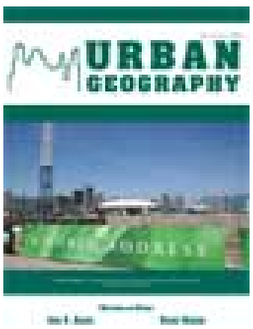

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Urban resilience for whom, what, when, where, and why?

Sara Meerow and Joshua P. Newell

School of Natural Resources and Environment, University of Michigan, Ann Arbor, MI, USA

ABSTRACT

In academic and policy discourse, the concept of urban resilience is proliferating. Social theorists, especially human geographers, have rightfully criticized that the underlying politics of resilience have been ignored and stress the importance of asking "resilience of what, to what, and for whom?" This paper calls for careful consideration of not just resilience for whom and what, but also where, when, and why. A three-phase process is introduced to enable these "five Ws" to be negotiated collectively and to engender critical reflection on the politics of urban resilience as plans, initiatives, and projects are conceived, discussed, and implemented. Deployed through the hypothetical case of green infrastructure in Los Angeles, the paper concludes by illustrating how resilience planning trade-offs and decisions affect outcomes over space and time, often with significant implications for equity.

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Urban resilience; urban sustainability; social-ecological systems; vulnerability; adaptation; green infrastructure

1. Introduction

Urbanization processes drive change in the Anthropocene, presenting environmental and social challenges that are unprecedented in scale, scope, and complexity (Seto, Sánchez-Rodríguez, & Fragkias, 2010). Climate change introduces additional uncertainties, placing pressure on local institutions to adapt. To marshal the actors and resources necessary for cities to effectively adjust and sustain key functions, academics and policymakers are turning to the concept of "urban resilience" as an organizing principle (Leichenko, 2011). In both the broader academy and public discourse, the concept's growing popularity is evident. Figure 1 illustrates the exponential increase in studies that apply the concept of resilience to cities, a trend especially pronounced in the fields of climate change and hazards (Beilin & Wilkinson, 2015). Policy initiatives related to urban resilience are also proliferating (Vale, 2014)[1].

One of the attractions of the resilience concept is its ability to serve as a "boundary object" (Brand & Jax, 2007) or "bridging concept" (Beichler, Hasibovic, Davidse, & Deppisch, 2014), thereby allowing multiple knowledge domains to interface. The shared concept of urban resilience, for example, has helped fuse the "climate change adaptation" and "disaster risk reduction" agendas (ARUP, 2014, p. 3), as well as security and sustainability priorities (Coaffee, 2008). But the term's flexibility and inherent inclusiveness has also led to conceptual confusion, especially in relation to

CONTACT Sara Meerow sameerow@umich.edu

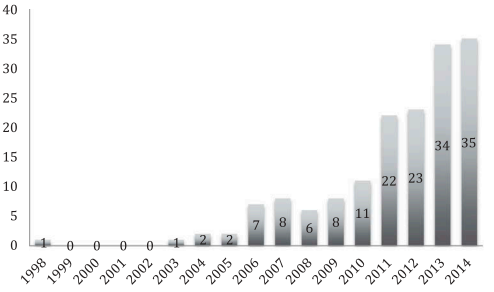

Figure 1. The rapid rise of urban resilience research: a graph showing the number of publications in the Web of Science database for each year from 1998 to 2014 with the terms "urban resilience," "resilient city," or "resilient cities" in the title, abstract, or keywords. *Note*: This may be an underestimate as Web of Science has stronger coverage of the natural sciences and engineering than social sciences.

like-minded terms such as sustainability, vulnerability, and adaptation (Elmqvist, 2014). These concepts are all commonly used in urban studies and policy, but in a multitude of ways, including as measurable characteristics, descriptive concepts, metaphors, and modes of thinking or paradigms.

Nevertheless, the theoretical roots of resilience give it a particular focus and connotation that makes a resilience approach related to, but distinct from, sustainability, adaptation, and vulnerability.[2] In the influential ecological and social-ecological systems (SES) resilience literature, systems thinking is pervasive. The focus in this work has traditionally been on quantitative modeling rather than the interactions between individual components and dynamics within the boundaries of a system (Turner, 2014). The most trenchant critiques of resilience scholarship come from social theorists, who take issue with the ways in which ecological models are applied to social structures and the general lack of attentiveness to issues of politics, power, and equity (Cote & Nightingale, 2011; Cretney, 2014; Evans, 2011; MacKinnon & Derickson, 2012; Weichselgartner & Kelman, 2015). These scholars rightfully assert the need to consider questions of "resilience of what to what?" and "resilience for whom?" (Carpenter, Walker, Anderies, & Abel, 2001; Lebel et al., 2006; Vale, 2014), as well as to reflect on scalar and temporal trade-offs (Chelleri, Waters, Olazabal, & Minucci, 2015).

Yet the popularity of resilience, especially in policy discourse, continues to grow. As Weichselgartner and Kelman (2015, p. 254) recognize, "While the academic debate on describing resilience continues, governments around the world have developed plans and programmes that aim to guide cities, communities and authorities towards achieving it."

In this paper, we argue that the resilience concept is redeemable. What is missing is a process by which to incorporate these important critiques. The primary objective of this paper, therefore, is to introduce such a process, which can be divided into three phases. The first involves the establishment of urban resilience as a boundary object, in which collaborators share a common definition of resilience and come to a basic agreement on what is "urban." The second phase entails critically thinking through resilience for whom, what, when, where, and why. These "five Ws of urban resilience" shape how resilience is operationalized and mapped over time and space. The third phase then

explores urban resilience in empirical contexts. Taken together, this approach engenders a politics of resilience that includes grappling with trade-offs and scalar complexities and delineating how political context and power dynamics shape resilience policies, with inevitable winners and losers.

The next section briefly reviews the origins of the resilience concept and compares it with sustainability, vulnerability, and adaptation. Then Section 3 introduces the three-phase process designed to foster a politics of urban resilience, detailing in particular the five Ws. This is followed by Section 4, which uses a hypothetical example of green infrastructure planning for the city of Los Angeles to illustrate the ways in which questions of who, what, when, where, and why have wide-ranging implications for communities, institutions, and ecologies. The paper concludes by briefly considering how geographers could enrich urban resilience research.

2. The concept of resilience in the literature

Understanding the concept of urban resilience requires knowledge of how resilience theory has developed. Although the term has a long history of use in psychology and engineering, in the global environmental change literature, resilience is commonly traced back to ecologist C.S. Holling (Brown, 2014; Garschagen, 2013; Meerow & Newell, 2015). Holling (1973) defined resilience as an ecosystem's ability to maintain basic functional characteristics in the face of disturbance. Characterizing ecosystems as having multiple stable states and in a constant state of flux, Holling (1996) later distinguished between *static* "engineering" resilience, referring to a system's ability to bounce back to its previous state, and *dynamic* "ecological" resilience, which focuses on maintaining key functions when perturbed.

This ecological framing of resilience and understanding of ecosystems as dynamic, complex, and adaptive was seminal to the development of socio-ecological system (SES) theory, led by a group of interdisciplinary-minded ecologists (Folke, 2006; Gunderson & Holling, 2002). SES theory effectively extended Holling's ecological concepts to the "social" by conceptualizing nature-society as an intertwined, coevolving system. In the SES literature, resilience is identified as a product of (1) the amount of perturbation a system can endure without losing its key functions or changing states, (2) the system's ability to self-organize, and (3) the system's capacity for adaptation and learning (Folke et al., 2002).

The resilience concept has been applied in a wide range of empirical contexts, extending it from a descriptive term (i.e. reflecting how an ecosystem functions) to a normative approach or "way of thinking" (Folke, 2006, p. 260). This approach has become foundational for thinking through how complex systems can persist in the face of uncertainty, disruption, and change (Davoudi et al., 2012; Matyas & Pelling, 2014). Cities have been identified as the "example par excellence of complex systems" (Batty, 2008, p. 769); therefore, it is no surprise that resilience theory is increasingly applied in urban studies (Elmqvist, 2014; Leichenko, 2011; Meerow, Newell, & Stults, 2016). In its original, more descriptive form, resilience can be both positive and negative; however, "resilience thinking" and the concept of "resilient cities" have emerged as normative, desired goals in both academic and policy arenas (Cote & Nightingale, 2011; Vale, 2014). These different uses of the term have led to a multitude of definitions and

confusion about what resilience means and how it relates to other key concepts like sustainability, vulnerability, and adaptation, which we turn to next.

2.1. *Parsing differences: resilience, sustainability, adaptation, vulnerability*

Conceptually, the relationship between resilience and sustainability is often muddled (Redman, 2014). Sustainability is usually linked to "sustainable development," defined in the Bruntland Report (Bruntland, 1987) as: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs". In some instances, sustainability and resilience are used interchangeably, in others resilience is presented as an important component of broader sustainability goals, and resilience has even been heralded as a new and improved paradigm (Derissen, Quaas, & Baumgärtner, 2011). Leading resilience scholars have generally argued that system resilience is crucial for achieving sustainability in "a world of transformations" (Folke et al., 2002). Thus, as a descriptive concept, resilience does not necessarily conflict with sustainability. Due to different theoretical legacies, however, when conceived as a way of thinking, or as a paradigm of environmental change and management, there are notable distinctions.

In the SES resilience literature, systems exist in a constant state of flux, requiring flexible planning and management (Folke, 2006). In comparison, some resilience thinkers find sustainability management approaches that seek an optimal balance between current and future needs problematically "static" (Cascio, 2009, p. 92). In other words, rather than predicting and planning for a more sustainable future, resilience stresses uncertainty and building systems-based adaptive capacity to unexpected future changes(Meerow & Baud, 2012). There are situations in which this conflicts with traditional sustainability goals. Sustainability measures often seek to optimize eco-efficiency, yet research suggests that functional redundancy fosters resilience (Korhonen & Seager, 2008). So, "an efficient optimal state outcome" (Walker & Salt, 2006, p. 9) could conceivably reduce resilience rather than foster it. Similarly, Redman (2014, p. 8) points out that so-called "smart cities" are often presented as more sustainable, yet the increased efficiency and interconnectedness of smart cities suggests "an inflexibility and extreme hypercoherence that resilience theorists have often warned against."

There are other important differences. Resilience emphasizes systems-based modeling and relies on SESs as the basic unit of analysis. This can obfuscate inequalities within the system, fail to account for the range of social actors involved, and pay insufficient attention to social dynamics (Bahadur & Tanner, 2014; Leach, 2008).[3] In the sustainability literature, there is a strong emphasis on balancing economic, environmental, and social justice goals (Brand & Jax, 2007). In the resilience scholarship, such concepts receive less attention (Friend & Moench, 2013).

Concern with social equity and political issues also distinguish the vulnerability and adaptation scholarship from the resilience literature. Although all three research domains share an interest in linked human-natural systems and how these SESs cope with disruptions and change, as Miller et al. (2010, p. 6) observe, adaptation and vulnerability research provides a "more politically nuanced understanding of social change and equity." In contrast to work on resilience, constructivist social scientists have heavily influenced the vulnerability and adaptation research (Miller et al., 2010). By focusing on

studies of human actors and communities and how the environment poses a threat or provides resources to them, this research also tends to be more anthropocentric than resilience studies (Turner, 2010). While adaptation and vulnerability research is somewhat interconnected, resilience scholarship is more isolated (Janssen, Schoon, Ke, & Börner, 2006). Collaboration between these research communities may be undermined by conceptual confusion. In some instances, as with sustainability and resilience, the terms are used interchangeably. At other times, they are inversely related, with resilience seen as the flipside of vulnerability or even as one determinant of it (Gallopín, 2006).

2.2. *Theoretical critiques of resilience*

A number of geographers and social scientists contend that issues of power, scale, and equity are not given sufficient attention when considering the resilience of SESs (Cote & Nightingale, 2011; Cretney, 2014; Evans, 2011; MacKinnon & Derickson, 2012; Pizzo, 2015; Weichselgartner & Kelman, 2015). They are especially concerned with the ramifications of applying ecological models to society, as well as how resilience as a concept is deployed and by whom. In other words, "resilience of what, to what, and for whom?" (Elmqvist, 2014). As a whole, this emerging critical discourse focuses on three shortcomings: (1) a general lack of clarity with respect to meaning, (2) failure to sufficiently address scalar dimensions and trade-offs, and (3) inherent conservatism and the resulting preservation of the status quo.

The concept of resilience is commonly criticized for being too ambiguous and difficult to operationalize or measure (Matyas & Pelling, 2014; Vale, 2014). As resilience is adapted to a wide array of disciplines and policy sectors, there is concern that it may lose meaning and become an "empty signifier" (Weichselgartner & Kelman, 2015).

Depending on how resilience is operationalized, it can lead to spatial and temporal trade-offs and inequitable benefits, but these issues have not been sufficiently scrutinized (Chelleri et al., 2015). Part of the problem has to do with the transference of an ecological concept (i.e. resilient ecosystems) to social systems, at least initially by scholars not especially familiar with complexities associated with studying how society functions (Brown, 2014). For MacKinnon and Derickson (2012), resilience approaches oversimplify issues of spatial scale because they tend to view cities or communities as a "self-organizing" unit, akin to an ecosystem, that must protect itself from external threats. This artificially separates them from wider scales and processes. Conceptualizing cities as predictable or generalizable systems has also been criticized as a theoretical regression (Beilin & Wilkinson, 2015), ignoring decades of work on urban interconnectedness and inequality by urban theorists (e.g. see Brenner and Schmid, 2011, Harvey, 1996, and Heynen, Kaika, and Swyngedouw, 2006).

For Joseph (2013) and others, the resilience agenda is inherently conservative and tends to perpetuate an unjust status quo (Cretney, 2014; MacKinnon & Derickson, 2012; Walker & Cooper, 2011; Welsh, 2014). By assuming that complex systems naturally go through adaptive cycles of collapse and reorganization, ecological resilience theory "accepts change somewhat passively," often precluding the consideration of the social causes of crises (Evans, 2011, p. 224). The onus is placed on individuals or communities to adapt to inevitable disruptions, rather than addressing the underlying causes of these crises (Wamsler, 2014). For some, this resonates with neoliberal efforts

to roll back the responsibilities of the state (Joseph, 2013; MacKinnon & Derickson, 2012; Welsh, 2014). As Evans and Reed (2014, p. 1) write, the resilience agenda is an effort on the part of liberal regimes to create a "catastrophic imaginary that promotes insecurity by design." Similarly, Walker and Cooper (2011) attribute the popularity of resilience theory to its ideological fit with the influential complexity theory-based financial system models of Friedrich Hayek.

For MacKinnon and Derickson (2012), a focus on resilience impedes necessary systemic transformation. Indeed, in analyzing the discourse of major international organizations' resilience-building initiatives, Brown (2012) found that resilience supported business as usual. In response, some leading resilience scholars have attempted to integrate transformation into resilience thinking, in addition to recovery and adaptability (see Olsson, Galaz, and Boonstra 2014 for a discussion). Nevertheless, MacKinnon and Derickson (2012) argue for replacing resilience with "resourcefulness," which they feel better supports social justice by providing marginalized communities with the capacity to transform society and enact their own desired futures.

While critical social scientists may ultimately disagree on the value of the resilience concept, together they highlight the need to examine the underlying politics of resilience. This includes questioning who sets the resilience agenda, how resilience is conceptualized, at what scales it is applied, and who benefits or loses.

3. Enabling a politics of urban resilience

This section introduces an iterative three-phase process to facilitate a politics of urban resilience in which knowledge is coproduced by decision makers and researchers and ideally leads to more usable science (Dilling & Lemos, 2011; Jasanoff, 2004) (Figure 2).

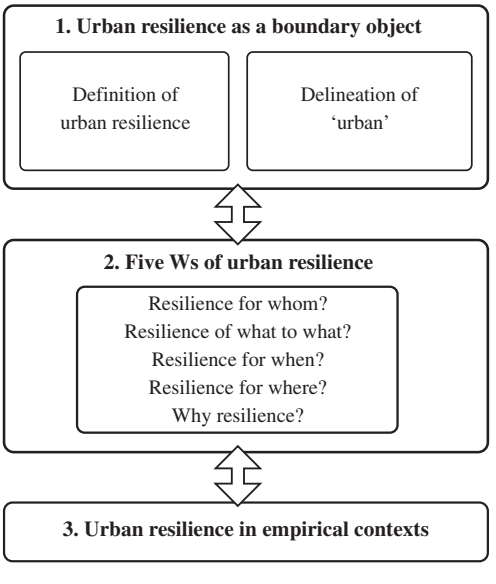

Figure 2. Process for enabling a politics of urban resilience.

Phase 1 involves conceptualizing urban resilience as a boundary object based on a shared definition and understanding of what is included in the "urban system." In phase 2, questions related to resilience for whom, what, where, when, and why are carefully considered. This forms the basis for testing, modeling, and applying urban resilience in empirical contexts (phase 3), thereby advancing both knowledge and practice.

3.1. *Urban resilience as a boundary object*

The concept of urban resilience serves a valuable function by initiating multidisciplinary dialogue; however, some consensus on both the meaning of "resilience" and "urban" provides a stronger basis for collaboration. Thus, in phase 1, an inclusive definition of urban resilience and conceptual schematic of the urban serve as a boundary object, bringing together different stakeholders and disciplines.

A boundary object refers to an object or concept that resonates with different social worlds, and as a result, supports scientific collaboration across disciplines (Star & Griesemer, 1989). A boundary object's meaning is somewhat flexible, which allows it to be adapted to the needs of various disciplines and stakeholders. Previous studies have shown that resilience effectively functions as a boundary object or bridging concept (Beichler et al., 2014; Brand & Jax, 2007; Coaffee, 2013). As Vale (2014, p. 198) argues, "the biggest upside to resilience, however, is the opportunity to turn its flexibility to full advantage by taking seriously the actual interconnections among various domains that have embraced the same terminology." While some malleability in the meaning of resilience may foster collaboration, too much ambiguity makes it difficult to operationalize resilience for any specific policy context (Matyas & Pelling, 2014).

Like the broader concept of resilience, urban resilience has become an increasingly popular, but also increasingly vague term (Meerow et al., 2016). This ambiguity hinders effective operationalization, benchmarking, and measurement of resilience (Pizzo, 2015). A shared interest in building more resilient cities may bring different disciplines to the table, but conceptual tensions have made consensus on a shared definition elusive (Beichler et al., 2014). Some agreement on a common definition of urban resilience is needed to avoid it becoming an empty signifier (Vale, 2014). Therefore, Meerow et al. (2016) recently proposed the following definition:

> Urban resilience refers to the ability of an urban system—and all its constituent socio-ecological and socio-technical networks across temporal and spatial scales—to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity.

Part of what makes urban resilience so difficult to define is the inherent complexity of cities (Jabareen, 2013). Geographers and urban scholars have long debated what constitutes the "urban." Should cities be understood as individual bounded systems or even ecosystems (Pickett et al., 2001), as linked systems of cities (Ernstson et al., 2010), or a complex system of networks (Desouza & Flanery, 2013)? Developing a conceptual model of the urban requires delineating the various political, social, ecological, and technical features of cities as well as complex urban–rural and city-to-city linkages and resource flows. Figure 3 represents a conceptual model of an urban system developed by Meerow et al. (2016), which is composed of four interconnected components: (1)

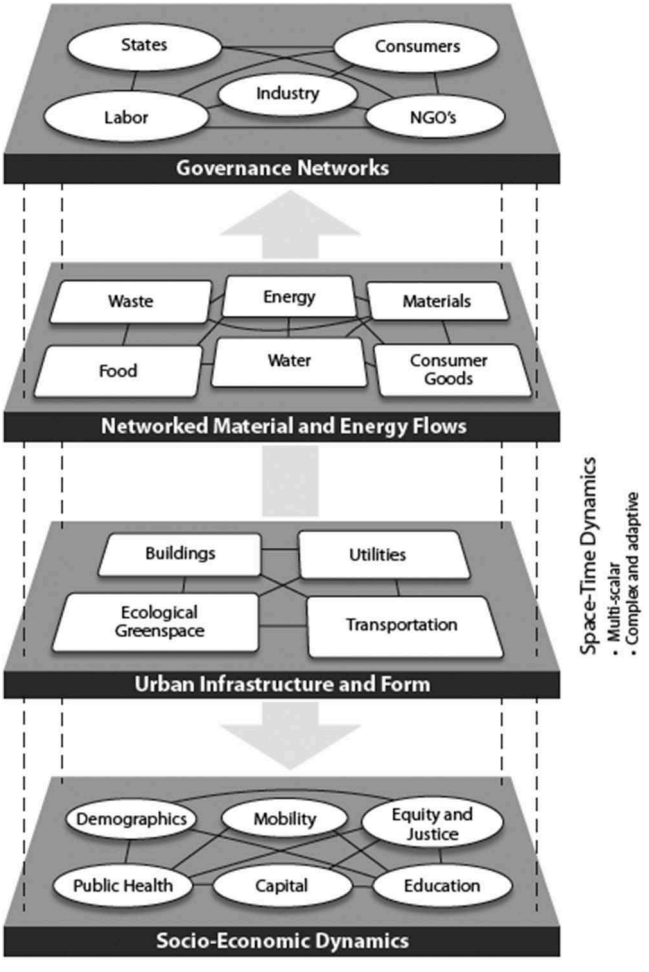

Figure 3. A conceptual schematic of the urban system proposed by Meerow et al. (2016) and inspired by Dicken (2011).

governance networks; (2) networked material and energy flows; (3) urban infrastructure and form; and (4) socioeconomic dynamics, all of which interact across spatial and temporal scales. A conceptual schematic like this one can help structure meaningful discussions about the complex and multiscalar components of cities or what is meant by "urban" in urban resilience.

3.2. *Elaborating the five Ws of urban resilience*

Once collaborators have a common interest in, and understanding of, urban resilience, the next phase is to collectively think through questions related to resilience for whom? What? When? Where? And why? (Table 1) These "five Ws" bring the politics of resilience to the forefront by encouraging the explicit recognition of politicized decisions, scalar dimensions, and trade-offs inherent to applying resilience empirically. Who determines the resilience priorities for a city and what are their motivations for

Table 1. The five Ws of urban resilience

		Questions to consider
Who?		Who determines what is desirable for an urban system? Whose resilience is prioritized? Who is included (and excluded) from the urban system?
What?	**T** **R** **A**	What perturbations should the urban system be resilient to? What networks and sectors are included in the urban system? Is the focus on generic or specific resilience?
When?	**D** **E** **O**	Is the focus on rapid-onset disturbances or slow-onset changes? Is the focus on short-term resilience or long-term resilience? Is the focus on the resilience of present or future generations?
Where?	**F** **F** **S**	Where are the spatial boundaries of the urban system? Is the resilience of some areas prioritized over others? Does building resilience in some areas affect resilience elsewhere?
Why?		What is the goal of building urban resilience? What are the underlying motivations for building urban resilience? Is the focus on process or outcome?

Note: Adapted from Meerow et al. (2016).

doing so? What spatial and temporal scales are included or excluded from the urban system? This section considers these and other questions related to the five Ws and the trade-offs within and between them.

When urban resilience theory is adapted to specific urban contexts, the process and outcome is highly dependent on the system and scales (e.g. temporal, spatial, jurisdictional) being included, and what disturbances or changes the system aims to become resilient to (Cutter et al., 2008; Vale, 2014; Walker & Salt, 2006). Although the resilience literature widely acknowledges that there are likely to be trade-offs in these decisions (Armitage & Johnson, 2006; Bahadur & Tanner, 2014; Fabinyi, 2008; Vale, 2014), the "nature and consequences of resilience trade-offs (between and within scales)" are still "poorly understood" (Chelleri et al., 2015, p. 182). As the remainder of this section demonstrates, considering potential trade-offs is a crucial step in thinking through each of the five Ws (Table 1).

3.2.1. *Resilience for whom?*

Whose vision of a desirable resilient future prevails and who benefits or loses as a result of this particular construct? Urban actors have diverse worldviews and priorities and those with the power to make decisions about how resilience is applied will do so based on their perspective. Adger (2006) and Vale (2014) suggest that decision-makers are primarily concerned with their personal short-term interests, rather than the long-term benefit of the most vulnerable. Who makes the decisions (often at a particular jurisdictional scale) thus shapes whose resilience is prioritized over what time scale (Wagenaar & Wilkinson, 2015).[4]

Who is included and excluded from the urban system of focus? Who gets to draw those boundaries? "Who counts as the city?" (Vale, 2014, p. 197). Thinking through questions of resilience for whom entails considering potential trade-offs between stakeholders (Fabinyi, 2008). As Wagenaar and Wilkinson (2015) observed in their case study of Melbourne, planning for resilience is inherently a struggle.

3.2.2. *Resilience of what to what?*

Operationalizing resilience requires specifying what will be made resilient to what (Carpenter et al., 2001). Urban policies and interventions vary depending on which disturbance is prioritized (e.g. climate change, natural disasters, terrorism). Enhancing resilience to military attack might require closing off access to important buildings, whereas easier entry could help aid relief efforts post disaster (Vale, 2014). Which parts of a city's population, infrastructure, or resource flows are going to be made more resilient? This entails revisiting what is included in the urban. Does it include the power plants that provide energy, for instance, if they are located outside the city proper?

A tension often exists between maximizing *specified* resilience to existing threats and *general* capacity to adapt to unanticipated disruptions (Walker & Salt, 2006, p. 121). Wu and Wu (2013) opt for general resilience based on the argument that focusing on specific threats tends to undermine the flexibility and diversity of possible system responses. Research on adaptive capacity, however, has shown that balancing the two is crucial (Eakin, Lemos, & Nelson, 2014). Chelleri and Olazabal (2012, p. 70) illustrate this potential trade-off by noting that an entirely wind-based electricity system might be a positive adaptation to current energy and climate concerns, but a more diverse and flexible energy portfolio (even including some fossil fuels) would increase the ability to adjust to future changes.

3.2.3. *Resilience for when?*

The wind electricity example also draws attention to temporal scale and trade-offs. Is the primary goal to build resilience to short-term disruptions (e.g. hurricanes) or long-term stress (e.g. precipitation changes caused by climate change)? If the focus is on the short term, then according to Chelleri and Olazabal (2012), the objective is system persistence, whereas a long-term perspective would likely require some degree of transition or transformation. How does building resilience for the current generation impact future ones? Walker and Salt (2006) argue that building long-term general resilience often comes at the expense of short-term efficiency. Another question related to temporal scale is whether resilience interventions focus on anticipating future threats or reacting to past disturbances (Chelleri & Olazabal, 2012; Vale, 2014).

3.2.4. *Resilience for where?*

Cities are inextricably linked to their surrounding regions and globally through commodity, social, economic, political, and infrastructure networks (Castells, 2002; Da Silva, Kernaghan, & Luque, 2012; Hodson & Marvin, 2010; Seitzinger et al., 2012). The resilience of a city, therefore, necessitates consideration of its relationship to larger networks of flows (Pearson & Pearson, 2014).

SES resilience theory does acknowledge the importance of cross-scalar dynamics (Bahadur & Tanner, 2014; Ernstson et al., 2010). This emphasis is represented in Gunderson and Holling (2002) influential panarchy model, where "revolt" and "remember" arrows link nested adaptive cycles (Olsson et al., 2014). These arrows indicate that local resilience may be affected by global-scale processes, such as a recession in global financial markets (Armitage & Johnson, 2006). Conversely, local-scale transformations can catalyze broader-scale change. Nevertheless, in empirical contexts, including urban

applications, these scalar dimensions often receive insufficient attention (Chelleri et al., 2015; MacKinnon & Derickson, 2012). As Beilin and Wilkinson (2015, p. 4) note, where the boundary of the urban is delineated "has implications across all levels of management, government and communities." Ideally the city should be conceptualized in terms of urbanization processes that cut across scales. In practice, operationalizing resilience necessitates some limitation of spatial extent, but should at least reflect on the implications of these designations, cross-scalar interactions, and how fostering resilience at one spatial scale affects those at others.

3.2.5. *Why resilience?*

Given the criticism that resilience-based policies are too focused on maintaining the status quo, it becomes crucial to question why urban resilience is being studied or promoted and the ultimate goal of these interventions. Is it to improve adaptive processes generally, achieve a certain outcome, or both? Urban resilience interventions tend to prioritize swift system recovery after a disturbance, but this is not necessarily desired. As Vale (2014, p. 198) writes, "It is all too easy to talk about 'bouncing back to where we were' without asking which 'we' is counted, and without asking whether 'where we were' is a place to which a return is desirable." This connects back to the "who" questions, highlighting the need to understand the political context, decision-making processes, and powerbrokers that define the resilience agenda and to carefully consider underlying motives.

In short, urban plans and interventions must be considered in terms of political context, trade-offs, interconnections, and multiple scales. Thinking through the questions related to who, what, when, where, and why should be followed by empirical research to illuminate how these trade-offs work when resilience is operationalized in a specific context. To illustrate how differences in the five Ws shape outcomes, we briefly examine the case of green infrastructure spatial planning.

4. Urban resilience in empirical contexts

One strategy cities employ to enhance resilience is to expand green infrastructure, which Benedict and McMahon (2002, p. 12) define as: "An interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations." Based on this definition, green infrastructure includes urban green spaces such as parks, greenways, rain gardens, or green roofs (Wise, 2008). Advocates focus on the multiple social and ecological benefits of green infrastructure, from improved public health to enhanced stormwater retention (Elmqvist et al., 2015; Sussams, Sheate, & Eales, 2015; Tzoulas et al., 2007).

Green infrastructure may be particularly attractive to city officials because it provides a concrete approach for enhancing different aspects of urban resilience (Kearns, Saward, Houlston, Rayner, & Viraswamy, 2014). Depending on the technology and scale of implementation, green infrastructure can support both short- and long-term resilience through its ability to counteract the urban heat island effect, reduce the need for building cooling, reduce storm vulnerability through natural absorption of water, reduce runoff and overflows of untreated stormwater into bodies of water, and even

provide a local source of food (Rouse & Bunster-Ossa, 2013). Less clear in the literature are the trade-offs between these benefits and who profits and why (Ernstson, 2013; Hansen & Pauleit, 2014; Lovell & Taylor, 2013).

Like resilience more broadly, planning for multifunctional green infrastructure requires "knowledge that crosses many disciplinary boundaries" (Kearns et al., 2014, p. 55), but getting traditionally siloed departments and agencies to work together is usually difficult (Sussams et al., 2015). Resources for urban green infrastructure (and resilience building generally) are limited, leading to difficult decisions about where to expand it. If managing stormwater is the primary determinant of where to locate new green space, for example, will it also alleviate relative park poverty? These concerns highlight the potential trade-offs between various social and environmental goals and the inherently political nature of green infrastructure planning. Thus, we briefly consider a hypothetical case of green infrastructure planning for the City of LA, which is the second largest city in the United States with a diverse population of 3.8 million living in 468 square miles (US Census, 2010). In recent years, city agencies and nongovernmental organizations have promoted green infrastructure expansion.[5] We present two hypothetical planning scenarios for LA corresponding to two desired resilience benefits or different responses to questions related to resilience for whom, what, when, where, and why (Table 2). The example shows how these choices would redraw which areas of the city are prioritized and who benefits as a result.

In hypothetical scenario #1, a municipal department (such as the Los Angeles Department of Public Works) seeks to increase resilience through better stormwater management. In scenario #2, a nongovernmental organization (such as the Trust for Public Land) aims to support community resilience by increasing access to green space. For both scenarios, existing spatial data sets are used to generate indicators for where the particular green infrastructure resilience benefit is needed most. These indicators are then aggregated and compared for each census tract within the city boundary using ArcGIS.

4.1. *Hypothetical scenario #1: optimizing green infrastructure for stormwater management*

The first scenario focuses on the stormwater management benefits of green infrastructure, historically the predominant rationale for its deployment (Newell et al., 2013). The goal is to build resilience through improved stormwater management, and in this case, flood risk maps are used as a spatial indicator for where stormwater is likely to accumulate. Consequently, the chief beneficiaries are residents living in these areas. Priority areas for stormwater management are based on 2008 Federal Emergency Management Agency National Flood Hazard Layer Flood Insurance Rate Maps for Los Angeles County. High-risk areas (1% annual chance of flood hazard) and medium-risk areas (0.2% annual chance of flood hazard) are merged. The final tract score is a function of the area of this flood hazard layer within (intersecting) the tract.

4.2. *Hypothetical scenario #2: optimizing green infrastructure to increase access to green space*

Access to green space is associated with many social benefits and increased community resilience, which is why cities like LA may aim to increase social equity with respect to green space access (Tidball & Krasny, 2014; Wolch, Byrne, & Newell, 2014). In this scenario, green infrastructure development is prioritized for neighborhoods that have relative park poverty as a proxy for access to green space. This scenario thus promotes generic community resilience through more equitable green space distribution. To identify areas of park poverty, we use a GIS data set containing all the parks in Los Angeles that was generated as part of the 2008 Green Visions Plan (Newell et al., 2007). A quarter-mile buffer is drawn around each park, and this area denoted as accessible park acreage (Wolch, Wilson, & Fehrenbach, 2005). To determine the average amount of accessible park area per person for each census tract, the total accessible park area intersecting each tract is divided by the population living in that tract. The resulting attribute is the basis of the park poverty indicator.

4.3. *Comparing green infrastructure scenarios*

Reflecting on the five Ws (Table 2), the two scenarios generate very different spatial outcomes, providing different benefits to communities in these areas. The motivation (or why question) for the green infrastructure differs, reflecting the interests of the actors setting the agenda. In scenario #1, individuals located in areas of high flood risk are likely to benefit. Scenario #2 would focus green infrastructure development in neighborhoods with smaller park acreage per resident in an effort to address inequalities in access to green space. Concerns related to spatial scale come up in both scenarios. In scenario #1 and #2, the system boundary is the City of LA, thus the residents living within its boundaries would benefit more directly, rather than the larger metropolitan area. Census tracts are the basic unit of analysis, but with an average population of 4000 they are likely heterogeneous, and this variation may not be accurately represented by tract-level data. For example, if there is a large park on one

Table 2. Illustrative applications of the "five Ws of urban resilience" to green infrastructure planning

		Scenario 1	Scenario 2
Who?	TRADEOFFS	Beneficiaries are city residents living in flood risk zones	Beneficiaries are city residents with most limited access to green space
What?		Specifically focused on stormwater management	Generic community resilience
When?		Focused on current residents and based on current estimates of risk	Both short-term and long-term resilience
Where?		Neighborhoods with the most area in flood hazard zones within the municipal boundaries	Neighborhoods with the lowest average access to green space (parks) within the municipal boundaries
Why?		Goal is an outcome: flood losses and investments in "gray" stormwater infrastructure are reduced	Goal is an outcome: increased social justice

side of a tract, the park poverty score may be low, even if residents on the other side of the tract have no accessible park area.

The scenarios also differ in terms of what is being made resilient to what. The first is aimed at building resilience to a specific challenge (e.g. stormwater management), whereas the second seeks to foster generic community resilience through more equitable distribution of green space. With regard to temporal scale, both are similarly focused on current populations rather to past or future generations. For example, scenario #1 uses current estimates of flood risk rather than future risk profiles based on long-term climate impacts.

Figure 4 illustrates how different areas of LA would be prioritized for green infrastructure in the two hypothetical scenarios. In both cases, standardized census tract indicator values are divided into 10 quantiles, with a score of 1 representing "low priority" and 10 "high priority." The statistically significant negative correlation[6] between the tract values in the two scenarios indicates that spatial trade-offs are involved. If flood risk is the primary determinant, then it may not address other resilience needs. If green infrastructure is only developed in flood hazard zones in LA, environmental justice advocates concerned with park poverty might be less willing to provide support than if it were implemented in their priority areas. One possible solution might be to layer different criteria and identify spatial "hotspots" (i.e. areas where green infrastructure benefits can be coupled). A wide range of stakeholders could then be asked to weight the importance of the criteria for siting it, and these weights used to develop combined planning scenarios.

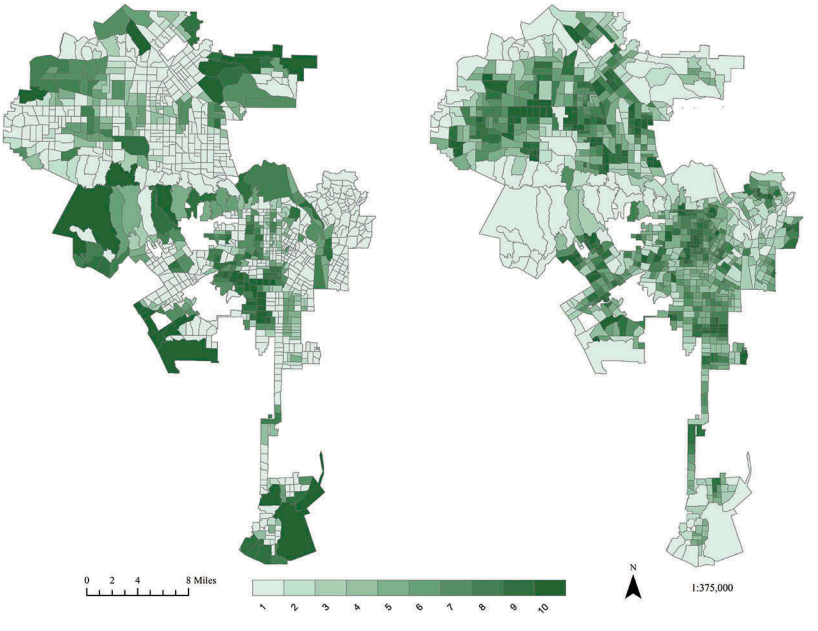

Figure 4. Priority census tracts for green infrastructure development in the City of Los Angeles based stormwater management (left) and access to green space (right)
Note: Maps show standardized census tract scores divided into 10 quantiles. Darker colors indicate higher priority.

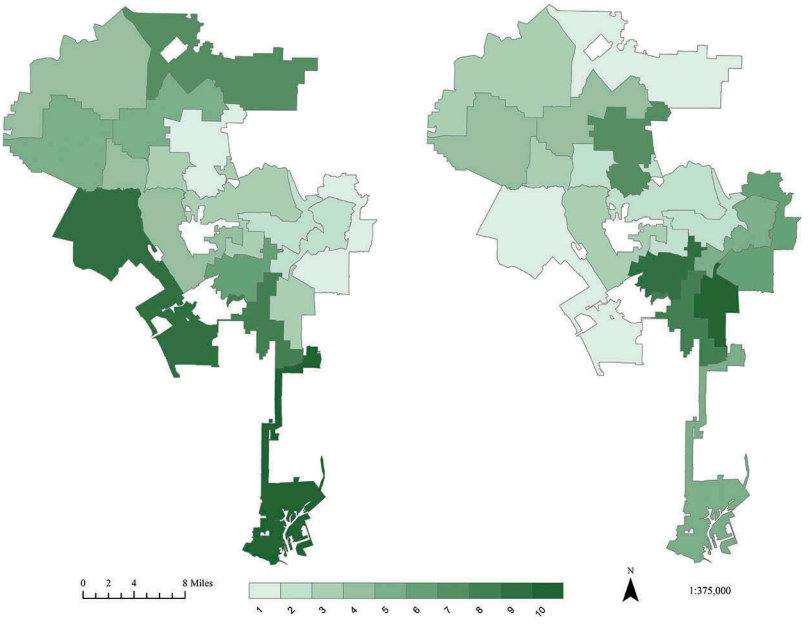

Figure 5. Priority council districts for green infrastructure development in the City of Los Angeles based on stormwater management (left) and access to green space (right)
Note: Standardized tract scores are aggregated at the council district level, and these district scores divided into 10 quantiles. Darker colors indicate higher priority.

The scale of analysis (and scale at which planning decisions are made) has implications for what gets prioritized and where. When the scenario scores are aggregated to the LA Council District scale (Figure 5), different trade-off patterns emerge. While a negative relationship still persists between stormwater management and park access, it is no longer statistically significant. When comparing the results of the two scenarios at the scale of the census tract and council district, priority hotspots that appear in the census tract analysis are obscured in the council district analysis.

This brief example provides a basic illustration of how spatial planning based on different resilience benefits, and at different scales, would impact priorities for green infrastructure development. It, therefore, highlights the challenges associated with planning for urban resilience, the likelihood of inherent trade-offs in this process, and the need to critically examine the politics and practices of resilience planning to determine whose priorities are being implemented and at what cost. Every resilience planning or measurement decision is inevitably a political one, with winners and losers, thus resilience needs be operationalized through a collaborative and inclusive process that takes into account varying stakeholder priorities.

5. Conclusion

Resilience theory has evolved into an influential global discourse, including for urban research and policy. For some, resilience is eclipsing sustainability, vulnerability, and adaptation as the primary organizing principle for managing the unpredictable and

changing futures of SESs, including cities(Davoudi et al., 2012; Elmqvist, Barnett, & Wilksonson, 2014; O'Hare & White, 2013). As the popularity of the urban resilience concept grows, it becomes increasingly important to interrogate the ways in which it is used. Social scientists have made significant contributions to this discourse by critically evaluating the term's conceptual ambiguities, conservative tendencies, and underdeveloped usage in social contexts.

The paper introduces a collaborative process for advancing a *politics of urban resilience*, which entails confronting inherent political and scalar complexities and trade-offs. We have divided this process into three phases: urban resilience as a boundary object, the five Ws of urban resilience, and urban resilience in empirical contexts. To highlight trade-offs and policy implications related to the five Ws and the politics of urban resilience, we provided two potential scenarios of green infrastructure spatial planning in Los Angeles. This brief example illustrated how prioritizing one resilience benefit of green infrastructure (e.g. stormwater abatement) over another (e.g. alleviating park poverty) could lead to markedly different spatial priorities, with implications for a city's ecology and socioeconomic fabric. This suggests a need for future research to scrutinize resilience-building planning decisions and the ways in which different models of decision-making affect outcomes.

Critical human geographers were among the first scholars to interrogate the growing influence of resilience discourse, contributing to a richer understanding of the concept's limitations. This provides a foundation for additional investigations into, for example, issues of power and how disparities might impact even the most collaborative resilience decision-making, which has been understudied in the resilience literature (Olsson et al., 2014). Urban political ecologists could contribute by continuing to ask "questions about who produces what kind of social-ecological configurations for whom" (Heynen, Kaika, & Swyngedouw, 2006, p. 2). The urban resilience literature needs a more nuanced appreciation for what defines the "city" or "urban," as well as attentiveness to scalar dimensions. Finally, geographers can continue to provide empirically rich place-based research that advances our understanding of what resilience means and how it is applied in different urban contexts.

Notes

1. Examples of international resilience policy initiatives include the Rockefeller Foundation's "100 Resilient Cities" campaign, the United Nations Office for Disaster Risk Reduction's "Making Cities Resilient" program, and ICLEI's "Resilient Cities" program.
2. Why resilience seems to have become more of a buzzword than vulnerability or adaptation is unclear. One explanation is that resilience is more politically tractable than vulnerability or adaptation simply because of its positive connotation (McEvoy, Fünfgeld, & Bosomworth, 2013; O'Hare & White, 2013; Sudmeier-Rieux, 2014).
3. Vale (2014) provides a helpful anecdote: In Sri Lanka, poor fishing villages were relocated inland following the 2004 tsunami, and more robust hotel structures built in their place. If the "system" is defined as the entire city, this would seem a positive development, but closer examination reveals that wealthy hotel owners benefitted, while the fishing communities lost their livelihoods.
4. The question of resilience for whom has obvious relevance to nonhuman actors. As Beilin and Wilkinson (2015, p. 3) write, "We cannot ignore the non-human species encapsulated

within the territory of and significantly affected by the ever-expanding urban or its amorphous boundaries."

5. The city has a number of plans and initiatives including the Green Streets program and the Emerald Necklace Forest to Ocean Extended Vision Plan (Goodyear, 2014).
6. Pearson's correlation coefficient is −0.07, which is significant at $p < 0.05$.

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ORCID

Sara Meerow http://orcid.org/0000-0002-6935-1832
Joshua P. Newell http://orcid.org/0000-0002-1440-8715

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