

## Probing the relationship between ecosystem perceptions and approaches to environmental governance: an exploratory content analysis of seven water dilemmas

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### ABSTRACT

Addressing wicked ‘water dilemmas’ requires an understanding of the context within which they are embedded. This study explored perceptions of the ecosystem in terms of resilience and the governance approaches employed through a content analysis of documents from seven case studies across the globe. Analytical constructs developed for resilience and governance approaches guided the exploration. Multiple resilience types were present in documents for each case, but few patterns emerged across cases. Governance approaches were strongly focused on state approaches in most cases. A relationship between resilience type and governance approach was not clear; however, a pattern emerged between the presence of the social-ecological resilience type and non-state-centred governance forms. The type of author (government, non-government) or the type of document (research and advisory, descriptive) were not found to mediate the findings as resilience framings varied considerably and state governance approaches were emphasised throughout. As the findings stand in contrast to contemporary scholarship on understanding ecosystems and environmental governance they raise important issues to which individuals must be cognizant when accessing documents for guidance. They also open avenues for future investigation of water dilemmas at the nexus of theory, policy and practice.

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## Introduction

Water dilemmas are situations involving the biophysical world and humans where difficult choices are required among contested alternatives. These dilemmas are often described as wicked problems (e.g. FitzGibbon & Mensah, 2012; Head, 2010; Hearnshaw, Tompkins, & Cullen, 2011; Reed & Kasprzyk, 2009). While the definition of precisely what constitutes a wicked problem varies, it generally refers to a class of challenges characterised by extreme

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complexity (high risk, scientific uncertainty, ecological and social interdependencies, large scope and scale) and ‘the absence of a clear public consensus on value, the nature of the problem, or acceptable solutions’ (Balint, Stewart, Desai, & Walters, 2011, p. 9; see also Batie, 2008; Lazarus, 2009; Rittel & Webber, 1973).

Addressing water dilemmas is imperative and connected to how people see these wicked problems. Who should make decisions in water dilemmas and how should interventions occur? A vast discussion is underway about who should intervene in society and how it should take place; thus, governance has emerged as an integral concern in rethinking approaches to planning and managing water resources (de Loë & Kreutzwiser, 2007; Galaz, 2007; Pahl-Wostl et al., 2013; Plummer, de Grosbois, Velanakis, & de Loë, 2011; Rogers & Hall, 2003).

As wicked problems are inherently embedded in a social context and involve multiple actors, attention is directed to diversity in terms of values, views/perceptions and problem framings (Balint et al., 2011; Batie, 2008; Rittel & Webber, 1973). Attention to diversity is necessary for understanding and navigating wicked problems as they are inherently embedded in a social context and involve multiple actors (Balint et al., 2011; Batie, 2008; Rittel & Webber, 1973). The question of how individuals perceive the environment has been explored in relation to geography, complex and synergistic causes, and complicated and contested solutions (Dunlap, Van Liere, Mertig, & Jones, 2000; Holling, Gunderson, & Ludwig, 2002; Stern, 1993). Stern, Dietz, and Guagnano (1995, p. 740) argue that: ‘Given the ongoing debates about public understanding of science, and especially of risk, we need to understand the way values and worldview are implicated in the framing of public debate and the construction of public opinion ... – how the general influences the specific.’ Exploring this connection has firmly taken hold within research examining the contingency of action for climate change (i.e. mitigation and adaptation) as related to endogenous societal factors such as perception and attitude of risk, knowledge, ethics and culture (e.g. Adger et al., 2009; Leiserowitz, 2007). It also extends into research on risk relating to water resources (e.g. Pahl-Wostl, 2007; Stenekes, Colebatch, Waite, & Ashbolt, 2006; Wolsink, 2006). Resilience has been an increasingly common framing in the context of wicked problems (e.g. Goldstein, 2011; Martin-Breen & Andries, 2011; Powell, Larsen, & van Bommel, 2014; Termeer, Dewulf, & Breeman, 2013; Waddock, 2013).

This article explores the relationship between ecosystem perceptions in terms of resilience and the approaches to governance in a series of water dilemmas as described in documents arising from the cases. In line with the purpose of this research, the following four questions were explored:

- (1) How are ecosystems perceived in terms of resilience?
- (2) What governance approaches are taken to address the water dilemmas and how are they expressed?
- (3) Is there a relationship between perceptions of the ecosystem and governance approaches in these water dilemmas (and if yes, what is it)?
- (4) How does the relationship between ecosystem perceptions and governance approaches vary across document type? Unpacking the constructs of resilience and environmental governance in the following section illuminates different ways of understanding the natural world and approaches for intervening. It also sets out important implications of resilience framing for environmental interventions that

have been established with the scholarly evolution of these constructs. The main premise underpinning this study is that resilience framing relates to the approach for intervention in the seven water dilemmas from around the world.

### ***Unpacking resilience and environmental governance: background and theory***

The natural world is understood in many different ways and the historical assumptions underpinning the views people hold of it have implications for policy and action (Holling et al., 2002). Resilience entered the academic lexicon in the 1970s and developed rapidly in the disciplines of psychology and ecology along parallel tracks (Lundholm & Plummer, 2010). Several thorough reviews have traced the historical and conceptual development of the resilience construct in these disciplines as well as its more contemporary integrative usage (see Folke, 2006; Martin-Breen & Andries, 2011; Masten, 2007). More recently, resilience is increasingly identified in association with understanding and responding to wicked problems in the scholarly literature (e.g. Goldstein, 2011; Martin-Breen & Andries, 2011; Termeer et al., 2013; Waddock, 2013) and has been extended to popular news sources such as the *New York Times* (Zolli, 2012).

While several entry points are possible to consider how people perceive the environment, we draw upon the construct of resilience and employ it as a lens in this research for several reasons. First, types of resilience have been traced to differences in world views held by people (Holling et al., 2002) and these have important implications as set out in the introductory section of this paper. Second, notwithstanding duly noted difficult normative issues, resilience has spurred conversation about governance in relation to contemporary conditions of complexity and change (Brown, 2014; Duit, Galaz, Eckerberg, & Ebbesson, 2010; Nelson, Adger, & Brown, 2007). Third, recent approaches of using resilience as an optic to usefully explore different subjects with characteristics of wicked problems have been established, such as rural studies (Scott, 2013) and ecosystem services in cities (Barthel, Parker, & Ernstson, 2013). In developing a resilience lens to meet the needs of our inquiry we direct attention to a descriptive aspect by drawing upon work by Cumming et al. (2005), as well as an interpretive aspect by developing a typology of resilience perspectives.

Resilience is thus understood in several ways and tensions are evident among interpretations (e.g. Brand & Jax, 2007; Brown, 2014; Hornborg, 2009, 2013; Leech, 2008; Strunz, 2012). Categorising types of resilience is essential to its use as a lens to illuminate how actors perceive the ecosystem in water dilemmas. A resilience typology, using four 'types' of resilience (engineering, ecological, social-ecological and epistemic) was developed in 2012 based on a thorough review of the literature (see Plummer, Baird, Dupont, & Renzetti, 2012). It was subsequently operationalised for use in content analysis by identifying corresponding word and phrase indicators for each type. Table 1 provides an overview of the resilience typology and for each type sets out its boundaries, desirable attributes, relationships among system elements described and proxies/measures. While considerable efforts were made to clearly distinguish between the types, it is important to recognise that they are not mutually exclusive and a degree of overlap exists between some of the boundaries due to the nature of development of resilience types over time by diverse disciplinary perspectives (see e.g. Folke, 2006).

**Table 1.** A typology of ecosystem perception in terms of resilience.

Type of resilience	System boundary	Dimensions		
		Desirable system attributes	Relationships among elements	Proxies/measures of resilience
Engineering	Ecological boundaries, typically at the level of populations and communities	Efficiency of function Constancy and predictability Ability to resist disturbance and change Far from instability	Linear Behaviour around a single equilibrium	Maximum sustained yield Carrying capacity speed of return to equilibrium
Ecological	Ecological boundaries	Persistent Able to withstand disturbances and maintain function Adaptive	Non-linear dynamics Multiple stability domains Thresholds	Adaptive capacity Size of stability domains  Limited predictability Systems go through adaptive cycle and are part of panarchy
Social-ecological	Boundaries may be bio-physical, ecological, social and/or a combination	Capacity to absorb shocks and still maintain function  Capacity for renewal, re-organisation and development  Responsiveness between ecosystem dynamics and management/governance which is flexible and adaptive	Interconnectedness between social and ecological systems  Multiple thresholds  Uncertainty and nonlinearity  Panarchy	Adaptive capacity – learning, innovation, flexibility  Capacities for self-organisation, adaptation and learning  Resilience surrogates
Epistemic	Contested (soft) boundaries Stakeholder/purpose defined systems	Negotiable and flexible Plasticity  Learning oriented	Nonlinear and dynamic Inherently unstable  People and their environment are structurally coupled and co-specify	Adaptive capacity  Collective action  Ability to generate scenarios and options  Capacity of the coupled system to learn co-dependently

Source: adapted from Plummer et al. (2012).

Governance, in the broadest sense, is deliberate intervention in society that is goal oriented (Kooiman, 1993). As set forth by the Global Water Partnership, water governance refers to 'the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society' (Rogers & Hall, 2003, p. 16). Water is one of many resources about which attendant concerns about governance are growing. For example, the World Water Assessment Programme (2003) diagnoses the present dilemma concerning water as a crisis of governance, brought about by the mismanagement of water by humans. Ideas of environmental governance are being taken up in specific relation to water.

Questions of governance are often expressed or represented as models. These models reflect underlying positions about who should make decisions, the manner in which decisions should be made, and how societal change should occur (Glasbergen, 1998). A reconfiguration of environmental governance is underway in which the state or government is no longer seen as the sole decision-making authority (Armitage, de Loë, & Plummer, 2012; Bryant & Wilson, 1998). Attention is thus being directed to a broader array of governance models that highlight the particular roles of markets, civil society, self-regulation and co-operation (Glasbergen, 1998). Moreover, a growing emphasis is being placed on the way these models hybridise (see Armitage et al., 2012; Lemos & Agrawal, 2006) and combine to influence outcomes (Duit & Galaz, 2008) in light of the complex and multi-scale nature of contemporary environmental challenges. Table 2 summarises four of the more common models of environmental governance and unpacks each in terms of who is involved, how decisions are made and the anticipated outcomes of change.

As set out in the introduction, the intent of this study is to explore the relationship between how a system of interest is understood in terms of resilience and the governance approach(es) to the water dilemma. Resilience framing has important implications for environmental interventions. An exclusive emphasis on engineering resilience is associated with the pervasive application of top-down command and control management (Folke et al., 2004; Holling & Gunderson, 2002; Holling & Meffe, 1996; Plummer, 2010). Government is the main entity in this model of intervention and control occurs through regulations (Glasbergen, 1998). The fundamental distinction in framing resilience away from an equilibrium steady state (i.e. ecological resilience) connotes the need for adaptive management (e.g. Gunderson, 2000; Holling & Meffe, 1996). The social–ecological framing of resilience broadens the context to linked systems of humans and nature (Folke, 2006) and correspondingly emphasises adaptive and collaborative approaches (e.g. Folke, Hahn, Olsson, & Norberg, 2005; Olsson, Folke, & Berkes, 2004; Walker, Holling, Carpenter, & Kinzig, 2004). Finally, the epistemic framing of resilience is rooted in social constructivism epistemology and draws attention to the contested boundaries defining systems with the implied requirement of participation in collective action with the hallmarks of agency, negotiation and co-dependence (Powell & Jiggins, 2003; Powell et al., 2014).

## Methods

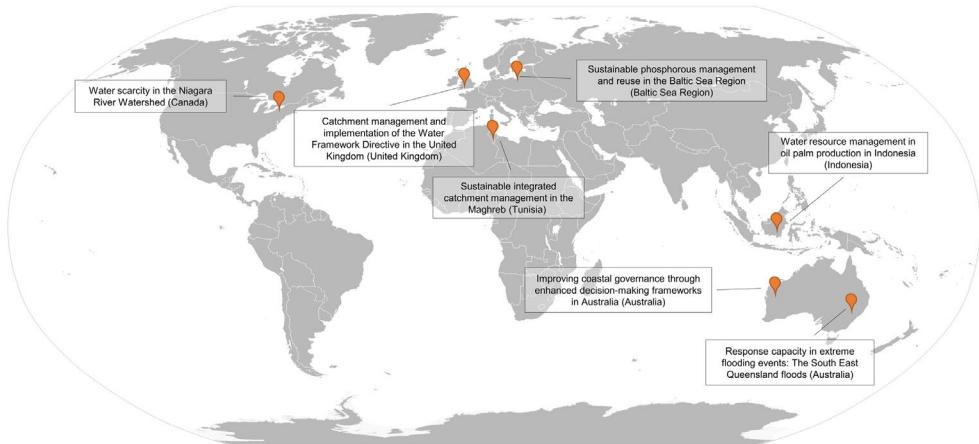
A multiple case study design was used to explore the relationship between ecosystem perceptions and the approaches to governance in a series of water dilemmas. In line with direction from Kuzel (1999) and Shakir (2002), the selection of cases fulfilled the objectives of appropriateness and adequacy. Specifically, each exhibited a water dilemma (the unit of

**Table 2.** Environmental governance models and key analytical considerations (Glasbergen, 1998; Lemos & Agrawal, 2006).

Model	Considerations		
	Who is primarily involved in governance?	How are decisions made?	What are the outcomes (how does change occur)?
State	Government (state, agencies, legislators, centralised, bureaucracy, regulators, administrators) is the main entity	Decisions are made through 'formal' policy processes with an emphasis on legal/regulatory aspect	Change takes place through regulations, rules, prescriptions, proscriptions, legislations, acts, standards, policies, plans, procedures Bureaucratic administration and enforcement
Market	State (government) facilitates market processes to varying degrees which mediate the interactions of corporations, private businesses and citizens	Consumers and industries make choices with the environmental costs of production incorporated	Price or allocation mechanisms account for environmental costs and/or considerations (e.g. taxes, fees, tradable permits, market exchanges, certification)
Civil society	Citizens, non-governmental organisations (NGO), community, stakeholders	Determinations achieved through democracy ('participatory ideal' and 'rejectionist approach'), with emphasis placed on broad participation, deliberation, consensus, public debate, civil opposition	Interventions occur at small scales (involving resource users) and through decentralisation Informal institutions are emphasized where authority and legitimacy is connected to community-based processes
Hybridised forms	Governance is a shared endeavour	Decisions are made in a myriad of ways (e.g. problem-solving process, deliberation, negotiation, joint policy practices), but some degree of power sharing is present	The following outcomes are examples from some popular hybrid environmental governance forms Co-management: cooperative agreements, joint-management boards, voluntary/negotiated agreements Public-private: concessionary arrangements, self-regulation Private-social: payments for ecosystem services, carbon sequestration

analysis) and was located in a different geographic location, and the boundary of the location was defined by the water dilemma. The opportunity to engage with these cases was made possible through a broader research consortium, of which all the case studies were part, entitled 'Climate Adaptation and Water Governance' (CADWAGO). The locations of each case study and a brief description of the water dilemma are shown in Figure 1.

Analysis of documents is often undertaken in association with case study research (Stake, 1995; Yin, 2003) as well as policy relevant questions in the environmental domain (e.g. Berke & Conroy, 2000; Gupta et al., 2010; Plummer et al., 2011). A request was made via e-mail to each case study leader (a person in each case with extensive knowledge of the water dilemma and who had undertaken primary research in the case) for three key documents that



**Figure 1.** Geographic location of cases.

addressed the water dilemma (e.g. management plans, research reports, policy documents). Each document was scrutinised to ensure it encompassed the elements of a water dilemma and that it was directly relevant to the case. Where a portion of a document was not directly relevant to the water dilemma or was clearly redundant it was excluded from the analysis.

The data collection protocol resulted in three documents for each case (21 documents in total) with an average length of 65 pages (see Appendix 1 for the list of documents). Content analysis was guided by analytical constructs in the literature – specifically, the resilience typology and governance approaches identified in Tables 1 and 2. A comprehensive codebook was prepared which elaborates upon each aspect of these constructs by providing definitions, keywords, phrases and examples (as suggested by Creswell, 2009; Krippendorff, 2013). Coding was performed in two stages using NVivo 10 (QSR International). Text queries were initially used to identify all relevant passages related to ecosystems and/or governance. A subsequent round of deductive coding, using the codebook as a guide, assigned all relevant codes to passages identified via the text query (Creswell, 2009; Krippendorff, 2013).

In coding for the analytical construct of 'resilience typology', codes were assigned by resilience type (i.e. engineering, ecological, social–ecological and epistemic) and by consideration (i.e. system boundary, desirable system attributes, relationships and functions, and/or proxies/measures of resilience) that were exhibited in the passage. The proportion of all codes assigned for each consideration within each resilience type was calculated. From these data, a simple mean value for each resilience paradigm was calculated to identify relationships in the cross-case analysis. Codes for the analytical construct 'governance approaches' were assigned for: (1) the governance approach (i.e. state, market regulation, civil society and hybrid forms); (2) considerations for governance approaches (i.e. actors, processes and outcomes); (3) the tone of the language used within each passage (positive, negative or neutral); and, (4) the magnitude, or intent, of the language used within the passage. Tone and magnitude provide a means to gauge the governance approach and associated considerations in terms of the nature and strength of expression. Magnitude was assigned using three categories (i.e. explicit, implicit and empty) described in detail in Plummer et al. (2011). The number of codes assigned to a single magnitude was divided by the total number of

magnitude codes assigned and a proportion value was identified for each tone type for each document and combined for cases.

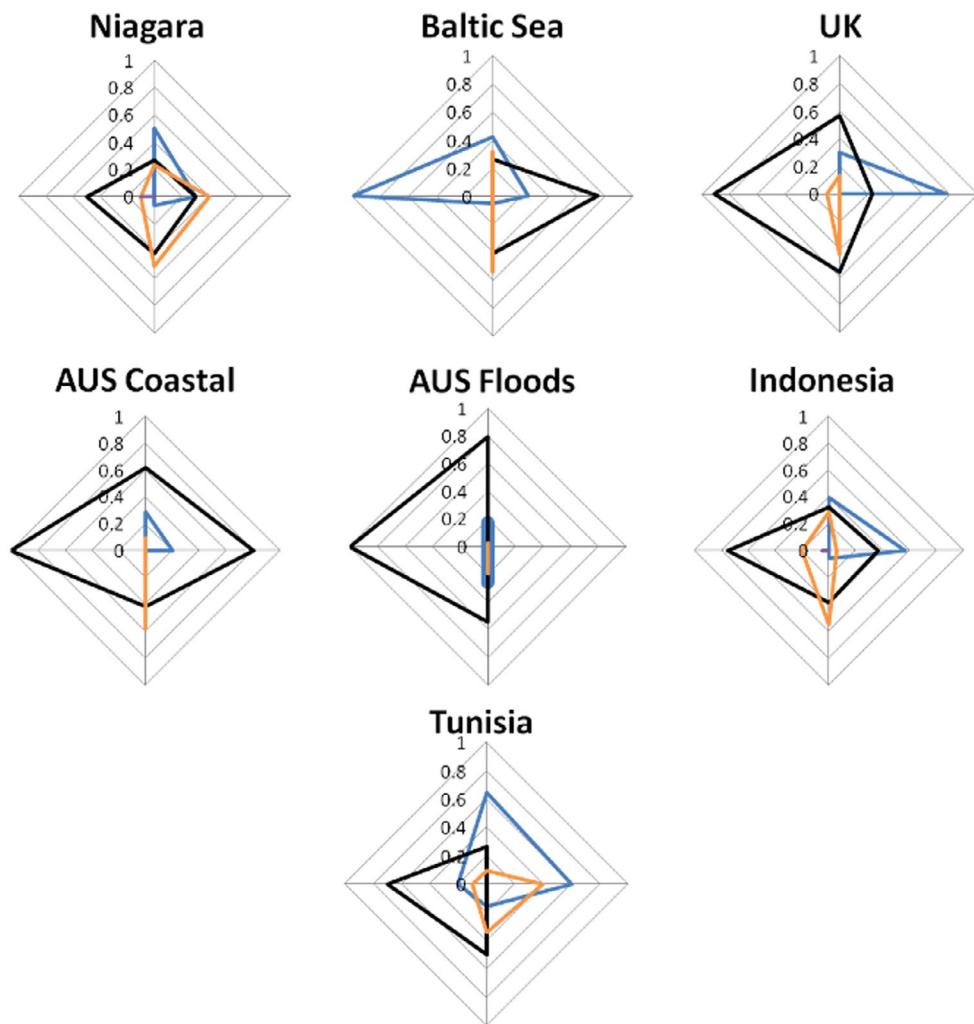
Cross-case analysis was subsequently undertaken to probe patterns among the water dilemmas that related to the four research questions guiding the study. 'Fingerprints' were created to visualise how resilience and governance was expressed across the cases by plotting the proportion of coded passages using a radar graph, where each axis represents a resilience consideration or governance dimension. All points on each axis sum to one (100% of codes assigned to that axis) and the resulting 'shape' shows how strongly it is expressed within each case (i.e. shapes with greater area indicate a stronger expression of the resilience type/governance approach). Relational patterns between how the ecosystem was perceived in terms of resilience and governance of the water dilemma were then explored through the use of scatterplots.

A limitation to the methods and study relates to the documents used for the analysis. Each case study leader was asked for three key documents that addressed the water dilemma. We relied upon the case study leaders to identify 'key' documents that address the water dilemma because it was beyond the scope of this research to investigate the extent to which the documents accurately reflected perspectives of actors in each case. While the wording of the request was intended to enable flexibility in the provision of documents based on a high degree of familiarity with the case, their selection has acknowledged implications. These include a different mix of document types between cases document as well as preparation by a variety of organisations (governmental and non-governmental) and the perceptions presented therein are reflective of author(s)/organisations. To explore the influence(s) of different types of documents, each document was classified into one of three categories: research and advisory documents authored by government agencies ( $n = 8$ ); research and advisory documents written by non-governmental groups ( $n = 6$ ); and descriptive documents authored by any source ( $n = 7$ ). This categorisation was used to understand the differences between the two main types of documents provided by case study leaders, as well as potential differences between author types for research and advisory documents as this category was broad.

## Findings

### ***How are ecosystems perceived in terms of resilience?***

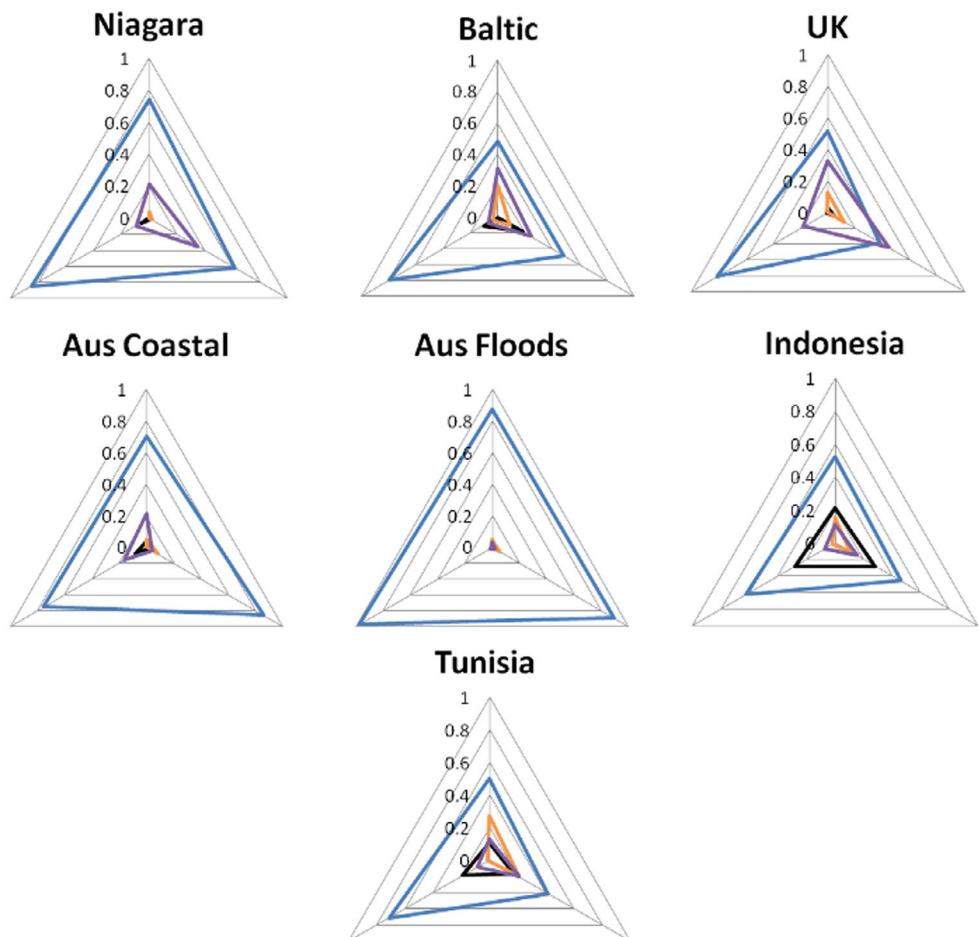
A 'resilience fingerprint' using the resilience typology was generated for each case and is illustrated in Figure 2. Multiple resilience types were represented in each case (albeit to varying extents). The fingerprints highlighted the similarity of the UK, AUS coastal, AUS floods, Indonesia and Tunisian case in the dominance of ecological resilience framings of proxies/measures of resilience. It also showed a relatively similar 'fingerprint' for Niagara and Tunisian cases. The associated water dilemmas in these similar cases showed little similarity. For example, the Niagara and Indonesian cases focus on water quality and transboundary issues, the Tunisian case focuses on water quantity variability, the UK case deals with institutional constraints to integrated water resource management and the AUS coastal case deals with diverse development pressures on protection of marine ecosystems. In addition, the types of stakeholders and governance structures in these cases vary substantially. This supports the assertion that diverse actors from different places can still commonly frame



**Figure 2.** Resilience fingerprints for each case. Notes: axes of the radar graph correspond to the four considerations of resilience paradigms: top = system boundary, right = system attributes, lower = relationships and functions, and left = proxies/measures of resilience. Line colours correspond to resilience types: blue = engineering, black = ecological, orange = social-ecological, and purple = epistemic.

issues because they are connected to a larger environmental discourse ('resilience' and 'climate change' being prime current examples) (Dryzek, 2005; Forsyth, 2003). As Forsyth (2003, p. 226) observes: 'all forms of environmental explanation reflect a wider social framing and solidarity such as a network or community...'

Some discernible patterns appeared with regards to perception of the ecosystem across cases. First, multiple resilience framings occurred in each of the cases. Engineering and ecological resilience framings tended to occur most strongly in different axes in the resilience fingerprint (i.e. for different considerations) and often in isolation of other resilience framings (Figure 2). Social–ecological resilience often co-occurred with other types and also tended to more frequently be oriented towards 'system boundary' and 'relationships and functions'



**Figure 3.** Governance fingerprints for each case. Notes: axes of the radar graph correspond to the three considerations of governance approaches: top = actors, lower right = processes and lower left = outcomes. Line colours correspond to governance approaches: blue = state, black = market, orange = civil society and purple = hybrid forms.

considerations. Expressions of these multiple types may reflect evolution, uptake and overlapping boundaries associated with resilience as an analytical construct, which has evolved and been shaped by various disciplines in the social and natural sciences. Epistemic resilience was not identified in key documents in a proportion large enough to be exhibited in the fingerprints. This finding is unsurprising given the relatively recent advent of epistemic resilience and the formative nature associated with its scholarship.

#### ***What governance approaches are taken to address these water dilemmas and how are they expressed?***

The second analytical construct concerned approaches to water governance and was unpacked using the fingerprint technique in terms of actors, processes and outcomes (Figure 3). A clear pattern emerged across cases with state governance approaches most

common across all governance considerations. State approaches were particularly strongly represented in the consideration of outcomes across cases, while non-state approaches (market regulation, civil society and hybrid forms) appeared more often for the considerations of actors and processes. This finding was unsurprising as government regulatory control forms the basis of environmental policy (Glasbergen, 1998; Kettl, 2002) and thus is likely to be closely aligned with governance outcomes.

Metrics of magnitude and tone were analysed to gauge strength and direction of the governance approaches to each water dilemma. Three distinguishable patterns emerged from the cross-case analysis. First, magnitude types were distributed among governance approaches and considerations, but passages mentioning state approaches tended to be explicit or empty, market approaches tended to be implicit or empty, and no clear patterns emerged for civil society and hybrid approaches. Second, as the proportion of state governance approaches increased, the proportion of passages with a neutral tone also increased, indicating a positive relationship between them. This is indicative of a descriptive tone (i.e. statements of what 'is') in reference to state governance approaches and is consistent with the findings about regarding the prevalence of this type of approach in most cases. Third, as the proportion of hybrid governance approaches increased, the proportion of passages with a positive tone increased, and those with a negative tone decreased, indicating that hybrid governance approaches are positively related to a positive tone and negatively related to a negative tone. While all magnitude types occur for all governance approaches, the proportions of passages mentioning market regulation, civil society and hybrid governance approaches are much lower than for state approaches. This highlights the explicit (directive) and empty (descriptive) nature of many of the passages that address state governance approaches and the implicit (advisory) and empty nature of passages for other governance approaches. This finding may be a signal of change in terms of water governance (while acknowledging the study limitation identified above), and coincides with growing emphasis for transformation of water governance beyond state approaches (e.g. Pahl-Wostl, 2009; Rogers & Hall, 2003; Tropp, 2007). A case study example of this can be drawn from the United Kingdom where non-governmental organisations legally challenged the existing approach to water management in the 1990s and fundamentally changed the way water resources were managed (Melo Zurita et al., 2013). The Department for Environment Food and Rural Affairs' (Department for Environment Food & Rural Affairs (DEFRA), 2013, p. 3) most recent policy framework for an integrated catchment approach states: 'We firmly believe that better coordinated action is desirable at the catchment level by all those who use water or influence land management and that this requires greater engagement and delivery by stakeholders'.

### ***Is there a relationship between perceptions of the ecosystem and governance approaches in these water dilemmas (and if yes, what is it)?***

This question brings together the previous analyses and informs the overarching intent of the research. The relationship(s) between perception of the ecosystem and governance approaches across cases were probed using a scatterplot to identify patterns (data not shown), however, a clear relational pattern did not appear from this exercise. The lack of clear patterns between resilience paradigms and governance approaches was surprising given the inherent associations in the literature, as set out in second section of the paper.

Our findings stand in contrast to the literature (e.g. Folke et al., 2004; Holling & Gunderson, 2002; Holling & Meffe, 1996; Plummer, 2010) in which the engineering framing of resilience corresponds to intervention via government regulation. Specifically, resilience was framed in a variety of ways in the cases whereas an emphasis on intervention by government approaches was found consistently. The absence of relationship between resilience framing and governance intervention in the cases contradicts the main premise with which the research was undertaken. However, previous content analyses of discourse illustrate how contradictions and tensions can and do often exist both within and among framings of complex problems (Creed, Langstraat, & Scully, 2002). This may well be the situation in regard to the multiple framings of resilience and the implications for governance.

Two tendencies were observable in the relationship between resilience types and governance approaches. When social-ecological resilience was present in cases, the proportion of codes assigned for state governance approaches tended to decrease, indicating that state governance approaches were mentioned in a lesser proportion to other approaches when a social-ecological paradigm was expressed. This may indicate the possibility of an emphasis on non-state agents, processes and outcomes occurs in texts exhibiting this resilience type. Moreover, weak positive relationships between the social-ecological resilience type and market, civil society and hybrid governance approaches were also evident, indicating an increase in the presence of these approaches as the social-ecological resilience type was expressed. These findings are generally consistent with the transition underway in natural resources management and environmental governance scholarship where the limitations of command and control approaches are being acknowledged (e.g. Holling & Meffe, 1996; Ludwig, 2001) and novel governance arrangements are being explored (e.g. Armitage et al., 2012; Folke et al., 2005). Further, it appears that the social-ecological resilience perspective is most congruent with the promotion of this transition.

### ***How does the type and source of document influence the findings?***

Finding relatively few patterns among cases in the above question prompted further investigation into the influence(s) documents themselves may be having in mediating the findings. The presence of patterns within and across document types was explored spanning all cases in regard to each of the aforementioned queries. In terms of perceptions of the ecosystem, engineering resilience was more consistently present (in boundary and attributes considerations) in research and advisory documents authored by government agencies than for the non-government documents of the same type, or the descriptive documents. This may reflect the historically dominant role played by engineers and engineering consulting firms in water resource management. The perceptions of the ecosystem also were highly variable within each document type. Patterns within and across document type in reference to governance approach revealed that: state approaches were highly dominant in passages for all three document types for all considerations; for research and advisory documents authored by non-governmental groups, there was some mention of civil society actors and market outcomes; for research and advisory documents authored by government agencies and for descriptive documents, hybrid actors and processes were sometimes mentioned; and in terms of outcomes, research and advisory documents authored by government agencies were highly focused on state outcomes. While it was anticipated that documents authored by government would emphasise state governance approaches, the dominance

of these approaches within and across document types was unexpected. Again, a clear relationship between resilience framing and governance approach was not evident. Moreover, the findings also suggest little uptake of non-state governance approaches as has been argued for in the scholarly literature over the past 15 years (e.g. Armitage et al., 2012; Folke et al., 2005; Glasbergen, 1998) and as required for second or next generation environmental policy (Durant, Chun, Kim, & Lee, 2004; Kettl, 2002). Thus, agents directly participating in these cases and drawing upon these texts for information and guidance may find that the documents reflect resilience perspectives not entirely congruent with their own or other agents participating in the same cases.

In considering magnitude, research and advisory documents authored by non-governmental groups exhibited mostly empty and implicit language for market, civil society and hybrid approaches, whereas state-based approaches were associated with a higher proportion of explicit passages (mean of 25% of all passages). Research and advisory documents authored by government agencies were written using mostly explicit and empty language for all governance types, and descriptive documents exhibited a mix of magnitude types for all governance approaches with no clear pattern. For all three document types, tone was most often neutral; however, a pattern was evident in tone between document types with research and advisory documents authored by both governments and non-governmental groups being more negative (approximately 30 and 20% of passages coded, respectively) as compared to descriptive documents (approximately 30% of passages coded were positive and only 10–16% negative). It is possible that certain document types could have been written to support a political position on an issue or set of issues or written by individuals that have a conceptual or professional stake in advancing the material and knowledge presented. As Bullock, Armitage, and Mitchell (2012, p. 317) observe with respect to dominant framings of resilience and non-resilience in natural resource dilemmas:

Experts cannot and should not be viewed as neutral consultants and objectives technicians employed to advise their client social groups in situations of learning – because they bring their own disciplinary assumptions, tools and reputations to a problem domain, based on certain cultures of learning.

Robust relational patterns between ecosystem perceptions and governance approaches were not evident within document types; however, a trend emerged in government authored research in advisory reports and descriptive documents where a strong focus on state-based governance approaches was consistent despite the resilience perspectives expressed. This finding, again, stands in opposition to the anticipated relationship, informed by the literature, in which government regulatory intervention is associated with engineering framing of resilience. It also contradicts the tendencies outlined above between social–ecological resilience framing and governance approaches across the cases investigated. Consequently, evidence from the document analysis suggests relatively little reflection or uptake of the widespread calls for new and different approaches to intervening. For example, the need for new approaches for management and governance that correspond or ‘fit’ with complex adaptive systems perspective of resilience has been argued strongly (e.g. Boyd & Folke, 2012; Folke et al., 2004; Holling & Meffe, 1996). Attention to shifting paradigms and cultivating corresponding governance approaches is similarly present in water resource scholarship (e.g. Ison, Röling, & Watson, 2007; Pahl-Wostl, 2007; Scholz & Stifel, 2005). Inroads into wicked problems (e.g. water dilemmas) require processes and tools that are different from those contributing to their creation (Brown, Harris, & Russel, 2010; FitzGibbon & Mensah, 2012).

## Conclusion

Ecosystem perceptions, governance approaches and the relationships among these were explored in a document analysis of seven water dilemmas across the globe. In drawing upon conceptual developments of resilience in relation to ecosystems and environmental governance, relationships were anticipated between resilience framing and approaches for intervening in the cases. However, these patterns did not clearly emerge from the analysis. In particular, the relationship between engineering framing of resilience and regulatory intervention via government was absent. A pattern across cases linked the presence of the social–ecological resilience framing and non-state-centred governance approaches. This trend appeared most strongly in references to governance actors and processes, and less so in governance outcomes which is consistent with a transition in governance from command and control to other forms (Armitage et al., 2012; Folke et al., 2005). However, the findings from these cases indicate that transition may be occurring slowly and in an incomplete way, and that a transfer of authority from state to non-state actors may not have accompanied this shift. The persistent expression of state governance approaches found in documents authored by governments, regardless of the resilience perspective taken, raises important questions about the limited uptake as called for above as well as the entrenchment pathology within resource agencies (cf. Holling & Meffe, 1996).

While this research was initiated with expectations of finding congruence between resilience framings and governance approaches, the discordance found reveals important cautions when considering documents as well as opens directions for future research. Reflections on the process of using documents in this research highlight the influence of author type and messaging (language and tone) in the analysis. Results indicating the occurrence of negative content emanating from government and non-government authors serve as a reminder that while documents are stable sources of data, they must not be viewed as apolitical or neutral data sources. Instead, they are imbued with the political meanings of their authors, explicit and implicit, whether intentional and unintentional. This is a noteworthy challenge for actors who are addressing local water issues and perhaps participating in governance that in their efforts to gain information and guidance from available texts, may confront resilience perspectives in these texts that do not reflect the most recent conceptualisations of the wicked water dilemmas being addressed.

The findings from this study also highlight several important directions for future research. The (mis)alignment of perceptions and beliefs about ecosystems and governance by stakeholders in the water dilemmas with the anticipated relationships from the literature is extremely perplexing and requires further investigation. Grounded speculation from this research suggests that resilience may be a challenging lens to capture framing because of the multi-faceted nature of the construct, incremental manner in which it has evolved and issues of mutual exclusivity. The pervasiveness of the government regulatory approach to address the water dilemmas studied requires concerted investigation. Why is the transition underway in water scholarship and policy regarding the inclusion of non-state actors in contemporary water governance not reflected in documents associated with water dilemmas? Is the emphasis on government regulation manifest in documents reflective of how water dilemmas are being addressed in practice? Another question called up by this study is how individuals (stakeholders) in water dilemmas perceive ecosystems and prefer governance to be approached. Comparisons could then be made among those conceptually

advanced by scholars, manifest in documents and held by individuals. These future avenues of research are essential next steps to sort out inconsistencies in addressing water dilemmas among theory, policy and practice.

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## Appendix 1

**Table A1.** Documents used for content analysis of water dilemmas.

Case	Document (citation)
Australia coastal management	Natural Resource Management Ministerial Council. (2006). <i>National cooperative approach to integrated coastal zone management. Framework and implementation plan</i> . Canberra, Australia: Australian Government. Retrieved from <a href="http://www.environment.gov.au/resource/national-cooperative-approach-integrated-coastal-zone-management-framework-and">http://www.environment.gov.au/resource/national-cooperative-approach-integrated-coastal-zone-management-framework-and</a>
O'Toole, K., Haward, M., Coffey, B., Leith, P., Rees, C., Quinn, G., Wescott, G., Scarborough, H., Wallis, A., Keneley, M., Macgarvey, A., Miller, K., Baxter, T., Kriwoken, L., Mount, R., Nursey-Bray, M., & Vince, J. (2013). <i>Knowledge systems theme. Final report</i> . CSIRO.	
Stocker, L., Bruekers, G., Danese, C., Hofmeester, C., Shaw, J., Petrova, S., Middle, G., Pokrant, B., & Zafrin, S. (n.d.). <i>Final report: Governance theme</i> . CSIRO.	
Australia flooding	Brisbane City Council. (2012). <i>Brisbane City Council disaster management plan</i> . Retrieved from <a href="http://www.brisbane.qld.gov.au/downloads/community/community_safety/Section%201%20-%20Disaster%20Management%20Plan%20-%20no%20signature%20copy.pdf">http://www.brisbane.qld.gov.au/downloads/community/community_safety/Section%201%20-%20Disaster%20Management%20Plan%20-%20no%20signature%20copy.pdf</a>
Queensland Floods Commission of Inquiry. (2012). <i>Final report of the Queensland Floods Commission of Inquiry</i> . Retrieved from <a href="http://www.floodcommission.qld.gov.au/_data/assets/pdf_file/0007/11698/QFCI-Final-Report-March-2012.pdf">http://www.floodcommission.qld.gov.au/_data/assets/pdf_file/0007/11698/QFCI-Final-Report-March-2012.pdf</a>	
Wenger, C., Hussey, K., & Pittcock, J. (2013). <i>Living with floods: Key lessons from Australia and abroad</i> . Gold Coast, Australia: National Climate Change Adaptation Research Facility.	
Baltic	Heeb, A. (2012). <i>Constructed wetlands and flood control a synthesis of four Baltic COMPASS case studies. Part I: Background report – September 2012</i> . Retrieved from <a href="http://www.balticcompass.org/PDF/Reports/WetlandsFloods-synthesis-AH-final.pdf">http://www.balticcompass.org/PDF/Reports/WetlandsFloods-synthesis-AH-final.pdf</a>
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