Wildland Fire Management: Movement Towards Enabling Resiliency?

Michael R. Czaja

Abstract Wildfires in the western US are changing. Research suggests they are expanding in size and duration. The results include civilian and firefighter fatalities, record destruction and damage to homes and infrastructure, and increasing costs to agencies responsible for fire management. Two developments within the framework of wildland fire management suggest potential movement towards enabling resiliency. One of these is development of the National Cohesive Wildland Fire Management Strategy. The other is a state-level initiative, Colorado's Task Force on Wildfire Insurance and Forest Health. A goal of both processes is to seek methods which allow human populations and infrastructure to withstand a wildfire without loss of life and property. One implication will be how these initiatives enable resiliency within the larger subject of disaster management. Another will be to potentially apply this type of strategy development and working group methodology to other appropriate fields of disaster management.

Keywords Wildland fire management · Cohesive strategy · Resilience · Fire-adapted communities · Wildland-urban interface

1 Introduction

Wildland fire management across all landscapes and jurisdictions in the United States (US) involves a complex matrix of fuel types, climate considerations, mission goals, polices, land and resource values, social concerns, and costs [23]. In the western US, wildland fire activity increased markedly over the past two

M.R. Czaja (✉)
National Science Foundation—Funded Postdoctoral Fellow,
Colorado State University, Fort Collins, USA
e-mail: michael.czaja@colostate.edu

A. Masys (ed.), *Disaster Management: Enabling Resilience*,
Lecture Notes in Social Networks, DOI 10.1007/978-3-319-08819-8_14

decades, with a higher frequency of fires larger than 121 ha (or approximately 300 acres), longer incident durations, and longer fire seasons driven by both land use history and climate change [3, 79]. This increase in fire behavior results in increased risk to responders, home and property losses, higher costs, and increased threats to communities and landscapes [23].

Collectively, these trends lead the US Congress, the fire community, and the public to call for a new wildland fire management strategy. The Federal Land Assistance, Management, and Enhancement Act of 2009 (FLAME Act) required the Secretary of Agriculture and the Secretary of the Interior to submit a report to Congress which contained a cohesive wildfire management strategy [14, 15, 20, 29]. It must be noted that the FLAME Act, while containing the requirement for development of a cohesive strategy, was enacted due to the financial strains placed upon Federal agencies with wildland fire responsibilities. The cohesive strategy is a collaborative process involving all levels of government and non-governmental organizations, as well as the public, to seek national, all-lands solutions to wildland fire management issues. The cohesive strategy focuses on three areas: restore and maintain resilient landscapes, fire-adapted communities, and response to wildland fire. It is being implemented in three phases to allow the development of a systematic approach to plan for, respond to, and recover from wildland fire incidents [20]. Developed as a result of a changing landscape, the cohesive strategy has the potential to provide a significant contribution to the enabling of resilience in communities and landscapes. While the collaborative community continues to implement the cohesive strategy, other parallel actions are occurring at different scales. Several of these are at the state level. One example includes actions currently taking place within the State of Colorado.

During the 2012 wildfire season, Colorado experienced several significant wildfire events. All took place within the wildland-urban interface and resulted in the loss of lives, structures, and significant acreage burned. In January, 2013, Colorado's Governor, John Hickenlooper, used an executive order to establish the Wildland and Prescribed Fire Advisory Committee. This body will advise the Director of the Division of Fire Prevention and Control on all matters pertaining to wildfire preparedness, response, suppression, coordination, or management, as well as prescribed fire-related issues. The Governor also established a Task Force on Wildfire Insurance and Forest Health. Members included the Colorado State Forest Service (CSFS), US Forest Service (USFS), representatives from the insurance industry, non-profit groups, and others. The task force was charged to examine how to protect residents of the wildland-urban interface and the state's landscape [9, 69, 84]. In light of the implementation of the cohesive strategy, one area to examine is how will the state's initiatives contribute to meeting the cohesive strategy's goals and objectives?

The scope of this chapter is to introduce the current wildfire situation in the western US and in Colorado and examine the tools and processes available to enable resiliency found within the cohesive strategy and identified by Colorado's task force. The analytical flow will define the key terms, including disaster, wildfire, wildland fire management, and resiliency, review the larger issue of wildfires in

the western US and in Colorado, and discuss the cohesive strategy and task force. In this discussion, programs, capabilities, and objectives will be examined. This includes the status and any identifiable policy and action outcome. Further, the relationship, if any, between the cohesive strategy and Colorado's initiative will be explored. The increasing risk of wildfire to lives, infrastructure, communities, and the landscape makes this an appropriate, and timely, subject to address. One implication will be to examine how these programs, recommendations, and policies enable resiliency within the larger framework of disaster management. Another will be to potentially apply this type of strategy development and working group methodology to other appropriate fields of disaster management.

2 Definition of Key Terms

Within the US, wildland fire management incorporates numerous participants, with various responsibilities and interests, responding to a complex natural process. The following section provides a foundation for the following examination of the cohesive strategy and associated actions within Colorado.

2.1 Disaster and Wildfire

The new wildfire reality can lead to disaster on several scales. Disasters are those events, concentrated in time and space, in which a society faces danger and incurs such losses that the social structure is disrupted and the delivery of essential services may be prevented [16, 32]. The social, economic, and political effects of wildfires can be seen at various levels. A wildfire which necessitates evacuations, damages or destroys homes and infrastructure, disrupts essential services, and potentially impacts watersheds providing municipal water can be overwhelming. In many cases, insurance coverage is lacking or insufficient for those living within a wildfire's burn zone. Often, residents are unable, or choose not, to rebuild. This can disrupt a locale's social fabric and can impact a community's ability to rebuild and gather tax revenue.

The goal of disaster policy is to reduce vulnerability and increase resilience to all types of events, whether natural or man-made. This includes a political component, with the appropriate societal institutions and policy development [32]. In examining resilience within the context of wildfires, it is appropriate to frame the issue within a coupled human-environment, or social-ecological system (SES), context. As Walker et al. [78] observe, resilience within a SES can be defined as the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain the same function, structure, identity, and feedbacks. Within the context of this chapter, landscapes are complex intersections of natural, built, and human components [8]. For wildfires, the objective is to withstand fire

without the loss of life or property and to recover without significant impact on the infrastructure or the landscape. When assessing the size and frequency of wildfires, one key area to consider is fire severity. This is the landscape's response to fire and can be used to describe the effects of fire on the soil and water system, flora and fauna, the atmosphere, and society [62]. While a wildfire can be successfully suppressed with minimal or no damage to homes and infrastructure, a severe wildfire can have far-reaching effects on watersheds and the communities that depend on them. Fire management includes those activities required for the protection of lives, homes, infrastructure, and other values from fire and the use of certain practices, such as prescribed fire, to meet land management objectives. One common objective of prescribed fire is the reduction of fuels, seeking to lessen the risk of future catastrophic fires [56].

2.2 Wildland Fire Management

Regarding the actual implementation of wildland fire management, a variety of participants are found at various scales, both within and outside of government. This includes, but is not limited to, the US Congress, the interagency community, state, and local resources. The Congressional committees with oversight are the Committee on Appropriations, the Committee on Natural Resources, and the Committee on Agriculture in the House of Representatives (House) and the Committee on Appropriations, the Committee on Energy and Natural Resources, and the Committee on Indian Affairs in the Senate, including their respective staffs [76, 77].

The Wildland Fire Leadership Council (WFLC) provides strategic leadership and oversight to implement national fire planning [86]. The council is an intergovernmental council of Federal, state, tribal, county, and local government officials. The council is convened by the Secretaries of Agriculture and the Interior to consistently implement wildland fire policies, goals, and management activities. The Wildland Fire Executive Council (WFEC), a sub-component of the WFLC, coordinates policy and strategic direction. It is the focal point for the accomplishment of the WFLC's strategic direction. A subcomponent of the WFEC, the National Wildfire Coordinating Group (NWCG) coordinates policy and program implementation. It responds to WFEC taskings [86].

The respective national agencies primarily concerned with wildland fire policy are the USFS (Department of Agriculture); the Department of the Interior (DOI), including the Bureau of Indian Affairs, National Park Service, Bureau of Land Management, and the US Fish and Wildlife Service; US Fire Administration (Federal Emergency Management Agency); Intertribal Timber Council; and the National Association of State Foresters [51, 55, 88]. Each of these agencies has specific offices with wildland fire management responsibilities. In turn, these agencies also have state, local, and tribal partners [38].

Other non-governmental organizations and professional groups also participate in wildland fire management processes. These include the International Association of Fire Chiefs (IAFC), with its "Ready, Set, Go!" program and the National Fire Protection Association (NFPA), proponent for the "Firewise Communities" and "Fire Adapted Communities" programs [36, 37, 46]. The Western Forestry Leadership Coalition (WFC in this chapter), Western Governors Association (WGA), and Insurance Institute for Business and Home Safety (IIBHS), among others, can also be included. Individual participants are also found throughout the interest group community. Some are research specialists with the Federal Government Accountability Office (GAO), others are members of research organizations, such as Headwaters Economics, or the academic community. Stephen Pyne, a noted academic researcher at Northern Arizona University, is a recognized and influential member of this community.

2.3 Wildfire, Mitigation, and Landscape Disturbance

Wildfires occur in the wildland, an area in which development is essentially non-existent, except for roads, railroads, powerlines, and similar transportation facilities. Structures, if any, are widely scattered or found in the wildland-urban interface. This is the area where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels [56, 70]. The International Association of Wildland Fire [39] expands this to specifically include the merging of structures and vegetation in a wildfire-prone environment. Wildland fire is now a general term describing any non-structure fire that occurs in the vegetation and/or natural fuels. There are three types of wildland fire. They are wildfire, wildland fire use, and prescribed fire. The revised NWCG definitions define a wildfire as an unplanned, unwanted wildland fire including unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, and all other wildland fires where the objective is to put the fire out. Wildland fire use includes the management of a naturally-ignited wildfire to meet management objectives. Prescribed fire will be discussed as one of the following mitigation strategies [56, 57].

Mitigation strategies are an important component of wildland fire management and enabling resilience. Four common mitigation strategies can be implemented to reduce wildfire risk. Two individual actions are establishing defensible space around a home or structure and using fire-resistant, or "Firewise," materials in construction. Defensible space includes a fuel-free area immediately around a home, with a buffer zone outside of this that has thinned vegetation and the removal of dead vegetation. It also includes landscaping with fire-resistant plants and pruning branches back off of roofs and up off of the ground. Firewise construction includes fire-resistant roofs, walls, windows, and attachments (such as decks, porches, and fences) [48, 49]. These are important components of the "Firewise Communities" and "Fire Adapted Communities" programs, addressed later in the chapter.

There are two fuels treatment actions which are commonly conducted by land management agencies. Fuels treatments reduce the quantity, depth, and continuity, both vertical and horizontal, of fuels to mitigate potential fire behavior and severity. These agency actions include prescribed fires and mechanical thinning [1, 31]. As previously introduced, prescribed fire is any fire intentionally ignited by management, under an approved plan, to meet specific objectives, often fuel reduction [56, 57]. These fires can replicate the benefits of wildfires on the landscape, maintaining biodiversity, assisting with the restoration of ecosystem health, and reducing the risk to people and property [62, 73]. Properly managed, they also cause far less damage to ecological processes than uncontrolled, severe wildfires [42, 74]. Mechanical thinning removes excess trees and ladder fuels to reduce the likelihood that a surface fire will move into the tree crowns. Ladder fuels are those that allow fire to move from the surface into the crowns of trees and shrubs. This method of thinning also reduces the connectivity of tree crowns, making it more difficult for fire to spread through the canopy [18].

In general, forest and other landscape disturbances have profound economic, social, political, and ecological implications for people living, working, and recreating in and near these landscapes. Because of this, the values, interests, and concerns of local stakeholders should be incorporated into management strategies. This avoids costly conflicts and reduces the long-term impacts of disturbances [25]. Natural, or ecological, disturbances are the dominant factor in defining composition and structure of forest ecosystems. Fires, insects, and pathogens are the primary agents of disturbance and, under certain circumstances, can cause extensive tree mortality [30].

Even when wildfire suppression efforts are successful, the cost in lives and money, and the impact on communities and the landscape, can be staggering. The following section introduces the nature of wildfires on the landscapes of the western US. This provides background on why the cohesive strategy and other actions have been considered necessary.

3 Wildfires in the Western United States

The dynamics of wildfires on the landscape of the western US are changing. Different ecosystem types and geographic areas in the western US are naturally characterized by different fire regimes. In some places, fire activity is greatly exceeding the normal range. In others, it is not [43]. In general, the fire season is lengthening and observers note that we are entering a period of megafires, which have not been seen in decades. These fires have a high combustion intensity, are inherently complex to manage, and are dangerous to firefighters [63]. Ecosystems and human populations are becoming more vulnerable. This situation has been described as a complex mix of physical, ecological, economic, and social developments [6].

3.1 Changing Nature of Wildfires

Research by Westerling et al. [79] focused on 1166 large [>400 ha (approximately 988 acres)] forest wildfires between 1970 and 2003 on western, Federal land-management areas. Their findings suggest that the incidence of large wildfires significantly increased in the 1980s. They also found that at the end of their research period, wildfire frequency was nearly four times the average of 1970–1986, and the total area burned was more than six and half times its previous level. In addition, their research indicates that the length of the wildfire season increased by 78 days when comparing 1970 –1986 with 1987–2003. These findings have been supported by other research. Gebert [26] observes that 1987 was the year when statistical tests indicate that a structural change occurred with increased acres burned and suppression costs.

A quick review of wildfire statistics is necessary when examining the objectives of the cohesive strategy and related state-level initiatives. Across the nation in 2012, 67,744 wildfires burned 9,326,238 acres. The 10-year average for 2003–2012 was 63,162 fires and 6,670,780 acres burned. The number of fires in 2012 was below the 5- and 10-year national averages, while the acreage was above the national average [50]. This follows a recent trend, where there are fewer wildfires, but the acreage is growing. Regionally, a review of recent fire seasons found increasing figures for both categories. In the geographic breakdown for wildland fire management, Colorado is located within the Rocky Mountain coordination region, along with Kansas, Nebraska, and the majority of South Dakota and Wyoming [27]. As an example of 2012 fire behavior, compared to the 10-year average, the Rocky Mountain region experienced 149 % of fires and 367 % of acres burned. In Colorado alone, there were 1,498 wildfires and 246,445 acres burned in 2012 [50]. The 10-year average for the state is 1,433 fires annually, with 82,062 acres burned.

3.2 Wildland-Urban Interface

There is a direct correlation between the expansion of the wildland-urban interface (subsequently identified as the WUI) into fire-prone landscapes and lives lost, plus destroyed and damaged property. As previously defined, the WUI is an area where humans and their development meet or intermix with wildland fuel [56, 70]. The continuing population growth within the WUI results in increased risks to human safety and higher potential costs for destroyed or damaged property. Nationally, a 2006 estimate by the Federal GAO found 44 million homes in the contiguous 48 states were located within the WUI [61]. A 2013 analysis conducted by the data analytics firm CoreLogic found that in the years between 1990 and 2008, close to 17 million homes were constructed in the US. Of these, approximately 10 million (58 %) were built in the WUI and potentially located near high wildfire risk zones.

Within 13 western states, the same analysis found approximately 740,000 homes to be at high or very high risk for wildfire damage [5].

In Colorado, the CSFS estimates that 1 million Colorado residents live in proximity to 6 million acres of forests at high risk to wildfires [13]. With the presence of 117,472 homes, approximately 20 % of Colorado's WUI is developed [34]. With a regional average of 16 % WUI development, Colorado is second only to Washington State's 29 % level of development. From 2004 to 2012, primary structure losses due to wildfires were over 13,000 [47]. In 2012, 4,244 structures were destroyed by wildfires, including 2,216 residences, 1,961 outbuildings and 67 commercial structures. This is above the annual average of 1,416 residences, 1,253 outbuildings, and 46 commercial structures (data from 1999 to the present). Colorado accounted for the majority of 2012's structural loss, with 656 residences and 162 outbuildings destroyed [50]. Colorado's 2013 wildfire season also left its mark. The season's most significant wildfire was the Black Forest Fire. The fire claimed two lives, destroyed over 450 homes, and burned 14,280 acres before being contained [72]. The fire is the most costly, in terms of homes destroyed, in Colorado history.

As suggested by the Black Forest Fire, humans are often put at risk by wildfires. Within Colorado, eight civilians died in wildfires during 2012 and 2013 [7, 12, 40, 72]. While no wildland firefighters died in Colorado during those 2 years, an average of 17 wildland firefighters die each year in the line of duty (2003–2012 statistics). These deaths result from various causes, such as entrapment (five in California during 2006), helicopter crashes (nine in California during 2008), and vehicular accidents (eight in Oregon during 2003). In some instances, these firefighters perish during suppression operations in WUI environments [53]. Initial statistics indicate that 37 wildland firefighters died in 2013. Nineteen of these belonged to a single crew, the Granite Mountain Hotshots (Prescott, AZ), who were killed June 30 in an entrapment during a WUI fire near the community of Yarnell, AZ [87].

Solving the problem of fire within the WUI may never be complete because of continual changes in social and biophysical systems associated with population growth, cultural change, fuel, and climatic shifts [28]. This results in civilian and firefighter fatalities, record destruction and damage to homes and infrastructure, and increasing costs to agencies responsible for fire management. When considering the expansion of the WUI into fire-prone areas, the potential for disaster becomes far too real.

3.3 Wildland Fire Costs

Along with the expansion in fire size and severity, costs are also rising. This is an important consideration. As Pyne [64] observes, what you propose as a solution depends on how you define the problem. Fire suppression costs, due to lengthening fire seasons and increasing severity, has been identified as a problem. It is

important to note that while the FLAME Act legislation required the development of a national cohesive strategy, addressing resilience, the impetus for the legislation was cost. The rising cost of wildland fire suppression precludes the expenditure of funds on other programs, such as fuels mitigation, which can potentially support community and landscape resiliency.

Concerns about costs have been growing for over a decade. Stephens and Ruth [71], citing the US Departments of Agriculture and the Interior, plus other organizations, observed that even with large expenditures and substantial infrastructure dedicated to fire suppression, the annual area burned by wildfire has increased in the previous decade. Cost has also been a significant factor for agencies with wildland fire-fighting responsibilities. The NWCG stated that the high costs of wildland fire suppression, particularly large and complex incidents, are of considerable concern to Congress, the Office of Management and Budget (OMB), the GAO, the public, and the agencies themselves [58].

The cost for wildland fire suppression in the western US is significant for Federal agencies. In 2013, the National Association of State Foresters (NASF) reported that the USFS and the DOI's agencies ran out of money to suppress emergency wildfires eight times between 2000 and 2013 [68]. This often requires an emergency supplement, generally coming at the expense of other programs. For example, between 1999 and 2006, more than $3 billion was transferred from other DOI or USFS accounts to support fire suppression, placing strains on other agency programs [45]. In 2010, citing several former Chiefs of the USFS, the WFC stated that suppression funding accounts for an increasing amount of the total USFS budget each year. From 2000 to 2008, this funding increased from 25 to 44 percent of the service's budget [17]. Federal fire suppression costs have been over $1 billion annually since 2006. In 2012, the total Federal expenditure for fire suppression was $1.90 billion, with the bulk of that, $1.44 billion, expended by the USFS [54]. Since 1985, that is the second-highest cost, only behind 2006's $1.93 billion, and does not include state and local costs. Of note, 2012 Federal wildfire-related appropriations to the USFS and DOI totaled $2.76 billion. Combined with fire protection activities, such as fuel reduction and preparedness, the total Federal costs for the period 2002–2012 exceed $3 billion annually [29, 35].

An analysis of wildland fire costs by the WFC found fire suppression costs are only a portion of the true costs associated with a wildfire. Total costs can range from 2 to 30 times the reported suppression costs. These include not only fire-fighting costs, but damage to homes and natural resources, and other costs, such as lost tax revenue and payments to families of a fire fighter killed during a wildfire [17]. For the years 2012–2013 in Colorado, a recent estimate of insurance costs for the 2012 High Park and Waldo Canyon Fires are $113.7 million and $453.7 million, respectively. The estimated insurance costs for the 2013 Black Forest Fire are $292.8 million [66].

Using Birkland's [2, p. 147] definition, one can argue that wildfires have become "common events under uncommon circumstances." In his view, these are generally common events that gain greater attention due to some unique and unusual feature of the event that makes them newsworthy and, not coincidentally,

worthy of greater government attention and potential policy change. Historically speaking, the occurrence of wildland fires is common. What has made them recently "uncommon," however, is the combination of factors previously discussed, requiring a new strategy to deal with the increasing complexity and costs.

4 Cohesive Strategy and Colorado Task Force

To this point, the chapter introduced an extremely complex socio-environmental dynamic, wildland fire, which is found on landscapes within the US. While wildfires are found across the nation, this chapter is focused on the western region and, in particular, Colorado. It is outside the scope of the chapter to explore other factors, such as climate change, drought, and previous forest management techniques, which research suggests are contributing to the new wildfire reality. One objective of this book is to examine the underlying fragilities that can potentially turn shocks and stresses into crises and how to enable resilience to support risk, crisis, and disaster management. As we have seen, wildfires can potentially be extremely disruptive to both communities and the landscape. This is not only true for loss of life and physical damage or destruction to homes or infrastructure, but also the impact on the landscape when a severe wildfire occurs, potentially affecting the landscape's ability to act as a watershed or to undergo regeneration. The financial impact is another critical component. This can make recovery challenging for individuals and communities, and agencies may see disrupted funding priorities or the need to transfer needed funding out of certain programs to cover wildfire suppression costs.

This section of the chapter will address how the national cohesive strategy and actions within one state seek to address wildfire-related fragilities and, potentially, enable individual, community, and landscape resilience. Any linkages between the cohesive strategy and the state actions will be identified, as will specific legislative or policy initiatives within Colorado. It is no accident that wildfire costs served as one of the major catalysts to develop the national cohesive strategy and initiatives within Colorado.

4.1 Federal Legislation

During Senate testimony in 2007, Robin M. Nazzaro, the GAO's Director for Natural Resources and the Environment, stated that if the responsible agencies and Congress are to make informed decisions about an effective and affordable long-term approach to wildland fire issues, there should be a cohesive strategy that identifies long-term options and necessary funding [60]. While it should be noted that the GAO also explored other aspects of Federal wildland fire management, such as fuels reduction and use of firefighting assets, the identification of a

cohesive strategy and necessary budgetary options reinforced that the development of solutions was taking place within the wildland fire management and policy communities.

Specific solutions to the overall funding problem, components of which were subsequently incorporated into the subsequent FLAME Act, were developed within the policy community. Stephens and Ruth [71] observed that Congress should provide an improved budgetary process for fire and fuels management, with a larger annual Federal fire-suppression budget. They suggested that the President and Congress develop more realistic and multiyear funding, such as a trust fund or reserve account. In 2010, the WFC recommended the development of a new funding mechanism for emergency fire suppression activities, including a separate account for wildland fire suppression costs. A key component to this proposal was that the funding for this account must not come from the agency budgets, nor factored into the 10-year rolling average of suppression costs used to develop agency budgets [17].

The responsible Federal agencies also noted the need for restructuring budgets. In its fiscal year 2010 (FY 2010) budget proposal to Congress, the USFS identified the need for a separate reserve in order to provide funding for firefighting when its 10-year average funding amount was exhausted. The service indicated that the President's administration was taking a new approach to the complexities associated with managing wildland fire [75].

In response to the increasing cost of wildland fire suppression, the US Congress enacted the Federal Land Assistance, Management, and Enhancement (FLAME) Act of 2009, contained within Public Law 111-88 (October 30, 2009), Interior Department and Further Continuing Appropriations, Fiscal Year 2010. The act establishes, within the US Treasury, separate FLAME Wildfire Suppression Reserve Funds for the Departments of Agriculture and the Interior. These are available to cover the costs of large or complex wildfires and act as a reserve when amounts for wildfire suppression and Federal emergency response in the Wildland Fire Management appropriation accounts are exhausted. The act also required the Secretaries of Agriculture and the Interior to submit a report to Congress which contained a cohesive wildland fire management strategy [14, 15, 21, 29].

The act was the direct result of a recognized need for increased funding to meet fire suppression costs and was a significant success at a time of competing budgetary priorities. The enactment of the FLAME Act makes funds available for catastrophic, emergency wildland fire suppression activities. Funds will also be made available for activities on state and private land, in accordance with existing agreements, and on Native American Lands. Two components of the act also satisfied suggested recommendations made by members of the wildland fire management and policy communities. First, FLAME funds made available to the appropriate Federal agencies to pay wildfire suppression costs are separate from amounts annually appropriated for this purpose. Second, the act required the USFS and DOI to submit a report to Congress, as previously recommended by the GAO, which contains a cohesive wildfire management strategy. As envisioned by Congress, the cohesive strategy would include cost-effective allocation

of fire management budgets, the allocation of hazardous fuels reduction funds, an assessment of climate change on the frequency and severity of wildfire, and other subjects.

4.2 National Cohesive Strategy

In response to the requirements of the FLAME Act, the WFLC directed the development of the National Cohesive Wildland Fire Management Strategy [20, 85]. The WFLC stresses that through the active participation in the development of the cohesive strategy, attention can be brought to the policies and actions necessary to strategically approach the issue of effective wildland fire mitigation and response.

The strategy development was a collaborative process involving all levels of government and non-governmental organizations, as well as the public, to seek national, all-lands solutions to wildland fire management issues. The strategy focuses on three areas: restore and maintain resilient landscapes, fire-adapted communities, and response to wildland fire. It is being implemented in three phases to allow the development of a systematic approach to plan for, respond to, and recover from wildland fire incidents [20]. In development of the cohesive strategy's guiding principles and core values, the WFLC incorporated components of the current Federal wildland fire policy.

4.3 Federal Wildland Fire Policy

Pyne [65] made the observation that fire policy and fire sociology are the study of how, granted fire's physical properties, people should apply and withdraw fire and how they should protect themselves from its threats. Stephens and Ruth [71] observe that the wildland fire policies of Federal agencies have evolved from the use of small patrols in the newly created National Parks to diverse policy initiatives and institutional arrangements that affect millions of hectares of forests. This is clearly reflected in the current Federal policy. The 1995 Federal Wildland Fire Policy was updated in 2001, with implementation policy issued in 2003 and 2009 [52, 59].

Several elements of the Federal wildland fire management policy were incorporated into the cohesive strategy's guiding principles. Most important, firefighter and public safety is foremost and must be reflected in all plans and activities. Plans and programs will be based upon the best available science. The full range of fire management activities will be used to achieve ecosystem sustainability, including interrelated ecological, economic, and social components. Response to wildland fire will be based on ecological, social, and legal consequences of the fire. Rehabilitation and restoration efforts will be undertaken to protect and sustain ecosystems, public health, safety, and to help communities to protect infrastructure.

Finally, setting priorities among protecting public communities and community infrastructure, other property and improvements, and natural and cultural resources will be done based on the values to be protected, public health and safety, and the costs of protection [51]. Values are defined as property, structures, physical improvements, natural and cultural resources, community infrastructure, and environmental, economic, and social values [56].

4.4 Cohesive Strategy Governance

Governance of the cohesive strategy is the responsibility of several previously established councils and new organizations created to support this effort. The WFLC provides executive leadership and broad oversight for the effort. In turn, the WFLC appointed the WFEC to provide oversight over the implementation of the cohesive strategy. The Cohesive Strategy Subcommittee (CSSC) was appointed by the WFEC to advise the WFEC on implementation of the cohesive strategy. The CSSC's membership mirrors that of the WFEC and WFLC, with several members having long-term continuity with development of the cohesive strategy. The National Science and Analysis Team (NSAT), reporting to the CSSC, is comprised of experts who conduct data collection, synthesis, analysis, and modeling in support of the cohesive strategy. Finally, the WFEC chartered three Regional Strategy Committees (RSC), West, Northeast, and Southeast, to coordinate regional assessments. The regional committees appointed working groups to develop and update the regional assessments [19].

4.5 Cohesive Strategy Implementation Phases

As previously mentioned, the cohesive strategy is being implemented in three phases. This allows the development of a systematic approach to plan for, respond to, and recover from wildland fire incidents. The phased approach was designed to promote dialogue at the national, regional, and local levels [20]. The following discussion will highlight pertinent aspects that relate to resiliency, focused on the western US.

Phase I. Development of the cohesive strategy and the report to Congress, mandated by the 2009 FLAME Act, were the objectives of this phase. These serve as the two foundation documents for the strategy's development. The two documents were approved and released to the public in March, 2011 [24]. Several partner organizations in the development of the cohesive strategy sent letters to the Secretaries of Agriculture and the Interior, expressing support for the effort. These included the International Association of Fire Chiefs (IAFC), National Association of Counties (NAC), National Association of State Foresters (NASF), National League of Cities (NLC), and the Western Governors Association (WGA) [20].

The cohesive strategy recognizes that wildfire is not just a fire management, fire operations, or a wildland-urban interface problem. It is a larger, more complex land management and societal issue [23]. The strategy's vision for the following century:

> Safely and effectively extinguish fire, when needed; use fire where allowable; manage our natural resources; and, as a Nation, live with wildland fire (p. 1).

To achieve this vision, three primary factors have been identified as presenting the greatest challenges and opportunities to make a positive difference in addressing the wildland fire problem. These are the national goals for wildland fire management. They are restoring and maintaining resilient landscapes, creating fire-adapted communities, and responding to wildfires. Goals and outcome-based performance measures for each factor will serve as the foundation for the regional tasks, actions, and performance measures that were developed in Phase II.

Restoring and Maintaining Resilient Landscapes. The strategy recognizes the lack of ecosystem health and variability from geographic area to geographic area. Landscape conditions and needs vary, based on local climate, fuel conditions, and other factors. Because of this, the strategy will address landscapes at a regional and sub-regional scale.

Goal: Landscapes across all jurisdictions are resilient to fire-related disturbance in accordance with management objectives

Outcome-based performance measure: Risk to landscapes is diminished. Outcome-based metrics will center on risk to ecosystems at landscape scales

Creating Fire-Adapted Communities. The strategy will offer options and opportunities to engage communities and work with them to become more resistant to wildfire threats.

Goal: Human populations and infrastructure can withstand a wildfire without loss of life and property.

Outcome-based performance measures: Risk of wildfire impacts to communities is diminished; individuals and communities accept and act upon their responsibility to prepare their properties for wildfire; jurisdictions assess level of risk and establish roles and responsibilities for mitigating both the threat and consequences of wildfire; and the effectiveness of mitigation activities is monitored, collected, and shared. Output-based metrics will include indicators relevant to communities with mitigation plans and planned or completed treatments.

Responding to Wildfires. This component recognizes the full spectrum of fire management activities. It recognizes the differences in missions among local, state, tribal, and Federal agencies. The strategy will offer collaboratively methodologies to move forward.

Goal: All jurisdictions participate in making and implementing safe, effective, and efficient risk-based wildfire management decisions.

Outcome-based performance measures: injuries and loss of life to the public and firefighters are diminished; response to shared-jurisdiction wildfire is efficient and effective; and pre-fire, multi-jurisdictional planning occurs. Output-based metrics will reflect trends in changing risk to support the national measure.

Indicators include pre-season agreements and annual operating plans, integrated wildfire response scenarios, and shared training. Risk exposure to firefighters will be based on a balanced consideration of values to be protected and the probability of success.

Phase II. There were two main components to this phase. The first was to bring together stakeholders and communities to look for synergies and ways to work together to improve land management, reduce wildfire risk, improve suppression capability. The second was to gather information describing conditions in the three regions pertaining to the threat of wildfire, values at risk and objectives. During this phase, three regional assessments and action plans were developed and used to inform the final cohesive strategy. This phase implemented a collaborative planning and analytical process and the regions identified alternative management strategies. These, in turn, were used in the Phase III report and actions plan.

In June, 2012, the Departments of Agriculture and the Interior released the cohesive strategy's Phase II national report [67]. During this phase, the regional assessments were completed to link the national goals to the need and challenges found at regional and local levels. The regional committees examined the processes by which wildland fire, or its absence, threatens areas and issues of value to the American public, including local economies, watershed quality, wildlife habitat, and others [22]. The regions also explored the social and economic implications of landscape and wildland fire management. The western region encompassed 17 states in the western US, including Alaska and Hawaii, plus the affiliated Pacific Islands.

Each region identified numerous national laws, regulations, and policies which impact the accomplishment of wildland fire management goals. These included the National Environmental Policy Act, Endangered Species Act, National Forest Management Act, the Clean Air Act, and the US Forest Service's National Forest System Land Management Planning Rule. State laws and policies also guide management activities and impact wildland fire and resource management goals. Examples include mandates to suppress wildland fire on state and private lands and laws or policies limiting, or preventing, the use of prescribed fire or fire for resource benefit.

Values. Values were identified by each regional committee, stakeholders, working group member's professional observations, peer-reviewed literature, and previous analyses. Values common to all three regional groups included the safety of firefighters and the public, protection of private property, water conservation and quality, air quality, maintenance and enhancement of local economies, and restoration of healthy and resilient landscapes. The following values were specifically identified by the western regional committee: valuing people for who they are, not what they have in the bank; living or respecting the Western or frontier culture; enjoying vast, wild, open landscapes; and using, and stewarding, public lands.

In development of the cohesive strategy, it was necessary to identify trends and uncertainties. As with values, all regions identified a common core group: population growth; increasing WUI development; changing climate; invasive species spread; changing public expectations regarding wildland fire response; economic

fluctuations; land parcellation; and the increasing role of wildland fire equipment and personnel in other disaster and all-hazard response. The western regional committee also identified certain unique trends and uncertainties, including the increased incidence and spread of uncharacteristically large wildfires and degradation of drinking water and watersheds.

Objectives and Actions. The aim of the cohesive strategy is to produce a blueprint for achieving the national goals and reducing risks posed by wildland fire, incorporating objectives and actions at the national, regional, and local levels [22]. Several objectives were found in all three regions. Collaboration and communication were recognized as being the keys to success. Other common objectives: develop and conduct effective education and outreach to empower public engagement in, and support for, wildland fire management activities; proactively use a variety of vegetation management techniques, such as prescribed fire, to achieve local and large landscape objectives; support working forest, wildlands, and local economies; and collaborate to create jobs and diverse products and markets.

Western regional objectives included: the protection of landscapes and multiple values from the effects of unwanted fire; continue to develop, support, and maintain community wildfire protection plans as one of the primary means to achieve the goals of the cohesive strategy; and develop community-based strategies to deal with the impact of post-fire hazards on natural and cultural resources, emergency responders, communities, and planned activities. In turn, the regional committees developed potential actions and activities to support the objectives. Over 300 actions were included in the three regional assessments during Phase II. The actions and their potential to reduce risk were evaluated during Phase III.

Alternative management strategies were developed at the regional level, based on the three national goals and incorporating specific regional needs and constraints [22]. Each regional committee began developing their alternatives using management scenarios and areas to explore for reducing risk. For example, the western regional committee developed one scenario emphasizing landscape resilience, placing a greater emphasis on restoring the landscape with fuels treatments through prescribed fire, mechanical thinning, and wildland fire. Another scenario emphasized the creation of fire-adapted communities through collaboration and self-sufficiency. The three regional committees' management concepts laid the foundation for the Phase III analysis [22].

Finally, the National Science and Analysis Team (NSAT) provided active support during this phase. The NSAT was created for two purposes. First, provide analytical support to the regional committees and Cohesive Strategy Subcommittee. Second, support the development and implementation of the cohesive strategy through the application of proven scientific processes and analysis. Individuals from Federal, state, and tribal agencies, plus universities and the nonprofit community, participated in NSAT activities. Research areas included such topics as fuels management, wildfire extent and intensity, landscape resilience, firefighter safety, fire-adapted human communities, public acceptance, and policy effectiveness. Many topics overlap and intersect. Team researchers developed conceptual models which were used to build more rigorous models in the next phase.

Phase III. This phase, which continues at the time of publication, involves taking the qualitative information gathered in Phase II and translating it into quantitative models which can inform management actions on the ground [20]. It will build and test analytical tools, based on science, incorporating the results of the previous two phases. The models which are developed will assess risks to values and inform decision makers. These analyses will help stakeholders understand how their decisions, actions, and policies are likely to influence wildland fire risks. They will also help identify where scientific research should be directed to support stakeholders, decision makers, and policy development.

Regional Risk Analysis Reports. During the initial stage of Phase III, NSAT researchers worked with each regional committee to develop data to assess the wildfire situation. Using this data, each region developed Regional Risk Analysis Reports containing recommendations to achieve the three cohesive strategy goals. These reports were designed as a practical decision support tool for wildland fire management organizations, Federal, state, and local governments, and non-governmental organizations and local communities. The regional reports suggest how key elements can be integrated into strategy, provide examples of how to connect Federal, state, and local interests, provide ideas of how projects and funds can be better aligned and leveraged, and profile organizations which have blended these lessons to build stronger collaborations [20].

The western regional report was framed within the context of the regional landscape. One component was the significant wildfire risk from overstocked fuels, drought, insects and disease, invasive species, and urban development in WUI areas. The unhealthy forest and rangeland conditions in the West are widespread and increasing, providing conditions for uncharacteristically large, severe, and costly wildfires, with increasing threats to human life and property. These environmental conditions, along with the spread of the WUI, underlie four broad areas of risk: risk to firefighters and civilian safety, plus ecological, social, and economic risks. The report also noted that with a variety of landscapes and land ownership in the region, one key weakness was the availability of data. The region has a large amount of land administered by various Federal agencies, often interspersed with private property or property owned by local or state governments. This poses a management and response challenge for wildfires or other incidents at landscape scale. Fires that start on Federal land move into private land, threatening homes and communities.

As outlined in the regional report [81], the region's risk analysis data provides a generalized picture of the entire region, while identifying existing biophysical and social conditions. Its analysis identifies where wildfires are burning, where future wildfires are likely to occur, and where mitigation may reduce the severity of future wildfires. The analysis also summarizes the three previously discussed alternatives in relation to the cohesive strategy's goals and social, economic, and ecological conditions. Similar to the strategy's goals, the three alternatives are not exclusive. There is no one preferred option to be applied across the region. The alternatives are considered investment options that are thought to offer the greatest possible impact.

The western regional committee oversaw the development of recommendations that applied to the cohesive strategy's goals, either collectively or individually. The following are examples of the various recommendations. Two recommendations were for the collective goals. The first was providing resources to support local government officials, including fire chiefs, in the integration of the cohesive strategy into their communities and operations. The second was addressing identified barriers and promoting critical success factors across the region and at all levels. For the goal of landscape resiliency, one recommendation was to encourage agencies to use existing legislation and contracting tools to expedite fuels treatments. Criteria could include projects that reduce the risk to landscapes and communities by focusing on areas with a high burn probability. Regarding fire-adapted communities, recommendations included: facilitating shared learning among communities for adaptation, review and modifying requirements for technical and financial support of communities, and develop and promote local collaborative capacities to implement fuels treatments and response to fires. Finally, for fire response, one recommendation is to integrate Federal, state, local, and tribal response capability. This would be done by identifying where the greatest opportunities exist in communication, training, qualification, and mobilization.

Regional Action Plans. Each region's risk analysis, combined with the Phase II assessment and strategy, was further refined into the Regional Action Plan, describing the actions and tasks identified to implement the recommendations for landscapes, communities at risk, and fire response [80]. Planning included agencies and other stakeholders involved in each specific action. As with the other regional plans, the Western Region Action Plan is a dynamic document that will be updated continually and modified on a 5-year basis to best focus on the issues surrounding wildland fire in the West. It is a science-based guide to direct a regionally-focused approach to wildland fire that holistically addresses the needs of the landscape, communities, and emergency responders. The plan builds upon the previously developed recommendations to identify specific actions and tasks, suggests lead and collaborating agencies, and establishes timeframes in which the actions and tasks should take place.

The recommendations fell into four broad categories: overarching actions, actions to restore and maintain landscapes, actions to promote fire-adapted communities, and actions to promote fire response. Using fire-adapted communities as an example of enabling resilience, the western region intends to promote the development of community capacity and link them into a sub-regional communication and learning network. Fire adaptation is viewed as a continuum, with communities moving toward adaptation through a collaborative process involving the development and refinement of community wildfire protection plans, fuels treatments, the "Firewise Communities," "Fire Adapted Communities," and "Ready, Set, Go!" programs, and other community-level activities. This is a continuous process requiring periodic reviews and a renewal of commitment to be successful. Communities will also need technical and financial support to move toward fire adaptation [8]. There are additional recommendations for monitoring and accountability. The action plan serves as a guide for moving forward to recognize the benefits of fire on the

landscape, where and when it is appropriate, and to reduce the negative impacts of wildfire on natural resources, humans, and values at risk [80].

National Strategy. The WFEC accepted the regional plans in April, 2013. Regional contributions inform the national-level analysis, which includes not only an analysis of wildland fire issues, but also interrelationships between biophysical and socio-economic drivers and the development of policy options [8]. The draft Phase III report, National Wildland Fire Management Strategy and Risk Analysis Report (National Strategy), was released in August of 2013, with the final report and national action plan released in April, 2014. The national strategy and companion national action plan represent the completion of the cohesive strategy effort. The national strategy is comprehensive and science-based. It is being implemented across the country and overseen by the WFEC, which will establish a 5-year review cycle to provide updates to Congress.

The risk analysis report identified eleven barriers and critical success factors (CSF). The barriers have to be removed, and critical success factors met, for the national strategy to be successful. Each was selected by the regional committees as being the highest priority barriers and CSFs to be addressed in order to contribute to a successful strategy implementation. Continuing with the discussion of resilient communities, one barrier and CSF was growth management, land development, and zoning laws. Reducing the risk to firefighters and homeowners, reduced suppression costs, and lowered insurance rates were identified as top priorities. There is a need for growth management, land development, and zoning laws that require defensible space and wildfire risk reduction actions as communities develop. These include creation of defensible space, fire-resistant construction, hazard reduction, and other actions, plus the continued maintenance of these actions. Another barrier and CSF was the implementation of enforceable fire prevention ordinances at the state and local levels [8].

Policy Options. In its Phase III report, the CSSC stated that the key to strategy success and building national policy options is to understand the underlying relationships between biophysical landscapes, the people who inhabit them, and wildland fire. In 2012, the NSAT was tasked to explore potential options for achieving the goals of the national strategy and to identify the challenges, opportunities, and trade-offs inherent in each option [8]. These options are presented in the final report. The purpose was to conduct a broad, strategic overview that could inform subsequent decision making at both the regional and national levels. The policy options support intergovernmental decisions about maintaining, emphasizing, or de-emphasizing, management actions in different contexts and locations. A wide range of environmental, socioeconomic, and wildfire data has been collected to support the development of the strategy and its components. This data was consolidated and summarized at the county level (3,109 nationwide) to provide a comparable unit of analysis across data sets. This allowed the data to identify relationships among key factors and variables. It also allowed the development of maps that highlighted intra- or inter-regional or state similarities and differences.

As previously discussed, a central goal of the national strategy is promoting fire-adapted communities. The plan views the wildfire risk to communities and

values as the intersection of three principal elements. They are wildfire occurrence and extent, homes and communities, and socioeconomic resources. The values threatened include homes, buildings, infrastructure, firefighter and public safety, public health, and the benefits communities derive from the landscape around them. Analysis and development of the report's policy options considered this community framework, plus landscape resiliency (fire frequency, forested area, etc.), WUI area, home density, demographic measures, and other factors. In developing the policy options, factors were grouped into the two principal themes of landscape resiliency and risk to communities [8].

One conceptual view of the national strategy is that of a collection of policies and management actions that collectively influence vegetation composition and structure, wildfire extent and intensity, response to wildfire, and community preparedness and resiliency. These then influence the goods and services received from forests and rangelands, firefighter and public safety, and homes and property affected by fire. This conceptual framework can be applied at any scale. For the purpose of the national risk analysis, the WFEC considered a series of options that might be considered from a national perspective. They are grouped into the four management themes of broad scale fuels management, managing human ignitions, home and community actions, and response to wildfire [8].

Moving Toward the Future. The national strategy recognizes that while wildfire is a national challenge, each fire is a local event, impacting people, landscapes, and resources. The national plan compliments regional plans in addressing wildfire issues with both national and local perspectives. Several steps remain to be taken. Issues of national scope are addressed in the national action plan. The plan identifies actions, tasks, and lead agencies. It also identifies priorities and a methodology for monitoring and accountability. Stakeholders and collaborative partners will continue to be involved as the plan is implemented. Finally, working groups will address recommendations to improve barriers and CSF's and examine efficient governance and oversight [8].

In summary, the national strategy identifies several outcomes. Foremost, responsibility for actions resides with all stakeholders at various scales. The strategy is designed to be developed and implemented in a collaborative environment, where all stakeholders engaged and effected by wildfire work toward common goals, are aware of wildland fire risks and opportunities to address risks, and make decisions with compatible and cohesive information. The strategy also creates a policy environment recognizing opportunities to reduce risk, rewarding successful efforts at reducing risk, recognizing barriers that prevent the achievement of common goals, and attempting to reduce barriers through an iterative process using adaptive learning. The strategy also creates a science environment that enhances multi-scale understanding of wildfire risks to important values, opportunities to reduce risk, and trade-offs among options intended to reduce risk. A final outcome is that of a decision-making environment where complimentary decisions are possible among agencies, organizations, and stakeholders at all scales, risks are reduced and managed, and the three strategy goals of healthy and resilient landscapes, fire-adapted communities, and fire response influence outcomes [21].

The regional or local component of the national strategy development was a common theme in the chapter's previous sections. The remaining section explores this relationship further. Recent wildfire incidents in Colorado necessitated action on the part of the state's Governor. How the national strategy's formulation informed analysis and policy implementation in Colorado is the subject of the following section.

4.6 Task Force on Wildfire Insurance and Forest Health

While the national strategy involves multiple scales, linked initiatives are taking place within Colorado. In response to the catastrophic wildfires of 2012, the state's governor, John Hickenlooper, issued executive orders to establish two entities in January, 2013. One was the Task Force on Wildfire Insurance and Forest Health (Task Force), created by Executive Order B 2013-002. The Governor charged the task force to identify and reach agreement on ways to encourage activities, practices, and policies that would reduce the risk of loss in WUI areas and provide greater customer choice and knowledge of insurance options. The other was the Advisory Committee to the Director of the Division of Fire Protection and Control on Wildland Fire and Prescribed Fire Matters (Executive Order B 2013-001). Governor Hickenlooper tasked the advisory committee to work to improve the state's approach to forest health and develop a long-term strategy for sustaining vital resources [69]. As identified in the national strategy, linkages between the national, regional, and local levels are critical for successful implementation. This section provides an overview of the task force's activities and how recommendations are nested with the national strategy. Task Force-related legislative proposals, currently progressing through the state's legislative process, are also discussed. The Advisory Committee's activities are not being addressed in this chapter and would be an appropriate subject for further analysis.

Members of the Task Force represented a variety of public and private entities. Public agency membership included the state's Department of Natural Resources, Division of Fire Protection and Control, Division of Homeland Security and Emergency Management, Forest Service, local government representatives, and other agencies. Private sector representatives came from the insurance and banking industries, and a non-governmental conservation organization, among others. The chair was Barbara Kelley, Executive Director of the Colorado Department of Regulatory Agencies [83].

To successfully complete its mandate, the Task Force stated that it had to first, identify the scope of the problem in Colorado and determine how to quantify the magnitude of the wildfire risks in the WUI and second, then identify and consider a variety of ways to address the problems. Recognizing that there is no single solution to wildfires in the WUI, the Task Force developed a series of findings and recommendations which can make a "significant and sustainable difference" in reducing the risk of loss of life and property in future WUI wildfires. The Task

Force also recognized that the recommendations would be "debated, developed, adapted, and implemented" through legislation, rulemaking, and public discourse at all levels of government [84, cover letter].

Convening in February, 2013, the Task Force conducted hearings and working group meetings throughout the year, often at locations within the WUI. While the executive order didn't specifically reference the parallel national strategy development as a guide, the Task Force used it as a foundation document [9]. In accordance with the national strategy's philosophy, the Task Force placed an emphasis on a science-based approach to carrying out its mandate. To provide a common baseline for members, the Task Force established an extensive reference set of peer-reviewed, professional, and technical publications. This also included the use of lessons-learned reports from previous wildfire incidents which impacted infrastructure or the landscape. Subject matter experts from a variety of relevant fields presented information to the Task Force in hearing rooms and on the ground. The Task Force presented its findings and recommendations to the Governor on September 30, 2013, and met for the last time on October 22 [9, 84].

Identified in the Task Force mandate, and similar to the cohesive strategy goal, one key focus area was reducing the risk of loss within the WUI. The Task Force examined the condition of Colorado's forests, noting the challenges resulting from the increase of fuels, drought, pests, and the effects of recent, severe wildfires in the state. This analysis then considered the values at risk from wildfire. Those identified by the Task Force were recreation, wildlife habitat, air and water quality, and homes and infrastructure. In examining the risk to homes and infrastructure, the Task Force framed the subject identical to that used in the cohesive strategy process. To increase safety in fire-adapted communities, the goal would be to withstand a wildfire without the loss of life and property [82]. The Task Force examined four general areas. These were: defensible space, including the adoption of building codes and participation in the "Firewise Communities" and "Fire Adapted Communities" programs; land use zoning and planning at the county, municipal, and homeowner association level; implementation of community wildfire protection plans; and emergency management, such as residential egress and the use of reverse emergency notification (telephone and texts) for residents. The Task Force also looked to other regional states, such as California, Montana, Oregon, and Washington, to gain a better understanding of how these states addressed issues such as WUI development and the implementation of specific building codes and fire protection fees [4, 82].

Task Force Recommendations and Resulting Legislation. Task Force recommendations covered a number of key themes, including risk assessment mapping, improving forest health, building codes and zoning activities, and insurance. The following recommendations were submitted to the Governor and legislative leaders:

1. In coordination with stakeholders, further develop the on-line Colorado Wildfire Risk Assessment Portal (CO-WRAP) to create a mapping tool with the capability to identify and quantify wildfire risks to specific WUI properties. The state forest service developed the CO-WRAP in 2012.

2. Disclose CO-WRAP results to relevant stakeholders.
3. Create a process to handle appeals and updates for CO-WRAP scores.
4. Continue and enhance state-supported grant funding for wildfire risk mitigation.
5. Create a pilot program for prescribed fire and more flexible air quality permitting options from the appropriate state regulatory agencies.
6. Work with stakeholders to identify and disseminate consistent information about WUI best management practices (BMPs) and watershed impacts.
7. Adopt a state-wide model ordinance for WUI properties.
8. Assess a fee on WUI properties to help fund mitigation activities.
9. Prohibit community building or land-use requirements that are inconsistent with science-based, "Firewise" principles.
10. Amend the standard real estate contract to include a WUI disclosure, including the CO-WRAP score.
11. Increase homeowner and stakeholder awareness of financial and technical assistance in Colorado to support wildfire risk mitigation.
12. Develop and require a Wildfire Mitigation Audit for WUI high-risk properties.
13. Disseminate information about pending legislative changes dealing with homeowner's insurance laws. In essence, reinforce the need to for homeowners to protect themselves with adequate insurance.

Release of the Task Force recommendations resulted in an immediate discussion among the public, agencies, and elected officials. Several of the recommendations were viewed as being a radical departure from the status quo. This was especially true of recommendations seen as putting restrictions on building in the WUI or establishing risk-based fees. The Task Force's chair noted that the recommendations were holistic and that she expected homeowners, firefighters, governments, and insurance companies to work together to ensure beneficial changes are made [33]. Senior elected officials have prominently joined the discussion. Governor Hickenlooper doesn't support the recommendations concerning building codes or fees. He observes that these are delegated to counties and municipalities, with state-level mandates not appropriate. While supported by firefighters and agency wildland fire managers, these recommendations were also opposed by housing developers, the real estate industry, and local governments [41, 44].

Legislation resulting from the recommendations and associated discussion was quickly proposed. To date, this has been the sole method for Task Force recommendations to enter the policy process. The Second Regular Session of the Sixty-Ninth General Assembly (state legislature) convened on January 8, 2014. A proposed bill for mandating building codes in the WUI, based on a Task Force recommendation, didn't advance out of legislative committee [11]. As previously mentioned, there is no overarching political support for this initiative at this time. While it is possible that related legislation may still be proposed, it is not seen as being probable at this point. Variations of less contentious Task Force recommendations were introduced as proposed bills and advanced from committee. Currently making their way through the legislative process, these bills will

establish a wildfire information and resource center (Senate Bill 14-008), create a wildfire mitigation tax credit (House Bill 14-009), and create a local firefighter safety grant program (Senate Bill 14-046) [10].

The Task Force dealt with a complex subject and made some far-reaching and innovative recommendations. There was general recognition that Colorado must address wildfire-related issues. At this time, however, the political process is focusing on actions which are not seen as being contentious or politically risky. The extent to which further non-legislative rules and management actions are introduced remains to be seen.

5 Conclusion

To use a colloquial term, there are a lot of moving pieces when it comes to wildland fire management in the western US. Governments and agencies at various scales, private sector entities, individuals, management plans, funding priorities, the level of community preparedness, and the landscape, itself, are just a few pieces that fit into this puzzle. The mix of an ever-increasing WUI and the changing nature of fire on the landscape can result in loss of life and damage or destruction to infrastructure, often with significant social and economic implications. Recent wildfire incidents in Colorado have reinforced this only too well.

This chapter examined how the recently-developed National Cohesive Wildfire Management Strategy could enable resilience in light of the severity of the various challenges associated with wildfires. It also explored how a recent initiative by Colorado's governor, nested with the national strategy, attempted to deal with forest health, wildfires, and communities within the state. It is too soon to determine whether the national strategy or Colorado's emerging legislation will be successful. The national strategy was just implemented within the pastyear. Based on its goals and methodology, however, the strategy offers the potential to meet its objectives and enable resiliency.

The national strategy is a collaborative process seeking a national, all-lands solution to wildland fire management issues. The goals of restoring and maintaining resilient landscapes, fire-adapted communities, and responding to wildland fire provide a guide to plan for, respond to, and recover from wildland fire incidents. In this age of scare resources and funding, a collaborative strategy is essential. The incorporation of a science-based process will prove critical when dealing with wildfire's complex biophysical, social, and economic components.

Colorado has seen significant impacts from wildland fire, in both lives and property, over the past several years. This chapter summarized a recent review and analysis process which resulted in recommendations seeking to minimize the impacts of wildfires on individuals, communities, and infrastructure. The link to enabling resilience was clearly established by the Task Force's reference to the national strategy and its goal of communities withstanding a wildfire without the loss of life or property. The major factor within the state shaping pending

legislation and potential management initiatives is political will. The Governor would not publicly support certain recommendations that changed the status quo in WUI development. Similar legislative efforts also failed. Only time will tell whether perspectives change and a new thought process develops regarding how to prepare for, and manage, wildfires in the state.

This is truly a dynamic time for wildland fire management. In the short term, national, regional and local initiatives will be implemented. Further research is appropriate to determine how successful they will be in the accomplishment of their goals. Potential application of this methodology to other fields of disaster management is also a potential area to be examined. Anecdotally, the author has spoken with fire managers and incident commanders in his hometown of Fort Collins, Colorado. One county-level manager said that in his 20 years in wildland fire management, current fires have a much higher level of intensity than those on the past. He has never seen anything like their rate of spread and impact on the landscape and communities. Time will tell whether the national strategy and nested regional and local planning are robust and agile enough to deal with this new reality in the American West.

References

1. Absher J, Vaske J (2005) An analysis of homeowner and agency wildland fire mitigation strategies. In: Peden JG, Schuster RM (eds.) Proceedings of the 2005 Northeastern Recreation Research Symposium, April 10–12, Bolton Landing, NY. General Technical Report NE-341, pp 231−236. US Department of Agriculture, Forest Service, Northeastern Research Station, Newtown Square, PA
2. Birkland T (1997) After disaster: agenda setting, public policy, and focusing events. Georgetown University Press, Washington DC
3. Black AE, McBride BB (2013) Safety climate in the US Federal Wildland Fire Management Community: influences of organizational, environmental, group and individual characteristics. Int J Wildland Fire 22(6):850–861
4. Burton L (2013) Wildfire mitigation law in the Mountain States of the American West: a comparative assessment, http://www.ucdenver.edu/academics/colleges/SPA/Research/EAWG/Research/wildfires/Documents/WhtPprIntrstStdy15jul13.pdf
5. California Environmental Associates (2013) EcoWest: counting homes in the Western WUI, http://www.ecowest.org/2013/07/05/counting-homes-in-the-western-wui/
6. Carroll M, Blatner K, Cohn P, Morgan T (2007) Managing fire danger in the forests of the US Inland Northwest: a classic, "wicked problem" in public land policy. J Forest 105:239–244
7. City of Colorado Springs (2013) Waldo Canyon Fire: Final After Action Report, http://www.springsgov.com/units/communications/ColoradoSpringsFinalWaldoAAR_3April2013.pdf
8. Cohesive Strategy Subcommittee (2013) The national cohesive wildland fire management strategy and risk analysis-phase III report (draft, 2013)
9. Colorado Department of Regulatory Agencies (2013) Informational website for the task force on wildfire insurance and forest health, http://www.dora.state.co.us/taskforce/
10. Colorado General Assembly (2014) Bill folders, http://www.leg.state.co.us/CLICS/CLICS2014A/csl.nsf/MainBills?openFrameset
11. Colorado Legislative Council (2014) Wildfire Matters Review Committee: bills not recommended to legislative council, http://www.colorado.gov/cs/Satellite/CGA-LegislativeCouncil/CLC/1251642784983

12. Colorado State Forest Service (2012) Lower north fork fire, http://csfs.colostate.edu/pages/lnf-fire-information.html
13. Colorado State Forest Service (n.d) Agency overview (Brochure). Author, Fort Collins, CO
14. Congressional Research Service (2010a) H.R. 2996-Department of the interior, environment, and related agencies appropriations act, 2010, 111th Congress (2009–2010), http://beta.congress.gov/bill/111th-congress/house-bill/2996
15. Congressional Research Service (2010b) Summary S.561–111th Congress (2009–2010), http://beta.congress.gov/bill/111th/senate-bill/561
16. Coppola D (2007) Introduction to international disaster management. Butterworth-Heinemann, Burlington
17. Dale L (2010) The true cost of wildfire in the Western U.S. Western Forestry Leadership Coalition, Lakewood, CO
18. Dennis F, Sturtevant R (2007) Forest restoration guidelines in ponderosa pine on the front range of Colorado. Colorado State Forest Service, Fort Collins
19. Departments of Agriculture and the Interior (2013a) Cohesive strategy governance and engagement, http://www.forestsandrangelands.gov/strategy/governance.shtml
20. Departments of Agriculture and the Interior (2013b) Overview: national cohesive wildland fire management strategy, http://www.forestsandrangelands.gov/strategy/overview.shtml
21. Departments of Agriculture and the Interior (2013c) The cohesive strategy, http://www.forestsandrangelands.gov/strategy/communicators.shtml
22. Departments of Agriculture and the Interior (2012) A national cohesive wildland fire management strategy phaseii national report, http://www.forestsandrangelands.gov/strategy/documents/reports/phase2/CSPhaseIIReport_FINAL20120524.pdf
23. Departments of Agriculture and the Interior: A National Cohesive Wildland Fire Management Strategy. Authors, Washington, DC (2011a)
24. Departments of Agriculture and the Interior (2011b) The federal land assistance, management and enhancement act of 2009 report to congress. Authors, Washington, DC, http://www.forestsandrangelands.gov/strategy/documents/reports/2_ReportToCongress03172011.pdf
25. Flint C, McFarlane B, Müller M (2009) Human dimensions of forest disturbance by insects: an international synthesis. Environ Manage 43(6):1174–1186
26. Gebert K (2008) Venture capital. Wildfire, March/April, pp 24–29 (2008)
27. Geographic Area Coordination Center (2014) Rocky mountain area coordination center, http://gacc.nifc.gov/rmcc/ (2014)
28. Gill M, Stephens S (2009) Scientific and social challenges for the management of fire-prone wildland-urban interfaces. Environ Res Lett 4:1–10
29. Gorte W (2011) Federal funding for wildfire control and management. Congressional Research Service Report RL33990 (2011)
30. Goyer R, Wagner MR, Schowalter TC (1998) Current and proposed technologies for bark beetle management. J Forest 96(12):29–33
31. Graham R, McCaffrey S, Jain T (2004) Science basis for changing forest structure to modify wildfire behavior and severity. General Technical Report RMRS-GTR-120. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, UT (2004)
32. Handmer J, Dovers S (2013) Handbook of Disaster Policies and Institutions: Improving Emergency Management and Climate Change Adaptation, 2nd edn. Routledge, NY
33. Handy M (2013) Group's suggestions spur mixed feelings. Fort Collins Coloradoan, 13 October 2013
34. Headwaters Economics (2013a) As wildland-urban interface (WUI) develops: firefighting costs will soar, http://headwaterseconomics.org/interactive/wui-development-and-wildfire-costs
35. Headwaters Economics (2013b) The rising costs of wildfire protection, http://headwaterseconomics.org/wildfire/fire-cost-background
36. International Association of Fire Chiefs (2014) Ready, set, go! http://www.wildlandfirersg.org/ (2014)
37. International Association of Fire Chiefs (2012) Wildland fire programs: ready, set, go! [Pamphlet] (2012)

38. International Association of Fire Chiefs (2009) Quadrennial fire review, http://www.iafc.org/displayindustryarticle.cfm?articlenbr=38303 (2009)
39. International Association of Wildland Fire (2013) WUI fact sheet, http://www.iawfonline.org/pdf/WUI_Fact_Sheet_08012013.pdf
40. Larimer County Sheriff (2012) High park fire, http://larimersheriff.org/press-release/high-park-fire-3 (2012)
41. Lee K (2014) Worsening wildfires spark modest fixes. The Denver Post, 24 January 2014
42. McLoughlin D (2011) Prescribing fire: a hot Australian topic. Wildfire 20(5):14–19
43. Miller JD, Safford HD, Crimmins M, Thode AE (2009) Quantitative evidence for increasing forest fire severity in the Sierra Nevada and Southern Cascade Mountains, California and Nevada. USA Ecosystems 12:16–32. doi:10.1007/s10021-008-9201-9
44. Moreno I (2014) Governor supports bills to combat wildfires. The Fort Collins Coloradoan, 24 January 2014
45. National Association of State Foresters (2009) Quadrennial fire review 2009. Author, Washington, DC (2009)
46. National Fire Protection Association (2014a) Our initiatives, http://www.nfpa.org/about-nfpa/our-initiatives
47. National Fire Protection Association (2014b) Wildland fires, http://www.nfpa.org/safety-information/for-consumers/outdoors/wildland-fires
48. National Fire Protection Association (2013) Fire Adapted Communities (Pamphlet)
49. National Fire Protection Association (2012) How to Have a Firewise Home (Pamphlet)
50. National Interagency Coordination Center (2013) Wildland fire summary and statistics 2012 annual report, http://www.predictiveservices.nifc.gov/intelligence/2012_statssumm/intro _summary.pdf
51. National Interagency Fire Center (2014a) Interagency standards for fire and fire aviation operations: chapter 1, federal fire program policy and guidance overview, http://www.nifc.gov/PUBLICATIONS/redbook/2014/Chapter01.pdf
52. National Interagency Fire Center (2014b) Policies, http://www.nifc.gov/policies/policies_main.html
53. National Interagency Fire Center (2014c) Safety: historical wildland firefighter fatality reports, http://www.nifc.gov/safety/safety_HistFatality_report.html
54. National Interagency Fire Center (2014d) Statistics: suppression costs (1985–2012), http://www.nifc.gov/fireInfo/fireInfo_documents/SuppCosts.pdf
55. National Wildfire Coordinating Group (2013) NWCG Members, http://www.nwcg.gov/nwcg_admin/members.htm
56. National Wildfire Coordinating Group (2012) PMS 205: glossary of wildland fire terminology, http://www.nwcg.gov/pms/pubs/glossary/p.htm
57. National Wildfire Coordinating Group (2010) NWCG #24-2010: Terminology updates resulting from release of the guidance for the implementation of federal Wildland fire management policy
58. National Wildfire Coordinating Group (2009a) Interagency large fire cost reviews-process and guidance (NWCG Memorandum #003-2009). National interagency fire center, boise, ID, http://www.nwcg.gov/var/of-interest-1/nwcg-excutive-board/eb-historical-documents/memos/2009/nwcg-003-2009-interagency-large-fire-cost-reviews-process-and-guidance/view
59. National Wildfire Coordinating Group (2009b) Update on the modifications to the interagency strategy for the implementation of federal Wildland fire management policy (NWCG Memorandum #001-2009). National Interagency Fire Center, Boise, ID, http://www.nwcg.gov/general/memos/nwcg-001-2009
60. Nazzaro R (2007) Wildland Fire management: lack of a cohesive strategy hinders agencies' cost-containment efforts. Testimony before the Committee on Natural Resources, US Senate. United States Government Accountability Office (GAO) Publication GAO-07-427T. US Government Printing Office, Washington, DC
61. Nazzaro R (2006) Wildland fire suppression: lack of clear guidance raises concerns about cost sharing between federal and nonfederal entities. Report to the chairman, subcommittee on public lands and forests, Committee on Natural Resources, US Senate. United States Government Accountability Office (GAO) Publication GAO-06-570. US Government Printing Office, Washington, DC

62. Neary D, Ryan K, DeBano L (2004) Summary and research needs. In: Neary D, Ryan K, DeBano L (eds.) Wildland fire in ecosystems: effects of fire on soil and water. General Technical Report RMRS-GTR-42-vol. 4, pp 207–212. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, UT
63. Pyne S (2010) America's fires: a historical context for policy and practice. Forest Historical Society, Durham
64. Pyne S (2009) Fire on the fringe. Environ Res Lett 4:1–3
65. Pyne S (2007) Problems, paradoxes, paradigms: triangulating fire research. Int J Wildland Fire 16(3):271–276
66. Rocky Mountain Insurance Information Association (2012) Wildfire, http://www.rmiia.org/Catastrophes_and_Statistics/Wildfire.asp
67. Salazar K, Vilsack T (2012) Cohesive strategy phase II transmittal letter, http://www.forestsandrangelands.gov/strategy/documents/reports/phase2/CSPhaseIIReportTransmittalLetter052212.pdf
68. Schwedler J (2013) Forest coalition lauds new emergency fire funding bill in senate. National Association of State Foresters Press Release
69. State of Colorado (2013) Gov. Hickenlooper announces wildfire insurance and forest health task force, Wildland Fire Advisory Committee, http://www.colorado.gov/cs/Satellite=Pagechildpagename=GovHickenlooper2FCBONLayoutcid=1251639076858pagename=CBONWrapper
70. Stein S, Menakis J, Carr M, Comas S, Stewart S, Cleveland H, Bramwell L, Radeloff V (2013) Wildfire, wildlands, and people: understanding and preparing for wildfire in the wildland-urban interface. General Technical Report RMRS-GTR-299. US Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR
71. Stephens S, Ruth L (2005) Federal forest-fire policy in the United States. Ecol Appl 15(2):532–542
72. United State Forest Service (2013) InciWeb: black forest fire, http://inciweb.nwcg.gov/incident/3424/
73. United States Forest Service (2012a) Managing wildland fires through ecosystem restoration, http://www.fs.fed.us/fire/management/ecosystem_restoration.html
74. United States Forest Service: Managing Wildland Fires: Prescribed Fire, http://www.fs.fed.us/fire/management/rx.html (2012b)
75. United States Forest Service (n.d.) US forest service FY 2010 president's budget overview, http://www.fs.fed.us/publications/budget-2010/overview-fy-2010-budget-request.pdf
76. United States House of Representatives (2014) Committees, http://www.house.gov/committees/
77. United States Senate (2014) Committees, http://www.senate.gov/pagelayout committees/d_three_sections_with_teasers/committees_home.htm
78. Walker B, Holling CS, Carpenter SR, Kinzig A (2004) Resilience, adaptability, and transformability in social-ecological systems. Ecol Soc, 9(5), http://www.ecologyandsociety.org/vol9/iss2/art5
79. Westerling AL, Hidalgo HG, Cayan DR, Swetnam TW (2006) Warming and earlier spring increase western us forest wildfire activity. Science 313(5798):940–943. doi:10.1126/science.1128834
80. Western Regional Strategy Committee (2013a) The national cohesive wildland fire management strategy: phase III western regional action plan, http://www.forestsandrangelands.gov/strategy/documents/rsc/west/WestRAP_Final20130416.pdf
81. Western Regional Strategy Committee (2013b) The national cohesive wildland fire management strategy: phase III western regional science based risk analysis report, http://www.forestsandrangelands.gov/strategy/documents/reports/phase3/WesternRegionalRiskAnalysisReportExecSummary11162012.pdf
82. Wildfire Insurance and Forest Health Task Force (2013a) Forest health and the wildland-urban interface, http://www.dora.state.co.us/taskforce/

83. Wildfire Insurance and Forest Health Task Force (2013b) Membership and contact information, http://www.dora.state.co.us/taskforce/Membership2.html
84. Wildfire Insurance and Forest Health Task Force (2013c) Report to the governor of Colorado, the speaker of the house of representatives, and the president of the senate. Colorado Department of Regulatory Agencies, Denver, CO
85. Wildland Fire Leadership Council (2012a) Implementation of the national cohesive wildland fire management strategy
86. Wildland Fire Leadership Council (2012b) Wildland fire governance
87. Wildland Firefighter Foundation (2013) Fallen wildland firefighters, http://www.wffoundation.org/Page.asp?NavID=22
88. Wilfong T (2004) Fire programs. In: Oldham C (ed) Forest service centennial: a new century of service, 1905–2005. Fairmont Publications, Tampa, pp 48–61