



Toward a Research Agenda on Transformative Resilience: Challenges and Opportunities for Post-Trauma Urban Ecosystems

Kevin Fox Gotham and Richard Campanella

This paper provides a critical review of urban scholarship on the relationship between social-ecological diversity and resilience. We identify empirical and theoretical gaps in the urban literature, suggest areas for future research, and develop a research agenda to examine and evaluate the social, institutional, and policy roots of urban ecosystem resilience. We develop the concept of *transformative resilience* as a heuristic device to examine how different urban ecosystems can adapt, adjust, renew, and transform in response to trauma. Explaining variation in post-trauma urban ecosystem resilience holds tremendous potential for uncovering the causal mechanisms and drivers of political, economic, and social change with policy implications for sustainable development.

Recent years have witnessed the growth of an interdisciplinary literature that seeks to identify the indicators, measures, and processes of social and ecological resilience. In ecology, resilience refers to “the capacity of a system to absorb disturbance and reorganize and yet persist in a similar state” (Gunderson, et al. 2006). In Holling’s (1973) original and influential thesis, ecological resilience is akin to “stability behavior” and refers to an ecosystem’s return to equilibrium after a disturbance. Since the 1980s, scholars have applied the concept of resilience to human systems to explain how both humans and urban ecosystems respond to traumatic events, and what factors explain the pace, trajectory, and nature of recovery (for an overview, see Brand and Jax 2007). An integrative component of ecological systems and human systems, practiced by the Resilience Alliance through their journal *Ecology and Society*, suggests that “adaptive capacity” is an essential characteristic of resilient urban ecosystems (Dietz et al. 2003). In this conception, resilience does not just mean adjustment, recovery, and return to a pre-disturbance state. Rather, resilience implies the capacity for renewal, regeneration, and re-organization when faced with disturbances (Folke 2006; Berkes et al. 2003, 13; Olsson et al. 2004). Resilient systems are those that are able to adapt to uncertainty and surprise, absorb recurrent disturbances to retain essential structures and processes, and build capacity for learning, improvement, and advancement over pre-disturbance conditions (Adger, et al. 2005; Folke 2006; Redman 2005; Pickett, Cadenasso, and Grove 2004, 373). Overall, resilience is not an inherent or static property of systems but varies by scale, organizational units, place, and time.

The purpose of this paper is to develop an exploratory theorization of the complex ecological, institutional, and social interfaces among trauma, diversity, and resilience. Trauma refers to an extraordinary and potentially dangerous and life-changing event linked to reacting and coping, including but not limited to human responses (Figley 2009). Trauma may involve social and ecological disruption and devastation caused by war, terrorism, pandemics, and natural disasters (fires, drought, hurricanes, floods, heat waves, tornados, etc.). Diverse systems are thought to be more resilient systems because of “their individuality of components; localized interactions among those components; and an autonomous process that selects from among those components, based on the results of local interactions, a subset for replication or enhancement” (Levin 1998, 432). For ecologists, spatial heterogeneity, biodiversity, functional redundancy and interdependence of subunits within the system are central factors that influence ecosystem resilience (Pickett, Cadenasso, and Grove 2004). Despite this promising line of research, scholarship lacks specificity in theorizing and analyzing how and under what conditions social and ecological diversity are positively associated with different measures of social resilience at different scales.

We develop the concept of *transformative resilience* as a heuristic device and analytical tool to guide research on the nature of system change, innovation, and creativity in the face of stress or trauma. In this conceptualization, resilient communities, cities, or regions do not just return to a pre-trauma state or the status quo, but have the capacity to reinvent themselves with new relationships, modes of organization, and networks. Our theorization directs attention to the ways in which regions, cities, and neighborhoods may have

particular kinds of social relationships, socio-economic and demographic features (e.g., age of residents, levels of education, income and other heterogeneous resources), and ties between social networks that can enhance the capacity for post-trauma transformation. This emphasis on “buffer capacity” (Folke 2006) or robustness in the face of changing internal or external conditions eschews a notion of resilience as reaching an end-point or finale and examines resilience as a non-linear and multidimensional process (Redman 2005; Pickett, Cadenasso, and Grove 2004, 373). To evaluate resilience, in other words, one must be able to identify the degree of pre-disturbance vulnerability or risk to the system, and the degree of post-disturbance renewal, reorganization, and innovation (Masten and Obradovic 2007; Masten and Coatsworth 1998, Masten 2001, Luthar 2006).

Why is Urban Resilience Important?

The study of urban resilience is important for understanding how urban ecosystems respond to major trauma, national economic and demographic challenges, and global climate change. As a theoretical framework and perspective, resilience helps explain how communities operate as groups with a sense of collective cohesion and identity, deal with adversity and stress, and gain or lose functioning and strength as a result of trauma and disaster. Scholars have hypothesized that community resilience is linked to health status and individual upward mobility (Kulig, Edge, and Joyce 2008). A city or region’s ability to manage resilience resides in actors, social networks, and institutions (Ostrom 1999; Carpenter, et al 2001; Holling 2001). During a disaster, community net-

works, institutions, and organizations must be able to buffer negative effects and survive and function under extreme and unique conditions. If they break down, decision-making and response will stagnate, communities will not be able to address needs, and the system might not be able to learn from experience. Social and institutional networks exhibit varying degrees of organization, identity, cohesion, flexibility, and resources. In resilient systems, these networks are interdependent, heterogeneous, collaborative, and functionally redundant, with reserve capacity achieved through duplication, interchangeability, and vertical and horizontal interconnections (Comfort 1999; Tierney 2002; Godschalk 2003, 137-139).

Addressing resiliency (and vulnerability) to both natural as well as man-made disasters and extreme events, such as hurricanes, urban epidemics and acts of terrorism, is becoming centrally important in the design and management of infrastructure in cities (Nicholls 2004). Scholars and researchers have theorized and examined the growing significance of urbanization on the health and well-being of human populations and ecosystems.

Much research has documented the increasing frequency and destructive tendencies of disasters, a development that correlates with increased urbanization thus making cities “crucibles of hazard” (Mitchell 1999). Oft-cited books by Perrow (2007), McQuaid and Schleifstein (2006), and Flynn (2007) suggest that weakening and aging public infrastructure projects such as dams, bridges, roads, water supply systems, and communication and transportation systems pose ominous threats to the safety and security of the United States. As the UN (2009) has recently pointed out, more people than ever live in harm’s way from

earthquakes, droughts, floods, and other disasters, largely because of a surge in urban populations in both developing and developed nations. The pervasiveness and ubiquity of disaster reflects urbanization processes including growing urban poverty and rapid uneven development that can concentrate poverty and increase vulnerability to hazards and catastrophe. In addition, spreading urban development expands the exposure window for hurricanes, earthquakes, and other catastrophes, further augmenting urban risk.



Historic cottage, two years later in 2007. Photograph by Richard Campanella.

The above points suggest several challenges for research on urban resilience. First, as urban populations increase and cities expand, there is a need for systematic comparison not only of cities and metropolitan areas but also among sub-units within regions and cities such as neighborhoods. Indeed, the literature linking community or neighborhood resilience to the adaptive functioning of larger social and ecological systems is scarce. Part of this problem is that identifying the different “scales” of resilience – community, city, region, and so on – and collecting systematic data at each scale is a laborious and complicated task as scalar boundaries are often fluid and porous, and constructed through different conceptual frameworks and theoretical orientations. Second, scholars disagree over meanings and definitions of different scales, and how so-called “neighborhood effects” produce spaces of vulnerability and disadvantage for some groups, and spaces of resilience and affluence for others. Third, there is also disagreement on how to measure resilience at different scales, the impact of policies on resilience, and whether ecological perspectives and assumptions capture and explain neighborhood resilience. Finally, in exploring the resilience of different neighborhoods, cities, and regions, we confront a variety of diverse organizations, social networks, institutions, and actors with varying degrees of political power and access to material and cultural resources. In this situation, scholars need to ask the question, resilience for whom and for what purpose? (see Lebel, et al. 2006). This question suggests, according to Ernstson (2008) that “system resilience is not just good or bad, but that it can be good for some and bad for others.”

Transformative Resilience as a Multidimensional Conceptual Tool

We develop the concept of *transformative resilience* to address the theoretical and analytical challenges in current scholarship on urban resilience. We view transformative resilience as a heuristic device to guide research into the indicators, properties, and drivers of post-trauma urban ecosystem transformation. In particular, the concept directs attention to the ways in which different urban ecosystems can transform and innovate in response to trauma. In this sense, transformative resilience suggests that urban ecosystems do not just automatically respond or adjust to trauma but can learn from traumatic experiences to reorganize and reinvent themselves in unique and distinctive ways. As a multidimensional conceptual tool, transformative resilience assumes that urban ecosystems have a variety of resilience elements and adaptive capacities that derive from the functional interdependence of different units and subunits. Such a conception encourages us to think about different regions, cities, and communities as forms of social organization constituted and reproduced by a multiplicity of complex networks, formal organizations, socio-legal regulations, and interlinked micro- and macro processes.

As complex and adaptive systems, cities and communities contain a diversity of social and political institutions, interlinked local and supra-local networks, cultures and subcultures, formal and informal organizations, associations, groups, and coalitions. Diversity is much more than a static ecological or social characteristic of a system at a single point in time (for example, the ethnic or racial composition of a census tract). Rather, diversity reflects a variety

of organizational linkages, vertical and horizontal networks, and multifarious institutional capacities that collaborate to achieve common goals. In their examination of the predictors of “regional resilience” in the face of the foreclosure crisis in six metropolitan areas, Swanstrom, Chapple, and Immergluck (2009) maintain that resilience depends on a locale’s ability to redeploy assets or expand organizational repertoires; collaborate within and across public, private, and nonprofit sectors; and mobilize or capture resources from external sources. Wallace and Wallace (2008, 1) have described how the ability of a metropolitan region to weather a major disaster depends “on the size of social networks in its neighborhoods and on the interconnections between the social networks. Diversity such as gained by social and economic integration influences the strength of the loose ties between social networks.”

As a heuristic device, transformative resilience suggests that particular network forms can build social capital and skills for social, economic, and ecological diversity and self-reliance. Paraphrasing Granovetter’s (1973) concept of the “strength of weak ties,” large, robust, and dense social networks that interconnect neighborhood coalitions, families/households, and other community institutions such as schools will be in a position to organize flows of information and resources to enhance community resilience. Consequently, “if social networks are small, tight, and isolated, the flow of information will be slow, if it occurs at all. Information may not be accepted because it comes from the authorities deemed responsible for the bad condition of the neighborhood” (Wallace and Wallace 2008, 8). Quoting Norris, et al (2008, 127), community resilience depends on the ability of individuals and organizations to “reduce

risk and resource inequalities, engage local people in mitigation, create organizational linkages, boost and protect social supports, and plan for not having a plan, which requires flexibility, decision-making skills, and trusted sources of information that function in the face of unknowns.” Organizations and networks form neighborhoods and communities; together, they form learning loops in which people respond to and drive social change through interactions with institutions, state officials, and public policies. In short, while socioeconomic status can be an important predictor of resilience or vulnerability, it is important to analyze the organization of social networks within and between neighborhoods, cities, and regions. Even poor neighborhoods can be resilient if they possess a dense fabric of social networks to maintain connections and information/resource flows when a major trauma strikes.

Traumatic events, natural disasters, and exogenous disturbances provide an opportunity for assessing the nature and strength of relationships between diversity and resilience across multiple scales of organization. There is a growing recognition that diversity is a key requirement for long-term (sustainable) functioning of ecological and social systems (Ostrom 2005; for an overview, see Perrings 2006). Ecologists have explored the links between functional diversity and resilience in the fields of economic sustainability (Garmestani, et al. 2006) and agroecosystems (Sengupta 2006). Perrings (2006, 424) suggests that “one critical indicator of the resilience of systems is their diversity.” Diversity represents a mix of assets and builds functional redundancy to enhance the capacity of a system to face economic and environmental shocks. Lebel, et al. (2006) suggest that the presence of polycentric and multilayered institutions can enhance a city’s

or community's capacity to draw on resources and knowledge to build resilient regions. Sheffi (2007) maintains that organizations that are more diverse or companies that have more diversified supply chains tend to be more resilient. Ecologists have long argued that spatial heterogeneity or species richness can build resilience to the extent a decline in one group is compensated by increases in other groups, thereby maintaining the integrating and functionality of the system (for an overview, see Pickett et al 2001; Grimm and Redman 2004). Adger, et al. (2005, 1037) make a similar analogy with human systems:

Spatial heterogeneity can also confer resilience, as when refuge areas provide sources of colonists to repopulate disturbed regions. Similarly, in social systems, governance and management frameworks can spread risk by diversifying patterns of resource use and by encouraging alternate activities and lifestyles. Such practices sustain ecosystem services, analogous to the way that management of a diverse portfolio sustains the growth of investments in financial markets.

Scholars suggest that both resilience and diversity (or heterogeneity) are central features of coupled natural and human systems but they disagree on how they are linked and affect one another. Scholars recognize that not all forms of diversity are positively associated with resilience. Social scientists have noted that diverse neighborhoods may be sites of conflict between residents of different income groups (Sanchez-Jankowski 2008). Researchers have hypothesized that neighborhood population diversity undermines the emergence and maintenance of social ties, networks, and norms of reciprocity that facilitate coordination and cooperation for mutual benefit. Sampson and Groves (1989) and Sampson, et al. (1999) confirmed

negative associations between indicators of population heterogeneity and different measures of community efficacy (for a recent overview, see Sampson and Graif 2009). Consistent with this notion, residential diversity breeds linguistic and cultural isolation and lack of trust that discourages communication between neighbors. Thus, the relationship between diversity of the neighborhood and the resilience of the neighborhood is an empirical question. It may be that some measures of social-ecological diversity are negatively associated with different indicators of neighborhood resilience. Moreover, some forms of social diversity may promote and enhance some forms of resilience rather than others, and may be associated with increasing vulnerability to trauma.

Despite the analytical utility of the resilience concept, there are unresolved dilemmas and conceptual limitations with current theorizations. Several critical scholars have argued that the resilience concept is a misguided term that deflects attention from examining the production of vulnerability and the centrality of social inequalities in organizing urban ecosystems. In the case of the Hurricane Katrina disaster, for example, scholars have argued that government actions and policies to rebuild the Gulf Coast are oriented toward a quick restoration of the status quo rather than enhancing long-term sustainability and increasing urban ecosystem resilience. Fragmentation of post-disaster management and planning processes combined with a well-meaning rush by organizations and aid agencies to rebuild New Orleans have caused some scholars to suggest that current policies and government interventions do not address the root causes of flood and hurricane vulnerability (Freudenburg, Gramling, Laska, and Erikson 2009). In examining urban resilience in post-disaster cities, Vale and

Campanella (2005) maintain that the intent to return to past dysfunctional practices and institutional deficiencies are present in many disaster-impacted cities. It may be that the hierarchies of class/ethnicity/race, government politics, and growth-oriented urban redevelopment practices could strengthen and exacerbate inequalities and social divisions as well as reinforce patterns of vulnerability to future disasters and trauma.

An important omission in ecological work on resilience in urban ecosystems is the impact of class exploitation, racial and gender discrimination, and relations of domination and subordination on the organization and historical development of cities and regions. Sociologist Charles Tilly (1999) challenges us to confront the centrality of "durable inequalities" in modern societies shaped by relational processes, boundary-making and resilient social bonds. Inequality has "a bewildering array" of concrete dimensions: of wealth, income and opportunity, gender, race, age, and ethnicity. Hierarchies of power, education, technology, language, culture, honor, beliefs and influence permeate individuals, groups and nations, and urban ecosystems -- more than any time in history. When looking globally, we see that there is an astonishing increase in cities with over a million inhabitants but almost all of that increase is in the poorer countries of the globe. Development traps (e.g. poor education, disease, drugs, and crime) can prevent many in urban poverty from benefiting from potential urban advantages and reinforce cycles of despair and vulnerability. To the extent that cities express antagonistic social relations and group struggles, resilience will be a fleeting and ephemeral condition bound up with conflict over access to and control over political power and material resources.

Toward a Research Agenda on Transformative Resilience

Despite much promising scholarship on urban resilience, research lacks specificity in analyzing how and under what conditions the various subsystems, institutions, and other components of urban ecosystems adjust and adapt to catastrophic events, and develop novel and innovative properties in response to trauma. Broadly, the interlocking dimensions of post-trauma human-ecosystem response and resilience are vastly understudied, especially the linkage between human perceptions of altered post-trauma ecosystem services, incentives affecting human responses to trauma, and the short-term and long-term consequences of human actions that affect post-trauma ecological and human systems. The human and ecological impacts and consequences of traumatic events have enduring global consequences with local effects that are often unpredictable, uncertain, and deadly.

Within this context, we develop a tentative research agenda and strategy comprised of six basic elements to guide future scholarship on urban resilience. In particular, our research agenda seeks to understand how the different social, economic, institutional, and environmental subsystems of urban ecosystems interact and respond differentially to direct traumatic events; how initial socio-ecological conditions constrain and limit the pace and trajectory of post-trauma recovery; and how post-trauma developmental patterns loop to affect the resilience of the different subsystems of urban ecosystems.

First, the concept of transformative resilience encourages us to think of urban ecosystems as composed of complex, multi-scale, interconnected processes with

powerful feedback effects that promote some forms of resilience for some units, degrade other kinds of resilience, and produce vulnerability to trauma for other units and groups. Thus, the accumulation or degradation of resilient properties both before and after a trauma influences the social vulnerability of a social or ecological system. The resilient properties of neighborhoods and cities depend on historical trajectories, including the political economy of resource flows, socio-economic and environmental background factors, and past impacts of disasters. Time frame and scale of analysis interconnect with each other as well as the nature of the threat. The role of cultural systems, mass media, socio-legal regulations, financial flows and networks that extend well beyond communities are important in influencing and determining vulnerability and resilience. There are multiple pathways to social-ecological resilience. An urban ecosystem may not return or recover to its pre-trauma population but may experience “transformative resilience” to the extent that new residents are able to learn and reorganize, and adjust to post-trauma conditions.

Second, the research agenda we outline suggests a need for improved theoretical orientations and methodological approaches to understand and explain the reciprocal effects and feedbacks between human action and urban ecosystem change at local, regional, and global scales. At the supra-local level, national institutions, parliamentary laws and statutes, public policies, and global flows and networks of activity can enable some groups to leverage material and cultural resources to build resilience through collective action. Policies and socio-legal regulations can also limit the effectiveness of adaptive governance and social-ecosystem management strategies, and degrade the urban and ecological environment. Instances of

urban resilience including adaptive capacity and transformability would be seen as manifestations of a city’s evolving structural position in a national or global economy, global division of labor, or other extra-local processes and geo-historical trajectories.

Reference to a city’s location within particular regional, socio-economic, political, and cultural contexts would explain the strength, tenacity, or weakness of urban resilience. These extra-urban and regional contexts might be further situated within a larger context of global-systemic processes and developments. Comparative analyses would presume a governing systemic unit and subordinate case units that are related to one another in a functionally interconnected fashion. This methodological strategy presumes a ‘whole’ that governs its ‘parts’ – and progressively constructs a whole and related socio-spatial scales or levels of analysis as methodological procedures by giving context to socio-historical phenomena such as urban resilience. Levels of analysis are not a priori or objective features of systems. Rather, scholars define and construct different levels or scales based on theoretical considerations.

Third, a research agenda on transformative resilience would clearly identify the effects of human actions and decisions on the pace and trajectory of post-trauma urban ecosystem recovery. Resilience is not a static property of urban ecosystems; nor is resilience the result of ‘natural’ aging processes such as in natural ecosystems. Indeed, a fundamental difference between ecological and social resilience is that ecological resilience flows from processes occurring in nature whereas social resilience is a product of human action and social organization. A natural ecosystem cannot change the laws of nature and physics whereas a city

or region can lobby state and federal officials for money, resources, and legal and policy changes for transformation and reorganization. Social resilience is subject to human agents’ conscious and strategic interventions and manipulations. Moreover, past decisions pertaining to human settlements and natural ecosystems can have legacy effects on present conditions and future possibilities. Just as pre-trauma socio-ecological conditions can constrain and limit post-trauma resiliency, post-trauma developmental patterns can feed forward to affect the future resilience or vulnerability of different urban neighborhoods and urban ecosystems.

An additional component of a research agenda would examine the ways in which policies can affect the rate and extensiveness of post-disaster redevelopment by limiting choices, discouraging some forms of decision-making, and encouraging other actions on the part of individual households, businesses, and government agencies. Policies can set in motion long-term developmental trajectories through which various lock-in mechanisms – such as hierarchies, networks, institutional patterns and power relations – sustain and reinforce dominant processes of urban development. At the same time, policies can perpetuate post-disaster traumatic conditions by promoting disinvestment, out-migration of people, or even contribute to the emergence of what scholars call “corrosive community” — that is, a consistent pattern of chronic and destabilizing impacts to individuals and communities (Erikson 1976; Freudenburg 1997; Picou, Marschall, and Gill 2004, 1496). Central to this critical perspective is the idea that human actions, institutions, social policies, and government laws and regulations can nurture some forms of resilience and undermine other kinds of resilience. Thus, public policies and

socio-legal regulations are powerful drivers of social resilience. Consequently, some systems may produce resilience to particular types of disturbances (but not others) while producing new vulnerabilities to system-wide breakdown and collapse. Policies pertaining to urban and suburban development, poverty and homelessness, irrigation and water resources control, ecosystem management, and so on are crucial to determining the resilience and vulnerability of cities and regions.

Fifth, explaining the dynamics of transformative resilience requires a research design that permits a thorough understanding of past, current, and future land-use changes. These transformations are rooted in past and present policies that state actors have implemented at the local, state, and federal government levels. In the case of the Hurricane Katrina disaster, for example, degradation of the wetlands, erosion of barrier islands, destructive growth policies and suburban development, and the construction of a weak and ineffective flood defense infrastructure created patterns of disaster risk and vulnerability. As many scholars acknowledge, Hurricane Katrina was a trigger event and not the actual cause of the massive flooding and subsequent property damage that affected the New Orleans region after August 29, 2005. New Orleans’s poorly designed and constructed levees and floodwalls collapsed under moderate hurricane conditions due to the multi-decade pursuit of economic growth and regional development by government officials, developers, and other profiteering interests, even as environmental conditions deteriorated and flood-protection engineering grew more challenging. Exploitative land-use pressures, driven by socio-economic processes, have been the catalysts of urban ecosystem change. The transformation of

the landscape with levees, canals, floodwalls, and real estate development in the swamps, in turn, generated new risks and increased vulnerabilities to hurricanes and flood hazards.

Lastly, measuring and assessing resilience at the different scales - regional, urban, or sub-urban - requires a comparative research agenda to analyze different social units and processes unfolding over time and space. Comparisons should aim to provide depth and breadth of analysis to explain both similarities and differences in a range of cases such as cities, neighborhoods and regions. As Denters and Mossberger (2006, 553) note, "the logic of the comparative method is that by comparing units (countries, cities, or any other units) that are most similar in some aspects, the researcher is able to control for the variables that are similar and isolate other variables as potential causes of observed differences." In Prezeworski and Treune's (1970) classical statements on the comparative method, the goal of different comparisons is to offer answers to descriptive or 'what?' questions pertaining to knowledge about the unique characteristics of particular cases. In addition, comparisons can offer answers to explanatory or 'why?' questions that emphasize the applicability of phenomena over a range of settings and cases. Charles Ragin (1987) maintains that comparisons can also answer 'how?' questions that place the analytical focus on explaining instances of the presence of the outcome. For Ragin, cases that do not display the outcome or which display it only vaguely are, at best, only indirectly relevant to explaining and understanding 'how' something happens. Thus, place matters in the study of urban resilience because an analysis of why and how resilience develops will need to take into account where, and when, it develops.

Conclusion

In this paper, we have suggested that the concept of transformative resilience can be a powerful tool to direct future research and investigation into the causes and consequences of post-trauma urban ecosystem organization and development. As the size and population of cities around the world increases, our growing collective susceptibility to disasters and other trauma demands sophisticated theoretical and methodological approaches for informing research and offering practical solutions to our urban problems. As Adgar, et al. (2005, 1037) note, the resilience and vulnerability of human and natural ecosystems "is more tightly linked to larger-scale processes than in the past." Economic and cultural globalization, political instability, military conflict and war, and the accelerated circulation of commodities, capital, people, and technologies interconnect regions, cities, and neighborhoods much more closely than ever before. Thus, what we need are theoretically driven, empirically rigorous studies that explain how the different social, economic, institutional, and environmental subsystems of cities interact and respond differentially to disturbances and traumatic events, including wars, disasters, or other conflicts. To help remedy the theoretical and analytical limitations of the resilience concept, we have elaborated an agenda for future research that is multidimensional and recognizes the centrality of human action to the development of urban ecosystems. Our goal is to offer empirical and theoretical guidance to planners, ecologists, and social scientists interested in understanding the linkages between trauma, diversity, and social-ecological resilience.

Overall, we suggest that the concept of transformative resilience offers a promising tool for promoting linkages among the disciplines of urban design and planning, urban ecology, and social science. Planners and policy analysts currently debate the micro- and macro-level determinants of resilience, what incentives can affect human responses to trauma, and the short-term and long-term consequences of behaviors that affect post-trauma ecological and human systems. As the 9/11 terrorist strike, Hurricane Katrina disaster, and the BP oil spill have shown us, the human and ecological impacts and consequences of traumatic events can have enduring global consequences. The concept of transformative resilience suggests that surprises, uncertainty, and nonlinearity at the urban scale often arise from both complex internal feedbacks and from interactions with structures and processes operating at supra-local scales (Liu, et al. 2007; Gunderson and Holling 2001; Gunderson, et al. 2002; Garmestani, Allen, and Gunderson. 2009). Integrated studies of coupled human and natural systems through the Baltimore and Phoenix Long-Term Ecological Research (LTER) projects reveal complex patterns and processes of social-ecological resilience not evident when studied by social or natural scientists separately (Pickett, Cadenasso, and Grove 2004; Grimm and Redman 2004). In short, the concept of transformative resilience provides urban planners and policy analysts with a set of conceptual and analytical tools that can generate integrative science and interdisciplinary collaboration on issues of fundamental importance for urban sustainability.

Lead Photograph

Severely damaged historic cottage in downtown New Orleans, marked with first responders' codes and owner's plea not to demolish, photographed shortly after Hurricane Katrina in 2005. Photograph by Richard Campanella.

References

- Adger, W. Neil, Terry P. Hughes, Carl Folke, Stephen R. Carpenter, and Johan Rockstrom. 2005. "Social-Ecological Resilience to Coastal Disasters." *Science*. 309.
- Berkes, F., J. Colding, and C. Folke (eds). 2003. *Navigating Social-Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge University Press, Cambridge, UK.
- Brand, F. S., and K. Jax. 2007. Focusing the meaning(s) of resilience: resilience as a descriptive concept and a boundary object. *Ecology and Society* 12(1): 23. [online] URL: <http://www.ecologyandsociety.org/vol12/iss1/art23/>
- Carpenter, S. R., B. Walker, J. M. Anderies, and N. Abel. 2001. From metaphor to measurement: resilience of what to what? *Ecosystems* 4:765-781.
- Comfort, L. K. 1999. *Shared risk: Complex systems in seismic response*. Elsevier, Oxford, U.K.

- Denters Bas and Karen Mossberger. 2006. "Building Blocks for a Methodology for Comparative Urban Political Research." *Urban Affairs Review*. 41(4): 550-71.
- Dietz, T., Ostrum, E., and P. Stern. 2003. "The Struggle to Govern the Commons." *Science* 302, 907-12.
- Erikson, Kai. 1976. *Everything in its Path: Destruction of Community in the Buffalo Creek Flood*. New York: Simon and Schuster.
- Ernstson, H. 2008. "The social production of ecosystem services: lessons from urban resilience research" In. *H. Ernstson In Rhizomia: Actors, Networks and Resilience in Urban Landscapes* PhD Thesis in Natural resource Management, Dept. of Systems Ecology, Stockholm University.
- Figley, C. R. 2009. "Editorial." *Traumatology*, 15:2, 1-6.
- Flynn, Stephen. 2007. *The Edge of Disaster*. New York: Random House.
- Folke, Carl. 2006. "Resilience: The Emergence of a Perspective for Social-Ecological Systems Analyses." *Global Environmental Change*. 16: 253-67.
- Folke, C., Carpenter, S.R., Walker, B.H., Scheffer, M., Elmqvist, T., Gunderson, L.H., Holling, C.S., 2004. "Regime Shifts, Resilience and Biodiversity in Ecosystem Management." *Annual Review in Ecology, Evolution and Systematics* 35, 557-581.
- Freudenburg, Gramling, Laska, and Erikson 2009. *Catastrophe in the Making: The engineering of Katrina and the disasters of tomorrow*. New York: Island Press.
- Freudenburg, William. 1997. "Contamination, Corrosion, and Social Order: An Overview." *Current Sociology*. 45(3): 19-39.
- Garmestani, A.S., C.R. Allen, J.D. Mittelstaedt, C.A. Stow, and W.A. Ward. 2006. "Firm size diversity, functional richness and resilience." *Environment and Development Economics*, 11.
- Garmestani, A. S., C. R. Allen, and L. Gunderson. 2009. "Panarchy: discontinuities reveal similarities in the dynamic system structure of ecological and social systems." *Ecology and Society* 14(1): 15. [online] URL: <http://www.ecologyandsociety.org/vol14/iss1/art15/>.
- Godschalk, D.R. 2003. "Urban hazard mitigation: Creating resilient cities." *Natural Hazards Review* 4: 136-143.
- Granovetter, Marc. 1973. "The Strength of Weak Ties", *American Journal of Sociology* 78 (6): 1360-1380.
- Grimm, N.B., and C.L. Redman. 2004. "Approaches to the Study of Urban Ecosystems: The Case of Central Arizona-Phoenix." *Urban Ecosystems*. 7:100-213.
- Gunderson, L. H., C. Folke, and M. Janssen. 2006. Generating and fostering novelty. *Ecology and Society* 11(1): 50. [online] URL: <http://www.ecologyandsociety.org/vol11/iss1/art50/>.
- Gunderson, L., and C. S. Holling. 2001. *Panarchy: understanding transformations in systems of humans and nature*. Island Press, Washington, D.C., USA.
- Gunderson, L. H., L. Pritchard, Jr., C. S. Holling, C. Folke, and G. D. Peterson. 2002. "A summary and synthesis of resilience in large-scale systems." Pp. 249-261 in L. H. Gunderson and L. Pritchard, Jr., editors. *Resilience and the behavior of largescale systems*. Island Press, Washington, D.C., USA.
- Holling, C. S. 2001. "Understanding the complexity of economic, ecological, and social systems." *Ecosystems* 4:390-405.
- Holling, C. S. 1973. "Resilience and stability of ecological systems." *Annual Review of Ecology and Systematics* 4:1-23.
- Kulig, J., Edge, D., & Joyce, B. 2008. "Understanding Community Resiliency in Rural Communities through Multimethod Research." *Journal of Rural and Community Development*. 3(3).
- Lebel, Louis, John M. Anderies, Bruce Campbell, Carl Folke, Steve Hatfield-Dodds, Terry P. Hughes, and James Wilson. 2006. "Governance and the Capacity to Manage Resilience in Regional Social-Ecological Systems." *Ecology and Society*. 11(1): online.
- Levin, Simon A. 1998. "Ecosystems and the Biosphere as Complex Adaptive Systems." *Ecosystems* 1: 431-436.
- Liu, J. et al. 2007. "Complexity of Coupled Human and Natural Systems." *Science*. 317 (5844): 1513-1516.
- Luthar, S. S. 2006. Resilience in development: a synthesis of research across five decades. in D. Cicchetti and D. J. Cohen, editors. *Developmental psychopathology. Volume 3. Risk, disorder, and adaptation*. Second edition. New York: Wiley, 739-795 .
- Masten, A. S. 2001. Ordinary magic: resilience processes in development. *American Psychologist* 56(3):227-238.
- Masten, A. S., and J. D. Coatsworth. 1998. The development of competence in favorable and unfavorable environments: lessons from research on successful children. *American Psychologist* 53 (2):205-220.
- Masten, A. S., and J. Obradovic. 2007. Disaster preparation and recovery: lessons from research on resilience in human development. *Ecology and Society* 13(1): 9. [online] URL: <http://www.ecologyandsociety.org/vol13/iss1/art9/>.
- McQuaid, John and Mark Schlei Feinstein. 2006. *Path of Destruction: The Devastation of New Orleans and the Coming Age of Superstorms*. New York, NY: Little, Brown and Company.
- Mitchell, James K. (editor). 1999. *Crucibles of Hazard: Mega-Cities and Disasters in Transition*. New York: United Nations University Press
- Nicholls, R.J. 2004. "Coastal Flooding and Wetland Loss in the 21st Century: Changes under the SRES Climate and Socio-economic scenarios." *Global Environmental Change* 14, 69.

- Nicholls, R. J., Wong, P.P., Burket, V.R., Codignotto, J., Hay, J.E., McLean, R.F., Ragoonaden, S. and Woodroffe, C.D. 2007. "Coastal Systems and Low-lying Areas." In, Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. and Hanson, C.E. (eds.) *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Cambridge, UK, Cambridge University Press, 315-356.
- Norris, Fran H., Susan P. Stevens, Betty Pfefferbaum, Karen F. Wyche, Rose 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.
- Olsson, P., C. Folke, and F. Berkes. 2004. "Adaptive Co-Management for Building Resilience in Social-Ecological Systems." *Environmental Management*. 34, 75-90.
- Ostrom, E. 1999. Coping with tragedies of the commons. *Annual Review of Political Science* 2:493-535.
- Ostrom, E. 2005. *Understanding Institutional Diversity*. Princeton: Princeton University Press
- Perrings, C. A. 2006. "Resilience and sustainable development." *Environment and Development Economics* 11:417-427.
- Perrow, Charles. 2007. *The Next Catastrophe: Reducing Our Vulnerabilities to Natural, Industrial, and Terrorist Disasters*. New Jersey: Princeton University Press.
- Pickett, S.T.A., et al. 2001. "Urban Ecological Systems: Linking Terrestrial, Ecological, Physical, and Socioeconomic Components of Metropolitan Areas." *Annual Review of Ecological Systems*. 32: 127-57.
- Pickett, S.T.A., M.L. Cadenasso, and J.M. Grove. 2004. "Resilient Cities: Meaning, Models, and Metaphor for Integrating the Ecological, Socio-economic, and Planning Realms." *Landscape and Urban Planning* 69:369-384.
- Picou, J., Brent K. Marschall, and Duane A. Gill. 2004. "Disaster, Litigation, and the Corrosive Community." *Social Forces*. 82(4): 1448-82.
- Przeworski, A., and H. Teune. 1970. *The logic of comparative social inquiry*. New York: Wiley.
- Ragin, C. 1987. *The comparative method: Moving beyond qualitative and quantitative strategies*. Berkeley, CA: University of California Press.
- Redman, C.L. 2005. "Resilience Theory in Archaeology." *American Anthropologist*. 107, 70-77.
- Sampson, Robert J. and Corina Graif. 2009. "Neighborhood Social Capital as Differential Social Organization." *American Behavioral Scientist*. 52(11): 1579-1605.
- Sampson, Robert J. and W.B. Groves. 1989. "Community Structure and Crime: Testing Social-Disorganization Theory." *American Journal of Sociology*. 94(4): 774-802.
- Sampson, Robert J. J.D. Morenoff, and F. Earls. 1999. "Beyond Social Capital: Spatial Dynamics of Collective Efficacy for Children." *American Sociological Review*. 64(5): 633-660.
- Sanchez-Jankowski, Martin. 2008. *Cracks in the Pavement: Social Change and Resilience in Poor Neighborhoods*. Berkeley: University of California Press.
- Sengupta, N. 2006. "Fragmented landholding, productivity and resilience management." *Environment and Development Economics*, 11, 507-532
- Sheffi, Y. 2007. *The Resilient Enterprise: Overcoming Vulnerability for Competitive Advantage*. Cambridge, MA: MIT Press.
- Small, C. and R. J. Nicholls. 2003. "A Global Analysis of Human Settlement in Coastal Zones." *Journal of Coastal Research*. Vol. 19, No. 3, Summer, 584-599
- Swanstrom, Todd, Karen Chapple, and Dan Immergluck. 2009. *Regional Resilience in the Face of Foreclosures: Evidence From Six Metropolitan Areas*. Working Paper 2009-05. Berkeley Institute of Urban and Regional Development. Macarthur Foundation Research Network on Building Resilient Regions. University of California, Berkeley.
- Tierney, Kathleen J. 2002. "Strength of a City: A Disaster Research Perspective on the World Trade Center Attack." Social Science Research Council at <http://www.src.org/sept11>.
- Tilly, Charles. 1999. *Durable Inequality*. Berkeley: University of California Press.
- United Nations International Strategy for Disaster Risk Reduction (UNISDR). 2009. *Global Assessment Report on Disaster Risk Reduction*. Geneva: United Nations.
- Vale, Lawrence, and Thomas J. Campanella (eds.). 2005. *The Resilient City: How Modern Cities Recover from Disaster*. New York, NY: Oxford University Press.
- Wallace, Deborah, and Rodrick Wallace. 2008. "Urban Systems During Disaster: Factors for Resilience." *Ecology and Society*. 13(1): 18. [online] URL: <http://www.ecologyandsociety.org/vol13/iss1/art18/>