Accepted Manuscript

Enhancing the Knowledge-Governance Interface: Coasts, Climate and Collaboration

Beverley Clarke, Laura Stocker, Brian Coffey, Peat Leith, Nick Harvey, Claudia Baldwin, Tom Baxter, Gonni Bruekers, Chiara Danese Galano, Meg Good, Marcus Haward, Carolyn Hofmeester, Debora Martins De Freitas, Taryn Mumford, Melissa Nursey-Bray, Lorne Kriwoken, Jenny Shaw, Janette Shaw, Tim Smith, Dana Thomsen, David Wood

PII: S0964-5691(13)00034-3
DOI: 10.1016/j.ocecoaman.2013.02.009
Reference: OCMA 3176

To appear in: Ocean and Coastal Management


This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.
Enhancing the Knowledge-Governance Interface: Coasts, Climate and Collaboration

Authors:
Beverley Clarke¹
¹Faculty of Science and Engineering
Flinders University
GPO Box 2100, Adelaide, South Australia 5001
beverley.clarke@flinders.edu.au

Laura Stocker² CORRESPONDING AUTHOR
²Curtin University Sustainability Policy Institute
Curtin University
GPO Box U1987
Perth, Western Australia 6845
Tel: +61 8 9266 9034
Fax: +61 8 9266 9031
Mobile: 0439 311 043
L.Stocker@curtin.edu.au

Brian Coffey³
³School of Humanities and Social Sciences
Deakin University
Warrnambool Campus
P O Box 423
Warrnambool, Victoria, 3280
brian.coffey@deakin.edu.au

Peat Leith⁴
⁴University of Tasmania
Private Bag 78, Hobart, Tasmania 7001
Peat.Leith@utas.edu.au

Nick Harvey⁵
⁵Humanities and Social Sciences
The University of Adelaide
South Australia 5005
nick.harvey@adelaide.edu.au

Claudia Baldwin⁶
⁶Faculty of Arts and Business
University of Sunshine Coast
Locked Bag 4, Maroochydore DC
Queensland 4558
cbaldwin@usc.edu.au
Tom Baxter\textsuperscript{7}
\textsuperscript{7}School of Accounting & Corporate Governance
University of Tasmania
Private Bag 86, Hobart, Tasmania 7001
Tom.Baxter@utas.edu.au

Gonni Bruekers\textsuperscript{8}
\textsuperscript{8}Curtin University Sustainability Policy Institute
Curtin University
GPO Box U1987
Perth, Western Australia 6845
gbruekers@bigpond.com

Chiara Danese Galano\textsuperscript{9}
\textsuperscript{9}Curtin University Sustainability Policy Institute
Curtin University
GPO Box U1987
Perth, Western Australia 6845
chiara.daneseagalano@postgrad.curtin.edu.au

Meg Good\textsuperscript{10}
\textsuperscript{10}Faculty of Law
University of Tasmania
Private Bag 89, Hobart, Tasmania 7001
Meg.Good@utas.edu.au

Marcus Haward\textsuperscript{11}
\textsuperscript{11}Institute for Marine and Antarctic Studies
University of Tasmania
Private Bag 129
Hobart, Tasmania 7001

Carolyn Hofmeester\textsuperscript{12}
\textsuperscript{12}Curtin University Sustainability Policy Institute
Curtin University
GPO Box U1987
Perth, Western Australia 6845
carolyn.hofmeester@postgrad.curtin.edu.au

Debora Martins De Freitas\textsuperscript{13}
\textsuperscript{13}Australian National Centre for Ocean Resources and Security University of Wollongong
Wollongong, NSW 2522
debara@uow.edu.au

Taryn Mumford\textsuperscript{14}
\textsuperscript{14}Humanities and Social Sciences
The University of Adelaide  
South Australia 5005

taryn.mumford@adelaide.edu.au

Melissa Nursey-Bray  
15 Humanities and Social Sciences
The University of Adelaide  
South Australia 5005
Melissa.Nursey-Bray@adelaide.edu.au

Lorne Kriwoken  
16 School of Geography and Environmental Studies
University of Tasmania
Private Bag 50, Hobart, Tasmania 7001
L.K.Kriwoken@utas.edu.au

Jenny Shaw  
17 Curtin University Sustainability Policy Institute
Curtin University
GPO Box U1987
Perth, Western Australia 6845
ejenny.shaw@postgrad.curtin.edu.au

Janette Shaw  
18 Australian Maritime College,
University of Tasmania
Locked Bag 1399
Launceston, Tasmania 7250
jrshaw@amc.edu.au

Tim Smith  
19 Sustainability Research Centre
University of Sunshine Coast
Locked Bag 4
Maroochydore DC, QLD 4558
tsmith5@usc.edu.au

Dana Thomsen  
20 Sustainability Research Centre
University of Sunshine Coast
Locked Bag 4
Maroochydore DC, QLD 4558
dthomsen@usc.edu.au

David Wood  
21 DVC International
Curtin University
GPO Box U1987
142  Perth, Western Australia 6845
143  D.Wood@curtin.edu.au
144
Abstract
Conventional systems of government have not been very successful in resolving coastal management problems. This lack of progress is partially attributable to inadequate representation in governance processes of the variety of knowledges present on the coast. In particular there has been a struggle to engage effectively with climate science and its implications. There has also been a broader failure to capture the complexity of voices, interests, values, and discourses of coastal users. We argue here that coastal governance challenges are not likely to be resolved by singular solutions; rather, interaction and collaboration will generate improvements. We suggest that a co-requisite for progress in coastal management is the development of institutions and processes that enable different knowledges to have a bearing on governance processes. This paper examines a selection of the many opportunities available to broaden and enhance the use of knowledge in decision-making for the coast. A description is provided of emerging elements of coastal governance from an Australian perspective, together with new types of institutions, processes, tools and techniques that may help to achieve an improved coastal knowledge-governance interaction.
1. Introduction

Despite considerable effort over several decades effective governance of the coastal zone remains a considerable challenge in many parts of the world (Sorensen 1997, Agardy and Alder 2005), including Australia (Harvey and Caton 2003; State of the Environment 2011 Committee, 2011; Stocker et al., 2012b). Given the complexity and dynamism of the biophysical processes shaping the coast, the variety of administrative processes for managing the coast, and the diversity of stakeholders with an interest in matters related to the coast (Green and Penning-Rowsell 1999, Cicin-Sain and Knecht 1998, Kay and Alder 2005) this should not be a surprise. Under circumstances such as these it is clearly imperative, and yet a considerable challenge, to make the best use of the rapidly expanding information and knowledge that is available. However, as we will explore, achieving effective knowledge uptake requires both receptive governance processes and accessible knowledge systems. Accordingly, we analyze Australia’s coastal governance system in relation to knowledge generation, exchange and uptake, and suggest foci for improvement within an uncertain and complex coastal system, especially in the face of climate change. Both formal and informal institutions of governance are considered within our discussion.

In Australia, as elsewhere, effective governance of coastal areas is challenged by: complexity of natural coastal systems; diverse uses of coastal areas; diverse jurisdictions (e.g. international, Commonwealth, state, local) and administrative bodies with coastal responsibilities (e.g., shipping and ports, planning, biodiversity management, fishing, recreation); diverse ways of understanding and appreciating coasts (Stocker and Kennedy, 2009); and diverse perspectives on how it should be governed, managed, and used (Harvey and Caton, 2003; Stocker et al., 2012a). Reliance on linear or ‘loading dock’ approaches to transferring
knowledge to governance is likely to be ineffective (Cash, Borck and Patt, 2006). Rather, there is much to be gained from bringing different disciplinary perspectives to bear on coastal governance, expanding institutional capacity and enabling varied stakeholder engagement approaches, notwithstanding the considerable challenge that this represents.

We argue here that:

- conventional systems of government have not adequately responded to, or represented, the variety of voices and knowledges present on the coast
- more collaborative approaches to governance that incorporate these voices and knowledges are required
- processes, tools and techniques are available that can help support the adoption of more collaborative approaches.

We expand upon these arguments by first considering some of the conceptual underpinnings to enhanced knowledge uptake in coastal governance. Second, we discuss aspects of Australian coastal government and governance (and its shortcomings). Third, we consider some of key challenges which limit the effective use of knowledge in coastal governance, with a particular focus on knowledge uptake in relation to climate change. Finally, emerging elements of Australian coastal governance are described and some newer processes tools and technologies for an improved knowledge-governance interface are presented and illustrated through case examples. While the focus of our analysis is on coastal governance in Australia, we expect that the insights provided may have relevance for other jurisdictions.
2. Conceptual background

This section considers some of the conceptual underpinnings associated with the use of knowledge in coastal governance, and how knowledge uptake may be enhanced.

2.1. Epistemological bases

The challenges for coastal governance presented by issues such as climate change require epistemologies capable of dealing with complex social ecological systems and ramifying relationships. First, Funtowicz and Ravetz (1993), in their work on post-normal science, highlight that particular kinds of research may be appropriate for answering particular questions in particular situations, and not others. For example, in the case of coastal adaptation to climate change, where decision stakes are high and system uncertainty great, applied science and technical consultancies alone may be of limited value. By contrast, research that is participatory, acknowledges local knowledge and recognizes the importance of values may be more effective, or may complement any technical studies. Second, a broader perspective on coastal knowledge and the practice of science is evident in the guiding principles of sustainability science, which emphasizes: an issue-driven agenda; co-production of knowledge; interdisciplinary and transdisciplinary approaches; acknowledging earth system complexity; focusing communication and research activities at the local level; and focusing on social learning rather than definitive answers (Cummins and McKenna, 2010). Third, in contrast to the traditional ‘science-first model’ approach which elevates ‘science’ above other knowledge systems (Kelsey, 2003), there is benefit to be gained by adopting broad and more engaged and interactive forms of coastal inquiry (Leith et al., 2012) producing outputs from a variety of sources and perspectives. This approach can also lead to better sharing and communication of lay, managerial, Indigenous and scientific knowledge about the coast.
2.2. **Cognitive and psychological bases**
Transformation of coastal governance systems to account for knowledges such as climate science will require a greater awareness of how this knowledge is received, interpreted and socially constructed. From a transactional psychology perspective (Altman and Rogoff, 1987; Gergen, Harré and van Langenhove, 1999), any interaction between coastal knowledge-makers and decision-makers will be situated in a particular social context: it will be guided by the cognitive and affective states of the stakeholders, and will reflect the rules and norms of social behaviour. As such these interactions are dynamic, emergent and unique (Altman and Rogoff, 1987 p.28). They are in turn shaped by deeper social-cultural forces including worldviews, as defined above (Clayton and Myers, 2009; Dunlap et al., 2000; Koltko-Rivera, 2004).

2.3. **Cultural bases**
Thus, society’s consideration of issues like coastal adaptation does not arise simply from the scientific evidence of its urgency. Rather, consideration is influenced by phenomena such as worldviews, cultural symbols and metaphors of coasts and climate change, and the historical, cultural and political context that determines which particular account is considered as the ‘truth’ (Hajer and Versteeg, 2005). Cultural meaning and context are therefore central to the discourse and narratives\(^1\) that develop around coastal adaptation. Discourse in turn has important implications for governance. The discourse around coastal adaptation should encourage the ability, indeed the responsibility, to reflect critically on itself and consider other discourses inviting a sustainable governance model that is reflexive and open to new ideas and ‘truths’ (Stocker and Kennedy, 2009).

---

\(^1\) For our purposes, a discourse is the envelope of possible truths and acceptable terms within which coastal adaptation occurs. Narratives are considered a specific category of discourse. Narratives involve a sequenced account of connected events, often in story form. Discourse is broader and can include conversations, issuing instructions, arguments, persuasions and expressive activities such as song (Harré et al. 1999).
2.4. Indigenous knowledge bases

A specific example of the impact of worldviews on knowledge production and application can be found in a comparison between Indigenous and Western perspectives. Western knowledge systems tend to be linear, sequential, and scientific, whereas Indigenous people's knowledge is more circular; their knowledge systems operate concurrently and loop/feed back to the community (Sillitoe et al., 2002). In the Western world, science is a 'common pool' resource open to all (Ostrom, 1999); by contrast, in an Indigenous context, knowledge is distributed, held and maintained by different members of society, strictly adhering to various delineations that prescribe specific responsibilities in relation to that knowledge. For example, within fisheries, certain Indigenous people have knowledge of specific fish, rules and norms for which they are partly responsible (Haggan et al., 2007).

2.5 New modes of coastal governance: collaboration and networks

We noted above the complexity of coastal systems and the benefits of considering diverse information sources and perspectives. However, a challenge of considering complexity (in issues such as coastal adaptation) is that associated knowledge tends to be emergent, dispersed, fragmentary, diverse, uncertain and with unexpected interactions (Dryzek, 2005; Duit and Galaz, 2008; Snowdon, 2002).

An effective governance model for responding to this knowledge is likely to require, in combination with institutional stability, capacities for flexibility, collaborative action and learning (Duit and Galaz, 2008). These capacities may be achieved through ‘networked governance’ which features multiple nodes and complex pathways of participant interactions including private-public-partnerships and voluntary collaborations between government, businesses and not for profit organizations (Dryzek, 2005 pp. 108-109).

Effective knowledge exchange and information flows within a governance network require a high diversity of competencies in communication, policy
analysis and subject knowledge, and high connectivity among actors in the network (Snowdon, 2002). When governance networks function effectively the collaborative development of policy between diverse and dispersed participants is possible. Deliberative processes leading to adaptive learning can support such policy development (see below). This approach involves ‘a dynamic interplay of problem solving and relational activities’ within the network (Bouwen and Taillieu (2004, p.142).

Although there is some scepticism about the level of critical analysis and empirical support for collaborative modes of governance (Backstrand et al., 2010), there are examples from natural resource management in Australia where collaborative governance is becoming the norm, often involving several government agencies, community groups and industry in decision-making (Head 2009).

3. Coastal governance in Australia
The 36,000 km of the mainland Australian coast makes it one of the longest in the world (Short and Woodroffe, 2009); it spans temperate and tropical waters and gives rise to a vast array of coastal landscapes, habitats and unique life forms. The coast also signifies Australian culture (Lazarow et al., 2008); the majority of the population (85%) lives in coastal cities and towns, most of it heavily concentrated along the east and south-east of the continent. Australia’s population will grow in coastal settlements, especially in high amenity locations (ABS, 2010). The Australian coast is also vital for the economy. Commercial fishing and coastal tourism contribute significantly to the country’s income; estuaries of Australia’s major river systems and their surrounds support port facilities serving industry and trade, and a productive agricultural sector (State of the Environment 2011 Committee, 2011).

The pressures placed upon Australia’s coastal environment correspond to broad international trends. Continued urban development in the coastal zone and agricultural expansion in water catchments bring many threatening processes. For example, there is a reduction and decline of
habitat in settled coastal areas as a consequence of vegetation clearance, near-shore water pollution, and engineering works; and fluvial introduction of chemicals and sediments. Australian coasts are also vulnerable to invasive pests, introduced by the ballast water of visiting vessels. Climate change is an emerging threat for Australia’s coasts and sea level rise is on the agenda for planning around the country.

Dealing effectively with these existing and emerging pressures is paramount because this response will shape the future of Australia’s coast.

3.1 Australia’s coastal governance system
This section outlines Australia’s coastal governance system, in order to provide a context for later sections. A multi-level system of governance has emerged in Australia to manage competing interests and enduring challenges on the coast (Lazarow et al., 2008; Stocker et al., 2012b). This coastal governance system comprises a diverse array of formal and informal institutions, organisations and stakeholders, but as we shall argue below, has not proved to be effective.

Legislation is the most formal of the institutions shaping coastal governance processes, authoritatively codifying rules which legally bind all stakeholders. Australian coastal legislation includes statutes governing: coastal policy and planning; development assessment and approval mechanisms; and the statutory bodies entrusted with these, and other, coastal management tasks (see Baird, 2011 for an overview of Australian coastal legislation).

Responsibility for governing the coast is shared unevenly across three tiers of government (Commonwealth, state and local) involving multiple interacting government agencies and other stakeholders. Governance of coasts and seas in Australia is in accordance with the United Nations Convention on the Law of the Sea (UNCLOS). Following the development of the law of the sea, Australia needed to align its international law
obligations with its Constitution (Commonwealth of Australia, 2002; Harvey et al., 2012; Kenchington et al., 2012). The alignment was achieved through the *Seas and Submerged Lands Act 1973*, followed by the Offshore Constitutional Settlement in 1979 and the related legislation that implemented it² (Commonwealth of Australia, 2002). This Settlement surrendered to the States jurisdiction over the sea and seabed within 3 nautical miles of the shoreline. The Commonwealth retains sole responsibility for Australia’s Exclusive Economic Zone (EEZ) from three to 200 nautical miles off the mainland coast (Commonwealth of Australia, 2002; Harvey et al., 2012; Kenchington et al., 2012).

The Commonwealth’s *Environment Protection and Biodiversity Conservation Act 1999* also provides substantial powers with respect to matters that affect Commonwealth waters (Harvey et al., 2012b; Kenchington et al., 2012), imposing an environmental assessment and approval regime on actions with national environmental significance, which includes impacts on Commonwealth marine areas; it also establishes regimes for marine protected areas in its waters (Commonwealth of Australia, 2002).

The Commonwealth exerts its influence on *coastal* management principally through indirect funding powers, policy development and research. The Commonwealth has funded important environmental initiatives (the Natural Heritage Trust and Caring for Our Country); some of these funds have been divested to coasts. The Commonwealth has not produced a dedicated coastal policy since 1995 (Commonwealth of Australia 1995). A National Framework for Integrated Coastal Zone Management followed in 2006 but it is described as a ‘policy without implementation’ (Wescott, 2011).

Coastal lands and waters (including the seabed) out to three nautical miles in Australia are the responsibility of state and territory governments

---

² *Coastal Waters (State Title) Act 1980* (Cth) and *Coastal Waters (State Powers) Act 1980* (Cth)
which have legislation, policies and agencies to regulate use of this zone. Table 1 provides a summary of the various legislation, policies and agencies for each of the states and the Northern Territory. Local government is broadly responsible for strategic land use planning, development approval, management of public land, coastal protection and preparation of plans for specific coastal areas (Harvey and Caton, 2003).

There are many other stakeholders, besides government, who influence decisions that affect coasts. For example, advocacy groups serve to agitate a wider community of interest, raising awareness and promoting coastal health (Wescott and Fitzsimons 2010). Such groups have the potential to use knowledge and information in powerful and targeted ways to influence political agenda and disseminate ideas. Advocacy groups therefore play an important intermediary role between formal institutions and a wider public. Two important examples of such groups presently active in Australia include: the National Seachange Taskforce, a national body representing the interests of coastal councils and communities experiencing the effects of rapid population and tourism growth; and, the Australian Coastal Society, another national body seeking to: promote knowledge and understanding of the values of Australian coast; provide a forum for discussion and debate; and build capacity of coastal managers. Both of these groups effectively lobby and contribute ideas and solutions to existing contemporary coastal management challenges (Wescott, 2011).

Universities, whilst without formal responsibility for governing coastal areas, often contain coastal scientists and policy analysts who influence coastal governance, sometimes through their formal individual roles on planning commissions or boards.
Table 1: State Coastal Governance Comparison

<table>
<thead>
<tr>
<th>State</th>
<th>Lead Agency or Body</th>
<th>Coastal Act</th>
<th>Coastal Responsibility (non Coastal Act)</th>
<th>Specific Coastal Zone Policy</th>
<th>State or Territory Department and Minister</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA</td>
<td>SA-Coast Protection Board (CPS) Primary authority on managing coast protection issues and providing advice on coastal development</td>
<td>Coastal Protection Act 1972 (This Act was to be replaced by a Coast and Marine Act) Development Act 1993 Natural Resources Management (NRM) Act 2004</td>
<td>(Policy on coastal protection and new coastal development 1991) (CSP Policy Document 2002) (South Australia’s Living Coast Strategy 2004)</td>
<td>Department of Environment and Natural Resources (DENR) Minister for Environment and Conservation Department of Planning and Local Government (for planning) Minister for Urban Development and Planning</td>
<td></td>
</tr>
<tr>
<td>WA</td>
<td>Western Australian Planning Commission (WAPC) the peak body for land use, planning and development in WA. Coastal Planning Coordinating Committee is the statutory sub-committee WAPC.</td>
<td>No dedicated legislation particular to management of the Coast or Marine Environment Planning and Development Act 2005</td>
<td>(WA Draft coastal policy 2001)</td>
<td>Department of Planning and Infrastructure is responsible for planning and development of coastal infrastructure Minister for Planning and Minister for Transport Minister for Regional Development; Lands; Minister Assisting Minister for State Development; Minister Assisting the Minister for Transport</td>
<td></td>
</tr>
<tr>
<td>TAS</td>
<td>Number of lead agencies (Integrated system) State Coastal Advisory Committee formed in 1997/98 but since 2002 there has been no effective coordinating body</td>
<td>No dedicated legislation particular to management of the Coast or Marine Environment State Policies and Projects Act 1993 Land Use Policy and Approvals Act 1993 Climate Change (State Action) Act 2008</td>
<td>(Tasmanian State Coastal Policy 1996). Binding on all spheres of government</td>
<td>Dept Primary Industries, Parks, Water and Environment (DPIPWE) Minister for Environment, Parks, Heritage and the Arts</td>
<td></td>
</tr>
<tr>
<td>NT</td>
<td>85% coastline under Aboriginal ownership No co-coordinating body for coastal matters</td>
<td>No dedicated legislation particular to management of the Coast or Marine Environment Planning Act 2009 NT Local Government Act</td>
<td>(Northern Territory Coastal Policy 2001) Main objective to enable integrated approach to management of coastal and marine zones but never endorsed.</td>
<td>The Department of Infrastructure, Planning and Environment (DIPE) Landcare Council of NT</td>
<td></td>
</tr>
</tbody>
</table>

(Source: Clarke, 2010)
Indigenous Australians have rights over some coastal lands and are often directly involved in coastal management: 90% of the Northern Territory coast is owned by Indigenous peoples. Indigenous Land and Sea Councils typically work on natural resource management projects, often in close cooperation with catchment councils and coastal community groups. Traditional owners more generally have special rights and responsibilities in relation to the coast, including the maintenance and transmission of intangible cultural heritage, such as language, stories and ceremonies about the coast (Stocker and Kennedy, 2009).

The media have the potential to increase public and political understanding and acceptance of coastal management issues. However, largely inadequate or biased media commentaries shape Australia’s unwillingness to act on critical information about, for example, sea level rise (Lambert, 2011; Manne, 2011).

Some individuals have attained high public profile through their effective communication of coastal knowledge to decision-makers. Such ‘champions’ are variously referred to as agents of change, advocates, emergent leaders or opinion leaders (Markham et al., 1991; Ottaway, 1983; Schon, 1963). Champions possess a high level of innovativeness, use their networks and powers of persuasion to informally exert influence on the activities conducted within organizations, aiding their success in promoting causes (Thompson et al., 2006). Two ‘Ministerial’ champions are identified by Wescott (2011): Senator Robert Hill who progressed Australia’s National Oceans Policy in a short time frame in the late 1990s and David Kemp who achieved a ‘sixfold increase in ‘no-take’ marine zones in the Great Barrier Reef marine park in early 2000s.

The activities of coastal volunteers have been inspirational, and therefore, significant in raising awareness and contributing to knowledge of the coast (see Clarke, 2008 who analyses Coastcare,
a high profile Australian coastal volunteer program, and Harvey and
Caton, 2003 pp.240-243). Volunteer groups and individuals have
shown their capacity to raise the profile and maintain the focus on
coastal matters of local significance when these might otherwise fall
away from organizational interests which are diverted by competing
pressures (such as budgets and other political agenda).

Individuals within their own locales and communities arguably
have a heightened awareness of and affinity for their coast, i.e. a
sense of place, and are therefore able to provide important insights
(local knowledge and values) otherwise absent from policy
development (Lazarow et al., 2008).

Informal networks exist among many of the above stakeholders,
where channels of communication often depend on personal
relationships involving trust, reciprocity and a shared history in the
field. Significantly, some voices have greater sway on decision-
making than others, such as the coastal scientist Professor Bruce
Thom in Australia who, through his informal networking and roles
on the think-tank Wentworth Group of Concerned Scientists and the
Coasts and Climate Change Council which advises the federal
government, has exerted significant influence (Stocker et al.,
2012b).

Within the gamut of institutions and organisations described above,
many forms of knowledge exist such as lay, Indigenous and
managerial knowledge, that can constructively complement
traditional ‘scientific’ knowledge as a basis for decision-making. The
different worldviews held by the various coastal stakeholders within
the coastal governance system and the ways that knowledge is
generated, constructed and transmitted have profound implications
for coastal management. In this context a worldview can be thought
of as “An integrated set of beliefs about what is real, what is
knowable, what is valuable, and what it means to be human”
(Clayton and Myers, 2009 p.20). One of Australia’s challenges as a coastal society is to develop skills and processes that enable the better understanding of diverse worldviews, and to enhance the democratization of coastal decision-making and knowledge co-production through an expanded approach to governance.

3.2 Governance rather than government for Australia’s coasts

Australia’s coasts face continued environmental, cultural, economic and social challenges (Stocker et al., 2012a) and governments have not been able to solve enduring, well-documented problems (Stocker et al., 2012b). This lack of progress is argued here to be partially attributable to inadequate representation in governance processes of the variety of voices and knowledges present on the coast. This paper therefore recognizes and supports a shift in focus from a hierarchical, government-based style of governance to a more collaborative or networked approach to governance which recognizes that decisions affecting the coast are often a reflection of the shared, collective effort of networks of government, private business, civic organizations, communities, political parties, universities, the media and the general public operating (Ansell and Gash, 2008; Bouwen and Taillieu, 2004; Hofmeester et al., 2012). A collaborative or networked approach to governance can also include the deliberation and determination of goals, including the values, norms and principles underpinning them (Jentoft and Chuenpagdee, 2009, p. 554). Thus the concept of collaborative or networked governance offers a more holistic and dynamic approach to decision-making than is provided by reliance on government alone (see section 4.5 below for further details). However, to date, although the movement from hierarchical government to a more broad-based approach to coastal governance has begun, Australia’s current system is far from fully collaborative.
4. Challenges to knowledge use in current coastal governance

Having outlined Australia’s approach to coastal governance, we now consider some challenges raised in light of the issues discussed in Section 2. We do so through exploring several of the challenges for coastal governance related specifically to knowledge uptake with regards to climate change. This is because existing coastal issues are compounded by climate change; as a result, super-wicked problems and social messes are emerging (Stocker et al., 2012b), and central to responding to such challenges is the ability to uptake diverse knowledges including climate science, into coastal decisions.

4.1 Timing of decision making and knowledge making

One of the most confounding challenges to coastal governance relates to time. Physical coastlines are affected by natural processes on time scales ranging from minutes (wave movements) to centuries (sea level). Management responses might be reactive, for example, the repair of localized storm damage; or responses might be proactive, such as planning for long-term sea level rise. Coastal governance is therefore necessarily predicated upon varying timescales. There is an additional challenge for timeliness and governance: the mismatch between first, the processes of government, which by following formal rules and patterns, need timely information through which to inform decisions affecting the coast (through policy making); and second, the generation of detailed knowledge about natural systems (through scientific research). Scientific monitoring of coastal environments frequently takes longer than most political cycles which are fixed to a regular, half-decadal rhythm. Widespread engagement and consequent decision-making for the coast requires long-term, visionary thinking (Lazarow et al., 2008). Collaborative governance, discussed above, is not straightforward or cheap, and requires (among other things)
commitment to long-term engaged dialogue and development of trusting relationships among those involved.

These requirements do not match the immediacy of governments’ needs to demonstrate tangible outputs and quick solutions that will influence electorates at the right point in the election cycle.

4.2 Agency policy and planning
Common processes used to enhance understanding between knowledge-makers and decision-makers in agency policy and planning are through workshops and committees. Advisory committees such as the Coastal Climate Change Advisory Committee (Victoria) or the Great Barrier Reef Marine Park Authority’s Catchment and Reef Advisory Committee are key examples here. A common form of knowledge transfer is through “sector representation” on such committees. While this approach can draw together various perspectives, a key challenge is to manage sectoral interests in the context of longer term priorities such as coastal environmental health, adaptation to climate change and community wellbeing. There is a requirement for better knowledge solutions that give clear options and associated risks (Cross et al., 1994; Evans and Shaw, 1986; Shaw, 2008; Shaw, 2010).

Another challenge to informed decision-making is the lack of explicit environmental objectives found in coastal plans and policy (e.g. see Shaw, 2010 for an Eastern Victorian case study). Glazewski and Haward (2005) highlight the tension between local government’s desire to increase overall rate revenue consistent with coastal development and environmental management. Explicitly addressing environmental objectives and increasing agency expertise in relation to assessment of such objectives can help resolve this tension.
4.3 Litigation and case law

Most responsibility for planning and developmental control is delegated to local government authorities who are becoming increasingly exposed to litigation in cases where they have approved poorly planned developments, including with respect to climate change impacts on the coast. The courts in Australia have become de facto policy makers in relation to coastal adaptation, where controversy exists around climate change risks to the coast. This trend has created high levels of certainty for decision-making on new coastal development in specific cases, but has created uncertainty in general because of the diverse outcomes of cases. Harvey et al. (2012a) illustrate this with case studies showing how council decisions can be either upheld as in Marion Bay, South Australia or overturned, as in Gippsland Lakes, Victoria depending on the extent to which the scientific knowledge on climate change and coastal erosion has been taken into account. Elsewhere, it has proved difficult to reject private coastal protection works initiated in response erosion and climate change, as in Byron Bay, New South Wales, where previous council actions confounded the application of climate science. The courts’ role in filling the vacuum where uncertainty exists in the knowledge-governance interface illustrates the need for climate-related policies such as planned retreat to be enshrined in legislation (Harvey et al., 2012a).

4.4 Insurance industry

Risk levels for existing and new coastal development are only partly incorporated into the knowledge-governance interface by government zoning regulations, planning guidelines and decisions. Scientific knowledge on climate change and coastal erosion is also needed by the insurance industry for risk assessment of potential damage to coastal properties and facilities. The Insurance Council of Australia (ICA) commissioned its own risk study for Australian
properties (Chen and McAneney, 2006) the results of which have become incorporated into the knowledge-governance interface at the intergovernmental level (Hennessy et al., 2007) and the national level (HORSCCCWEA, 2009) where the ICA estimated the number of coastal addresses at risk of coastal damage. The insurance industry has thus taken action to fill perceived gaps in the knowledge-governance interface. The Insurance Australia Group (IAG) has also expressed concern about potential climate-change related changes to insurance cover in coastal areas noting that land value which is not currently insured, forms a high proportion of the overall property value at the coast (IAG, 2008).

The four examples above, by no means an exclusive list, serve to illustrate how there are significant challenges in the availability and application of appropriate knowledge to coastal decision-making, and how these challenges or gaps are sometimes bridged by ad hoc or make-do processes. There are opportunities for new approaches to governance that may address the challenges of short-term versus futuristic thinking by improving engagement at the knowledge-governance interface. The following section introduces a range of possibilities.

5. Towards an improved coastal governance in Australia
This section outlines some of the practical possibilities and processes designed to support the enhanced knowledge-governance interface suggested by this paper as necessary for progressing decision making at the coast. Tools and techniques that offer means of putting theory into practice are also described.

5.1 Linking knowledge systems and new governance
Organizations and individuals can be effective agents (go-betweens) in creating dialogue, negotiating, mediating, and representing viewpoints working between knowledge-makers and decision-
makers. Organizations and individuals use a range of processes to enhance understanding between knowledge-makers and decision-makers.

5.1.1 Boundary organizations

Over the past two decades, interest has grown in boundary organizations as a way of dealing with wicked problems such as climate change adaptation that necessarily transcend scientific responses. Boundary organizations play an intermediary role between knowledge production and decision-making (in different domains and levels), with a view to achieving co-operation in relation to a shared objective (Lorenzoni et al., 2007; Guston, 2001; Cash et al., 2004). They can be organizations specifically created to provide this function or can exist within larger organizations (Cash et al., 2004).

Successful boundary organizations are institutionally set up to be accountable to at least two groups of stakeholders and are thus able to maintain a bridging position, despite external pressures, and meet the requirements of the various parties (Guston, 2001). The boundary will, however, be continually renegotiated and will shape the organization itself (Guston, 2001). According to Cash, Borck and Patt (2006), boundary organizations can help increase the salience, credibility and legitimacy across boundaries through four institutional processes, set out below.

Convening connotes the process of bringing parties together for face-to-face contact. Translation can be literal and/or metaphorical in order to provide information across boundaries of culture, language, assumptions and experiences for example. Collaboration is the process of co-producing knowledge by experts and decision-makers. Mediation represents and evaluates the different interests in such a way that the parties involved perceive fairness and procedural justice. These functions will be present in different mixes
in different systems. With the appropriate institutional design, leadership and capacity, universities and NGOs can play the role of boundary organizations whether intentionally designed in the first instance or not.

An example of a successful boundary organization in Australia is the National Sea Change Taskforce (NSCT), a body representing the interests of coastal councils and communities experiencing the effects of rapid population and tourism growth (NSCT, 2010). This coalition involves over 68 councils with the aim of providing leadership and influencing policy development for coastal areas (NSCT, 2010). The NSCT engages with three tiers of government, industry, community groups, and research institutions. The NSTC’s aim of collaboration and direct linkages between research and governance institutions helps enable sustainability learning and build adaptive capacity. As a part of a very well attended annual conference convened by the Taskforce, the Coastal Research Forum brings together coastal researchers and coastal decision-makers to share insights and strengthen communication and networking. The Taskforce supports the roles of convening, translating, mediating and collaborating to create more informed decision-making for local governments in coastal Australia. The efforts of the NSCT also inform other strategic planning processes.

5.1.2 Boundary agents

Boundary agents, or knowledge brokers, play a central role operating in the knowledge-governance space by developing influential relationships, building trust, communicating information needs and facilitating bridging the gaps among various stakeholders (McNie et al., 2008).

Boundary agents, or knowledge brokers, can be found within a variety of contexts, and their roles may be formal or informal (Pettitt et al., 2011). An example of an effective boundary agent in
the Australian coastal scene is the Executive Director of the National
Sea Change Taskforce, Alan Stokes. His goal and capacity to enable
communication and build relationships among a wide range of
decision-makers, researchers and other stakeholders make him
highly credible and respected as a boundary agent.

Consultants can also play the role of boundary agent, commonly in
relation to the representation of expert information. The format of
scientific information is not always suitable for policy-makers and
planners, so boundary spanning consultants are often employed by
government to collect, collate and translate scientific information
into an accessible locally relevant form, typically working with their
existing relationships and networks. Consultants who play this
boundary agent role advising local or state governments include
lawyers, coastal scientists or coastal engineers. However, by no
means are all consultants genuine boundary agents in the relational
sense; some play purely technical role as intermediaries.

Complex scientific knowledge can be ‘re-presented’ to be broadly
appealing or better understood through the use of visualizations,
graphics, informatics and the many other visual interactive media
now available. The role of a designer in this context is to ensure
that science communication is accurate and has integrity (Tufte,
2006 p. 9). As such designers can function as boundary agents,
although this role is poorly understood (but see Fernandez et al.,
2009). Innovative visuals require careful design because of their
power to affect consequent behaviors of the target audience (Jude,
2008). The relational role of the designer, as boundary agent, in
understanding and drawing out the intent of the scientist is as
important as the designer’s technical skills.

5.1.3 Deliberation

Deliberation is a term that implies deep and careful consideration,
often of scientific information and societal values together. In the
context of community and stakeholder engagement it emphasizes “participation, cooperation, and discourse characterized by reason-giving” (Hartz-Karp and Briand, 2009 p.4). If well facilitated, it can enable a group to span boundaries, learn in a social and trusting setting and respond adaptively to emerging challenges and phenomena. Deliberation can employ a wide variety of techniques and approaches, including many of those described in the sections below. Quality deliberation aims to build new relationships among stakeholders and even between citizens and democratic political institutions (Hartz Karp and Stocker, in press). Deliberative techniques aim to "bring together a wide range of perspectives and demographics in “an egalitarian environment that encourages mutual understanding and trust, carefully considering options and producing decisions and actions that are broadly supported and perceived to be legitimate” (Hartz Karp and Stocker, in press).

5.1.4 Adaptive learning

Typically, iterations of coastal policies, programs and projects have been ineffective in transferring learning from one phase to the next. Evaluation cycles have not been reflexive (Smith and Smith, 2006). This can be partly attributed to the mismatch of the needs of political versus environmental decision-making time cycles. Adaptive learning is a contemporary concept offering a vision for improved transference of knowledge towards improved management practice. For adaptive learning to be applied in a coastal management context there is a requirement for coastal practitioners and their organizations to be intimately connected with the dynamic social and ecological dimensions of coastal systems (Smith et al., 2009). Adaptive learning follows a process that is cyclic and incremental, with each stage providing the foundation for the next (e.g., dynamic system goals; adaptive organizational
goals, strategies and activities; reflection on goals and strategies; and networking and ideas generation). Detecting and responding to socio-ecological change must also facilitate broader system goals. This requires knowledge, creativity and vision. It also requires that organizations facilitate learning networks across various scales of learning and action (e.g., from individual to societal or local to global). By taking an approach that facilitates adaptive learning and adaptive practice, the knowledge interface between science, society and governance systems is enhanced (Smith et al., 2009). The South East Queensland ‘Healthy Waterways’ partnership (2001 – current) bases itself on an adaptive learning philosophy. It is a network of over 113 member organizations (including government, industry, research and the community) responsible for managing the water cycle from catchment to coast (SEQ Healthy Waterways, 2009). The Partnership implements five programs including monitoring, science and innovation, capacity building, education, and strategy coordination. It has won numerous awards and is recognized as a national leader for adaptive management along the catchment to coast continuum.

5.2 Tools and techniques

The sections above highlight the roles that can be taken by individuals or organizations and the processes they might employ in trying to enhance the knowledge-policy dialogue. In each of the situations described above, there is an opportunity to use specific communication, negotiation and decision-support tools. Practical examples are set out below.

5.2.1 Communication support

‘Communication support’ provides opportunities to share information and raise awareness. The information may or may not have immediate application.

5.2.1.1. Coastal research web portal
The CSIRO’s coastal research web portal is an open access Internet resource for local councils (decision-makers), other stakeholders (agents) and researchers (knowledge-makers). The portal enhances the ability of decision-makers and stakeholders to access scientific knowledge in a form that is readily understandable. It uses a spatial visualization technique to locate Australian coastal research projects. Topic based icons on Google maps are viewable at a range of scales and include topics such as mangroves, wetlands, pollution, water quality, and iconic species. Summary information for each research project is available and links are provided to various data repositories; researchers may also provide links to data directly related to the project.

5.2.1.2. Coastal conversations
According to Preston et al. (2011) sharing knowledge about the risks posed by climate change to coastal communities is considered essential for the development of robust management solutions. Identifying and implementing solutions to complex problems where uncertainty is high has been shown to require conscious and active learning among multiple stakeholders (Walters and Holling, 1990). In recognition of an increasing trend in participatory approaches to strategic planning (Brownill, 2009) the Northern Agricultural Catchments Council (NACC) in Western Australia commenced a series of communication support initiatives titled: ‘the Coastal Conversation’ in 2009 and 2011. The series represented an opportunity for local communities, land managers, and other key stakeholders in a regional area of Western Australia, to discuss the future management of their coastlines with experts in the field of coastal management, shoreline monitoring and coastal protection.

5.2.1.3. Art and community cultural development
Art and community cultural development have the potential engage the public and possibly even decision-makers in the interpretation and representation of complex ideas about coastal adaptation. While
scientific texts, figures and statistics are regarded as the most
legitimate form of knowledge for policy and management of the
coasts and seas, shifts in mind-sets are not always achievable by
cognitive, scientific or didactic methods. Emotional and affective
responses to the environmental threats can be more powerful than
government reports or scientific data (Miles, 2010). Exposure to
both the power of cognitive scientific evidence and imaginative
representations together in a variety of projects and conditions may
have a cumulative effect that leads to awareness and personal
action (Miles, 2010; Stocker and Kennedy, 2011).

5.2.2. Negotiation support
‘Negotiation support’ provides opportunities through a purpose-
designed deliberative process for participants to collectively shape
and apply information to their individual and shared purposes. It
includes the negotiated co-production of knowledge for immediate
or future application.

5.2.2.1. Participatory modelling
Participatory modeling is a technique for improving social and policy
learning about social ecological systems. It draws together a
variety of stakeholder perspectives into a single visual object to
enable collaborative description, negotiation and analysis.
Participatory modeling can be agent-based (Perez, 2009), numerical
(Jones et al., 2011), qualitative (Dambacher, 2007) or mixed
(Fulton et al., 2011). The Coastal Collaboration Cluster used
qualitative modelling (Dambacher et al., 2007) to investigate the
extent to which current coastal planning arrangements can respond
to climate change impacts such as coastal erosion and recession in
the southwest of Western Australia. The workshop drew ideas from
70 participants from diverse backgrounds. The modeller used a
whiteboard in real time, encouraging discussion and translation
across the science-governance interface, and entering both
scientific and governance variables and processes into the model (Stocker et al., 2011).

5.2.2.2. Participatory Google Earth mapping
Participatory GIS enables participants to analyze land and resource use issues, raises awareness and knowledge of sustainability and fosters good governance incorporating the principles of participation, equity and transparency (McCall, 2003).

Participatory Google Earth Mapping has been used by the Coastal Collaboration Cluster in workshops for the City of Fremantle, City of Mandurah, and Rottnest Island Authority (Hartz Karp and Stocker, in press). The mapping collaboratively identifies sustainability and climate change pathways for coastal areas. Knowledge experts present critical information on coastal and climate issues orally and in map format. In small groups, participants deliberate on and document: coastal places of importance, management hotspots, concerns about these hotspots, and proposed adaptive pathways.

The method enhances dialogue through its spatially explicit platform, its ability to engage knowledge- and decision-makers simultaneously, its ability to map qualitative and quantitative information and community values, and its ability to consider social, cultural, ecological and economic values without giving primacy to any set.

5.2.2.3. Scenario planning
Scenario analysis is a process of ‘future-casting’ designed to assist decision-making for problems where there is considerable uncertainty and where decisions have the capacity to affect a great many people. Stakeholders are required to think through an array of different futures that may come to pass. The act of creating scenarios forces participants to challenge assumptions about the future. Decisions are shaped on the most likely scenarios.
Scenarios have become a ubiquitous feature of climate change science and dialogue and are central to the science communication strategy of the IPCC (2007). In the last few years they have been used for climate adaptation planning (Dessai et al., 2005) as a way to engage stakeholders (Tompkins et al., 2008). A recent workshop carried out by the Coastal Collaboration Cluster for Western Australian Department of Sports and Recreation aimed to develop shared understandings within that agency about the implications of sea level rise, more extreme events, water shortages, temperature increase, and fossil fuel shortages to the future and present management of their core business - coastal sport and recreation in Western Australia. The workshop presented purpose-written creative stories and narrative scenarios about coastal sports and recreation under three clearly-defined climate futures. These were based explicitly on IPCC(2007) storylines, including embedded governance arrangements and social-economic structures, and used CSIRO climate projections for the region (Suppiah et al., 2007). Small groups of participants deliberated on these to develop strategic responses and practical projects (Hartz-Karp and Stocker, in press).

5.2.2.4. Visualizations
Visualizations are a factually accurate, graphical representation of numerical data that may include changes over time (animation). The most useful kinds of visualization enable an understanding of large, multivariate and interdisciplinary datasets (Ellis and Dix, 2007; Matthies et al., 2007). These visualizations in turn help provide mutual understanding between the researcher and the stakeholders affected by the research results. Visualizations can help enable novel insights for both researchers and decision-makers by providing alternative representations and consequent interpretations of the data, for example through presenting different scenarios. In relation to coastal adaptation, 3D visualizations have
proved useful in demonstrating the consequences of environmental change and fostering action (Sheppard, 2005; Paar et al., 2008). The Coastal Collaboration Cluster has worked closely with CSIRO Mathematics and Informational Sciences to produce an animation based on fluid dynamic modeling that shows the interactions among sea level rise, storm surge and catchment flooding on a hypothetical Australian estuary and adjacent coast, for use by coastal decision-makers. A proof of concept has been trialed in two workshops.

5.2.2.5. PhotoVoice

PhotoVoice involves participants taking photos according to a theme and discussing their photos in a group to reach a consensus about the message they wish to convey to decision-makers, using a selection of their photos and storyline or captions. As a result, it is a thoroughly engaging approach that fosters deliberation and learning, capacity building and empowerment. PhotoVoice has been used by a range of disciplines to understand community values and perspectives and to give the community a 'voice' - health, community development (Wang and Burris, 1997; Baker and Wang, 2006), resource management (Baldwin, 2008), and climate change (Baldwin and Chandler, 2010). It has also been used with diverse communities: youth, children, minority groups (Carlson et al., 2006; Castleden et al., 2008; Strack et al., 2004), and seniors (Baldwin et al., 2011). Such 'participant elicited data' in a visual form elicits a deeper insight into complex issues and puts participants in control of the responses. The Coastal Collaboration Cluster is using PhotoVoice to engage commercial rock lobster fishers at the Abrolhos Islands in considering the likely impacts of climate change on their industry and lifestyle.

5.2.3. Decision support

‘Decision support’ provides necessary and sufficient information and feedback to enhance the reliability and accuracy of decisions made
by managers. Management Strategy Evaluation (MSE) is a decision support mechanism that was originally used in individual sectors e.g., fisheries and forestry (Walters, 1986) and more recently in coastal zone management. MSE involves feedback mechanisms and is referred to as ‘adaptive management’.

In South-East Queensland, CSIRO worked with Healthy Waterways Partnership to develop integrated computer simulation MSE to compare the impacts of different management strategies on environmental, social and economic performance indicators related to water quality. Management actions to improve water quality resulted in proportional changes on indicators such as total nitrogen and turbidity (de la Mare et al., 2012). The costs of management actions (indicative capital and annual operating costs) are viewed alongside willingness to pay based household benefits due to and resulting from these actions, as are the environmental report cards scores and quantification of social values. The participatory workshop in which the MSE found that the process assisted decision-makers and stakeholders in not only direct knowledge but also implicit understanding of the environmental, economic and social outcomes of particular suites of management actions to improve water quality.

Earlier in this paper the wide array of voices contributing to coastal management decisions were identified. Accordingly, a final important decision-support tool for consideration is multi-stakeholder analysis. This offers a criteria-based and systematic method by which to select a sample of people, or organizations likely to be affected by a decision. It allows for the sorting of stakeholders both for their likely impact on an action and for the impact an action might have on them. This purpose of the process is to developing cooperation between the various parties engaged towards an agreed goal.
6. Conclusion: Towards more integrated coastal knowledge-governance relations

This paper has explored issues associated with knowledge—governance relations for the coastal zone and suggested enabling pathways and associated tools and technology for enhancing knowledge uptake. Conventional modes of decision-making at the coast have had limited success in terms of sustainable coastal management, experiencing numerous inhibitors such as short-term decision cycles, the uncertainty of climate change, and poor knowledge-governance interaction.

Effective coastal governance is clearly a substantial challenge, requiring action across several arenas, via a wide variety of institutions, processes, tools and techniques. It is also the case that integrated coastal knowledge-governance interactions will not happen suddenly: they may develop over time as a consequence of both conscious action and as emergent practice. Therefore, while deliberate actions can be undertaken to enhance the interactivity of coastal knowledge and governance, more collaborative coastal governance may also be supported through a more open, outward looking and collaborative culture.

Conceptually, the complexity of coastal environments and the diversity of interests, worldviews and stakeholder knowledge means that there will never be one right way in which coastal governance should occur. Furthermore, coastal governance is an ongoing process, rather than one where issues may be solved once and for all. What emerges from such a perspective is that real progress can only be made through the adoption of more interactive and collaborative forms of knowledge-governance relations: solutions will emerge from engagement and interaction rather than through imposition. Importantly, this means that the processes will never be
easy or formulaic; however, over the longer term it is possible to
develop a more robust and resilient system.

A key element in progressing such an approach is the development
of appropriate institutions and processes that enable different forms
of knowledge to have a bearing on decision making. Awareness of
the boundaries, which may be cultural, social, epistemological
boundaries, is integral to enabling such processes, and is a
necessary precondition to working more effectively. The research
being undertaken within the Coastal Collaboration Cluster
represents a modest yet significant contribution to improving
understanding of the challenges and pathways associated with
exploring how and why appropriate institutional and governance
arrangements can be developed, implemented and sustained.

**Acknowledgements**

This research is undertaken by the CSIRO Flagship Coastal
Collaboration Cluster with funding from the CSIRO Flagship
Collaboration Fund. The Coastal Collaboration Cluster is an
Australian research program designed to enable more effective
dialogue between knowledge-makers and decision-makers in
Australia’s coastal zone, and to thereby contribute to coastal
sustainability in Australia. The Cluster is composed of seven
Australian universities working with the CSIRO’s Wealth from
Oceans Flagship and Climate Adaptation Flagship.

**References**

ABS, 2010, Oceans and estuaries. Measures of Australia’s progress,

Agardy, T., and Alder, J., 2005. Coastal systems, in: Hassan, R.,
Scholes, R., Ash, N. (Eds.), Ecosystem and human wellbeing:


Baldwin, C., Buys, L., Osborne, C., 2011. Voices of older Australians on infill development: using participant action research methods to
understand home and neighbourhood for planning purposes, State of Australian Cities Conference, 28 Nov—2 Dec 2011, Melbourne.


Island’s socioeconomic system and reef-edge fish community. Envir Sci Tech. 41, 555—562.


assessment report of the Intergovernmental Panel on Climate

cultural influences on current and future coastal governance.

Futures. 44, 719—729.

HORSCCCWEA, 2009. Managing our coastal zone in a changing
climate: the time to act is now. House of Representatives Standing
Committee on Climate Change, Water, Environment and the Arts
(HORSCCCWEA), Canberra.

IAG, 2008. Insurance Australia Group (IAG) submission to the
inquiry into climate change and environmental impacts on coastal
communities. Insurance Australia Group, Sydney.

IPCC, 2007. Summary for policymakers. Climate change 2007: the
physical science basis. Contribution of Working Group I to the fourth
assessment report of the Intergovernmental Panel on Climate

Jentoft, S., Chuennagdee, R., 2009. Fisheries and coastal
governance as a wicked problem. Marine Policy. 33, 553—560.

and resilient futures: destination modelling and tourism
development—the case of the Ningaloo coastal region in Western
Australia. Planning Practice and Research. 26(4), 393—415.

Jude, S., 2008. Investigating the potential role of visualization
techniques in participatory coastal management, Coastal
Management. 36(4), 331—349.

Kay, R., Alder, J., 2005. Coastal planning and management. Taylor
& Francis, London.


Environ Modell Softw. 22, 123—127.


1297 Ottaway, R.N., 1983. The change agent: a taxonomy in relation to
1298 the change process. Hum Relat. 36(4), 361.
1299 Paar, P., Appleton, K., Clasen, M., Gensel, M., Jude, S., Lovett, A.,
1300 2008. Interactive visual simulation of coastal landscape change, in:
1301 Digital Earth Summit on geoinformatics 2008: tools for global
1304 an agent-based model to address coastal management issues in the
1305 Yucatan Peninsula, in: Anderssen, R.S., Braddock, R.D., Newham,
1306 L.T.H (Eds.), 18th World IMACS Congress and MODSIM09
1307 International Congress on Modelling and Simulation, Cairns,
1308 Queensland, pp. 72—79.
1309 Pettitt, C., Ewing, S., Coffey, B., Geraghty, P., Hocking, G., Meyers,
1310 N., Butters, S., Weston, M., 2011. Exploring the potential of
1311 knowledge brokering in natural resource management. Aust J Env
1312 Management. 18(4), 233—247.
1314 risk assessment within a governance context. Presented at the
1315 Colorado Conference on Earth System Governance, Crossing
1316 Boundaries and Building Bridges, Colorado State University, 17—20
1317 May 2011, Colorado, USA.
1319 Bus Rev. 41(2), 77—86.
1320 SEQ Healthy Waterways, 2009. South East Queensland healthy
1322 South East Queensland Healthy Waterways Partnership, Brisbane.
1324 Victoria’s eastern coastline?, in: Clarkson, B., Kurian, P., Nachowitz,

Shaw, J., 2010. The sustainability of coastal planning: an Australian example. The International Journal of Environmental, Cultural, Economic and Social Sustainability. 6(2), 43—54.


Enhancing the Knowledge-Governance Interface: Coasts, Climate and Collaboration

Highlights

• We research the interface between knowledge- and decision-making in Australia’s coastal zone
• Good dialogue requires both a receptive governance process and accessible knowledge systems
• Traditional systems of government do not reflect the variety of coastal perspectives and knowledges
• More collaborative approaches to governance using diverse knowledges are required
• We present processes and tools that support these approaches