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Wildfire Protection in the Wildland-Urban Interface

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Summary

Congressional interest in funding to protect against wildfire threats has focused on communities in and near forests, an area known as the *wildland-urban interface* (WUI). The WUI is expanding in size and population, leading to increased concern for life and property that could potentially be damaged by wildfires. Approximately 10% of all land in the lower 48 states is classified as WUI. A significant concentration lies along the East Coast, although western states have the highest proportions of homes in the WUI.

Federal funding for wildfire protection has increased over the last decade. The U.S. Forest Service (USFS) and the Department of the Interior (DOI) receive the bulk of funding to prevent and suppress wildfires. In 2014, approximately 56% of the USFS budget (discretionary funding) was allocated for wildfire management. A portion of this funding is spent on WUI efforts.

Wildfire, whether in a WUI community or not, occurs primarily as a surface fire or a crown fire. A *surface fire* burns the needles or leaves, grass, and other small biomass within a foot or so of the ground and quickly moves on. A *crown fire* burns biomass at all levels, from the surface through the tops of the trees.

Wildfire suppression involves removing one of the three elements that cause fire—fuel, heat, or oxygen. A variety of WUI wildfire control efforts may be used for structures, including building structures to meet protective standards. Some standards vary by state, and many are voluntary, such as removing burnable materials in proximity of a structure (i.e., defensible space). Control efforts for protecting wildlands include fuel reduction, or allowing the fire to burn if the ecosystem is able to adapt to and recover from periodic burning.

Programs and other options exist to address wildfires in the WUI. However, these programs could be refined to better address the current situation, and new initiatives and funding could be applied towards WUI issues not yet addressed. For example, programs could be expanded to educate homeowners, state and local governments, and the insurance industry about the ways to protect homes through actions, planning, and zoning and building regulations. Congress could consider expanding protection for defensible space beyond the home ignition zone to a community protection zone. Congress could also consider appropriating additional funds through the states for fuel reduction on private lands in the WUI where the treatments would be effective. Additionally, Congress could consider expanded compensation for landowners who suffer resource losses from wildfires.

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Wildfires have made national headlines in recent years, with major fires in the West and South killing firefighters, burning homes, and threatening communities. With the population and size of the wildland-urban interface (WUI) expanding, more money is being spent on fire management in these locales. Federal funding for fire protection has increased over the past decade, and administration and congressional leaders have urged additional wildfire protection. In FY2014, approximately \$3.9 billion was appropriated to protect federal lands and approximately \$91.0 million to assist in protecting nonfederal lands.¹ The U.S. Forest Service (USFS) in the Department of Agriculture, along with the Department of the Interior (DOI), are responsible for protecting the majority of federal lands from wildfire, including any federal areas that comprise a WUI. Wildfire funding accounts for approximately 56% of the USFS budget and roughly 8% of the DOI budget in 2014. While attention has focused on protecting life, property, and communities in the WUI, opinions vary over how to provide protection. This report describes the growth of the wildland-urban interface, wildfire suppression efforts, post-fire responses, and especially the programs and options for protecting the interface before the next wildfire strikes.

What Is the Wildland-Urban Interface?

The term *wildland-urban interface* (WUI) has been used for more than two decades to suggest an area where structures (usually homes) are in or near wildlands (forests or rangelands). There is no standard WUI definition. However, the definition listed in a 2001 *Federal Register* notice is commonly referenced—the urban-wildland interface community exists where humans and their development meet or intermix with wildland fuel.² In this same notice, the USFS and DOI identified three types of WUI communities: interface, intermix, and occluded. Based on state data, they listed nearly 4,500 interface communities (with 11 states not providing data). The agencies defined an *interface community* as one where wildlands abut structures with a clear line of demarcation between residential, business, and public structures and wildland fuels, while an *intermix community* is where structures are scattered and intermingled with wildlands and fuels. An occluded community, generally existing within a city, is where structures abut an island of wildland fuels (e.g., park or open space).

One source indicates that all states within the contiguous United States contain land classified as WUI.³ See **Figure 1**. Furthermore, approximately 10% of all land within the lower 48 states is classified as WUI, with a significant concentration along the East Coast, although western states have the highest proportions of their homes in the WUI.⁴ The area of intermix communities is large and is growing faster than the area of interface communities, based on data from 1990 to 2000.⁵ Nationwide, in 2010, the interface area was equal to approximately 39 million acres, and

¹ The \$3.9 billion appropriated includes the additional sum of \$628.5 million in supplemental funding. The amount spent to protect nonfederal lands includes appropriations for the State Fire Assistance and Volunteer Fire Assistance budget line items from the FS Wildland Fire Management account. For more information, see CRS Report R43077, *Wildfire Management: Federal Funding and Related Statistics*; and CRS Report RL33990, *Federal Funding for Wildfire Control and Management*.

² U.S. Dept. of Agriculture and Dept. of the Interior, “Urban Wildland Interface Communities Within the Vicinity of Federal Lands That Are at High Risk From Wildfire,” 66 *Federal Register* 753 (January 4, 2001).

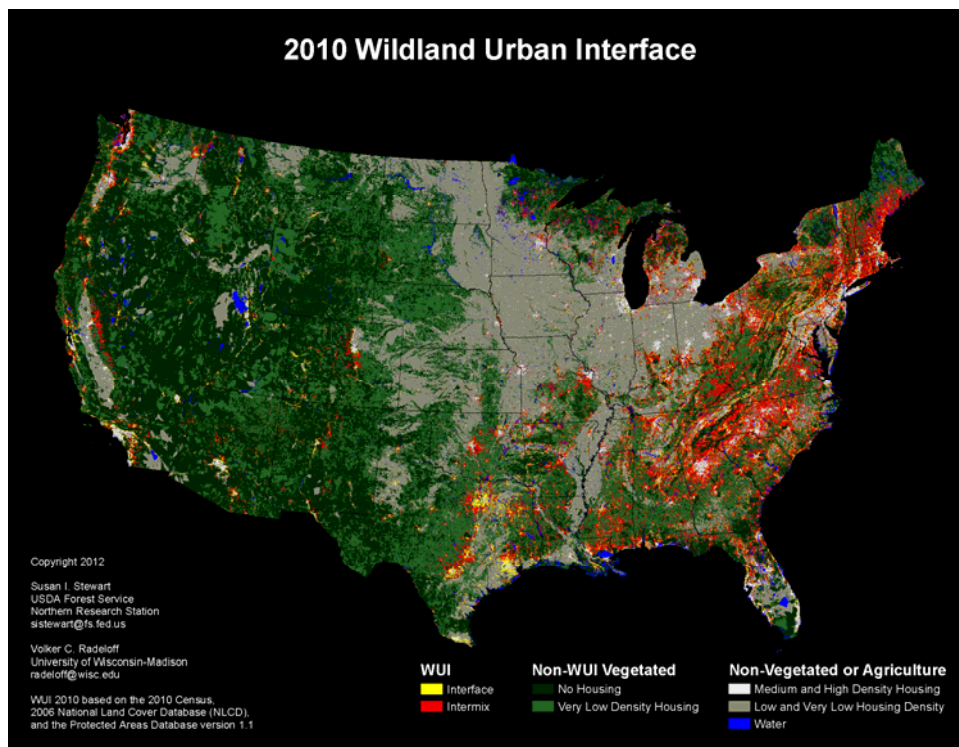
³ U.S. Forest Service, *The Public and Wildland Fire Management: Social Science Findings for Managers*, November 2006, http://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs1.pdf.

⁴ Email from Miranda Mockrin, USFS, May 15, 2013.

⁵ R. B. Hammer, V. C. Radeloff, J. S. Fried, and S. L. Stewart, “Wildland-Urban Interface Housing Growth During the 1990s in California, Oregon, and Washington,” *International Journal of Wildland Fire*, v. 16 (2007), pp. 255-265.

the intermix area equal to approximately 152 million acres. In 2010, intermix communities in the three Pacific Coast states totaled 9.3 million acres, almost three times the 3.6 million acres in interface communities in those states.⁶ From 1990 to 2000, the 10-year growth in area of intermix communities was 14.1%, compared to only 2.5% for interface communities. However, the study acknowledged that determining the area of WUI communities was imprecise: “Mapping [the *Federal Register*] definition of the WUI using data and operational definitions we developed, we arrived at one possible representation of the WUI.”⁷ The intermingled nature of intermix communities poses significant challenges for fire protection efforts.

Figure 1. 2010 WUI Map



Source: U.S. Forest Service, United States Wildland Urban Interface Maps, 2011, <http://silvis.forest.wisc.edu/maps/wui/state>; V. C. Radeloff, R. B. Hammer, S. I. Stewart, J. S. Fried, S. S. Holcomb, and J. F. McKeefry, “The Wildland Urban Interface in the United States,” *Ecological Applications*, v. 15 (2005), pp. 799-805.

Fire Suppression

In most of the United States, wildfires are inevitable. Biomass plus dry conditions equals fuel to burn. Add an ignition source (e.g., lightning or a match) and a wildfire may ignite. Fire is a self-sustaining chemical reaction that perpetuates itself as long as all three elements of the fire

⁶ Email from Miranda Mockrin, USFS, January 28, 2014. The data for 2010 is the most recent data available. The FS states that while WUI data on change from 1990 to 2000 is available, additional data processing is needed before change information from 2000 to 2010 will be available.

⁷ Hammer et al., “Wildland-Urban Interface Housing Growth,” p. 256.

triangle—fuel, heat, and oxygen—remain available. Fire control focuses on removing one of those elements.

There are two principal kinds of wildfire, although an individual wildfire may contain areas of both kinds.⁸ A *surface fire* burns the needles or leaves, grass, and other small biomass within a foot or so of the ground and quickly moves on. Such fires are relatively easy to control by removing fuel with a *fireline*, essentially a dirt path wide enough to eliminate the continuous fuels needed to sustain the fire, or by cooling or smothering the flames with water or dirt.⁹

A *crown fire* burns biomass at all levels, from the surface through the tops of the trees. Crown fires do not consume all the biomass; rather, a crown fire quickly burns the needles or leaves and small twigs and limbs on the surface and throughout the crown of the trees. Because the needles and leaves in the crown are green, they require more energy to burn than dry fuels on the surface. Furthermore, because of the green fuels and the often discontinuous biomass of the canopy, wind is usually needed to sustain a crown fire. Once burning vigorously, a crown fire can create its own wind—the strong upward convection of the heated air can draw in cooler air from surrounding areas, thus creating a wind that feeds the fire. The strong upward convection can also lift burning biomass (*firebrands*) and send it soaring ahead of the fire, creating spot fires and accelerating the spread of the wildfire. Thus, crown fires are difficult, if not impossible, to control. Firelines are often ineffective, especially if winds are causing spot fires. Water or fire retardant (*slurry*) dropped from helicopters or airplanes can sometimes knock a crown fire down (back to a surface fire) if the area burning and the winds are not too great. Often, however, crown fires burn until they run out of fuel or the weather changes (the wind dies or it rains or snows).

Fires burn structures in one of three ways: through direct contact with fire (the fire burning right up to the structure); through radiation (heating from exposure to flames); and through firebrands landing on a flammable roof.¹⁰ Surface fires generally only burn houses through direct contact, and protection is a relatively simple matter of a break in the continuous burnable material. In observing houses that burned in Los Alamos in 2000, one researcher stated “in several cases, a scratch line that removed [pine] needles from the base of a wood wall kept the house from igniting.”¹¹ Crown fires, however, can burn houses in any of the three ways. The opportunity and ability to prevent structures from burning during a crown fire is small. Occasionally, water or some other wetting agent sprayed on walls or roofs can prevent ignition or extinguish firebrands from an advancing wildfire, but the firefighters could die of heat exposure or smoke inhalation from the approaching fire.

⁸ See S. F. Arno and S. Allison-Bunnell, *Flames in Our Forest: Disaster or Renewal?* (Washington, DC: Island Press, 2002), pp. 45-46.

⁹ A fireline may be as narrow as 1 foot for suppressing a fire in shortgrasses and light fuels, or can be more than 100 feet wide for heavier-fueled fires. U.S. Forest Service, *About Handcrews*, http://www.fs.fed.us/fire/people/handcrews/about_handcrews.html.

¹⁰ National Wildland/Urban Interface, Fire Protection Program, *Wildland/Urban Interface Fire Hazard Assessment Methodology*, p. 5, at <http://www.firewise.org/resources/files/wham.pdf>.

¹¹ Jack Cohen, “The Cerro Grande Fire: Why Houses Burned,” *Forest Trust Quarterly Report*, no. 13 (December 2000): p. 11.

In the Aftermath

Recovery and efforts to support recovery after a severe wildfire vary, depending on the nature of the damages. For burned structures, insurance payment is the standard means for homeowners to pay for recovery—repair, if that is possible, or replacement, depending on the insurance policy. In a severe event, a presidential declaration of an emergency (in response to a request from a governor) initiates a process for federal assistance to state and local governments and to families and individuals to help with recovery. The nature and extent of the assistance depends on several factors, such as the nature and severity of damages and the insurance coverage of the affected parties.¹²

For burned areas, site rehabilitation is sometimes warranted. In many temperate ecosystems, wildfires (including crown fires) are natural events, and the ecosystems are adapted to recover from the fire. Often, in severely burned areas, grass seed is spread to try to accelerate growth of ground cover and slow erosion, but grass often inhibits tree seed germination and growth, and thus may slow forest recovery. Rehabilitation efforts commonly focus on the firelines created to try to control the fire, since firelines consist of exposed bare earth and often run uphill, and thus can readily erode into gullies if left untreated. Some severely burned areas, particularly in coastal southern California, are susceptible to landslides during the subsequent rainy season. Monitoring can provide a warning to homeowners to evacuate an area prior to a landslide, but little can be done to prevent landslides in such situations.

Minimizing Wildfire Damages

Various efforts can protect structures and wildlands from some of the damages of wildfires.¹³

Protecting Structures

A structure's characteristics and landscaping significantly affect its chance of surviving a wildfire. Evidence from models, experiments, and case studies demonstrates that structural characteristics, especially the roofing materials, largely determine whether a home burns in a wildfire. Homes of brick or adobe with non-flammable roofs (e.g., tile, slate, metal) are far less likely to burn than homes with wood siding and flammable roofs (e.g., wood shingles).¹⁴ Burnable materials (such as trees, shrubs, grass, pine needles, woodpiles, wood decks, and wooden deck furniture) within 40 meters (131 feet) of the structure also strongly influence whether the structure burns in a wildfire.¹⁵

Furthermore, the structure and landscape characteristics are more important than the intensity of the fire in determining whether a house burns. The Hayman Fire, in Colorado in June 2002,

¹² For more information, see CRS Report RL34146, *FEMA's Disaster Declaration Process: A Primer*; and CRS Report RL33503, *U.S. and Coalition Military Operations in Afghanistan: Issues for Congress*.

¹³ See CRS Report RL34517, *Wildfire Damages to Homes and Resources: Understanding Causes and Reducing Losses*.

¹⁴ Jack D. Cohen, "Preventing Disaster: Home Ignitability in the Wildland-Urban Interface," *Journal of Forestry*, v. 98, no. 3 (March 2000): 15-21.

¹⁵ Cohen, "Preventing Disaster."

burned 132 houses—70 houses (53%) were surrounded by crown fire, while 62 houses (47%) were surrounded by surface fire.¹⁶ In addition, 662 homes (83% of all homes within the fire perimeter) survived the fire, even though 35% of the area was severely burned and 16% was moderately burned.¹⁷ This suggests that at least some of the structures survived despite a crown fire around them.

Protecting Wildlands

The impact of wildfires on wildlands depends largely on the nature of the ecosystem. Some ecosystems are adapted to and recover from periodic crown fires—perennial grasslands, chaparral, lodgepole and jack pines, and more. In these ecosystems, the plants have evolved to resprout or reseed the burned areas, and thus recover from crown fires by outcompeting other plant species. Eliminating crown fires could eventually eliminate these ecosystems. However, eliminating crown fires in these ecosystems is probably impossible, since the plants contribute to the development and spread of crown fires—grasses burn quickly; chaparral has a high volatile-oils content; and lodgepole and jack pines grow in dense, even-aged stands.

Other ecosystems are adapted to relatively frequent (5- to 35-year intervals) surface fires. Fire suppression has been moderately successful in controlling surface fires, and thus the needles, twigs, and other fine and small fuels have been accumulating for three or more fire cycles. This abnormal fuel accumulation, combined with fuel ladders of brush, small trees, and low limbs (many of which would have burned in a surface fire), have led to crown fires where such fires were historically rare. Fuel reduction treatments can restore conditions in frequent-surface-fire ecosystems to again make crown fires rare occurrences, reducing damages to resources.

Protecting the WUI

Reducing fuels in the WUI has been a controversial aspect of congressional debates over fire protection legislation. The evidence discussed above indicates that fuel reduction provides little protection for structures. However, some observers have noted that the WUI is more than just a collection of houses:¹⁸

A town is not just the place where people have homes. Communities are in the forest because they are emotionally, economically, and socially linked and dependent on the forest. When we consider the areas that need immediate treatment we should consider the human community “impact area”—the entire area that, if impacted by a catastrophic fire, will undermine the health and livelihood of a community.

At a minimum, most would agree on the need for an area of *defensible space* around homes that needs to be cleared of burnable materials—at least 10 meters (33 feet) and possibly as much as

¹⁶ Jack Cohen and Rick Stratton, “Home Destruction Within the Hayman Fire Perimeter,” *Hayman Fire Case Study*, Gen. Tech. Rept. RMRS-GTR-114 (Ft. Collins, CO: USDA Forest Service, September 2003), p. 264.

¹⁷ Peter Robichaud, Lee MacDonald, Jeff Freeouf, Dan Neary, Deborah Martin, and Louise Ashman, “Postfire Rehabilitation of the Hayman Fire,” *Hayman Fire Case Study*, Gen. Tech. Rept. RMRS-GTR-114 (Ft. Collins, CO: USDA Forest Service, September 2003), p. 294.

¹⁸ W. Wallace Covington, Director, The Ecological Restoration Institute, Northern Arizona University, “Prepared Statement,” *National Fire Plan*, hearing before the Senate Committee on Energy and Natural Resources, July 16, 2002, S.Hrg. 107-834 (Washington, DC: GPO, 2003), p. 61.

40 meters (131 feet). One observer recommended that protecting communities should include intensive treatment to reduce fuels and burnable materials in the *home ignition zone*, up to 200 meters (655 feet) around structures, with less intensive fuel treatment in the *community protection zone*, generally up to 500 meters (1,640 feet, or about a third of a mile) from structures.¹⁹

The National Fire Protection Association's (NFPA's) Firewise Communities program assists communities with specific wildfire safety needs. The term "Firewise" describes the goal of teaching residents about wildfire and about smart practices around their homes that can reduce the risk of destruction. The program started in 1986 as a national project and gradually evolved to become a national program in 2002. The program, co-sponsored by the USFS, DOI, and the National Association of State Foresters, encourages local solutions for wildfire safety by involving homeowners, community leaders, planners, developers, firefighters, and others in the effort to protect people and property from wildfire risks.

The Healthy Forests Restoration Act of 2003 (HFRA; P.L. 108-148; 16 U.S.C. §6511) established a somewhat broader standard for fuel reduction activities under its authorities. Section 101(16) of HFRA defined the WUI to include an area out to ½ mile from the boundary of an *at-risk community* or 1½ miles from the boundary if a sustained steep slope could cause dangerous fire behavior or to an effective fire break, such as a road or ridge top. HFRA included no guidance on how to apply these standards in intermix communities, with no definitive boundary.

Issues for Congress

At least 4.1 million acres are reported to have burned in 2013.²⁰ While there have been slightly fewer total fires in recent years as compared to a peak experienced in 2006 and 2007, more than 9.3 million acres burned in 2012, which was the third-largest acreage burned annually since 1960.²¹ Thus, people are still at risk from wildfires when they occur in the WUI. The National Interagency Fire Center (NIFC) reports that 2,135 structures burned in 2013.²² Congress faces increasing pressures for wildfire protection. Congress decides what programs to authorize and fund to protect the WUI from wildfires. Many programs exist, and other options are possible.

Suppression has usually received the majority of wildfire management funding, ranging from \$786.5 million to \$1.4 billion annually (not including emergency supplemental funds) since FY2008.²³ Further, a significant portion of emergency wildfire supplemental funds—which can be hundreds of millions of dollars—are directed towards wildfire suppression efforts. The public and policymakers expect the agencies to clearly demonstrate that they are doing what they can to stop threatening and damaging fires, and this often involves large sums of money. However, given the difficulty of suppressing crown fires, and the difficulty and cost associated with measuring what has burned and what was suppressed, some may question the effectiveness of continued increases in suppression funding.

¹⁹ Brian Nowicki, *Effectively Treating the Wildland-Urban Interface to Protect Houses and Communities from the Threat of Forest Fire* (Tucson, AZ: Center for Biological Diversity, August 2002).

²⁰ National Interagency Fire Center, national year-to-date report on fires and acres burned by state, November 7, 2013.

²¹ National Interagency Fire Center, *Wildland Fires and Acres*.

²² Structures include primary residences, commercial buildings, outbuildings, and seasonal dwellings. Information provided in an email from NIFC on January 16, 2014.

²³ After a restructuring in FY2012, the FS budget now directs more money to preparedness.

To date, Congress has mostly addressed wildfire prevention and suppression by increasing funding. It is difficult to gauge if the funding amounts provided by Congress each year are adequate. National data on what transpired during the year are hard to locate and are disjointed when available. More comprehensive and accurate national performance measures (e.g., number of fires that started on federal lands, number of structures burned due to wildfires) could give better insight into the effectiveness of wildfire prevention and suppression efforts.²⁴ National wildland fire data collection and analysis could start with Congress explicitly requesting the numerous fire reporting agencies to work together to provide annual statistics and performance measures.²⁵ Such a directive could require more resources than are available at the moment. Given the current economic climate, better national data could provide insight as to whether or not other options to address wildfire management (e.g., a reduction in funding or a do-nothing approach) should receive more careful consideration.

Federal programs to protect homes are currently limited to information for homeowners on how to protect their homes, primarily provided through the NFPA Firewise Communities program. Programs could be expanded to educate homeowners, state and local governments, and the insurance industry about the ways to protect homes through actions, planning, and zoning and building regulations. Congress could create and fund new programs to assist homeowners in renovations to make their homes fire-safe and to create defensible space around their structures, through direct federal assistance or through the states.

Congress could also consider expanding protection for defensible space beyond the home ignition zone to a community protection zone. HFRA authorizes an expedited review process for activities on federal lands in the WUI. Perhaps other changes could further accelerate action. Funding for fuel reduction in the WUI could also be expanded. Appropriations for fuel reduction have averaged \$502.9 million annually since FY2008, but only a portion is used in the WUI, and funding is far below the estimated amount needed to treat the lands at risk.²⁶ State fire assistance funding through the Forest Service could be used for fuel reduction in the WUI, at the discretion of the states, but funding has averaged \$138.7 million annually from FY2008 to FY2014 and the states have many wildfire priorities.²⁷ Additional funding through the states for fuel reduction on private lands in the WUI is a possibility that Congress could contemplate.

In addition, Congress might debate choices for compensating homeowners for property losses due to wildfires. One option might be to restrict compensation to those who had acted to protect their homes, but got burned anyway. Another option might be to require that compensation for rebuilding be used only for fire-safe building designs and materials. Alternatively, Congress could establish a national wildfire insurance program, with premiums based on fire threats, the fire-safety of the structures, and the defensible space being maintained.

²⁴ This is not a new issue. The Government Accountability Office (GAO) has produced numerous reports addressing various aspects of fire strategies by both the FS and DOI. One GAO report discusses measures federal agencies can take to ensure that federal dollars, on a national basis, are spent wisely on wildland fire prevention. U.S. Government Accountability Office, *Federal Agencies Have Taken Important Steps Forward, but Additional, Strategic Action Is Needed to Capitalize on Those Steps*, GAO-09-877, September 9, 2009, <http://www.gao.gov/products/GAO-09-877>.

²⁵ Most wildland fire data comes from NIFC, USFS, and NFPA.

²⁶ See the discussion in CRS Report RL33990, *Federal Funding for Wildfire Control and Management*.

²⁷ The average is based on state fire assistance funding appropriated under the wildland fire management (WFM) account and the state and private forestry (S&PF) account for FY2008-FY2013. The WFM account state fire assistance funding average is \$116.2 million, and ranged from \$250 million in FY2009 to \$52.7 million in FY2013. The S&PF account state fire assistance funding average is \$32.6 million.

Finally, Congress could consider compensation for landowners that suffer resource losses from wildfires. An emergency reforestation assistance program has existed for many years, although it has not been funded since FY1993.²⁸ In the 2008 farm bill, Congress included forest restoration assistance in an existing emergency conservation program.²⁹ These programs can provide assistance in recovery from a wildfire disaster, but do not compensate landowners for losses in the way that homeowners are compensated for the loss of their homes. Congress might consider such additional compensation.

The 113th Congress has proposed legislation that would address some of the issues stated above. For example, the House passed H.R. 1526, which could allow states a more pronounced role in designating high-risk areas for emergency hazardous fuel reduction projects, and could expedite the implementation process for both hazardous fuel reduction projects and forest health projects, among other things. In the 112th Congress, H.R. 1485 would have, in part, authorized an expedited review process by the FS and DOI for fuel reduction and forest restoration projects in the WUI. And in the 112th Congress, some measures were introduced that would have reduced wildfire program funding, such as H.Amdt. 764 to H.R. 2584, which sought to reduce funding for the Wildfire Suppression Program by \$50 million and to increase funding for the Forest Legacy Program by a similar amount.

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This report was originally written by Ross Gorte, retired CRS specialist in Natural Resources Policy. The listed contacts are available to respond to inquiries on the subject.

²⁸ See CRS Report RL31065, *Forestry Assistance Programs*.

²⁹ See CRS Report RL33917, *Forestry in the 2008 Farm Bill*.

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