborative engagement of local communities beyond local marine park advisory committees to involve marine stakeholders such as commercial/recreational fishers, marine tourism operators, conservation NGOs	
Cohesion and direction	Improve integration of marine and terrestrial governance, planning and management	Reinstate regional catchment-based arrangements for NRM and foster integrated planning and management of landscapes and seascapes at the regional scale	
		Work towards the longer-term objective of establishing an integrated coastal and marine management authority with powers to work with CMAs, terrestrial and marine park authorities, and local government	
	Develop a bilateral discourse between Queensland and NSW governance authorities	Establish an informal cross-boundary cooperative group composed of agency personnel, scientists, policy-makers, representatives of organizations such as SEQ Healthy Waterways Partnership, local governments and NRM authorities and charge the group with keeping a watching brief on marine biodiversity developments	
Institutional forms and processes	Build improved integration of agency functions	Build on existing relationships between management agencies and work with NGOs and NRM bodies to increase engagement with and between agencies and industry sectoral groups and peak bodies	East Coast Tasmania
Leadership and resources	State Government to establish a framework to support adaptive management	Empower DPIPWE with a lead role in ensuring that commitments to adaptive management are incorporated into key policies and plans in a manner that supports implementation of the adaptive cycle	
Engagement and decision-making	Maintain and strengthen commitment to adaptive management	Make explicit provision for adaptive management in key policy documents and guidance, including regular reporting and review of achievements (and challenges)	
Cohesion and direction	Focus on integrating marine and terrestrial governance, planning and management	Develop an integrated terrestrial coastal and marine plan that incorporates provisions for sustainability of the coast and protection of biodiversity in coastal habitats in current policy and planning documents	

6. OUTCOMES, BENEFITS AND ADOPTION

This project focused on marine biodiversity governance such that it engaged both fisheries and marine conservation sectors. Within these sectors, key stakeholders that have benefitted directly from the research include the Australian, Queensland, New South Wales and Tasmanian governments, particularly marine environmental management and fisheries agencies. Indirect beneficiaries include fishing industries, recreational fishers, and conservation bodies such as catchment management or natural resources management organizations. Feedback from government agency staff and marine stakeholders indicates that changes we have proposed to the current arrangements are likely to enhance adaptive capacity, and thereby enhance marine biodiversity conservation outcomes.

The flow of benefits includes an opportunity to improve governance arrangements in order to reduce the costs of adaptation to changing climate and conservation of marine biodiversity. We identified requirements for adaptive marine biodiversity conservation governance in the context of climate change. These requirements have influenced how governing agency personnel think about governance design. Identification and assessment of key requirements for effective governance provides a yardstick for agencies, industry and community stakeholders to assess performances and to consider potential improvements in management practices.

Ongoing management and policy reform during the life of the project provided both opportunities and constraints. Our assessments of current marine biodiversity governance arrangements have influenced governance improvement processes occurring in Tasmania and NSW. It is clear from work with key advisors that the project was important in helping inform processes in each of the regions, particularly in New South Wales (the Marine Estate management processes) and Tasmania (the Natural Heritage Strategy framework). We recognise that it is difficult to ascribe and directly attribute our research findings to these reforms. The project did, however, provide opportunities for agency partners and officials to incorporate research findings as reported in project technical reports into these initiatives. We expect the influence of our work will continue to be evident, particularly as windows of opportunity for adopting our proposals arise, and as our findings are communicated through our recently-prepared policy advisory notes.

Within the academic community we have received positive responses to the two journal publications arising so far from the research, with several colleagues indicating that our work has influenced their thinking about adaptive governance and governance assessment methods. As these publications become more widely cited, and with the recent submission of another article, and plans for two more, it is reasonable to expect that the legacy of the project will continue to grow.

A summary of the relationships between the broad project outputs, potential impacts and outcomes to date is given in Table 10. These outcomes continue to be strengthened by dissemination of publications arising from the project (see Appendix 2). We expect the influence of our work will continue to be evident, particularly as windows of opportunity for adopting our proposals arise, and our findings are communicated through our recently-prepared summaries for policymakers.

Table 10. Project outputs, potential impacts and outcomes

Output	Potential impact	Outcomes
Requirements for adaptive marine biodiversity conservation governance in the context of climate change	Improved design of adaptive governance and management regimes	Our adaptive governance requirements provide a benchmark for assessing current arrangements and supporting their reform. Stakeholder feedback indicates that the adaptive governance requirements have influenced how governing agency personnel think about governance design.
Assessment of current marine biodiversity governance and management regimes	Agency understanding of current capacity for adaptive governance and recognition of where reform is needed	NSW's Marine Estate process and Tasmania's draft Natural Heritage Strategy have drawn on the project's research workshops and reports.
Changes to current regimes that are likely to enhance adaptivity and thereby enhance marine biodiversity conservation outcomes	Agency adoption of an agenda for governance reform designed to enhance adaptation to environmental change	Proposals for changes to current arrangements have been judged by government agency staff as likely to enhance adaptive capacity, and thereby enhance marine biodiversity conservation outcomes.

7. FURTHER DEVELOPMENT

We recommend ongoing research into the knowledge gap that exists around the influence of governance arrangements on marine biodiversity outcomes. Learning from this work can be incorporated into governance reviews and, where necessary, reforms. Our work demonstrates the power of a qualitative, stakeholder-driven approach, based on social-ecological system thinking and an outlook orientation, for undertaking such research. In particular, we suggest monitoring the experiment in integrated marine management provided by implementation of the new NSW marine estate management regime. Lessons can be drawn from the regime's implementation and applied in other regions. A particular focus of future work should include assessments of the main institutional arrangements – the Marine Estate Management Authority, the Expert Knowledge Panel and the Marine Estate Management Strategy – for their effectiveness in building resilience of marine ecosystems and marine social-ecological systems as an adaptive response to climate and other global change drivers.

We provided an outline of the range of forms available to designers of marine governance institutions. We suggest that there is scope for further research into the design of institutional forms for integrated marine governance, particularly in a context of highly dynamic global change. By improving our understanding of the most suitable institutional forms to apply in institutional design for adaptive governance, this institutional analysis would thereby improve the fitness of certain forms for particular stages of governance maturity and governance level, and so make for better biodiversity outcomes. A key question to explore is: how can flexibility be incorporated into institutional design to maintain optimum resilience of the social-ecological system, while also providing an appropriate level of certainty?

While the process of developing social-ecological systems models involved identification of key drivers of marine biodiversity outcomes, the scope of the project did not allow us to explore further their policy implications and possible intervention points. In order to better manage their influence on marine system resilience, we suggest that further work be undertaken to identify the most effective policy intervention points relevant to specific key non-climate drivers.

8. CONCLUSION

The project application stated that the research would:

- specify the requirements for adaptive and effective marine biodiversity conservation governance and management in the context of climate change;
- identify and assess alternatives to the current regimes that are likely to enhance adaptivity; and
- recommend how the most effective regime or regimes can be implemented (including how barriers, limits and costs can be addressed).

The project has delivered on these outputs.

The twelve-step process outlined in Section 4 proved to be an effective means for identifying pathways to adaptive governance and associated reforms to current arrangements. Joint deployment of a social-ecological system model, requirements and scenarios delivers a qualitative assessment of adaptive capacity and identification of pathways for improvement. The social-ecological system model provided us with the means to identify where interventions could be made; the requirements provided us with a means of identifying what improvements needed to be made; and the scenarios provided us with a choice of pathways to potential governance improvement.

Two-stage scenario planning provided evidence of potential governance regime outcomes and reform effects. The benefit of the two-stage scenario approach was that it allowed exploration of marine biodiversity futures if the current regimes remain in place, and also to anticipate possible outcomes for marine biodiversity if our proposed changes were successfully implemented. This comparison of outcomes was effective in demonstrating the potential value of the reform proposals.

A further iteration of revised proposals and feedback from advisors was followed by final sets of proposals that included specific sets of recommendations for each case study area and suggested pathways for their implementation (see Table 9). Informed by the governance assessments against requirements, our prognoses for marine biodiversity governance in each region are as follows.

In the Whitsundays, current governance arrangements exhibit good adaptive capacity in many respects, but attention needs to be given to knowledge of social drivers; capacity to deal with uncertainty and account for complexity; attitudes that are supportive of marine conservation; coordination between marine and terrestrial planning processes; and integration of conservation and fisheries management. Our principal concern for the Whitsundays is the enhancement of existing structures and arrangements through selected changes that address these key governance requirements. In particular, the declining condition of key reef ecosystems is a potential crisis that demands an overarching and integrated model of coastal/terrestrial and marine governance.

The Tweed region will experience further changes in marine ecosystems over the coming years in response to climate change and other drivers. These changes can be addressed through implementation of the proposed Marine Estate Management Strategy and its ongoing development. Our principal concern in the provision of guidance for Tweed marine biodiversity governance is the enhancement of existing structures and arrangements through measures that improve capacity to deal with uncertainty and account for complexity; build leadership capacities for critical reflection and learning; secure political support and resources; improve stakeholder engagement to overcome public distrust of the marine parks system; and further integrate the work of relevant agencies, especially between conservation and fisheries and between marine and terrestrial planning processes.

Current governance for East Coast Tasmania is sectorally-oriented. Building on linkages within existing legislative responsibilities provides a workable pathway for improvement in inter-agency collaboration. Resourcing a more integrative governance approach will be a challenge, as will be establishing processes, support and funding for environmental monitoring and policy review. We argue that the government resource management and environmental agency needs to play a lead role in ensuring commitments to adaptive management are incorporated into key policies, plans support implementation of adaptive management, and processes and resources are targeted to completing the adaptive cycle.

From the project, it is evident that the current performance on adaptive governance requirements and the scale of the challenge to move towards an adaptive governance regime is related to general governance capacity and maturity. Thus, for the governance challenges imposed by environmental change, variations in governance maturity have significant implications for the uptake of more adaptive models of governance. Although flexible institutional arrangements and processes are an important component of an adaptive governance regime, they must be suited to the maturity of the regime in question. In making our reform proposals we considered their feasibility, and for that reason we largely restricted our recommendations to small or medium adjustments to existing arrangements, including activating the provisions of extant legislation.

It is also evident that the scale of the challenge to move towards an adaptive governance regime is significantly greater for those systems where there are substantial practical constraints on the adoption of such a regime. Deficiencies in factors such as the level of system knowledge, available resources, political support or leadership, and existing institutional settings may impose substantial limitations on adopting more adaptive governance models. All Australian states could well look to the example of the Whitsundays case, and GBRMPA governance arrangements more generally, in designing such regimes. Key distinguishing elements of the Whitsundays adaptive approach include the depth of knowledge of the social-ecological system; a level of sophisticated leadership demonstrated by achievements in securing political and community support and resources for initiatives to improve reef water quality; establishment of a range of collaborative, inclusive and trusted engagement and advisory processes that contribute to legitimacy of reef management; formal arrangements to coordinate cross-government interaction; a strong legislative base for the GBRMPA that clearly articulates goals and objectives; and processes, such as the Reef Protection Plan, that support the primacy of higher level biodiversity objectives. These components comprise the basic framework for addressing the complex challenges of marine biodiversity impacted by climate change.

In transitioning towards an adaptive regime, Tweed authorities might aspire to adopt provisions from the Great Barrier Reef institutional setting such as design for collaborative, inclusive and trusted partnership processes, and alignment and coordination arrangements across government levels through formal agreements. Authorities responsible for East Coast Tasmania could learn lessons from the NSW experience, which is closer in scale and maturity. Relevant learnings include stakeholder processes that have generally allowed a wide diversity of views to be presented, as well as the recent proposed changes that involve a more integrated approach to marine estate management. These changes include the establishment of an authority comprising senior representatives from all agencies whose planning and management activities impact the marine environment, and an expert knowledge panel to provide advice across the social, ecological and economic sciences. Consideration could also be given to adoption of an adaptive management approach, a threat and risk management framework to prioritise management action, and a protocol to effect coordination between state and Commonwealth authorities.

Our suggested strengthening of Great Barrier Reef intergovernmental arrangements could be broadly disseminated through intergovernmental consultative arrangements so that other states can draw on the lessons to inform their efforts at building integrated governance approaches and hence improve their capacity to deal with the complex challenges of climate change impacts and their interaction with other global change drivers.

Beyond 2030, transformations in governance will almost inevitably need to be considered to cope with the changes in marine and coastal ecosystems that existing drivers will produce. For example, although significant advances have been made in improving inshore water quality in the Whitsundays, potential expansion of port infrastructure, shipping, and coastal developments provide ongoing governance challenges. A [high climate change / high development] scenario, which is where current trends are tracking, carries the potential for unravelling existing governmental relationships. Crises such as that brought on by the World Heritage Committee's 2012 investigation of the state of conservation of the Great Barrier Reef World Heritage Area, which triggered a major strategic assessment by the Australian and Queensland Governments, may open a window of opportunity for an overarching and integrated model of coastal/terrestrial and marine governance.

For the Tweed region, further anticipated strengthening and inshore expansion of the East Australian Current and upward trending population growth have implications for authorities' management of coastal and island habitats. While the new Marine Estate Management regime augurs well, its ongoing development leading to a fully integrated coastal, catchment and marine management regime will be a necessary progression to be able to cope with the complex and interacting impacts of these drivers.

For East Coast Tasmania, current crises of marine biodiversity and marine production triggered by a combination of primary and secondary climate change impacts (including warming sea temperatures, marine pest invasions, and toxic algal blooms) are likely to be compounded by further ocean warming and development pressures on coastal and marine ecosystems. While our proposals were limited to approaches that might supersede the existing sectorally-oriented model and increase support for institutionalising integrative processes, we conclude that to cope with current and future crises, a policy framework for integrated and adaptive marine biodiversity governance regime is required in the longer term.

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APPENDIX 1. INTELLECTUAL PROPERTY AND PUBLICATIONS

The intellectual property generated by the research is embodied in the following publications.

Journal articles

Lockwood, M., Davidson, J., Hockings, M., Haward, M., Kriwoken, L. (2012) Marine biodiversity conservation governance and management: regime requirements for global environmental change. *Ocean and Coastal Management* 69: 160-172.

Haward, M., Davidson, J., Lockwood, M., Hockings, M., Kriwoken, L. (2013) Climate change, scenarios and marine biodiversity conservation. *Marine Policy* 38: 438-446.

Lockwood, M., Davidson, J., Haward, M., Hockings, M., Kriwoken, L. (submitted) Governance challenges for marine biodiversity conservation: adapting to environmental change in the Whitsundays, Australia. *Environmental Conservation*.

Book chapter

Kriwoken, L.K., Davidson, J., Lockwood, M. (2012) Marine protected areas and transboundary governance, in Warner, R., Marsden, S. (eds) *Transboundary environmental governance: inland coastal and marine perspectives*. Ashgate, Farnham.

Conference papers

Davidson, J., Haward, M., Lockwood, M., Kriwoken L., Hockings, M. (2012) Using scenarios to identify adaptive governance regimes for marine biodiversity in a changing climate. Paper presented to *Climate adaptation in action: sharing knowledge to adapt*, NCCARF, Melbourne.

Hockings, M., Lockwood, M., Haward, M., Davidson, J., Kriwoken. L. (2013) Marine governance and climate change. Paper presented to *Climate adaptation: knowledge and partnerships*, NCCARF, Sydney.

Lockwood, M., Davidson, J., Haward, M., Kriwoken, L., Hockings, M. (2013) Governance responses to climate change impacts on marine biodiversity: methods and results from three Australian case studies. Paper presented to *Climate adaptation: knowledge and partnerships*, NCCARF, Sydney.

Technical reports

Lockwood, M., Davidson, J., Hockings, M., Haward, M., Kriwoken, L., Allchin, R. (2011) *Requirements for marine biodiversity conservation governance and management in a changing climate*. Report #1 to the Fisheries Research and Development Corporation. School of Geography and Environmental Studies, University of Tasmania, Hobart.

Haward, M., Davidson, J., Lockwood, M., .Hockings, M., Allchin, R., Kriwoken, L. (2012) *Scenarios for marine environments in Eastern Australia and implications for biodiversity*. Report # 2 to the Fisheries Research and Development Corporation. School of Geography and Environmental Studies, University of Tasmania, Hobart.

Davidson, J., Lockwood, M., Haward, M., Kriwoken, L., Hockings, M., Allchin, R. (2013) *Improving marine biodiversity governance in the context of environmental change: three Australian case studies.* Report # 3 to the Fisheries Research and Development Corporation. School of Geography and Environmental Studies, University of Tasmania, Hobart.

Summaries for policy makers

Three summaries for policy makers have been prepared by the research team, one for each of the study areas: Whitsundays, Tweed and East Coast Tasmania.

APPENDIX 2. RESEARCH TEAM AND ADVISORS

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Agency Advisors

Advisors from the following agencies contributed to the research:

- Australian Government Department of Sustainability, Environment, Water, Population and Communities, Marine Division
- Great Barrier Reef Marine Park Authority
- Queensland Parks & Wildlife Service
- New South Wales Department of Primary Industries (Division of Fisheries)
- Tasmanian Parks and Wildlife Service.