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## 43. Resilience

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### INTRODUCTION

‘Resilience’ as a concept has gained increasing attention within climate change policy and research circles. The term is used by multiple and diverse disciplines, which consequently has resulted in numerous meanings and uses of the term. However, these diverse understandings and uses of the term have the potential to affect conceptual clarity and might restrict researchers and practitioners in applying resilience as a response to climate change. In this chapter we therefore explore how useful the term is in enabling normative aspirations to reduce net losses to climate change impacts. This is particularly relevant in light of more recent conceptualizations towards transformation. In this chapter, we highlight recent studies that review trends in conceptualizations and uses of resilience, and offer a grounded elaboration on broader normative aspects that are relevant for climate policy and governance.

First, we summarize conceptualizations of resilience based on the origins and evolution of the term, followed by a brief overview of its specific use in climate-related disaster research and a synopsis of the current debate on shortcomings in its application. We then take stock of the term’s seemingly rapid rise by presenting analyses from two studies on existing understandings of climate resilience in academic discourse and public policy. We conclude with a general discussion and suggestions to enhance normative orientations and therefore support practical applications of resilience in climate research and governance.

#### **Conceptualizing Resilience: Origins and Evolution**

Resilience can be traced to several academic disciplines (e.g., see detailed reviews in Aldunce 2013; Bodin and Wiman 2004; Moser 2008). Some suggest that resilience was first developed within mathematics and physics (Bodin and Wiman 2004), whereas Waller (2001) attributes resilience to psychology and psychiatry in the 1940s. Within ecology, resilience appeared in the 1960s and 1970s in the study of ecological and social-ecological systems (Holling 1961; Lewontin 1969; May 1972; Rosenzweig 1971). As with diverse disciplinary origins, meanings of resilience are also diverse. In mathematics and physics, the term refers to the ability of a material or system to resist or bend without breaking, and to the speed of return or ‘bounce back’ to equilibrium after displacement (Aldunce 2013; Bodin and Wiman 2004; Gordon 1978; Norris et al. 2009). In psychology and psychiatry, resilience is a trait at individual, community or large societal scales (Aldunce 2013; Norris et al. 2008), with further applications within the social sciences including studies in communities and societies (Adger 2000). Within the latter, resilience

describes the process, outcome or capacity of individuals and communities to resist, recover and return to baseline functioning after a misfortune, stress or external shock (Aldunce 2013; Norris et al. 2008; Pfefferbaum et al. 2005). Egeland et al. (1993) describe resilience as involving adaptation; whereas Chenoweth and Stehlik (2001) qualify this as a ‘strengthening’ of community bonds. Others describe resilient communities as possessing ‘adaptive capacities’ through networked resources such as economic and/or social capital, information and communication, and competences following an impact (Aldunce 2013; Norris et al. 2008).

Holling (1973) introduces ‘resilience thinking,’ which is linked to the concept of coupled ‘social-ecological systems’ (SES), i.e., diverse components of people and nature interacting with feedbacks and interdependencies, and ‘complex adaptive systems’ where several connections between people and nature occur at the same time on different levels (Adger et al. 2005; Gunderson and Folke 2005). SES resilience originally focused on a SES’s ability to absorb disturbance and persist without altering its fundamental structure (Holling 1973). This understanding of resilience has evolved to include a capacity to adapt, self-organize, learn, renew and develop (Adger et al. 2005; Aldunce 2013; Gunderson and Folke 2005; Liu et al. 2007; Resilience Alliance 2012), and it is often used in the context of climate change.

### **Resilience in Climate-related Disasters**

Over the course of the past decade, the concept of resilience has received growing attention within the disaster risk management (DRM) field (Aldunce 2013; Moser 2008), particularly following the adoption of the ‘Hyogo framework for action 2005–2015: building resilience of nations and communities to disasters’ (UN/ISDR 2007). Studies of disaster resilience within the field of DRM have been undertaken from various disciplinary perspectives, consequently resulting in various applications and generating multiple definitions within DRM (Table 43.1).

The IPCC special report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (IPCC 2012), represents one of the biggest efforts to date to bring climate change and DRM scientists together, where attention was paid by the working groups to the relevance of resilience in these fields. Decision-makers have consequently started to include resilience in various documents, policies and programs at national and subnational levels (see Aldunce et al. 2014a). Interestingly, this tendency has occurred before rigorous theoretical and empirical grounding in social sciences has occurred (Brown 2011).

### **Shortcomings in Uses of Resilience**

Despite its popularity, resilience has been often criticized (Aldunce 2013; Brown 2011; Moser 2008; Walker and Cooper 2011). A recurring critique targets its abstract nature, where resilience can be seen as ambiguous and lacking attention to issues of power and agency (Nelson et al. 2007; Walker and Cooper 2011). Davoudi et al. (2012) further elaborate on these critiques and categorize them within four general themes. First is lack of reference to human agency, where the role of individuals through to state authorities and other actors in the social system are vaguely addressed in terms of how they

Table 43.1 Definitions of resilience in disaster risk management

Author	Definition
Timmerman (1981)	The capacity of a system to absorb and recover from the occurrence of a hazardous event.
Wildavsky (1991)	Resilience is the capacity to cope with unanticipated dangers after they have become manifest, learning to bounce back.
Miletti (1999)	Local resilience with regard to disasters means that a locale is able to withstand an extreme natural event without suffering devastating losses, damage, diminished productivity, or quality of life without a large amount of assistance from outside the community.
Comfort (1999)	The capacity to adapt existing resources and skills to new systems and operating conditions.
Paton et al. (2000)	Resilience describes an active process of self –righting, learned resourcefulness and growth – the ability to function psychologically at a level far greater than expected given the individual’s capabilities and previous experiences.
Klein et al. (2003)	Facilitates and contributes to the process of recovery . . . describes specific system attributes concerning (i) the amount of disturbance a system can absorb and still remain within the same state or domain of attraction and (ii) the degree to which the system is capable of self-organization.
Bruneau et al. (2003)	The ability of social units (e.g. organizations, communities) to mitigate hazards, contain the effects of disasters when they occur, and carry out recovery activities in ways that minimize social disruption and mitigate the effects of future earthquakes.
Pelling (2003)	The ability of an actor to cope with or adapt to hazard stress.
Longstaff (2005)	The ability by an individual, group, or organization to continue its existence (or remain more or less stable) in the face of some sort of surprise . . . Resilience is found in systems that are highly adaptable (not locked into specific strategies) and have diverse resources.
Paton (2006)	The measure of how well people and societies can adapt to a changed reality and capitalize on the new possibilities offered.
UN/ISDR (2007)	The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself, to increase this capacity for learning from past disasters for better future protection and to improve risk reduction measures.
IPCC (2012)	The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the reservation, restoration, or improvement of its essential basic structures and functions.

Source: Aldunce et al. 2014b.

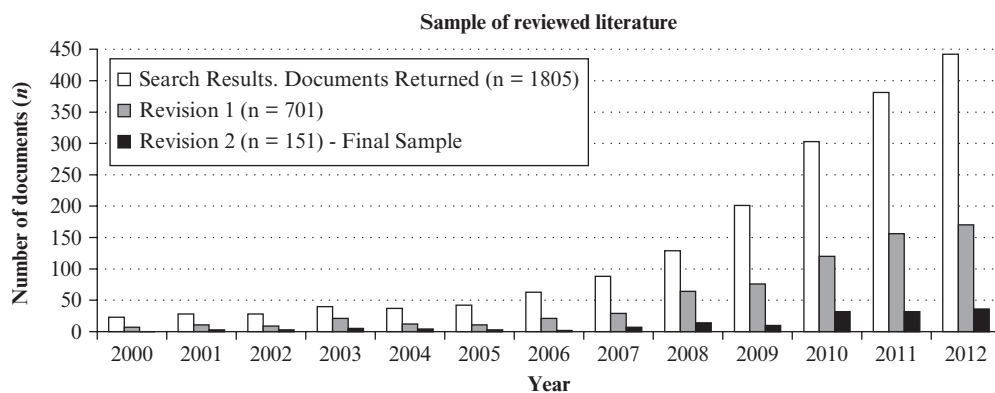
diminish, sustain or enhance resilience. For example Prior and Hagmann (2013), citing Lund Petersen (2012), point at evidence from risk and resilience research that highlights the importance of making explicit the roles and responsibilities of the state, the economy, civil society and even individuals on implementing resilience policies to avoid certain actors assuming a ‘task supervisor’ role and thus divulging responsibility for implementing to other actors. Second is a lack of structure to define goals, where ambiguity (see also Prior and Hagmann 2013) exists on what resilience means in more normative terms, given that in social systems defining what is desirable is always tied to normative judgments. Third are system boundaries, where choices on defining a SES inevitably place focus on some aspects of the system while excluding or discounting others. This selective and bounded approach can, for instance, exclude certain relevant actors from providing input on what counts as a system component. Fourth, is the issue of de-politicization and power, given that in social systems we cannot consider resilience without paying attention to procedural justice and fairness and the distribution of gains and losses. Yet, in the context of resilience, who gets to make decisions on these matters, and for whom, often remain unaddressed (Bailey and Revell this volume). However, as Olsson et al. (2014) discuss, the concept of power is gaining attention among scholars, for instance by focusing on articulating the type and mechanism of power relation being discussed in context (e.g., ‘power to’ or ‘power over’) and in turn how they influence dynamics of social-ecological change.

In order to facilitate the application of the term in a climate adaptation context (Dilling this volume)—i.e., the resilience of what, to what, for what, and for whom?—a policy process needs to first focus on the goals of the participants, rather than their risks, vulnerabilities or resilience in silos (Lynch et al. 2008). A process that frames its starting point from a values-based approach (O’Brien and Wolf 2010)—i.e. defining what the human system ‘values’—does not deny the need for analysis of resilience (Lynch et al. 2008), yet we appear to lack the means to pragmatically use the term in helping to define normative goals.

## ‘RESILIENCE’ IN CLIMATE CHANGE: EXAMPLES OF TRENDS IN ACADEMIC DISCOURSE AND PUBLIC POLICY

### Rationale

As Davoudi et al. (2012) note, a simple frequency count of the use of resilience over time depicts the term as *the* trending buzzword of the moment. However, this trend warrants a closer look, particularly if we are to make sense of how best to incorporate a contested term that is ‘here to stay’ (Norris et al. 2008). In order to move forward and advance the debate, we need to take stock and clarify on where and how the term has evolved. To this end, we rely on two studies that were carried out in parallel to systematically review patterns and trends in the conceptualization of resilience in the academic literature (Aldunce et al. 2014b; Indvik 2014), as well as in public policies (Alegría 2014).



Source: Aldunce et al. 2014b; Indvik 2014.

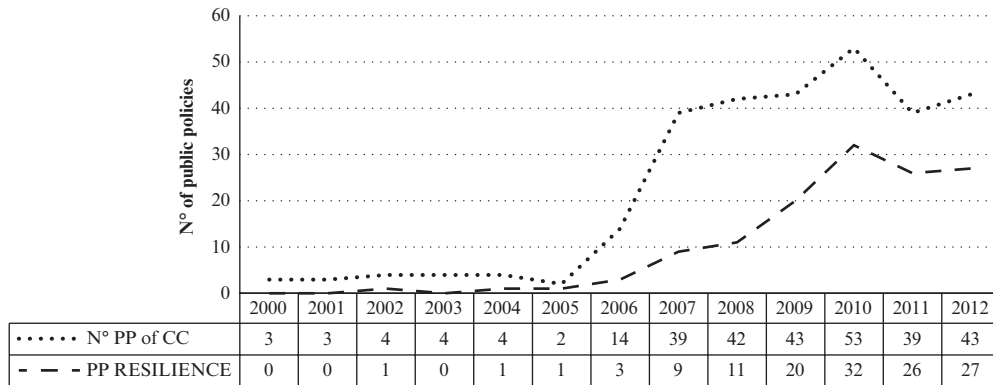
Figure 43.1 Summary of search results, document selection and final inclusion

### 'Climate Resilience' in Academic Discourse and Public Policies

Indvik (2014) and Aldunce et al. (2014b) show how climate change resilience literature has increased over time (Figure 43.1), based on peer-reviewed literature searched in the SCOPUS database for the search terms 'resilien\*' AND 'climat\* chang\*', within document title, abstract and/or keywords.

Additional data was collected for the final sample of 151 articles to account for authors, institutions and countries, allowing for a spatial (i.e., geographic) analysis of academic output and identify countries based on with greater (and lesser) productivity, principal investigators and associated institutions. Indvik (2014) found that resilience is diversely conceptualized and framed within climate change-related publications across fields and disciplines. Definitions of resilience can be categorized as social, ecological, social-ecological and structural/physical resilience. Social-ecological resilience is the most frequently defined within reviewed literature (54 percent); 41 percent of definitions describing social resilience, and 35 percent define ecological resilience. Significant overlap exists between resilience 'types,' with the greatest overlap between social-ecological resilience and social resilience.

Alegria (2014) reviewed peer-reviewed climate change policy literature published in English, Spanish and Portuguese from 2000 to 2013 in SciVerse Scopus® and SciELO databases, with a focus on the country in which the study or research was conducted and reported in the paper. A separate search was conducted for public policies at national level from 2000 to 2012 for each of the countries identified in the peer-reviewed studies. Countries that are represented in the 'top ten'<sup>1</sup> and 'bottom ten'<sup>2</sup> for total peer-reviewed publications were selected (n = 20) and their public policies reviewed to determine the extent and context in which the term 'resilience' appears in the text. Overall, 134 climate change-focused policies produced between 2000 and 2012 were identified, of which 42 percent made reference to resilience, with an increase in the number of these policies over time most notably since 2006 (Figure 43.2).



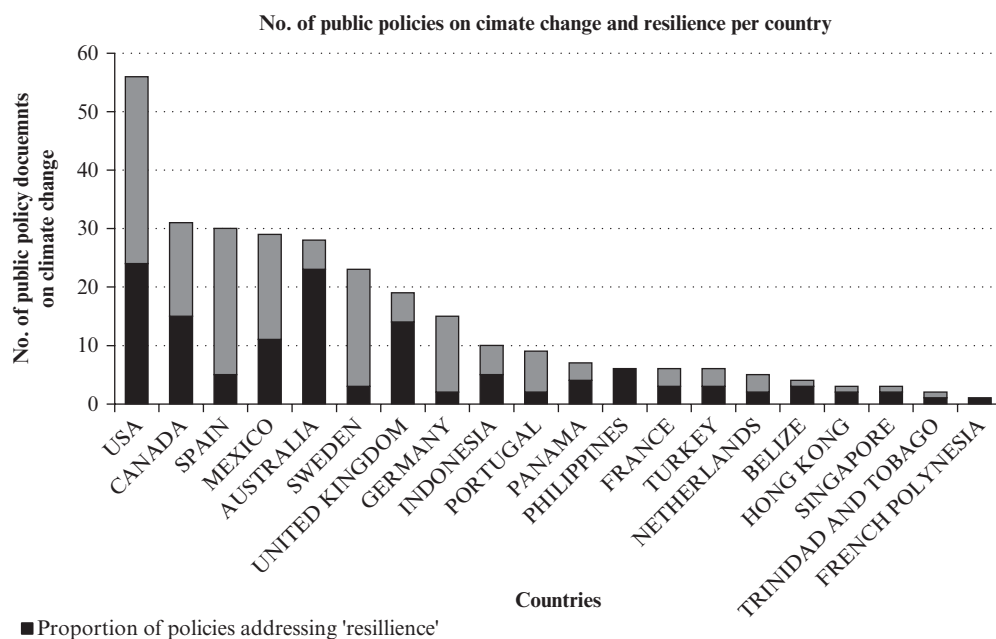
Source: Alegria 2014.

Figure 43.2 Number of public policies (pp) on climate change (cc) and resilience, by year of publication

Figure 43.3 shows the number of climate change policies by country and the relative proportion of policies that contain the term ‘resilience.’ Despite some nations classified within the ten countries with least or no references to ‘resilience’ in their policy texts, the relative proportion of policies with resilience with respect to total public policies on climate change is quite high (e.g., French Polynesia). This suggests a potential emphasis on resilience there as a response to addressing climate change, and may warrant closer examination of conditions under which these policy processes prominently incorporate resilience as part of those policies.

Based on the methodology described in Osuna and Márquez (2000), seven categories that generally depict stages of the policy formulation process were used to classify climate policies identified in Alegria’s research: (1) diagnosis; (2) objective; (3) internal strategy; (4) diagnosis and objective; (5) diagnosis and internal strategy; (6) objective and internal strategy; and (7) throughout the document (diagnosis, objective, internal strategy). In all cases, resilience appears mostly associated with strategic formulation rather than in setting concrete and/or measurable objectives. Overall, policies broadly encapsulate the term ‘resilience’ in their aims and objectives, but not in the actual implementation, assessment or evaluation of policies. Furthermore, it is also difficult to discern how resilience is framed and represented in each context, where we would expect diverse meanings of the term. Therefore, the extent to which ‘climate resilience’ can be said to be enshrined at the core of climate policies is questionable, in line with much of the theoretical critique directed at the applicability of the term in action.

Other inferences from analyses in these studies indicate that of the ten most academically productive countries in the academic field of resilience, eight correspond to countries of the northern hemisphere and account for 84 percent of the total number of reviewed publications. Finally, countries with greater scientific production on resilience tend to include climate change resilience within their political agenda; however,



Source: Alegría 2014.

*Figure 43.3 Number of climate change policies per country, with proportion of policies with reference to resilience*

the concept of resilience is rarely incorporated beyond goals and objectives, and lacks implementation and/or evaluation frameworks to monitor and assess progress in achieving climate resilience.

Despite the potential wealth of relevant information in non-academic 'grey' literature such as reports, peer-reviewed journals represent a more readily accepted source of information for a standardized review of current knowledge on a given topic (Ford et al. 2011). Nevertheless, it is important to consider limitations of bibliographic searches and analyses limited to material in English and primarily produced within developed countries, where alternative conceptualizations in other languages may not be captured, or other channels of communication not captured in scientific databases (Ríos Gómez and Herrero Solana 2011).

## DISCUSSION AND MOVING FORWARD

The increasing recognition and use of resilience as an integral part of responding to climate change calls for more reviews of the concept. We relate resilience to other relevant concepts often used in climate change, such as vulnerability (Forsyth this volume), adaptation and adaptive capacity (Dilling this volume), and transformation, with a view towards situating resilience within this broader scope of applicable concepts.

Although vulnerability is sometimes considered the ‘flip side’ or opposite of resilience (see, e.g., Bravo 2009; Olwig 2012; Walker et al. 2011), the relationship between vulnerability and resilience is not necessarily one of a simple inverse nature (Frommer 2011; Klein et al. 2003; Marshall 2010). The enhancement of resilience and capacity-building is often considered a prerequisite for the management of climate change risks and for the reduction of vulnerability to these risks (O’Brien et al. 2006; Robledo et al. 2004). Additionally, resilience deals with ‘systems’ as interconnected components of the whole, while vulnerability tends to focus on more specific single factors (social groups, crops, species, etc.). As a result, resilience represents a systems-oriented and complementary lens in which these specific factors that hinder progress on reducing net losses to climate impacts can be examined, allowing for a focus on opportunity (Miller et al. 2010). Adaptation is a process of change associated with adaptive capacity, which in turn is understood as the potential to facilitate conditions that enable individuals or groups to respond to climate change (Adger et al. 2011; Beermann 2011; O’Brien et al. 2006). In this context, adaptation and adaptive capacity are considered important determinants of resilience (Klein et al. 2003; Myers et al. 2012; Tompkins and Adger 2004).

Transformability and adaptability have come to be recognized as concepts illustrating different *types* of resilience (Folke et al. 2010). Olsson et al. (2014) illustrate this distinction, stating: ‘Transformability refers to the social-ecological capacities that enable shifts from one regime to another and adaptability refers to the capacities to deal with change and stay within a regime.’ However, despite efforts to provide general conceptual clarity, a ‘regime shift’ in the context of climate governance is not often explicitly elaborated in the literature, for instance the role that certain policies at national level might have in reshaping or even shifting politics and governance at other scales such as global. Nevertheless, capacities to enable shift in a ‘transformative’ sense entail identifying desired end goals implies a values-based and normative judgment that inevitably deals with subjectivity and diverse world views, where options are negotiated and decisions are made by and between those who are selected to be a part of the ‘system’ or regime. Therefore, to enable greater utility of resilience in terms of implementation, a concerted and necessarily political dialogue should take place in not only defining the system but also the conditions to participate in clarifying goals in the common interest, i.e., resilience of what, to what, for whom and how within safe and just operating spaces (see, e.g., Dearing et al. 2014; Raworth 2012).

To address climate change, the main normative goal or aspiration can be broadly defined as seeking to reduce net losses to the impacts of climate change of what is valued in a given context (Brunner 2014; Brunner and Lynch 2010). This entails the ‘valued’ as being anywhere from securing tangible assets such as infrastructure along coastal areas from sea level rise to less tangible and intrinsic assets like preserving cultural norms and identity (Lynch et al. 2012). Therefore, the focus should be on how best to respond to this goal orientation, given the increasing number of references to resilience in both academia and public policies that appear deficient in application on an evidentiary basis. In the academic discourse, there are continuing tensions between normative and analytical stances on resilience, propagating in policy discourses and lack of evidence in local level actions on resilience (see also Brown 2014).

In the most recent IPCC assessment report (AR5), it is suggested that strategies and actions that move us towards climate-resilient pathways for sustainable development



are transformative, or in the resilience context, *evolutionary* resilience where ‘resilience is not conceived of as a return to normality, but rather as the ability of complex socio-ecological systems to change, adapt, and, crucially, transform in response to stresses and strains’ (Davoudi et al. 2012, p. 302). This entails clarifying visions and approaches for transformations that achieve sustainable development in accordance with local circumstances and priorities, highlighting the need for specifying normative goals that serve the common interest. Defining these goals places a focus on target knowledge production, employing transdisciplinary principles (see, e.g., Hirsch Hadorn et al. 2008; Lasswell and McDougal 1992; Lasswell 1971; Pohl and Hirsch Hadorn 2007), which in turn require institutional architectures and processes that allow for such deliberations and negotiations to take place, starting with how knowledge on climate change is selected and assessed (Adler and Hirsch Hadorn 2014; Beck et al. 2014).

Much work remains to be done on issues pertaining to institutional architecture and global governance processes (Lederer this volume), and ways to facilitate the integration of diverse knowledge and perspectives in the application of the concept. For instance, one attempt to bring more functionality to interpretations and use of resilience is through the ‘resilience wheel’ (Aldunce et al. 2014b), developed as a result of the synthesis work that grounded a better understanding of the origins and use of the term and status of its application in public policies. The inclusion of determinants, attributes, and supporting theoretical assumptions for resilience-building within a functional framework lends these concepts the importance they deserve. A flexible tool for situating the term in terms of distinct realities and contexts allows for the explicit incorporation of resilience theory—emerging from multiple disciplinary perspectives—to applications within different cases (Aldunce et al. 2014b). Incorporating diverse stakeholder perspectives on resilience represents challenges for policymakers and decision-makers when the term is framed as a goal in itself, rather than as a means to identify what is valued and the acceptable means to reduce net losses in the longer term. Additional challenges in the implementation of resilience involves the need for the devolution of power to communities and other social actors beyond government agencies in order to enable self-organization, diversity of actors and citizen participation, thus implementing resilience beyond a pure theoretical interpretation (Betts and Schroeder this volume).

## NOTE

1. Top ten countries: USA, Australia, UK, Canada, France, Sweden, Germany, Spain, Singapore, Netherlands.
2. Bottom ten countries: Mexico, Indonesia, Portugal, Panama, Philippines, Turkey, Belize, Hong Kong, Trinidad and Tobago, French Polynesia.

## BIBLIOGRAPHY

- Adger, W.N. (2000), Social and ecological resilience: are they related?, *Progress in Human Geography*, **24**(3), 347–364.
- Adger, W.N., T.P. Hughes, C. Folke, S.R. Carpenter and J. Rockström (2005), Social-ecological resilience to coastal disasters, *Science*, **309**(5737), 1036–1039.
- Adger, W.N., K. Brown, D.R. Nelson, F. Berkes, H. Eakin, C. Folke, K. Galvin, L. Gunderson, M. Goulden,

- K. O'Brien, J. Ruitenbeek, and E.L. Tompkins (2011), Resilience implications of policy responses to climate change, *Wiley Interdisciplinary Reviews: Climate Change*, **2**(5), 757–766.
- Adler, C.E. and G. Hirsch Hadorn (2014), The IPCC and treatment of uncertainties: topics and sources of dissent, *Wiley Interdisciplinary Reviews: Climate Change*, **5**(5), 663–676.
- Aldunce, P. (2013), *Framing Resilience: Practitioners' Views of its Meaning and Usefulness in Disaster Risk Management Practice*, Melbourne: University of Melbourne, Department of Geography and Resource Management.
- Aldunce, P., R. Beilin, J. Handmer and M. Howden (2014a), Framing disaster resilience: the implications of the diverse conceptualisations of 'bouncing back,' *Disaster Prevention and Management*, **23**(3), 252–270.
- Aldunce, P., Indvik, K., Bórquez, R., Adler, C., Galaz, V. (2014b). *Resilience in the context of climate change: A systematic review of the literature to aid a navigation of diversity*. Working Paper CR2, Centre for Climate and Resilience Research, University of Chile.
- Alegria, D. (2014), *Uso del concepto de 'Resiliencia' en la literatura científica en el contexto del Cambio Climático y su relación con la actual aplicación en Políticas Públicas*, unpublished MSc thesis, University of Chile.
- Beck, S., M. Borie, J. Chilvers, A. Esguerra, K. Heubach, M. Hulme, R. Lidskog, E. Lövbrand, E. Marquard, C. Miller, T. Nadim, C. Nebhöver, J. Settele, E. Turnhout, E. Vasileiadou and C. Görg (2014), Towards a reflexive turn in the governance of global environmental expertise: the cases of the IPCC and the IPBES, *GAIA: Ecological Perspectives for Science and Society*, **23**(2), 80–87.
- Beermann, M. (2011), Linking corporate climate adaptation strategies with resilience thinking, *Journal of Cleaner Production*, **19**(8), 836–842.
- Bodin, P. and B. Wiman (2004), Resilience and other stability concepts in ecology: notes on their origin, validity, and usefulness, *ESS Bulletin*, **2**, 33–43.
- Bravo, M.T. (2009), Voices from the sea ice: the reception of climate impact narratives, *Journal of Historical Geography*, **35**(2), 256–278.
- Brown, K. (2011), Policy discourses of resilience, in M. Pelling, D. Manuel-Navarrete and M. Redclift (eds.), *Climate Change and the Crisis of Capitalism: A Chance to Reclaim, Self, Society and Nature*, London: Routledge, pp. 37–50.
- Brown, K. (2014), Global environmental change I: a social turn for resilience?, *Progress in Human Geography*, **38**(1), 107–117.
- Bruneau, M., S.E. Chang, R.T. Eguchi, G.C. Lee, T.D. O'Rourke, A.M. Reinhorn, M. Shinozuka, K. Tierney, W.A. Wallace and D. v. Winterfeldt (2003), A framework to quantitatively assess and enhance the seismic resilience of communities, *Earthquake Spectra*, **19**(4), 733–752.
- Brunner, R.D. (2014), Harvesting experience for adapting to climate change, *Weather, Climate, and Society*, **6**(1), 5–8.
- Brunner, R.D. and A.H. Lynch (2010), *Adaptive Governance and Climate Change*, Chicago: University of Chicago Press.
- Chenoweth, L. and D. Stehlik (2001), Building resilient communities: social work practice and rural Queensland, *Australian Social Work*, **54**(2), 47–54.
- Comfort, L. (1999), *Shared Risk: Complex Systems in Seismic Response*, New York: Pergamon.
- Davoudi, S., K. Shaw, L.J. Haider, A.E. Quinlan, G.D. Peterson, C. Wilkinson, H. Fünfgeld, D. McEvoy, L. Porter and S. Davoudi (2012), Resilience: a bridging concept or a dead end?/'Reframing' resilience: challenges for planning theory and practice/Interacting traps: resilience assessment of a pasture management system in northern Afghanistan/Urban resilience: what does it mean in planning practice?/Resilience as a useful concept for climate change adaptation? The politics of resilience for planning: a cautionary note, *Planning Theory & Practice*, **13**(2), 299–333.
- Dearing, J.A., R. Wang, K. Zhang, J.G. Dyke, H. Haberl, M.S. Hossain, P.G. Langdon, T.M. Lenton, K. Raworth, S. Brown, J. Carstensen, M.J. Cole, S.E. Cornell, T.P. Dawson, C.P. Doncaster, F. Eigenbrod, M. Flörke, E. Jeffers, A.W. Mackay, B. Nykvist and G.M. Poppy (2014), Safe and just operating spaces for regional social-ecological systems, *Global Environmental Change*, **28**, 227–238.
- Egeland, B., E. Carlson and L.A. Sroufe (1993), Resilience as process, *Development and Psychopathology*, **5**(4), 517–528.
- Folke, C., S.R. Carpenter, B. Walker, M. Scheffer, T. Chapin and J. Rockström (2010), Resilience thinking: integrating resilience, adaptability and transformability, *Ecology and Society*, **15**(4).
- Ford, J.D., L. Berrang-Ford and J. Paterson (2011), A systematic review of observed climate change adaptation in developed nations, *Climatic Change*, **106**(2), 327–336.
- Frommer, B. (2011), Climate change and the resilient society: utopia or realistic option for German regions?, *Natural Hazards*, **58**(1), 85–101.
- Gordon, J. (1978), *Structures*, Harmondsworth: Penguin Books.
- Gunderson, L. and C. Folke (2005), Resilience – now more than ever, *Ecology and Society & Natural Resources*, **10**(2), 22.

- Hirsch Hadorn, G.H., H. Hoffmann-Riem, S. Biber-Klemm, W. Grossenbacher-Mansuy, D. Joye, C. Pohl, U. Wiesmann and E. Zemp (2008), *Handbook of Transdisciplinary Research*, Berlin: Springer.
- Holling, C. (1961), Principles of insect predation, *Annual Review of Entomology*, **6**, 163–182.
- Holling, C. (1973), Resilience and stability of ecological systems, *Annual Review Ecological Systems*, **4**, 1–23.
- Indvik, K. (2014), *Una revisión sistemática y un meta-análisis de la conceptualización multidisciplinaria de la resiliencia en su aplicación al contexto del cambio climático*, unpublished MSc thesis, University of Chile.
- IPCC (2012), *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change*, Cambridge and New York: Cambridge University Press.
- Klein, R.J.T., R.J. Nicholls and F. Thomalla (2003), Resilience to natural hazards: how useful is this concept?, *Environmental Hazards*, **5**(1–2), 35–45.
- Lasswell, H. (1971), *A Pre-View of Policy Sciences*, New York: Elsevier Publishing Company.
- Lasswell, H. and M. McDougal (1992), *Jurisprudence for a Free Society: Studies in Law, Science, and Policy*, Netherlands: Martinus Nijhoff Publishers.
- Lewontin, R. (1969), *The Meaning of Stability: Diversity and Stability of Ecological Systems*, paper presented at the Brookhaven symposia in biology no 22, Brookhaven, New York.
- Liu, J., T. Dietz, S.R. Carpenter, M. Alberti, C. Folke, E. Moran, A.N. Pell, P. Deadman, T. Kratz, J. Lubchenco, E. Ostrom, Z. Ouyang, W. Provencher, C.L. Redman, S.H. Schneider and W.W. Taylor (2007), Complexity of coupled human and natural systems, *Science*, **317**(5844), 1513–1516.
- Longstaff, P. (2005), *Security, Resilience, and Communication in Unpredictable Environments such as Terrorism, Natural Disasters, and Complex Technology*, Cambridge, MA: Harvard University.
- Lund Petersen, K.L. (2012), *Corporate Risk and National Security Redefined*, New York: Routledge.
- Lynch, A., L. Tryhorn, and R. Abramson (2008), Working at the boundary: facilitating interdisciplinarity in climate change adaptation research, *Bulletin of the American Meteorological Society*, **89**(2), 169–179.
- Lynch, A., D. Griggs, L. Joachim, and J. Walker (2012), The role of the Yorta Yorta people in clarifying the common interest in sustainable management of the Murray–Darling Basin, Australia, *Policy Sciences*, 1–15.
- Marshall, N.A. (2010), Understanding social resilience to climate variability in primary enterprises and industries, *Global Environmental Change*, **20**(1), 36–43.
- May, R. (1972), Will a large complex ecosystem be stable?, *Nature*, **238**, 413–414.
- Miletti, D. (1999), *Disaster by Design: a Reassessment of Natural Hazards in the United States*, Washington: Joseph Henry Press.
- Miller, F., H. Osbahr, E. Boyd, F. Thomalla, S. Bharwani, G. Ziervogel, B. Walker, J. Birkmann, S. van der Leeuw and J. Rockström (2010), Resilience and vulnerability: complementary or conflicting concepts, *Ecology and Society*, **15**(3), 11.
- Moser, S. (2008), *Resilience in the Face of Global Environmental Change*, Oak Ridge: CARRI Research report 2.
- Myers, S.A., M.J. Blackmore, T.F. Smith and R.W. Bill Carter (2012), Climate change and stewardship: strategies to build community resilience in the Capricorn Coast, *Australasian Journal of Environmental Management*, **19**(3), 164–181.
- Nelson, D., N. Adger and K. Brown (2007), Adaptation to environmental change: contributions of a resilience framework, *Annual Review Environmental Resources*, **32**, 395–419.
- Norris, F.H., S.P. Stevens, B. Pfefferbaum, K.F. Wyche and R.L. Pfefferbaum (2008), Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness, *American Journal of Community Psychology*, **41**, 127–150.
- Norris, F.H., M. Tracy and S. Galea (2009), Looking for resilience: understanding the longitudinal trajectories of responses to stress, *Social Science Medicine*, **68**(12), 2190–2198.
- O'Brien, K.L. and J. Wolf. (2010), A values-based approach to vulnerability and adaptation to climate change, *Wiley Interdisciplinary Reviews: Climate Change*, **1**(2), 232–242.
- O'Brien, G., P. O'Keefe, J. Rose and B. Wisner (2006), Climate change and disaster management, *Disasters*, **30**(1), 64–80.
- Olsson, P., V. Galaz and W.J. Boonstra (2014), Sustainability transformations: a resilience perspective, *Ecology and Society*, **19**(4).
- Olwig, M.F. (2012), Multi-sited resilience: the mutual construction of 'local' and 'global' understandings and practices of adaptation and innovation, *Applied Geography*, **33**(1), 112–118.
- Osuna, J.L. and C. Márquez (2000), *Guía para la evaluación de políticas públicas*, Spain: Instituto de Desarrollo Regional, Fundación Universitaria.
- Paton, D. (2006), Disaster resilience: building capacity to co-exist with natural hazards and their consequences, in D. Paton and D. Johnston (eds.), *Disaster Resilience: an Integrated Approach*, Springfield: Charles C. Thomas Publisher, pp. 3–10.
- Paton, D., L. Smith and J. Violanti (2000), Disaster response: risk, vulnerability and resilience, *Disaster Prevention and Management*, **9**(3), 173–179.

- Pelling, M. (2003), *The Vulnerability of Cities: Natural Disaster and Social Resilience*, Londong: Earthscan Publications.
- Pfefferbaum, B., D. Reissman, R. Pfefferbaum, R. Klomp and R. Gurwitsch (2005), Building resilience to mass trauma events, in L. Doll, S. Bonzo, J. Mercy and D. Sleet (eds.), *Handbook on Injury and Violence Prevention Interventions*, New York: Kluwer Academic Publishers, pp. 347–358.
- Pohl, C. and G. Hirsch Hadorn (2007), *Principles for Designing Transdisciplinary Research: Proposed by the Swiss Academies of Arts and Sciences*, Munich: Oekom.
- Prior, T. and J. Haggmann (2013), Measuring resilience: methodological and political challenges of a trend security concept, *Journal of Risk Research*, **17**(3), 281–298.
- Raworth, K. (2012), *A Safe and Just Space for Humanity: Can We Live Within the Doughnut?*, Oxfam Discussion Paper, Oxford: Oxfam.
- Resilience Alliance (2012), *Resilience Alliance: Key Concepts*, [www.resalliance.org/index.php/key\\_concepts](http://www.resalliance.org/index.php/key_concepts) (accessed June 6, 2012).
- Ríos Gómez, C. and V. Herrero Solana (2011), La producción científica latinoamericana y la ciencia mundial: una revisión bibliográfica (1989–2003), *Revista interamericana de Bibliotecología*, **28**(1).
- Robledo, C., M. Fischler and A. Patino (2004), Increasing the resilience of hillside communities in Bolivia: has vulnerability to climate change been reduced as a result of previous sustainable development cooperation?, *Mountain Research and Development*, **24**(1), 14–18.
- Rosenzweig, M. (1971), Paradox of enrichment: destabilization of exploitation ecosystems in ecological time, *Science*, **171**, 385–387.
- Timmerman, P. (1981). *Vulnerability, Resilience and the Collapse of Society*. Environmental Monograph 1, Institute for Environmental Studies, University of Toronto, Toronto.
- Tompkins, E.L. and W.N. Adger (2004), Does adaptive management of natural resources enhance resilience to climate change?, *Ecology and Society*, **9**(2).
- UN/ISDR (2007), *Hyogo Framework for Action 2005–2015: Building Resilience of Nations and Communities to Disasters*, Geneva, United Nations International Strategy for Disaster Reduction.
- Walker, J. and M. Cooper (2011), Genealogies of resilience: from systems ecology to the political economy of crisis adaptation, *Security Dialogue*, **42**(2), 143–160.
- Walker, R., J. Hassall, S. Chaplin, J. Congues, R. Bajayo and W. Mason, (2011), Health promotion interventions to address climate change using a primary health care approach: a literature review, *Health Promotion Journal of Australia: Official Journal of Australian Association of Health Promotion Professionals*, **22**, S6–S12.
- Waller, M.A. (2001), Resilience in ecosystemic context: evolution of the concept, *American Journal of Orthopsychiatry*, **71**(3), 290–297.
- Wildavsky, A. (1991), *Searching for Security*, New Brunswick: Transaction Books.