Chapter 2
Resilience and Transformation in the Red Zone

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Abstract Although not generally recognized in policy and research agendas, cases where humans who face disaster, conflict, or stress turn to greening as a source of resilience abound. Such examples cut across organizational scales, as demonstrated by the greening efforts of individuals and of groups of youth and adults who plant gardens and trees under the harshest of conditions, including during war, in communities approaching a threshold and at risk of becoming what Norton has referred to as 'feral cities', in refugee camps, in small villages, and in major cities. In some instances greening may have symbolic meaning and broad implications for the resilience of entire nation-states. We provide a brief overview of the term resilience as it has been used at the individual level and then go into more depth regarding its use at the scale of social-ecological systems, with particular reference to crisis settings that open up possibilities for transformation to more desirable states. Whereas we recognize the well-documented role of greening in adaptation to ongoing, relatively small changes at the individual level, we focus on how greening comes to the fore when social-ecological systems – a village, a city, a region dependent on a particular natural resource, or even a whole nation-state – undergo transformations following a major perturbation.

Keywords Resilience • Transformation • Greening in the red zone • Disaster • Conflict

After stating that greening represents a critical source of resilience at multiple levels, co-authors Keith Tidball and Marianne Krasny present an overview of multiple constructs that help us understand individual and social-ecological systems resilience. They focus on resilience as both adaptation and transformation, and on the interactions of these and related processes across scales.

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Introduction

To understand the broader implications of humans turning to nature in times of disaster or crisis, we need working definitions of greening and red zones, as well as a conceptual or explanatory framework. Such a framework should describe the relationships between the act of greening and other components of the social-ecological system in which these actions are nested. We have chosen the notion of *resilience*, which we feel offers a strong foundation for understanding the role of greening following disaster and conflict at multiple, interrelated levels – individual, social, and ecosystem.

As used in this book, greening refers to the activities of humans, working alone or more commonly with others in their community, to restore local social-ecological systems[1] through such activities as community gardening, community forestry, and improving habitat for wildlife and aquatic biodiversity (Chap. 1, this volume; Tidball and Krasny 2007). We use the term red zone to refer to multiple settings (spatial and temporal) that may be characterized as intense, potentially or recently hostile or dangerous areas or times, including those in post-disaster situations caused by natural disasters such as hurricanes and earthquakes, as well as those associated with terrorist attacks and war (Chap. 1, this volume). *Resilience*, *in broad terms*, *refers to the ability of humans*, *communities and larger social-ecological systems to rebound and to reorganize in the face of outside stressors*, *including death of loved ones and full-blown war and conflict or disasters*. During such times of crisis, breakdown, and reorganization, existing and potential sources of resilience come to the fore; for this reason, discovering, building, and safeguarding those sources of resilience is critical to recovery from crisis (Walker et al. 2002). *We contend that greening*, *as a form of human agency and collective action applied to environmental stewardship*, *represents a critical source of resilience at multiple levels*.

Although not generally recognized in policy and research agendas, cases where humans who face disaster, conflict, or stress turn to greening as a source of resilience abound as evidenced by the chapters in this book. Such examples cut across organizational scales, as demonstrated by the greening efforts of individuals and of groups of youth and adults who plant gardens and trees under the harshest of conditions, including during war (Helphand[2], Chap. 17), in communities approaching a threshold and at risk of becoming what Norton has referred to as 'feral cities' (see Norton 2003; see also Chap. 8 by Chawla), in refugee camps (Moore, Chap. 31), in small villages (Lee, Chap. 12), and in major cities (Cheng and Mcbride, Chap. 18; Tidball, Chap. 20; Laćan and McBride, Chap. 22; Cramer, Chap. 34). In some instances greening may have symbolic meaning and broad implications for the resilience of entire nation-states – witness the novel initiatives in Cyprus, Korea, and

[1] We use the term 'social-ecological systems' to refer to ecosystems and the social systems nested therein. This is the terminology used by the Resilience Alliance network, and can be seen as a step toward envisioning humans as part of ecological systems, rather than as apart or separate from broader ecosystem processes.

[2] Where no date given, citations refer to chapters in this volume.

Germany to convert lines demarcating contested political boundaries into sites for biodiversity and outdoor recreation (Grichting, Chap. 33; Grichting and Lee, Chap. 15; Cramer, Chap. 34).

The fact that examples of greening as both a source and demonstration of resilience also cut across cultural, class, and national boundaries has important implications for post-conflict and post-disaster policy. Survivors of intense racial and political conflict turn to community gardening in Liberia (Holder, Chap. 32), South Africa (Shava and Mentoor, Chap. 6), and Serbia and Guatemala (Winterbottom, 30). Natural disasters, which have been referred to as 'shorthand for a humanitarian disaster associated with a natural hazard event' (Pelling and Dill 2009, p. 22), elicit a variety of greening responses, ranging from creating an urban park in Haiti (Pierre-Louis, Chap. 3) to planting trees in New Orleans (Tidball, Chap. 20) and Korean villages (Lee, Chap. 12). Given how greening responses often emerge spontaneously in conflict and disaster settings across multiple continents and cultures, the question arises of how such efforts could be leveraged by international rebuilding and development efforts sponsored by the UN, donor nations, and NGOs. We revisit this question in the concluding chapter of this volume.

Foundational to understanding the array of case examples in this book is a grounding in the human and social-ecological systems resilience literatures. Whereas we recognize the well-documented role of greening in adaptation to ongoing, relatively small changes at the individual level, we are particularly interested in how greening comes to the fore when social-ecological systems – a village, a city, a region dependent on a particular natural resource, or even a whole nation-state – undergo transformations following a major perturbation. Thus in this chapter, we provide a brief overview of the term resilience as it has been used at the individual level and then go into more depth regarding its use at the scale of social-ecological systems, with particular reference to crisis settings that open up possibilities for transformation to more desirable states. A review of the greening literature and how greening relates to human resilience can be found in the chapters by Tidball (Chap. 4), Okvat and Zautra (Chap. 5), and Wells (Chap. 7).

Resilience

The notion of individual or human resilience helps us to understand how people who face overwhelming adversity sometimes exhibit not only the capacity to maintain stability, but also the potential for growth experiences, or positive adaptation to the challenges they face (Bonanno 2004; Luthar et al. 2000, see also Chap. 5 by Okvat and Zautra, this volume). Whereas scant attention is paid to the role of nature in the individual or human resilience literature, in talking to red zone survivors, whether they be war refugees taking up a new life in Toronto or residents of New Orleans' 9th Ward after Hurricane Katrina, we often hear stories about how the act of planting – be it trees, vegetables, or flowers – has been critical to emotional survival and to engendering hope for the future. The recent emergence of multiple and

varied nature-based programs to help US and British soldiers and their families deal with the stress of overseas deployment (see Krasny et al. Chap. 13) provides another source of evidence for how people turn to nature as a resilience strategy in times of stress, a phenomenon Tidball (Chap. 4) has referred to as urgent biophilia. Empirical research reviewed in the chapters in this volume suggests cognitive (Wells, Chap. 7) and psychological (Okvat and Zautra, Chap. 5) mechanisms for how such expressions of urgent biophilia might aid in recovery of individuals facing disaster and other stressful situations. That connecting with nature plays a role in human resilience not only in red zone situations, but also for people encountering less profound challenges as they go about their daily lives, has been demonstrated by an impressive body of research on the role of nature in helping individuals cope with stresses ranging from attention hyperactive deficit disorder to recovering from surgery (Faber et al. 1998, 2001; Ulrich 1983, 1984) as well as in their daily work lives (Kahn et al. 2008). In short, interactions with nature play a role in maintaining well-being and in recovery among individuals facing a range of adversities.

Masten and Obradovic (2008) have called for an exploration of the intersection between resilience at the individual and social-ecological system levels. Similar to descriptions of resilience at the individual level, definitions of social-ecological systems resilience capture notions of recovery and reorganization following crisis. Social-ecological systems resilience has its roots in discussion among scholars about the distinctions between *engineering resilience*, emphasizing dynamics close to equilibrium and defined as the time required for a system to return to an equilibrium point following a disturbance event (Holling 1996), and *ecosystem resilience* (Gunderson and Holling 2002) or *ecological resilience* (Anderies et al. 2006; Gunderson 2000; Gunderson and Pritchard 2002; Holling 1996), which refers to dynamics *far* from any equilibrium steady state and is defined as the amount of disturbance that a system can absorb before changing to another stable state reflecting different variables and structure. In this chapter, we focus on *social-ecological systems resilience*, a hybrid concept from the social and ecological sciences (Brand and Jax 2007), which refers to the capacity of a social–ecological system to buffer perturbances and to renew and reorganize in response to change (Adger et al. 2005; Anderies et al. 2006; Folke 2006; Folke et al. 2002a; Gunderson and Holling 2002; Walker et al. 2006). The capacity of a system to adapt or to reorganize and renew in response to disturbance depends in part on the degree to which it is capable of self-organization (Levin 2005; Olsson et al. 2004), of learning through experience and through incorporating diverse forms of knowledge, and of adapting in the face of new information (Berkes 2004; Carpenter et al. 2001; Folke et al. 2002a). Self-organization refers to the emergence of larger-scale biological and social processes from smaller-scale phenomena or practices, for example, multiple gardening and tree-planting activities that spring up after disaster and that together form a city-wide urban community reforestation or greening program. Other attributes of resilient social-ecological systems include ecological variability, social capital, innovation, overlap in governance, and ecosystem services (Walker and Salt 2006).

Notably, resilience, as a buffering force, can be positive in cases where the social-ecological system is in a desirable state that a community would like to maintain

(e.g., the presence of green space can help buffer a livable neighborhood from social stresses). Resilience also can be thought of as a positive force in a system that is collapsing into an undesirable state (e.g., chaos following war) and is rebuilding back to a more positive state (e.g., peace and order). In contrast, resilience can be negative in the sense of an undesirable state that does not lend itself to change (e.g., a community that is in a vicious cycle of poverty, crime, and vandalized public spaces). While recognizing the multiple implications of the notion of resilience, in this and other chapters we focus largely on resilience as a positive force following a system's collapse, as implied by the notion of red zones.

Several factors can lead to loss of resilience and thus contribute to a system's collapse. One contributing factor is managing for maximum yield of a single resource, such as one tree or crop species, while ignoring the consequent slow erosion of other ecological, social, and cultural components of the system that confer resilience, such as biodiversity, landscape variability, social connectivity, and social memory (Davidson-Hunt and Berkes 2003; Holling et al. 2002a; McIntosh et al. 2000; Walker and Salt 2006). Once sources of resilience decline, a disturbance that may go relatively unnoticed in systems with high resilience can cause major impacts (Holling and Gunderson 2002; Yorque et al. 2002). Interestingly, even systems such as the rust belt cities of the northern US where change occurs more gradually (Stedman and Ingalls, Chap. 10, this volume), are often described in terms reminiscent of red zones. For example, Detroit is painted as a war zone,[3] or compared to the Ukrainian city that was evacuated following the nuclear disaster at Chernobyl: 'Unfortunately, the city of Detroit is starting to show similarities to this Ukrainian ghost town, as vacancies are on the rise and wildlife has overtaken some of the neighborhoods…. The desertion of Pripyat carries a certain, albeit radioactive, connection to the desertion of Detroit, and it will not be long until Detroit marks a stark resemblance to this lifeless city'.[4] Similarly, Wallace and Wallace (2008) refer to building-fire and building-abandonment 'epidemics' attributable to widespread dislocation and destruction of social capital in northeastern US cities as a result of urban 'renewal' policies in the 1970s. Stedman and Ingalls (Chap. 10, this volume) review literature depicting how the erosion of community capacity in rust belt cities leads to an inability to respond to sudden catastrophe.

Adaptive Cycle

Fundamental to an understanding of social-ecological systems resilience, and of how social-ecological systems move from a maintenance to a rebuilding stage after disaster, is the notion of the adaptive cycle. First proposed by Holling (1973, 1986) to describe recovery of a forested system ravaged by insects, the notion of the adaptive

[3]Genzlinger, Neil. Detroit Seeks Exit from Doom Highway. 4/16/10 http://www.nytimes.com/2010/04/17/arts/television/17dateline.html

[4]http://www.hnn.us/articles/124582.html

cycle was later expanded by Gunderson and Holling (2002) to incorporate humans or social systems. A double (infinity) loop is used to depict this cycle, with phases of growth and stability followed by collapse, leading to reorganization and regrowth. According to the resilience scholars, 'Generally, the pattern of change is a sequence from a rapid growth phase through to a conservation phase in which resources are increasingly unavailable, locked up in existing structures that have little flexibility, followed by a release phase that quickly moves into a phase of reorganization, and thence into another growth phase.… The growth and conservation phases together constitute a relatively long developmental period with fairly predictable, constrained dynamics; the release and reorganization phases constitute a rapid, chaotic period during which capitals (natural, human, social, built and financial) tend to be lost and novelty can succeed'.[5] The conservation phase is further characterized by a brittleness in the face of disturbance (Berkes and Folke 2002), loss in problem-solving ability as institutions become increasingly more complex (Tainter 2000), and more broadly a loss in adaptive capacity; thus the conservation phase is particularly vulnerable to disturbances that may flip the system into a state of collapse or chaotic release in which ongoing processes are no longer recognizable (Folke et al. 2002b). Although in contrast to the conservation phase, the renewal phase is a period ripe for experimentation and novelty, it is also vulnerable to disturbance and disaster (Gunderson and Holling 2002; Holling et al. 2002b). According to Carpenter et al. (2002) and Gunderson and Holling (2002), the overwhelming majority of research has been conducted on the growth or exploitation (r) phase and how it leads to a conservative (K) period of increasingly inflexible systems followed by a system's collapse. This leaves us with relatively little understanding of the reorganization (omega) and regrowth (alpha) phases, in spite of widespread recognition of the prevalence of perturbances that have the potential to flip systems into less desirable states. For this reason, and because decisions made in the collapse phase of the adaptive cycle critically impact the future of the system, and may even set the stage for a future collapse (Carpenter et al. 2002), examining the dynamics of the omega and alpha phases is critical. Hence the importance of the chapters in this book – inherent to a discussion of red zone systems is a focus on collapse, whereas greening plays a role in the reorganization and regrowth of disturbed social-ecological systems.

The notion of the adaptive cycle allows us to re-envision hierarchies of social and ecological systems 'from fixed static structures to dynamic adaptive entities whose levels are sensitive to small disturbances at the transition from growth to collapse (omega phase) and from reorganization to rapid growth (alpha phase)' (Holling et al. 2002b). Of relevance to red zones, some disasters might be predictable because they occur after an extended phase of growth and conservation leading to loss of adaptive capacity (e.g., the collapse of the former Yugoslavia after a long period of stability and perhaps loss of flexibility under Tito). Other disasters occur during the vulnerable reorganization phase shortly after a previous collapse, and thus disrupt the hypothesized progression from reorganization to renewal. For example, recent turmoil

[5] http://www.resalliance.org/564.php (accessed 23 November 23, 2010).

as a result of disputed elections in the Ivory Coast occurred after a period of conflict followed by only a short reorganization phase, and may have once again tipped the system into red zone conditions. Thus, whereas the adaptive cycle is useful in explaining a generalized pattern of change in social-ecological systems, in reality systems are often complex and do not always cycle through the four stages sequentially. Rather systems may skip or jump back and forth between different phases. Further, systems may experience different processes at various scales and in systems nested within one another (Walker et al. 2004), and disaster may strike during periods when the social and ecological systems are at different phases of the adaptive cycle. For example, the 2010 Gulf Coast oil spill in the southern US hit at a time when parts of New Orleans were showing significant signs of social and ecological reorganization following the 2005 hurricanes. However, efforts after the hurricane did not lead to successful or complete restoration of the nearby coastal social-ecological system, and the Gulf Coast continues to experience decline of protective wetlands (Carbonell and Meffert 2009; Ernstson et al. 2010b; Kida 2009).

Feedback Cycles

Within an adaptive cycle, one may find multiple processes that operate at shorter time scales. One such process can be described as virtuous and vicious cycles or feedback (Matthews and Selman 2006; Powell et al. 2002; Selman and Knight 2006). Such cycles represent interactions that are typically self-sustaining in that they 'feed' themselves and constantly reinforce one another (Varis 1999). If their direction of influence is negative, they are considered vicious cycles, and if their direction is positive, they are known as virtuous cycles (ibid).

Virtuous and vicious cycles provide a means to visualize how greening might interact with other processes to help transform a social-ecological system. For example, in the short chapter describing wildlife management as a kind of greening in a red zone time period in northern Kenya (Craig, Chap. 28), drought and overgrazing led to a collapse of traditional sources of livelihood, which in turn led to conflict, further cutting off access to traditional tourism and grazing revenue. One can envision a further downward spiral leading to larger conflict and food shortage, in short a vicious cycle. In this case, however, the Northern Rangelands Trust was able to interrupt this vicious cycle through an intervention centered around management of shared resources, which led to a period of regrowth and access to traditional livelihoods. In contrast, a small greening intervention such as that described in the chapter on Port Au Prince, Haiti (Chap. 3), while important in terms of providing an outlet for biophilia (see Tidball, Chap. 4) and perhaps generating feelings of empowerment (see Westphal 2003), may be too little too late to break the vicious cycle of poverty, natural disturbance, disease, and localized violence. Vicious cycles, such as poverty traps (also referred to as 'lock-in' traps, see Allison and Hobbs 2004), have themselves been described as resilient in an undesirable sense of the term. One challenge the authors in this book face is how greening can play a role in transforming

such vicious cycle systems, enabling them to enter an alternate cycle leading to reorganization and regrowth (Tidball and Krasny 2008, 2010, 2011).

In addition to vicious feedback cycles in which negative conditions feed into an ever more negative state, we can recognize a virtuous cycle when, for example, social capital and economic entrepreneurship contribute to favorable social-ecological system characteristics, which leads to a situation of mutual reinforcement between human activity and environmental capital (Selman and Knight 2006). Tidball and colleagues (Tidball and Krasny 2008, 2010; Tidball et al. 2010) describe how feedbacks between individuals engaged in civic ecology practices – i.e., community gardening, watershed restoration, and other small-scale community-initiated greening efforts – can result in ecosystems that provide greater ecosystem services, creating the foundation for societal and individual well-being, which in turn provides opportunities for greater engagement in greening. Importantly, this feeding back between the biophysical and social systems may also cross levels of organization. For example, changes brought about by a tree-planting effort could initially be important at the scale of the local community or neighborhood, but eventually may foster significant changes in the ecosystem in which the community is embedded. The community and ecosystem might in turn be nested in and impact larger governance processes, leading to policies that favor greening. Such policy changes may in turn cascade back down to impact the ecosystem and community (see Ernstson et al. 2010a, b).

In the parlance of resilience scholars, vicious cycles (Gallopin 2002) represent one stable state within a landscape (see Beisner et al. 2003). Any one landscape also contains other possible stable states, such as virtuous cycles of people stewarding green space leading to greater access to nature and enhanced community and ecosystem well-being (Tidball and Krasny 2008). Depicted graphically, a vicious or virtuous cycle can be imagined as a ball that is constantly swirling around one basin within a landscape. To move the ball to a different basin, for example from a vicious to a virtuous cycle, requires either moving the ball itself through making changes within the basin (e.g., increasing the magnitude of the stewardship activities) or by changing features of the landscape. One can envision a 'ridge' or bifurcation zone separating the two basins, and that by reducing the height of the ridge it becomes easier to move from the vicious to virtuous cycle basin. This would require an input of resources from outside the vicious cycle, such as an influx of outside money or change in government policy. In systems language, in order to move from one stable state to another, the system must experience a large perturbance to one of the state variables (such as integrity of the urban forest canopy or density of one or more species) or a change in parameters that determine the behavior of state variables and their interactions (e.g., species migration, Beisner et al. 2003).

Panarchy

In real systems, multiple adaptive cycles occur at varying temporal and spatial scales, nested within and interacting with one another – a concept referred to as panarchy (Gunderson and Holling 2002). At lower levels or adaptive cycles within

a panarchy, processes occur more rapidly and there is greater opportunity to 'invent, experiment, and test' (Holling et al. 2002b, p. 76). In contrast, the higher, slower levels 'stabilize and conserve accumulated memory of past successful, surviving experiments'. Thus, the whole panarchy is 'both creative and conserving' (ibid). Because the different levels within a panarchy enable it to maintain the capacity to create and test new solutions, while also preserving and accumulating memory, transformations up and down panarchies are different from those within the adaptive cycle. Again Holling et al. (2002b) help us understand how this occurs:

> Some developments emerge within adaptive cycles during the back loop (omega and alpha phases) of the cycle, when recombinations and external influences can generate unexpected new seeds of opportunity that can nucleate and modify the subsequent phase of growth. So long as connections with other levels are maintained, those innovations are contained and do not propagate to other levels. But as such recombinations and inventions independently accumulate in a number of adjacent levels, a time will come when the phases of several neighboring cycles become coincident, when each becomes poised as an accident waiting to happen in a shift from omega to alpha. Windows open that can allow those independent inventions and adaptations to interact to produce a cascade of novel self-organized patterns across a panarchy, creating fundamental new opportunity (p. 90).

Whereas efforts to assess the results of greening or management activities are relatively common, attempts to adapt and implement new practices based on assessments often become frustrated when they encounter entrenched interests and power (Holling et al. 2002b) sometimes leading to silencing and even violence (Pelling and Dill 2009). Even in relatively peaceful times, information that flows up through hierarchies may be ignored at upper policy levels, as for example when policy makers institute new agricultural incentives that destroy existing systems of agriculture that have persisted for generations or centuries (McIntosh et al. 2000). Thus, positive panarchical change cascading up the levels of nested adaptive cycles 'can occur only when a triggering event unlocks the social and political gridlock of larger levels in the panarchy' (Holling et al. 2002b, p. 91). Most of the chapters in this volume explore the role of greening in transformation at lower levels (neighborhoods, communities) of adaptive cycles in the panarchy, and thus do not address triggering events. However, several chapters focus on nation states where triggering events, such as the collapse of communism in eastern Europe or the potential reunification of North and South Korea or Greek and Turkish Cyprus, unlock larger levels and create vast opportunities for re-organization and re-growth of the social and ecological systems that are part of these nation-states (Cramer, Chap. 34; Grichting and Lee, Chap. 15; Grichting, Chap. 33).

Note that triggering events can also open space for negative social and political conditions and events to emerge, such as violence, property invasion, and crime (Pelling and Dill 2009). In their paper on disaster politics, Pelling and Dill (2000, p. 25) note that: 'Those rarer cases where [positive] political change was identified were most likely when popular mobilization was sustained by discursive (ideological), organizational (social capital) and material (financial) support'. The institutions or movements that enable such successful transitions generally exist prior to the disaster or other triggering event. Drawing from this volume, both urban forestry (Laćan and McBride, Chap. 22) and agricultural (Holder, Chap. 32) traditions existed

prior to widespread violence in Sarajevo and Ivory Coast, and may have embodied some elements (e.g., social capital, provision of material benefits) that were drawn on or 'remembered' following intense conflict (Tidball et al. 2010).

Adaptation and Transformation

The presence of two general phases in Holling's adaptive cycle – growth/conservation and reorganization/regrowth – implies two different resilience processes: adaptation and transformation. Adaptation occurs when a social-ecological system is able to adjust its responses to changing external and internal conditions, and thereby continue maintaining its self-reinforcing configuration along a current trajectory (Folke et al. 2010; Löf 2010; Walker et al. 2004). Human agency, including foresight, communication, and technology (Holling et al. 2002b), as well as collective action play a critical role in the ability of a system to adapt; put simply 'adaptive capacity can be increased through purposeful action' (Adger et al. 2005, p. 1037; see also Chap. 10 by Stedman and Ingalls, this volume). Transformation occurs when a system that has crossed a threshold is able to give rise to new responses that enable it to reorganize and eventually enter into a new, fundamentally different stability domain and development trajectory (Folke et al. 2010). Here too human agency, for example, the ability to envision an alternative future through scenario planning and other means, plays a critical role (Adger et al. 2005; Davidson 2010; Peterson et al. 2003; Walker et al. 2004). A comparison of two 'steel towns' is illustrative of adaptive and transformative responses to an external disturbance. In the face of global competition (an outside disturbance), the city of Gary Indiana has struggled to maintain its steel industry as the basis for its local economy. In contrast, Pittsburgh Pennsylvania has transformed itself from Steel City to 'med-ed' city – where livelihoods are based on the health, higher education, and technology sectors.[6]

We can readily apply the two resilience processes implied by the adaptive cycle – maintenance or conservation, and reorganization and re-growth – to the chapters in this book. First, greening and related community-based natural resources management may play a role in 'conservative' resilience, or the capacity of a system to resist change and maintain itself in the conservation phase. For example, in the short chapter by Craig, the trust among rival ethnic groups built through jointly managing a common wildlife resource in Kenya, may have played a role in averting ethnic violence or constraining it to a relatively short time period and small region (Craig, Chap. 28, this volume), thus avoiding an all-out civil war. In resilience parlance, the collaborative wildlife management efforts were a source of resilience that may contribute to the maintenance of stability in the face of ethnic conflict.

[6] From Steel To Tech, Pittsburgh Transforms Itself; http://www.npr.org/2010/12/16/131907405/from-steel-to-tech-pittsburgh-transforms-itself

How Gary, Ind., Hopes To Soften Its Steely Image; http://www.npr.org/2010/12/16/132079113/how-gary-ind-hopes-to-soften-its-steely-image?ps=rs

In other systems and at larger scales, existing sources of resilience may not be sufficient to maintain the system in the conservation phase so that a catastrophic disturbance, such as a hurricane or war, flips the system into a different and often chaotic or red zone state. During the ensuing reorganization phase, greening also may play a role. The chapters in this volume present numerous examples of the role of greening in this rebuilding phase of resilience, including reforestation in Japan (Cheng and McBride, Chap. 18), community or datcha gardens in Russia (Boukharaeva, Chap. 26), and conversion of 'red lines' to 'green lines' in Cyprus (Grichting, Chap. 33), Korea (Grichting and Kim, Chap. 15) and Berlin (Cramer, Chap. 34). Other contributions, such as the case of village groves in Korea (Lee, Chap. 12), describe how small-scale community-managed forests can play a role in both the conservative phase (through protecting against wind and erosion) and the rebuilding phase following a typhoon (through leveraging social memory to reassert cultural identity). Similarly, tree-planting may help to maintain stability among residents of a refugee camp in Cameroon (Moore, Chap. 31) and female heads of families in Afghanistan (Thompson, Chap. 9), who have previously suffered violence and displacement.

The attributes that enable systems to embark on a desirable path of re-growth or transformation following disturbance are similar to those of systems that are able to adapt to ongoing change, and include high levels of natural, social, and other forms of capital; biological, landscape, cultural, and institutional diversity; the ability to self-organize; the capacity to learn adaptively taking into account feedback from management actions; and support from networks and from higher scales in the governance structure (Adger et al. 2005; Folke et al. 2003, 2010; Walker and Salt 2006). Transformational change may require additional attributes, including the ability to question and when needed shift perceptions and meanings related to ongoing resource management practice (i.e., 'multiple loop learning', Armitage et al. 2008) as well as shifts in 'social network configurations, patterns of interactions among actors including leadership and political and power relations, and associated organizational and institutional arrangements' (multiple authors as synthesized in: Folke et al. 2010). Walker et al. (2004) emphasize 'diversity of functional types (kinds of education, expertise, and occupations); trust, strengths, and variety in institutions; speeds and kinds of cross-scale communication, both within the panarchy and between other systems elsewhere'. Adaptive governance, which captures the collaboration of a diverse set of stakeholders operating at different scales and institutions; individual actors who provide leadership, vision, and knowledge; and social networks that tie together people and governance system, also plays a critical role in transformability (Folke et al. 2005). Another source for innovation and renewal is memory – both biological (e.g., seeds and other propagules remaining after a disturbance, Nazarea 2005) and social (e.g., memories of traditional harvesting practices, Davidson-Hunt and Berkes 2003). McIntosh et al. (2000) compare two types of organization that respond differently in crises: hierarchies, in which a few people make decisions rapidly but which suffer from bureaucratic rigidity, and heterarchies, such as tribal councils, which are characterized by 'horizontal integration of multiple overlapping social lattices, each of which may have a different center', and

which are 'agonizingly slow to make decisions because everyone has a voice in the process, [but] have the advantage that information is not lost in a streamlining process' (p. 13).

McIntosh and colleagues (ibid) also emphasize the role of social memory in addressing environmental change. They present 'social memory as a concept to describe the ways by which communities curate and transmit both past environmental states and possible responses to them (see Colding et al. 2003). Far from being a stagnant pool of knowledge, social memory often involves innovation in the form of experimental recycling or reinvention of curated knowledge… and its intergenerational transmission.… Social memory is thus the source of the metaphors, symbols, legends, and attitudes that crystallize social action' (McIntosh et al. 2000, p. 24). Tengö and von Heland (Chap. 24, this volume) describe how social memories help to sustain rural societies in Madagascar, whereas Boukharaeva (Chap. 26) and Svendsen and Campbell (Chap. 25), and Tidball et al. (2010) have described how contemporary urban societies, such as communities responding to the collapse of the Soviet Union, 9/11 terrorist attacks, and Hurricane Katrina mobilize social memories in collective greening actions.

Social learning (see Blackmore et al. 2007; Pahl-Wostl 2006) as a result of impromptu actions taken in response to disaster can be incorporated into a community's social memory and better prepare that community to address a subsequent disturbance or disaster (Cutter et al. 2008). Thus, systems that demonstrate experimentation and learning 'feed back' information that goes into preparing for disaster and mitigating future disaster impacts. In particular, social learning and knowledge on the part of whole communities allows beneficial innovations to become formalized into institutional policy through such actions as disaster preparedness plans or improvements; this form of learning differs from more traditional debriefings post-disaster with their focus on 'lessons learned' (Cutter et al. 2008).

Cutter et al.'s (2008) place-based model for community resilience to natural disasters offers a practice-based framework for determining the ability of a disaster-impacted system to both absorb disturbance and to re-grow following major disaster. Their 'disaster resilience of place' (DROP) model begins with antecedent conditions related to vulnerability and resilience of the social, natural, and built environment, which interact with characteristics of the hazard event (e.g., frequency, duration, intensity, magnitude, and rate of onset) to produce immediate effects. At this point, mitigating actions and coping responses on the part of the community that is being impacted come into play, and determine whether or not the system is able to recover and return to its pre-disaster state or becomes transformed into a usually less desirable state. The recovery of three New Orleans neighborhoods after Hurricane Katrina illustrates how differences among communities in their vulnerability and resilience prior to the disturbance influence their coping responses and ability to recover (Kida 2009). In the Vietnamese neighborhood, a sense of community cohesion based on a collective memory of war and resettlement, and institutional capital in the form of a strong and highly organized Catholic church, enabled more rapid re-organization and resistance to further outside disturbance in the form of a city government bent on razing remaining housing and resettling residents. In contrast,

the New Orleans neighborhoods with lower levels of social and institutional capital experienced greater difficulties in coping with the aftermath of the flooding (Kida 2009; see also Brunsma et al. 2007; Miller and Rivera 2007; United States 2006).

Greening and Transformation

Although most often viewed from the perspective of their negative environmental, social, and cultural repercussions, shocks or crises that result in serious disruptions to normal processes also can help communities move beyond the state of denial and in so doing, 'open up opportunities for reevaluating the current situation, trigger social mobilization, recombine sources of experience and knowledge for learning, and spark novelty and innovation'. Further, such changes may 'lead to new kinds of adaptability or possibly to transformational change' (quoted from Folke et al. 2010; see also Olsson et al. 2007). Whereas a number of more formal processes exist for fostering such transformational change (e.g., scenario planning among watershed stakeholders, Peterson et al. 2003), this book focuses largely on transformational changes that *emerge*, or are 'self-organized', following shock or crisis. In the cases presented in this volume, we find multiple examples of how a crisis – including natural disturbance, conflict, and slower decline, often acting in concert – has sparked reevaluation, social mobilization, the coming together of multiple experiences and knowledge, and innovation. One needn't look far to find examples of self-organized greening that integrate components of transformation – whether in the creation of a community garden that brings together former enemies to create something of value and beauty on a site symbolic of devastating ethnic conflict in Soweto (Shava and Mentoor, Chap. 6, this volume), the construction of a first-of-its-kind national park in conflict-ridden Afghanistan (Smallwood, Chap. 21), or the coming together of war veterans in a fishing stream in upstate New York (Krasny et al., Chap. 13).

Even those greening responses that are initially self-organized with leadership from single community leaders or small groups of neighbors, soon grow to involve multiple levels of governance reflecting a network of community organizations, government institutions, NGOs, and sometimes business. Such connectivity enables those engaged in experimentation at small scales – the replanting of forests or reconstructing of wetlands – to learn across multiple experiments. The ability of actors from different levels of governance who are engaged in experimentation and learning to bridge from community to higher levels of social organization provides a means for what begins at a small scale to spark transformational change at increasingly higher scales (Folke et al. 2010). However, given barriers to transformational change embedded in existing policies and power structures (Pelling and Dill 2009), the challenge for proponents of greening's transformative potential continues to lie in understanding the processes and sources of resilience and adaptive and transformative change at multiple levels. Although at times critiqued for its broad notions of social-ecological processes (Brand and Jax 2007), the growing body of resilience scholarship provides an important avenue for gaining such an understanding through

sharing results of experiments, observations, and reflections among an international network of scholars and practitioners concerned with social-ecological system change.

Resilience, Biophilia, and Topophilia

How might we come to understand the relationship of individual resilience in post-crisis contexts to resilience at broader social-ecological scales? We start with the notion of biophilia, a term proposed by renowned socio-biologist E. O. Wilson to describe an innate human predisposition to affiliate with, or to love, life and nature more broadly (Wilson 1993). Tidball (Chap. 4, this volume) links biophilia to individual resilience, which may contribute to expansive virtuous cycles and therefore social-ecological systems resilience, in positing a switch from base-line biophilia during periods of relative stability, to urgent biophilia during times of collapse followed by reorganization. As captured in the notion of urgent biophilia, once war, hurricanes, or another disaster flips a social-ecological system into a less desirable state, humans may respond to a feeling of being threatened or to a sense of loss by seeking or remembering an emotional affiliation with other living organisms, and in so doing, may aid themselves as individuals and as societies in recovery and even re-growth (Tidball, Chap. 4). This biophilic response also may give rise to collective action to enhance local environments (e.g., through community forestry or community gardening), and, through the act of greening, humans may develop attachment to a particular place or to a representative ecosystem more broadly (Ryan and Grese 2005). Thus, biophilia may manifest itself in broader social and cultural behaviors, such as when humans who spend time in, restore, and steward nature develop feelings of attachment to a place, or 'topophilia' (Stedman and Ingalls, Chap. 10). Further, witnessing the destruction of a particular place or ecosystem to which one feels attached may elicit what Stedman and Ingalls have referred to as a topophilic response, such as greening to restore features of the place that was destroyed, including features that provide ecosystem services. Such topophilic responses may contribute, in the aggregate, to recovery and re-growth of the larger social-ecological system. Thus, through feedbacks among individual and collective action and ecosystem services (Tidball and Krasny 2008, 2010), both urgent biophilic and topophilic responses can play an important role in the adaptive and transformative capacity of social-ecological systems.

Conclusion

Folke et al. (2010) distinguish between general resilience, which refers to coping with uncertainty and shocks more broadly, and specified resilience relating to particular aspects of a system and a particular set of sources or shocks. Carpenter et al.'s (2001)

now classic questions – 'resilience of what? to what?' – are consistent with the notion of specified resilience and beg us to define what we are most concerned about – e.g., the resilience of a system's productivity, the species it contains, the livelihoods of its people? And what are the shocks that are the focus of our analysis – a drought, a fire, an economic downturn? In the context of this book, 'of what' in some chapters refers to the emotional, psychological and/or physical well-being of a specific set of actors, such as inmate populations (Lindemuth, Chap. 27, this volume), soldiers experiencing repeated deployment cycles (Krasny et al., Chap. 13), or the families of garbage pickers in Guatemala (Winterbottom, Chap. 30), whereas in other chapters, the 'of what' refers to a variety of indicators of the health of a social-ecological system, including biodiversity (Grichting, Chap. 33 and Grichting and Kim, Chap. 15), social connectivity (Smallwood, Chap. 21), and social-ecological memories, such as living memorials in New York City (Svendsen and Campbell, Chap. 25), and reforestation in Tokyo Hiroshima (Cheng and McBride, Chap. 18), and Sarajevo (Laćan and McBride, Chap. 22). The social-ecological systems similarly are diverse, encompassing a strip of land with symbolic and strategic importance for a nation or even globally (Cyprus Red Line, Korean Demilitarized Zone); cities emblematic or the focus of larger regional conflict (Berlin, Sarajevo, Hiroshima, Monrovia); cities with cultural and symbolic significance (New Orleans); as well as smaller communities that are replicated across a particular country, such as agricultural villages having undergone industrialization in Korea. The 'to what' is defined as a wide spectrum of red zones including war, ethnic conflict, political turmoil, hurricanes, typhoons, and earthquakes, or in some cases slow deterioration as in the declining industrial cities of the US.

In stark opposition to notions of providing space for adaptive governance, novelty and learning in post-crisis, and thus opening up opportunities for self-organized and collaborative transformations to emerge, governments often respond with increased rigidity following a conflict or other disturbance. This became all too evident when, after overthrowing the Saddam Hussein regime, the US fired all Iraqis who had played a role in the previous Iraqi government (Tidball et al. 2008; Tidball and Weinstein 2011; Weinstein and Tidball 2007). Chaos ensued as men with little opportunity to be engaged in meaningful activity and little hope for the future turned to violence. We suggest that while reestablishing order post-conflict is critical, greening is a next step in opening up possibilities for transforming a system that has collapsed. Engaging people in meaningful and collective action that draws on their knowledge and experience in growing things and their capacity as local leaders, and that provides opportunities to participate in local governance, to express biophilia and topophilia, and to transform often degraded ecosystems, may be an overlooked source of resilience in post-conflict and post-disaster settings.

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