Global Environmental Change 23 (2013) 1410–1423

Contents lists available at ScienceDirect

Global Environmental Change

journal homepage: www.elsevier.com/locate/gloenvcha

Flame and fortune in California: The material and political dimensions of vulnerability

Gregory L. Simon [a,*], Sarah Dooling [b]

[a] University of Colorado Denver, Department of Geography and Environmental Sciences, P.O. Box 173364, Campus Box 172, Denver, CO 80217-3364, USA
[b] University of Texas, Austin, School of Architecture & the Environmental Science Institute, 1 University Station B7500, Austin, TX 78712-0222, USA

ARTICLE INFO

Article history:
Received 16 November 2012
Received in revised form 7 August 2013
Accepted 18 August 2013

Keywords:
Environmental change
Governance
Materiality
Spatial history
Urban political ecology
Vulnerability
Wildfire

ABSTRACT

This paper seeks to clarify and refine the assertion that vulnerability exists as both a material, condition and discursive construct. Building off of previous scholarship analyzing the production of, vulnerabilities, we present a conceptual framework that illuminates how material vulnerabilities are translated into political vulnerabilities and ossified in the policy realm. We argue that specifying components of, and relationships between, the material and political aspects of vulnerability will result in a more sophisticated articulation of vulnerability as a recursive process. In order to achieve this level of analysis we propose a spatial–historical analytic approach that blends point-in-time and, empirically driven analysis with robust historical and political economic analysis. We use the largest urban wildfire – in terms of dwellings lost – in California's history to show how the persistent disconnection between material and political forms of vulnerability has, over time, resulted in contradictory landscapes where homes are intentionally placed in landscapes vulnerable to wildfires with reduced fire protection. Spatial historical analysis of the Tunnel Fire reveals how representations of vulnerability oftentimes deviate from lived experiences, engendering responses of exploitation, ignorance, mobilization and resistance. This framework also recognizes how these responses can create new vulnerabilities while also maintaining, deepening and diminishing existing material conditions. Finally, relational analysis illuminates how factors generating vulnerability in fire areas also contribute to and reinforce vulnerabilities within other parts of cities like Oakland, California.

1. Introduction

The relationship between point-in-time assessments of vulnerability and the larger political and economic context in which assessed vulnerabilities exist has garnered considerable scholarly attentions over the past several decades. This scholarship has argued for the inclusion of diverse variables and contextual factors when measuring and evaluating conditions of vulnerability. Early critical risk assessments, for example, described the need to integrate biophysical factors with political economic pressures that affect a population's vulnerability and shape their ability to cope with and respond to risks (e.g., Hewitt, 1997). A decade later, Bohle et al. (1994) proposed an aggregated measure of human welfare that integrated environmental, social, economic and political exposure in order to illustrate complex and interconnected processes involved in making places and people vulnerable. Yet another decade later, the concept of contextual vulnerability was developed to illustrate how biophysical and social processes shape local conditions and the adaptive capacity of particular populations and places to withstand and respond to changes (e.g., O'Brien et al., 2007).

Most scholars now recognize that vulnerabilities are influenced by biophysical factors in conjunction with social, political and economic conditions (Cutter et al., 2005; Cutter, 2006; Eakin and Luers, 2006; Adger, 2006; Füssel, 2007; Ionescu et al., 2009; Marino and Ribot, 2012; Dooling and Simon, 2012). These models and analyses of vulnerability have pushed scholarship to consider diverse contextual processes including the interplay between drivers of social–ecological change, vulnerability outcomes and a multitude of societal responses (Eriksen et al., 2005; Pelling and High, 2005; Adger, 2006). Researchers have identified the material conditions of vulnerabilities–such as floods, famine, drought and poverty resulting from environmental change–as byproducts of broader, historical political economic relationships (Hewitt, 1997; Mustafa, 1998; Cutter et al., 2003, 2005; Cutter, 2006; Wisner, 1993; Wisner et al., 2004; Rebotier, 2012). In sum, connecting the material and political aspects of vulnerabilities has allowed researchers to expand their interpretation of single events and point-in-time conditions of vulnerability by linking places and

* Corresponding author. Tel.: +1 303 556 6393; fax: +1 303 556 6197.
E-mail addresses: gregory.simon@ucdenver.edu (G.L. Simon), sarah.dooling@mail.utexas.edu (S. Dooling).

0959-3780/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.gloenvcha.2013.08.008

populations to broader social and political processes (Cutter et al., 2003; Muller and Dooling, 2011; Simon, 2012).

In this paper, we build on previous work analyzing and theorizing the connections between experienced and discursive/rhetorical aspects of vulnerability. By synthesizing and coalescing existing literature we propose a material–political vulnerabilities conceptual framework that distills and illuminates these linkages. This conceptual framework is intended to clarify (a) how material vulnerabilities interact with political vulnerabilities; and (b) the broader political economic conditions, social-environmental changes and complex structures of governance that influence material conditions and community experiences. Our framework allows us to (c) map how political representations of vulnerability quite often deviate from material conditions; (d) describe how political vulnerabilities engender responses of exploitation, ignorance, mobilization and resistance; and (e) recognize how these responses can produce new vulnerabilities, while also maintaining, worsening or reducing existing material conditions.

Notably, we suggest the need for a spatial–historical analytic approach to operationalize this material–political vulnerabilities conceptual framework. A spatial–historical analytic approach can illuminate the complexities associated with how landscapes of vulnerability are produced, responded to (politically and socially), regulated and used to achieve political economic objectives. We propose this approach in order to develop additional insights into how vulnerable communities emerge; how vulnerable landscapes are spatially and temporally connected to other vulnerable areas; and how the recursive relationships between the material and political aspects of vulnerability change and influence each other over time.

This essay is organized around four sequential objectives. First, we articulate key areas of synthesis in the vulnerability studies literature. Second, we propose a material–political vulnerabilities conceptual framework informed by these linkages. Third, we develop a spatial–historical analytic approach that promotes synthesizing diverse data sets in order to facilitate the construction of narratives. And fourth, we apply this framework and analytic approach to a case study in Oakland, California (USA) that explores how vulnerable urban landscapes are produced, politicized and exploited in an iterative manner. While this case study does not reflect every component of the conceptual framework, it effectively demonstrates some of the key dynamics influencing how material and political vulnerabilities are both connected and divergent – particularly when analyzed through a spatial–historical lens.

2. Areas of research synthesis on the production of vulnerability

Below, three areas of synthesis within existing vulnerability studies scholarship are summarized. These areas of synthesis inform our conceptual framework and analytic approach: (1) the role of governance structures and decision-making processes in shaping the production of vulnerabilities; (2) the temporal dynamics of vulnerability; and (3) the construction of narratives based on diverse data sets and relational inquiry.

2.1. Synthesis area 1: The role of governance structures and decision-making processes that shape the production of vulnerabilities

An extensive body of research has illuminated how material conditions of vulnerability are produced through complex and evolving governance arrangements (Marino and Ribot, 2012; Mearns and Norton, 2010; Muller and Dooling, 2011; Lynch, 2012; Tretter and Adams, 2012). These studies have revealed and explicated contradictions between societal experiences of being vulnerable and policy responses to managing risk. People are made vulnerable as a consequence of embedded power asymmetries and inequitable and non-representative structures of governance. Political and economic power imbalances, inadequate representation, and the marginalizing tendencies of powerful interest groups play significant roles in how the material conditions of vulnerability are translated, manipulated, and exploited in the political realm (Lynch, 2012). Disconnections between policies aimed at alleviating risk for communities and the limited involvement granted these populations in the planning process are well documented (Agrawal et al., 2012; McEvoy and Wilder, 2012; Marino and Ribot, 2012; Dooling, 2012; Muller and Dooling, 2011). Maladaptive outcomes–those that increase people's risk of harm and exacerbate current conditions of vulnerability (International Panel on Climate and Change, 2001)–may be the unanticipated byproduct of well-intentioned but ill-advised policies, or they may be the result of intentional efforts (though typically cloaked in benevolent terms) to neglect, exclude, or exploit certain places and populations in the policy making process (Beymer-Farris and Bassett, 2012; Dooling and Simon, 2012; Lynch, 2012). Assessing the socio-political drivers of risk and subsequent regulatory and institutional responses requires analyzing policies in relation to diverse descriptions and interpretations of risk from various civil society groups and government entities (Pelling et al., 2008; Marino, 2012; Rebotier, 2012).

2.2. Synthesis Area 2: Using dedicated temporal analysis to reveal vulnerability as a dynamic process

Scholars have come to understand vulnerability as more than a static, point-in-time condition, instead viewing vulnerability as a process influenced by constantly evolving and interacting material and political factors. By integrating analyses of the historical drivers of social and environmental change, researchers have illustrated how interactions between political economies of resource use and normative planning and management interventions–across local to global scales–influence levels of social stratification and, ultimately, which places and populations are made vulnerable (Orsi, 2004; Wisner et al., 2004; Hogan and Marandola, 2005; Collins, 2005, 2008, 2010; Mustafa, 1998, 2005; Adger, 2006; Dooling, 2009; Collins and Jimenez, 2012; Marino, 2012; Simon, 2012). The recursive production of vulnerabilities-driven by interactions between evolving material conditions and political discourses–reflects the notion that risk policies are an active and performative dimension of the political struggle over resources (Dooling and Simon, 2012; Rebotier, 2012).

2.3. Synthesis Area 3: Constructing narratives about vulnerability through the integration of spatial and historical data

Considerable research has explored vulnerabilities through environmental histories (Orsi, 2004; Ross, 2011), narratives about disasters (Brinkley, 2006; Solnit, 2009), political ecological scholarship highlighting the influence of power asymmetries (Gandy, 2002; Heynen et al., 2005; Boone et al., 2009; Perkins, 2011) and spatial analyses of vulnerable landscapes (Brody et al., 2008; Rahsed and Weeks, 2003; LaMotte and Greene, 2006). While each area has bridged the gap between historical and geographical analysis, the challenge moving forward is to further integrate these bodies of literature and the data they operationalize. Due to differing methodological commitments and epistemological orientations, these fields quite often fail to inform each other; instead, environmental histories and disaster narratives oftentimes prioritize the use of historical data with minimal spatial analysis. Likewise, geographical studies frequently prioritize analyses revealing spatial patterns yet often lack historical insights that

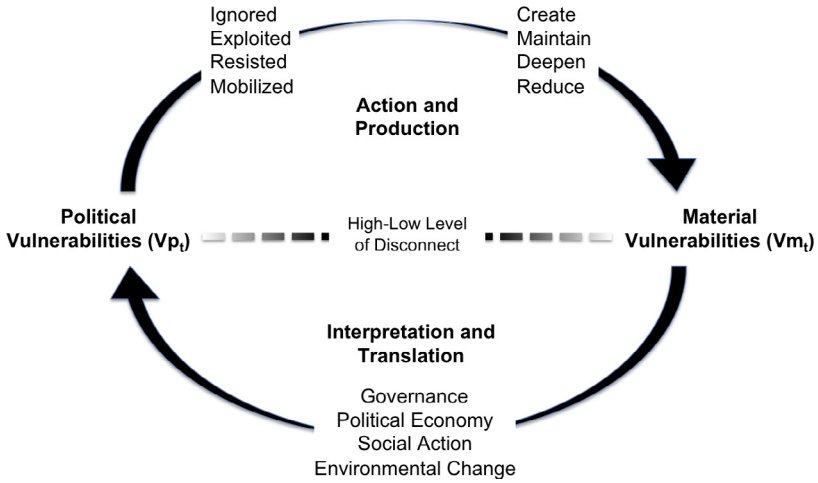

Fig. 1. A material–political framework for assessing vulnerabilities.

would shed light into how those patterns emerged. We suggest that further synthesis of spatial and historical data–that utilizes traditional methods associated with each distinct mode of inquiry–can generate narratives detailing the temporal and spatial dynamics of material and political vulnerabilities.

Fig. 1, above, articulates a conceptual framework that is informed by the first two synthesis areas. This includes highlighting governance structures that influence the translation of material conditions of vulnerability in the political realm. This allows us to identify how power asymmetries operate-through processes of exploitation, mobilization, resistance, and ignorance-to worsen, deepen, maintain or reduce existing vulnerabilities. This conceptual framework also highlights shifting temporal dynamics that are a key component to how we understand the recursive relationships between material and political vulnerabilities, and the spatial connections between two or more vulnerable landscapes. Meanwhile, Fig. 3 presents an analytic approach articulating the integration of spatial and historical data sets from diverse fields of inquiry, including those identified in syntheses area three.

While synthesis of the aforementioned scholarly areas has influenced this research approach, our analysis of contradictions emerging from the dialectics of capital, space and social-environmental change is clearly situated within the traditions of historical–geographical materialism and urban political ecology. Following Harvey (1973, 1996), we leverage dialectical perspectives utilized in urban political ecology to reveal social and environmental changes resulting from discursive and material social relations embedded in a capitalist system (e.g., Collins, 2008, 2010; Keil, 2003; Keil and Desfor, 2004; Heynen et al., 2005; Pelling, 2003; Perkins, 2009, 2011, 2012; Dooling and Simon, 2012; Swyngedouw, 2004).

3. Material–political vulnerabilities framework

Our proposed framework (see Fig. 1) details how material vulnerabilities are interpreted and translated; leading to societal responses that may align with, or diverge from, lived experiences and substantive needs (see O'Brien et al., 2007). Here, vulnerability operates in two forms: (1) as a material condition (Vm_t) defined and substantiated through lived experiences and documented through empirical analysis, and (2) in a political form (Vp_t) where direct experiences of being vulnerable have been interpreted and translated within a sphere of complex governance arrangements, political economic activity, civil society actions and environmental changes. We use subscript t (time) to capture the iterative process through which material and political vulnerabilities evolve. The process of interpretation occurs as material vulnerabilities are given meaning and assigned value by diverse individuals, communities, businesses and institutions which, in turn, influence how vulnerabilities are translated into new, recognizable and actionable forms. The development of policies targeting current and future conditions is deeply political (Vp_t), and may deviate from both experienced and empirically substantiated forms of vulnerability (Vm_t).

Our framework implies a shift from the study of vulnerability as a singular to the careful consideration of interrelated and co-occurring vulnerabilities. Such an approach requires a nuanced interrogation of various modalities of vulnerability: lived, perceived, narrated and political. Mapping the relationships between multiple vulnerabilities requires articulating and explaining clear distinctions between substantive and interpreted forms in the context of prevailing power relations and social-ecological changes.

Significant disconnections may exist between material and political conditions of vulnerability that contribute to a decline in the efficacy of formal policy and informal community responses. Levels of disconnection between the material conditions and political translations of vulnerability depend on a range of variables. High levels of disconnect may arise when those in charge of identifying, framing and responding to the problem have little understanding of, or desire to confront, the perspectives and experiences of vulnerable populations. Low levels of disconnect may occur when those controlling the interpretation process are intimately connected to on-the-ground realities of vulnerable communities–through forms of democratic representation, community outreach or social activism. In any given circumstance, there are multiple and diverse embodied vulnerabilities. As a result, certain groups will consider political vulnerabilities more disconnected from their experiences than others.

We use the general term "action" in Fig. 1 to connote a broad suite of formal and informal responses that characterize decisions and policies related to vulnerability. We propose a typology of responses below that reflect a diversity of strategies, ideas and rhetorical devices for pursuing goals and ideologies (see Fig. 2).

- Ignorance: Responses to material vulnerabilities may proceed through pathways of ignorance. Institutional and community decision making may not recognize conditions of vulnerability because the vulnerabilities are (a) new and/or not clearly defined and recognized as such, (b) not yet produced on the

Categories	Description	Examples
Ignorance	Vulnerabilities unrecognized discounted or disregarded by decision makers	• Not anticipating future vulnerabilities • Not recognizing new and/or not clearly defined vulnerabilities • Inability to engage existing and future vulnerabilities due to constraints • Disavowing and/or accepting vulnerabilities to secure assets
Exploitation	Vulnerabilities produced in order to concentrate benefits for a specific group	• Disempowering vulnerable communities • Taking unfair advantage of vulnerable communities • Producing new vulnerable communities • Worsening conditions in vulnerable communities
Mobilization	Vulnerabilities mobilized rhetorically within policy realm	• Promoting policy inaction to normalize or diminish unacceptable vulnera bilities • Promoting policy action to normalize or diminish unacceptable vulnerabilities • Promoting policy action through mobilization of vulnerabilities
Resistance	Vulnerabilities leveraged through social action by effected communities.	• Reinforcing vulner abilities through social action • Raising awareness about vulnerabilities • Assembling in response to vulnerabilities • Inciting social and political change

Fig. 2. Types of actions facilitating the production of new material vulnerabilities.

ground and/or not anticipated, (c) not considered high-priority concerns worthy of engagement (i.e., accepted–see Beck, 1992) or (d) disavowed–knowing that vulnerability exists yet not proactively responding. The possibility for vulnerabilities to be ignored by various stakeholders underscores challenges associated with confronting uncertain or anticipated developments. It also sheds light on how vulnerabilities considered politically or economically inconvenient may be exploited through blatant denial and intentionally ineffective policy interventions (see Simon, 2012). The "ignorance" category highlights how vulnerability is always operating and 'at play'–whether in the context of unintentional neglect or strategies of deliberate policy inaction.

- Exploitation: Translations of vulnerability in political arenas may produce, leverage and reproduce conditions of marginality and exploitation. Communities are made vulnerable through efforts to situate and maintain social groups in politically or economically disempowered situations. The disempowering effects of political and economic exploitation are crucial to our overall conceptualization of vulnerability as a regressive process. In some situations, policy makers may use the vulnerability of existing community to generate benefits for another group. It is analytically strategic to connect vulnerabilities for certain communities in relation to their counterpart: the augmentation of privilege, and access to desirable and essential resources for other segments of society (see Collins, 2008). In this sense, conditions of vulnerability are exploited (and reinforced) to secure and uphold economic and political gains. The "exploitation" category underscores the difference between marginalized populations being vulnerable, and the marginalizing influence of vulnerability.
- Mobilization: Vulnerabilities can be mobilized strategically to advance political agendas or normalize otherwise unacceptable risks (Beck, 2009, Mehta, 2011). Here, addressing and overturning conditions of vulnerability is less important than generating public concern to further the policy goals, planning objectives and ideological agendas of governments, businesses or community members (see Agyeman and Simons, 2012). The "mobilization" category highlights the instrumentalist use of vulnerability as a rhetorical strategy, while underscoring the relationship between material and symbolic vulnerabilities.
- Resistance: Vulnerabilities may be viewed as conditions and experiences to which social groups and individuals actively respond (Perkins, 2012). While some social actors may reinforce conditions of vulnerability, other groups will seek to chart new development and policy trajectories intended to alleviate or eradicate vulnerable conditions. Resistance includes exposing vulnerabilities (raising awareness), assembling (galvanizing support) and inciting change. As a source of active resistance and not merely as a byproduct of development decisions, vulnerabilities can be viewed as both starting points and ending points in the planning and policy process (Gibson-Graham, 2006). The "resistance" category understands vulnerable populations as acted upon and activated, as a site of harmful development outcomes and new harm reduction initiatives.

4. Spatial–historical analytic approach to vulnerability

Closely examining the relationship between material and political vulnerabilities will be aided by the application of integrated spatial and historical analysis (henceforth, spatial–historical analysis). Spatial–historical analysis begins with relational inquiry that ultimately holds the potential to generate new insights into socio-ecological relationships involved in the creation of and responses to vulnerabilities (see Fig. 3). Data collected and synthesized include sources not conventionally integrated—for

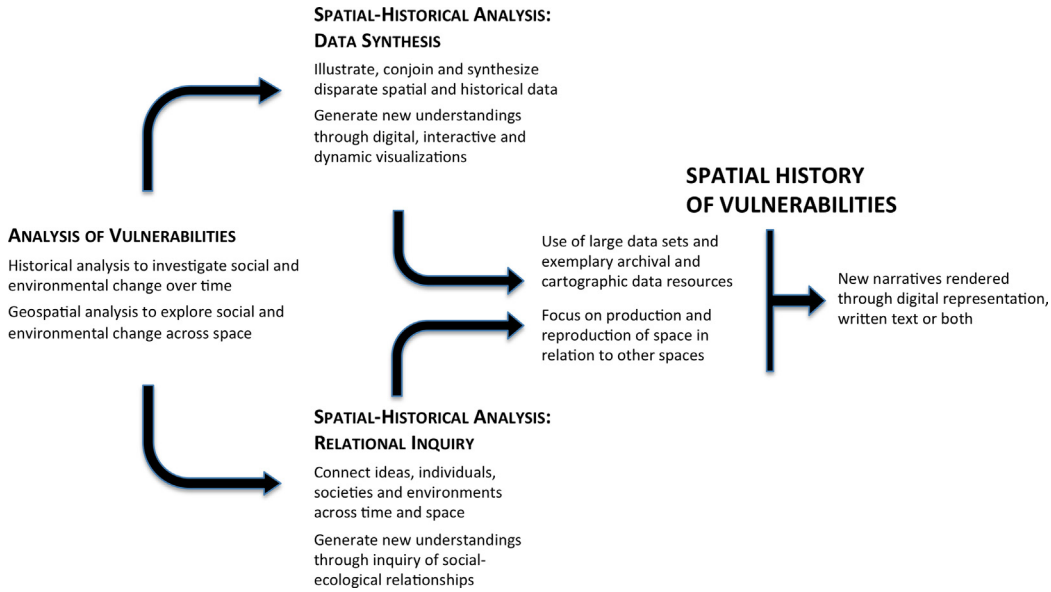

Fig. 3. Analytic approach to constructing narratives of vulnerabilities based on relational inquiry and synthesis of spatial and historical data.

example, census data, cartographic data, photographs, oral histories, land values and housing prices, land cover and land use change data. These data emerge from diverse sources, ranging from large and sometimes unwieldy data sets to unique and exemplary data points, images and quotes. A key focus of this analytic approach is to leverage these data to illuminate the production and re-production of vulnerable spaces in relation to other spaces. Analysis of diverse data sets can lead to the identification of unexpected connections; while extending inquiry longitudinally allows researchers to understand how vulnerable landscapes are connected in time and space through specific relationships that drive social and environmental change simultaneously.

Beginning with Hewitt (1997), Liverman (1990) and Wisner (1993), this body of scholarship identifies how interactions between political economies of resource use and normative planning activities influence which places and populations become vulnerable (e.g., Oliver-Smith, 2002; Cutter et al., 2000; Pelling, 2003; Orsi, 2004; Wisner et al., 2004; Hogan and Marandola, 2005; Collins, 2005, 2008, 2010; Mustafa, 1998, 2005; Dooling and Simon, 2012; Marino, 2012). Collectively, these studies have shown that effective mitigation of vulnerability requires studying what Mustafa (2005) labels dynamic "hazardscapes", through robust assessment of "the cumulative progression of vulnerability, from root causes through to local geography and social differentiation" (Adger, 2006, 272).

Being able to define and describe such hazardscapes is first dependent upon dissolving binaries of human/nature and urban/rural in favor of dedicated relational analysis. This requires embracing: (a) the mutually-constitutive relationship between cities and diverse economies, policies and ecological systems across temporal and spatial scales (e.g., Williams, 1973; Cronon, 1991; Gandy, 2002; Swyngedouw, 2004; Kaika, 2005); (b) the expansive ontological boundaries of urban nature which, as Braun (2005, 642) notes, exist as "material and narrated, ecological and political"; and (c) cities as complex ecological systems governed, to a large extent, by an unremitting commitment to economic growth (Wolch et al., 2001; Keil and Desfor, 2004; Dooling et al., 2006; Heynen et al., 2005; Robbins, 2007; Brownlee, 2003; Perkins, 2009, 2011; Collins and Jimenez, 2012; Muller and Dooling, 2011). Below, the application of a spatial–historical approach–comprised of integrated longitudinal and geographical analysis as well as a commitment to relational inquiry – is animated in relation to the production of vulnerability in a fire-prone landscape.

5. Material and political vulnerabilities in the Oakland hills of California: A spatial history

Each year around the western United States, news reports fill the airwaves with stories of devastating wildfires, shattered communities, lost lives and costly reconstruction efforts. In 2011, the State of California alone witnessed over 5800 separate fire incidents (CalFire, 2012). Similar patterns can be found in other high fire activity regions of the world such as Australia, Greece, Indonesia and many Sub Sahara African nations. These incidents – many of which occur at the wildland–urban interface (WUI)–fan debates among scholars, government agencies and the public over why homes are constructed in such vulnerable landscapes.

Fig. 4. Location of the tunnel fire (Map Credit: Peter Anthamatten).

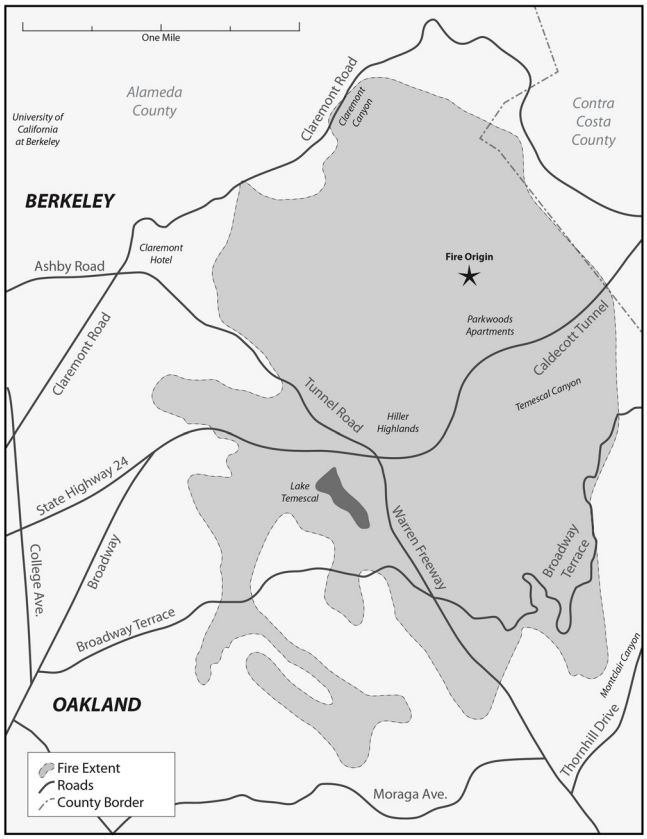

Fig. 5. The tunnel fire area extent, major land features and fire origin. (Map Credit: Peter Anthamatten).

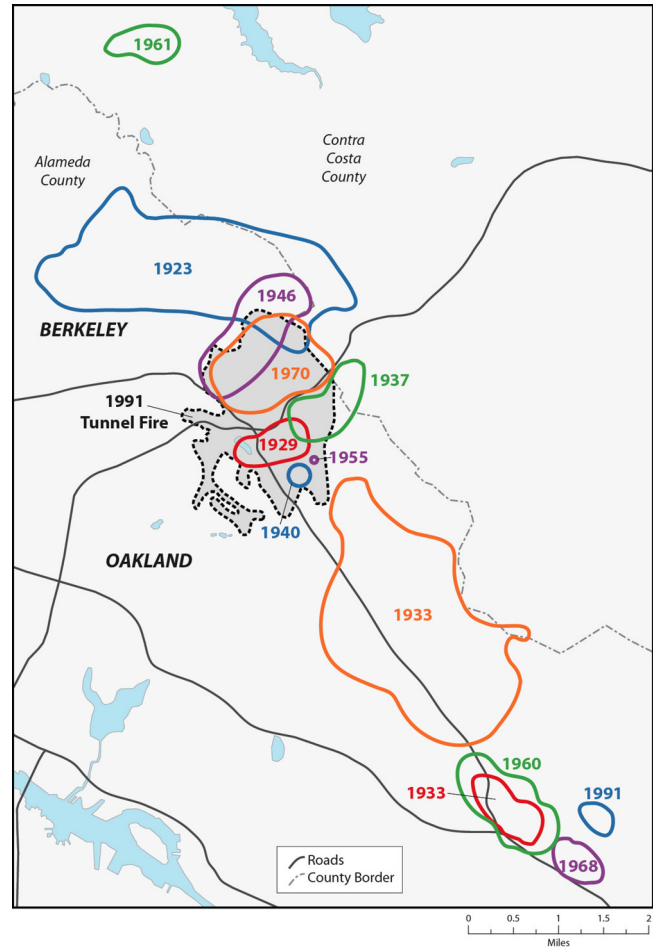

Fig. 6. Periodic fires in the East Bay hills over the past century reveal the persistent threat of conflagrations. (Map Credit: Peter Anthamatten).

The 1991 Oakland Hills Firestorm (henceforth, Tunnel Fire) stands as an exemplary case example. Located just east of the city of San Francisco, California, the Tunnel Fire (see Fig. 4) destroyed more than 3000 homes, killed 25 people and seriously injured more than 150 others during a 24 h period (FEMA, 1992). Over twenty years later, the Tunnel Fire has left a lasting legacy in the region as the largest wildfire-in terms of numbers of dwellings destroyed-in California's modern history (see Fig. 5). This is a dubious distinction given California's long history of frequent and intense WUI firestorms.

It is precisely this history of persistent conflagrations that raises questions about land use planning efforts in the area. Fire regime analysis of the Oakland hills region dating back to 1900 indicates the area has experienced a high frequency of wildfires (see Fig. 6). Between 1900 and 1991, for example, 12 fires were recorded in the hillside area of Berkeley and Oakland–a swath of land immediately surrounding the site of the Tunnel Fire (Simon, 2012). Given this history, why were residential communities built in such high-risk fire areas?

In order to explain the contradictory proposition of placing homes in fire-prone areas, one must first understand that the Tunnel Fire, like so many other global WUI fires, is closely connected to policies, landscapes and vulnerabilities across time and space. A longitudinal examination of developments in the Oakland Hills area reveals that the production of fire vulnerability is deeply intertwined with a number of development policies and land use practices in the city of Oakland and throughout California. The story of the Tunnel Fire reminds us how disaster events are always part of larger processes of economic development and natural resource management. Moreover, understanding the production of vulnerability requires highlighting the persistent disconnection between political and material vulnerabilities. We illustrate how, in the context of the Tunnel Fire, this disconnection has been generated and worsened through policies of ignorance, exploitation, mobilization and resistance. Moreover, these disconnections are shown to contribute to the production of interrelated vulnerabilities within flatland regions of Oakland.

Below, we use four narratives to generate a spatial history of vulnerabilities emphasizing the historical planning and policy context of vulnerability to the 1991 Tunnel Fire while also highlighting the stark difference between vulnerability as a material condition and political translation. These four storylines by no means represent the totality of factors influencing levels of risk for urban residents in the area. Other notable factors include the influence of unrelenting regional suburban sprawl (Cova et al., 2004), fire suppression in nearby wildland landscapes (e.g., Cohen, 2008; Pyne, 2008), extended periods of low humidity and prevailing dry winds (Westerling et al., 2003), and coordination deficiencies between citizens and local and regional fire prevention and mitigation agencies (e.g., Stephens et al., 2009). While many explanatory variables are not described here, our analysis does advance an understanding of the complex and political processes facilitating the production of vulnerability in WUI environments. Moreover, a spatial–historical approach also recognizes that factors generating vulnerability in the Tunnel Fire area contribute to and reinforce vulnerabilities throughout the rest of Oakland. See Fig. 7 for an overview of the recursive relationship between material and political vulnerabilities across temporal and spatial scales.

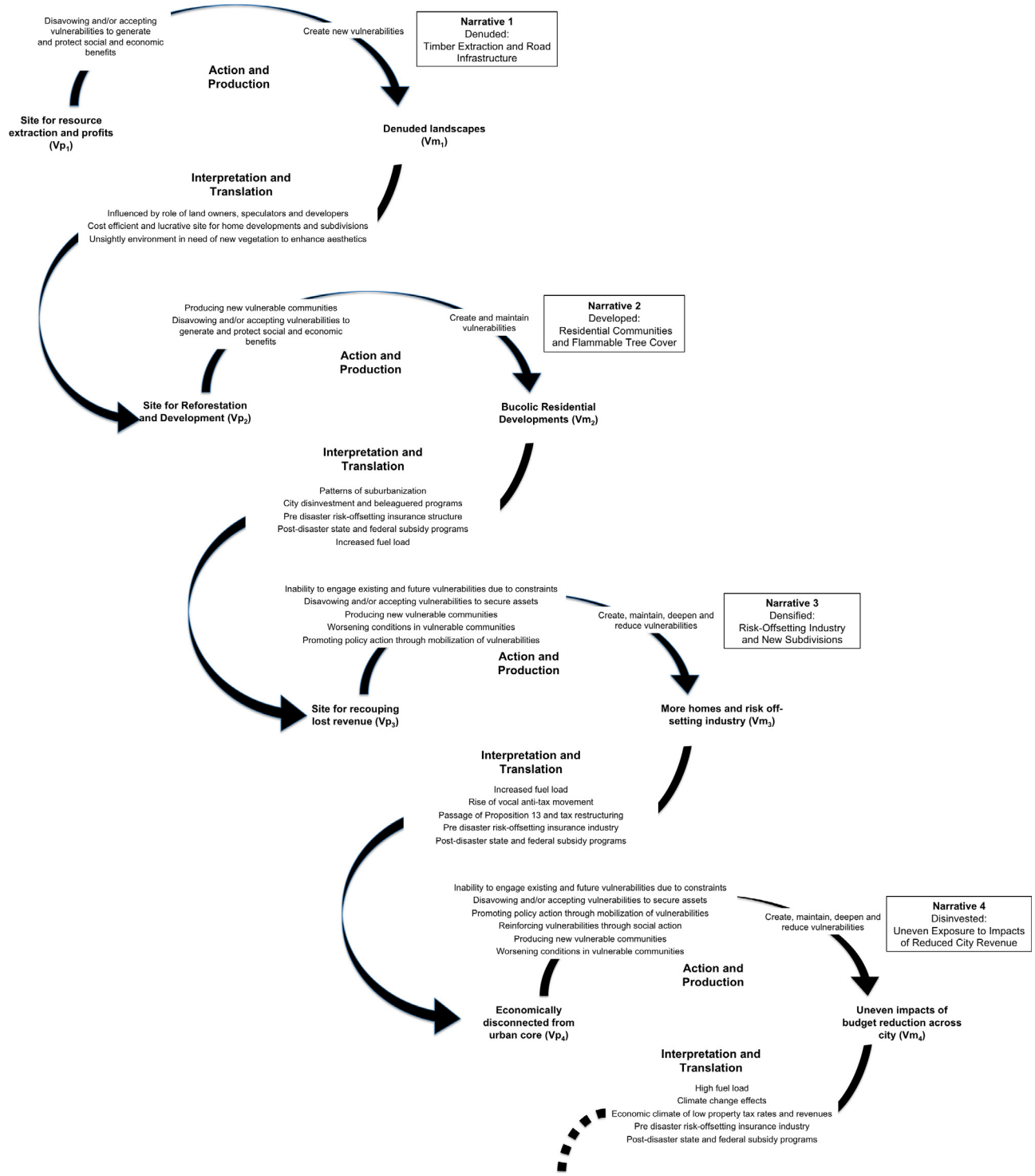

Fig. 7. Overview: the production of vulnerability in Oakland, CA as a cascading and recursive process.

5.1. Denuded: Timber extraction and road infrastructure

As early as 1840, a trajectory towards increased vulnerability took hold in the Oakland hills. (See overview of Narrative 1 in Fig. 7.) For landowners, lumber speculators and city officials, this area was perceived as a resource rich landscape capable of generating considerable revenues through large-scale timber extraction. Clear-cutting of redwood trees (*Sequoia sempervirens*) "as tall as 300 feet and as wide as 32 feet" were felled and hauled to shipping points and sent to assist construction activities in San Francisco and Oakland during the region's Gold Rush boom cycle of the mid 1800s (Bagwell, 1982, 15). Ironically, much of this lumber was used to replace structures and resurrect portions of the burgeoning city of San Francisco that had burned during major fires in 1850 and 1851.

The immense profit potential of these forests is reflected in commercial redwood lumber prices that rose steeply from $30/1000 board feet in 1847 to upwards of $600 in 1849 (Bagwell, 1982). By 1852, there were four steam sawmills operating in the Oakland Hills; and by 1860, scarcely a tree remained (City of

Oakland, 1996). Cattle grazing and various farming activities including wheat and hay production ensued during subsequent decades–an emerging set of land use practices that utilized the denuded landscape now free of coast live oak (*Quercus agrifolia*), redwoods and other native riparian woodlands.

For its ability to generate valuable timber (and later, mineral and agricultural resources) the Oakland hills stands as a productive resource extraction zone supporting frenzied construction activities in the San Francisco Bay Area during its gold rush economic ascendance. Views of the Oakland hills emphasizing profitable resource extraction (Vp_1) produced a dramatically different environment by the 1880s: a material landscape notable for its denuded slopes, erodible soils and desiccated landscape (Vm_1).

Just as importantly, this was a region containing the transport vestiges of a formerly intensive timber industry, including graded logging roads that would eventually provide cost-efficient points of entry into the hillside. This crude road infrastructure, several years later, fell under the speculative eye of housing developers in search of suburban homes and vacation retreats for the region's new elite. In fact, many current day roads in the Oakland hills fire area originally served as timber haul roads connecting logging sites to the Oakland Estuary and into the broader Bay Area growth economy. Fig. 8 illustrates how, for example, "several other East Bay roads (including present day Claremont Road and Thornhill Drive) also began as logging roads" (Bagwell, 1982, 18). While many of these pathways have been significantly modified, most

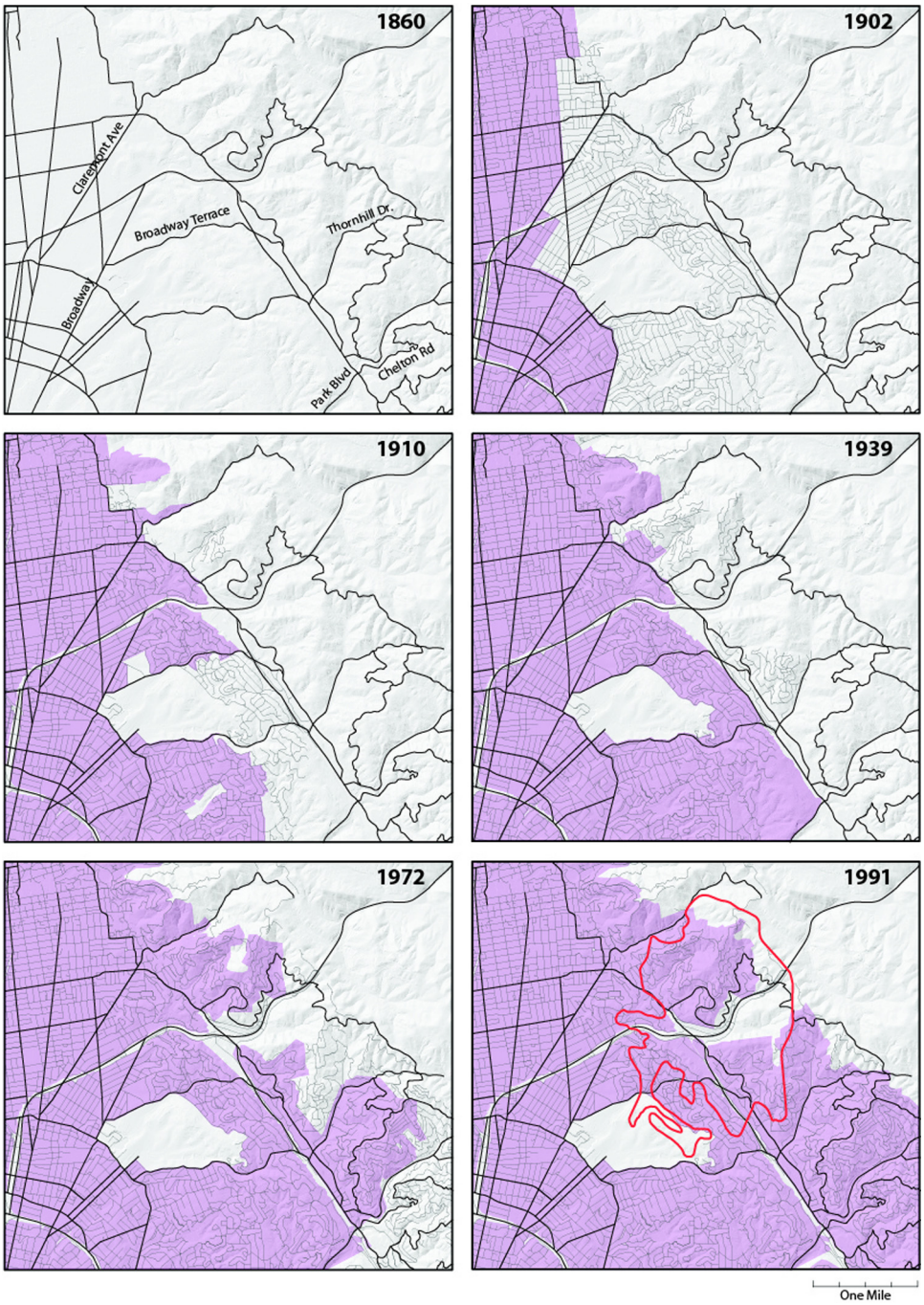

Fig. 8. Map sequence illustrating development of road and home construction in the City of Oakland. Real estate developers utilized early logging roads in subsequent decades as pre-established and cost efficient points of entry into the hillside. Magenta shading indicates extent of home development, which generally follows road construction. (Map Credit: Peter Anthamatten and Eric Ross). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of the article.)

remain in the same graded location as they existed during the mid to late 1800s. Early in the development of the Oakland Hills area we are able to see how vulnerability, as Adger (2006) notes "does not exist in isolation from the wider political economy of resource use" (p. 270).

5.2. Developed: residential communities and flammable tree cover

A transition from resource extraction to real estate speculation was facilitated by the presence of crude road infrastructure in Oakland. (See overview of Narrative 2 in Fig. 7.) The City of Oakland and local banks providing loans to public service corporations held a favorable view of road and public infrastructure financing decisions that reduced outlay costs. The graded and reinforced logging roads provided relatively easy access possibilities for developers and, in a matter of decades, were converted into arterial roads populated by municipal infrastructure, flammable tree cover and a vast collection of new and highly vulnerable home developments.

Faced with barren hill slopes and a network of former logging roadways (Vm_1), large landowners and powerful property developers set their sights on the region as a site for reforestation and profitable home developments (Vp_2). As early as the 1880s, massive tree planting ensued, including vast swaths of tree species such as cypress, acacia, eucalyptus and pine. Figs. 9 and 10 depict the denuded landscape confronting initial settlements and subsequent reforestation efforts. From 1885 to 1893, the California State Forestry Board populated hillside areas with quick growing eucalyptus (*Eucalyptus globulous*) trees. Between 1910 and 1913, prominent landowners in the region, planted approximately 3 million more non-native eucalyptus and Monterey Pine (*Pinus radiata*) seedlings along the region's hill slopes. Eucalyptus trees were initially planted for commercial lumber speculation due to their purported wood quality.

Fig. 9. Intensive logging during the mid 1800s left much of the Oakland Hills area void of tree cover. The homestead of well-known essayist Joaquin Miller (1886) sits in the foreground. (UC Berkeley Bancroft Library).

Fig. 10. By 1913 the environment around the Miller homestead and much of the Oakland Hills changed considerably. Non-native and ornamental species can be seen around the property. (UC Berkeley Bancroft Library.).

During the next several decades, the fast growing eucalyptus indeed proved to be a hearty species tolerant of high winds, shallow soils and seasonal drought conditions (Tyrell, 1999). Unfortunately for the timber industry, the tree species was a poor source of construction-worthy lumber due to its interlaced wood fibers and irregular grain. Despite having low construction utility, the Eucalyptus served a crucial development purpose by increasing land values along unsightly barren slopes and by generating a bucolic residential environment suited for affluent members of the San Francisco and east bay business class (Nowak, 1993). Following these successful Eucalyptus and Pine plantings, directors of the powerful Realty Syndicate noted, "the increased value their holdings would have if plentifully timbered" (Oakland Tribune, 1923). The Mahogany Eucalyptus and Land Company, which dominated local property holdings at the turn of the 19th century noted that, "This tree at this particular moment is in many instances the most valuable one on the face of the globe. . .The Company now sees plainly that it possesses a source of emolument higher than that of the average gold mine" (O'Brien et al., 2007, 2).

By the early 1900s, this newly forested hillside landscape began to fulfill its intended development potential as a number of housing subdivisions quickly colonized the area. The financial benefits for property owners were dramatic. In 1906 the assessed value of undeveloped real estate in the fire area was $250/acre. By 1911, and after only two years of market exposure, these same properties had experienced a twelve-fold increase in adjusted value (Laymance Real Estate and Company, 1911, 263). These increases rose steadily over the next several decades (see Fig. 12 below).

Reforestation efforts assisted in the transition of the North Hills region from "a lumbering center" to "a residential area best known for its spectacular views, forested character, winding streets, and hillside architecture" (City of Oakland, 1998, 205). In 1923, for example, the Oakland Hills witnessed a 900% increase in home construction over the previous five years (Bagwell, 1982). If Redwoods helped to construct a burgeoning San Francisco Bay Area during the 1850s, Eucalyptus and Monterey Pine plantings at the turn of the century assisted the construction of a suburban respite from the hustle-bustle of San Francisco's now frenzied business environment.

These developments heightened levels of vulnerability through the introduction and maturation of property value enhancing tree cover comprised, to a large extent, by flammable Eucalyptus and Monterrey Pine species. According to a Federal Emergency Management Agency (FEMA) report issued after the Tunnel Fire, Eucalyptus and Monterrey Pine are "highly vulnerable to rapid fire spread" because they "release massive amounts of thermal energy when they burn. They also create flying brands, which are easily carried by the wind to start new spot fires ahead of the fire front" (FEMA, 1992, 7). Five years prior to the Tunnel Fire, *The North Oakland Hill Area Specific Plan* mentioned that, "In addition to naturally-occurring fires, the potential for accidental fires has increased as a result of. . .plant species such as eucalyptus and highly flammable ornamental vegetation" (City of Oakland, 1986, 112). According to the historian Jared Farmer (In Press, 10), Eucalyptus "covered some 20 percent of the fire area. . .The trees hardly caused the fire, but they did add to its intensity."

Moreover, the housing stock itself added substantially to the region's fuel load thereby increasing the potential size and intensity of fires in the area. As an East Bay Regional Park District's report notes, "many structures that exist within the interface are wood-framed or have wood shingles further increasing the complexity of wildfire risks...homes generally present fires with densities of flammable materials that are much higher than the surrounding wildlands" (LSA Associates and Inc., 2009, 13). In the decades to follow this area would go on to experience a high number of large and costly wildfires (see Fig. 6). By WWII, a new set of hillside material vulnerabilities was firmly established in the form of bucolic neighborhoods, narrow curvilinear roads, a vast network of wooden home structures and a dense and flammable tree cover (Vm_2).

5.3. Densified: Risk-offsetting industry and new subdivisions

In the decades to follow, a second powerful force deepened conditions of vulnerability in the Oakland hills: post-WWII suburbanization and federal disinvestment in metropolitan core areas. (See overview of Narrative 3 in Fig. 7.) During this period, urban peripheries throughout California received substantial levels of public and private investments to attract homeowners, industry and financial capital. These investments marked a redistribution of wealth, property values and tax revenues that directly undercut the economic best interests of core cities like Oakland whilst increasing economic growth and livability in suburbia. This process was driven by large government subsidies in the suburban housing market and a growing coalition of construction entrepreneurs and suburban city boosters. Through federal urban policy retrenchment and market forces, the urban periphery was converted into various forms of capital: increased property values for homeowners, direct profits for developers, and taxes for public agencies (Self, 2003). The result of regional suburbanization during this postwar period was manifest in the rapid development of suburbia and the decline and/or stagnation of public programs, property values and city revenues in Oakland.

Government retrenchment in the City of Oakland during the 1950s and '60s led to a planning response notable for its pursuit of revenue equalization. The hills area thus became a site for recouping lost city revenues through the development of new hillside housing subdivisions (Vp_3). Beginning in the late 1950s, city builders in Oakland erected hundreds of high-density residential units in historically high fire danger areas. The Hiller Highlands Complex, Parkwoods Apartments and other new developments in Oakland's hillside areas (see Fig. 5) were constructed, in part, as a response to the reorientation of public and private finance towards metropolitan peripheries. As intended, new home subdivisions generated substantial income for the city, particularly due to their placement in hillside locations containing high property values and tax revenue potential (Chapman, 1998). Unfortunately, but not unsurprisingly, these expansive condominium developments, located at the Tunnel Fire epicenter, were the first units to be destroyed by the 1991 conflagration.

Local planning documents at the time supported this revenue replacement strategy, suggesting that "given the assumed value of new homes in the North Oakland Hills Area, and the significant level of property taxes generated, the net fiscal impact of development on public services is positive..." The plan goes on to note that this net fiscal benefit to the city of Oakland holds true "...unless an attempt is made to operate a new fire station" (City of Oakland, 1986, 122). Here, City officials seem to indicate that tax revenues from new housing developments in the Oakland Hills can have a positive fiscal impact on the city, but that net revenues will only increase without the construction and maintenance of a new fire station to serve the area.

In a stark paradox, this means that populating the hill slope to overcome beleaguered city budgets requires not only intentionally placing homes within a landscape historically vulnerable to frequent wildfires, it requires doing so without additional fire protection. As city planners in the same report soberly note, "New residential development will significantly increase the potential for loss of life and damage to property from fire hazards in the North Oakland Hills, especially given the poor accessibility" (City of Oakland, 1992a, 122). The ripple effect of city disinvestment and lost revenues is clear: the construction of more households with less fire protection in high fire risk areas.

The acceptance of high fire danger by these hillside residents is buoyed by a multi-level system of fire risk subsidization (see for example, Davis, 1998; Wolch et al., 2001). This structure of vulnerability-offsetting is maintained, to a large extent, by an expansive insurance industry supporting loss indemnification. If residents can afford the cost of comprehensive fire insurance–such as guaranteed replacement cost plans–they can effectively pay for the ability to live in highly vulnerable areas. Along with insurance coverage, a tiered structure of post-disaster redevelopment policies also facilitates the reduction of risk. Immediately after the Tunnel Fire, for example, the State of California paid an estimated $15 million to local governments in the form of public disaster assistance. This included payments directly to city governments, loans to owner-occupied and rental properties, individual and family grants and homeowner property tax deferrals. Meanwhile, federal grants were issued for an estimated $42 million to state and local governments to recover these and other incurred costs (State of California, 1991). By the late 1970s a new landscape of material vulnerabilities emerged (Vm_3), comprised of high-density housing units and a multi-level system of fire risk subsidization which reduced, but did not eliminate, various forms of vulnerability for hillside residents.

5.4. Disinvested: Uneven exposure to impacts of reduced city revenue

Another important driver of increased vulnerability emerged during the 1960 and '70s in the form a powerful anti-tax movement seeking to change preexisting California tax revenue structures. (See overview of Narrative 4 in Fig. 7.) Rapidly growing real estate values, rising inflation rates and elevated private property taxes gave rise to this homeowner-driven "tax revolt." In 1978, and after several decades of campaigning, public sentiment across California was put to the vote in the form of Proposition 13. The tax revolt initiative won overwhelmingly 64.8% to 35.2%, leading to the passage of the nation's first comprehensive tax limitation measure. The effects of Proposition 13 and subsequent changes to the State's taxation and revenue collection system were nothing short of profound for California's city economies. The Proposition set maximum tax rates at 1% of total property value, and restricted maximum increases in assessed value to 2% from one year to the next. Of even greater consequence, its passage mandated that property could only be revalued under a transfer of ownership.

Voting patterns for the Proposition were not equal across all cities. In Alameda County, suburban cities approved the measure with more than 70% of the vote; while the residents of Oakland rejected the measure with 52% (see Fig. 11) This voting pattern underscores an emergent post-war development sentiment around the state and nation: a desire by fast growing suburban populations to substantially detach their city investments, tax revenues and wealth from core urban areas. The impact on Oakland was particularly dramatic as the city contained aging

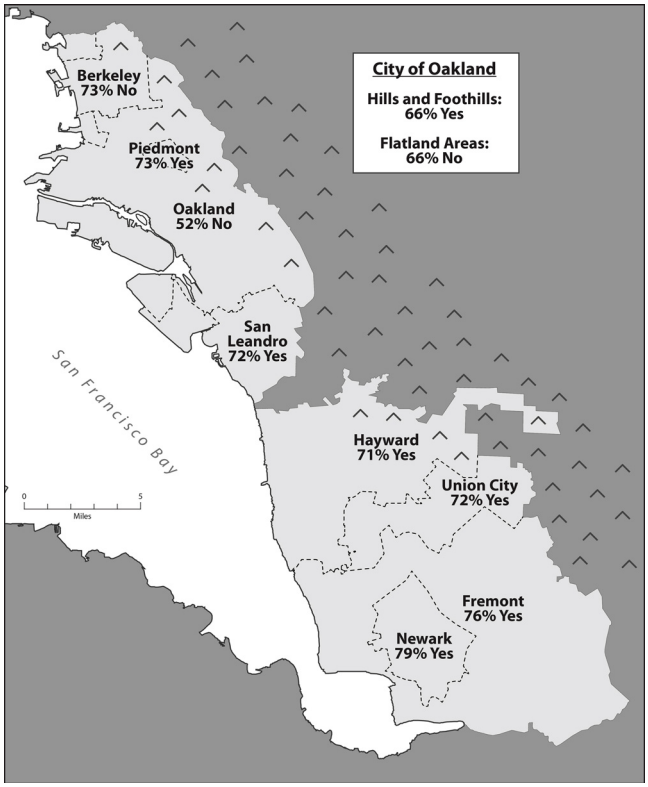

Fig. 11. California Proposition 13 voting outcomes in Oakland and its suburban neighbors in 1978. (Adapted from Self, 2003. Map Credit: Peter Anthamatten).

infrastructure, a large working class population and sizable public works programs.

Members of the Oakland hills community (who voted 66% in favor of the Proposition), like suburban residents, largely perceived hillside and other outlying areas as separate and economically disconnected from metropolitan core areas (Vp_4). Indeed, the passage of Proposition 13 was, ostensibly, a rebuke of public expenditures in older city segments far removed from the wealthy, suburban homeowner tax base. This sentiment contributed to disinvestments with unmistakable impacts on the Oakland Fire Department. Prior to Proposition 13, revenues from city property taxes in California were almost entirely earmarked for city expenditure items. For example, at the time of Proposition 13s passage, 90% of Fire Department budgets in California were funded through local property tax revenues (Brownlee, 2003, in Self, 2003). After the measure's passage, local property tax revenues witnessed a 53% reduction (Ross, 2011). By the 1990s, the proportion of city revenues drawn from property taxes had decreased to 8% within the state. This decline is evident at the county level as well. Prior to Proposition 13, counties in California drew 33% of their revenue from property taxes. By the 1990s that number decreased to a mere 10% (Chapman, 1998).

Sharply reduced city tax revenues resulted in underfunded fire response, mitigation and retrofitting programs throughout Oakland (Self, 2003); this despite efforts to supplement budgets through price systems comprised of fees and charges. According to FEMA, the Oakland hills were "particularly vulnerable in the fall of 1991, after 5 years of drought, several months with no recorded precipitation, and reduced efforts to control wildland interface fires due to State and local budget limitations" (1992, 2). The report goes on, "before budget reductions in the 1970s and 80s, [The Oakland Fire Department] was recognized as one of the strongest fire suppression departments in the western United States. The budget limitations reduced the number of companies in service and the staffing on each company. Several stations were closed during this period" (ibid, 50). Moreover, it is well documented that damaged and dead trees pose a significant fire risk. A deep freeze in 1972 and 1990 harmed numerous Eucalyptus groves and contributed to the formation of highly flammable land cover. Yet, according to the Oakland General Plan, budget reductions led to conditions where "the City lacks the funds to completely restore its damaged or dead vegetation" (City of Oakland, 1996, 38).

Still further, by the 1980s the Oakland Fire Department increasingly relied on a regional network of response agencies. This model of shared governance is exceedingly more cost efficient for participating municipalities than fully staffed, autonomous units. And yet, this interagency structure had its own notable shortcomings, particularly in the face of a conflagration the size and intensity of the Tunnel Fire. Communication breakdowns and technological incompatibilities rendered the hillside community under-protected. According to a State of California (2001) report, during the Tunnel fire "nozzle hook-ups for Oakland. . .actually had a smaller size than the other districts. So, when firefighters came from areas, they could not plug into the Oakland hydrants." The report goes on, "Communications broke down. They could not communicate with one another adequately because the radios were on different wave lengths. . .It was pretty much chaos" (12). Along with technical and communication incompatibilities, many of these coordinating agencies were themselves undergoing similar operational constraints from budget cuts (Pincetl et al., 2008). The Tunnel Fire illustrates how the citizens of Oakland had become increasingly dependent on, yet ultimately underserved by, this interagency response structure.

Up to this point, we have viewed vulnerability almost entirely as a series of hillside manifestations, characterized by enhanced fire risk due to a rapid increase in total fuel load, higher numbers of residential units and impaired fire fighting capabilities. While these landscape changes are extremely important, there exist other important and interrelated vulnerabilities within the rest of Oakland. To be clear, residing in these hillside areas presents very real risks for community members–including loss of life, personal injury and damage and/or loss of irreplaceable items, heirlooms and keepsakes. Yet, the presence of risk-offsetting policies has led many, including Rodrigue (1993), to suggest that although hillside residents live in fire-prone areas, they hold a lower level of net vulnerability when compared with less privileged residents in flatland areas. Poorer city residents who cannot afford comprehensive insurance premiums (and are thus rendered insufficiently indemnified) disproportionately feel the acute consequences of elevated fire vulnerability, resulting in a landscape comprised of individuals with highly differentiated abilities to ". . .anticipate, cope with, resist, and recover from the impact of a natural hazard" (Blaikie et al., 1994, 9 emphasis added; see also Mustafa, 2005, 566). Post-WWII anti-tax homeowner politics, when coupled with insurance and government risk reduction measures helps illustrate "why hazards affect people in varying ways and why people experience disasters differently" Ray-Bennett (2007, 420).

The effects of city revenue curtailment for flatland residents extend beyond reduced fire prevention, mitigation and household response capabilities. Financial hardships and reduced welfare are also influenced by declining support for public programs related to education, environmental health, psychological services, and childcare, among many others. Moreover, the impacts of disinvestment run across generational lines and thus disproportionately affect new and immigrant households who must buy into newly reassessed properties with adjusted (i.e., higher) property tax rates (Ross, 2011). Tax restructuring has led city officials to pursue alternate income streams including elevated sales tax rates. Many have argued, however, that sales taxes are regressive, and disproportionately impact lower income families who spend a

larger portion of their salary on household staples (e.g., Gale et al., 1996; Greenwood and Brown, 2003). Similarly, state and local budgets have become more reliant on income taxes for revenue, which can experience greater volatility during budget crises and economic downturns (Gamage, 2009).

This narrative section illuminates how diverse vulnerabilities (Vm_4) in flatland areas are influenced by the perception amongst many that hillside (and other suburban) areas should remain fiscally detached and insulated from the economic burdens of the metropolitan core (Vp_4). Here, flatland residents experience elevated vulnerability to fires as a result of (a) decreased fire prevention and mitigation services and (b) reduced capacity, for many households, to recover losses due to unaffordable comprehensive insurance plans. Adding to the burden are (c) other potential acute impacts of city revenue curtailment as responsibility for balancing city budgets is shifted onto household income and expenditure activities.

5.5. Connecting developments and vulnerabilities across time and space

After nearly 150 years of community and regional development, perhaps the most acute burden of risk to urban fires and reduced city spending besets flatland community members receiving only attenuated benefits from the region's land use history, lucrative real estate developments and skyrocketing property values. Fig. 12 shows how the financial dividends of homeownership in Oakland are disproportionately higher in hill areas and, in particular, in the area of the city impacted by the 1991 Tunnel Fire. Here, analysis of 70 years of census data reveals that median property values have increased from under $100,000 in 1940 to about $900,000 in 2010 while increases in flatland areas grew more modestly from nearly $60,000 to roughly $400,000 over the same period. Moreover, the most dramatic increases in home value occur in areas comprised predominantly by white residents, while segments of the city with higher minority populations have experienced considerably lower increases in home value.

Dedicated spatial–historical analysis reveals that these bifurcated development trajectories and levels of vulnerability are deeply intertwined. Resource extraction and subsequent real estate speculation activities contributed to the production of affluent communities and a "Mecca toward which the successful Californian turns..." (Laymance Real Estate and Company, 1911, 261). These turn-of-the-century sylvan neighborhoods were generated through the introduction of wooden structures, property enhancing replacement tree cover and other amenities–all of which increased levels of

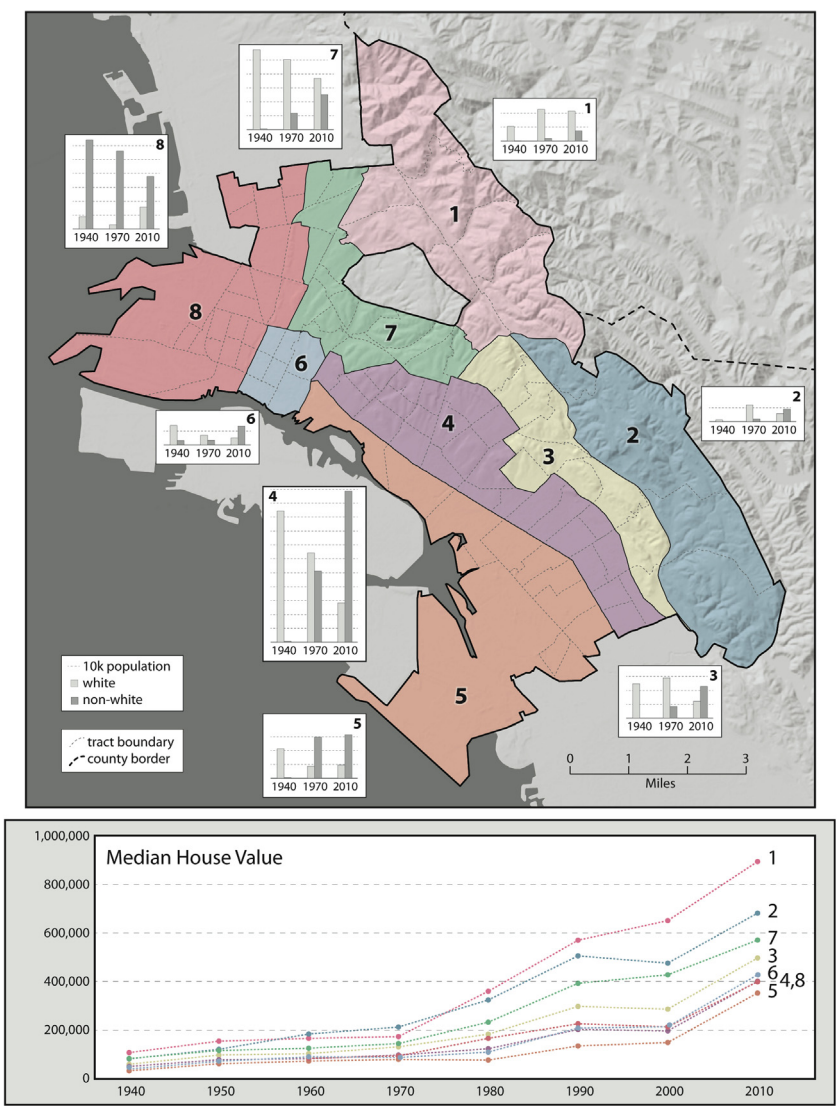

Fig. 12. Change in home values from 1940 to 2010 in Oakland. (Map Credit: Peter Anthamatten and Alejandra Uribe) (For interpretation of the references to color in this figure legend, the reader is referred to the web version of the article.).

fire vulnerability. Several decades later, the passage of Proposition 13 dismantled structures of revenue redistribution in a manner conforming to social stratification and real estate value disparities across Oakland. Voting patterns thus reinforced the divergent development trajectories that were first established under early land speculation activities a century earlier. Support for Proposition 13 and resulting citywide revenue losses were rationalized and accepted by hillside residents in part because of the presence of vulnerability offsetting pre- and post-disaster policies. This narrative illustrates the production of vulnerability as a series of cascading effects where perceptions of landscapes and vulnerabilities (Vp_t) contribute to the rise of new material vulnerabilities (Vm_t), which are in turn interpreted in the political sphere to generate new actionable conception of vulnerable landscapes.

The case of the Tunnel Fire presents an opportunity to animate the historical production of vulnerability by illustrating why disparate land values exist and how they contribute to and reinforce (through subsequent voting patterns) levels of vulnerability resulting from chronic city disinvestments. Our analysis demonstrates the political ecological nature of vulnerability-in-production–where the allocation of estate-based financial benefits and levels of net vulnerability are deeply intertwined, and unevenly distributed. Spatial histories of vulnerability means recognizing that factors generating vulnerability in the Tunnel Fire area contribute to and maintain vulnerabilities throughout the rest of Oakland. These are critical insights generated by the dedicated application of integrated spatial–temporal analysis to vulnerability.

6. Conclusion

A spatial history of the Oakland Hills illuminates and connects an expanded typology of vulnerability drivers and discontents. The impacts of these historical processes are shown to have traumatic consequences in terms of life, property, and the welfare of diverse city communities. The specific narrative of the Tunnel Fire demonstrates the recursive production of vulnerabilities across space and raises larger questions about how vulnerabilities are produced, re-produced and responded to: Who is vulnerable? How are vulnerabilities produced over time? How are vulnerabilities connected spatially? Which policies mitigate and reduce harms experienced by humans and the landscape? Which policies reverse the production of vulnerabilities? What are the dialectics of capital, space and socio-ecological change? Narratives that are constructed in response to such questions highlight the complexities, contradictions and connections that continue to support the production of unevenly distributed gains for a few while undermining longer-term stability for others.

The spatial–historical approach can be applied to a diversity of topics – including climate change, natural hazards, food insecurity, poverty, or reduced fiscal capacity in cities. In advocating for spatial history narratives, this paper argues for the development of more robust conceptualizations of vulnerability: as condition and process, as material and rhetorical, as temporally and spatially dynamic, and as comprised by a multiplicity of relationships that connect diverse people and landscapes. We strongly suggest the continuation of scholarship that translates the abstract concepts of contradictions, discourse, dialectics, materiality, production, and re-production into recognizable forms of risk, harm and vulnerability; the analysis of which can be used to inform development decisions and the governance of human-environment relationships. Understanding the recursive production of vulnerabilities, we contend, will assist in strategizing towards economically vibrant, culturally diverse, ecologically healthy, and socially just urban environments.

Acknowledgments

Thanks to the Spatial History Lab at Stanford University for their generous support of this project. We would also like to thank four anonymous reviewers and the Editor for the very insightful comments on previous drafts.

References

Adger, W.N., 2006. Vulnerability. Global Environ. Change 16 (3) 268–281.
Agrawal, A., Lemos, M., Orlove, B., Ribot, J., 2012. Cool heads for a hot world – social sciences under a changing sky. Global Environ. Change 22, 329–331.
Agyeman, J., Simons, B., 2012. Reimagining the local: Scale, race culture and the production of food vulnerabilities. In: Dooling, S., Simon, G. (Eds.), Cities, nature and development: the politics and production of urban vulnerabilities. Ashgate Publishing Group, Farnham.
Bagwell, B., 1982. Oakland: The Story of a City. Presidio Press, Novato, CA.
Beck, U., 1992. Risk Society: Towards a New Modernity. Sage, London.
Beck, U., 2009. World at Risk. Polity Press, Cambridge.
Beymer-Farris, B.A., Bassett, T.J., 2012. The REDD menace: resurgent protectionism in Tanzania's mangrove forests. Global Environmental Change 22 (2) 332–341.
Blaikie, P., Cannon, T., Davis, I., Wisner, B., 1994. At Risk: Natural Hazards Peoples' Vulnerability and Disasters. Routledge, London.
Boone, C., Buckley, G., Grove, J., Chona, S., 2009. Parks and people: an environmental justice inquiry in Baltimore, Maryland. Ann. Assoc. Am. Geogr. 99 (4) 1–21.
Bohle, H.G., Downing, T.E., Watts, M.J., 1994. Climate change and social vulnerability: toward a sociology and geography of food insecurity. Global Environmental Change 4, 37–48.
Braun, B., 2005. Writing a more-than-human urban geography. Prog. Human Geogr. 29, 635–650.
Brinkley, D., 2006. The Great Deluge: Hurricane Katrina, New Orleans and the Mississippi Gulf Coast. Harper Perennial, New York, New York.
Brody, S., Zaharan, S., Grover, H., Vedlitz, A., 2008. A spatial analysis of local climate change policy in the United States: risk, stress, and opportunity. Landscape Urban Planning 87, 33–41.
Brownlee, E. 2003. "California Taxes: Historical Roots" and "The Property Tax: Will it Survive?" Brief on Proposition 13 prepared by Assembly Committees on Local Government and Revenue and Taxation, IGS.
CalFire. 2012. http://cdfdata.fire.ca.gov/incidents/incidents_stats?year=2011. Accessed 18.07.12.
Chapman, J., 1998. Proposition 13: Some Unintended Consequences. Public Policy Institute of California, San Francisco, California.
City of Oakland, 1986. North Oakland Hill Area Specific Plan. The Oakland City Planning Department, Oakland, California.
City of Oakland, 1992a. The Oakland Fire Department's Response to the Office of Emergency Service Report: The East Bay Hills Fire or October 20, 1991. Office of the Fire Chief, Oakland, California.
City of Oakland. 1996. Open Space Conservation and Recreation (OSCAR). An Element of the General Plan.
City of Oakland. 1998. Envision Oakland. An Element of the General Plan.
Cohen, J., 2008. The wildland urban interface fire problem: a consequence of the fire exclusion paradigm. Forest 21, 20–26.
Collins, T., 2005. Households, forests, and fire hazard vulnerability in the American West: a case study of a California community. Global Environ. Change B: Environ. Hazards 6 (1) 23–37.
Collins, T., 2008. The political ecology of hazard vulnerability: marginalization, facilitation and the production of differential risk to urban wildfires in Arizona's white mountains. J. Political Ecol. 15, 21–43.
Collins, T., 2010. Marginalization, facilitation, and the production of unequal risk: the 2006 Paso del Norte floods. Antipode 42 (2) 258–288.
Collins, T., Jimenez, A., 2012. The neoliberal production of vulnerability and unequal risk. In: Dooling, S., Simon, G. (Eds.), Cities, nature and development: the politics and production of urban vulnerabilities. Ashgate Publishing Group, Farnham, UK, pp. 49–68.
Cova, T., Sutton, P., Theobald, D., 2004. Exurban change detection in fire-prone areas with nighttime satellite imagery. Photogram. Eng. Remote Sens. 70 (11) 1249–1257.
Cronon, W., 1991. Nature's metropolis: Chicago and the Great West. W.W. Norton, New York.
Cutter, S., Mitchell, J., Scott, M., 2000. Revealing the vulnerability of people and places: a case study of Georgetown County, South Carolina. Ann. Assoc. Am. Geogr. 90 (4) 713–737.
Cutter, S., Boruff, B., Shirely, W., 2003. Social vulnerability to environmental hazards. Soc. Sci. Q. 84 (1) 242–261.
Cutter, S., Emrich, C., Mitchell, J., Boruff, B., Gall, M., Schmidtlein, M., Burton, C., Melton, G., 2005. The long road home: race, class, recovery from Hurricane Katrina. Env.: Sci. Policy Sustainable Dev. 48 (2) 8–20.
Cutter, S., 2006. The geography of social vulnerability: race, class, and catastrophe. Understanding Katrina: Perspect. Soc. Sci. (June) Retrieved from: http://understandingkatrina.ssrc.org/Cutter/
Davis, M., 1998. Ecology of Fear: Los Angeles and the Imagination of Disaster. Metropolitan Books, New York.

Dooling, S., Simon, G., Yocom, K., 2006. Place-based urban ecology: a century of park planning in Seattle. Urban Ecosyst. 9 (4) 299–321.

Dooling, S., 2009. Ecological gentrification: a research agenda exploring justice in the city. Int. J. Urban Reg. Res. 33 (3) 621–639.

Dooling, S., 2012. Sustainability planning, ecological gentrification and the production of urban vulnerabilities. In: Dooling, S., Simon, G. (Eds.), Cities, Nature and Development: The Politics and Production of Urban Vulnerabilities. Ashgate Publishing, Aldershot, UK.

Dooling, S., Simon, G., 2012. Cities, Nature, Development: The Politics and Production of Urban Vulnerabilities. Ashgate Publishing, Aldershot, UK.

Eakin, H., Luers, A., 2006. Assessing the vulnerability of social-environmental systems. Annu. Rev. Environ. Resour. 31, 365–394.

Eriksen, S.H., Brown, K., Kelly, P.M., 2005. The dynamics of vulnerability: locating coping strategies in Kenya and Tanzania. The Geographical Journal 171 (4) 287–305.

Federal Emergency Management Agency (FEMA). 1992. The East Bay Hills Fire Oakland-Berkeley, California. U.S. Fire Administration/Technical Report Series USFA-TR-060.

Füssel, H., 2007. Vulnerability: a generally applicable conceptual framework for climate change research. Global Environmental Change 17 (2) 155–167.

Gale, W., Houser, S., Scholz, J., 1996. Distributional effects of fundamental tax reform. In: Aaron, H., Gale, W. (Eds.), Economic Effects of Fundamental Tax Reform. Brookings, Washington.

Gamage, D., 2009. Coping through california's budget crises in light of proposition 13 and california's fiscal constitution, Proposition 13 At 30. In: Jack Citrin, Isaac Martin, (Eds.), Public Policy Institute of California. pp. 51–67.

Gandy, M., 2002. Concrete and Clay: Reworking Nature in New York City. MA: MIT Press, Cambridge.

Gibson-Graham, J., 2006. A Postcapitalist Politics. University of Minnesota Press, Minneapolis, MN.

Greenwood, D., Brown, T., 2003. An Overview of Colorado's State and Local Tax Structures. Center for Colorado Policy Studies, Colorado Springs, Colorado.

Harvey, D., 1973. Social Justice and the City. Johns Hopkins University Press, Baltimore, MD.

Harvey, D., 1996. Justice, Nature and the Geography of Difference. Blackwell Publishing, Oxford, UK.

Hewitt, K., 1997. Regions of Risk. A Geographical Introduction to Disasters. Addison Wesley Longman, Essex, UK.

Heynen, N., Kaika, M., Swyngedouw, E. (Eds.), 2005. In the Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism. Routledge, New York.

Hogan, D.J., Marandola, E., 2005. Towards an interdisciplinary conceptualisation of vulnerability. Population and space 11, 455–471.

Ionescu, C., Klein, R., Hinkel, J., Kumar, K., Klein, R., 2009. Towards a formal framework of vulnerability to climate change. Environ. Model. Assess. 14 (1) 1–16.

International Panel on Climate Change. 2001. Working Group II: Impacts, Adaptations and Evaluation of Policy Options. Retrieved from: http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg2/648.htm.

Kaika, M., 2005. City of Flows: Modernity, Nature and the City. Routledge, New York.

Keil, R., 2003. Urban political ecology. Urban Geogr. 24 (8) 723–738.

Keil, R., Desfor, G., 2004. Nature and the City: Making Environmental Policy in Toronto and Los Angeles. University of Arizona Press, Tucson, AZ.

LSA Associates Inc. 2009. Wildfire Hazard Reduction and Resource Management Plan for the East Bay Regional Park District. Draft Report. 7/20/2009.

LaMotte, A., Greene, E., 2006. Spatial analysis of land use and shallow groundwater vulnerability in the watershed adjacent to assateague island national seashore, Maryland and Virginia, USA. Environ. Geol. 52, 1413–1421.

Laymance Real Estate Company, 1911. What the development of the foothills has meant to Oakland's growth. In: Blake, E. (Ed.), Greater Oakland. Pacific Publishing Co, Oakland.

Liverman, D.M., 1990. Drought impacts in Mexico: climate, agriculture, technology, and land tenure in Sonora and Puebla. Annals of the Association of American Geographers 80 (1) 49–72.

Lynch, B.D., 2012. Vulnerabilities, competition and rights in a context of climate change toward equitable water governance in Peru's Rio Santa Valley. Global Environmental Change 22 (2) 364–373.

Marino, E., 2012. The long history of environmental migration: assessing vulnerability construction and obstacles to successful relocation in Shishmaref, Alaska. Global Environ. Change 22, 374–381.

Marino, E., Ribot, J., 2012. Special issue introduction: adding insult to injury: climate change and the inequities of climate interventions. Global Environ. Change 22, 323–328.

McEvoy, J., Wilder, M., 2012. Discourse and desalination: potential impacts of proposed climate change adaptation interventions in the Arizona–Sonora border region. Global Environmental Change 22 (2) 353–363.

Mearns, R., Norton, A., 2010. Equity and vulnerability in a warming world: introduction and overview. In: Social Dimensions of Climate Change. The World Bank, Washington (DC).

Mehta, L., 2011. The social construction of scarcity: the case of water in Western India. In: Peet, R., Robbins, P., Watts, M.J. (Eds.), Global Political Ecology. Routledge Press, New York, NY.

Muller, E., Dooling, S., 2011. Sustainability and vulnerability: integrating equity into plans for central city redevelopment. J. Urbanism 4 (3) 201–222.

Mustafa, D., 1998. Structural causes of vulnerability to flood hazard in Pakistan. Econ. Geogr. 74 (3) 289–305.

Mustafa, D., 2005. The production of urban hazardscape in Pakistan: modernity, vulnerability and the range of choice. Ann. Assoc. Am. Geogr. 95 (3) 566–586.

Nowak, D.J., 1993. Historical vegetation change in Oakland and its implication for urban forest management. Journal of Arboriculture 19, 5.

Tribune Oakland, 1923. Oakland Hills' forest mantle all hand made. In: Oakland Tribune. July 15th.

O'Brien, K., Eriksen, S., Nygaard, L., Schjolden, A., 2007. Why different interpretations of vulnerability matter in climate change discourses. Climate Policy 7, 73–88.

Oliver-Smith, A., 2002. Theorizing disasters: nature, culture, power. In: Hoffman, S.M., Oliver-Smith, A. (Eds.), Culture and Catastrophe: The Anthropology of Disaster. The School of American Research Press, Santa Fe, New Mexico.

Orsi, J., 2004. Hazardous Metropolis: Flooding and Urban Ecology in Los Angeles. University of California Press, Berkeley, California.

Pelling, M., 2003. Toward a political ecology of urban environmental risk. In: Zimmerer, K., Basset, T. (Eds.), Political Ecology: An Integrative Approach to Geography and Environment-Development Studies. Guildford Publications, New York, pp. 73–93.

Pelling, M., High, C., Dearing, J., Smith, D., 2008. Shadow spaces for social learning: a relational understanding of adaptive capacity to climate change within organizations. Environ. Planning A 40 (4) 867–884.

Pelling, M., High, C., 2005. Understanding adaptation: what can social capital offer assessments of adaptive capacity? Global Environ. Change 15 (4) 308–319.

Perkins, H., 2009. Turning feral spaces into trendy places: a coffee house in every park? Environ. Planning A 41 (11) 2615–2632.

Perkins, H., 2011. Gramsci in green: neoliberal hegemony through urban forestry and the potential for a political ecology of Praxis. Geoforum 42, 558–566.

Perkins, H., 2012. The production of urban vulnerability through market-based parks governance. In: Dooling, S., Simon, G. (Eds.), Cities Nature, and Development: The Politics and Production of Urban Vulnerabilities. Ashgate Publishing, Aldershot, UK.

Pincetl, S., Rundel, P., De Blasio, J., Silver, D., Scott, T., Keeley, J., Halsey, R., 2008. It's the land use not the fuels: fires and land development in southern California. Real Estate Rev. 37, 25–42.

Pyne, S.J., 2008. Spark and sprawl: a world tour. For. Hist. Today: Publ. For. Hist. Soc. Fall, 4–10.

Rahsed, T., Weeks, J., 2003. Assessing vulnerability to earthquake hazards through spatial multicriteria analysis of urban areas. Int. J. Geogr. Inf. Sci. 17, 547–576.

Ray-bennett, N.S., 2007. Environmental disasters and disastrous policies: An overview from India. Social Policy and Administration 41 (4) 419–424.

Rebotier, J., 2012. Vulnerability conditions and risk representations in Latin-America: framing the territorializing urban risk. Global Environ. Change 22, 391–398.

Robbins, P., 2007. Lawn people: how grasses, weeds and chemicals make us who we are. Temple University Press, Philadelphia.

Rodrigue, C., 1993. Home with a view: chaparral fire hazard and the social geographies of risk and vulnerability. The California Geogr. 33, 105–118.

Ross, A., 2011. Bird on Fire: Lessons from the World's Least Sustainable City. Oxford University Press, Oxford.

Self, R., 2003. American Babylon: Race and the Struggle for Postwar Oakland. Princeton University Press, Princeton.

Simon, G., 2012. Development, risk momentum and the ecology of vulnerability: a historical-relational analysis of the 1991 Oakland hills firestorm. In: Dooling, S., Simon, G. (Eds.), Cities, Nature, and Development: The Politics and Production of Urban Vulnerabilities. Ashgate Publishing, Aldershot, UK.

Solnit, R., 2009. A Paradise Built in Hell: The Extraordinary Communities that Arise in Disaster. Penguin Group, New York, New York.

State of California. 1991. The 1991 East Bay Firestorm. California Legislative State Senate. Torres, R., Chairman. Senate Committee on Toxics and Public Safety Management.

State of California. 2001. Oral History Interview with Tom Bates. California State Archives. State Government Oral History Program. By McGarrigle, L. Regional Oral History Office, University of California.

Stephens, S., Adams, M., Hadmer, J., Kearns, F., Leicester, B., Leonard, J., Moritz, M., 2009. Urban-wildland fires: how alifornia and other regions of the US can learn from Australia. Environ. Res. Lett. 4, 1–5.

Swyngedouw, E., 2004. Social Power and the Urbanization of Water – Flows of Power. University Press, Oxford.

Tretter, E., Adams, M., 2012. The privilege to stay dry: the impact of flooding and racism on the emergence of the "Mexican" Ghetto in Austin's Low-Eastside, 1880–1935. In: Dooling, S., Simon, G. (Eds.), Cities, Nature, Development: The Politics and Production of Urban Vulnerabilities. Ashgate Publishing, Aldershot, UK.

Tyrell, I., 1999. True Garden of the Gods: California-Australian Environmental Reform '860-1930. University of California Press, Berkeley.

Westerling, A., Brown, T., Gershunov, A., Cayan, D., Dettinger, M.D., 2003. Climate and wildfire in the Western United States. Bull. Am. Meteorol. Soc. 84 (5) 595–604.

Wisner, B., 1993. Disaster vulnerability: scale, power, and daily life. GeoJournal 30 (2) 127–140.

Wisner, B., Blaikie, P., Cannon, T., Davis, I., 2004. At Risk: Natural Hazards, People's Vulnerability and Disasters, 2nd ed. Routledge, London.

Williams, R., 1973. The Country and the City. Oxford University Press, New York.

Wolch, J., Pincetl, S., Pulido, L., 2001. Urban nature and the nature of urbanism. In: Dear, M. (Ed.), From Chicago to L. A.: making sense of urban theory. Sage, London, pp. 367–402.