

Using knowledge to make collaborative policy-level decisions in Australia's Great Barrier Reef

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EXECUTIVE SUMMARY

Decentralised approaches to environmental governance have contributed to the problem of complex and fragmented institutional responsibilities for environmental management. Internationally, governance research is increasingly focused on the potential for policy-level institutional collaborations to negotiate the shared understanding necessary as a precursor to collaborative action. Straddling the boundary between science and policy, such collaborations tackle the notoriously challenging task of mediating and translating scientific (and other) knowledge for policy.

This paper focuses on the boundary work features of collaborative efforts to develop and implement policy associated with water quality programs in the Great Barrier Reef (GBR). The research objectives are to summarise the characteristics of institutional collaboration focused on policy-level decision-making, and to identify the critical factors which facilitate or impede knowledge-sharing for policy change and implementation.

These issues are examined through the institutional collaborations that have emerged in response to tackling the Reef Water Quality Protection Plan 2003 (Reef Plan) objective to halt the decline in the quality of water entering the GBR within ten years. Achieving this water quality objective requires an effective system of governance capable of facilitating the necessary cooperation and coordination between multiple environmental decision-makers and activities.

Reef Plan has evolved through three distinct phases of policy development and implementation. Through surveys and interviews, the perspectives of twenty-one senior representatives from government, non-government and scientific institutions were elicited regarding the evidence-base used for policy decisions, and the nature and role of institutional collaboration in these negotiations.

The first key research finding is that the large number of formal collaborative partnerships established between government and non-government organisations to facilitate the delivery of Reef Plan exhibit common characteristics. Examples of such partnerships associated with Reef Plan include the Reef Water Quality Partnership, the Water Quality Reef Advisory Committee, the Ministerial Committee on Reef Regulation and the Sustainable Agriculture Committee. Broadly, the objectives of these policy-level collaborative partnerships ('collaboratives') are to generate, share and negotiate knowledge (including scientific, bureaucratic, political and technical information); to influence, change, test and refine policy goals and strategies; and to coordinate programs, align effort and actively collaborate in program delivery.

In addition, these policy-level collaboratives are often underpinned by a mandate of inclusiveness to engage a range of stakeholders. In the GBR these arrangements have required considerable investment in time and resources for participants and in the provision of administrative support.

The second key research finding is that informal collaborative networks have been influential in policy-level decisions with regard to the GBR water quality issues. These networks are formed through ephemeral alliances between individuals, based on their capacity to quickly access the political level of government and to broker a mix of political, technical and bureaucratic knowledge for policy-level change. Generally, these networks form rapidly and reach sufficient consensus to support collaboration amongst individuals in the network. These collaborations are also generally short term in nature, and disperse rapidly once policy and institutional change occurs.

The third key research finding relates to the role of collaborative institutions in managing the boundaries that connect knowledge to decision-making and management action. This study draws on the framework developed by Cash et al. (2002), which outlines legitimacy, credibility and salience as attributes of knowledge needed to influence policy. Legitimacy

refers to the fairness of the process used to generate and synthesise the information. Credibility refers to how authoritative, believable and trusted the information is. Saliency refers to the relevance of the information to the policy decision at hand (timeliness, scope and scale). These knowledge attributes are based on participants and others' perspectives, and are often dependent upon each other in positive and negative ways (i.e. efforts to bolster one attribute can positively or adversely impact on another). As boundary organisations, collaborative partnerships and networks operating in the GBR have developed different mechanisms to facilitate the availability of knowledge for uptake in environmental policy decision-making.

These attributes – legitimacy, credibility and saliency - were used to analyse how formal and informal forms of institutional collaboration found to be operating in the GBR have negotiated the evidence-base underpinning water policy over time. Research findings show that the boundary work of formal collaborative partnerships mainly focuses on ensuring high thresholds of knowledge legitimacy (e.g. via mechanisms of accountability, stakeholder representation, authoritative rules, and evidence-based process) and scientific credibility. These characteristics aim to ensure that the processes of knowledge production and decision-making are unbiased, and meet standards of political and procedural fairness.

The ability of informal networks to influence policy change in the GBR, in contrast, stems from their capacity to provide highly salient information to decision-makers. Typically, this relies on a small ephemeral group of knowledge brokers who are able to quickly integrate and translate multiple forms of knowledge, including information about the practicality, feasibility, cost and political consequences of policy change, as well as about the scientific basis of policy decisions. Informal networks have been particularly active in the GBR when political circumstances, such as elections, provided opportunities for major policy change.

While the formal processes to achieve policy-level consensus have been slow and challenged by poor participation and leadership, the co-production of credible information has been achieved through formal consensus-building mechanisms to develop the policy evidence-base. Mechanisms to ensure these collaboratives are democratic and defensible has been achieved through formal mandates and partnership structures. On the other hand, informal networks have proven adept at providing salient information for political decisions, although its credibility and legitimacy can be questioned.

If formal collaboratives are to continue to be used for policy-level decision-making, attention will need to focus on the legitimacy problems associated with exclusion and passive participation. The steady build of agreed knowledge and negotiated actions in formal collaboratives can limit the potential for 'rogue' decisions based on poor (though salient) information. Weak leadership and limited participation in formal collaborative governance creates opportunities (and drivers) for an active informal network to effect change when political opportunities arise.

The research also highlights that in the GBR, collaborative approaches to water policy development represent an ongoing experiment in the context of democratic governance. Representatives from government and non-government institutions have been involved in 'opening up' and 'closing down' formal and informal mechanisms to build consensus. This experiment continues and still requires extensive scrutiny to ensure that these efforts to scale-up institutional collaboration result in the design and implementation of effective and appropriate water policy for GBR catchments and the coastal lagoon.

1. INSTITUTIONAL COLLABORATION IN AUSTRALIA'S GREAT BARRIER REEF

Australia's Great Barrier Reef (GBR) is recognised and protected for its outstanding natural, social and economic values. Yet land management within reef catchments could be leading to a water quality crisis due to the impacts of water-borne pollutants entering the reef lagoon. In response, the Australian and Queensland Governments released the Reef Water Quality Protection Plan (Reef Plan) in 2003, with the objective to halt and reverse the decline in water quality entering the reef within ten years (see <http://www.reefplan.qld.gov.au/>). Achieving this water quality objective relies on an effective system of governance to engage diverse government and non-government institutions in the delivery of coordinated land management and use, conservation and rehabilitation strategies and activities. As efforts to meet the overarching objective of the Reef Plan (halting water quality decline by 2013) have now passed the half-way mark, a key ingredient in the strategic response to the water crisis is to ensure collaboration between the multiple formal and informal institutions involved.

In terms of achieving purposive public policy outcomes, institutional fragmentation has become one of the most pernicious dimensions of contemporary western democracies. In environmental management, for instance, most commentators agree that the institutional landscape is crowded with multiple institutions - both formal and informal - whose roles, relationships and practices are both confused and conflicted. Holmes argues that many regions are marked by "uncertain, complex and often contradictory modes of decision making, swayed by multiple interest-groups, each with its own distinctive set of values and ideologies, not susceptible to swift resolution in multiple-value, multiple-use contests" (Holmes 1994, 148). Decentralised approaches to (environmental) governance, with their accent on non-state actors (communities and non-government organisations) further complicate the scene by increasing the role and importance of informal institutions in environmental management (Lane et al. 2004). This kind of complexity is regarded as problematic, in that it not only congests decision-making and increases zones of conflict, but it also displaces traditional venues of control and responsibility, and produces unintended consequences. Many regard these conditions as 'wicked' (Friedmann 1987; Freeman 2000).

A host of strategies have been proposed to combat institutional fragmentation through governmental efforts to collaborate with non-state actors in policy development and implementation, and to co-ordinate local, state and federal government policies and activities. We have seen, for instance, a host of single-scaled, integrated approaches to natural resource management (e.g. integrated catchment management, integrated coastal management) (Lane et al. 2004). At the governmental level, efforts have focused on sectoral and departmental coordination ('whole-of-government' approaches) (Morrison and Lane 2005). In some cases this has involved institutional re-design to encompass the entirety of environmental problems, such as the development of the Wet Tropics Management Authority.

The effort to understand the causes of the 'wicked' state of complex and conflicting environmental governance has prompted researchers to explore the patterns, practices and promise of **institutional collaboration** to resolve these issues (Margerum 2008; Robinson et al. in press). Institutional collaboration is used here to refer to "the pooling of appreciations and/or tangible resources, (e.g., information, money, labour, etc.), by two or more stakeholders to solve a set of problems which neither can solve individually" (Gray 1985, 912). Collaboration, then, is collective action in pursuit of a shared value or set of values. Recalling that one of the greatest obstacles to improved environmental management is the *decreasing* potential for coordinated action by multiple actors across a landscape, collaboration emerges as an approach to governance that has much to offer.

1.1. The research problem and its significance

Much of what is known about collaboration draws on consensus-building efforts at the level of local, action-based relationships and activities (Margerum 2008; Wondolleck and Yaffee

2000). Yet there are also collaborative efforts to address environmental issues at wider scales (regional and cross-regional), where the focus is on policy-level relationships. Little is known about the difference between strategic, policy-level collaboratives and the relatively well-understood community-based efforts (Heikkila and Gerlak 2005; Robinson et al. in press). Even less research has been done on formal collaborative arrangements and how they are affected by informal collaborative networks in their efforts to develop, implement and adapt policy-level changes (Neuman 2007). This shift in research attention reflects a shift toward partnership-based approaches at the policy-level in the Great Barrier Reef (Olsson et al. 2008; Lane and Robinson 2009), the USA (Koontz et al. 2004; Margerum 2008), and Europe (Steyaert and Jiggins 2007; Pahl-Wostl et al. 2008).

A shared understanding of the environmental problem and agreed course of action needs to be developed and negotiated to enable collaborative action (Healey 1987). As in many other environmental decision-making arenas, the GBR involves diverse perspectives and an uncertain and contested knowledge-base (Kroon et al. 2009). Not surprisingly, the negotiation of a shared understanding of water quality planning priorities and management responsibilities is not a trivial matter.

Communication and knowledge-sharing are vital to collaborative efforts if advances in scientific and other forms of knowledge (technical, bureaucratic etc.) are to be integrated and translated to bridge the knowledge–policy ‘gap’ (Owens et al. 2006; Neuman 2007). It is widely recognised, however, that good information does not automatically influence policy and management decisions (Cash et al. 2006; Roux et al. 2006). This challenge has prompted investigations into ‘*when and how* knowledge matters in the policy process’ (Raedelli 1995, 160). Formal institutional collaborations can provide a ‘hard-wired’ institutional space to facilitate the transfer and adoption of science for policy, and thus to negotiate the boundary between knowledge and policy action. Such collaboration has been observed in ‘boundary organisations’ that straddle the divide between science and policy, defined as ‘those social arrangements, networks, and institutions that increasingly mediate between the institutions of “science” and the institutions of “politics”’ (Miller 2001, 482). A key role of boundary organisations is to facilitate the transfer of relevant and useable knowledge between these separate domains (Guston 2001).

Less formal science–policy intermediaries may also be used to manage the boundaries between knowledge and policy decision-making (Moss et al. 2009). The work of intermediaries is political in that it involves the pursuit of particular goals by interacting with multiple actors (service providers, users and regulators) of diverse influence and capacity (Medd and Marvin 2008). These ‘strategic intermediaries’ deliberately act across a particular set of relationships in order to achieve a particular goal (Marvin and Medd 2004). Growing interest in these informal collaborations that ‘shadow’ formal partnerships has raised critical debate about whether these ‘covert’ forms of governance corrupt or enable consensus-building efforts (High et al. 2006).

In this paper, we focus on the collaborative boundary work of formal partnerships and informal networks for policy change and implementation in the GBR. Our research identifies:

1. The characteristics of institutional collaboration focused on policy-level decision-making.
2. The critical factors which facilitate knowledge-sharing for policy change and implementation.
3. The critical factors which impede knowledge-sharing for policy change and implementation.

The paper proceeds as follows. First, we review the boundary work literature that has focused on the integration of knowledge across scales and sectors in order to facilitate collaborative decision-making for public policy goals. Next, we outline the research approach used to examine boundary work strategies and activities occurring during the development and refinement of the Reef Plan. We then describe and discuss the formal arrangements (partnerships) and informal networks through which institutional collaboration at the policy

level occur. We conclude by highlighting the implications this has for the way in which collaborative efforts use and translate available knowledge for policy-level decision-making, by outlining the implications this may have for the design, expectations and evaluation of future collaborative partnership efforts.

1.2. Boundary work and collaborative governance

The conceptual framing of planning as the translation of knowledge into action in the public domain poses serious questions about what kinds of knowledge should inform planning decisions and what institutional mechanisms of translation are involved (Healey 2008; Friedmann 1987). The translation of multiple forms of knowledge has now been attempted through various models of institutional coordination and collaboration (Lane and Robinson 2009; Robinson et al. 2009). This has highlighted the need to analyse the evidence-base used for decentralised forms of environmental decision-making as an active process that is mediated, negotiated and contested. No longer can science claim authoritative status as the provider of systematised, logical and empirically grounded knowledge for use in the public realm. The privileged status of science has been questioned, as debates over the relationship between knowledge and practical activity have highlighted that all knowledge used in planning is shaped, to some degree, by the purposes of its practical uses (Healey 2008). As such, the relationship between scientific and practical knowledge is interactive rather than linear.

Cash et al. (2002) found that information requires three attributes to bridge boundaries, such as the boundary between science and policy: credibility, legitimacy and salience. Moreover, each attribute can be perceived differently by actors on either side of the boundary in question. Effective boundary work thus involves the negotiation or creation of knowledge that is accepted as credible, legitimate and salient by all parties.

Credibility refers to how authoritative, believable and trusted the information is. Credibility can be difficult to establish when uncertainty is high and the science is contested.

Legitimacy refers to perceptions of procedural fairness. Legitimacy considers bias, procedural standards and whether the appropriate values, concerns and perspectives of different actors have been taken into account.

Salience refers to the relevance of information for the decision choices at hand, especially in terms of timeliness, scope and scale.

Importantly, all three attributes are required for scientific and other types of information to influence the policy response, although there are tensions and trade-offs between the attributes. For example, efforts to increase salience by narrowing the problem focus can decrease legitimacy by making the process appear to be politically biased. At the same time, these attributes can also be mutually reinforcing. For example, efforts to increase credibility by including multiple forms of knowledge can also increase salience and legitimacy for a wider range of stakeholders (Cash et al. 2002).

Pursuing effective institutional collaboration for policy-level decisions in the GBR thus requires careful consideration of how collaborative structures and processes can manage the thresholds involved in delivering salient, credible and legitimate information. In the following sections we describe our data collection processes and then reflect on our findings, which suggest formal and informal collaboratives have had different influences on how knowledge is used for GBR policy level decisions and change.

1.3. Research approach

The first stage of this research focused on understanding the dynamic history of governance associated with the Reef Plan. We identified three key phases of Reef Plan (see Figure 1). Each phase is associated with a specific policy response:

- Phase I The establishment of Reef Plan in 2003 as a bilateral policy response to the threat of agricultural water quality impacts on the GBR.
- Phase II The engagement of regional water quality planning to develop water quality improvement plans, and the establishment of the Reef Water Quality Partnership between regional Natural Resource Management (NRM) bodies, and Queensland and Australian Governments (2006-2008).
- Phase III The current government policy responses (grants and regulation) to Reef Plan, initiated in 2008. The Australian Government has commenced implementation of the Reef Rescue Plan, investing \$200M in grants to accelerate the adoption of improved agricultural practices. The Queensland Government has commenced the development of a regulatory framework for agricultural practices in high priority GBR regions. The Reef Plan itself has also been updated.

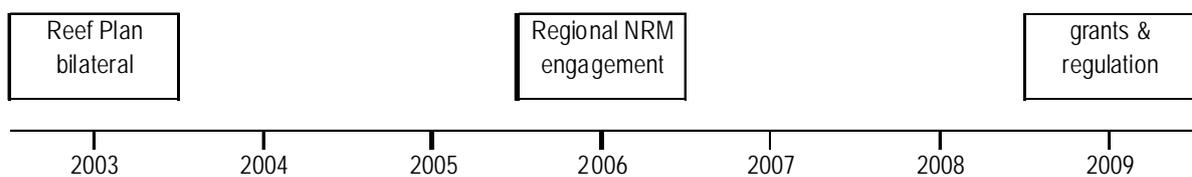


Figure 1 Timeline of Reef Plan governance change and reform.

Participants were selected according to several criteria. The research team identified individuals with recognised high-level expertise and a history of involvement in Reef Plan across a range of institutions (Queensland and Australian Government agencies, NRM bodies, peak agricultural industry and conservation groups). These individuals were selected from a stakeholder analysis (Table 1) that identified organisations that have been active at the policy level in the three phases of Reef Plan. Individuals who actively participated in these processes were approached to contribute their perspectives on the history of Reef Plan decisions, by survey or interview. The survey and interview questions are provided in Appendix 1. Of those approached, 78% (21 individuals) contributed, mostly by interview (17 by interview, 6 by survey). A high level of participation was achieved at the level of officers and senior officers in government departments, and executives and staff of non-government organisations. Gaps in the research data generated include the perspectives of Ministers, ministerial staff and officers from the Queensland Department of Premier and Cabinet.

The survey and interview questions were aimed at understanding individuals' perceptions of the history of Reef Plan decisions. Questions focused on the evidence base for the historical policy decisions, the influence of individual institutions and the role of institutional collaboration in these decisions, and the mechanisms used to manage the boundaries between different types of knowledge and water quality policy decision-making. A review was also conducted of secondary data sources, including relevant policies and programs (Reef Plan, NRM arrangements), and minutes of meetings and papers developed in various formal collaborative arrangements (e.g. terms of reference, minutes and other documentation). Documentation of formal collaborative arrangements was mainly sources from the Reef Water Quality Partnership documents.

Table 1 Great Barrier Reef institutional stakeholders at the policy level

Sector	Organisations	Relevant interests	Relevant activities	Level of Involvement in Reef Plan			in this study
				Phase I	Phase II	Phase III	
Australian Government	Department of Environment, Heritage and the Arts; Department of Agriculture, Forestry and Fisheries	environment and agricultural policy	major investors, Australian Government policy	high	high	high	yes
Queensland Government	Department of Premier and Cabinet; Department of Environment and Resource Management; Department of Employment, Economic Development and Innovation	environment, resource management and agricultural policy and programs	major investors and in-kind support e.g. NRM program management, monitoring, agricultural services and other technical support	high	high	high	No
Local government	42 local governments	environmental management and sustainability	local land use planning and management	none	low	none	no
Natural Resource Management (NRM)	Cape York Sustainable Futures; Terrain NRM; Dry Tropics NRM; Reef Catchments (Mackay Whitsunday NRM); Fitzroy Basin Association; Burnett Mary Regional Body for NRM.	strategic regional NRM	engage community, on-ground program delivery (grants program and other incentives) with local partners	low	high	high	yes
Agricultural industry	Queensland Farmers Federation; Canegrowers; Growcom; AgForce; Queensland Dairyfarmers Organisation.	profitable and sustainable agricultural industries	engage members, various roles in program delivery	none	low	high	yes
Conservation	World Wildlife Fund	strategic environmental outcomes	engage community	none	low	high	yes
Indigenous	Cape York Land Council; Balkanu; Giringun	indigenous livelihoods and environmental management	engage indigenous community and land managers	none	none	low	no
Tourism	Association of Marine Park Tourism Operators	profitable and sustainable tourism industry in the marine park	engage members, support programs (resources and in-kind)	low	none	none	no

Note: Level of involvement refers to the level of engagement in Reef Plan policy-level decision-making. High = active and influential in policy-level decisions. Low = some level of engagement in policy-level decisions. None = no level of engagement in policy-level decisions evident.

2. RESEARCH FINDINGS

2.1. A dynamic policy environment and diverse collaborations

There have been multiple and diverse forms of institutional collaboration evident during the different phases of Reef Plan (Figure 1). While a core of Australian and Queensland Government agencies have been involved throughout, there have been significant shifts in the level of engagement and influence of non-government stakeholders in the policy process. The establishment of Reef Plan (Phase 1) was essentially a bilateral process between the Queensland and Australian Governments, with little stakeholder engagement in its development. Regional NRM bodies were increasingly engaged by governments through the NRM programs (Phase 2), and subsequently through the Australian Government funding of regional Water Quality Improvement Plans. The regional NRM bodies initiated the Reef Water Quality Partnership to improve coordination and collaboration with government. Since the Reef Water Quality Partnership concluded in 2009, governments have undertaken stakeholder engagement with a loose coalition of agricultural industry peak bodies, regional NRM bodies and the conservation sector.

Changes in Reef Plan governance also reflect the broader changes in government associated with election cycles, and developments in the national NRM programs (Table 2). The influence of two electoral cycles (Australian and Queensland Governments), evolving NRM programs and emerging science suggest that Reef Plan has been a highly dynamic environment in which environmental policy has been negotiated and re-negotiated over time.

Table 2 Alignment of Reef Plan policy, national NRM programs and election cycles

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Reef Plan phases	Pre-Reef Plan								Reef Plan Phase I			Reef Plan Phase II		Reef Plan Phase III	
National NRM programs	National Landcare Program		Natural Heritage Trust					Natural Heritage Trust extension , National Action Plan for Salinity and Water Quality					Caring for Our Country		
	Landcare groups		Project grants to groups					Regional NRM programs					Competitive tender		
Australian Governments and elections	Labour		Liberal/National										Labour		
	*		*		*			*			*		*		
Queensland Governments and elections	Labour		Liberal/National			Labour									
	*		*			*			*			*		*	

Note: * = government election

Not surprisingly, this dynamic environment has generated a diversity of collaborative structures over the last five years. Table 3 lists some examples of the formal collaborations that have been associated with the delivery of Reef Plan.

Table 3 Examples of formal collaborative partnerships engaged in Reef Plan

Name	Membership	Administration	Purpose
Reef Water Quality Partnership	QG, AG, NRM	QG and NRM secretariat	Coordination of target-setting, monitoring and reporting to support Reef Plan implementation
Sustainable Agriculture Committee	QG, Ag., NRM	QG	Advice on strategic issues and coordination of sustainable agriculture policy initiatives
Reef Regulation Committee	Ag., NRM, Cons.	QG	Advice to the Minister for Sustainability, Climate Change and Innovation on the proposed agricultural regulation for the GBR (implementation of policy commitment)
Reef Water Quality Steering Committee	QG, AG, Ag., NRM, Cons., Sci.	Sci.	Oversight of research direction (program implementation)
Water Quality Coordination Group	QG, AG, NRM	AG	Coordination and advice on implementation of specific Reef Plan actions
Reef Alliance	NRM, Ag.	NRM	Delivery of agricultural grants programs (implementation of Reef Rescue)
Water Quality Reef Advisory Committee	QG, Ag., NRM, Sci., Cons., and others	AG	Advice to management agency on Reef Plan and water quality issues (relevant to implementation of agencies activities)

Note: QG = Queensland Government agencies, AG = Australian Government agencies, NRM= natural resource management bodies, Ag. = peak agricultural industry bodies, Cons. = conservation bodies, Sci. = science institutions

Interviewees described a diverse set of objectives and expectations with regard to participating in these arrangements, some of which are described in more detail in the following sections. Broadly, the purpose of **formal** arrangements to achieve institutional collaboration at the policy-level is to deliberate about policies and programs that guide action at lower levels (Margerum 2008; Robinson et al. in press). The data collected through this research showed that formal collaboration in the GBR involved:

- Policy advice, influence, change, testing and refinement;
- Program coordination, effort alignment and active collaboration in delivery;
- Negotiation of the knowledge base underpinning policy development and implementation.

Interviewees described the negotiation of knowledge as important to determining 'What needs to be done', 'How it should be done' and 'How success is to be evaluated'. Knowledge

brought to the collaborative table may be modified by collaborative negotiation, and may be co-produced through the process of collaboration. Table 4 describes examples of collaborative actions that have been the focus of formal partnership activity in the GBR, and the broad types of knowledge that were identified by participants as needed for these collaborative decisions.

Table 4 Examples of collaborative actions in the GBR and supporting knowledge

Planning purpose	Action	Relevant knowledge
Prioritisation of efforts	Agree regional and GBR targets	Management options (technical and industry knowledge), ecosystem processes and impacts (scientific and place-based knowledge), feasibility (bureaucratic and operational knowledge)
Investing in action	Align partner activities	Management options (technical and industry knowledge), feasibility (bureaucratic and operational knowledge)
	Source additional investment	Feasibility (bureaucratic and operational knowledge)
Evaluating outcomes	Establish multilateral monitoring program	Management options (technical and industry knowledge), ecosystem processes and impacts (scientific and place-based knowledge), feasibility (bureaucratic and operational knowledge)

With regard to the role of institutional collaboration in Reef Plan discussions, interviewees described the operation of formal collaborative partnerships such as the Reef Water Quality Partnership, as well as the operation of informal collaborative networks that have been particularly active in the periods leading up to policy change. As such, the research results highlight that major changes in policy direction at the highest level are inherently political decisions, which may or may not be strongly informed by existing formal collaborative arrangements between government and non-government organisations.

In the following sections, the distinctive characteristics of formal (Section 2.2) and informal (Section 2.3) modes of collaboration are described and then our attention turns to their impact on brokering knowledge for policy change and implementation (Section 2.4).

2.2. Boundary work of formal collaborative partnerships

Many formal collaborative partnerships have been developed to inform and influence policy development and implementation in the GBR (see Table 2); examples include the Reef Water Quality Partnership, Reef Plan working groups such as the Water Quality Reef Advisory Committee (WQRAC), the Ministerial Committee on Reef Regulation, the Sustainable Agriculture Committee and Water Quality Steering Committee, among many others. These examples are briefly described below to illustrate the purpose and characteristics of policy-level collaboratives that exist in the GBR.

The Reef Water Quality Partnership was supported by a formal Memorandum of Understanding between Queensland and Australian Governments and regional NRM bodies to coordinate and collaborate on target-setting, monitoring and reporting. The Reef Water Quality Partnership existed for two years, and was comprised of a management committee, science advisory panel, regional implementation group, support team and working group.

The WQRAC is supported by the Great Barrier Reef Marine Park Authority. It has a formal Terms of Reference, secretariat support from the Authority, and provides a stakeholder advisory committee to inform and respond to the water quality work of the Authority.

A Ministerial Committee on Reef Regulation (Reef Regulation Committee) was an advisory committee established in 2008 by the then Queensland Minister for Sustainability, Climate Change and Innovation to seek stakeholder input into the development of agricultural regulation to protect GBR water quality. The committee had a formal Terms of Reference and completed its business within a six month period.

The Sustainable Agriculture Committee (SAC) comprised senior Queensland Government bureaucrats, executives of the peak agricultural industry bodies and other stakeholders. The objective of the SAC was to progress the sustainable agriculture and farm management system agenda (with an initial focus on the GBR). The SAC existed for approximately 12 months and the Queensland Department of Primary Industry and Fisheries provided administrative support.

The Water Quality Steering Committee was established by the Reef and Rainforest Research Centre Ltd (RRRC) to engage key institutional stakeholders (government and non-government) in the oversight of the Marine and Tropical Sciences Research Facility's water quality research program. The committee has a formal Terms of Reference and is administered by the RRRC.

2.2.1. Characteristics

The examples described above represent just a few of the formal partnerships established to tackle water quality decisions in the GBR. Typically, these formal arrangements have exhibited the following characteristics:

- Formal, sanctioned processes generally (but not exclusively) initiated and administered by government.
- Inclusive of a range of stakeholders.
- Formal and documented purpose and operating rules.
- An extended but usually defined period of operation – from approximately six months to two years or longer.
- Mechanisms to ensure accountability, such as Terms of Reference, and formal record-keeping and meeting processes.
- Considerable investment in time and resources to develop and sustain these arrangements, by participants and through administrative support. Often involve subsidiary working groups.
- Objectives include policy development, consultation and advice, as well as program delivery, coordination and effort alignment.

Many of the formal arrangements have had overlapping or closely related membership and objectives. This can present a confusing and demanding challenge - particularly for the limited human resources of small, non-government organisations. A number of interviewees expressed frustration with the apparent duplication and/or disconnection between these different fora. For example, comments were made about the apparent overlap in policy agendas between the Sustainable Agriculture Committee and the Reef Water Quality Partnership, and the poor linkages between Reef Plan policy discussions in the Reef Water Quality Partnership and the administration of the Queensland NRM programs through the Joint Steering Committee

Yet many formal partnerships actually represented progressive iterations and adaptations that occurred in response to developments in policy objectives and decisions. For example, the Water Quality Reef Advisory Committee spawned the Water Quality Coordination Group to improve the coordination of monitoring activities, which, in turn, generated the proposal for

the Reef Water Quality Partnership. The experience of the Reef Water Quality Partnership informed the update of Reef Plan and its stakeholder engagement mechanisms. The adaptive characteristics of these policy-level collaboratives reflect what Genskow and Born (2006) describe as the “richness of multi-modal institutional arrangements that commonly change over time”. This richness nonetheless presents a particular challenge in evaluating the impact of any specific collaborative arrangement.

2.2.2. Making policy-level collaboratives work

The seminal work of Wondolleck and Yaffee (2000) investigates the institutional characteristics of what makes collaboration work. Much of this work and that of subsequent studies has focused on the innovations achieved through action-level collaboratives (such as Landcare groups) that have been formed through the efforts of key individuals. Collaborative leaders in these arrangements tend to be strongly connected through social networks and strong connections to place, circumstances that allow them to bring together people to address a common cause, even when those participants come from different ideological perspectives.

Based on our research, we suggest that these conditions are less likely to hold in policy-level collaborative contexts because such collaborations are more likely to be enmeshed in higher-level government structures and political processes. As a result, they are likely to rely less on the actions of lay individuals and instead to involve more agencies, more levels of government, and more participants representing organisations. In the following section, quotes are drawn from the survey and interview data to highlight the key attributes of collaboration when deliberation is focused on policy-level decisions. While these quotes necessarily refer to the specific arrangements that the individual participated in, they have been chosen to represent views that were more broadly held, as expressed by multiple interviewees.

The need for a common objective to underpin collaboration was widely recognised by study participants. A number of interviewees commented on the importance of a vision to engage partners and to muster the benefits of a collective intellectual capacity:

Build a partnership around a vision: 'How good could it be?' Sell the benefit and the cost... What will make it work? 'hard wisdom' i.e. the collective wisdom of the group.

Many interviewees commented on the importance of effectively linking policy to on-ground action. This was seen to provide a critical linkage across regional programs, and between the regional programs and Reef Plan policy. Individuals from government agencies commonly saw collaborative forums as a mechanism to test emerging policy or implementation strategies with stakeholders, which provides benefits through improved policy, and ultimately delivers cost-efficiencies:

Getting the stakeholders engaged, and keeping them engaged... It's a valuable sounding board for Reef policy... More like action learning.

Pretty open and frank conversation is, I think, a pretty timely characteristic, to allow that information sharing to take place prior to a concrete decision being made... The cost efficiencies ... and cost benefits. More bang for the buck.

Coordination was also raised as an important issue by both government and non-government interviewees. In particular, the alignment of effort between government agencies and regional NRM bodies has been a significant focus of collaborative efforts to-date:

I think what we need to achieve or the goal that we need to achieve is a more effective alignment of effort across state agencies and the [Reef Water Quality] Partnership.

The challenges of institutional fragmentation were acknowledged by most interviewees, but the choice to negotiate through formal collaboratives was tempered by the consideration of resource requirements, and the potential risks of engagement:

Make a decision about how important this is to you in terms of achieving your outcomes. And if you think it's really important, then look at engaging, the real genuine thing ... So if they believe the partnership's going to achieve aims that other bodies or groups aren't going to do, then they need to think about how to resource it.

An assessment of risk – particularly the risk of action, and inaction – was noted to be an important consideration in the negotiations of actions within collaborative partnerships. At the policy-level of decision-making these risks have significant political dimensions:

... but what I really care about maybe is how much is it going to cost? Is it going to piss anyone off? How does it sit within Reef Plan or the partnership objectives? Those kinds of things. What are the risks?

Having established a common objective, formal collaboratives typically invest substantial time and effort in developing a common understanding of the relevant science. This is a critical foundation for the negotiation of action. In the GBR, the complex and contested science of land management and water quality-ecosystem response provides fertile ground for dispute (cf. Kroon et al. 2009). Interviewees recognised the need for dialogue to negotiate the diverse values and knowledge associated with complex water quality issues that sit across institutional boundaries. Negotiating an agreed process to address technical issues, and especially to set regional water quality targets and to improve multilateral monitoring programs, was a related issue that was frequently raised by participants.

Negotiating actions also required the development of a mutual understanding between collaborating individuals – both about the knowledge that underpins the action in question, and about the positions and interests of the negotiating institutions. As one senior industry representative argued:

It's of mutual benefit for industry and conservation to understand each other's business, in a way they both need each other to compromise. This is [a] much more productive collaboration – always a place for constructive tension. It depends on the personalities – you need to be clear on your own position, prepared to listen and respond.

For stakeholders, engagement depends on the judgement that a collaborative approach is better than other ways of achieving organisational goals:

I guess the true test of the partnership is whether the partners actually say that this is the way we want to achieve whatever it is, and whether they actually say that that is part of our core business and this is a better way of us doing it together.

A formally sanctioned and well-resourced mechanism for collaboration provided additional impetus for engagement in collaboration:

The collaborations were effective because there was NAP [National Action Plan for Salinity and Water Quality] and NHT [National Heritage Trust] money on the table – cash poor state agencies and scientists saw opportunities, the Commonwealth saw an opportunity to push Queensland, regional bodies saw an opportunity to push them both.

However, despite a general agreement that a collaborative approach was necessary and appropriate, some government and non-government stakeholders expressed contradictory views on how such an approach should operate. The difference seems to relate to divergent positions on how non-government stakeholder views should be taken on board in government decision-making (bottom-up), and the ultimate accountability of government (top-down) to the general public for their decisions. As a senior government interviewee observed:

I guess in terms of our role, it's definitely a top-down model, and to try and do anything else would be foolish.

That comment may be compared with an alternative view put forward by a regional NRM body interviewee:

[The] fundamental problem with Reef Plan is it's too top-down.

Some interviewees (from both government and non-government institutions) expressed disappointment that collaborative dialogue did not readily lead to changes in institutional behaviour, such as government policy and program directions:

[The partnership is] floundering because of a lack of leadership and support and commitment across the partners.

Interviewees described a deliberate 'deadening' strategy of passive participation adopted by some agencies. The perspective is that some agencies were happy to be 'seen to be' collaborating (through participating in collaborative forums), but in reality had no intention of making any commitments to action through those forums. In this sense, the commitment to collaboration was not viewed as sincere:

Some representatives or delegates consistently contribute very little to discussion or decisions.

[I am] worried that this [Reef Water Quality Partnership] has allowed ... government to ignore its government responsibilities under guise of being part of [a] collaborative group.

Some interviewees saw this problem as a consequence of the inability of government representatives to effect change processes within their own organisations. This reflects a dilemma evident in other policy-level collaborative experiences, when participants who represent organisations are asked to negotiate organisational priorities, objectives and implementation approaches. This creates a complex 'two-table' negotiation process in which participants must deliberate in the stakeholder forum and deliberate on policy direction within their organisation (Robinson et al. in press). This issue of accountability within and between institutions involved in the collaborative process appears to be a critical issue for the effectiveness of formal partnerships. On the one hand, negotiating agreed actions and distributing accountability appears to hold much promise for addressing issues that cross scales and institutional boundaries. Yet negotiating commitment to collective actions appears problematic – particularly where the agreed actions represent a change to existing policies or programs:

Before the [Reef Water Quality] Partnership everyone and no one was accountable for Reef Plan action at the Reef wide level.

The Partnership only exists if the partners are contributing, once that stops... there can be a perception someone else is driving it.

Despite the challenges and frustration described above, there was a general agreement amongst interviewees that formal collaborative partnerships have been instrumental in building institutional collaboration in the GBR over the previous five years. This cooperation culminated in the announcement of the Reef Rescue Plan in 2008, which had been promoted by an alliance of non-government groups:

As a lobby – conservation, industry and regional bodies pushing in the same direction is quite powerful, and unusual as they are traditionally opposed stakeholders. They had quite an impact on Reef Rescue and the ways it's configured.

This cooperative lobbying was, in and of itself, a huge milestone in the implementation of the Reef Plan.

Interestingly, this process built on the formal collaborative agreements negotiated over the previous two years, and utilised informal collaborative networks to access the political decision-making processes during an election phase. The work of informal collaboration at this and other phases of Reef Plan is described in the next section.

2.3. Informal collaborative networks

Informal collaborative networks have been active and influential over the history of Reef Plan policy making. These networks are best described as ephemeral alliances of individuals working towards a common policy objective. Co-production of knowledge is a central feature of this form of collaborative governance, where scientific, political and social information are simultaneously negotiated and contested (Jasanoff 2004). The development and experience of these GBR networks reflect analysis of the critical role leaders and boundary spanners play in creating linkages between knowledge systems and systems of organisation (Wells and Tail 1982). It also highlights the political realities associated with such interactions, whereby the state is only one actor in the policy process (Rhodes 1997). Typically these actors collaborate when opportunities to effect change arise, and then the alliances disperse once policy and institutional changes have been made. Actors include scientists, executives from non-government organisations (including conservation, tourism, regional NRM bodies and peak agricultural industry groups), supportive bureaucrats and Ministerial staff (cf. Wells and Tail 1982).

Informal networks have been notably active preceding the decisions that initiated each phase of Reef Plan described earlier (Figures 1). Leading up to the announcement of Reef Plan (Phase I), the collaborative network comprised representatives from the science community, working actively with Ministers' offices at both levels of government.

The move to invest in the regional Water Quality Improvement Plans and the Reef Water Quality Partnership in 2006 (Phase II of Reef Plan) was led by a dialogue between Australian Government officers and regional NRM bodies, supported by Queensland Government officers. This change was less a change in policy than a change in the operationalisation of the existing bilateral policy (Reef Plan) by aligning Australian Government investment programs (the Coastal Catchments Initiative) and engaging regional NRM bodies more as delivery agents.

Phase III of Reef Plan represents two distinct policy changes at the two levels of government. Firstly, the Australian Government committed to the Reef Rescue Plan, a \$200M program mostly committed to grants to accelerate uptake of improved agricultural practices for water quality benefits. A broad coalition across regional NRM bodies, peak agricultural industry groups and conservation groups actively lobbied for this investment in the lead up to the last federal election in 2008. The proposal was supported by the tourism industry, the science community and Australian Government bureaucrats. Secondly, the Queensland Government made a policy commitment to regulating agricultural practices in GBR catchments. This decision was actively sought by a network that was led by the conservation sector and included some science community advocates.

The most formalised of these ephemeral networks has been the network that proposed and actively lobbied governments for the Reef Rescue investment. The development of a broad business case for investment in agricultural incentives was prepared by a coalition of non-government organisations (regional NRM bodies and peak agricultural industry groups). Members negotiated the content of the business case, and the advocacy pathways to promote the business case to the government and opposition parties. The proposal was adopted (and adapted) as an election commitment by the opposition, and following the election has been implemented as the Reef Rescue program. Interestingly, the conservation sector was a key supporting advocate in this process. The presentation of a common position across the traditionally polarised agricultural and conservation sectors was seen as instrumental in its success, as was the broad support provided by key individuals within the science community and government.

As the decision-making processes moved from the development and advocacy of a common position to the negotiation of implementation arrangements for Reef Rescue, the group of proponents has coalesced into the 'Reef Alliance'. The Reef Alliance shows some characteristics of a more formal collaborative partnership (including organisational representation, secretariat support and record-keeping), with the aim of managing the coordinated delivery of Reef Rescue contracts. Conservation advocates (World Wildlife

Fund) have been excluded from this arrangement (largely because of different positions in relation to agricultural regulation) but remain in active dialogue with some member organisations. While not members, staff from Queensland and Australian Government agencies attend by invitation when relevant agenda items arise.

2.3.1. Characteristics

Typically, informal collaborative networks exhibit the following characteristics:

- Small, fluid coalitions generally initiated by non-government actors and seeking major policy change through Ministerial direction.
- The coalitions form rapidly and reach sufficient consensus to support collaboration amongst individuals in the network.
- The collaborations disperse rapidly once policy and/or institutional change occurs.
- Membership is available to individuals with political savvy and access to the relevant networks (generally high-level bureaucrats, Ministers and their offices).
- These networks are effective at providing political and bureaucratic knowledge along with scientific information, packaged for their target audience (i.e. highly salient).

2.3.2. Making informal collaborative networks work

This section highlights the general findings in relation to the objectives, operation and outcomes of informal GBR collaborative networks. The findings are highlighted by quotes drawn from the survey and interview data to demonstrate stakeholder perceptions. These have been chosen to represent views common across multiple interviewees.

The need for a common focus was considered important for informal as well as formal collaborations. An *“allegiance to outcomes”* was considered to be important, as was the *“... alignment of self-interests [amongst a] well-placed network of key government influencers”*.

A key difference between the formal and informal GBR collaborations has been how they operate. The informal network comprises a loose alliance of individuals whose ability to work across institutional boundaries was viewed as critical to their effectiveness:

... a small number of like-minded individuals across institutions are more effective than institutions. Institutions are unwieldy, no nuance in their positions.

Individual knowledge brokers who have the capacity to take advantage of ‘policy windows’ in Reef Plan reform are a key feature of these informal alliances (cf. Olsson et al. 2008). These networks of individuals are flexible and responsive in their brokering strategies, able to overcome the inertia that tends to characterise the decision-making processes displayed by formal collaborative institutions:

The informal alliance of regional bodies and industry was more effective in making something happen than the formal arrangement of the Reef Water Quality Partnership – probably because of government inertia in the latter ... the success was about the individuals involved.

As with formal collaborative partnerships, the management of risk is an important aspect of informal alliances:

Critical collaborations are actually between individuals at this phase – not institutions ... relationships at [the] strategic high-level [are] really. ... about risk management, and alliances are formed to manage this risk.

A notable focus for interviewees was the role of individuals, as knowledge brokers, in transferring, translating and managing information for policy-making. Their ability to work across the boundary between science and policy, and to provide salient information, was a key characteristic of the informal collaborative networks. In contrast to the frustrations

expressed with formal collaborations, the informal networks were commonly described as highly effective at driving policy change:

The evidence has been there for ages that the reef is dying – critical has been for people to ensure this is exposed and translatable to inform policy.

Interviewees identified characteristics that made this information pertinent to policy change. It needed “good science” and “savvy scientists”. It also needed to be communicated in a timely manner to the right people. This brokering role required a more tacit kind of operational knowledge, or ‘know how’:

... key leaders who get policy-level change [through informal collaborations] are those who have been in different parts of system, know the players and how to make it operate.

The political impact of informal alliances is often gauged by media attention. Many interviewees commented on the strength of the conservation sector in attracting timely media attention, which in turn, is perceived as providing better access to political and policy spheres. Other non-government organisations also utilise the media when they can:

... the heading “Toxic Rivers in the Great Barrier Reef” on the front page in the media is gold for catalysing [policy-level] change.

At the same time, the fleeting influence of informal alliances on policy decisions means that more formal arrangements are needed for policy delivery. As two interviewees put it, the role of individuals is ultimately limited to engaging Ministers and therefore agencies in policy change rather than policy implementation:

... the passion and political grunt, but not the institutional capacity to deliver... you have to keep the momentum ... Ministerial grunt is important [because it] gets it to the table bilaterally.

There are formal and informal processes. The informal processes can only go so far, then it has to go up to the line ... Informal is about individuals not organisations, networks of individuals. [They] can be very effective up to a point, for example in setting the scene [but after that you] need substantive resourcing, momentum, political support.

In sum, collaborative efforts that have focused on deliberating policy-level decisions have been achieved through formal structures and informal processes in the GBR. Both mechanisms of environmental governance have emerged and re-emerged to develop, refine and implement policies underpinning the Reef Plan. A key function of these collaborative efforts has been to manage the boundary between science and policy, as part of the effort to negotiate and influence the evidence used for senior-level decisions in the GBR. At the same time, the distinct styles and timing of these two models of collaboration mean that they make different contributions to the communication, sharing and integration of knowledge for policy. The location of formal partnerships at the boundary between science and policy decision-making provides conditions for participants to *share, negotiate and co-produce knowledge*. The ephemeral nature of informal alliances enables actors within the network to act as *knowledge brokers* with the ‘know how’ to facilitate policy change across institutional boundaries. While formal collaboratives also act as knowledge brokers, theirs is more a communication – rather than a transformation role.

As noted earlier, for this boundary work to be effective in linking knowledge to strategic policy-making, the information has to be considered legitimate, credible and relevant to the decision at hand. The following sections outline the distinctive, and yet complementary, influence of formal and informal collaborations towards this end.

2.4. Institutional collaboration and the utilisation of knowledge

A key feature and function of collaborative approaches to environmental governance is that they enable both local and technical systems of knowledge to be effectively used in environmental decision-making (Jasanoff 2004). Collaborative groups and processes working at local scales of decision-making have been attributed to be more sensitive to local contexts and circumstances because local actors and interest groups have been able to contribute their perspectives and knowledge into management decisions (Wondolleck and Yaffee 2000). In contrast, significant reliance on scientific and bureaucratic knowledge has found to be central to collaborative efforts focused on policy-level decisions (Robinson et al. in press; Margerum 2008). Understanding the ways in which these institutional arrangements and alliances manage the boundaries between scientific and other knowledge, and policy-level decisions, is an area of scant yet growing scholarship.

The analysis underpinning the next section of this report draws on Cash et al.'s (2002) framework of science communication in the public arena, developed to understand how organisations manage the many complex boundaries in knowledge-action systems. Fundamental to this framework is the challenging need and inevitable tensions inherent in managing knowledge contributions that are legitimate, credible and salient to inform strategic policy decisions.

2.4.1. Managing the legitimacy of knowledge

As highlighted earlier, a key feature of formal collaborative partnerships is the way these formal structures and mechanisms enable a high level of legitimacy in the way knowledge is deliberated, critiqued and used (e.g. via mechanisms of accountability, stakeholder representation, authoritative rules, and evidence-based process). These characteristics aim to ensure that the processes of knowledge production and decision-making are unbiased, and meet standards of political and procedural fairness.

A key aspect of legitimacy is trust. Trust between the producers and users of policy-relevant knowledge are critical to its production, acceptance, uptake, diffusion and use. One interviewee explained how 'fairness' is judged in this way:

... to inspire confidence and trust you need to have intelligence and justice (i.e. fairness). Even if there is low intelligence, but the process is fair, you can have reasonable confidence ... probably less trust if there is intelligence without justice.

Building the relationships of trust and mutual understanding of capacities and interests can be achieved through the interactions facilitated by boundary organisations. The inclusion of relevant actors and the consideration of appropriate concerns from multiple perspectives across jurisdictional boundaries, enabled by such organisations and focused on relevant issues of concern, are central to perceptions of fairness. Many of these attributes were associated with the regional Water Quality Improvement Plans, which were described as:

... highly effective institutional collaborations between regional bodies, science providers, industry and government. They were effective because they were formal, funded adequately, had clear objectives and tried to be inclusive of most interested groups. Of course, not all worked to the same effectiveness level.

Building trust typically takes time (Cash 2001). Sustaining the roles played by individuals in this process is therefore important to enable trust to be developed and maintained. In our research, frequent changes in staff were identified as an impediment to sustained collaboration for policy impact:

Constant change in Canberra staff makes it difficult to ensure that scientific rigour is translated into good policy decisions.

... changing leaders in industry groups – at state and regional levels shifts the dynamics of the network ... and how to get alliances made.

The trust placed in regional communities by government, often judged on the level of community competence, was also identified as an issue:

... from my experience with working with regional communities, they're pretty smart, they can work it out, in terms of understanding what the issues are, understanding what the importance of moving ahead is. And trusting them is a challenge for government, a challenge for industry, a challenge for all of us, to recognise that our role is actually to support our communities. That's what government is about in the end.

The inclusive nature of collaborative arrangements is another critical factor influencing determinations of their legitimacy (Ingram and Bradley 2006). The Reef Water Quality Partnership triggered internal debate as to the appropriate level of participation within several Queensland Government agencies. Organisations may opt out of collaborations so as not to legitimise them. In the GBR this has been most visible in the behaviour of some non-government organisations (conservation and agricultural industry groups in particular). At the same time, the small size of some non-government organisations, such as conservation and some agricultural industry groups, can impact on their capacity to participate in collaborative fora:

Roles [of different conservation organisations] are separated on the basis of strategic capacity, campaign focus and divvying up of responsibilities.

Organisations may also be excluded from collaborative groups and efforts. For example, the peak agricultural industry bodies have at times been excluded at key points of Reef Plan policy development:

I think it's fair to say that Reef Plan was primarily an intergovernmental program. The involvement of industry and regional bodies in its formulation, and the first three years of implementation, was minimal.

This is significant, given the role of farmers (as decision-makers) and industry bodies in policy delivery:

So while I think the [Reef Water Quality] Partnership is going well, there are those worrying signs of industry down in Brisbane saying, well, we're not engaged in the Partnership and we're responsible for delivering best management practice. And those are some tensions that will have to be very carefully managed by government and by regions.

When overtly political decisions change policy, collaborative processes may be disrupted and the process perceived as unjust. If behaviour is perceived as inconsistent over time, or inconsistent across different negotiations, interviewees reported feelings of mistrust and injustice:

Industry was specifically locked out of the process and government officers were gagged from talking to us. Industry was engaged in a fake collaborative approach, but was kept out of the real decision-making process.

When knowledge is connected to action, the legitimacy of a collaborative process rests upon participants' belief that their views and concerns have been taken into account in the consideration of problems and solutions. Participants scrutinised processes for consistency (intelligence) and openness (justice) (Miles et al. 2000) in both formal and informal Reef Plan collaborations. Where collaborating institutions have both shared and conflicting perspectives/objectives, this scrutiny will be intense, and is a threat to effective collaboration on common objectives. This tension is evident, for example, amongst the non-government organisations – regional NRM bodies, conservation and peak agricultural industry groups.

Several empirical studies have confirmed the value of formal boundary organisations in NRM contexts. In a study of water management in the United States of America (USA) High Plains Aquifer, Cash (2001) found that extension offices, acting as boundary organisations, integrated scientific expertise and knowledge to produce useful and relevant scientific products to guide management decisions. These boundary organisations also provided an institutional space to facilitate adaptive management. The collaborative modification of hydrological models to incorporate emerging understandings was achieved by linking decision-makers across different organisational levels of government, and by ensuring sustained relationships over time (Cash 2001). The California Bay Delta Authority has also played a boundary spanning role, facilitating adaptive management by questioning prevailing assumptions, re-framing issues and incorporating previously marginalised knowledge (Ingram and Bradley 2006).

2.4.2. Managing the credibility of knowledge

To be accepted by collaborating partners and policy-makers, scientific and technical advice needs to be credible (of an appropriate standard) as well as legitimate (unbiased and fair). Credibility is most commonly associated with scientific consensus, which is often central in defining the problem and giving it substance, as well as in providing a solid justification for action. In the formation of the Reef Plan, one interviewee described science as a “*stick*” in this sense (i.e. beating policy into action).

Scientific uncertainty combined with diverse values and perspectives can be a major impediment to the consolidation of agreement on actions. The Reef Water Quality Partnership Scientific Advisory Panel and Regional Implementation Group were both mechanisms to address this issue, and were effective at resolving an impasse on approaches to setting regional water quality targets. This is classic boundary work:

The work that came up with ‘paddock to reef’. Seeing that is now accepted as received wisdom. For example, the monitoring and evaluation program is now doing this... The Reef Water Quality Partnership was responding to a need... A public good response to a complex inchoate need for water quality outcomes.

Participants reported that formal collaboration around the Reef Plan improved the credibility of the science over time by including a broader range of expertise, incorporating socio-economic data along with water quality data and evidence of crown of thorns starfish damage to the reef. Including evidence from a range of sources – including government, industry and conservation groups – also increased legitimacy by expanding the ownership of the process, and ensured that the information was relevant to a wider set of stakeholders.

The role of knowledge brokers is important in this boundary work because they span the boundaries between science and policy, and between partners and other actors (Clark and Holliday 2006; McNie and Elisabeth 2007). Knowledge brokers operated in both formal partnerships and informal interactions in the GBR. Formal advisory committees have an important role as knowledge brokers by communicating research science for management purposes, which can ensure both credibility and relevance to users:

Advisory role is essential ... for good value for money the science has to be transmitted to management. Formal committee seems to work best. Taking research and producing credible advice. And perhaps vetting government science.

[Reef and Rainforest Research Centre] were critical at helping to synthesise this material and more importantly to translate it to inform political directions.

The translation of science for policy was noted by government interviewees as particularly important:

So give me a techo paper and I'll read it, and I'm not a moron, so I can understand it, but I can't tell you the answers to those questions, because I cannot translate that level of information for the next one up. And that's a translating role.

Knowledge brokers acting within informal alliances can provide credibility due to their reputation with stakeholders:

... there is as certain know-how you develop from working in the system ... a sort of knowledge built up from years of experience ... a reputation as a person who can make the necessary changes.

The intermediary role of knowledge brokers in framing policy choices and interpreting scientific assessments for decision-makers has been recognised as critical in agricultural extension and global environmental policy contexts (Cash 2001; Cash and Moser 2000; O'Toole et al. 2006; Farrell and Jaeger 2006). Knowledge brokers can exercise considerable political power in this translation process by conferring authority on a particular framing, or re-framing, of the available knowledge (Litfin 1994). In the case of individuals acting within informal alliances, the political nature of this role may become more overt as "policy entrepreneurs" "push" "pet proposals or problems" in a timely manner or persistently over time (Kingdon 1984: 21; Owens and Rayner 1999).

In the GBR, individual knowledge brokers active in informal collaborative networks were also well-informed by, or active participants in, the formal collaborative processes. Several interviewees commented that the knowledge brokered through the informal channels included and supplemented that brokered through the formal channels. In particular, a wider range of information was offered to increase salience (i.e. political and bureaucratic dimensions of problems and solutions). If the formal and informal collaborative processes were offering contradictory information then the credibility of both would appear to be at risk.

2.4.3. Managing the salience of knowledge

In contrast to formal partnerships, the characteristics of informal alliances mean that they have a limited capacity to generate perceptions of legitimacy in the conventional sense (i.e. through representativeness, openness, participation and accountability). Instead, the ability of informal networks to influence changes stems from their capacity to quickly provide *salient* political and scientific information when a 'policy window' opens up, utilising knowledge for which credibility and legitimacy is already sufficiently established.

To effect change, policy advice needs to be salient (relevant to the decisions at hand). Scientific uncertainty needs to be weighed against urgency for action and available technologies:

The science was, and to a large extent still is, inconclusive as to the sources of declining water quality. The need to improve our knowledge in this regard, while implementing some 'no regrets' actions was a driving force behind Reef Plan.

Salient information includes not only science but additional information, such as institutional capacity, affordability and practicality, political risks and consequences. One interviewee described this mix as:

A mix of science and politics. Science provides the politicians with the necessary clout to drive critical agendas. Just as important is what science doesn't get onto the policy table.

The multiple forms of knowledge that collectively contributed to perceptions of salience is illustrated by the following account of Reef Rescue:

[The] Reef Rescue package was a pre-election promise, announced to buy the green vote. It was, however, handed to them with precisely that intent by the partnership of regional bodies, industry peak bodies and [World Wildlife Fund]. These organisations all saw the need to put some serious investment into Reef Plan, particularly on-ground action. Science information was useful in developing the proposal and modelling the impacts (reduction of sediment etc.) that could be achieved. The evidence base, then, was science provided by the regional bodies, and evidence that the key players were willing to work together, and that industry was prepared to lead their constituents through a change process (indicating that they had accepted some responsibility).

Policy changes commonly occur during a 'policy window' (Kingdon 1984, Olsson et al. 2006) framed by political circumstances (e.g. elections) or other external factors, so that the timeliness of information to inform transformative change is critical. Recent GBR policy announcements by Australian and Queensland Governments have both been associated with electoral cycles:

Elections are an enabling thing. They provide the impetus for change. This should be positive. Democracy relies on governments being tested against what the community wants – if they are doing this you can get significant change.

Rather than the metaphor of a 'bridge' between science and policy, which implies a linear process of transferring scientifically legitimised findings from the research domain into the policy domain, the interactions of informal alliances might be better described as 'spider webs' of connectivity and interaction (Vogel et al. 2007). Ephemeral alliances exhibited multiple nodes and complex linkages, and the appearance and disappearance of different actors at different times. Informal collaborative networks of actors can play an explicit role in creating relationships by linking actors who might not otherwise interact. Their 'stealth' nature nonetheless means that these boundary spanners can be difficult to identify (Kristjanson et al. 2009).

3. DISCUSSION AND CONCLUSION

In this paper, we have explored the characteristics of collaborative forms of environmental governance focused on policy-level deliberation and decision-making in Australia's GBR. Our findings show that consensus-building efforts between senior representatives of government, and non-government partners, are achieved through both formal partnerships and informal networks in the GBR.

3.1. Institutional collaboration for policy-level decisions

There are a number of formal collaborative structures and processes that have been involved in the delivery of Reef Plan. The characteristics, strengths and limitations of these formal collaborative partnerships are summarised in Table 5 below.

Table 5 Characteristics, influence and effectiveness metrics of formal collaborative partnerships

Formal collaborative *partnerships* tackling GBR water quality policy and programs are generally characterised by:

- * Officially sanctioned processes and rules of consensus-building and policy change
- * Fairly stable membership based on individuals who can legitimately represent organisations
- * An extended time period of sustained activity, typically six months to two years or longer
- * Considerable investment of human and financial resources, such as a formal secretariat
- * Mechanisms to ensure accountability (e.g. MoUs, record-keeping of decisions)
- * A heavy reliance on credible scientific and technical information

Formal collaboratives are most effective:

- * In creating an accountable environment through which the legitimacy and adequacy of institutional practice is open to scrutiny, assistance and improvement over time
- * In translating policy-relevant information through knowledge-policy boundary work
- * At enabling processes of individual and institutional learning as a result of sharing, negotiating and co-producing policy-relevant information

The effectiveness of formal collaboratives is limited when:

- * Policy change is disconnected from collaborative processes
- * Support and mandate from policy leadership is weak
- * Key organisations choose not to participate, or are excluded from participating
- * Time and resources to build and maintain legitimacy are not available
- * Partner commitment to shared responsibility and accountability for agreed directions and actions is limited or inconsistent
- * Partners are unable to lead change through the partnership and their own organisations
- * Slow formal processes limit capacity to provide salient information for political decisions

Informal collaborative networks operate alongside the formal partnerships described above. The dynamic policy environment of Reef Plan has demonstrated the influence of these networks on a series of policy changes over the past five years. The characteristics, strengths and limitations of these informal collaborative networks are summarised in Table 6 below.

Table 6 Characteristics, influence and effectiveness metrics of informal collaborative networks

<p>Informal collaborative networks involved in GBR water policy decision-making are characterised by:</p> <ul style="list-style-type: none"> * Unstated, loose rules of consensus building and strategies for policy change * A highly dynamic membership that reflects individual interests, capacity to participate, and strong links to relevant information or policy-making networks * Their highly ephemeral nature – very active in response to institutional or policy change opportunity, and subsequently disperse or turn dormant * Limited human and financial resources, but members rely on links with other partnerships and networks to inform collaborative pathways and implementation strategies * A heavy reliance on salient scientific, political and operational information <p>Informal collaborative networks are most effective:</p> <ul style="list-style-type: none"> * Because the flexibility of their operations and objectives can adapt to fit for single policy decisions or institutional change directives * Through the use of multiple policy change pathways, (e.g. media, social networks, political advocacy) * Through the effective use and targeting of salient information at multiple points of political decision-making * By brokering knowledge through individual collaborators involved in the political processes of policy formulation * Through their reliance on the boundary work of formal collaborative partnerships to enhance perceptions of their credibility and legitimacy <p>The effectiveness of informal collaborative networks is limited when:</p> <ul style="list-style-type: none"> * Lack of transparency and accountability produces the perception that these networks are undemocratic, with the associated risk of reduced legitimacy and credibility * They effect change without also generating the will and capacity to implement it
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Formal and informal collaborations potentially provide complementary roles in facilitating policy implementation and policy change, respectively. Formal collaborations have been involved in the slow, steady build of shared knowledge and understanding that has contributed to the development of trust and social capital between partners. While the tangible influence of institutional collaboration on a particular action provides the visible evidence of effectiveness, the less visible changes in relationships that occur through sustained dialogue and negotiation are more powerful than immediate outcomes suggest. The recent policy initiatives in particular have utilised the outcomes of formal collaborations in guiding policy change (albeit facilitated through the informal networks). As Forester

(1989:71) notes, collaborative interaction “not only produces a result, it also reproduces, strengthening or weakening, the specific social working relations of those who interact”.

The political significance of formal collaborative partnerships at the policy level exercises a distinct influence on the behaviour of all participants, and may partly explain the respective roles of formal and informal collaborations observed in the GBR. In a comparison of USA and Australian experiences, Robinson et al. (in press) highlighted the following, distinct characteristics of policy-level collaboratives versus local-scale collaboration:

- While relationships remain important, policy-level collaborations are more formalised and closely related to political and legal processes.
- Formal organisational participation potentially involves many vertical and horizontal linkages within and across organisations and levels of government, which makes decision-making cumbersome and slow.
- The political and legal consequence of policy decisions requires a strong scientific foundation, which may raise tensions between the types and scales of ‘evidence’ considered (scientific versus experiential, broad scale versus local scale).
- Implementation of policy-level collaborative decisions relies on the negotiation of government policies and programs rather than generation of new capacity, and may also involve linkages to ‘lower-level’ collaboratives for program delivery.

Formal collaborations at the policy level are thus heavily influenced by the proximity to political processes, with significant implications for all participants. Governments must be seen to be accountable to their Ministers and the public for their decision-making, and not be perceived as ‘captive’ of any particular interest group. Similarly, non-government organisations must manage their engagement with government and the interests and perceptions of their constituents (i.e. members and investors). This accounts for some of the slow speed of decisions and agreements through formal processes.

Another facet of the formal collaborative relationships is the resulting strength of the decisions and agreements made through them. While the political process may over-ride what has previously been agreed, there would be a political risk in being seen to act inconsistently. This is obviously less of a risk when a change in government occurs, as this is more legitimately associated with a perceived mandate for change. Nonetheless, the steady build of collaborative knowledge and agreements may provide a foundation for policy change that is, on balance, more likely to be consistent with previous processes and decisions than might otherwise be the case. Operating as a boundary organisation to facilitate the way in which knowledge is used and co-produced can strengthen the stability of relationships through being “accountable and responsive to external opposing forces” (Guston 2001: 402).

3.2. Using knowledge to make collaborative policy-level decisions

The distinctive and yet interconnected roles of formal partnerships and informal alliances in this study suggests that the types of ‘institutional architecture’ to support effective knowledge sharing and policy influence may involve different types of networks and links that are embedded in wider contexts (Vogel et al. 2007). The relationships of formal partners in a knowledge–action system may be better understood as arenas of shared responsibility, which are embedded within wider networks of power and knowledge that change over time (van Kerkhoff and Lebel 2006).

Of particular interest to this study is the boundary work features of these collaborative efforts whereby a mix of local, bureaucratic and scientific or technical systems of knowledge is used in environmental decision making. The knowledge attributes of legitimacy, credibility and salience (Cash et al. 2001) provide a framework for understanding the impacts of collaborative processes on the translation of knowledge to action at the policy-level. The following discussion summarises the characteristics and impacts of formal partnerships and informal networks collaborating in the GBR ascertained through the present research, and synthesises the implications for collaborative governance.

The design of formal collaborative partnerships as arrangements for the production and use of knowledge is mainly focused on ensuring their legitimacy (e.g. via mechanisms of accountability, stakeholder representation, authoritative rules, and evidence-based process). These characteristics aim to ensure that the processes of knowledge production and decision-making are unbiased, and meet standards of political and procedural fairness.

A key aspect of legitimacy is trust. Trust between the producers and users of policy-relevant knowledge are critical to its production, acceptance, uptake, diffusion and use. Trust requires time to develop, and this is difficult if the individuals involved, positions taken or behaviour observed changes frequently or appears inconsistent. Legitimacy is also strongly influenced by the participation of key stakeholders, which can be limited by the exclusion of some institutions. Alternatively, institutions may choose not to participate in order to not legitimise the outcomes.

Credibility is particularly important where there is scientific complexity, uncertainty and dispute. Credibility can be demonstrated by scientific consensus, both in defining the problem and providing justification for action. Knowledge-brokers become important in the translation and communication of science for policy, and between partners. Formally, this process may be supported by science panels, but individuals also play a critical role, particularly in the capacity to provide relevant information for political and policy decisions (in both formal partnerships and informal networks).

The ability of informal networks to influence policy change in the GBR stemmed from their ability to provide salient information to decision-makers. Typically, this involves multiple forms of knowledge, including the practicality, feasibility, cost and political consequences of policy change, as well as the scientific basis. The informal networks appeared to be active when political circumstances, such as elections, provided opportunities for major policy change.

Formal partnerships and informal networks interact in the dynamic reef policy arena. Collectively they have delivered legitimate, credible and salient information to inform policy change. At the same time, however, this research indicates that formal collaborative efforts need to recognise and manage the changing policy context, emerging knowledge and the operation of the informal networks in influencing policy change.

Formal collaborative partnerships, such as the Reef Water Quality Partnership, appear to offer many benefits for addressing the challenges of institutional fragmentation. While these processes have been slow and challenged by poor participation and leadership, nevertheless a common understanding has been built across institutions, activities have been coordinated and policy refined. The formalisation of these collaborations ensures that they are transparent and therefore democratic and defensible.

In comparison, informal networks have been very effective at influencing political and policy changes by providing critical information in a timely manner to decision-makers. The informality of the network means that its operation (and the information) it provides is not open to scrutiny, and is thus undemocratic in a formal sense. These networks are not typically involved in program alignment and delivery beyond the 'tipping point' of policy change – a situation which may mean they are less cognisant of the consequences of such change.

Thus, both formal and informal collaborations act as critical filters and mechanisms which influence perceptions of the credibility, salience and legitimacy of the evidence used for decision-making. Formal partnerships can negotiate improved credibility of information through consensus-building, although stakeholders excluded from the process are unlikely to accept its legitimacy. Informal networks have proven adept at providing salient information for political decisions, although its credibility and legitimacy can be questioned.

The key challenge for formal collaborative governance is thus to provide a democratic balance to the operation of the informal network in the arena of policy change. This will require attention to the legitimacy problems that may arise in formal collaboratives too, such as those associated with exclusion and the 'deadening' of institutional representation by

passive participation. In this regard, the steady build of agreed knowledge and negotiated actions in formal collaboratives is also beneficial because it can limit the potential for 'rogue' decisions based on poor (though salient) information. Weak leadership and limited participation in formal collaborative governance creates opportunities (and drivers) for an active informal network to effect change when political opportunities arise.

Table 7 Impacts of formal and informal policy-level collaborations on perceptions of knowledge credibility, legitimacy and salience

Collaboration influences the credibility of knowledge:

- * Policy-level collaboratives are highly reliant on robust scientific information
- * Collaboration offers a mechanism to integrate diverse expertise for policy responses to 'wicked' problems
- * Collaborations may gather, translate and co-produce scientific information for multiple purposes, linking scales from policy to on-ground management

Collaboration influences the legitimacy of knowledge:

- * Inclusion is an effective mechanism to ensure the knowledge base incorporates appropriate values
- * By providing some stability in a dynamic environment, collaborations offer a place for building trust
- * Formal collaborations offer an opportunity for early testing and refinement of policy initiatives with stakeholders

Collaboration influences the salience of knowledge:

- * Salient knowledge for policy change includes science, alongside considerations of capacity, resourcing, risks and political implications
- * Windows for policy change are ephemeral and informal networks respond rapidly to these opportunities
- * Salient information for policy implementation is focused on opportunities to better align existing initiatives for enhanced outcomes

The research summarised in this paper suggests that the significant knowledge that scholars and practitioners have developed regarding collaborative efforts focused on small-scale activities cannot be readily mapped onto policy-level arrangements. The proximity to political arenas frames collaboration at this level and drives many of the constraints reported by participants. Based on deliberations surrounding water policy development and reform in the GBR, it is apparent that institutional collaboration can be fostered through formal partnerships and informal institutional networks. Both mechanisms of collaborative governance are highly dynamic and adaptive – even formal arrangements have evolved into other consensus-building structures, making it difficult to evaluate the efficacy of a particular group or arrangement.

The role of collaborative structures and alliances in undertaking boundary work that facilitates the transfer of knowledge for environmental decision-making has been of particular interest to this study. At the policy-level, collaborations in the GBR have demonstrated a high reliance on the integration and translation of scientific, political and bureaucratic systems of knowledge. We found that the formal and informal mechanisms of collaboration in the GBR played distinct (but closely related) roles in decision-making through negotiating the thresholds of sufficient credibility, legitimacy and salience to generate policy action responses. The relative strengths of the two modes of collaboration in the GBR appear to be

in negotiating knowledge for policy change (informal networks) and policy implementation (formal partnerships). Managing this duality highlights some potential risks in the evolving governance of environmental resources. While there is no simple solution to this governance conundrum, mechanisms that recognise and actively manage the benefits and weaknesses of both formal and informal collaborations offer an approach to the development and delivery of more effective and legitimate public environmental policy.

REFERENCES

- Cash, D.W. (2001) In order to aid in diffusing useful and practical information: Agricultural extension and boundary organisations. *Science, Technology and Human Values* 26, 431–453.
- Cash, D.W., and Moser, S.C. (2000) Linking local and global scales: designing dynamic assessment and management processes. *Global Environmental Change* 10, 109–120.
- Cash, D., Clark, W.C., Alcock, F., Dickson, N., Eckley, N., and Jaëger, J.S. (2002) Credibility, Legitimacy and Boundaries: Linking Research, Assessment and Decision Making. *KSG Working Papers Series RWP02-046*. Available at SSRN.
- Cash, D.W., Borck, J.C. and Patt, A.G. (2006) Centering the loading dock approach to linking science and decision making: Comparative analysis of El Nino/Southern Oscillation (ENSO) forecasting systems. *Science, Technology & Human Values* 31, 465-94.
- Clark, W.C. and Holliday, L. (2006) Linking Knowledge with Action for Sustainable Development. (National Research Council of the National Academies, Washington DC). Available at www.nap.edu/catalog.php?record_id_11652.
- Farrell, A.E. and Jaëger, J. (eds.) (2006) *Assessments of Regional and Global Environmental Risks: Designing Processes for the Effective Use of Science in Decision making*. Resources for the Future, Washington, DC.
- Forester, J. (1989). *Planning in the face of power*. University of California Press, Berkeley.
- Freeman, D.M. (2000) Wicked water problems: Sociology and local water organisations in addressing water resources policy. *Journal of the American Water Resources Association*, 36, 483-491.
- Friedmann, J. (1987) *Planning in the Public Domain from Knowledge to Action*. Princeton University Press, Princeton.
- Genskow, K.D. and Born, S. M. (2006) Organisational dynamics of watershed partnerships: A key to integrated water resources management. *Journal of Contemporary Water Research & Education*, 135: 56-64.
- Gray, B. (1985) Conditions facilitating inter-organisational collaboration. *Human Relations* 38, 911-936.
- Guston, D.H. (2001) Boundary Organisations in environmental policy and science. An introduction. *Science, Technology and Human values* 26(4), 399-08.
- Healey, P. (1987) *Collaborative Planning. Shaping Places in Fragmented Societies*. MacMillan, New York.
- Healey, P. (2008) Knowledge flows, spatial strategy making, and the roles of academics. *Environment and Planning C: Government and Policy* 26, 861-81.
- Heikkila, T. and Gerlak, A.K. (2005) The formation of large-scale collaborative resource management institutions: Clarifying the roles of stakeholders, science, and institutions. *Policy Studies Journal* 33, 583- 612.
- High, C., Slater, R. and Rengasamy, S. (2006) Are shadows dark? Governance, informal institutions and corruption in rural India in L. Cheshire, V. Higgins & G. Lawrence, (eds.) *Rural Governance: International Perspectives*. Routledge, Abingdon.
- Holmes, J.H. (1994) Changing values, goals, needs and expectations of rangeland users. *Rangeland Journal* 16, 147- 154.
- Ingram, H. and Bradley, B. (2006) Water sustainability: Policy innovation and conditions for adaptive learning. Draft discussion paper for the SMEP Academy, November 18- 19, 2006.

- Jasanoff, S. (2004) (eds.) *States of Knowledge: The Co-production of Science and Social Order*, Routledge, Abingdon.
- Kingdon, J. (1984) *Agendas, Alternatives and Public Policy*. Boston, MA, Little, Brown.
- Koontz, T.M., Steelman, T.Q., Carmin, J.A., Korfmacher, K.S., Moseley, C., (2004) *Collaborative Environmental Management: What Roles for Government? Resources for the Future Press: Washington, DC.*
- Kroon, F.J., Robinson, C.J. and Dale, A.P (2009) Integrating knowledge to inform water quality planning in the Tully-Murray basin, Australia. *Marine and Freshwater Research* 60, 1183- 88.
- Kristjanson, P., Reid, R.S., Dickson, N., Clark, W.C., Romeny, D. et al. (2009) Linking international agricultural research knowledge with action for sustainable development. *Proceedings of the National Academy of the Sciences of the United States of America* 106, 5047-52.
- Lane, M.B., McDonald, G.T. and Morrison, T. (2004) Decentralisation and Environmental Management in Australia: A comment on the prescriptions of the Wentworth Group, *Australian Geographical Studies* 42, 102-114.
- Lane, M.B. and Robinson, C.J. (2009) Institutional complexity and environmental management: the challenge of integration and the promise of extra-regional collaboration. *Australasian Journal of Environmental Management* 16, 27- 35.
- Litfin, K.T. (1994) *Ozone Discourses*. New York: Columbia University Press.
- Margerum, R.D. (2008) A typology of collaboration efforts in environmental management, *Environmental Management*, 41, 487- 500.
- McNie, L. and Elizabeth, C. (2007) Reconciling the supply of scientific information with user demands; An analysis of the problem and review of the literature. *Environmental Science and Policy* 10, 17–38.
- Medd, W. and Marvin, S. (2008) Making water work: Intermediating between regional strategy and local practice. *Environment and Planning* 26, 280-299.
- Miles, E.M., Snow, C.C. and Miles, G (2000) TheFuture.org *Long Range Planning* 33, 300-321.
- Miller, C. (2001) Hybrid management: boundary organisations, science policy, and environmental governance in the climate regime. *Science, Technology and Human Values* 26, 478 - 500.
- Morrison, T.H. and Lane, M.B. (2005) What whole-of-government means for environmental policy and management: An analysis of the connecting government initiative. *Australasian Journal of Environmental Management* 12, 47 - 54.
- Moss, T., Medd, W., Guy, S. and Marvin, S. (2009) Organising water: The hidden role of intermediary work. *Water Alternatives* 2, 16 - 33.
- Neuman, M. (2007). Multi-scalar large institutional networks in regional planning. *Planning Theory and Practice* 8, 319-344.
- Olsson, P., L. H. Gunderson, S. R. Carpenter, P. Ryan, L. Lebel, C. Folke, and C. S. Holling (2006) Shooting the rapids: navigating transitions to adaptive governance of social-ecological systems. *Ecology and Society* 11, 18. [online]
[URL:http://www.ecologyandsociety.org/vol11/iss1/art18/](http://www.ecologyandsociety.org/vol11/iss1/art18/)
- Olsson, P., Folke, C., Hughes, T. (2008) Navigating the transition to ecosystem-based management in the Great Barrier Reef, Australia, *Proceedings of the National Academy of Sciences of the United States of America* 105, 9489 - 9494.
- Owens, S. and Rayner, T. (1999) 'When knowledge matters': The role and influence of the Royal Commission on Environmental Pollution. *Journal of Environmental Policy & Planning* 1, 7 - 24.

- Owens, S., Petts, J. and Buckley, H. (2006) Boundary work: knowledge, policy and the urban environment. *Environment and Planning C: Government and Policy* 24, 633 - 643.
- Pahl-Wostl, C., Kabbat, P. and Moltgen, J. (2008) *Adaptive and Integrated Water Management: Coping with Complexity and Uncertainty*. Springer, Berlin.
- Radaelli, C.M. (1995) The role of knowledge in the policy process. *Journal of European Public Policy* 2, 159 - 183.
- Rhodes, R. (1997) *Understanding Governance: Policy Networks Reflexivity and Accountability*. Open University Press, Buckingham.
- Robinson, C.J., Taylor, B.M., Pearson, L., O'Donohue and M., Harman, B. (2009) A SMART Assessment of Water Quality Partnership Needs in Great Barrier Reef Catchments. *Australasian Journal of Environmental Management* 16: 84 - 93 .
- Robinson, C.J., Margerum, R.D., Koontz, T.M., Mosley, C. and Lurie, S. (in review). Policy-level collaboratives for effective environmental management: Lessons and Challenges from Australia and the United States, *Society and Natural Resources*.
- Roux, D.J., Rogers, K.H., Biggs, H.C., Ashton, P.J. and Sergeant, A. (2006) Bridging the science-management divide: moving from unidirectional knowledge transfer to knowledge interfacing and sharing. *Ecology and Society* 11, 4.
- Steyaert, P and Jiggins, J. (2007) Governance of complex environmental situations through social learning: a synthesis of SLIM's lessons for research, policy, and practice. *Environmental Science and Policy* 10, 575 - 586.
- van Kerkhoff, L. and Lebel, L. (2006) Linking knowledge and action for sustainable development. *Annual Review of Environmental Resources* 31, 12.1–12.33.
- Vogel, C., Moser, S.C., Kasperson, R.E. and Dabelko, G.D. (2007) Linking vulnerability, adaptation and resilience science to practice: Pathways, players, and partnerships. *Global Environmental Change* 17, 349 - 364.
- Wondolleck, J. M. and Yaffee, S. L. (2000) *Making Collaboration Work: Lessons from Innovation in Natural Resource Management*. Island Press, Washington, D.C.

APPENDICES

Appendix 1: Survey and interview questions

The CSIRO Natural Resource Planning Unit is conducting research on the role of adaptive and collaborative approaches in water quality planning in the Great Barrier Reef. Details of the project objectives and team are attached.

This survey aims to capture your perspectives on the development of Reef Plan and the evidence and collaborations that have triggered major policy changes since 2003.

This survey is being sent to a **selection of individuals who have recognised expertise and a history of involvement in Reef Plan issues** .

We would appreciate it if you fill out your response to questions below that ask questions about each of the three key phases of Reef Plan development:

1. The current government response to Reef Plan (e.g. Reef Rescue investments and proposed regulatory framework)
2. The engagement of regional water quality planning
3. The establishment of Reef Plan.

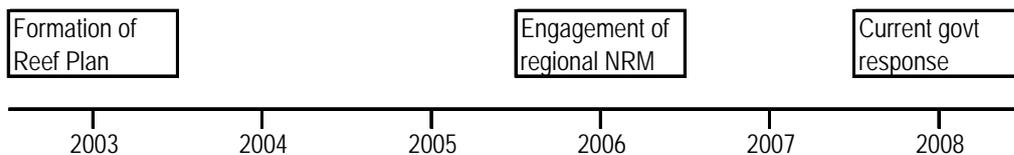


Figure 1. Timing of 3 key phases of Reef Plan

Three questions will be asked for each of the three phases:

1. The evidence used to inform changes in the plan or strategies
2. The key institutions involved
3. The nature and contribution of effective collaborations in this process

Your contributions will remain confidential. If you are willing and available, we would like to discuss your survey response further by subsequent interview. If you have any questions please [insert names and contact details].

Your response by email would be appreciated by [insert date]. If you don't wish to participate, please advise by return email.

1. Current Govt response (late 2008 onwards)

Recently the Australian Government committed \$200M through the Reef Rescue Plan to accelerate the adoption of proven agricultural 'best management practices' for the benefit of the reef. At the recent reef summit the Queensland Government committed to the development of a regulatory framework to manage agricultural impacts on reef water quality.

What was the key evidence used to inform these changes in GBR-scale planning and strategies, and what institution/s provided it? (e.g. science, industry, policy knowledge)

Who were the key institutions involved in the planning change?

Can you identify effective institutional collaborations that contributed to this planning change, (e.g. formal arrangements and informal alliances). Why were these collaborations effective?

2. Engagement of regional NRM (2005 onwards)

In 2005-2006 DEWHA commenced the contracting of regional NRM bodies in GBR catchments to develop Water Quality Improvement Plans. The Reef Water Quality Partnership was formed to enhance collaboration between regional NRM bodies and Queensland and Australian Governments.

What was the key evidence used to inform these changes in GBR-scale planning and strategies, and what institution/s provided it? (e.g. science, industry, policy knowledge)

Who were the key institutions involved in the planning change?

Can you identify effective institutional collaborations that contributed to this planning change, (e.g. formal arrangements and informal alliances). Why were these collaborations effective?

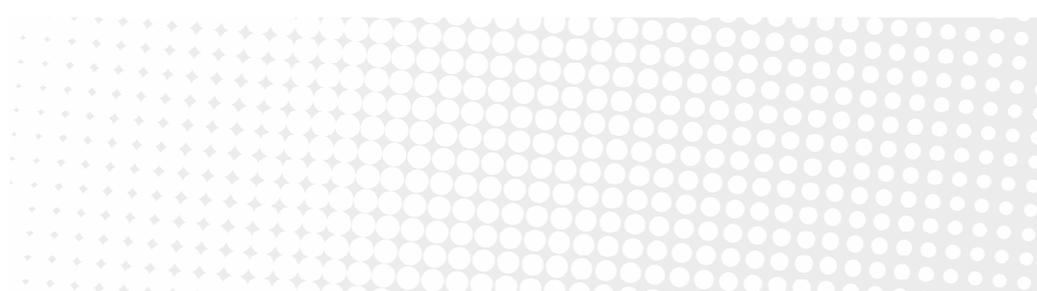
3. Formation of Reef Plan (2003 onwards)

The bilateral Reef Water Quality Protection Plan was developed to manage diffuse agricultural impacts on GBR water quality. The Reef Plan was launched in 2003.

What was the key evidence used to inform these changes in GBR-scale planning and strategies, and what institution/s provided it? (e.g. science, industry, policy knowledge)

Who were the key institutions involved in the planning change?

Can you identify effective institutional collaborations that contributed to this planning change, (e.g. formal arrangements and informal alliances). Why were these collaborations effective?



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