

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](https://doi.org/10.1016/j.ocecoaman.2013.02.009)

Reference: OCMA 3176

To appear in: *Ocean and Coastal Management*

Please cite this article as: Clarke B, Stocker L, Coffey B, Leith P, Harvey N, Baldwin C, Baxter T, Bruekers G, Galano CD, Good M, Haward M, Hofmeester C, De Freitas DM, Mumford T, Nursey-Bray M, Kriwoken L, Shaw J, Shaw J, Smith T, Thomsen D, Wood D, Enhancing the Knowledge-Governance Interface: Coasts, Climate and Collaboration, *Ocean and Coastal Management* (2013), doi: 10.1016/j.ocecoaman.2013.02.009.

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.

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

3
4 Authors:

5 Beverley Clarke¹

6 ¹Faculty of Science and Engineering

7 Flinders University

8 GPO Box 2100, Adelaide, South Australia 5001

9 beverley.clarke@flinders.edu.au

10
11 Laura Stocker² CORRESPONDING AUTHOR

12 ²Curtin University Sustainability Policy Institute

13 Curtin University

14 GPO Box U1987

15 Perth, Western Australia 6845

16 Tel: +61 8 9266 9034

17 Fax: +61 8 9266 9031

18 Mobile: 0439 311 043

19 L.Stocker@curtin.edu.au

20
21 Brian Coffey³

22 ³School of Humanities and Social Sciences

23 Deakin University

24 Warrnambool Campus

25 P O Box 423

26 Warrnambool, Victoria, 3280

27 brian.coffey@deakin.edu.au

28
29 Peat Leith⁴

30 ⁴University of Tasmania

31 Private Bag 78, Hobart, Tasmania 7001

32 Peat.Leith@utas.edu.au

33
34 Nick Harvey⁵

35 ⁵Humanities and Social Sciences

36 The University of Adelaide

37 South Australia 5005

38 nick.harvey@adelaide.edu.au

39
40 Claudia Baldwin⁶

41 ⁶Faculty of Arts and Business

42 University of Sunshine Coast

43 Locked Bag 4, Maroochydore DC

44 Queensland 4558

45 cbaldwin@usc.edu.au

46

47 Tom Baxter⁷
48 ⁷School of Accounting & Corporate Governance
49 University of Tasmania
50 Private Bag 86, Hobart, Tasmania 7001
51 Tom.Baxter@utas.edu.au
52
53 Gonni Bruekers⁸
54 ⁸Curtin University Sustainability Policy Institute
55 Curtin University
56 GPO Box U1987
57 Perth, Western Australia 6845
58 gbruekers@bigpond.com
59
60 Chiara Danese Galano⁹
61 ⁹Curtin University Sustainability Policy Institute
62 Curtin University
63 GPO Box U1987
64 Perth, Western Australia 6845
65 chiara.danesegalano@postgrad.curtin.edu.au
66
67 Meg Good¹⁰
68 ¹⁰Faculty of Law
69 University of Tasmania
70 Private Bag 89, Hobart, Tasmania 7001
71 Meg.Good@utas.edu.au
72
73 Marcus Haward¹¹
74 ¹¹Institute for Marine and Antarctic Studies
75 University of Tasmania
76 Private Bag 129
77 Hobart, Tasmania 7001
78
79 Carolyn Hofmeester¹²
80 ¹²Curtin University Sustainability Policy Institute
81 Curtin University
82 GPO Box U1987
83 Perth, Western Australia 6845
84 carolyn.hofmeester@postgrad.curtin.edu.au
85
86 Debora Martins De Freitas¹³
87 ¹³Australian National Centre for Ocean Resources and Security University
88 of Wollongong
89 Wollongong, NSW 2522
90 debora@uow.edu.au
91
92 Taryn Mumford¹⁴
93 ¹⁴Humanities and Social Sciences

94 The University of Adelaide
95 South Australia 5005
96 taryn.mumford@adelaide.edu.au
97
98 Melissa Nursey-Bray¹⁵
99 ¹⁵Humanities and Social Sciences
100 The University of Adelaide
101 South Australia 5005
102 Melissa.Nursey-Bray@adelaide.edu.au
103
104 Lorne Kriwoken¹⁶
105 ¹⁶School of Geography and Environmental Studies
106 University of Tasmania
107 Private Bag 50, Hobart, Tasmania 7001
108 L.K.Kriwoken@utas.edu.au
109
110 Jenny Shaw¹⁷
111 ¹⁷Curtin University Sustainability Policy Institute
112 Curtin University
113 GPO Box U1987
114 Perth, Western Australia 6845
115 jenny.shaw@postgrad.curtin.edu.au
116
117 Janette Shaw¹⁸
118 ¹⁸Australian Maritime College,
119 University of Tasmania
120 Locked Bag 1399
121 Launceston, Tasmania 7250
122 jrshaw@amc.edu.au
123
124 Tim Smith¹⁹
125 ¹⁹Sustainability Research Centre
126 University of Sunshine Coast
127 Locked Bag 4
128 Maroochydore DC, QLD 4558
129 tsmith5@usc.edu.au
130
131 Dana Thomsen²⁰
132 ²⁰Sustainability Research Centre
133 University of Sunshine Coast
134 Locked Bag 4
135 Maroochydore DC, QLD 4558
136 dthomsen@usc.edu.au
137
138 David Wood²¹
139 ²¹DVC International
140 Curtin University
141 GPO Box U1987

142 Perth, Western Australia 6845
143 D.Wood@curtin.edu.au
144

ACCEPTED MANUSCRIPT

157

158 **Abstract**

159 Conventional systems of government have not been very successful in resolving coastal
160 management problems. This lack of progress is partially attributable to inadequate
161 representation in governance processes of the variety of knowledges present on the
162 coast. In particular there has been a struggle to engage effectively with climate science
163 and its implications. There has also been a broader failure to capture the complexity of
164 voices, interests, values, and discourses of coastal users. We argue here that coastal
165 governance challenges are not likely to be resolved by singular solutions; rather,
166 interaction and collaboration will generate improvements. We suggest that a co-
167 requisite for progress in coastal management is the development of institutions and
168 processes that enable different knowledges to have a bearing on governance processes.
169 This paper examines a selection of the many opportunities available to broaden and
170 enhance the use of knowledge in decision-making for the coast. A description is
171 provided of emerging elements of coastal governance from an Australian perspective,
172 together with new types of institutions, processes, tools and techniques that may help to
173 achieve an improved coastal knowledge-governance interaction.

174

175 **1. Introduction**

176

177 Despite considerable effort over several decades effective governance of
178 the coastal zone remains a considerable challenge in many parts of the
179 world (Sorenson 1997, Agardy and Alder 2005), including Australia
180 (Harvey and Caton 2003; State of the Environment 2011 Committee,
181 2011; Stocker et al., 2012b). Given the complexity and dynamism of the
182 biophysical processes shaping the coast, the variety of administrative
183 processes for managing the coast, and the diversity of stakeholders with
184 an interest in matters related to the coast (Green and Penning-Rowell
185 1999, Cicin-Sain and Knecht 1998, Kay and Alder 2005) this should not be
186 a surprise. Under circumstances such as these it is clearly imperative, and
187 yet a considerable challenge, to make the best use of the rapidly
188 expanding information and knowledge that is available. However, as we
189 will explore, achieving effective knowledge uptake requires both receptive
190 governance processes and accessible knowledge systems. Accordingly, we
191 analyze Australia's coastal governance system in relation to knowledge
192 generation, exchange and uptake, and suggest foci for improvement
193 within an uncertain and complex coastal system, especially in the face of
194 climate change. Both formal and informal institutions of governance are
195 considered within our discussion.

196 In Australia, as elsewhere, effective governance of coastal areas is
197 challenged by: complexity of natural coastal systems; diverse uses of
198 coastal areas; diverse jurisdictions (e.g. international, Commonwealth,
199 state, local) and administrative bodies with coastal responsibilities (e.g.,
200 shipping and ports, planning, biodiversity management, fishing,
201 recreation); diverse ways of understanding and appreciating coasts
202 (Stocker and Kennedy, 2009); and diverse perspectives on how it should
203 be governed, managed, and used (Harvey and Caton, 2003; Stocker et
204 al., 2012a). Reliance on linear or 'loading dock' approaches to transferring

205 knowledge to governance is likely to be ineffective (Cash, Borck and Patt,
206 2006). Rather, there is much to be gained from bringing different
207 disciplinary perspectives to bear on coastal governance, expanding
208 institutional capacity and enabling varied stakeholder engagement
209 approaches, notwithstanding the considerable challenge that this
210 represents.

211 We argue here that:

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

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

231 **2. Conceptual background**

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

235 **2.1. Epistemological bases**

236 The challenges for coastal governance presented by issues such as climate
237 change require epistemologies capable of dealing with complex social
238 ecological systems and ramifying relationships. First, Funtowicz and
239 Ravetz (1993), in their work on post-normal science, highlight that
240 particular kinds of research may be appropriate for answering particular
241 questions in particular situations, and not others. For example, in the case
242 of coastal adaptation to climate change, where decision stakes are high
243 and system uncertainty great, applied science and technical consultancies
244 alone may be of limited value. By contrast, research that is participatory,
245 acknowledges local knowledge and recognizes the importance of values
246 may be more effective, or may complement any technical studies. Second,
247 a broader perspective on coastal knowledge and the practice of science is
248 evident in the guiding principles of sustainability science, which
249 emphasizes: an issue-driven agenda; co-production of knowledge;
250 interdisciplinary and transdisciplinary approaches; acknowledging earth
251 system complexity; focusing communication and research activities at the
252 local level; and focusing on social learning rather than definitive answers
253 (Cummins and McKenna, 2010). Third, in contrast to the traditional
254 'science-first model' approach which elevates 'science' above other
255 knowledge systems (Kelsey, 2003), there is benefit to be gained by
256 adopting broad and more engaged and interactive forms of coastal inquiry
257 (Leith et al., 2012) producing outputs from a variety of sources and
258 perspectives. This approach can also lead to better sharing and
259 communication of lay, managerial, Indigenous and scientific knowledge
260 about the coast.

261 **2.2. Cognitive and psychological bases**

262 Transformation of coastal governance systems to account for knowledges
263 such as climate science will require a greater awareness of how this
264 knowledge is received, interpreted and socially constructed. From a
265 transactional psychology perspective (Altman and Rogoff, 1987; Gergen,
266 2009; Harré and van Langenhove, 1999), any interaction between coastal
267 knowledge-makers and decision-makers will be situated in a particular
268 social context: it will be guided by the cognitive and affective states of the
269 stakeholders, and will reflect the rules and norms of social behaviour. As
270 such these interactions are dynamic, emergent and unique (Altman and
271 Rogoff, 1987 p.28). They are in turn shaped by deeper social-cultural
272 forces including worldviews, as defined above (Clayton and Myers, 2009;
273 Dunlap et al., 2000; Koltko-Rivera, 2004).

274 **2.3. Cultural bases**

275 Thus, society's consideration of issues like coastal adaptation does not
276 arise simply from the scientific evidence of its urgency. Rather,
277 consideration is influenced by phenomena such as worldviews, cultural
278 symbols and metaphors of coasts and climate change, and the historical,
279 cultural and political context that determines which particular account is
280 considered as the 'truth' (Hajer and Versteeg, 2005). Cultural meaning
281 and context are therefore central to the discourse and narratives¹ that
282 develop around coastal adaptation. Discourse in turn has important
283 implications for governance. The discourse around coastal adaptation
284 should encourage the ability, indeed the responsibility, to reflect critically
285 on itself and consider other discourses inviting a sustainable governance
286 model that is reflexive and open to new ideas and 'truths' (Stocker and
287 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).

288 **2.4. Indigenous knowledge bases**

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

302 **2.5 New modes of coastal governance: collaboration and networks**

303 We noted above the complexity of coastal systems and the benefits of
304 considering diverse information sources and perspectives. However, a
305 challenge of considering complexity (in issues such as coastal adaptation)
306 is that associated knowledge tends to be emergent, dispersed,
307 fragmentary, diverse, uncertain and with unexpected interactions (Dryzek,
308 2005; Duit and Galaz, 2008; Snowdon, 2002).

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

317 Effective knowledge exchange and information flows within a governance
318 network require a high diversity of competencies in communication, policy

319 analysis and subject knowledge, and high connectivity among actors in
320 the network (Snowdon, 2002). When governance networks function
321 effectively the collaborative development of policy between diverse and
322 dispersed participants is possible. Deliberative processes leading to
323 adaptive learning can support such policy development (see below). This
324 approach involves 'a dynamic interplay of problem solving and relational
325 activities' within the network (Bouwen and Taillieu (2004, p.142).
326 Although there is some scepticism about the level of critical analysis and
327 empirical support for collaborative modes of governance (Backstrand et
328 al., 2010), there are examples from natural resource management in
329 Australia where collaborative governance is becoming the norm, often
330 involving several government agencies, community groups and industry in
331 decision-making (Head 2009).

332 **3. Coastal governance in Australia**

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

346 The pressures placed upon Australia's coastal environment correspond to
347 broad international trends. Continued urban development in the coastal
348 zone and agricultural expansion in water catchments bring many
349 threatening processes. For example, there is a reduction and decline of

350 habitat in settled coastal areas as a consequence of vegetation clearance,
351 near-shore water pollution, and engineering works; and fluvial
352 introduction of chemicals and sediments. Australian coasts are also
353 vulnerable to invasive pests, introduced by the ballast water of visiting
354 vessels. Climate change is an emerging threat for Australia's coasts and
355 sea level rise is on the agenda for planning around the country.

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

359 **3.1 Australia's coastal governance system**

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

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

374 Responsibility for governing the coast is shared unevenly across three
375 tiers of government (Commonwealth, state and local) involving multiple
376 interacting **government agencies** and other stakeholders. Governance of
377 coasts and seas in Australia is in accordance with the *United Nations*
378 *Convention on the Law of the Sea* (UNCLOS). Following the development
379 of the law of the sea, Australia needed to align its international law

380 obligations with its Constitution (Commonwealth of Australia, 2002;
381 Harvey et al., 2012; Kenchington et al., 2012). The alignment was
382 achieved through the *Seas and Submerged Lands Act* 1973, followed by
383 the Offshore Constitutional Settlement in 1979 and the related legislation
384 that implemented it² (Commonwealth of Australia, 2002). This Settlement
385 surrendered to the States jurisdiction over the sea and seabed within 3
386 nautical miles of the shoreline. The Commonwealth retains sole
387 responsibility for Australia's Exclusive Economic Zone (EEZ) from three to
388 200 nautical miles off the mainland coast (Commonwealth of Australia,
389 2002; Harvey et al., 2012; Kenchington et al., 2012).

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

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

407 Coastal lands and waters (including the seabed) out to three nautical
408 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)

409 which have legislation, policies and agencies to regulate use of this zone.
410 Table 1 provides a summary of the various legislation, policies and
411 agencies for each of the states and the Northern Territory.

412 Local government is broadly responsible for strategic land use planning,
413 development approval, management of public land, coastal protection and
414 preparation of plans for specific coastal areas (Harvey and Caton, 2003).

415 There are many other stakeholders, besides government, who influence
416 decisions that affect coasts. For example, **advocacy groups** serve to
417 agitate a wider community of interest, raising awareness and promoting
418 coastal health (Wescott and Fitzsimons 2010). Such groups have the
419 potential to use knowledge and information in powerful and targeted
420 ways to influence political agenda and disseminate ideas. Advocacy groups
421 therefore play an important intermediary role between formal institutions
422 and a wider public. Two important examples of such groups presently
423 active in Australia include: the National Seachange Taskforce, a national
424 body representing the interests of coastal councils and communities
425 experiencing the effects of rapid population and tourism growth; and, the
426 Australian Coastal Society, another national body seeking to: promote
427 knowledge and understanding of the values of Australian coast; provide a
428 forum for discussion and debate; and build capacity of coastal managers.
429 Both of these groups effectively lobby and contribute ideas and solutions
430 to existing contemporary coastal management challenges (Wescott,
431 2011).

432 **Universities**, whilst without formal responsibility for governing coastal
433 areas, often contain coastal scientists and policy analysts who influence
434 coastal governance, sometimes through their formal individual roles on
435 planning commissions or boards.

436

Table 1: State Coastal Governance Comparison

State	Lead Agency or Body	Coastal Act	Coastal Responsibility (non Coastal Act)	Specific Coastal Zone Policy	State or Territory Department and Minister
VIC	Victorian Coastal Council (VCC) Independent peak body specialising in coastal matters.	<i>Coastal Management Act (CMA) 1995</i>	<i>Planning and Environment Act 1987</i> <i>Local Government Act 1989</i> <i>Crown Land (reserves) Act 1978</i> <i>Catchment and Land Protection Act 1994</i>	(<i>Victorian Coastal Strategy 2008</i>) Additional Policies/Guides/Plans <ul style="list-style-type: none"> • Future Coasts Program • Victoria Planning Provisions • State Planning Policy Framework (SPPF) • Coastal Spaces 	Department of Sustainability and Environment (DSE) Minister for Environment and Climate Change Department of Planning and Community Development (DPCD) Minister for Planning
NSW	Department of Environment, Climate Change and Water (DECCW) No co-coordinating body for coastal matters since the dissolution of the NSW Coastal Council in 2003.	<i>Coastal Protection Act 1979 (Currently under revision)</i>	<i>Environmental Planning and Assessment Act 1979</i> <i>Local Government Act 1993</i>	(<i>NSW Coastal Policy 1997</i>) Additional Policies/Guides/Plans <ul style="list-style-type: none"> • Coastal Protection Package (2010) • State Environmental Planning Policy Number 71: Coastal Protection (SEPP 71) • Coastal Lands Protection Scheme (CLPS) • Sea Level Rise Policy Statement • Draft Coastal Risk Management Guide 2009 • Draft Flood Risk Management Guide 2009 • Coastal Design Guidelines for NSW 	Department of Environment, Climate Change and Water (DECCW) Department of Planning Minister for Planning
QLD	Department of Environment and Resource Management (DERM)	<i>Coastal Protection and Management Act 1995 (Currently under revision)</i>	<i>Sustainable Planning Act 2009 (repeals the Integrated Planning Act (IPA) 1997)</i>	(Queensland State Coastal Management Plan 2002 and Regional Coastal Management Plans). SE QLD Healthy Waterways partnership GBR Intergovernmental Agreement Reef Water Quality Protection Plan	Department of Environment and Resource Management (DERM) The Minister for Natural Resources, Mines and Energy The Minister for Climate Change and Sustainability
SA	SA Coast Protection Board (CPB) Primary authority on managing coast protection issues and providing advice on coastal development	<i>Coast Protection Act 1972 (This Act was to be replaced by a Coast and Marine Act)</i>	<i>Development Act 1993</i> <i>Natural Resources Management (NRM) Act 2004</i>	(Policy on coast protection and new coastal development 1991) (CBP Policy Document 2002) (South Australia's Living Coast Strategy 2004)	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
WA	<i>Western Australian Planning Commission (WAPC)</i> the peak body for land use, planning and development in WA. Coastal Planning Coordinating Committee is the statutory sub-committee WAPC.	No dedicated legislation particular to management of the Coast or Marine Environment	<i>Planning and Development Act 2005</i>	(WA Draft coastal policy 2001)	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
TAS	<i>Number of lead agencies (Integrated system)</i> State Coastal Advisory Committee formed in 1997/98 but since 2002 there has been no effective coordinating body	No dedicated legislation particular to management of the Coast or Marine Environment	<i>State Policies and Projects Act 1993</i> <i>Land Use Policy and Approvals Act 1993</i> <i>Climate Change (State Action) Act 2008</i>	(Tasmanian State Coastal Policy 1996). Binding on all spheres of government	Dept Primary Industries, Parks, Water and Environment (DPIPWE) Minister for Environment, Parks, Heritage and the Arts
NT	<i>85% coastline under Aboriginal ownership</i> No co-coordinating body for coastal matters	No dedicated legislation particular to management of the Coast or Marine Environment	<i>Planning Act 2009.</i> <i>NT Local Government Act</i>	(Northern Territory Coastal Policy 2001) Main objective to enable integrated approach to management of coastal and marine zones but never endorsed.	The Department of Infrastructure, Planning and Environment (DIPE) Landcare Council of NT

(Source: Clarke, 2010)

437

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

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

453 Some **individuals** have attained high public profile through their
454 effective communication of coastal knowledge to decision-makers.
455 Such 'champions' are variously referred to as agents of change,
456 advocates, emergent leaders or opinion leaders (Markham et al.,
457 1991; Ottaway, 1983; Schon, 1963). Champions possess a high
458 level of innovativeness, use their networks and powers of
459 persuasion to informally exert influence on the activities conducted
460 within organizations, aiding their success in promoting causes
461 (Thompson et al., 2006). Two 'Ministerial' champions are identified
462 by Wescott (2011): Senator Robert Hill who progressed Australia's
463 National Oceans Policy in a short time frame in the late 1990s and
464 David Kemp who achieved a 'sixfold increase in 'no-take' marine
465 zones in the Great Barrier Reef marine park in early 2000s.

466 The activities of **coastal volunteers** have been inspirational, and
467 therefore, significant in raising awareness and contributing to
468 knowledge of the coast (see Clarke, 2008 who analyses Coastcare,

469 a high profile Australian coastal volunteer program, and Harvey and
470 Caton, 2003 pp.240-243). Volunteer groups and individuals have
471 shown their capacity to raise the profile and maintain the focus on
472 coastal matters of local significance when these might otherwise fall
473 away from organizational interests which are diverted by competing
474 pressures (such as budgets and other political agenda).

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

480 **Informal networks** exist among many of the above stakeholders,
481 where channels of communication often depend on personal
482 relationships involving trust, reciprocity and a shared history in the
483 field. Significantly, some voices have greater sway on decision-
484 making than others, such as the coastal scientist Professor Bruce
485 Thom in Australia who, through his informal networking and roles
486 on the think-tank Wentworth Group of Concerned Scientists and the
487 Coasts and Climate Change Council which advises the federal
488 government, has exerted significant influence (Stocker et al.,
489 2012b).

490 Within the gamut of institutions and organisations described above,
491 many forms of knowledge exist such as lay, Indigenous and
492 managerial knowledge, that can constructively complement
493 traditional 'scientific' knowledge as a basis for decision-making. The
494 different worldviews held by the various coastal stakeholders within
495 the coastal governance system and the ways that knowledge is
496 generated, constructed and transmitted have profound implications
497 for coastal management. In this context a worldview can be thought
498 of as "An integrated set of beliefs about what is real, what is
499 knowable, what is valuable, and what it means to be human"

500 (Clayton and Myers, 2009 p.20). One of Australia's challenges as a
501 coastal society is to develop skills and processes that enable the
502 better understanding of diverse worldviews, and to enhance the
503 democratization of coastal decision-making and knowledge co-
504 production through an expanded approach to governance.

505 **3.2 Governance rather than government for Australia's coasts**

506 Australia's coasts face continued environmental, cultural, economic
507 and social challenges (Stocker et al., 2012a) and governments have
508 not been able to solve enduring, well-documented problems
509 (Stocker et al., 2012b). This lack of progress is argued here to be
510 partially attributable to inadequate representation in governance
511 processes of the variety of voices and knowledges present on the
512 coast. This paper therefore recognizes and supports a shift in focus
513 from a hierarchical, government-based style of governance to a
514 more collaborative or networked approach to governance which
515 recognizes that decisions affecting the coast are often a reflection of
516 the shared, collective effort of networks of government, private
517 business, civic organizations, communities, political parties,
518 universities, the media and the general public operating (Ansell and
519 Gash, 2008; Bouwen and Taillieu, 2004; Hofmeester et al., 2012). A
520 collaborative or networked approach to governance can also include
521 the deliberation and determination of goals, including the values,
522 norms and principles underpinning them (Jentoft and Chuenpadgee,
523 2009, p. 554). Thus the concept of collaborative or networked
524 governance offers a more holistic and dynamic approach to
525 decision-making than is provided by reliance on government alone
526 (see section 4.5 below for further details). However, to date,
527 although the movement from hierarchical government to a more
528 broad-based approach to coastal governance has begun, Australia's
529 current system is far from fully collaborative.

530 **4. Challenges to knowledge use in current coastal governance**

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

540 ***4.1 Timing of decision making and knowledge making***

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

560 commitment to long-term engaged dialogue and development of
561 trusting relationships among those involved.

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

565 **4.2 Agency policy and planning**

566 Common processes used to enhance understanding between
567 knowledge-makers and decision-makers in agency policy and
568 planning are through workshops and committees. Advisory
569 committees such as the Coastal Climate Change Advisory
570 Committee (Victoria) or the Great Barrier Reef Marine Park
571 Authority's Catchment and Reef Advisory Committee are key
572 examples here. A common form of knowledge transfer is through
573 "sector representation" on such committees. While this approach
574 can draw together various perspectives, a key challenge is to
575 manage sectoral interests in the context of longer term priorities
576 such as coastal environmental health, adaptation to climate change
577 and community wellbeing. There is a requirement for better
578 knowledge solutions that give clear options and associated risks
579 (Cross et al., 1994; Evans and Shaw, 1986; Shaw, 2008; Shaw,
580 2010).

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

590 **4.3 Litigation and case law**

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

613 **4.4 Insurance industry**

614 Risk levels for existing and new coastal development are only partly
615 incorporated into the knowledge-governance interface by
616 government zoning regulations, planning guidelines and decisions.
617 Scientific knowledge on climate change and coastal erosion is also
618 needed by the insurance industry for risk assessment of potential
619 damage to coastal properties and facilities. The Insurance Council of
620 Australia (ICA) commissioned its own risk study for Australian

621 properties (Chen and McAneney, 2006) the results of which have
622 become incorporated into the knowledge-governance interface at
623 the intergovernmental level (Hennessy et al., 2007) and the
624 national level (HORSCCWEA, 2009) where the ICA estimated the
625 number of coastal addresses at risk of coastal damage. The
626 insurance industry has thus taken action to fill perceived gaps in the
627 knowledge-governance interface. The Insurance Australia Group
628 (IAG) has also expressed concern about potential climate-change
629 related changes to insurance cover in coastal areas noting that land
630 value which is not currently insured, forms a high proportion of the
631 overall property value at the coast (IAG, 2008).

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

641 **5. Towards an improved coastal governance in Australia**

642 This section outlines some of the practical possibilities and
643 processes designed to support the enhanced knowledge-governance
644 interface suggested by this paper as necessary for progressing
645 decision making at the coast. Tools and techniques that offer means
646 of putting theory into practice are also described.

647 ***5.1 Linking knowledge systems and new governance***

648 Organizations and individuals can be effective agents (go-betweenes)
649 in creating dialogue, negotiating, mediating, and representing
650 viewpoints working between knowledge-makers and decision-

651 makers. Organizations and individuals use a range of processes to
652 enhance understanding between knowledge-makers and decision-
653 makers.

654 **5.1.1 Boundary organizations**

655 Over the past two decades, interest has grown in boundary
656 organizations as a way of dealing with wicked problems such as
657 climate change adaptation that necessarily transcend scientific
658 responses. Boundary organizations play an intermediary role
659 between knowledge production and decision-making (in different
660 domains and levels), with a view to achieving co-operation in
661 relation to a shared objective (Lorenzoni et al., 2007; Guston,
662 2001; Cash et al., 2004). They can be organizations specifically
663 created to provide this function or can exist within larger
664 organizations (Cash et al., 2004).

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

674 Convening connotes the process of bringing parties together for
675 face-to-face contact. Translation can be literal and/or metaphorical
676 in order to provide information across boundaries of culture,
677 language, assumptions and experiences for example. Collaboration
678 is the process of co-producing knowledge by experts and decision-
679 makers. Mediation represents and evaluates the different interests
680 in such a way that the parties involved perceive fairness and
681 procedural justice. These functions will be present in different mixes

682 in different systems. With the appropriate institutional design,
683 leadership and capacity, universities and NGOs can play the role of
684 boundary organizations whether intentionally designed in the first
685 instance or not.

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

704 **5.1.2 Boundary agents**

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

710 Boundary agents, or knowledge brokers, can be found within a
711 variety of contexts, and their roles may be formal or informal
712 (Pettitt et al., 2011). An example of an effective boundary agent in

713 the Australian coastal scene is the Executive Director of the National
714 Sea Change Taskforce, Alan Stokes. His goal and capacity to enable
715 communication and build relationships among a wide range of
716 decision-makers, researchers and other stakeholders make him
717 highly credible and respected as a boundary agent.

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

729 Complex scientific knowledge can be 're-presented' to be broadly
730 appealing or better understood through the use of visualizations,
731 graphics, informatics and the many other visual interactive media
732 now available. The role of a designer in this context is to ensure
733 that science communication is accurate and has integrity (Tufte,
734 2006 p. 9). As such designers can function as boundary agents,
735 although this role is poorly understood (but see Fernandez et al.,
736 2009). Innovative visuals require careful design because of their
737 power to affect consequent behaviors of the target audience (Jude,
738 2008). The relational role of the designer, as boundary agent, in
739 understanding and drawing out the intent of the scientist is as
740 important as the designer's technical skills.

741 **5.1.3 Deliberation**

742 Deliberation is a term that implies deep and careful consideration,
743 often of scientific information and societal values together. In the

744 context of community and stakeholder engagement it emphasizes
745 “participation, cooperation, and discourse characterized by reason-
746 giving” (Hartz-Karp and Briand, 2009 p.4). If well facilitated, it can
747 enable a group to span boundaries, learn in a social and trusting
748 setting and respond adaptively to emerging challenges and
749 phenomena. Deliberation can employ a wide variety of techniques
750 and approaches, including many of those described in the sections
751 below. Quality deliberation aims to build new relationships among
752 stakeholders and even between citizens and democratic political
753 institutions (Hartz Karp and Stocker, in press). Deliberative
754 techniques aim to “bring together a wide range of perspectives and
755 demographics in “an egalitarian environment that encourages
756 mutual understanding and trust, carefully considering options and
757 producing decisions and actions that are broadly supported and
758 perceived to be legitimate” (Hartz Karp and Stocker, in press).
759 Participatory mapping (5.2.2.2 below) is one example of a tool that
760 can be used to support deliberations.

761 **5.1.4 Adaptive learning**

762 Typically, iterations of coastal policies, programs and projects have
763 been ineffective in transferring learning from one phase to the next.
764 Evaluation cycles have not been reflexive (Smith and Smith, 2006).
765 This can be partly attributed to the mismatch of the needs of
766 political versus environmental decision-making time cycles.
767 Adaptive learning is a contemporary concept offering a vision for
768 improved transference of knowledge towards improved
769 management practice. For adaptive learning to be applied in a
770 coastal management context there is a requirement for coastal
771 practitioners and their organizations to be intimately connected with
772 the dynamic social and ecological dimensions of coastal systems
773 (Smith et al., 2009). Adaptive learning follows a process that is
774 cyclic and incremental, with each stage providing the foundation for
775 the next (e.g., dynamic system goals; adaptive organizational

776 goals, strategies and activities; reflection on goals and strategies;
777 and networking and ideas generation). Detecting and responding to
778 socio-ecological change must also facilitate broader system goals.
779 This requires knowledge, creativity and vision. It also requires that
780 organizations facilitate learning networks across various scales of
781 learning and action (e.g., from individual to societal or local to
782 global). By taking an approach that facilitates adaptive learning and
783 adaptive practice, the knowledge interface between science, society
784 and governance systems is enhanced (Smith et al., 2009). The
785 South East Queensland 'Healthy Waterways' partnership (2001 –
786 current) bases itself on an adaptive learning philosophy. It is a
787 network of over 113 member organizations (including government,
788 industry, research and the community) responsible for managing
789 the water cycle from catchment to coast (SEQ Healthy Waterways,
790 2009). The Partnership implements five programs including
791 monitoring, science and innovation, capacity building, education,
792 and strategy coordination. It has won numerous awards and is
793 recognized as a national leader for adaptive management along the
794 catchment to coast continuum.

795 ***5.2 Tools and techniques***

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

802 ***5.2.1 Communication support***

803 'Communication support' provides opportunities to share
804 information and raise awareness. The information may or may not
805 have immediate application.

806 ***5.2.1.1. Coastal research web portal***

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

819 **5.2.1.2. Coastal conversations**

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

835 **5.2.1.3. Art and community cultural development**

836 Art and community cultural development have the potential engage
837 the public and possibly even decision-makers in the interpretation
838 and representation of complex ideas about coastal adaptation. While

839 scientific texts, figures and statistics are regarded as the most
840 legitimate form of knowledge for policy and management of the
841 coasts and seas, shifts in mind-sets are not always achievable by
842 cognitive, scientific or didactic methods. Emotional and affective
843 responses to the environmental threats can be more powerful than
844 government reports or scientific data (Miles, 2010). Exposure to
845 both the power of cognitive scientific evidence *and* imaginative
846 representations together in a variety of projects and conditions may
847 have a cumulative effect that leads to awareness and personal
848 action (Miles, 2010; Stocker and Kennedy, 2011).

849 **5.2.2. Negotiation support**

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

855 **5.2.2.1. Participatory modelling**

856 Participatory modeling is a technique for improving social and policy
857 learning about social ecological systems. It draws together a
858 variety of stakeholder perspectives into a single visual object to
859 enable collaborative description, negotiation and analysis.
860 Participatory modeling can be agent-based (Perez, 2009), numerical
861 (Jones et al., 2011), qualitative (Dambacher, 2007) or mixed
862 (Fulton et al., 2011). The Coastal Collaboration Cluster used
863 qualitative modelling (Dambacher et al., 2007) to investigate the
864 extent to which current coastal planning arrangements can respond
865 to climate change impacts such as coastal erosion and recession in
866 the southwest of Western Australia. The workshop drew ideas from
867 70 participants from diverse backgrounds. The modeller used a
868 whiteboard in real time, encouraging discussion and translation
869 across the science-governance interface, and entering both

870 scientific and governance variables and processes into the model
871 (Stocker et al., 2011).

872 **5.2.2.2. Participatory Google Earth mapping**

873 Participatory GIS enables participants to analyze land and resource
874 use issues, raises awareness and knowledge of sustainability and
875 fosters good governance incorporating the principles of
876 participation, equity and transparency (McCall, 2003).

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

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

892 **5.2.2.3. Scenario planning**

893 Scenario analysis is a process of 'future-casting' designed to assist
894 decision-making for problems where there is considerable
895 uncertainty and where decisions have the capacity to affect a great
896 many people. Stakeholders are required to think through an array
897 of different futures that may come to pass. The act of creating
898 scenarios forces participants to challenge assumptions about the
899 future. Decisions are shaped on the most likely scenarios.

900 Scenarios have become a ubiquitous feature of climate change
901 science and dialogue and are central to the science communication
902 strategy of the IPCC (2007). In the last few years they have been
903 used for climate adaptation planning (Dessai et al., 2005) as a way
904 to engage stakeholders (Tompkins et al., 2008). A recent workshop
905 carried out by the Coastal Collaboration Cluster for Western
906 Australian Department of Sports and Recreation aimed to develop
907 shared understandings within that agency about the implications of
908 sea level rise, more extreme events, water shortages, temperature
909 increase, and fossil fuel shortages to the future and present
910 management of their core business - coastal sport and recreation in
911 Western Australia. The workshop presented purpose-written
912 creative stories and narrative scenarios about coastal sports and
913 recreation under three clearly-defined climate futures. These were
914 based explicitly on IPCC(2007) storylines, including embedded
915 governance arrangements and social-economic structures, and used
916 CSIRO climate projections for the region (Suppiah et al., 2007).
917 Small groups of participants deliberated on these to develop
918 strategic responses and practical projects (Hartz-Karp and Stocker,
919 in press).

920 **5.2.2.4. Visualizations**

921 Visualizations are a factually accurate, graphical representation of
922 numerical data that may include changes over time (animation).
923 The most useful kinds of visualization enable an understanding of
924 large, multivariate and interdisciplinary datasets (Ellis and Dix,
925 2007; Matthies et al., 2007). These visualizations in turn help
926 provide mutual understanding between the researcher and the
927 stakeholders affected by the research results. Visualizations can
928 help enable novel insights for both researchers and decision-makers
929 by providing alternative representations and consequent
930 interpretations of the data, for example through presenting different
931 scenarios. In relation to coastal adaptation, 3D visualizations have

932 proved useful in demonstrating the consequences of environmental
933 change and fostering action (Sheppard, 2005; Paar et al., 2008).
934 The Coastal Collaboration Cluster has worked closely with CSIRO
935 Mathematics and Informational Sciences to produce an animation
936 based on fluid dynamic modeling that shows the interactions among
937 sea level rise, storm surge and catchment flooding on a hypothetical
938 Australian estuary and adjacent coast, for use by coastal decision-
939 makers. A proof of concept has been trialed in two workshops.

940 **5.2.2.5. PhotoVoice**

941 PhotoVoice involves participants taking photos according to a theme
942 and discussing their photos in a group to reach a consensus about
943 the message they wish to convey to decision-makers, using a
944 selection of their photos and storyline or captions. As a result, it is
945 a thoroughly engaging approach that fosters deliberation and
946 learning, capacity building and empowerment. PhotoVoice has been
947 used by a range of disciplines to understand community values and
948 perspectives and to give the community a 'voice' - health,
949 community development (Wang and Burris, 1997; Baker and Wang,
950 2006), resource management (Baldwin, 2008), and climate change
951 (Baldwin and Chandler, 2010). It has also been used with diverse
952 communities: youth, children, minority groups (Carlson et al.,
953 2006; Castleden et al., 2008; Strack et al., 2004), and seniors
954 (Baldwin et al., 2011). Such 'participant elicited data' in a visual
955 form elicits a deeper insight into complex issues and puts
956 participants in control of the responses. The Coastal Collaboration
957 Cluster is using PhotoVoice to engage commercial rock lobster
958 fishers at the Abrolhos Islands in considering the likely impacts of
959 climate change on their industry and lifestyle.

960 **5.2.3. Decision support**

961 'Decision support' provides necessary and sufficient information and
962 feedback to enhance the reliability and accuracy of decisions made

963 by managers. Management Strategy Evaluation (MSE) is a decision
964 support mechanism that was originally used in individual sectors
965 e.g., fisheries and forestry (Walters, 1986) and more recently in
966 coastal zone management. MSE involves feedback mechanisms and
967 is referred to as 'adaptive management'.

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

984 Earlier in this paper the wide array of voices contributing to coastal
985 management decisions were identified. Accordingly, a final
986 important decision-support tool for consideration is multi-
987 stakeholder analysis. This offers a criteria-based and systematic
988 method by which to select a sample of people, or organizations
989 likely to be affected by a decision. It allows for the sorting of
990 stakeholders both for their likely impact on an action and for the
991 impact an action might have on them. This purpose of the process
992 is to developing cooperation between the various parties engaged
993 towards an agreed goal.

994 **6. Conclusion: Towards more integrated coastal knowledge-**
995 **governance relations**

996 This paper has explored issues associated with knowledge—
997 governance relations for the coastal zone and suggested enabling
998 pathways and associated tools and technology for enhancing
999 knowledge uptake. Conventional modes of decision-making at the
1000 coast have had limited success in terms of sustainable coastal
1001 management, experiencing numerous inhibitors such as short-term
1002 decision cycles, the uncertainty of climate change, and poor
1003 knowledge-governance interaction.

1004 Effective coastal governance is clearly a substantial challenge,
1005 requiring action across several arenas, via a wide variety of
1006 institutions, processes, tools and techniques. It is also the case that
1007 integrated coastal knowledge-governance interactions will not
1008 happen suddenly: they may develop over time as a consequence of
1009 both conscious action and as emergent practice. Therefore, while
1010 deliberate actions can be undertaken to enhance the interactivity of
1011 coastal knowledge and governance, more collaborative coastal
1012 governance may also be supported through a more open, outward
1013 looking and collaborative culture.

1014 Conceptually, the complexity of coastal environments and the
1015 diversity of interests, worldviews and stakeholder knowledge means
1016 that there will never be one right way in which coastal governance
1017 should occur. Furthermore, coastal governance is an ongoing
1018 process, rather than one where issues may be solved once and for
1019 all. What emerges from such a perspective is that real progress can
1020 only be made through the adoption of more interactive and
1021 collaborative forms of knowledge-governance relations: solutions
1022 will emerge from engagement and interaction rather than through
1023 imposition. Importantly, this means that the processes will never be

1024 easy or formulaic; however, over the longer term it is possible to
1025 develop a more robust and resilient system.

1026 A key element in progressing such an approach is the development
1027 of appropriate institutions and processes that enable different forms
1028 of knowledge to have a bearing on decision making. Awareness of
1029 the boundaries, which may be cultural, social, epistemological
1030 boundaries, is integral to enabling such processes, and is a
1031 necessary precondition to working more effectively. The research
1032 being undertaken within the Coastal Collaboration Cluster
1033 represents a modest yet significant contribution to improving
1034 understanding of the challenges and pathways associated with
1035 exploring how and why appropriate institutional and governance
1036 arrangements can be developed, implemented and sustained.

1037 **Acknowledgements**

1038 This research is undertaken by the CSIRO Flagship Coastal
1039 Collaboration Cluster with funding from the CSIRO Flagship
1040 Collaboration Fund. The Coastal Collaboration Cluster is an
1041 Australian research program designed to enable more effective
1042 dialogue between knowledge-makers and decision-makers in
1043 Australia's coastal zone, and to thereby contribute to coastal
1044 sustainability in Australia. The Cluster is composed of seven
1045 Australian universities working with the CSIRO's Wealth from
1046 Oceans Flagship and Climate Adaptation Flagship.

1047 **References**

1048 ABS, 2010, Oceans and estuaries. Measures of Australia's progress,
1049 2010. Australian Bureau of Statistics. 1370.0. Canberra.

1050

1051 Agardy, T., and Alder, J., 2005. Coastal systems, in: Hassan, R.,
1052 Scholes, R., Ash, N. (Eds.), Ecosystem and human wellbeing:

- 1053 current state and trends. Island Press, Washington, DC, pp. 513—
1054 549.
- 1055 Altman, I., Rogoff, B., 1987. World views in psychology: trait,
1056 interactional, organismic, and transactional perspectives, in Stokols,
1057 D., Altman, I. (Eds.), *Handbook of environmental psychology*. John
1058 Wiley & Sons, New York, pp. 7–40.
- 1059 Ansell, C., Gash, A., 2008. Collaborative governance in theory and
1060 practice. *J Publ Adm Res Theor.* 18 (4), 543-571.
- 1061 Backstrand, B., Khan, J., Kronsell, A., Lovbrand, E., 2010.
1062 *Environmental politics and deliberative democracy: examining the*
1063 *promise of new modes of governance*. Edward Elgar, Cheltenham
1064 UK, Northampton MA, USA.
- 1065 Baird, R., 2011. The national legal framework, in: Baird, R.,
1066 Rothwell, D.R. (Eds.), *Australian coastal and marine law*. The
1067 Federation Press, Annandale, NSW, pp. 44-66.
- 1068 Baker, T., Wang, C., 2006. Photovoice: use of a participatory action
1069 research method to explore the chronic pain experience, in older
1070 adults, *Qual Health Res.* 16, 1405—1413.
- 1071 Baldwin, C., 2008. Integrating values and interests in water
1072 planning using a consensus-building approach. PhD thesis,
1073 University of Queensland, Brisbane.
- 1074 Baldwin, C., Chandler, L., 2010. At the water's edge: community
1075 voices on climate change, *Local Environment: the International*
1076 *Journal of Justice and Sustainability*. Special issue on local peoples
1077 and climate change. 15(7), 637—649.
- 1078 Baldwin, C., Buys, L., Osborne, C., 2011. Voices of older Australians
1079 on infill development: using participant action research methods to

- 1080 understand home and neighbourhood for planning purposes, State
1081 of Australian Cities Conference, 28 Nov—2 Dec 2011, Melbourne.
- 1082 Bouwen, R., Taillieu, T., 2004. Multi-party collaboration as social
1083 learning for interdependence: Developing relational knowing for
1084 sustainable natural resource management. *J Community Appl Soc.*
1085 *14*, 137—153.
- 1086 Brownill, S., 2009. The dynamics of participation: modes of
1087 governance and increasing participation in planning. *Urban Policy*
1088 *and Research.* *27*(4), 357—375.
- 1089 Carlson, E, Engebretson, J., Chamberlain, R., 2006. Photovoice as a
1090 social process of critical consciousness. *Qual Health Res.* *16*(6),
1091 836—852.
- 1092 Cash, D., Adger, N., Berkes, F., Garden, P., Lebel, L., Olsson, P.,
1093 Pritchard, L., Young, O., 2004. Scale and cross-scale dynamics:
1094 governance and information in a multi-level world. *Millennium*
1095 *Ecosystem Assessment Bridging Scales and Epistemologies*
1096 *Conference, 17—20 March 2004, Alexandria.*
- 1097 Cash, D., Borck, J., Patt, A., 2006. Countering the loading-dock
1098 approach to linking science and decision making: comparative
1099 analysis of El Niño/Southern Oscillation (ENSO) forecasting
1100 systems. *Sci Technol Hum Val.* *31*(4), 465—494.
- 1101 Castleden, H., Garvin, T., Huu-ay-aht First Nation, 2008. Modifying
1102 photovoice for community-based participatory Indigenous research.
1103 *Soc Sci Med.* *66*(6), 1393—1405.
- 1104 Chen, K., McAneney, J., 2006. High resolution estimates of
1105 Australia's coastal population with validations of global population:
1106 shoreline and elevation datasets. *Geophys. Res. Lett,* *33*, L16601.

- 1107 Cicin-Sain, B., Knecht, R.W., 1998. Integrated coastal and ocean
1108 management, concepts and practices. Island Press, Washington DC.
- 1109 Clarke, B., 2008. Seeking the grail: evaluating whether Australia's
1110 Coastcare program achieved 'meaningful' community participation.
1111 Soc Natur Resour. 21(10), 891–907.
- 1112 Clarke, B., 2010. Analysis of coastal policies of Australian state and
1113 territory governments. Report Prepared for the South Australian
1114 Coast Protection Board, Department of Environment and Natural
1115 Resources, Adelaide.
- 1116 Clayton S., Myers G., 2009. Conservation psychology.
1117 Understanding and promoting human care for nature. Wiley-
1118 Blackwell, Chichester.
- 1119 Commonwealth of Australia, 1995. Living on the coast, the
1120 Commonwealth coastal policy. Department of Environment, Sport
1121 and Territories (DEST), Canberra.
- 1122 Commonwealth of Australia, 2002. Ocean management—the legal
1123 framework. The South-east Regional Marine Plan Assessment
1124 Report. National Oceans Office, Hobart.
- 1125 Cross, H., Ardill, S., Shaw, J., 1994. Management of environmental
1126 flow in NSW. A review of techniques, in: proceedings of
1127 Environmental Flows Seminar. Australian Water and Wastewater
1128 Association, 25-26 August 1994, Canberra, pp. 70–75.
- 1129 Cummins, V., McKenna, J., 2010. The potential of sustainability
1130 science in coastal zone management. Ocean Coast Manage. 53,
1131 796–804.
- 1132 Dambacher, J.M., Brewer, D.T., Dennis, D.M., Macintyre, M., Foale,
1133 S., 2007. Qualitative modelling of gold mine impacts on Lihir

- 1134 Island's socioeconomic system and reef-edge fish community. *Envir*
1135 *Sci Tech.* 41, 555–562.
- 1136 de la Mare, W.K., Ellis, N., Pascual, R., Tickell, S., 2012. An
1137 empirical model of water quality for use in rapid management
1138 strategy evaluation in Southeast Queensland, Australia. *Mar Pollut*
1139 *Bull.*64(4), 704–11.
- 1140 Dessai, S., Lua, X., Risbey, J., 2005. On the role of climate
1141 scenarios for adaptation planning. *Global Environ Chang.* 15, 87–
1142 97.
- 1143 Dryzek, J.S., 2005. *The politics of the earth, environmental*
1144 *discourses.* Oxford University Press, Oxford.
- 1145 Dui, A., Galaz, V., 2008. Governance and complexity, emerging
1146 issues for governance theory. *Governance.* 21(3), 311–335.
- 1147 Dunlap, R., Van Liere, K., Mertig, A., Jones, R., 2000. Measuring
1148 endorsement of the new ecological paradigm: a revised NEP scale. *J*
1149 *Soc Issues.* 56(3), 425–442.
- 1150 Ellis, G., Dix, A., 2007. A taxonomy of clutter reduction for
1151 information visualisation. *IEEE T Vis Comput Gr.* 13 (6), 1216–
1152 1223.
- 1153 Evans, D., Shaw, J., 1986. Conflicts between in-stream and off-
1154 stream uses of rivers, in: *Hydrology and Water Resources*
1155 *Symposium 1986, River Basin Management; Preprints of Papers.*
1156 *Institution of Engineers, Barton, ACT,* pp. 238–244.
- 1157 Fernandez, W., Bergvall-Kåreborn, B., Djordjevic, M., Lovegrove,
1158 K., Nayar, S., 2009. Using design as boundary spanner object in
1159 climate change mitigation projects. *Aust J Information Systems,*
1160 16(2), 51–69.

- 1161 Fulton, E., Randall, G., Sporcic, M., Scott, R., Hepburn, M., Gorton,
1162 B., Hatfield, B., Fuller, M., Jones, T., De la Mare, W., Boschetti, F.,
1163 Chapman, K., Dzidic, P., Syme, G., Dambacher, J.M., McDonald, D.,
1164 2011. Adaptive futures for Ningaloo. Ningaloo Collaboration Cluster.
1165 CSIRO, Perth.
- 1166 Funtowicz, S., Ravetz, J., 1993. Science for the post-normal age.
1167 *Futures*. 25(7), 739–755.
- 1168 Gergen, K., 2009. *Relational being, beyond self and community*.
1169 Oxford University Press, New York.
- 1170 Glazewski, J., Haward, M., 2005. Towards integrated coastal area
1171 management: a case study in co-operative governance in South
1172 Africa and Australia. *The International Journal of Marine and Coastal*
1173 *Law*. 20(1), 65–84.
- 1174 Green, C., Penning-Roswell, E. 1999. Inherent conflicts at the coast.
1175 *J Coastal Conservation*. 5(2), 153–62.
- 1176 Guston, D.H., 2001. Boundary organisations in environmental policy
1177 and science: an introduction. *Science, Technology and Human*
1178 *Values*. 26(4), 399–408.
- 1179 Haggan, N., Neis, B., Baird, I., 2007. *Fishers' knowledge in fisheries*
1180 *science and management*. UNESCO, Paris.
- 1181 Hajer, M., Versteeg, W., 2005. A decade of discourse analysis of
1182 environmental politics: achievements, challenges, perspectives. *J*
1183 *Env Pol Plann*. 7(3), 175–184.
- 1184 Harré, R., van Langenhove, L., 1999. The dynamics of social
1185 episodes, in: Harré, R., and van Langenhove, L. (Eds.), *Positioning*
1186 *theory*. Blackwell Publishers Ltd., Oxford.

- 1187 Harré, R., Brockmeier, J., Mühlhäusler, P., 1999. Greenspeak: a
1188 study of environmental discourse. Sage Publications Inc., Thousand
1189 Oaks.
- 1190 Hartz-Karp, J., Briand, M., 2009. Institutionalizing deliberative
1191 democracy. *J Publ Affairs*. 10(1), 125—141.
- 1192 Hartz-Karp, J., Stocker, L., (In Press). Deliberative democracy, a
1193 collaborative action oriented learning process for a more sustainable
1194 future, in: Shultz, L., Kajner, T. (Eds.), *Education and the political
1195 project of engagement and disengagement*. Sense Publishers,
1196 Boston.
- 1197 Harvey, N., Caton, B., 2003. *Coastal management in Australia*.
1198 Oxford University Press, Melbourne.
- 1199 Harvey, N., Clarke, B., Nursey-Bray, M., 2012a. Australian coastal
1200 management and climate change. *Geogr Res*. 50(4), 356—367.
- 1201 Harvey, N., Clarke, B., Pelton, N., Mumford, T., 2012b. Evolution of
1202 sustainable coastal management and coastal adaptation to climate
1203 change in Australia, in: Kenchington, R., Stocker, L., Wood, D.,
1204 (Eds.), *Sustainable coastal management and climate adaptation:
1205 lessons from regional Australia*. CSIRO Publishing, Collingwood,
1206 Victoria, pp. 75—96.
- 1207 Head, B., 2009. From government to governance: explaining and
1208 assessing new approaches to NRM, in: Lane, M., Robinson, C.,
1209 Taylor, B. (Eds.), *Contested country: Local and regional natural
1210 resources management in Australia*. CSIRO Publishing, Collingwood,
1211 Victoria, pp. 15—28.
- 1212 Hennessy, K., Fitzharris, B., Bates, B., Harvey, N., Hughes, L.,
1213 Howden, M., Salinger, J., Warrick, R., 2007. *Australia and New
1214 Zealand climate change 2007: impacts, adaptation and
1215 vulnerability*. Contribution of Working Group II to the fourth

- 1216 assessment report of the Intergovernmental Panel on Climate
1217 Change. Cambridge University Press, Cambridge, UK.
- 1218 Hofmeester, C., Bishop, B., Stocker, L., Syme, G., 2012. Social
1219 cultural influences on current and future coastal governance.
1220 *Futures*. 44, 719–729.
- 1221 HORSCCWEA, 2009. Managing our coastal zone in a changing
1222 climate: the time to act is now. House of Representatives Standing
1223 Committee on Climate Change, Water, Environment and the Arts
1224 (HORSCCWEA), Canberra.
- 1225 IAG, 2008. Insurance Australia Group (IAG) submission to the
1226 inquiry into climate change and environmental impacts on coastal
1227 communities. Insurance Australia Group, Sydney.
- 1228 IPCC, 2007. Summary for policymakers. Climate change 2007: the
1229 physical science basis. Contribution of Working Group I to the fourth
1230 assessment report of the Intergovernmental Panel on Climate
1231 Change. Cambridge University Press, Cambridge, UK.
- 1232 Jentoft, S., Chuenpagdee, R., 2009. Fisheries and coastal
1233 governance as a wicked problem. *Marine Policy*. 33, 553–560.
- 1234 Jones, T., Glasson, J., Wood, D., Fulton, B., 2011. Regional planning
1235 and resilient futures: destination modelling and tourism
1236 development—the case of the Ningaloo coastal region in Western
1237 Australia. *Planning Practice and Research*. 26(4), 393–415.
- 1238 Jude, S., 2008. Investigating the potential role of visualization
1239 techniques in participatory coastal management, *Coastal
1240 Management*. 36(4), 331–349.
- 1241 Kay, R., Alder, J., 2005. Coastal planning and management. Taylor
1242 & Francis, London.

- 1243 Kelsey, E., 2003. Integrating multiple knowledge systems into
1244 environmental decision making: two case studies of participatory
1245 biodiversity initiatives in Canada and the implications for
1246 conceptions of education and public involvement. *Environmental*
1247 *Values* 12, 1–16.
- 1248 Kenchington, R., Stocker, L., Wood, D., 2012. Lessons from regional
1249 approaches to coastal management in Australia: a synthesis, in:
1250 Kenchington, R., Stocker, L., Wood, D., (Eds.), *Sustainable coastal*
1251 *management and climate adaptation: Lessons from regional*
1252 *Australia*, CSIRO Publishing, Collingwood, Victoria, pp.193–208.
- 1253 Koltko-Rivera, M., 2004. The psychology of worldviews. *Rev Gen*
1254 *Psychol.* 8(1), 3–58.
- 1255 Lambert, T., 2011. Bad tidings: reporting on sea level rise in
1256 Australia is all washed up. *The Conversation*. Melbourne.
1257 [http://theconversation.edu.au/bad-tidings-reporting-on-sea-level-](http://theconversation.edu.au/bad-tidings-reporting-on-sea-level-rise-in-australia-is-all-washed-up-2639)
1258 [rise-in-australia-is-all-washed-up-2639](http://theconversation.edu.au/bad-tidings-reporting-on-sea-level-rise-in-australia-is-all-washed-up-2639). 1st September 2011.
- 1259 Lazarow, N., Smith, T., Clarke, B., 2008. Coasts, in: Lindenmayer,
1260 D. Dovers, S. Harriss-Olson, M., Morton, S. (Eds.), *Ten*
1261 *commitments, reshaping the lucky country's environment*. CSIRO
1262 *Publishing*, Collingwood, Victoria, pp. 87–94.
- 1263 Leith, P., Coffey, B., Haward, M., O'Toole, K., Allen, S., 2012.
1264 Improving science uptake in coastal zone management: principles
1265 for science engagement and their application in South East
1266 Tasmania, in: Kenchington, R., Stocker, L., Wood, D., (Eds.),
1267 *Sustainable coastal management and climate adaptation: Lessons*
1268 *from regional Australia*, CSIRO Publishing, Collingwood, Victoria,
1269 pp.135–154.

- 1270 Lorenzoni, I., Jones, M., Turnpenny, J.R., 2007. Climate change,
1271 human genetics, and post-normality in the U.K. *Futures*. 39(1),
1272 65–82.
- 1273 Manne, R., 2011. Bad news: Murdoch's Australian and the shaping
1274 of the nation. *Quarterly Essay*. 43, 1–142.
- 1275 Markham, S., Green, S., Basu, R., 1991. Champions and
1276 antagonists: Relationships with RandD project characteristics and
1277 management. *J Eng Technol Manage*. 8(3-4), 217–242.
- 1278 Matthies, M., Giupponi, C., Ostendorf, B., 2007. Environmental
1279 decision support systems: current issues, methods and tools.
1280 *Environ Modell Softw*. 22, 123–127.
- 1281 McCall, M., 2003. Seeking good governance in participatory—GIS: a
1282 review of processes and governance dimensions in applying GIS to
1283 participatory spatial planning. *Habitat Int*. 27, 549–573.
- 1284 McNie, E., van Noordwijk, M., Clark, W., Dickson, N.,
1285 Sakuntaladewi, N., Suyanto, N., Joshi, L., Leimona, B., Hairiah, K.,
1286 Khususiyah, N., 2008. Boundary organizations, objects and agents:
1287 Linking knowledge with action in agroforestry watersheds. Center
1288 for International Development, Graduate Student and Postdoctoral
1289 Fellow Working Paper No. 34, Harvard University.
- 1290 Miles, M., 2010. Representing nature: art and climate change. *Cult*
1291 *Geogr*. 17(1), 19–35.
- 1292 NSCT, 2010. Home. National Sea Change Taskforce.
1293 <http://www.seachangetaskforce.org.au/Home.html>, 12th December
1294 2012.
- 1295 Ostrom, E., 1999. Coping with the tragedy of the commons. *Annu*
1296 *Rev Polit Sci*. 2, 493–535.

- 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
1302 change research. Wichmann, Heidelberg, pp. 153–159.
- 1303 Perez, P., Dray, A., Cleland, D., Arias-Gonzalez, J., 2009. SimReef:
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.
- 1313 Preston, B., Danese, C., Yuen, E., 2011. Embedding climate change
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.
- 1318 Schon, DA., 1963. Champions for radical new inventions. *Harvard*
1319 *Bus Rev.* 41(2), 77–86.
- 1320 SEQ Healthy Waterways, 2009. South East Queensland healthy
1321 waterways partnership annual report, July 2008–December 2009.
1322 South East Queensland Healthy Waterways Partnership, Brisbane.
- 1323 Shaw, J., 2008. Coastal planning and conservation: what next for
1324 Victoria's eastern coastline?, in: Clarkson, B., Kurian, P., Nachowitz,

- 1325 T., Rennie, H. (Eds.) Conserv-Vision Conference Proceedings. The
1326 University of Waikato, 2–4 July 2007. Waikato, New Zealand.
- 1327 Shaw, J., 2010. The sustainability of coastal planning: an Australian
1328 example. *The International Journal of Environmental, Cultural,*
1329 *Economic and Social Sustainability.* 6(2), 43–54.
- 1330 Sheppard, S.R.J., 2005. Landscape visualisation and climate
1331 change: the potential for influencing perceptions and behaviour.
1332 *Environ Sci Policy.* 8, 637–654.
- 1333 Short, A. and Woodroffe, C.D., 2009. *The coast of Australia.*
1334 Cambridge University Press, Port Melbourne.
- 1335 Sillitoe, P., Bicker, A., Pottier, J., 2002. *Participating in*
1336 *development: approaches to indigenous knowledge.* Routledge,
1337 London and New York.
- 1338 Smith, T., Smith, D., 2006. Institutional adaptive learning for
1339 coastal management. in Lazarow, N., Fearon, R., Souter, R.,
1340 Dovers, S. (Eds.), *Coastal management in Australia: key*
1341 *institutional governance issues for coastal natural resource*
1342 *management and planning.* Cooperative Research Centre for
1343 *Coastal Zone Estuary and Waterway Management, Indooroopilly*
1344 *Queensland,* pp.55–60.
- 1345 Smith, T.F., Carter, R.W., Thomsen, D.C., Mayes, G., Nursey-Bray,
1346 M., Whisson, G., Jones, R. Dovers, S., O’Toole, K., 2009. Enhancing
1347 science impact in the coastal zone through adaptive learning, *J*
1348 *Coastal Res.* 56, 1306–1310.
- 1349 Snowdon, D., 2002. Complex acts of knowing: paradoxes and
1350 descriptive self-awareness. *Journal of Knowledge Management.*
1351 6(2), 100–111.

- 1352 Sorenson, J., 1997. National and international efforts at integrated
1353 coastal zone management: definitions, achievements, and lessons.
1354 *Coastal Management*. 25, 3–41.
- 1355 State of the Environment 2011 Committee, 2011. Australia state of
1356 the environment 2011. Independent Report to the Australian
1357 Government Minister for Sustainability, Environment, Water,
1358 Population and Communities, DSEWPC, Canberra.
- 1359 Stocker, L., Kennedy, D., 2009. Cultural models of the coast in
1360 Australia: Towards sustainability. *Coastal Management*. 37(5),
1361 387–404.
- 1362 Stocker, L., Kennedy, D., 2011. Artistic representations of the sea
1363 and coast: Implications for sustainability. *Landscapes*. 4(2), 97–
1364 123.
- 1365 Stocker, L., Kennedy, D., Metcalf, S., Dambacher, J., Middle, G.,
1366 Wood, D., 2011. Modelling coastal governance in the south west of
1367 Western Australia: complexity, collaboration and climate adaptation,
1368 in: Chan, F., Marinova, D., Anderssen, R.S. (Eds.), MODSIM2011:
1369 19th International Congress on Modelling and Simulation, Modelling
1370 and Simulation Society of Australia and New Zealand. 12–16 Dec
1371 2011, Perth, Western Australia.
- 1372 Stocker L., Kenchington, R., Kennedy, D., Steven, A., 2012a.
1373 Introduction to Australian coasts and human influences, in:
1374 Kenchington, R., Stocker, L., Wood, D., (Eds.), *Sustainable coastal*
1375 *management and climate adaptation: Lessons from regional*
1376 *Australia*, CSIRO Publishing, Collingwood, Victoria, pp. 1–27.
- 1377 Stocker L., Kennedy, D., Kenchington, R., Merrick, K. 2012b.
1378 Sustainable Coastal Management? in: Kenchington, R., Stocker, L.,
1379 Wood, D., (Eds.), *Sustainable coastal management and climate*

- 1380 adaptation: Lessons from regional Australia, CSIRO Publishing,
1381 Collingwood, Victoria, pp.29–50.
- 1382 Strack, R., Macgill, C., McDonagh, K., 2004. Engaging youth
1383 through photovoice. *Health Promot Practice*. 5(1), 49–58.
- 1384 Suppiah, R., Hennessy, K.J., Whetton, P.H., McInnes, K., Macadam,
1385 I., Bathols, J., Ricketts, J., Page, C.M., 2007. Australian climate
1386 change projections derived from simulations performed for the IPCC
1387 4th Assessment Report. *Australian Meteorological Magazine*. 56(3),
1388 131–152.
- 1389 Thompson, G.N., Estabrooks, C.A., Degner, L.F., 2006. Clarifying
1390 the concepts in knowledge transfer: a literature review. *J Adv Nurs*.
1391 53(6), 691–701.
- 1392 Tompkins, E., Few, R., Brown, K., 2008. Scenario-based
1393 stakeholder engagement: incorporating stakeholders preferences
1394 into coastal planning for climate change. *J Environmental*
1395 *Management*. 88, 1580–1592.
- 1396 Tufte, E., 2006. *Beautiful evidence*. Graphics Press LLC,
1397 Connecticut, USA.
- 1398 Walters, C. J., 1986. *Adaptive management of renewable resources*.
1399 Macmillan Press, New York.
- 1400 Walters, C. J., & Holling, C. S., 1990. Large-scale management
1401 experiments and learning by doing. *Ecology*, 71(6), 2060-2068.
- 1402 Wang, C., Burriss, M., 1997. Photovoice: concept, methodology, and
1403 use for participatory needs assessment. *Health Educ Behav*. 24(3),
1404 369–387.
- 1405 Wescott, G., 2011. Disintegration or disinterest? Coastal and marine
1406 policy in Australia, in: Crowley, K., Walker, K. (Eds.), *Environmental*
1407 *policy failure*. Tilde University Press, Melbourne, pp. 88–102.

1408 Wescott, G., Fitzsimons J., 2010. Stakeholder involvement and
1409 interplay in coastal zone management and marine protected area
1410 planning, in: Gullett, W., Schofield, C., Vince, J. (Eds.) Marine
1411 resources management. LexisNexis, Chatswood, Victoria, pp. 225—
1412 238.

ACCEPTED MANUSCRIPT

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