Social and Economic Issues of the Hayman Fire

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Introduction

On June 26, 2002, U.S. Representative Mark Udall wrote the US Forest Service Chief, requesting that the Forest Service conduct an analysis of the Hayman Fire. In response to the Congressman's letter, five teams were established in August, 2002 to analyze various aspects of the Hayman Fire experience. This report describes the Hayman Fire analysis work conducted by the social/economic team and presents our findings.

When a fire the size and intensity of the Hayman Fire occurs largely in an urban/wildland area as highly developed as the Colorado Front Range, the social and economic effects or consequences will be extensive, complex, and long lasting. Any attempt to comprehensively catalog these impacts will be difficult, in part because it has never been attempted, especially for a fire as large and complex as the Hayman. Typically, social and economic or human dimensions consequences of wildfires have not received the attention that ecological issues have (Ffolliett, 1988; McIver and Starr, 2000), especially on the part of the Federal agencies directly involved with firefighting, such as the USDA Forest Service and the USDI Bureau of Land Management. As an example, Butry and others (2001) note that they are unaware of the existence of any "organization in the United States that systematically and empirically quantifies economic impacts of wildfires." The situation is perhaps even worse for the assessment of wildfire-related social impacts, with research having been limited to such key areas as public health and safety impacts, and social and community impacts (Machlis and others 2002). In fact, an understanding of the nature of these impacts is only now beginning to appear in the relevant literature.

Historically, wildfires, especially in the Western United States, typically burned in areas of low or nonexistent human habitation, with the result of minimal impacts on social or economic systems. For fires such as these, the importance of human dimensions issues was and is relatively low. As human populations in the West have grown; as the popularity of living in the wildland-urban interface has increased; and as the frequency and magnitude of wildfires has increased, especially in lower elevation Ponderosa pine and mixed conifer forests because of significant fuel buildups and extreme drought, more wildfires are causing significant damage and disruption to both social and economic systems. This trend ensures that the interplay between wildland fire management and human dimensions issues takes on far greater importance than it did historically. As pointed out in (Machlis and others 2002):

> The *human dimension* of Federal wildland fire management – the relationship of people and wildland fire in America – is an important and driving force in how Federal agencies respond to wildland fire, now and in the future. In many ways, it is *the* critical element, for the management of wildland fire is very much the management of people, communities, and organizations. From the fire prevention behaviors of local residents, to the safety of fire crews, to the economic impacts and ecological benefits of wildland fire, fire management has social, economic, and cultural consequences. Hence there is a need for accurate and comprehensive understanding of the human dimensions of wildland fire.

The Hayman Fire certainly is a first-class example of large, severe fire that had and will continue to have significant impacts on social and economic systems. It directly impacted four Counties: Park, Jefferson, Douglas, and Teller. Some of the immediate impacts that are relatively easy to tally up include the destruction of 132 residences, one commercial building, and 466 outbuildings; estimated suppression costs of $39,100,000; and numerous resources threatened including communities, subdivisions, isolated homes, gas transmission lines, electrical facilities and lines, timber, the major watershed for Denver County and recreation areas (from the Hayman Fire Web site: http://wildfires.nwcg.gov/colorado/hayman/index.shtml.) Other impacts will be much more difficult to estimate or, in many cases, to predict with great confidence, for they will make themselves felt over the next several years. Examples include; reduced property values and property tax revenues (The Jefferson County assessor's office is reducing values by 50 percent for burned acreages and up to 100 percent for burned structures *Rocky Mountain News*, September 18, 2002); lost sales tax and business revenues from causes such as reduced tourism; damage to the health

of individuals and resultant costs, such as doctor and medical expenses; lost productivity – by evacuees, suppression volunteers and others; increased water treatment costs, both in terms of water quality and quantity issues; and nonmarket costs – including, aesthetics, habitat damage, reduced or lost recreation use, and reduced access. As a simple example of one of these questions, what will be the resultant damage to the blue ribbon trout fishery on the South Platte River and what will be the cost of this damage? Clearly, fully characterizing all of the monetary and nonmonetary impacts from the Hayman Fire especially in advance of when they occur will be difficult.

It is generally acknowledged that wildland ecosystems are complex and that there is much about the ways in which they function that humans do not understand. Perhaps less frequently recognized is the fact that human social and economic systems are also complex and in most cases, not fully understood. In terms of impacts from wildland fire, it may be easier to characterize ecological consequences than to characterize social/economic ones. In both cases some impacts such as those arising from the actual destruction by fire are relatively easy to determine. However, for social/economic systems, many other impacts are less obvious. In addition, simply identifying all of the components of social/economic systems that are impacted can be quite difficult. For example, in the case of the Hayman Fire, local and County governments in the four Counties directly affected were clearly impacted, as were residents in these areas. Beyond this, who else was affected and how?

As a closeout to this introduction, our team would like to point out that compared to other natural and human-caused environmental disasters such as hurricanes and floods, there is little social information and completed research results regarding wildland fire. In addition, social scientific data on the specific area impacted by the Hayman Fire is especially sparse. So when asked what we already know, what we are already doing, or what needs to be done it is hard to be specific. Organizations need to invest more in this area of research. For example, two of our team members have been working on a framework for monitoring the social/community impacts and recovery efforts associated with fires that took place in Forest Service Regions 1 and 4, but thus far have had little opportunity to test and refine this model. There is an urgent need and a real opportunity to learn how communities handle/react to a large wildfire. While work in other natural hazards can point to a variety of demographic and personal factors that are likely influential in understanding the social impacts of fire, it is important to establish information specifically related to wildfire.

We begin by looking at a preliminary formulation of a possible framework for organizing our thoughts about a social/economic analysis of the effects of a large-scale wildfire. We then describe four question areas that are considered in developing this analysis. We look briefly at the geographic scope of a social/economic analysis of the Hayman Fire. Next, we report on our findings for social and economic effects of the Hayman Fire. Then we turn our attention to a determination of what those individuals who live with the Hayman Fire and its aftermath every day have seen and learned. Next, we present some preliminary considerations pertaining to designs of social and economic monitoring systems for communities impacted by wildfire. We close with some conclusions and a review of key findings.

A Study Framework for Examining the Social/Economic Effects of the Hayman Fire

Our first step in trying to answer the above questions involved the definition of a study framework that facilitates identification of both Hayman Fire social/economic impacts and the individuals and organizations that were impacted. As an example of such a framework relating to social issues, Carroll and others (2000) conducted a social assessment for three Oregon communities that were impacted by wildfires on the Wenatchee National Forest in 1994. The primary purpose of their assessment was to determine the public's interest in fire recovery management on the Wenatchee in response to the 1994 fires. The framework they developed comprises five categories of people or organizations: (1) political coalitions such as those representing environmentalism and multiple use interests, (2) stakeholder groups such as civic leaders and residents directly effected by the fire, (3) residency tenure distinctions, or long timers and newcomers, (4) geographic divisions, or in town and up the valley, and (5) ethnic communities, or Latinos and non-Latinos. This framework of categories and descriptors was used to organize the data collected during interviews and also to help in understanding the data.

Butry and others (2001) modeled and analyzed the economic impacts of 6 weeks of large catastrophic wildfires that took place in northeastern Florida in 1998. Their framework consisted of seven categories of costs and losses: (1) presuppression costs, (2) suppression costs, (3) disaster relief expenditures, (4) timber losses, (5) property damage, (6) tourism-related losses, and (7) human health effects. As they note, this list is by no means complete, "as other potential costs and losses may exist (for example, lost wages, decreased quality of life, higher long-run fire expenditures, landscape rehabilitation, environmental degredation)."

Clearly, a social/economic framework designed for looking at most or all of the social/economic effects of

the Hayman Fire would be considerably more complex than either of these examples. In addition, a complete analysis of all the social/economic consequences of the fire would require substantial resources and several years to complete because of the time needed for all impacts to play out. However, due to the need to complete this analysis by March 2003, the scope of this analysis is both broader in focus and shallower in depth than the example studies. It is broader in that it looks at other issues (although by no means all possible issues) in addition to fire recovery and economic costs, and it is shallower in that none of these issues are examined in as much detail as were the impacts/issues addressed in the example studies.

Our social/economic team explored possible designs for a framework to use for this analysis. We wanted a framework that would help us identify the key social and economic factors to consider in designing our analysis. In addition, we felt this exercise would assist in organizing our thinking. The first framework we considered involved the identification of four dimensions (when, who, what, and where), and a set of parameters associated with each dimension (table 1). The first dimension – when impacts occurred or will occur – breaks the overall timeline into three periods, before, during and after the fire. The second dimension – who was impacted – much like the Wenatchee study, divides people into categories: individuals, nongovernment organizations, governments, and markets. The third dimension or what is impacted includes money, attitudes and behaviors. Finally, the fourth dimension – where the impacts are felt – includes neighborhoods, communities, Counties, multicounty areas, States, and the Nation. In this model or framework each unique combination of dimension and associated parameter is a component of the entire picture of social/economic impacts arising from the Hayman Fire and therefore is a candidate for analysis.

Table 1—Four dimensional (when, who, what, and where) framework for Hayman Fire Social/Economic Review.

Dimension	Parameter
1) When	Before the fire During the fire After the fire
2) Who	Individuals Non-governmental organizations Governments Markets
3) What	Money Attitudes Behaviors
4) Where	Neighborhoods Communities Counties Multi-county areas States Nation

This framework clearly could be developed further, for example, by recognizing that there is some overlap across dimensions; that is, some organizations (say, volunteer fire departments) might fall into the who, the where, and the what dimensions. However, the simple version in table 1 already suggests more analysis possibilities than we had either time or funding to carry out. Therefore, we needed to refine the list of possible analysis topics into a manageable set, and we did this by translating the dimensions and parameters in the above framework into a series of four question areas. The criteria we used were the importance of the questions within in each question area, and the ease with which we could collect and interpret relevant data, where possible, taking advantage of work conducted as part of other ongoing and related projects.

Question Areas Identified by the Social/Economic Analysis Team

Our analysis addresses portions of four broad question areas that the team identified based on the framework in table 1. We do not provide full answers to all aspects of these question areas – they are all many faceted and complex. The four areas are:

1. How do we begin to get a handle on the various economic effects (both during and after the fire) associated with the Hayman Fire? Specific examples include:

- How were money and other resources utilized in fire suppression and postfire rehabilitation (BAER) and in the initial responses to the fire by communities? How do these costs compare to historic costs for other fires? Are they reasonable when factoring in the values of property etc damaged or destroyed, other values (for example, water quality), and in relation to the costs of prevention of postfiredamage including erosion?
- What impacts to society were caused by the fire (for example, tourism including hunting/fishing, other economic impacts, aesthetics, and so forth)?
- What values may be assigned to things that are at-risk due to postfire erosion, including soils, water quality, and so forth?
- What impacts pertaining to businesses and governments were caused by the fire (for example, property, business revenues, income taxes, sales taxes, property taxes, and so forth)?
- What is the value of lost human productivity and human health costs resulting from the fire?
- What are the equity considerations (who paid vs. benefited and individuals versus organizations) as a result of the fire?

2. How have stakeholder positions toward fuel treatments been influenced by the fire; in other words, what were they prefire and during the fire, and what are they now? How do stakeholders partition blame for the fire among various possible organizations, climatic conditions, and so forth? How do we work to collectively make progress on implementing fuels management treatments to reduce the risk of another Hayman Fire along the Colorado Front range in the future?

3. What have individuals, organizations, and communities learned from the Hayman Fire experience, what changes have they adopted, and how sustainable are these adoptions? How has the collaborative HayRAC project worked to facilitate the beginning of recovery for affected communities? What needs for additional education remain; for example, what does the general public need to know about forest management? How do we capitalize on the "teachable moment" that will exist only for a short while to get important lessons across? Is there a need to educate many on a wide variety of issues relating to natural resource management/wildfires? How do we institutionalize memories of lessons learned from the Hayman incident, especially in the face of a rapidly changing/growing population? In other words, how do we enhance community preparedness for future wildland fires?

4. How would we design and implement a long-term social and economic monitoring protocol for community impacts, recovery/rehabilitation needs, and risk preparedness following the Hayman Fire? What pieces of such a plan could be put into place in the near future?

Geographic Scale of the Analysis

In thinking about the area directly affected by a wildfire it is natural to think first about the area burned. Certainly, many of the most significant impacts are found only here. In the social/economic arena the most obvious example is structures/homes damaged or destroyed. However, as we have suggested above, social/economic effects of a fire such as the Hayman, reach far beyond the burn area. Figure 1 provides a partial picture by illustrating the four Counties within which the fire occurred. This fire

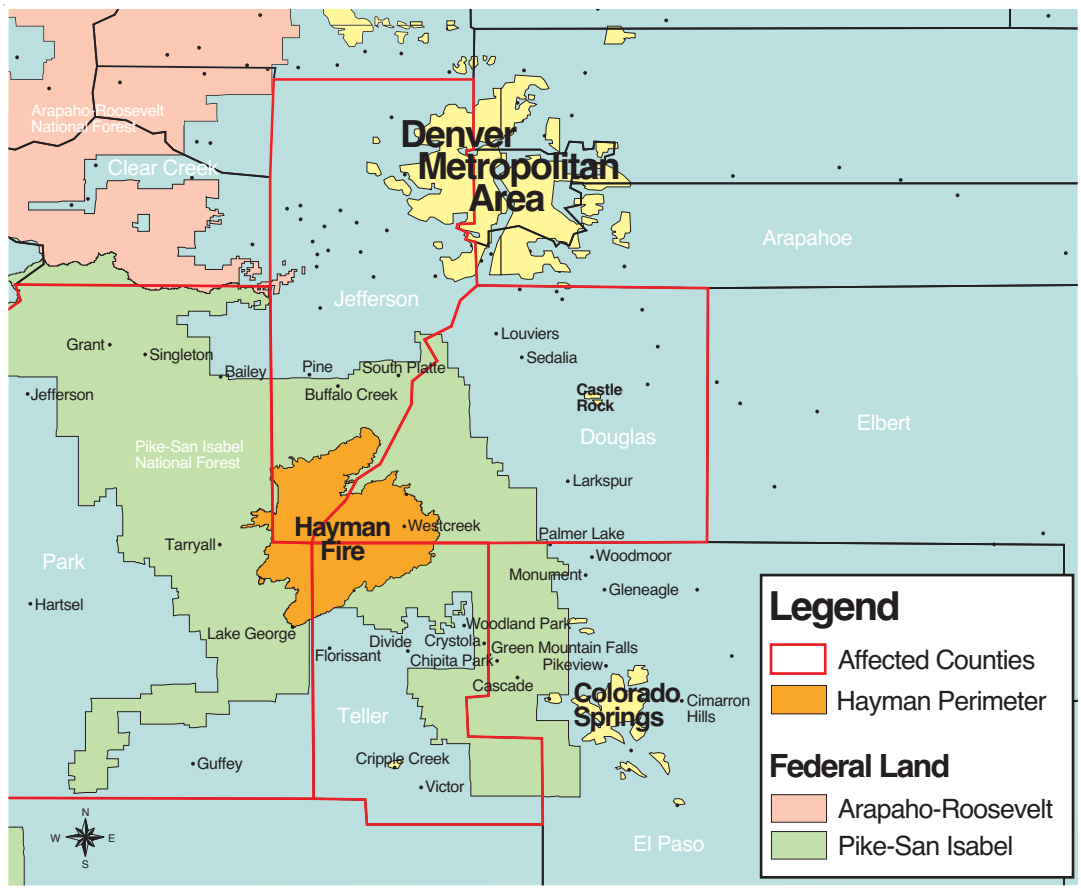

Figure 1—Map of the area influenced by the Hayman Fire from a social and economic perspective.

event has and will continue to make itself felt by virtually all social/economic systems in these Counties. Figure 1 also includes the Denver and Colorado Springs Metropolitan Areas as well as the area and communities in between. It is safe to say that many of these communities and their residents will also feel impacts from the fire, although perhaps not to the extent that residents of Park, Jefferson, Teller and Douglas Counties do.

As an example of the impacts on a community in the area, during the fire, consider the following. The city of Colorado Springs is the population and media center for southern Colorado. Although the fire did not reach the city, it directly impacted the city's emergency response resources and media. During the fire, the city committed operational and nonoperational resources to the effort. A task force of city engines was placed at the Rainbow Falls subdivision, and brush patrols were put in service along the shared boundary between the city and the Pike-San Isabel National Forest. The indirect impacts on the city included the threat to values at risk including water sources, communication sites and nonoperational resources. On June 19, Area Command tasked the Hayman East Type I Team (Vail, CO) with the production of a structure protection plan for El Paso County. (Information for this example was adapted from a letter from the Colorado Springs Fire Department, to RMRS Station Director Marsha Patton-Mallory, February 20, 2003.)

It is also safe to say that fire effects will stretch beyond the area shown in figure 1. As an example, there may be residents of other States who might have had a second or mountain home damaged or destroyed by the fire. Another example involves an individual or family that always vacationed in the area of the fire but no longer wishes to do so because of the loss of scenic beauty or some special favorite place.

Selected Economic Aspects of the Hayman Fire

The Hayman Fire was the largest recorded fire in Colorado's history, burning 138,114 acres in the four Counties of Douglas, Teller, Park, and Jefferson, with estimated suppression costs of over $42 million. Burned Area Emergency Rehabilitation (BAER) on Federal lands, including erosion control, noxious weed control, seeding, and so on, is expected to cost $24 million, with longer term restoration and rehabilitation projects estimated to cost another $37 million. Other related expenditures, such as rehabilitation on State and private land, water treatment, and evacuation costs add up to another $14 million. These costs, however, may be only a small part of the total cost of the fire. During the 41 days it took to control the fire, 600 structures burned, including 132 residences. The magnitude of other, less visible, effects is more difficult to assess. Water quality, erosion, tourism, property values, business revenues, income taxes, property taxes, and lost productivity are but some of the other values affected by the fire.

Though it is not really possible to assess the "total" economic cost of the Hayman Fire, or any large fire for that matter, it is important to be aware of the range of economic consequences associated with large wildfires. Another section in this case study entitled "A Framework for Anticipating and Understanding Economic Concerns Associated with Catastrophic Events Such as the Hayman Fire," presents an outline of the types of economic concerns that may be raised due to such an event. We have done our best to address many of these issues. Due to the limited time available to review the economic aspects of the Hayman Fire, however, it was not possible to complete such an indepth analysis. Instead, we tried to measure some of the more direct aspects, such as actual suppression and BAER expenditures, property losses, and changes in economic activity and resource values such as recreation visitation. Even these aspects have been difficult to assess within such a short period following the fire. For example, the most obvious economic aspect, the actual cost of suppression, may not be known for some time. On large fires, it is often 1 to 2 years before all of the actual expenditures are entered into the various agencies' accounting systems and all final accounting adjustments are made.

Methodology

Assessing selected economic aspects of an event such as the Hayman Fire can be a time-consuming and complex process. Analyses often take place several years after the event has occurred due to the time lag between the event and the availability of related economic data. Due to the timeframe for completion of this study, we restricted our analysis to those aspects for which we could collect adequate data in the time allotted. We collected information on the effect of the fire in four general areas: suppression and rehabilitation related expenditures, regional economic activity, property-related losses, and resource/output values.

Suppression and Rehabilitation Expenditures

We sought to answer two questions in this analysis: (1) how were money and other resources utilized in the Hayman Fire for suppression and postfire rehabilitation and (2) how do these costs compare to historic costs for other fires. To answer these questions we

looked at expenditures on the Hayman Fire from five perspectives: (1) fire suppression expenditures as detailed in the financial system, (2) rehabilitation and restoration expenditures (both expended and planned), (3) daily expenditures (for both suppression and BAER), (4) other fire-related expenditures, and (5) comparison of expenditures on the Hayman compared to other historic fires in the same geographic area or of the same size. All monetary units were expressed in terms of constant 2002 dollars, based on the Gross Domestic Product Implicit Price Deflator.

Hayman Suppression Expenditures: Financial System: Expenditures associated with a specific wildfire correspond to different phases of firefighting and postfire activities. The action taken by those first to arrive at a fire is entitled initial attack. Initial attack is carried out when a fire is still small and limited firefighting resources are needed. If a fire (or "incident") is not contained/controlled by initial attack forces within a reasonable period and more resources are needed, the second phase, extended attack, is entered. Extended attack generally involves fires less than 100 acres, when the incident is expected to be controlled within 24 hours (NWCG 1998). For both initial and extended attack, actual expenditures for individual fires are almost impossible to ascertain from the Forest Service's financial system. Fires less than 100 acres (termed ABC fires) are generally charged to a forest's generic, ABC miscellaneous P-code (accounting codes used to track fire-related expenses are entitled P-codes since they consist of a "P" followed by five numbers). One ABC miscellaneous P-code may have hundreds of small fires charged to it; therefore, under the current system there is no way to match the actual expenditures from the financial system with individual fires.

Due to the inability to ascertain initial and extended attack expenditures for the Hayman Fire directly from the financial system, we obtained estimates of these expenditures from the Incident Cost Accounting and Reporting System (ICARS), a software application that can be used on incidents to track resources and expenditures (ICARS 2002a). From the ICARS database for the Hayman Fire (ICARS 2002b), we obtained an estimate of daily expenditures by P-code, including estimated charges to the ABC miscellaneous P-code. However, because of the rapid progression of the fire, the line between initial and extended attack and expansion to a larger firefighting force is unclear in the ICARS data. There was $9 million worth of expenditures in ICARS that were not assigned a P-code of any kind. We approximated the amount spent on initial and extended attack by counting the first day of these uncoded expenditures as initial and extended attack activities, as well as counting the charges to the miscellaneous ABC P-code.

Once it is determined that a fire will not be contained within the first operational period, the transition is made to a larger, more complex firefighting force. When this happens, a fire is assigned its own unique P-code to track fire-related expenditures. Therefore, once it was determined that the Hayman Fire would pass the extended-attack phase, which actually happened the first day of the fire, it was assigned a unique P-code, thereby enabling detailed expenditure information to be obtained from the Forest Service's financial system. In fact, the Hayman Fire was actually assigned three unique P-codes during the course of the fire. The initial P-code was established the first day when it was determined that the fire would pass the initial/extended attack phase. On June 9, it was decided that because of the fire complexity, the fire would be split into two parts, on a north/south basis, and a second incident management team would be ordered. On June 11, the actual split was made and the second P-code for the North Hayman was assigned (the first unique P-code established June 8 was designated for the South Hayman). Starting on June 18, the fire made a run toward the eastside of the fire perimeter, jumping over Highway 67 in some places. The concern was that the fire might continue to move east, or even southeast toward the development of Woodland Park. At this time a third incident management team was assigned, as well as a third P-code, for what was now designated the East Hayman (Moore, personal communication).

In addition to Forest Service expenditures, we also collected expenditure information for the other agencies involved in fighting the Hayman Fire. All five Federal agencies with firefighting capabilities and responsibilities (USDA Forest Service, USDI Bureau of Land Management, Bureau of Indian Affairs, Fish and Wildlife Service, and National Park Service) contributed resources to fighting the Hayman Fire. Inquiries were sent to each of these agencies to obtain detailed fire suppression expenditure information from their financial systems. We also attempted to obtain expenditure information from the State of Colorado and the Counties involved in fighting the Hayman. However, we were unable to get anything other than a lump-sum figure of what the State and Counties spent; detailed information on the types of expenditures was unavailable at the time of this report.

Hayman Rehabilitation and Restoration Expenditures: In addition to expenditures spent fighting a fire, money is also spent after a fire for rehabilitation and restoration. BAER treatments, such as mulching, log erosion barriers, and seeding or scarification, are conducted within a short period after the fire (up to a year) to prevent erosion and control noxious weeds. Forest Service BAER expenditures associated with a given fire are given their own

accounting code, consisting of the same five numbers as the P-code assigned to the fire, preceded by an "H" instead of a "P". We obtained detailed BAER expenditure information for the Hayman Fire directly from the Forest Service's financial system. We also obtained BAER expenditures from the other involved Federal agencies as well as the Natural Resource Conservation Service (NRCS) and Denver Water. The NRCS provides grants to conduct rehabilitation on State, County, and private lands. These are matching grants, with the NRCS providing 75 percent of the project funding and the landowner providing the remaining 25 percent. Personnel from Denver Water provided data on rehabilitation efforts on lands within the Denver municipal water system.

In addition to BAER treatments, other longer term (1 to 5 years) restoration and rehabilitation projects are also carried out by the Forest Service to mitigate the effects of a fire. These projects include restoring trails, campsites, and watersheds. Information on these longerterm projects was obtained directly from the Pike-San Isabel National Forest.

Daily Suppression and BAER Expenditures on the Hayman: ICARS: Using the ICARS database for the Hayman Fire, we estimated daily expenditures for both fire suppression and BAER by resource type. We aggregated these data into seven resource categories: (1) aircraft – air tankers, helicopters, lead planes, and so forth, (2) crews – the actual hand crews fighting the fire, (3) camp support – resources to support activity at the camp such as vehicles, camp crews, facilities, and caterers, (4) direct personnel – Incident Command staff as well as any individual that has direct duties on or around the fire line, (5) indirect personnel – personnel other than direct personnel, (6) equipment – dozers, engines, water tenders, and so forth, and (7) supplies. These daily data were available from the start of the fire on June 8, 2002 to August 3, 2002, the last entry in the database. Consequently, daily estimates of suppression expenditures were available for the entirety of the suppression effort, but BAER expenditure estimates are not complete. Additionally, ICARS data were available for the South Hayman only; information on the North Hayman and the East Hayman are missing.

Other Expenditure Data: Data on FEMA reimbursements to Counties for roadblocks, traffic control, evacuations, and other nonsuppression fire expenditures associated with the Hayman were provided by the Colorado Department of Forestry. Red Cross expenditures for disaster relief on the Hayman Fire were calculated by Dennis Lynch, Forest Science, Colorado State University. The Red Cross provided Dr. Lynch with a consolidated cost for disaster relief for catastrophic fires in Colorado in 2002. He obtained information on the fires that were not evacuated and subtracted the acres burned on these fires from the total acres burned in Colorado in 2002. He divided the remaining acres (for evacuated fires) into the consolidated costs to calculate a cost per acre. He then used this cost per acre to arrive at an estimate of the amount spent by Red Cross on the Hayman Fire.

Historical Comparisons: Finally, to put the Hayman Fire into historic context, we needed historical data on fire expenditures and fire occurrence. Data on actual Forest Service expenditures (suppression and BAER) were obtained from Forest Service accounting systems (Central Accounting Data Inquiry—CADI (pre-fiscal year (FY) 2000) and Foundation Financial Information System—FFIS (FY 2000 and beyond)). Fire occurrence information such as acres burned was obtained from the National Interagency Fire Management Integrated Database (NIFMID).

Regional Economic Activity

The goal of our inquiry into regional economic aspects of the Hayman Fire was simple: we sought to describe historical economic activity in a multicounty impact area, by semidetailed industrial classification, and how that activity level changed during the fire and the months immediately thereafter. To accomplish this, we: (1) identified appropriate geographical impact areas; (2) identified economic activities and industrial sectors of concern; (3) specified an analytical procedure, complete with appropriate statistical tests; and (4) collected data needed to implement the analytical procedure.

Geographical Impact Areas: The Hayman Fire took place in central Colorado, and its extent touched on four Counties: Douglas, Jefferson, Park, and Teller. We term these Counties the Primary Impact Area, but clearly there are other geographical perspectives that should be addressed. For instance, there is an issue of displaced economic activity. Economic activity lost by a County in the Primary Impact Area might be gained by an adjacent County. We addressed this issue with a Secondary Impact Area consisting of the 13 Counties bordering the Primary Impact Area. This area includes Adams, Arapaho, Boulder, Broomfield, Chaffee, Clear Creek, Denver, Elbert, El Paso, Fremont, Gilpin Lake, and Summit Counties. Because of the dominating role of Denver County, we assessed the Secondary Impact Area with and without Denver County. Finally, because of the statewide notoriety of the Hayman Fire and concern over its effect on the entire state, our third geographical impact area was the entire State of Colorado.

Economic Activities: There are numerous ways of describing the economy of an area. At the national

level, measures derived from income and national product are common, such as national income and gross national product. Our analytical needs, however, required us to use measures of economic activity that were available: (1) for detailed industrial sectors, (2) by month, (3) for an extended period of time, and (4) at the County level. Those requirements excluded nearly all measures of economic activity. In the end, we selected three measures: wages (including salaries), employment, and retail sales. Data on wages along with employment are the basic data from which national income accounts derive. These data stem from ES-202 reports filed by employers as part of the Federal unemployment insurance process. Quarterly reports, containing monthly employment and wage information, are filed with the Colorado Department of Labor. These records do not cover the entire spectrum of economic activity because not all sectors and employers are liable for unemployment insurance payments. Importantly, employers with few employees and sole proprietorships do not file reports. Data on retail sales are collected by the Colorado Department of Revenue for purpose of calculating sales tax liability.

Economic Sectors: An economy is divided into numerous sectors, such as manufacturing, construction, and retail sales. There exist two taxonomies by which industrial sectors and related information are organized. Prior to 2000, the Standard Industrial Classification system (OMB 1987) was used throughout the United States. As a result of considerations prompted by the North American Free Trade Act, the North American Industrial Classification System was adopted for use in the United States, effective in 2000 (USDC-BOC 2003). Both systems are hierarchical, but the crosswalk between them is less than perfect. These industrial classification systems are important to our research because firms providing information on economic activity are classified under the hierarchical system, and economic information is aggregated and disaggregated according to the prescribed taxonomy. Although our time series data reflect both classification systems (SIC for 1999-2000 and NAICS for 2001-2002), we defined sectors according to the Standard Industrial Code. For purposes of our research, we chose to focus on entire economies of impact areas (that is, all industrial sectors) and on featured sectors. The sectors we chose to feature were the sectors thought to be most reflective of tourism and potentially most affected by the Hayman Fire. We chose to feature the Lodging sector (all SIC 70's, includes hotels, rooming houses, camps, and other lodging places), the Eating and Drinking sector (all SIC 58's), and the Recreation sector (all SIC 799's, including miscellaneous amusement and recreation services, such as physical fitness facilities, public golf courses, sports and recreational clubs, boat and canoe rental, hunting guides, and so forth).

Analytical Procedures and Tests: In a test-tube world, we would determine the effect of the Hayman Fire on regional economic activity by running the economy without the fire and rerunning it with the fire, the difference being the effect of the fire. In essence, we attempted to analytically model that difference. The first step was to develop statistical models describing the prefire economic activity situation. We collected monthly data (by economic activity, economic sector, and geographical area) from January 1999 through September 2002 (the most recent quarterly data then available). These data constituted the dependent variables ("Y").

Selection of independent variables was influenced by several considerations. Specifically, we wanted to model economic activity in the impact areas while accounting for: (1) national economy, (2) regional trends, (3) recent activity, (4) seasonal trends, and (5) the 9/11/2001 event. The general approach to independent variables was used consistently in all models with the intent of promoting statistical estimation efficiency and comparability of results:

USPCDPI =	United States Per Capita Disposable Personal Inc…accounts for trends in the national economy.
Colorado "Y" =	Equivalent economic activity for larger without impact area… accounts for statewide trends in economic activity.
"Y" lagged =	Economic activity for the impact area lagged one month …accounts for linkage between past and present activity.
Dummy variables =	June, July, August, December… accounts for seasonal differentials.
Dummy variable =	9/11 …accounts for change differential in economic activity.

For example, we built a statistical model to estimate lodging sector employment in the Primary Impact Area that used: (1) USPCDPI; (2) lodging sector employment in Colorado, excluding the Primary Impact Area; (3) lodging sector employment in the Primary Impact Area the previous month; and (4) five dummy variables to account for 9/11 and seasonal variation. All monetary units were expressed in terms of constant 2002 dollars, based on the Gross Domestic Product Implicit Price Deflator.

Using the variable configuration just described, we built 88 multiple linear regression models, one for every relevant combination of economic activity, industrial sector, and geographical area. These prefire models were based on data from January 1999 through

May 2002. We used all coefficients from these prefire models to estimate levels of economic activity for the fire months (June and July) and the postfire months (August and September). These estimates represented what could be expected to happen to regional economic activity without the Hayman Fire. We also had available the actual levels of economic activity, with the Hayman Fire. The deviation between the estimated level of economic activity (from the prefire models) and the actual level represented changes in economic activity occurring during the summer of CY 2002. We used the standard error of the estimate from the prefire models to establish 95 percent confidence intervals around deviations from the June to September estimates of economic activity. We noted whenever actual economic activity exceeded the bounds of the upper or lower confidence interval for the deviations.

Data Sources: Data needed to perform analyses of regional economic activity came from three sources. Data on United States per capita disposable personal income and the GDP implicit price deflator were developed by the USDC-Bureau of Economic Analysis (USDC-BEA 2003). Data on retail sales (CDR 2003) were provided by the Office of Tax Analysis, Colorado Department of Revenue (Donna Stepan). Data on salary, wages, and employment (CDL 2003) were provided by the Colorado Department of Labor (Bill Harris) through the Colorado Demographer's Office (Cindy DeGroen), as facilitated by the Forest Service's Inventory and Monitoring Institute (Susan Winter). Wage, salary, and employment data result from a mandatory, quarterly report. Final, third-quarter data were not available for the study, but the Colorado Department of Labor provided preliminary data.

Property-Related Losses

We contacted the County assessors in Douglas, Teller, Park, and Jefferson Counties and requested data on real property-related losses associated with the Hayman Fire. Each assessor's office provided estimates of total real property loss, assessed value of the property loss, and the effects of the loss in property value on County tax receipts. We also contacted the Rocky Mountain Insurance Information Association for data on insured property losses derived from a survey of major insurance companies. The Small Business Administration provided information relating to long-term, low-interest loans for uninsured property and business losses and the Federal Emergency Management Agency (FEMA) provided information on grants issued to individuals with specified losses associated with the Hayman Fire. A number of power lines were destroyed due to the Hayman Fire and Excel Power and Intermountain Rural Electric Association provided data on the value of these lost power lines.

Resource Outputs and Values

Resource outputs and values were divided into the effects of the Hayman Fire on: (1) tourism and recreation and (2) other resource outputs and values. Tourism and recreation information includes recent trend data for developed recreation sites, outfitters and guides, and campsite cancellations, as well as anecdotal information of individual tourism-related losses. Other resource outputs and values pertained to Forest Service resource losses, including timber, forage, water storage, fisheries and wildlife, and recreation.

Tourism and Recreation: Data for developed recreation sites (fee day use areas and campgrounds) came from reports provided by the two concessionaires that manage developed areas within the three affected Ranger Districts of the Pike-San Isabel National Forest (Pikes Peak, South Platte, and South Park Ranger Districts). The Rocky Mountain Recreation Company manages recreation sites within the Pikes Peak and the South Platte Ranger Districts, while Canyon Enterprises Inc. manages sites within the South Park Ranger District. Monthly visitation data were obtained for January 2000 through December 2002.

We also explored the effects of the Hayman Fire on visitation to several developed recreation sites outside the Pike-San Isabel National Forest but near the fire perimeter. All sites reviewed remained open throughout the Hayman Fire event. Monthly visitation data were obtained for January 2000 through December 2002 for Florissant Fossil Beds National Monument, Pikes Peak Cog Railway and Toll Highway, and Eleven-Mile State Park.

Actual use data for outfitters and guides with permits to operate on the three affected districts of the Pike-San Isabel were obtained from actual use reports and the Special Use Database System. These data are maintained at the individual Ranger Districts and are measured in terms of annual National Forest Service client days for 2000, 2001, and 2002.

Changes in dispersed recreation visitation patterns due to the Hayman Fire could not be identified. However, the National Visitor Use Monitoring Results (NVUMR) conducted on the Pike-San Isabel National Forest in 2001 provides reference visitation data for total visitation and wilderness visitation. Additionally, recent research into the effects of forest fires on dispersed recreation behavior was reviewed.

It is difficult to determine if individuals who had planned to visit areas closed due to the fire made alternative recreation plans, and where they went instead of the Pike-San Isabel National Forest. We explored the effects of the closure order on individuals who made reservations through Reserve America, a nationwide system that allows users to make reservations for Forest Service and other Federal land

campgrounds. All individual cancellations associated with the Hayman Fire closure were noted, as well as if subsequent reservation to an alternative campground within the system was made, and if so, the location of the subsequent reservation. Additionally, a survey question contained within the 2001 NVUMR report asked individuals what substitute behavior they would have participated in if the recreation area where they were interviewed had been closed.

Anecdotal information relating to financial losses associated with the Hayman Fire was obtained from telephone interviews with representatives from the Girl Scouts of America and the Lost Valley Guest Ranch. These organizations were identified as having been significantly impacted by the Hayman Fire.

Other Resources: Resource value losses to the Forest Service in terms of mature timber, forage, water storage, fisheries and wildlife, and recreation were estimated within the Wildland Fire Situation Analysis (WFSA) system by Ted Moore, Fire Management Officer, Pike and San Isabel National Forest. In discussion with Ted Moore, it was determined that the valuation of timber-related losses within WFSA was inadequate for our purposes; therefore, we estimated timber value losses by combining reports from the National Fire Management Analysis System (NFMAS) and fire intensity maps of the Hayman Fire event. The NFMAS system identifies estimated timber value loss by fire intensity level for the six forest management zones on the Pike-San Isabel National Forest that burned during the Hayman Fire. These results were overlaid with fire intensity maps to determine total timber value losses. The analysis using WFSA and NFMAS data provides a coarse overview of general long-term resource losses to the Pike-San Isabel National Forest. Information on specific short-term losses to the recreation and timber programs were provided by Lance Tyler, Recreation Program Manager, Pike-San Isabel National Forest, and Gary Roper, Timber Program Manager, Pike-San Isabel National Forest.

Results

The results that follow give an overview of some of the economic consequences of a fire as large and severe as the Hayman occurring in such proximity to populated areas. We have, in no way, attempted to measure the "total" economic consequences of this fire. Given the timeframe of this study, we restricted our analysis to those aspects for which we could collect adequate data in the time allotted. We collected information on the effect of the fire in four general areas: (1) suppression and rehabilitation related expenditures, (2) regional economic activity, (3) property-related losses, and (4) resource/output values. However, even in these four areas, the picture is somewhat incomplete. For instance, the cost of rehabilitation may not be known for years. Additionally, data on regional economic activity was available only through September of 2002; therefore, we were unable to conduct a long-term "after the fire" analysis. Any downturns, or upturns, in the economy could not be followed forward in time from the fire to see how the economy adjusted.

Suppression and Rehabilitation Costs: Before concentrating on the details of suppression and rehabilitation expenditures for the Hayman Fire, it might be helpful to step back and assess these expenditures in a broader context. Figure 2 shows fire suppression expenditures (2002$) by the Forest Service's Rocky Mountain Region (Region 2) from FY 1970 to 2002. It also shows the amount of money spent by all Forest Service firefighting organizations to suppress fires occurring in Region 2's geographic area (Colorado, Nebraska, Kansas, and parts of South Dakota and Wyoming) since 1995. Forest Service regional expenditures for fires can be thought of in two ways: (1) expenditures by the organizational unit known as a region (such as Region 2), which consist of expenditures for firefighting resources employed by that region regardless of where those resources are sent (within that region or to another region) or (2) expenditures on fires occurring within the region's geographical bounds regardless of who is sending and paying for the firefighting resources.

As can be seen, FY 2002 was an extremely expensive fire season for Region 2. Over the last three decades, Region 2's annual fire suppression expenditures averaged $8 million (not counting FY 2002). Before FY 2000, only 2 years—FY 1988 and FY 1996—saw expenditures as high as $20 million. Concentrating on the period from FY 1995 to 2001, for which we have data on both suppression expenditures *by* Region 2 (the organization) and *in* Region 2 (the geographic area), annual fire suppression expenditures by Region 2 averaged $14.5 million and Forest Service suppression expenditures for fighting fires in Region 2 averaged $16 million. FY 2002 was a record-breaking year. Expenditures spent fighting fires in Region 2 totaled $182 million, more than four times the amount spent in FY 2000, the next most expensive year. Although the $38 million in Forest Service expenditures accounted for only about 20 percent of this total, it is obvious that the Hayman Fire was expensive. More money was spent on suppressing the Hayman Fire than the total, yearly, suppression expenditures either by Region 2 or in Region 2 in any year except FY 2000 or FY 2002.

FY 2002 was also an extraordinarily expensive year for BAER (fig. 3) primarily due to the Hayman Fire. Previous to FY 1996, BAER expenditures by Region 2 averaged $140,000 per year (2002$). Starting in FY

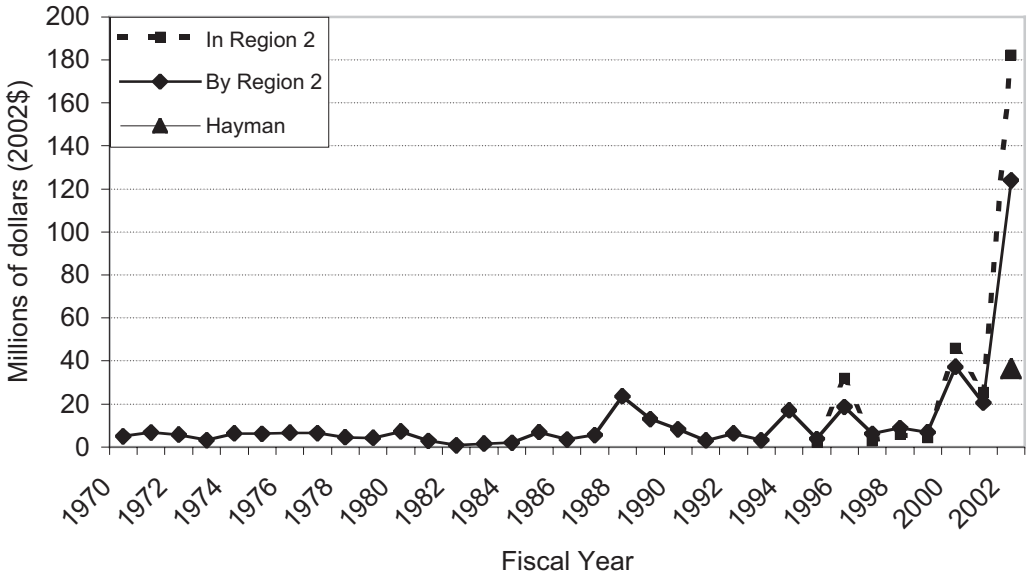

Figure 2—Forest Service fire suppression expenditures (2002$) - Region 2. (Source: USDA Forest Service financial accounting systems)

1996, BAER expenditures began to increase, averaging slightly more than $735,000 from FYs 1996 through 2001. In FY 2002, BAER expenditures by Region 2 reached $22 million, 29 times the 1996 to 2002 average, $14 million of which was attributable to the Hayman Fire.

Looking at the fire from another perspective, we might ask if the Hayman Fire was so expensive because it was so large or if it was so expensive because the cost per acre was much higher than average. If we take the initial $38 million spent by the Forest Service on this fire (before the cost-share agreement was finalized with the State of Colorado) and divide it by 137,760 acres, the cost per acre is around $273. According to NIFMID (National Interagency Fire Management Integrated Database), the fire reporting sys-

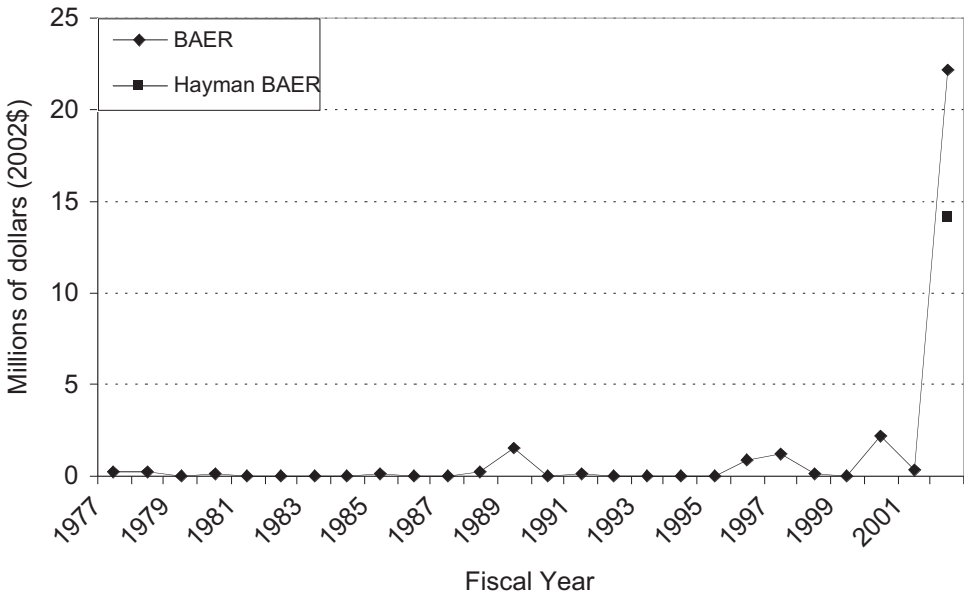

Figure 3—Forest Service, Region 2, Burned Area Emergency Rehabilitation expenditures (2002$). (Source: USDA Forest Service financial accounting systems)

tem used by the Forest Service, since 1970 the Forest Service has been involved in the suppression of 12 fires in Colorado which burned more than 10,000 acres: one in FY 1980, two in FY 1996, two in FY 2000, and seven in FY 2002. The cost per acre on these fires varied widely, from a low of $59 to a high of $522 (both in FY 2002).

Looking at the individual years, no cost information was available for the fire in FY 1980. For the two fires in FY 1996, each of which burned just a little over 10,000 acres, suppression expenditures were about $136 per acre (2002$), substantially less than the $273 per acre for the Hayman Fire. The two fires occurring in FY 2000, each of which also burned a little more than 10,000 acres, cost more than $300 per acre, $349 for one and $509 for the other (2002$), substantially more than for the Hayman Fire. In FY 2002, the cost per acre for the six fires (not counting the Hayman) reported in NIFMID was highly variable: one fire was below $100 per acre, three were between $100 and $200 per acre, and two fires were above $400 per acre. A study conducted by the Rocky Mountain Research Station (RMRS) of Forest Service fires in FY 1996 and 1997 in the western Forest Service regions of the United States (Forest Service Regions 1-6) (unpublished data on file at RMRS, Missoula, MT) showed that G+ fires (fires greater than 5,000 acres) averaged about $568 per acre, with costs ranging from $30 per acre up to $2,900 per acre. This average is significantly higher than the cost per acre for the Hayman Fire. When we restrict the analysis to fires burning 50,000 or more acres, the cost per acre averaged $211, less than the $273 per acre for the Hayman. Suppression expenditures vary widely from fire to fire because many factors have the potential of affecting per acre expenditures, such as topography, access, infrastructure, and the number of acres, though little empirical evidence exists to support these claims.

However, it should be noted that studies have shown that the cost per acre for suppressing fires tends to decline as the number of acres increases (see Schuster and others 1997). The reason for this is not known, but it is widely suspected that larger fires have a greater amount of unburned acres within their perimeter than do smaller fires, thus understating the true cost per acre. According to the Hayman BAER Team, 21,200 acres within the fire perimeter were unburned, or conversely, 116,400 acres were burned. The cost per acre computed using 116,400 acres rather than 137,600 comes to $324, higher than the two fires in FY 1996, but still lower than many of the other Colorado fires. The cost per acre of larger fires may also be lower due to economies of scale: fixed costs are spread out over more acres.

Based on these comparisons, the per acre cost of the Hayman Fire does not seem excessively high. It appears that the large amount of money spent to suppress this fire was largely due to the large land area burned rather than to an extremely high cost per acre. If this fire had occurred in a less populated area, the cost per acre may have been even lower. Much of the suppression effort, both because of the proximity to populated areas and the extreme fire behavior, was focused on protecting structures. Though the State of Colorado provided many of the resources for structure protection, even if we add their estimated expenditures, the cost per acre still is less than $300 per acre. The fact that the cost of structure protection is being spread over such a large acreage tends to make the cost per acre lower than if the same structure protection had been done on a smaller fire (Moore, personal communication).

Fire Suppression Expenditures on the Hayman: We turn now to the specifics of the Hayman Fire itself. From the ICARS data, it was difficult to distinguish initial or extended attack expenditures. The fire grew so rapidly that the line between initial and extended attack and large fire operations is blurred. Charges to the ABC miscellaneous P-code amounted to about $86,000; 65 percent was for hand crews and the remaining 35 percent was classified as support. However, there is also approximately $19,000 worth of estimated expenditures on the first day that were not assigned any sort of P-code in ICARS—74 percent of this was spent on hand crews, 13 percent on camp support, and 6 percent each on aircraft and direct personnel. Because of the difficulty of separating initial/extended attack from the large fire expenditures, the remainder of the report does not make the distinction between the two.

As of May 2003, the bill for suppressing the Hayman Fire came to approximately $42 million (table 2). Initially, expenditures by the Forest Service accounted for 89 percent of suppression expenditures. The Bureau of Land Management spent another $2 million, the State of Colorado spent $1.5 million, and the remaining Federal agencies spent relatively little on the fire.

The final determination of financial responsibility between the Forest Service and the State of Colorado, however, is determined through a cost-share agreement between the two agencies. Initial expenditures by the Forest Service are later allocated between the Forest Service and the State, mainly according to acreage, with a few exceptions. Aviation support costs for the first 72 hours (approximately $495,000) and the expenditures on the East Hayman (approximately $215,000) are to be split 50/50 between the Forest Service and the State. Remaining expenditures are to be allocated according to acreage, with 85 percent of the acres and, therefore, the expenditures

Table 2—Fire suppression and BAER expenditures, as of May 2003 by agency. (Source: USDA Forest Service and USDI financial accounting systems, Colorado State Forest Service)

	FS	BLM	BIA	FWS	NPS	State/local	Total
	Thousands of Dollars						
Before Cost-Share Agreement							
Suppression	37,698	2,265	196	148	397	1,527	42,231
BAER	23,709	—	—	54	48	—	23,811
After Cost-Share Agreement							
Suppression	31,886	2,265	196	148	397	7,339	42,231

Note: This table reflects agency expenditures as shown in the financial systems as of May 2003 and does not reflect the cost share agreement between the Forest Service and the state of Colorado.

being Forest Service responsibility and 15 percent State responsibility. The cost share agreement shows a total of $37,120,356, of which the Forest Service is accountable for $31,307,872 and the State of Colorado for $5,812,785. These numbers differ from the original expenditures shown in the top section of table 2, which are the expenditures showing up in the financial systems as of May 2003 and do not reflect any billing as a result of the cost share agreement. When all adjustments have been made, expenditures among agencies should be as shown in the bottom section of the table: approximately $32 million for the Forest Service and $7.3 million for the State of Colorado (the $5.8 million share of the initial Forest Service expenditures and $1.5 million of additional expenditures by the State). Additional expenditures ($578,000) showing up in the Forest Service's financial system after finalization of the cost share agreement have been added to the Forest Service amount, which is why the Forest Service expenditures shown in the bottom section of table 2 ($31,886,000) do not equal the amount stated in the agreement ($31,308,000). For the remainder of this report, Forest Service expenditures will reflect expenditures before any cost share adjustments since these adjustments are not yet reflected in the financial system.

To begin to answer the question of how money and other resources were utilized in the Hayman Fire for suppression, we broke down the expenditures by each Federal agency into four categories: Personnel Compensation (including benefits), Personnel Travel, Supplies and Services, and Other. A breakdown of expenditures by category was not available for the State expenditures, so the following discussion does not include State expenditures. Overall, about 23 percent of expenditures were for Personnel Compensation, including base pay, overtime, hazard pay, and so on (table 3). Supplies and Services, which include contractual services such as flying contracts, catering services, and so on, as well as cooperative agreements with State agencies, accounted for 74 percent of expenditures. In other investigations of fire suppression expenditures undertaken by the RMRS (unpublished analyses on file at RMRS, Missoula, MT),

Table 3—Fire suppression expenditures for the Hayman Fire, by category and Federal agency, as of May, 2003. (Source: USDA Forest Service and USDI financial accounting systems)

	Agency					
Category	**FS**	**BLM**	**BIA**	**NPS**	**FWS**	**Total**
	Thousands of dollars					
Personnel compensation	6,987	1,537	160	344	127	$9,155
Personnel travel	1,121	130	7	37	20	$1,316
Supplies and services	29,502	423	29	16	1	$29,971
Other	88	175	—	—	—	$263
Total	$37,699	$2,265	$196	$397	$148	$40,705

Note: Breakdown by expenditure category not available for State/local expenditures. Also, Forest Service expenditures do not reflect any adjustments due to the cost share agreement between the Forest Service and the State of Colorado.

expenditures on Personnel Compensation averaged somewhere around one-third of total expenditures, indicating relatively less money was spent on the Hayman Fire for personnel expenses and more for contractual services, such as flying contracts, than is usually the case. The distribution of expenses for the Hayman, however, varies widely by agency. For the Forest Service, personnel expenses made up only 19 percent of the total, with nearly 78 percent of expenditures going to supplies and services. Conversely, the other Federal agencies spent the vast majority of their money on personnel expenses, with Personnel Compensation ranging from 68 percent for the Bureau of Land Management to a high of 87 percent for the National Park Service.

To gain further insights into how money was spent suppressing the Hayman Fire, table 4 shows the breakdown of Forest Service expenditures by major BOC (budget object class) and by P-code (South Hayman, North Hayman, East Hayman). (Budget object classification codes are used by the Federal government to record its financial transactions according to the nature of services provided or received when obligations are first incurred; classes consist of major budget object classes, at the two-digit level, such as 1100, 2500, and so forth, with more specific breakdowns at the three- and four-digit level, such as 1101, 2540, 2541,and so on). For the categories containing the majority of expenses, a more detailed breakdown is provided in table 4. Other agencies are not included

Table 4—Forest Service fire suppression expenditures on Hayman Fire as of May 2003 by budget object category and incident. (Source: USDA Forest Service—Foundation Financial Information System)

Major BOC	Description	Expenditures (thousands of dollars)							
		South Hayman		North Hayman		East Hayman		Total	
		Dollars	Pct of total	Dollars	Pct of total	Dollars	Pct of total	Pct of Dollars	total
0200	**Internal Transactions**	**20**	**<0.1**	**—**		**—**		**20**	**<0.1**
1100	**Personnel Compensation**	**4,905**	**17.8**	**1,369**	**13.9**	**101**	**47.0**	**6,375**	**16.9**
*1101**	*Regular pay - FT-permanent employees*	*960*		*285*		*27*			
1121	*Regular pay – FT-temporary employees*	*262*		*94*					
1165	*Hazard pay*	*282*		*81*					
1170	*Overtime*	*2,466*		*718*		*58*			
1193	*Casual employment*	*802*		159		8			
1200	**Personnel Benefits**	**463**	**1.7**	**139**	**1.4**	**11**	**5.1**	**613**	**1.6**
2100	**Travel/Transportation of Persons**	**788**	**2.9**	**301**	**3.0**	**32**	**14.9**	**1,121**	**3.0**
2200	**Transportation of Things**	**207**	**0.7**	**4**	**<0.1**	**—**		**211**	**0.6**
2300/ 2400	**Rent,Communications, & Utilities/Printing**	**684**	**2.5**	**43**	**0.4**	**11**	**5.1**	**738**	**2.0**
2500	**Other Services**	**19,407**	**70.3**	**7,825**	**79.3**	**51**	**23.7**	**27,283**	**72.4**
2540	*Contractual Services - Other*	*7,850*		*4,567*		*21*			
2541	*Flying Contracts*	*7,250*		*2,723*		*10*			
2550	*Agreements*	*1,475*		*82*					
2551	*Cooperating State Agencies*	*919*		*291*					
2600	**Supplies/Materials**	**1,080**	**3.9**	**180**	**1.8**	**9**	**4.2**	**1,269**	**3.4**
4100	**Grants/Subsidies/ Contributions**	**52**	**0.2**	**11**	**0.1**	**—**		**63**	**0.2**
4200	**Insurance Claims/ Indemnities**	**5**	**<0.1**	**<1**	**<0.1**	**—**		**5**	**<0.1**
4300	**Interest/ Dividends**	**<1**	**<0.1**	**<1**	**<0.1**	**—**		**<1**	**<0.1**
Total		**$27,612**	**100%**	**$9,872**	**100%**	**$215**	**100%**	**$37,698**	**100%**

*Detailed breakdown within major BOC only for categories with substantial expenditures; detailed expenditures will not add up to major categories.
Note: FS expenditures do not reflect any adjustments due to the cost share agreement between the FS and the State of Colorado.

in the BOC breakdown because the Forest Service was responsible for the vast majority of the expenditures. Appendix I provides a detailed description of the BOCs discussed below.

The categories "Other Services" (BOC 2500), which includes contractual services such as flying contracts and catering services, and Personnel Compensation and Benefits (BOCs 1100 and 1200), account for 91 percent of expenditures. Travel (BOC 2100), Rent, Communications and Utilities/Printing (BOCs 2300 and 2400), and Supplies and Materials (BOC 2600) each accounted for another 2 to 3 percent of suppression expenditures and included items such as equipment rental, domestic transportation, car rentals, general supplies and materials, and office supplies.

Nearly three fourths of Forest Service expenditures ($27.2 million) was spent on "Other Services" - 46 percent of these expenditures ($12.4 million) were coded as "Contractual Services – Other" (BOC 2540) and 37 percent ($10 million) as "Flying Contracts" (BOC 2541). "Contractual Services – Other" is a budget object classification code used for contractual services not otherwise classified in the budget object class system, and may include such items as mobile food, mobile commissary, and shower facilities. A large amount of expenditures can get charged to a general category, such as "Contractual Services – Other" for two reasons. First, there may not be a finer breakdown for a particular expense, such as shower facilities. Second, personnel entering expenditures into the financial system may use the more general two- or three-digit class rather than coding the expenditures at a more specific level, the four-digit class, even if a more specific classification exists. This causes problems in interpreting the data from the financial system. For instance, the 37 percent of expenditures coded as "Flying Contracts" may not be the only expenditures for flying contracts. Flying contracts may be entered under the more specific BOC 2541, or under the more general BOC 2540. It may be, therefore, that some flying contract expenditures are included in the $12 million for BOC 2540. However, the expenditures from the financial system roughly compare with the proportion of expenditures spent on aircraft from the ICARS data, indicating that the coding in the financial system was probably done correctly. The BOC data from the financial system shows that 26 percent of total expenditures were coded to BOC 2541, Flying Contracts. The ICARS data show that 25 percent of suppression expenditures were spent on aircraft. The rest of the expenditures in the category "Other Services" were mainly spent on Agreements (BOC 2550) and Agreements with Cooperating State Agencies (BOC 2551).

The majority (51 percent) of the $6.4 million spent on Personnel Compensation was for overtime (BOC 1170). Regular base pay, including salaries for full-time permanent employees (BOC 1101), full-time temporary employees (BOC 1121), and casual employees (BOC 1193) made up another 40 percent of personnel expenditures, with hazard pay (BOC 1165) accounting for 6 percent. Other types of personnel expenditures accounted for less than 2 percent of personnel expenditures.

Looking at the breakdown of expenditures by P-code, more than 73 percent ($27.6 million) of the expenditures on the Hayman Fire were connected with the South Hayman (table 4). The North Hayman accounted for another $9.9 million, while only $215,000 was spent on the East Hayman. As indicated earlier, the East Hayman was set up in case the fire made an eastern run. Charges to the East Hayman occurred only on June 18, 19, and 20. A third Incident Command Team was brought in to meet with community leaders and local fire departments to get agreements in place and to set up a good contingency structure protection plan.

The distribution of expenditures by BOC varies somewhat by P-code. The South Hayman and North Hayman distributions were similar; although somewhat more was spent on Personnel Compensation on the South Hayman and somewhat more was spent on Other Services on the North Hayman. However, the breakdown for the East Hayman varied substantially from the other two. Nearly one-half of all expenses on the East Hayman were for Personnel Compensation, while only 24 percent was for Other Services. Travel/Transportation of Persons accounted for about 15 percent of expenditures on the East Hayman, rather than 2 to 3 percent, as seen on the North and South. The vast difference in the distribution for the East Hayman was because the expenditures were for contingency planning, not fighting fires, meaning no firefighters were assigned, but a lot of overhead and travel expenditures were incurred.

Another way to differentiate among expenditures focuses on who spent the money. This question was answered in an agency context early in this section, where we showed that the Forest Service was responsible for more than 89 percent of suppression expenditures. Now we ask the question: how were the expenditures distributed among Forest Service organizational regions. Though all Forest Service regions may send resources to fight a particular fire, it is expected that the regional organizational unit corresponding to the geographic region in which the fire occurs would incur the majority of the suppression expenses. Region 2, as expected, did incur the majority of the expenses (62 percent) (table 5). Region 15 accounted for another 27 percent of the expenditures. Region 15 is an accounting region designated for tracking national contracts, a new accounting procedure tried out for the first time in

Table 5—Forest Service fire suppression expenditures on Hayman Fire, as of May 2003 by Forest Service Region. (Source: USDA Forest Service – Foundation Financial Information System)

Region	Expenditures (thousands of dollars)	Pct of total expenditures
1 – Northern	82	0.2
2 – Rocky Mountain	23,513	62.4
3 – Southwestern	131	0.4
4 – Intermountain	93	0.2
5 – Pacific Southwest	1,392	3.7
6 – Pacific Northwest	1,479	3.9
8 – Southern	51	0.1
9 – Eastern	64	0.2
10 – Alaska	372	1.0
13 – National Interagency Fire Center	219	0.6
15 – National contracts	10,270	27.2
Other	32	<0.1
Total	$37,698	100%

Note: FS expenditures do not reflect any adjustments due to the cost share agreement between the FS and the State of Coloroado.

FY 2002. Of the $10 million spent on these national contracts, at least $8 million was for flying contracts with another $2 million being coded to "Contractual Services - Other" that consists mainly of expenditures on mobile food, mobile commissary, and shower facilities. The percentage of total expenditures on the Hayman accounted for by the remaining regions ranged from a low of 0.1 percent for the Southern Region to 3.9 percent for the Pacific Northwest Region.

Thus far, we have looked at suppression expenditures on the Hayman Fire in total as described using data from the financial system. From the ICARS data for the South Hayman, we were able to get a picture of how resources and dollars were expended over the course of the fire. Once the fire began, daily expenditures increased rapidly due to the speed with which the fire grew. Suppression expenditures reached a peak of $1.2 million per day on June 18, 2002, a day of extreme fire weather and increased fire activity (fig. 4). After June 18, daily expenditures began to drop due to the arrival of monsoon weather, after which the fire made little progression. Expenditures

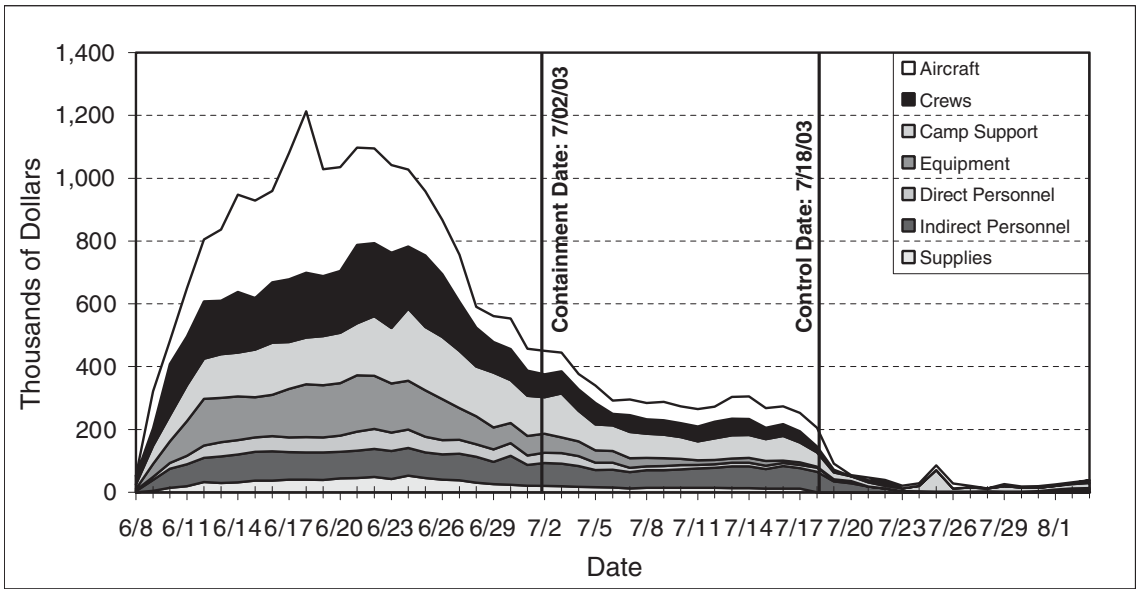

Figure 4—Estimated daily fire suppression expenditures for the Hayman fire by kind, as of August 3, 2002. (Source: USDA Forest Service Incident Cost Accounting and Reporting System)

still were running above a $1 million per day up until June 25, but then began to decrease more rapidly. The Hayman Fire was declared contained on July 2, 2002, which meant a containment line had been established around the entire perimeter and the fire was not expected to increase in size past natural or human made barriers. At this time, estimated expenditures were around $450,000 per day. From the time the fire was declared contained until it was declared controlled on July 18, expenditures averaged $305,000 per day. After the declared control date, expenditures fell substantially, dropping below $100,000 per day with an average of $36,000 per day.

Figure 4 also shows the type of resources used each day. Aircraft expenditures made up the majority of the expenses up until June 24. After that, until about July 22, the majority of expenditures were for camp support or direct and indirect personnel (mainly indirect). Although overall expenditures peaked on June 18, aircraft was the only category to also peak on that day. Indirect personnel peaked earlier, on June 16, although expenses in this category remained fairly consistent until the fire was controlled. The rest of the categories reached their peaks between June 22 and June 24.

Rehabilitation and Restoration: Once the fire was declared contained on July 2, the BAER work began (fig. 5) (although a small amount was spent before this). BAER expenditures increased substantially once the fire was declared controlled on July 18, reaching a high of $208,000 per day on July 29. By August 3 (the last day for which ICARS data were available), daily BAER expenditures had dropped to around $100,000 per day. After August 3, we do not have a daily account of estimated BAER expenditures.

Looking at the daily BAER expenditures in more detail (fig. 6), we can see that until the control date of July 18, the majority of BAER expenditures were for crews. After the fire was declared controlled, most expenditures were for camp support, followed by indirect personnel, and then crews. Expenditures on aircraft were small and only occurred for a few days, July 27 through July 29.

Estimated daily expenditures from ICARS provided a picture of BAER expenditures only up to August 3, 2003. Expenditures obtained from the financial system provide information on overall expenditures (table 6). BAER expenditures as of May 2003 were mainly for "Other Services" (BOC 2500), accounting for 85 percent of the total $24 million of expenditures. The majority (92 percent) of "Other Services" are coded as "Contractual Services – Other" (BOC 2540), with another 5 percent ascribed to Miscellaneous Services and 2 percent to Agreements. Only 8 percent of BAER expenditures were for personnel expenses, with the largest amount of that going to overtime (BOC 1170). This overall expenditure pattern corresponds to the pattern of expenditures in the ICARS data, where the largest expenditure categories were

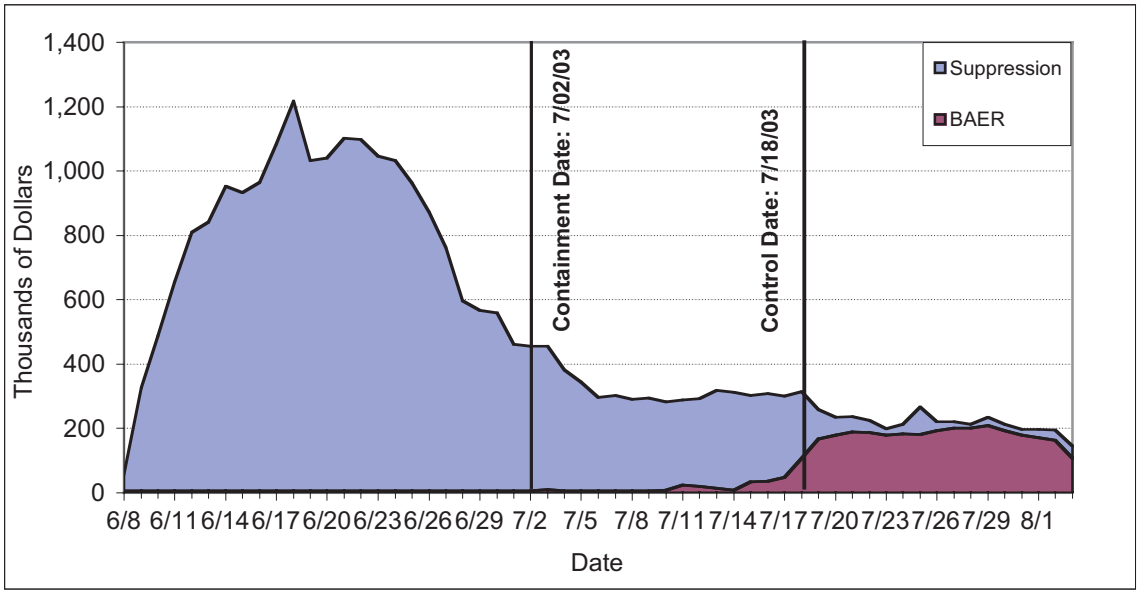

Figure 5—Estimated daily fire suppression and Burned Area Emergency Rehabilitation expenditures for the Hayman fire, as of August 3, 2002. (Source: USDA Forest Service Incident Cost Accounting and Reporting System)

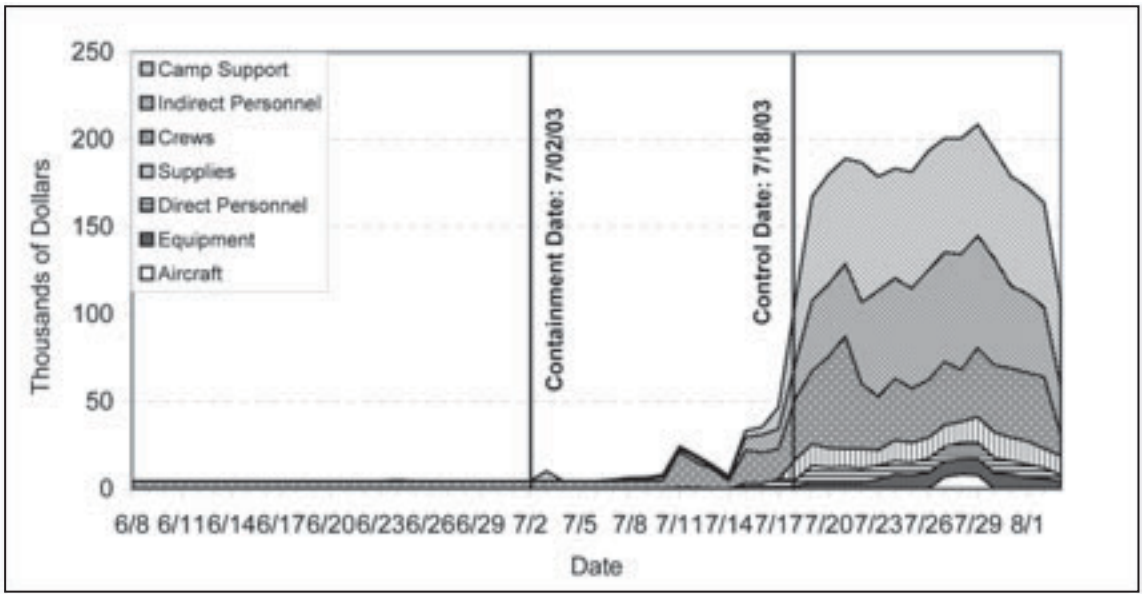

Figure 6—Estimated daily Burned Area Emergency Rehabilitation expenditures for the Hayman fire by kind, as of August 3, 2002. (Source: USDA Forest Service Incident Cost Accounting and Reporting System)

Table 6—Forest Service BAER expenditures on Hayman Fire as of May 2003 by budget object category. (Source: USDA Forest Service – Foundation Financial Information System)

Major BOC		Description	FS expenditures (thousands of dollars)	Pct of total FS expenditures
1100		**Personnel Compensation**	**1,825**	**7.7**
	*1101**	*Regular pay - Full-time permanent employees*	*469*	
	1121	*Regular pay – Full-time temporary employees*	*60*	
	1170	*Overtime*	*665*	
	1193	*Casual employment*	*480*	
1200		**Personnel Benefits**	**177**	**0.7**
2100		**Travel and Transportation of Persons**	**340**	**1.4**
2200		**Transportation of Things**	**45**	**0.2**
2300/2400		**Rent/Communications/ Utilities/Printing**	**688**	**3.0**
2500		**Other Services**	**20,253**	**85.4**
	2540	Contractual Services - Other	*18,688*	
	2550/2559	Agreements	*439*	
	2570	*Miscellaneous Services*	*1,037*	
2600		**Supplies and Materials**	**367**	**1.5**
3100		**Equipment**	**10**	**<0.1**
4200/4300		**Insurance Claims & Indemnities/Interest & Dividends**	**4**	**<0.1**
Total			**$23,709**	**100%**

* Detailed breakdown within major BOC only for categories with substantial expenditures; detailed expenditures will not add up to major category totals

Camp Support and Indirect Personnel, both of which likely fall under BOC 2540—Contractual Services-Other.

In addition to BAER projects, other longer term (1 to 5 years) rehabilitation and restoration projects are also planned by the Forest Service in connection with the Hayman Fire. These projects fall under one of seven categories: (1) land and facilities, including trail and road reconstruction, campground and heritage site reconstruction and restoration, (2) habitat restoration, (3) forest health, including noxious weed control, (4) planning and administration, (5) reforestation, (6) watershed restoration, and (7) research projects, such as analyzing soil productivity and the effectiveness of rehabilitation. Nearly $37 million in rehabilitation and restoration projects are planned by the Pike-San Isabel National Forest in connection with the Hayman Fire (table 7), but these projects will only be completed if funding is forthcoming. Approximately a third of this is due to be spent in FY 2003 if funds are available. However, at the time of this report, the Pike had received only $2.95 million in funding from Region 2 for FY 2003 projects. The Pike-San Isabel National Forest is planning on spending the largest amount of money on projects connected with land and facilities ($13.7 million), followed by reforestation at $9.9 million. Research projects make up only $360,000 of the proposed expenditures, with the remaining categories slated for spending of $2 million to $4 million.

Rehabilitation and restoration projects are also occurring on State, County, and private land in connection with the Hayman Fire. Table 8 shows the magnitude of the expenditures connected with these projects.

Table 7—Forest Service rehabilitation and restoration costs associated with the Hayman Fire, by project type. (Source: Pike-San Isabel National Forest)

Project type	FY 2003	Total cost
Land and facilities	5,215,700	13,748,700
Habitat restoration	2,163,900	4,493,800
Forest health	816,500	2,827,500
Planning and administration	1,264,100	3,424,300
Reforestation	243,100	9,896,300
Watershed restoration	509,000	2,026,300
Research projects	255,000	359,500
Total	$10,467,300	$36,776,400

Table 8—Other expenditures associated with suppression and rehabilitation of the Hayman Fire. (Source: NRCS, Colorado; Denver Water; Colorado State Forestry Department)

		Dollars
NRCS Grants [1]	**Rehabilitation of state/county/private lands**	**10,802,800**
Denver Water [2]	Emergency Rehabilitation Immediately following the fire EPA Matching Grant Monitoring and lab work Water treatment	1,300,000 830,000 15,000 85,000
FEMA	Reimbursement to counties for road blocks, traffic control, evacuations, and other non-direct suppression expenses	1,099,679
State of Colorado	Administrative expenses for handling billing of counties and other cooperators	48,906
American Red Cross [3]	Estimated expenditures on Hayman Fire evacuees	765,940

[1] Matching grants: 75% NRCS, 25% land owner for a total of $10,802,800.
[2] Does not include $3.2 million matching NRCS grant ($2.4 million NRCS, $0.8 million Denver Water), which is included in the $10.8 million for NRCS.
[3] Provided by Dennis L. Lynch, Forest Sciences, Colorado State University – prorated from consolidated statewide costs.

NRCS is funding rehabilitation on State, County, and private lands with a matching grant program. NRCS provides 75 percent of the funding and the landowner provides 25 percent. These projects are to protect properties from damage related to increased sediment and/or flooding and to reduce erosion. In order to qualify for funding, the value of the property must be in excess of what it will cost to do the rehabilitation work. Recipients of these matching grants include Denver Water, the State of Colorado, the four involved Counties, numerous camps, such as the YMCA, and private landowners. In some cases, landowners are able to do volunteer work, such as seeding, to pay for their 25 percent of the project.

Estimates of rehabilitation and treatment expenditure by Denver Water in connection with the Hayman total about $5.4 million, $3.2 million of which is to be funded through the matching grant program with NRCS ($2.4 million from NRCS and $0.8 million from Denver Water) (Table 8). Denver Water expects that water treatment expenditures will be less for the Hayman than for the Buffalo Creek fire that occurred in 1996 because a majority of the sediment is being trapped at Cheesman Reservoir. Stroncha Reservoir downstream from the Cheesman Reservoir is the primary treatment intake for Denver Water. However, it is still unknown what the long-term effects on water quality will be.

Other Fire-Related Expenditures: In the course of our investigation, we also came upon several other categories of expenditures connected with the Hayman Fire, but not directly related to suppression or rehabilitation (table 8). The Counties involved expect to receive a reimbursement from FEMA for fire-related activities, such as roadblocks, traffic control, and evacuations, amounting to $1.1 million. The State of Colorado spent $48,906 on administrative expenses connected with the fire, such as handling the billing for the Counties and other cooperators. Also, according to Dennis Lynch of Colorado State University, the American Red Cross spent an estimated $766,000 on disaster relief for Hayman Fire evacuees.

Regional Economic Activity

The Hayman Fire burned during the months of June and July in the summer of CY 2002. When finished, the fire touched on land in Douglas, Jefferson, Park, and Teller Counties, which we refer to as the Primary Impact Area (fig. 7). The 13 Counties adjoining the Primary Impact Area are referred to as the Secondary Impact Area. Our inquiry into regional economic aspects of the Hayman Fire intended to describe historical economic activity in a multi-County impact area, by semidetailed industrial classification, and how that activity level changed during the fire and several

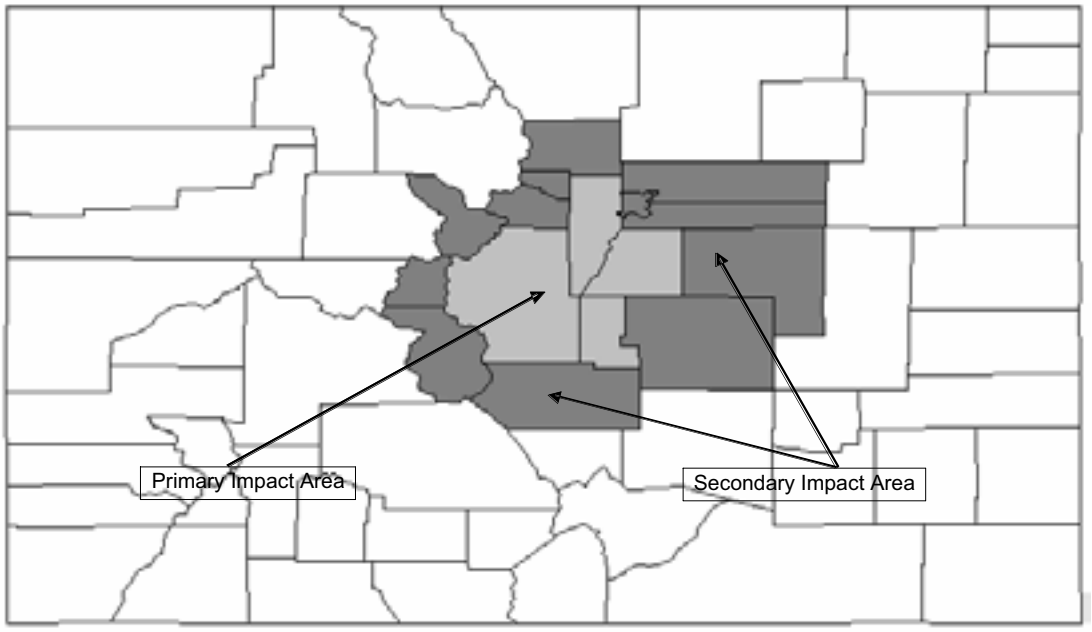

Figure 7—State of Colorado and impact areas.

months thereafter. We focused on the overall economies and tourism-related economic activity in the Primary Impact Area, the Secondary Impact Area, and the State of Colorado. We measured economic activity by wages, employment, and retail sales. Where appropriate, monetary units are expressed in terms of constant, CY 2002 dollars.

In terms of analysis of regional economic activity, we attempted to analyze the direct economic effect of events during the summer of 2002. A typical regional economic analysis would interpret direct economic effects in light of associated indirect and induced effects. Because of ambiguities surrounding the direct economic effects, we chose to not assess secondary effects. Questions may arise as to the relationship between the firefighting expenditures previously discussed and the direct economic effects now being discussed. The relationship is somewhat murky. Firefighting expenditures may or may not affect local economies. That is because some expenditures are associated with national contracts, such as some aviation and food service contracts. Expenditures on these contracts can go to the contractor's corporate office, regardless of where the fire is located. Similarly, firefighter paychecks can be electronically deposited in home bank accounts, unrelated to where the fire is located. This economic activity (employment and wages) will show up in economic accounts at the firefighter's home location. However, some firefighting expenditures make their way into local economies through retail sales. These expenditures have been captured in our analysis.

Prefire Economies: When the Hayman Fire burned into the four-County Primary Impact Area, it affected a geographical area that constitutes a substantial portion of the Colorado economy. According to the Colorado Department of Labor, businesses in the Primary Impact Area employed about 13 percent of the workers and paid about 12 percent of the wages in CY 2001 (CDL 2003). Similarly, according to the Colorado Department of Revenue, the Primary Impact Area accounted for about 15 percent of Colorado's retail sales in CY 2001 (CDR 2003). In consideration of brevity, much of the following discussion will portray economic activity in terms of wages. Discussions of employment and retail sales would be quite equivalent.

The importance of economic activity in the Primary Impact Area is due to Jefferson County. It overwhelms the other Counties, constituting about 75 percent of the wages paid in CY 2001. Douglas County constituted about 22 percent of the wages; Teller County paid about 2 percent; and Park County about 1 percent.

A profile of the Primary Impact Area's economy in CY 2001 is quite reflective of the Colorado economy in general. In fact, the top three sectors of the two economies are the same—Services, Manufacturing, and Retail Trade, in that order. About 34 percent of the wages in the Primary Impact Area were paid by employers in the Services industry (fig. 8), while these sectors accounted for about 37 percent in the Colorado economy. Retail Trade accounted for about 13 percent of the wages paid in the Primary Impact Area and

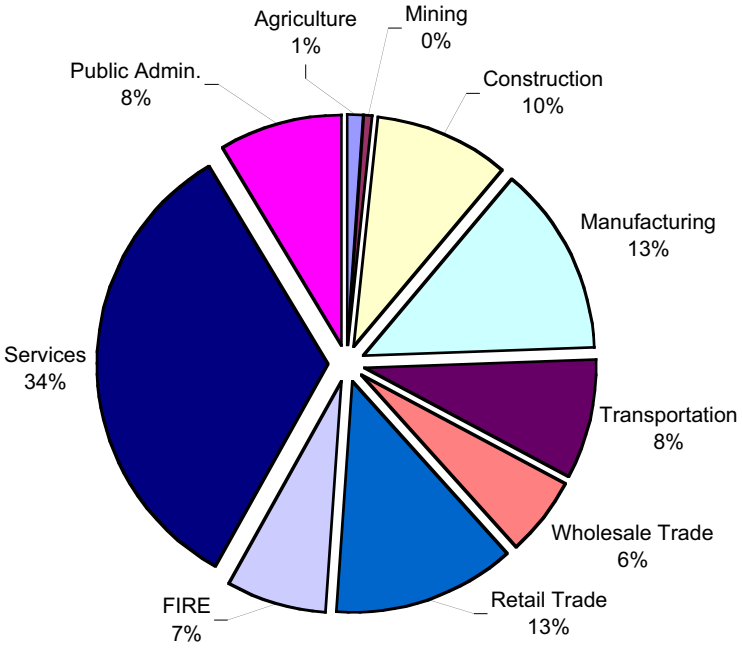

Figure 8—Percent distribution of industry divisions in economy of primary impact area, 2001. (Source: Colorado Department of Labor)

about 10 percent for the State of Colorado. Services and Retail Trade is important to our analysis because the Services industry contains two of our featured economic sectors, Lodging and Recreation, while the Retail Trade industry contains Eating and Drinking establishments.

Because of the dominant role it plays in the Primary Impact Area, the distribution of industrial sectors in Jefferson County closely approximates that of the Primary Impact Area. Moreover, the sizeable role of the Services industry is reflected in all Counties of the Primary Impact Area (fig. 9). But that is where similarities end. The second largest industry, in terms of wages, is Manufacturing for Jefferson County, Construction for Park County, and Retail Trade for Douglas and Teller Counties. These distributions are important to our analyses because the Construction and Manufacturing industries, so important to Park and Jefferson Counties, are not part of our featured, tourism-related industrial sectors.

Our focus on the Eating and Drinking, Lodging, and Recreation sectors is a direct reflection of interest expressed to us about tourism-related activity, so it is important to keep these tourism-related sectors in proper perspective. The Eating and Drinking sector resides within and is a major component of the Retail Trade industry. In fact, wages paid in Eating and Drinking establishments accounted for about one-fourth of all wages paid in Retail Trade in the Primary Impact Area in CY 2001; for Counties, the percentage ranged from 23 percent in Douglas County to 35 percent in Park County. However, because of the large magnitude of the Services industry, the tourism-related sectors play a much more minor role. In total for the Primary Impact Area, the Lodging sector and Recreation sector only accounted for slightly over 4 percent of the wages in the Services industry, with wages in the Recreation sector dominating those in the Lodging sector by 3 to 1. So it is that in CY 2001, tourism-related sectors constituted a scant 5 percent of the wages paid in the Primary Impact Area—3.5 percent from Eating and Drinking, 0.5 percent from Lodging, and 1 percent from Recreation. Considering that wages in the tourism-related sectors include business unrelated to the wildland base, the prospect of discerning a Hayman Fire-induced effect seems remote.

Two situations are noteworthy. First, in Teller County (which accounts for only 2 percent of wages in the Primary Impact Area), the Recreation sector and Lodging sector account for about 54 percent of the Services industry, with Recreation alone accounting for 51 percent; the Recreation sector seems to dominate tourism-related activities in Teller County. Second, in Park County (which accounts for only 1 percent of the wages in the Primary Impact Area), the Recreation sectors and Lodging sectors account for 8 percent of the Services industry, with Lodging alone accounting for 7 percent; the Lodging sector seems to dominate tourism-related activities in Park County.

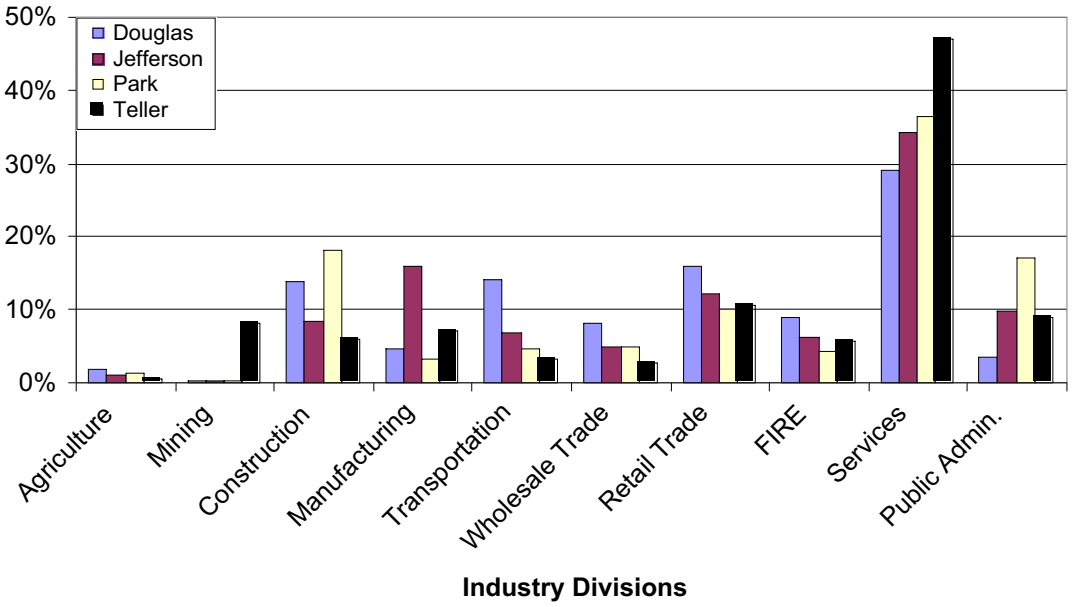

Figure 9—Percent distribution of industry divisions in primary impact area, by county, 2001. (Source: Colorado Department of Labor)

Fire and Postfire Economies: The level of economic activity in an economy, such as the Primary Impact Area, varies by the month and with the measure of economic activity, be it wages, employment, or retail sales (fig. 10). Many factors play a role in determining the monthly level of economic activity, thus complicating our assessment of the role of the Hayman Fire. In the case of the Primary Impact Area, employment averaged about 280,000 per month for the 17 months immediately preceding the Hayman Fire; employment averaged 281,000 for the next 4 months, the fire and postfire months, almost a 0.5 percent increase. Wages averaged $869 million (2002$) per month for the months preceding the Hayman Fire and only $843 million for the next 4 months, a 3 percent decrease. Retail sales averaged $1.281 billion (2002$) per month before the Hayman Fire and $1.329 billion per month during and after the fire, almost a 4 percent increase. At least in terms of the Primary Impact Area, the overall picture of economic activity is mixed but modest.

The analytical question is: What portion of the change in economic activity can be ascribed to events and circumstances taking place during and after the Hayman Fire? To answer this question, we built numerous statistical models to estimate the level of economic activity that would have occurred without the events and circumstances surrounding the Hayman Fire. Those models focused on the Primary Impact Area as well as the associated, individual Counties, the Secondary Impact Areas, and the State of Colorado. They focused on economic activity measured by employment, wages, and retail sales. In addition, they focused on overall economies, as well as the tourism-related sectors of Eating and Drinking, Lodging, and Recreation.

Perhaps it is somewhat difficult to detect changes in economic activity shown in figure 10 because of aggregation. Figure 11 provides a more detailed breakdown of wages in tourism-related sectors of the Primary Impact Area. The relative size of these sectors is easily compared, with wages in Eating and Drinking establishments being roughly two to three times those in the other sectors. In the Primary Impact Area, wages paid in Eating and Drinking establishments averaged about $29.2 million (2002$) per month for the 17 months immediately preceding the Hayman Fire and $30.7 million for the next 4 months, a 0.5 percent increase. A similar situation holds for wages in Lodging and Recreation establishments. Wages in Lodging averaged $3.3 million (2002$) per month for the months preceding the Hayman Fire and $3.7 million for the next 4 months, a 12 percent increase. Wages in Recreation averaged $9.9 million (2002$) per month before the Hayman Fire and $11.6 million per month during and after the fire, a 17 percent increase. The decrease in overall wages shown earlier in figure 10 was not the result of decreases in tourism-related sectors; some other sector(s) caused the decrease.

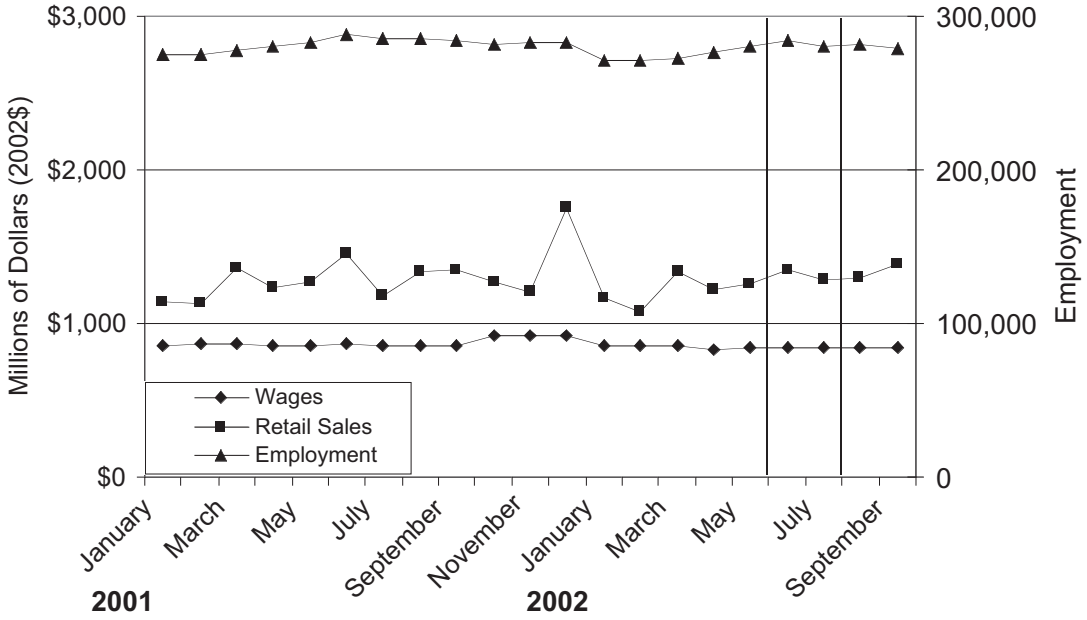

Figure 10—Economic activity in primary impact area, by type of economic activity. (Source: Colorado Departments of Labor and Revenue)

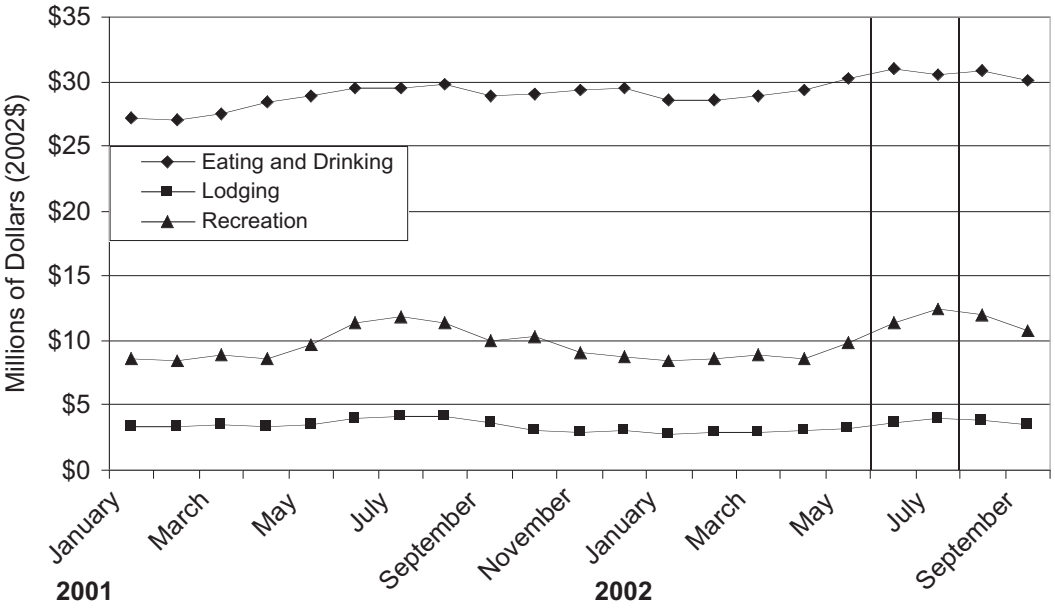

Figure 11—Wages (2002$) in primary impact area, by tourism-related sector. (Source: Colorado Department of Labor)

Figures 12 and 13 also provide information on the tourism-related sectors of the Primary Impact Area. Figure 12 displays employment levels and figure 13 shows retail sales expressed in 2002$. In all cases, the monthly average for the 4 months (June through September) during and after the Hayman Fire exceeds that for the 17 months before the fire. So as in the case of wages, employment and retail sales in tourism-related sectors of the Primary Impact Area showed an increase during and after the fire.

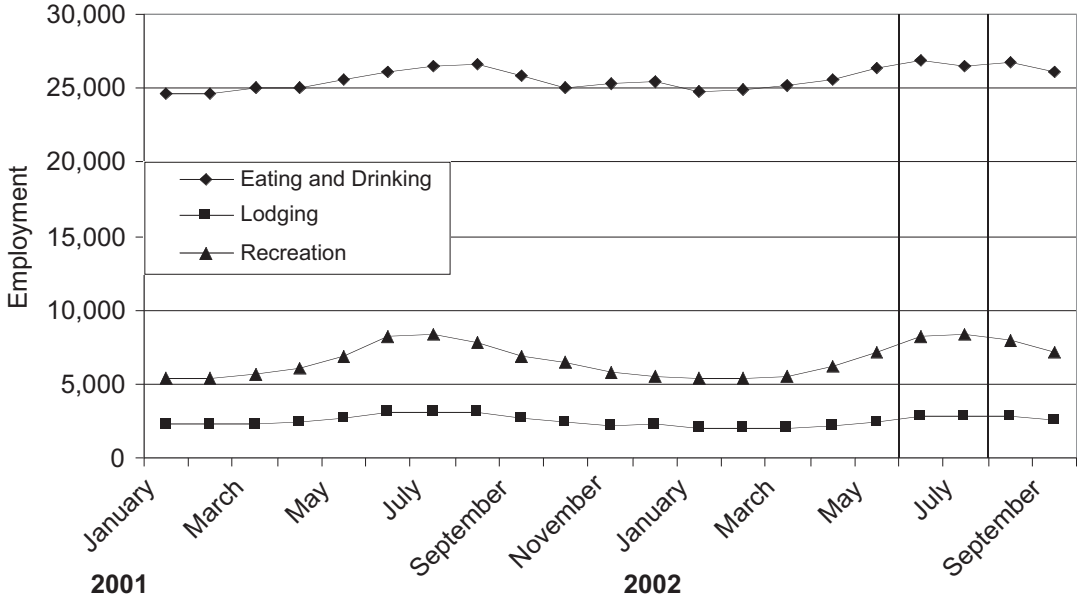

Figure 12—Employment in primary impact area, by tourism-related sector. (Source: Colorado Department of Labor)

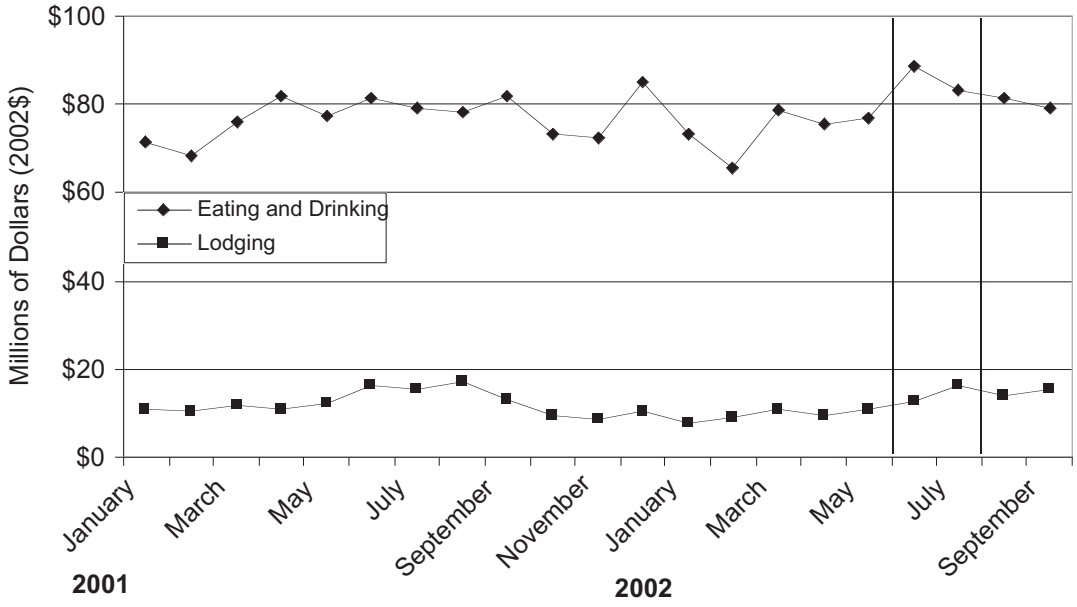

Figure 13—Retail sales (2002$) in primary impact area, by tourism-related sector. (Source: Colorado Department of Revenue)

The impressions of economic activity in the Primary Impact Area portrayed by figures 10 through 13 are both illuminating and deceptive. They are illuminating in that they should dispel the notion that the level of economic activity plummeted during and after the Hayman Fire, especially in the tourism-related sectors. To the contrary, most indicators of economic activity show increases during and after the fire, including tourism-related sectors. The figures are deceptive, however. An increase or decrease in economic activity during and after the Hayman Fire may or may not be related to the fire or other events during the 4 months. For example, the increase in retail sales for Eating and Drinking establishments during the Hayman Fire (fig. 13) could be due to the onset of the summer tourist season; it could be that without the fire, the increase would have been even larger. Similarly, the slight downturn in overall wages for the Primary Impact Area (fig. 10) could have reflected a flattening of the national economy and again have nothing to do with the Hayman Fire.

To further investigate the information displayed in the figures, we constructed statistical models to estimate monthly economic activity that would have happened, absent events and circumstances during and after the Hayman Fire. These models, based on historical monthly data from January 1999 through May 2002, were specific to each measure of economic activity (wages, employment, and retail sales), each economic sector (Eating and Drinking, Recreation, and Lodging), and each geographical area (the Primary Impact Area, the Secondary Impact Area with and without Denver County, and the State of Colorado). The statistical models estimated economic activity in light of national economic trends, economic trends in the Colorado economy, seasonal influences, and the events of September 11, 2001. We built 88 multiple linear regression models. The explanatory capability of these models was generally outstanding, with adjusted R-squares typically above 90 percent. The estimated level of economic activity was compared to the actual level to determine if the actual economic activity during the summer of 2002 was significantly different from that expected, in light of the national and State economies, season of year, and so on.

The effect of events and circumstances surrounding the Hayman Fire on regional economic activity has two time perspectives—during the fire and following the fire. Table 9 shows the results of our analyses to detect changes in economic activity during June and July 2002, the months of the Hayman Fire. First, table rows are organized by type of geographical area and economic activity, while the columns account for economic sectors and the fire months of June and July. If the actual level of economic activity is below that expected (that is, the level estimated via the regression model), that difference is coded with a minus sign (-), meaning the actual level of economic activity (during the Hayman Fire) was less than the level expected based on historical relationships (without events and

Table 9—Results of analyses to identify changes in economic activity in June and July 2002 during the Hayman Fire.

Impact area	County	Economic activity	Eating and Drinking		Lodging		Recreation		Total	
			June	July	June	July	June	July	June	July
Primary Impact Area	Douglas	Wages	-	--	-	--	-	-	-	+
		Employment	-	--	-	--	+	+	+	-
		Retail sales	-	-	-	-	na	na	-	-
	Jefferson	Wages	+	+	-	-	-	-	-	-
		Employment	-	+	0	--	-	-	+	+
		Retail sales	+	-	--	-	na	na	--	+
	Park	Wages	-	+	+	+	--	-	+	+
		Employment	-	+	+	-	--	-	+	+
		Retail sales	-	-	-	-	na	na	-	+
	Teller	Wages	+	-	--	--	-	+	+	+
		Employment	-	+	-	--	-	-	-	-
		Retail sales	-	+	-	-	na	na	+	-
	TOTAL	Wages	+	-	-	--	-	-	-	-
		Employment	-	-	-	--	-	-	-	+
		Retail sales	+	-	--	-	na	na	--	-
Secondary Impact Area	w/ Denver	Wages	-	-	-	++	+	--	-	+
		Employment	-	-	--	-	++	--	--	+
		Retail sales	-	-	-	+	na	na	-	-
	w/o Denver	Wages	+	-	+	+	-	-	+	+
		Employment	-	-	+	+	-	-	-	-
		Retail sales	-	-	-	-	na	na	-	-
State of Colorado		Wages	-	-	+	-	-	-	-	-
		Employment	-	-	+	+	+	-	-	--
		Retail sales	-	-	-	+	na	na	-	-

Key: "+"indicates actual economic activity > expected; "++" indicates statistical significance
"0" indicates actual economic activity = expected
"-" indicates actual economic activity < expected; "--" indicates statistical significance
"na" indicates "not available"

circumstances during the Hayman Fire); if the actual level is above that expected, the difference is coded with a positive sign (+). If the difference is statistically significant (that is, outside the 95 percent confidence interval for each model), it is coded with a double symbol (— or ++).

Table 9 displays few instances of statistically significant differences. There are 21 statistically significant negative differences and only two statistically significant positive differences, out of 176 differences displayed. Consider the case of wages in the Eating and Drinking sector of Douglas County, which is shown as a statistically significant negative difference. The prefire statistical model used to generate this outcome was excellent, with an adjusted R-square of 0.94. That model estimated July wages to be $8.3 million whereas they actually were $7.8 million, about $0.5 million low. Because the $-0.5 million difference exceeded the 95 percent confidence interval of $\pm$0.4 million, the difference was declared statistically significant; that is, there is a 95 percent likelihood that the $-0.5 million difference was not due to chance. Most differences, however, were not statistically significant. This means that although there is some evidence of positive or negative influences on economic activity during the fire months, the evidence is weak. In all sectors, negative differences outnumber positive differences and account for 72 percent of the differences overall.

Table 10 displays information comparable to that found in table 9, except that table 10 focuses on the postfire months of August and September 2002. As with table 9, there are few situations of statistically significant differences between the actual and expected levels of economic activity, even fewer than for the previous 2 months. In fact, there are no statistically significant positive differences and only 12 negative differences. Overall, negative differences account for 67 percent of the differences.

Results displayed in tables 9 and 10 are difficult to interpret. Table 11 has been developed to display

Table 10—Results of analyses to identify changes in economic activity in August and September 2002 after the Hayman Fire.

Impact area	County	Economic activity	Eating and Drinking		Lodging		Recreation		Total	
			Aug.	Sept.	Aug.	Sept.	Aug.	Sept.	Aug.	Sept.
Primary Impact Area	Douglas	Wages	-	-	-	-	-	-	-	-
		Employment	-	-	-	-	+	+	-	-
		Retail sales	-	-	-	-	na	na	-	+
	Jefferson	Wages	+	-	-	-	-	-	-	+
		Employment	+	-	--	-	-	-	+	+
		Retail sales	-	-	-	+	na	na	-	+
	Park	Wages	+	+	-	-	-	-	+	+
		Employment	-	-	-	-	--	-	+	+
		Retail sales	+	+	--	+	na	na	+	+
	Teller	Wages	+	+	-	+	+	+	+	+
		Employment	+	+	-	+	+	-	+	+
		Retail sales	-	+	-	+	na	na	-	+
	TOTAL	Wages	-	-	-	-	-	-	-	-
		Employment	-	-	-	-	-	+	+	+
		Retail sales	-	-	--	+	na	na	-	+
Secondary Impact Area	w/ Denver	Wages	+	+	+	+	-	--	-	-
		Employment	-	--	+	-	-	--	-	--
		Retail sales	+	+	-	-	na	na	-	-
	w/o Denver	Wages	-	-	+	-	-	--	+	-
		Employment	-	-	-	-	-	--	-	--
		Retail sales	-	+	-	-	na	na	--	-
State of Colorado		Wages	-	+	-	-	-	-	-	-
		Employment	-	-	-	+	-	-	-	-
		Retail sales	+	+	-	+	na	na	-	-

Key: "+"indicates actual economic activity > expected; "++" indicates statistical significance
"0" indicates actual economic activity = expected
"-" indicates actual economic activity < expected; "--" indicates statistical significance
"na" indicates "not available"

Table 11—Summary of results to identify changes in economic activity during and after the Hayman Fire.

Impact area	County	Eating and Drinking		Lodging		Recreation		Total	
		Fire	Post-fire	Fire	Post-fire	Fire	Post-fire	Fire	Post-fire
Primary Impact Area	Douglas	M-	W-	M-	W-	W Mixed	W Mixed	W Mixed	W-
	Jefferson	W Mixed	W Mixed	M-	W-	W-	W-	W Mixed	W Mixed
	Park	W Mixed	W Mixed	W Mixed		W-	M-	W-	W+
W+									
	Teller	W Mixed	W+	M-	W Mixed	W-	W+	W Mixed	W+
	TOTAL	W Mixed	W-	M-	W-	W-	W-	W-	W Mixed
Secondary Impact Area	w/ Denver	W-	W Mixed	M Mixed	W Mixed	M Mixed	M-	W Mixed	W-
	w/o Denver	W-	W-	W Mixed	W-	W-	M-	W Mixed	M-
State of Colorado		W-	W Mixed	W Mixed	W Mixed	W-	W-	W-	W-

Key: "W"indicates weak evidence; "M" indicates moderate evidence; "S" indicates
"-" indicates a negative effect; "+" indicates positive effect; "Mixed" indicates negative

summary conclusions relative to changes in economic activity for the fire months (June and July) and the postfire months (August and September). Information in table 11 was developed from information in the boxed, cell clusters of tables 9 and 10 using the following rules: (1) if a cell cluster has five to six positive or negative signs, call it "positive" (+) or "negative" (-), otherwise call it "mixed"; and (2) if a cell cluster has five to six nonsignificant differences, call it "weak" (W); if three to four nonsignificant differences, call it "moderate" (M); otherwise call it "strong" (S). For example, the Douglas County cell for Eating and Drinking displays six negative signs, two of which are statistically significant; according to the rule, this cell would be described as "moderate negative" (M-). This means, according to our research on wages, employment, and retail sales in Eating and Drinking establishments in Douglas County, we believe that events and circumstances during June and July (for example, the Hayman Fire) had a "moderately negative" effect on economic activity.

Information displayed in table 11 can be interpreted in several ways. When viewed horizontally, the focus is on a given geographical area and how it was affected by events and circumstances during and after the Hayman Fire. For example, regarding Park County, events during and after the Hayman Fire seemed generally to have a weak, but negative, effect on economic activity in the tourism-related sectors, but there is some weak evidence of a positive effect on total economic activity in the County. When viewed vertically, the focus is on a particular economic sector for a specific period in time. For example, consider the Lodging sector during the fire months (June and July). Our research indicates there is moderate evidence of a negative effect (M-) on Lodging activity within the total Primary Impact Area, and weak or moderate evidence of a mixed effect on Lodging activity in the Secondary Impact Area and the State of Colorado.

The main message conveyed by table 11 is that we found no strong evidence of any effect, positive or negative, on either the tourism-related sectors or the total economy of the Primary Impact Area or its constituent Counties, the Secondary Impact Area with or without Denver, or the State of Colorado. We found moderate evidence of negative effect, mostly in the Lodging sector for several Counties. But mostly we found weak evidence and much of that was mixed, where one measure of economic activity went up and another went down. Moreover, there seems to be little pattern to these effects—one County going up while another goes down.

Property-Related Losses

According to the County assessors, private real property loss for the four County area directly impacted by the fire was valued at $23,750,000 with an annual assessed value of $3.4 million, resulting in an annual loss of revenue to the Counties of approximately $238,000 per year (table 12). These loss figures include the value of all destroyed structures that had previously been listed on the County assessors' tax roles and decreased land values associated with the Hayman Fire. Property that is tax exempt and structures not listed on County assessors' roles are not included in these loss estimates. For example, exempt property might include lands owned by nonprofit organizations such as Denver Water and the Girl Scouts of America. Property value losses and assessed value estimates are based on the individual assessor's adjustments to property value and property appraisal dates.

Cathy Smith, Operations Manager for Rocky Mountain Insurance Information Association, estimated that insured private property losses totaled $38.7 million. The Association derived this estimate by surveying major insurance companies on their loss experience related to the fire and projecting the final number using a market share calculation. Insured private property losses include loss of or damage to homes, as well as autos, smoke damage, food spoilage, additional living expenses, and loss of insured contents. Some of this $38.7 million is already included in the property loss valuation by the assessors. However, the assessors' figures don't include any personal property losses, or other insured losses other than real property (building and land values).

The Small Business Administration (SBA) makes low-interest, long-term loans to cover uninsured physical losses to homes, personal property, and business property. The SBA also makes loans (Economic Injury

Table 12—Property value lost (dollars). (Source: County Assessors' Office)

	Teller	Douglas	Park	Jefferson	Total
Property value lost	13,737,056	8,132,595	1,771,219	108,969	23,749,839
Assessed value	1,974,831	1,154,189	261,442	9,971	3,400,433
Annual losses in tax revenue	127,351	97,826	11,638	997	237,812

Disaster Loans) to small businesses to help cover financial losses sustained as a result of disasters. Jim Atkins, Congressional Liaison SBA Disaster Assistance - Area 3, provided data regarding total approved loans to the four Counties of Teller, Park, Douglas, and Jefferson (table 13). Total loans in the four Counties associated with the Hayman Fire totaled $4,005,200 with most of the loan approvals, $2,684,700 (67 percent) going to small businesses for financial losses associated with the wildfires. The Federal Emergency Management Agency (FEMA) issued grants to individuals for uninsured expenses totaling $851,600 for such things as lost employment earnings, emergency housing expenses, and personal property losses. Intermountain Rural Electric Association and Excel Energy reported that the Hayman Fire damaged or destroyed power lines valued at $650,000 and $230,000 respectively

Resource Outputs and Values

Much of the data collected on resource outputs and values are simply a compilation of existing data sources and studies. These data provide an overview of some short-term effects of the Hayman Fire. We did not attempt to place a dollar value loss on the effects of the fire on the recreation and tourism industries, but simply identified some of the relevant trend data. The long-term effects of the Hayman Fire are difficult to assess and will require future research after sufficient time has passed.

Tourism and Recreation: It is difficult to isolate the effects of the Hayman Fire on the tourism industry in Colorado from other effects such as the economic recession, declines in air travel relating to fears associated with the September 11 terrorist attack, and the serious drought experienced by Colorado in 2002. Furthermore, reductions in tourism in the summer of 2002 may have been exacerbated by intense media attention of the Hayman Fire and the comments of Colorado Governor Bill Owens describing the scene as a "nuclear winter" and stating "all of Colorado is on fire" (Richardson 2002; McCrimmon 2002). Another difficulty in identifying the economic effects of an event such as the Hayman Fire is that when individuals are unable to participate in planned vacation or recreation activities, many will choose other activities, other locations for the same activity, or both. Isolating the effects of these dislocations on a regional economy is extremely difficult and well beyond the scope of our investigation.

A report generated to assess the effects of the Bitterroot fires of 2000 in Montana (Missoula Area Economic Development Corp. 2002) estimated that tourism-related losses to the area economy totaled $27.3 million, including direct effects of $13.6 million and indirect effects of $13.6 million. These results came from a survey of outfitters and retail businesses involved in tourism-related activities, and confidence in these results was limited by the low response rates (18 percent in one portion of the survey). Due to the limited amount of time available to identify the economic effects of the Hayman Fire, we did not attempt to assess a total value loss to the tourism industry. However, we were able to identify visitation trend information for several different types of recreation facilities and activities that were likely affected by the fire.

The Hayman Fire prompted a general closure order for three Ranger Districts (Pikes Peak, South Platte, and South Park Ranger Districts) of the Pike-San Isabel National Forest. The closure order began June 10, 2002, and continued until July 19, 2002 (small portions of the Pike-San Isabel National Forest including five camping and recreation areas were reopened July 12, 2002). Furthermore, all areas within the Hayman Fire perimeter remained closed to recreation use, at least through March 2003.

Developed recreation sites (campgrounds and day-use fee areas) within the affected districts are operated by two concessionaires, Rocky Mountain Recreation Company (Pikes Peak and South Platte Ranger District) and Canyon Enterprises Inc. (South Park Ranger District). Monthly visitation data for campgrounds are presented in figures 14 to 16 and for day use areas in figures 17 to 19 for January 2000 through

Table 13—Small Business Administration disaster loans for counties included in the Hayman Fire (as of June 25, 2003). (Source: SBA Disaster Assistance Area 3)

	Home		Business		Economic Injury		Total	
County	#	$ Amount	#	$ Amount	#	$ Amount	#	$ Amount
Douglas	5	577,000	1	10,000	7	750,600	13	1,337,600
Jefferson	N/A	N/A	N/A	N/A	4	28,900	4	196,100
Park	1	99,000	N/A	N/A	10	339,600	11	438,600
Teller	6	437,700	1	29,600	40	1,565,600	47	2,032,900
Total	12	1,113,700	2	39,600	61	2,684,700	75	4,005,200

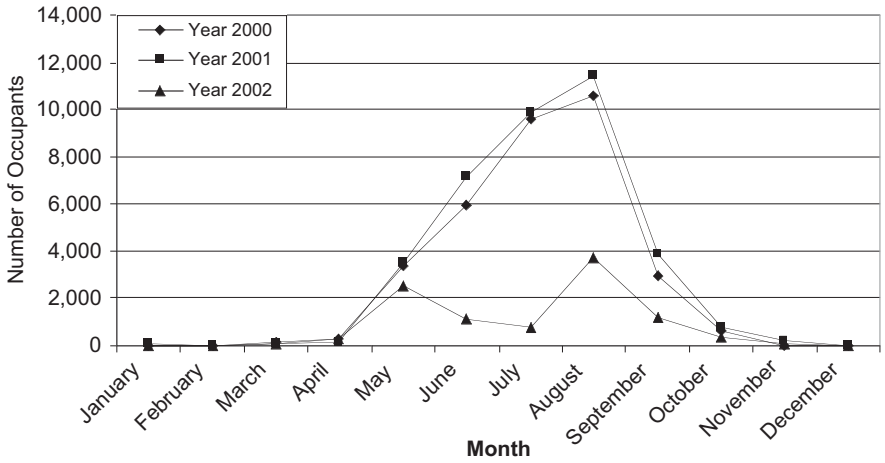

Figure 14—Campground visitation for Pikes Peak Ranger District. (Source: Rocky Mountain Recreation Company)

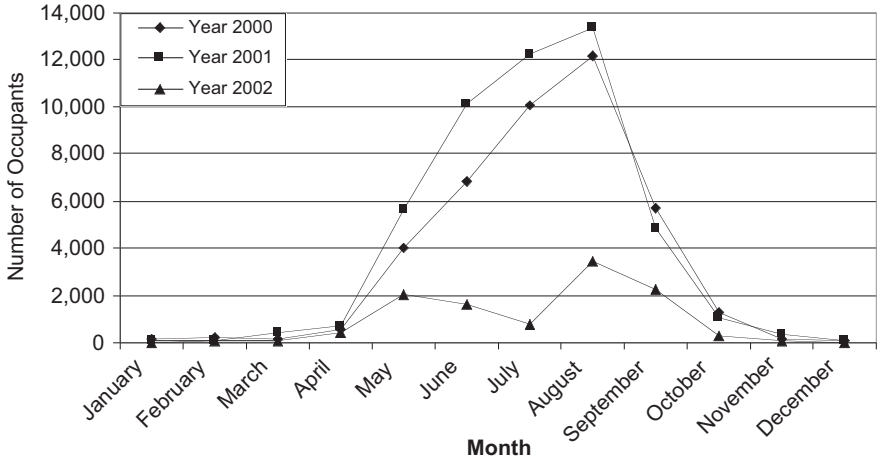

Figure 15—Campground visitation for South Platte Ranger District. (Source: Rocky Mountain Recreation Company)

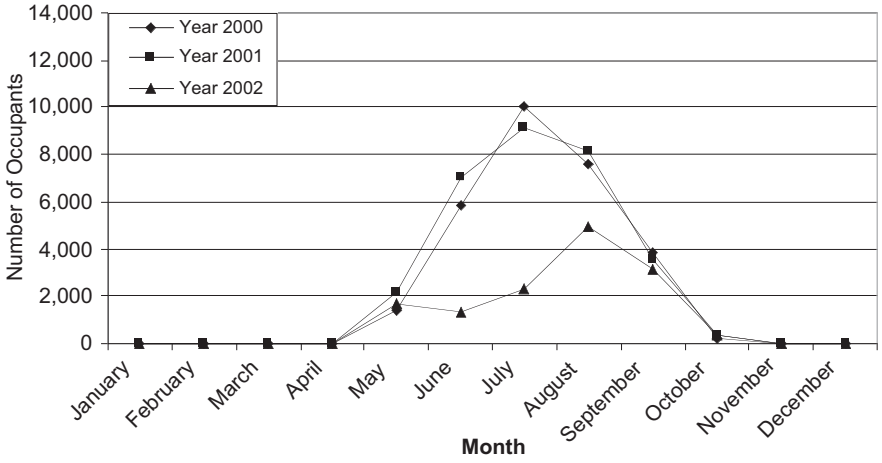

Figure 16—Campground visitation for South Park Ranger District. (Source: Canyon Enterprises Inc)

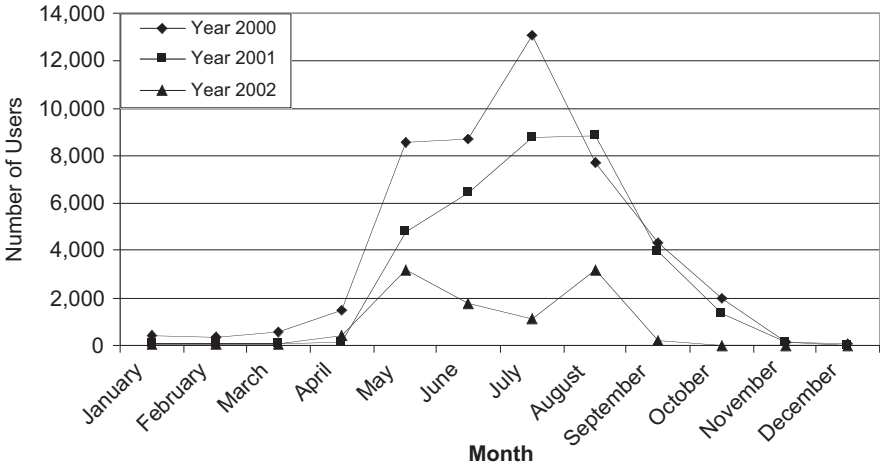

Figure 17—Day use area visitation for Pikes Peak Ranger District. (Source: Rocky Mountain Recreation Company)

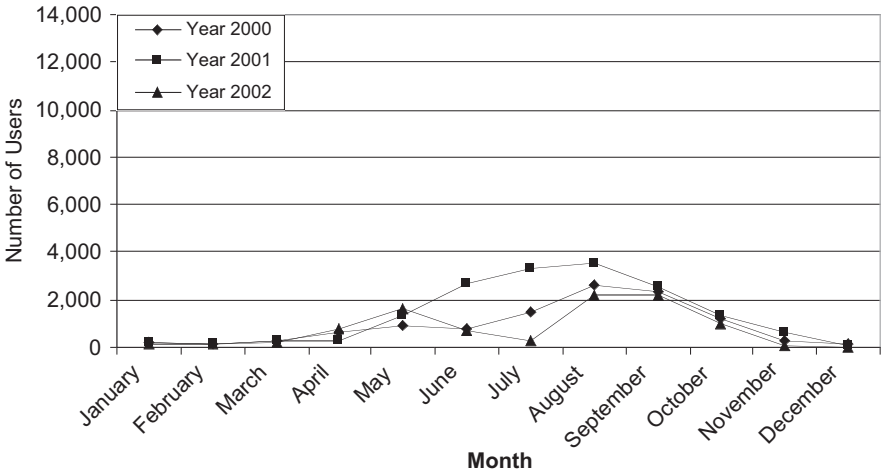

Figure 18—Day use area visitation for South Platte Ranger District. (Source: Rocky Mountain Recreation Company)

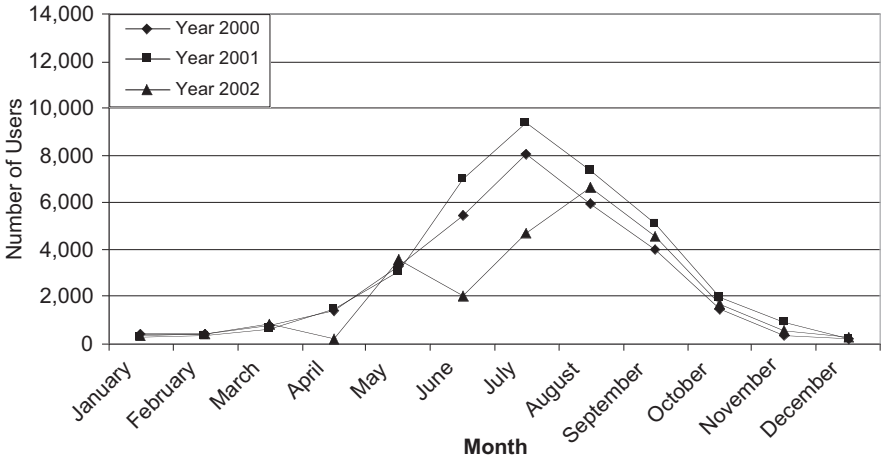

Figure 19—Day use area visitation for South Park Ranger District. (Source: Canyon Enterprises Inc)

December 2002 by Ranger District. Although longer term data would be revealing, accurate visitation data were only available for the 3 years 2000 through 2002. Aggregate data for the three Ranger Districts are presented in figure 20 for campgrounds and figure 21 for day use areas.

The closure occurred during two of the busiest visitation months. On the Pikes Peak Ranger District, the months of June and July accounted for 46 percent of all developed site visitation in CY 2000 and 45 percent in 2001. On the South Platte Ranger District, June and July accounted for 37 percent of all developed site visitation in 2000 and 43 percent in 2001, while on the South Park Ranger District, 48 percent of all developed site visitation occurred in June and July for both 2000 and 2001. Table 14 displays developed recreation visitation by prefire months (January through May), fire months (June and July), and postfire months

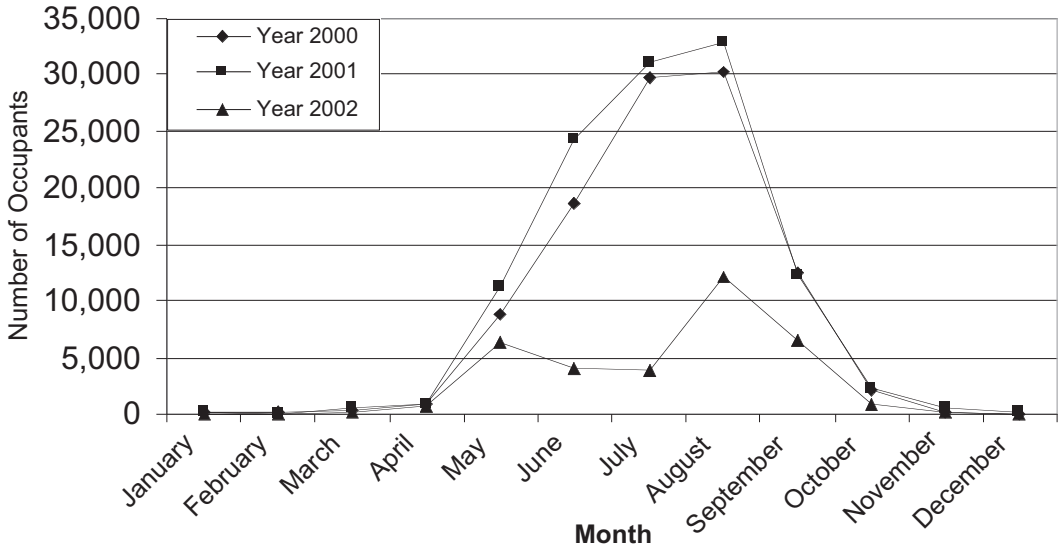

Figure 20—Aggregated campground visitation for the South Park, South Platte, and Pikes Peak Ranger Districts. (Source: Rocky Mountain Recreation Company and Canyon Enterprises Inc.)

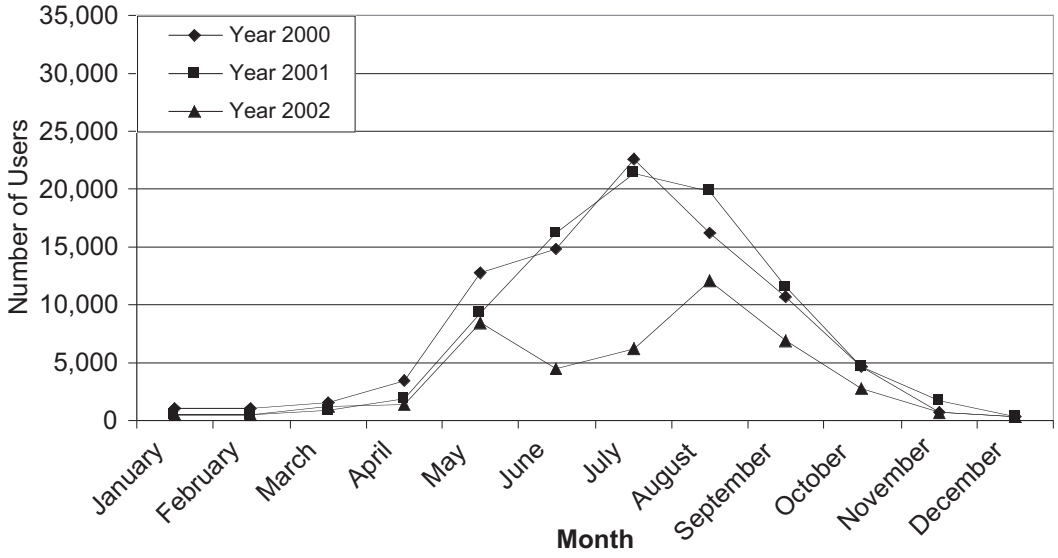

Figure 21—Aggregated day use area visitation for the South Park, South Platte, and Pikes Peak Ranger Districts. (Source: Rocky Mountain Recreation Company and Canyon Enterprises Inc.)

Table 14—Developed recreation visitation by time period by Ranger District (2000 through 2002). (Source: Monthly visitation reports for Rocky Mountain Recreation Company and Canyon Enterprises Inc.)

	Pikes Peak			South Platte			South Park		
	2000	2001	2002	2000	2001	2002	2000	2001	2002
Pre-fire months	15,190	8,840	6,803	7,188	9,189	5,513	7,711	7,965	7,074
Fire months	37,262	32,180	4,834	19,154	28,381	3,420	29,314	32,509	10,372
Post-fire months	28,282	30,573	8,699	25,888	27,958	11,504	23,563	27,680	22,097
Year Total	80,734	71,593	20,336	52,230	65,528	20,437	60,588	68,154	39,543

(August through December) for the three Ranger Districts. Comparing visitation count data for 2002 with prior year levels showed that visitation was slightly down in the prefire months (likely, due in large part to a campfire ban that existed prior to the outbreak of the Hayman Fire), substantially down in the fire months, and remained down in the postfire months in the three affected Ranger Districts. Pikes Peak Ranger District had the most substantial decline from 2001 levels with visitation at 77 percent of the 2001 level during the prefire months, 15 percent of 2001 during the fire months, and 28 percent during the postfire months, with total year visitation at 28 percent of 2001 levels. South Platte District had visitation at 60 percent of 2001 levels during the prefire months, 12 percent of 2001 during the fire months, 41 percent during the postfire months, and total year visitation at 31 percent. South Park District was the least affected with visitation at 89 percent of the 2001 level during the prefire months, 32 percent during the fire months, 80 percent during the postfire months, and total year visitation at 58 percent. It would be revealing to compare visitation trends on the Pike-San Isabel National Forest with visitation data on other National Forests in Colorado for 2002; however, the data are not readily available.

Rocky Mountain Recreation Company estimated that total income in 2002 was $275,000 less than the previous year ($135,000 less on the Pikes Peak Ranger District and $140,000 less on the South Platte Ranger District). Canyon Enterprises Inc. estimated that total income on the South Park Ranger District in 2002 was approximately $107,000 less than the 2001 total.

We also explored the effects of the Hayman Fire on non-Forest Service developed recreation sites near the fire perimeter. Pike-San Isabel National Forest recreation staff members identified four developed recreation sites that were most likely to have been affected by the Hayman Fire. We requested recreation visitation count data from each of the following locations: Florissant Fossil Beds National Monument, Eleven-Mile State Park, Pikes Peak Cog Railway, and Pikes Peak Toll Highway. Monthly visitation data by individual site are presented in figures 22 (Florissant Fossil Beds National Monument), 23 (Eleven-Mile State Park), and 24 (Pikes Peak Cog Railway and Pikes Peak Toll Highway were aggregated for confidentiality). Comparing visitation totals for June and July of 2002 with results from June and July of 2001 showed a decline at all sites, with 2002 visitation at 62 percent of 2001 visitation for Florissant Fossil Beds National Monument, 79 percent for Eleven-Mile State Park, and 85 percent at the Pikes Peak Cog Railway and Toll Highway.

The closure order associated with the Hayman Fire restricted the ability of outfitters and guides with permits to operate on the Pike-San Isabel National Forest to conduct their business and likely caused the following effects: cancellation of existing reservations, the inability of outfitters and guides to offer services to individuals who would have made reservations had the fire not occurred, and the transfer of the guided activities to secondary locations. We were unable to isolate these individual effects; however, we identified the total number of Forest Service client days that permitted outfitters and guides conducted in recent years on the Pike-San Isabel National Forest. Client days are defined as the number of trips times the number of persons taking the trips times the percent of time spent on the National Forest. Total client days for the years 2000, 2001, and 2002 on the Pikes Peak, South Platte, and South Park Ranger Districts are displayed in table 15. On all three districts, total client days were substantially lower in 2002 than 2001, with aggregated outfitter and guide use in 2002 at 75 percent of the 2001 levels. Pikes Peak District was the least affected, with 2002 client days at 86 percent of 2001 levels, while South Platte and South Park Districts were more substantially affected, with 2002 levels at 60 percent and 62 percent of prior year levels, respectively.

Identifying the effects of an event such as the Hayman Fire on dispersed recreation is difficult. In past years Forest Service visitation data have suffered from a lack of accuracy and consistency. The National Visitor Use Monitoring Results (NVUMR) improves the visi-

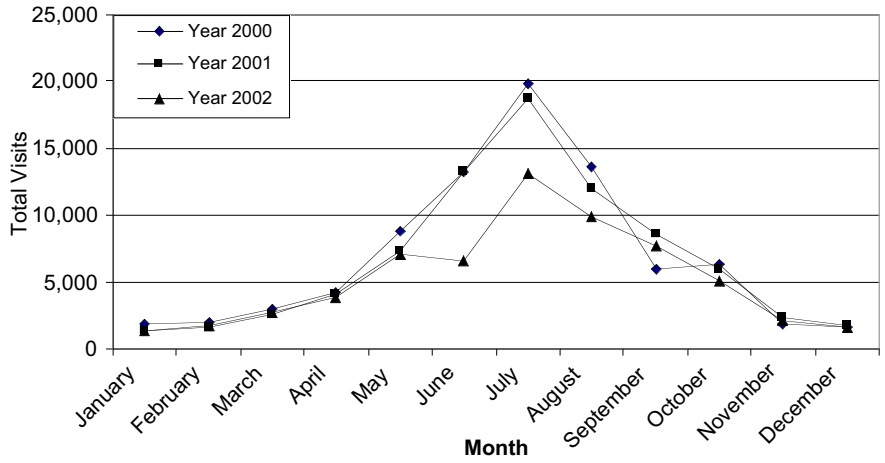

Figure 22—Visitation for Florissant Fossil Beds National Monument. (Source: Florissant Fossil Beds National Monument visitation records)

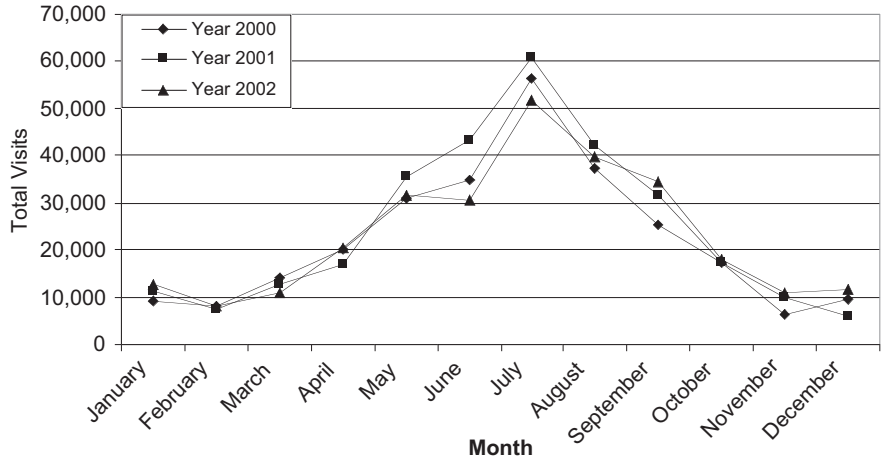

Figure 23—Visitation for Eleven Mile State Park. (Source: Eleven Mile State Park visitation records)

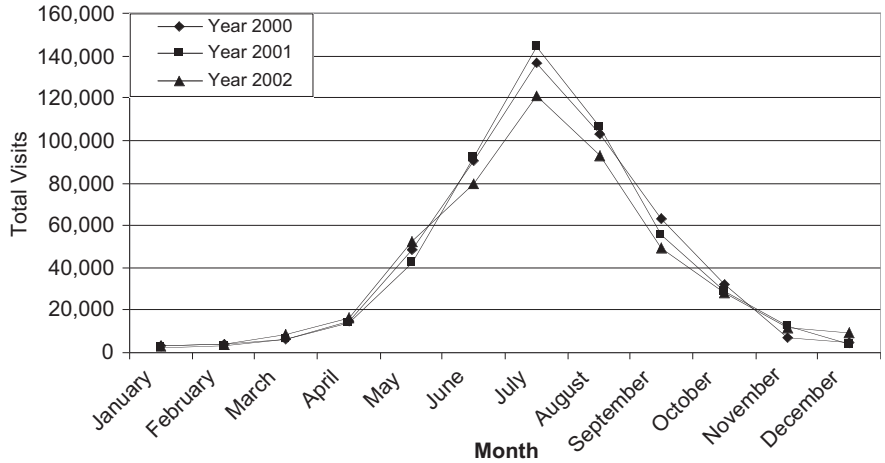

Figure 24—Visitation for Pikes Peak Cog Railway and Toll Highway. (Source: Pikes Peak Cog Railway and Toll Highway visitation records)

Table 15—Outfitter and guide client days by Ranger District. (Source: Actual Use Reports and SUDS records maintained at individual Ranger Districts.)

	2000 client days	2001 client days	2002 client days	2002 client days as a pct of 2001
Pikes Peak	37,726	35,763	30,663	86
South Platte	16,028	16,347	10,111	62
South Park	11,893	13,084	7,880	60
Total	64,949	64,604	48,221	75

tation data by using scientific sampling methods and an established study protocol. However, data from the NVUMR are collected at each National Forest on a 4-year cycle, and the information available in the NVUMR is applicable at the Forest level and "it is not designed to be accurate at the district or site level" (Kocis and others 2002). There may be a potential to use the NVUMR data to estimate the effects of an event such as the Hayman Fire in the future (English, personal communication); however, time constraints prohibited exploration for this study. The NVUMR was conducted on the Pike-San Isabel National Forest in FY 2001 (October 2000 through September 2001). Visits totaled 3,868,928 of which wilderness visits totaled 66,681 on the Pike-San Isabel National Forest in FY 2001 (Table 16).

Additionally, we reviewed recent research that attempted to determine recreation valuation and the effects of forest fire on dispersed recreation visitation behavior. Englin and others (2001) and Loomis and others (2001) conducted a recreation visitor survey in 1997 in Idaho, Wyoming, and Colorado including the Pike-San Isabel National Forest. Englin and others (2001) estimated consumer surplus of recreation visitors to Colorado National Forests at $109 per trip using travel cost models. Visitor surveys revealed an initial positive visitation response to a recent fire event with decreasing visitation in subsequent years. Loomis and others (2001) explored the same data and concluded that a recent crown fire had a positive effect on the value and demand for hiking trips and an adverse effect on mountain biking value and demand. It was surmised that curiosity relating to the effects of a fire might influence hikers' value and demand, while mountain bikers were concerned with the difficulty associated with large downed logs and trees in pathways. These results suggest that hiking activity may increase and mountain biking activity may decrease within the Hayman Fire perimeter. Recreation planners may use these results to help adjust management plans for the existing trail system on the Pike-San Isabel National Forest.

It is inappropriate to conclude that all reduction in recreation activity due to the Hayman Fire represents economic loss. When faced with a closed recreation area, many individuals will make alternative recreation plans. However, it is difficult to identify how many individuals made alternative recreation plans due to the Hayman Fire and what those plans entailed. We attempted to explore this question using data from an existing campground reservation system. Reserve America has a contract with the Forest Service to provide reservation services for all Forest Service campgrounds that accept reservations. We requested that Reserve America query its database to identify all reservations that were cancelled during the Hayman Fire closure on the 46 campgrounds within the Pike-San Isabel National Forest that accept reservations. An additional query identified individuals who made subsequent reservations within the Reserve America system during the closure period and the location of their new reservation. A total of 331 campground reservations on the Pike-San Isabel National Forest made within the Reserve America system were cancelled between the dates of June 10, 2002, and July 19, 2002 (the dates of the general forest

Table 16—NVURM visitation use for Pike-San Isabel NF 2001. (Source: NVURM report for Pike-San Isabel NF, Kocis and others 2002.)

National Forest visits		Site visits		Wilderness visits	
Visits	Error rate	Visits	Error rate	Visits	Error Rate
3,868,928	17.9%	4,406,348	16.2%	66,681	32.4%

closure associated with the Hayman Fire). About one in four of the cancelled reservations were subsequently remade within the Reserve America system. Of these new reservations, 58 percent were made to alternative locations within the State of Colorado. Caution should be used when interpreting these data, since it is likely that many who cancelled reservations with Reserve America because of the Hayman Fire made alternative recreation plans that simply did not include reservations through the Reserve America system.

Additional information regarding recreation substitution behavior comes from survey results of the 2001 NVUMR study (Kocis and others 2002). Individuals were asked questions relating to their choice of substitute recreation activities if the area they were interviewed in had been closed. Responses to this question are summarized in table 17. Over 75 percent responded that if the area were closed they would have still participated in some type of recreational activity. Again, these results should be viewed with caution because the question posed to individuals in 2001 did not suggest a closure due to an event of the magnitude of the Hayman Fire and are based on survey questionnaires and not actual visitor behavior.

We were also interested in identifying if large operators that were forced to cancel scheduled camps due to the Hayman Fire were able to make alternative arrangements for their clientele. Recreation managers on the Pike-San Isabel National Forest identified the Girl Scouts of America and the Lost Valley Guest Ranch as two of the organizations that were most severely affected by the fire. We interviewed representatives from two councils of the Girl Scouts, who each operated summer camps closed due to the Hayman Fire in the summer of 2002. Representatives from both councils stated that they were unable to make alternative camp arrangements for the majority of the members who had reservations at one of the closed camps.

The Girl Scouts Wagon Wheel Council (Colorado Springs) camp was within 1 mile of the Hayman Fire. During the summer of 2002, they experienced two evacuation orders and were shut down for 3 weeks. Approximately 400 campers missed camp and had their fees fully refunded. The Wagon Wheel Council estimated their total losses at $110,000.

The Girls Scouts Mile High Council (Denver) camp is contained within the perimeter of the Hayman Fire. The camp was closed down during the initial closure order and had plans to first reopen in May 2003. Fire effects within the camp were relatively minor considering the proximity of the fire, and property losses were estimated at $112,000. Approximately 750 campers were issued complete refunds at $240 to $460 per camper. In the fall season, the camp typically rents its facilities to Girl Scout troops; however, they were unable to provide these services in the fall of 2002 due to access issues relating to the Hayman Fire. Estimates for total value of losses to the Mile-High Council were not currently available.

The Lost Valley Guest Ranch is on the site of an old homestead and was completely within the Hayman Fire perimeter. The guest ranch was shut down from June 9, 2002, through September 1, 2002. The ranch operated a modest fall season at 40 percent occupancy. The owner estimated total losses associated with property damage, lost income, and fire-related expenses at $1.9 to $2.0 million. In January 2003, booking for the 2003 season was 50 percent of normal, and the owner estimates the 2003 season to be down 20 to 25 percent from typical years.

Other Resource Outputs and Values: Once a fire escapes initial and extended attack, a Wildland Fire Situation Analysis (WFSA) report is developed to explore alternative fire suppression strategies and relative resource and suppression costs. Ted Moore, the fire management officer for the Pike-San Isabel National Forest, developed resource loss estimates in the Hayman WFSA under the assumption of a final fire size of 150,000 acres. Estimates of the individual resource dollar losses made within this report, corrected for the actual size of the Hayman Fire, are provided in table 18. Total resource losses were estimated at $50.2 million for a 150,000-acre fire, which

Table 17—Substitute recreation choices for the Pike-San Isabel NF. (Source: NVURM report for Pike-San Isabel NF, Kocis and others 2002.)

Substitute choice	Percent who would have…
Gone somewhere else for the same activity	60.0
Gone somewhere else for a different activity	15.6
Come back another time	11.4
Stayed home	11.0
Gone to work at their regular job	0.6
None of these	1.4

Table 18—Resource loss estimates (dollars) adjusted from WFSA report. (Source: WFSA report dated 6/9/02, Ted Moore, Fire Management Officer Pike-San Isabel NF, author.)

Resource category	Change in resource value
Mature timber	–3,700,000
Forage	–1,430,000
Water storage	–37,000,000
Fisheries	–297,000
Wildlife- other	–2,660,000
Recreation	–992,000
Total	–$47,000,000

adjusted to $47 million based on the actual size of the fire. Water storage was the single most important category, representing 80 percent of total resource value losses. Alternative methods outside the WFSA report for estimating the value of lost water storage capability were not readily available.

Estimated timber losses within the WFSA report, adjusted for actual fire size, were $3.7 million. In discussion with Ted Moore, it was determined that the valuation of timber-related losses within the WFSA report were not adequate. Therefore, timber value losses were estimated by combining reports from the National Fire Management Analysis System (NFMAS) and fire severity maps of the Hayman Fire event. Forest Service acres burned by fire severity and associated timber value losses are presented in table 19. Total timber losses associated with the Hayman Fire were estimated at $34.3 million using this method. This value should be viewed with caution because these values were based on timber sales on the Pike-San Isabel National Forest that were several years old, and a reference year for these values was unavailable. Currently the timber sales program is relatively small on the Pike-San Isabel National Forest. Additionally, timber within the wilderness area burned by the Hayman Fire was valued at $0 using this approach.

Lance Tyler, recreation program manger for the Pike-San Isabel National Forest, provided loss estimates to the Pike-San Isabel National Forest recreation program. Direct recreation infrastructure losses totaled $56,500 on the Pike-San Isabel National Forest. Fee losses from reduced concessionaire revenue in 2002 were estimated at $58,000. Additionally, four recreational residences burned resulting in a loss of annual revenue to the Forest Service of $2,250.

Gary Roper, timber program manager for the Pike-San Isabel National Forest, provided estimates of lost value to planned timber sales and annual programs, such as Christmas tree and firewood cutting, as well as estimates of returns from salvage operations (table 20). One-time losses to proposed timber sales were estimated at $36,750. Annual timber losses were estimated at $62,000 to $ 65,000 with a majority of these losses coming from the personal use Christmas tree program. Total salvage value was estimated at $159,500. These results should be viewed in isolation of the estimated timber losses reported using the NFMAS data. They simply reflect the changes in revenue to the timber program from existing timber sales, Christmas tree sales programs, and expected salvage logging contracts.

Experiencing the Hayman: Human Perceptions, Knowledge, and Behavior Related to the Wildfire

The material in this section largely relates to question areas two and three, but has some overlap with areas one and four as well. Much of the material comes from local residents – the people who lived through and continue to live through the "Hayman experience." Even so, we only address a small portion of a bigger picture that includes all people affected by this fire. We begin this section with a literature review outlining some of what others have learned about how people react to wildfires. We then report on preliminary data collected from Woodland Park Colorado

Table 19—Forest Service acres burned by fire severity class and change in value (dollars) of timber resources due to Hayman Fire. (Source: Hayman burn severity GIS coverage, on file Pike-San Isabel NF.)

Fire severity	FS acres burned	Change in value (dollars)
Low	46,338	–1,440,000
Moderate	21,404	–7,330,000
High	47,697	–25,500,000
Total	115,439	–$34,270,000

Table 20—Effect of the Hayman Fire on the Pike-San Isabel NF timber program. (Source: Gary Roper, Timber Program Manager, Pike San-Isabel NF.)

Sale name	Proposed	Estimated volume	Estimated losses (dollars)
Annual change in value			
Personal use Christmas trees	Proposed annually	5,500 trees/ yr	– 55,000/ yr
Personal use fuelwood	Proposed annually	350-500 cords/ yr	–7,000-10,000/ yr
Total annual losses			–$62,000-65,000/ yr
One-time change in value			
Schoonover	Proposed	3,000 CCF	–33,750
Saloon Gulch Stewardship	Proposed	2 CCF	–2,000
Gunbarrel Stewardship	Proposed	1 CCF	–1,000
Total one-time losses			–$36,750
Salvage			
Road side salvage	Current	3,500 CCF	+24,500
Other salvage	Proposed	20,000 CCF	+135,000
Total Salvage			+$159,500

Residents in August 2002, shortly after the fire. Next we describe the results of two workshops conducted with residents of the Ridgewood subdivision, located within the USDA Forest Service's Manitou Experimental Forest, one a week before the fire broke out, and the other on February 15 and 16, 2003. Finally, we explore the results of followup interviews in Woodland Park, also conducted during February, 2003.

Literature Review

Wildfires are not new events, and it is useful to consider what scientific understandings already exist on social response to wildfires. Knowing the work that has already been done can provide useful insights about what assumptions are and are not correct and help prevent future research from reinventing the wheel. Clearly with fire the number of individuals living in high fire hazard areas who do little to protect their property indicates that people do not necessarily behave in a classically rational manner in the face of a hazard. Indeed, results for research on other natural hazards rarely show the logical progression that might be expected of: awareness of a hazard– increased risk perception – doing something to minimize risk exposure. The fact that individuals do not behave in a classically rational manner makes it even more important to understand what does guide their actions. Some of the variables that many would assume would influence individual responses that have been investigated by natural hazards studies include: awareness, perceived risk, sense of responsibility, and experience. (Perceived risk is based on how serious an individual deems a threat to be coupled with his or her estimation of the probability of experiencing a damaging event. It is important because if an individual deems the risk low he or she is less likely to act to reduce exposure. It is also important because it is extremely subjective, with level of risk and probability calculation influenced by a variety of considerations.)

Until recently only a handful of studies had been done on perception and response to the wildfire hazard, and these focused primarily on understanding individual response (Cortner and others 1990; Gardner and Cortner 1985). Perhaps more than most other natural hazards, effective fire mitigation depends on individual action – it is not just a case of enacting effective building codes (which are integral to hurricane, earthquake, and flood mitigation) but of changing both behavior and opinions on more personal matters of home design, desirable vegetation and aesthetics, and acceptable large-scale fuel management practices. Understanding what shapes an individual's response to wildfire can provide fire managers with useful insights into the most effective ways of working with members of their community. However, individual action alone will not be sufficient.

Awareness and Risk Perception

The study that comes closest to assessing before and after effects of a wildfire is a 1983 survey that compared opinions of homeowners in two wildland urban interface communities in San Bernardino County, California, one which had recently experienced a wildfire and another which had not (Gardner and Cortner 1985). Notably both awareness and risk perception in the affected area were lower than in the unaffected community. Actually experiencing a fire appeared, rather ironically, to dampen awareness and perceived

risk as homeowners in the unaffected community also had a higher perception of risk than those in the affected community (Gardner and Cortner 1985). The recent fire apparently created the illusion that a fire was much less likely to occur in the affected community, a reasonable example of gambler's fallacy in action as this was true only for a brief period immediately following the fire. (A good example of the gambler's fallacy occurs when an individual is asked to estimate the probability of heads or tails when flipping a coin. If it comes up heads the first time, most individuals then think the chances of tails coming up next are greater, whereas the probability is still 1/2.) The researchers concluded that this finding demonstrated, along with the ease with which individuals are willing to convince themselves that they won't be affected, the poor understanding respondents had of the fire regime in southern California (Cortner and others 1990).

In examining explanatory variables for current awareness and risk perception, the survey found different variables important in the two communities (Gardner and Cortner 1987). Initial awareness of the hazard was positively correlated with current awareness for both groups. Gender also was correlated with each group, with women having a higher present awareness level, although it was less strong for the unaffected community. However, age was predictive only for the unaffected group (older = more aware) whereas income was only associated (negatively) for the affected area. Newer residents in the unaffected area also were more likely to be aware of the hazard than established residents, perhaps as a result of greater media attention and availability of information on wildfire.

Awareness did show a correlation with perceived risk for both groups. When asked to estimate the likelihood of a wildfire merely occurring in the area, the key variable for both groups was current awareness level. In the unaffected area, other significant variables were education and length of residence—higher education and longer residence each leading to a higher estimated likelihood of a fire occurring. For residents in the affected area, current awareness level was the only significant variable. When asked to estimate the likelihood of a wildfire that caused structural damage, current awareness was significant and positively correlated for the unaffected area but not the affected area, again likely reflecting the illusion of safety created by the recent fire. For the unaffected area, awareness at time of purchase and length of residence were also significant, both positively related. For the affected area, awareness at time of purchase was significant as well as gender and education, with men and those with a higher education less likely to expect a structural fire (Gardner and Cortner 1985).

A survey of residents of the Santa Monica Mountains found that respondents were more aware of the hazard risk than had been expected, although their collective sense of responsibility was lower than anticipated (Loeher 1984). Understanding of causes of the problem was also better than expected, particularly in regard to fuel load concerns and mitigation measures, although much of this information was incomplete. Loeher found that both direct experience and education were predictive for awareness levels and that awareness level in turn was directly related to perceived threat.

In their survey of Florida residents Abt and others (1987) found that although residents generally estimated a high probability and perceived danger from fires, fire was not a high priority in home selection, although newer residents were more likely to include it in their decision. Age and experience were both positively correlated with perceived risk, but education was found to be inversely correlated. Income was correlated, but neither positively nor negatively, with those of middle income showing the lowest perceived risk level. This may be explained by the fact that insurance was also negatively correlated with perceived threat, suggesting that those of middle income have enough resources to buy insurance to cover their losses yet have nothing of overly high value to lose.

A survey of homeowners in Incline Village, NV, found that concern about the wildfire hazard was high: 74 percent of respondents saw the hazard in the Tahoe Basin as moderate to very severe, and 67 percent stated that the hazard was one of their top five concerns about living in Incline Village (McCaffrey 2002). Respondents also had a reasonably accurate knowledge of what causes the current wildfire danger in the area; 63 percent cited local natural processes (such as drought and insect infestation) as contributing a lot to the danger. Fuel load build up also was cited as a major contributor, with 52 percent thinking the fuel build up contributed a lot and 29 percent thinking it contributed some to the hazard.

Notably, individuals who saw the fuel load as contributing a lot were more likely to judge the fire hazard as very severe (83 percent) than those who saw it as contributing some (75 percent) or not much (43 percent). Respondents who thought the fuel load was a major contributor were more likely to live in single-family homes and to be permanent residents than those who thought the fuel load was only a partial or negligible contributor. The study attributed this result to the presence of an active wildfire education program that was primarily targeted at single-family homes and permanent residents.

Similar to the San Bernardino study, the Incline Village study suggests that experience may be most influential when it is second hand. (Although at the

time the Tahoe Basin had not experienced a major fire in over 75 years, given the transience of much of Incline's population, many respondents had either directly or indirectly experienced a wildfire elsewhere.) Direct experience had no association with risk perception or putting in defensible space, however. Direct experience had a significant association in only two places. Those with direct experience showed a clear preference for greater State responsibility and less individual responsibility in fire management. Respondents with direct experience were 20 percent more likely to cite cost effectiveness as a very important reason for putting in defensible space. Although one suggested reason individuals may not mitigate is the expectation that they will be "rewarded" with a bigger and better replacement house, this suggests that those who have actually lost or know someone who has lost property realize that any potential gains are not worth it.

Conversely, respondents who indicated that a friend or relative had been threatened by a wildfire were more likely to have a higher risk perception, to have put in defensible space measures, and to have an evacuation plan. Of note was the finding that for respondents with indirect experience, the fact that they knew someone who did not lose a house as a result of defensible space was *more* influential in adoption of defensible space measures than knowing someone who actually lost a house, although both had a positive effect.

Responsibility

The issue of who is responsible for mitigating the hazard is an important one. Loeher (1984) found that residents who took action were also more likely to feel that they were in some way responsible for protecting themselves. While this is heartening, less encouraging is that the general level of responsibility was lower than expected as 37 percent indicated *no* sense of personal responsibility to minimize the risk. However, 19 percent thought mitigation was solely their responsibility and 45 percent felt it was a joint public-private concern (Loeher 1984). Issues of responsibility were frequently found to be intertwined with freedom of choice; accepting some level of personal responsibility for the hazard might implicitly mean tolerating restraints on where one could live, a restraint many were unwilling to accept (Gardner and Cortner 1985; Cortner and others 1990, Abt and others 1990). The San Bernardino study also found that individuals felt that they were not responsible for any defensible space for their home if any of the area fell on government land, and other studies have found that in general individuals prefer to put the burden on the government (Gardner and Cortner 1985; Cortner and others1990). In Incline Village, a greater sense of individual responsibility was associated with higher risk perception but not with increased likelihood of putting in defensible space or having an evacuation plan (McCaffrey 2002).

A recent study in Michigan found that 54 percent of respondents felt homeowners and government shared responsibility, 26 percent felt it was primarily the homeowner's responsibility, while only 6 percent thought it was solely the government's job (Winter and Fried 2000). Focus group interviews of selected study respondents found that most felt homeowners were responsible for fireproofing their property while the government was responsible for education, enforcing burn regulations, and maintaining suppression forces. The fact that fire does not recognize property ownership was cited as a reason why fire protection was every person's responsibility. As one participant stated: "I think a forest fire doesn't care. When a forest fire starts, it's gonna burn anything in the way. It's not gonna say, 'Well, this is government land—I'm going around it'" (Winter and Fried 2000). Although a significant portion of homeowners agreed it was their responsibility to protect their own property, many were unwilling to do anything, preferring the additional risk to the perceived negative aesthetic impact of use of defensible space. "Maybe I should be spraying fire retardant on my cedar chip roof, maybe I should be cutting the branches off, but I'm reluctant to destroy the look of the property by doing all of that cutting and trimming" (Winter and Fried 2000).

Several of the Michigan respondents also felt that carrying insurance fulfilled whatever responsibility they carried. As one resident put it, "If you build there and it burns, you rebuild there. That's between you and your insurance company, or whoever" (Winter and Fried 2000). In this regard, insurance has often been found to be a main disincentive. Combined with disaster insurance it has in fact been found to profit those who do nothing over those who take mitigative action (Gardner and El-Abd 1985).

The Michigan study also provides an interesting example of the ability to externalize responsibility. Respondents attributed much of the fire problem to "ignorant" seasonal residents or tourists. However, the Department of Natural Resources statistics indicate that backyard debris burning is the main ignition source Statewide and that permanent residents are responsible for 80 percent of ignitions (Winter and Fried 2000).

Defensible Space

The tie between awareness, risk perception, and engaging in defensible space or other mitigation is not that clear cut. Although the San Bernardino study

found that homeowners were aware of the need to do something and claimed to support vegetation clearance, a large proportion still did nothing: in the effected area 83 percent had done nothing. Reflecting their higher awareness and risk perception levels, homeowners in the unaffected area were more active, with only 43 percent doing nothing (Gardner and Cortner1985).

On a more positive note, Loeher's study (1984) found that only 25 percent of respondents had done nothing. Perceived threat was directly related to taking action; the higher the perceived threat the more likely residents were to obtain information and engage in mitigation. Of those that had done something, 40 percent were choosing "active" measures—intending to stay and protect their property themselves—and 60 percent were engaging in "passive" protection involving brush clearance and use of fire-resistant building materials. The Michigan study found that 75 percent of homeowners claimed to have taken mitigation steps (Winter and Fried 2000).

Abt and others study (1990) of Palm Coast, FL, also found a high rate (67 percent) of residents using some type of defensible space measures, with vegetation clearance the most popular activity (53 percent). Showing a positive effect of experience, 93 percent of the measures put in place were done after a wildfire that occurred in the area in 1985. However, another study after the 1998 Florida fires found a negative association between wildfire experience and intention to take protective action (Jacobson and others 2001).

In Incline Village, 70 percent of respondents reported that they had put in some defensible space measures with 63 percent engaging in vegetation modification (McCaffrey 2002). The most common reason given for why defensible space measures were put in was a sense of responsibility for choosing to live in a high hazard area, with 77 percent of respondents stating it was a very important reason.

The Incline Village study found no associations between accuracy of understanding of the fire problem and either putting in defensible space or having an evacuation plan (McCaffrey 2002). However, higher risk perception did appear to lead to taking some degree of action. There was no association between hazard perception and putting in defensible space measures when the hazard was judged moderately to very severe. However, there was an association when the responses were grouped into very severe and moderately to not very severe. Those who saw the hazard as very severe were 13 percent more likely to have defensible space than respondents who found it less severe. However, having an evacuation plan appears to require a lower level of risk perception as those who saw the hazard as moderately to very severe were 11 percent more likely to have an evacuation plan. In this study, the degree of action taken appears to run parallel with the degree of perceived risk. Moderate risk perception only led to moderate action (having an evacuation plan), while very high risk perception potentially leads to more involved activities such as putting in defensible space measures.

In Incline Village, permanent residents were quite a bit more likely than part-timers to put in defensible space measures (83 percent versus 64 percent) and to have an evacuation plan (44 percent versus 24 percent). They also were more likely to think the fuel load was a major contributor to the hazard (70 versus 48 percent), have a higher risk perception, and a stronger sense of responsibility (McCaffrey 2002). The nature of residency was particularly interesting when significant relationships were looked at for different types of partial use: 4 to 8 months, 1 to 3 months, and weekend and vacations only. Certain variables were found to have a clear relationship with the amount of time spent at the residence. These included putting in defensible space and having an evacuation plan, risk perception, and putting in defensible space because it was the individual's choice to live in a high fire hazard area: all were positively associated with longer periods of residence use. Single-family homes also were found to be 28 percent more likely to have some defensible measures.

Several factors were found to inhibit mitigation. Loeher (1984) found that two hindrances were the issue of how to dispose of cleared vegetation and the need for others to take action for the mitigation to be effective. Uncertainty regarding the effectiveness of various adjustments also frustrated homeowners. This is a common dilemma with mitigation; it is difficult to prove that a house was saved due to mitigation and not just luck. A similar result was found in interviews in three California fire areas by Rice and Davis (1991) who found that the uncertainty around fire, both when it will occur and the effectiveness of mitigation, provided little incentive to do anything especially when other issues were more relevant. They also found the "It won't happen to me" belief prevalent at all levels, whether homeowners or government officials. Nor does experience with fire always lead to improved visions of defensible space. A 1990 wildfire in Michigan left residents with a view of wildfire as uncontrollable and random, leaving them skeptical of both suppression and mitigation activities. The fact that the fire came right up to, but did not burn, a woodshed and skipped over other vulnerable structures, yet destroyed houses with 300 feet of defensible space, left doubt about its usefulness (Winter and Fried 2000).

Prescribed Burning

Prescribed burning is often thought of as one of the more controversial fuel management activities due to issues of air quality and public acceptance. Studies,

however, indicate these concerns may not be as problematic as anticipated. While studies from the 1960s and 1970s did indicate public distrust or dislike of prescribed burning, studies from the 1980s show increasing public support (Cortner and others 1990). A 1981 phone survey of Tucson, AZ, residents found that 84 percent knew about prescribed burning and of these, 80 percent strongly approved of its use (Cortner and others 1984). A 1986 survey of western Oregon residents had similar results (Shelby and Speaker 1990). More recently a 1996 survey in the Blue Mountains of Oregon found that 84 percent of residents supported using prescribed burning over not using it (Shindler and others 1996) and a 1998 survey of Incline Village homeowners found 88 percent were aware of prescribed burning and, of these, 94 percent felt it an appropriate management tool (McCaffrey 2002). However, not everyone is supportive. Homeowners in Michigan were quite distrustful of prescribed burning as a fire management tool due to a previous prescribed burn that had escaped, destroying 44 structures and killing one firefighter. "I'm going to get real scared if I see smoke in the air and there's some government person out there saying, 'I'm your friend, I'm watching this over here'" (Winter and Fried 2000).

McCaffrey (2002) found some support for the conventional wisdom that aesthetics, smoke, and loss of control are important concerns; 57 percent of respondents agreed that they did not like the appearance after a burn and that they were worried the burn would get out of control. A lower percentage of respondents (36 percent) agreed that smoke was a health problem for someone in their household. A smaller percentage of Blue Mountain residents (24 percent) agreed that smoke was a health problem for their family while two-thirds agreed that it was acceptable if it helped forest health (Shindler and others 1996). Other potential public concerns expressed by participants in forums on prescribed burning in western Oregon were regarding resource waste and scenic visibility (Shelby and Speaker 1990).

Common factors that influenced approval were concerns about animal mortality (Carpenter and others 1986; Shelby and Speaker 1990), fear of losing control (Shelby and Speaker 1990; Cortner and others 1984); ignition source, size, intensity, and area of fire (Carpenter and others 1986); belief that nature was too complex to be managed and better left alone (Cortner and others 1984; Shelby and Speaker 1990), and whether the fire is perceived to have a positive or negative environmental effect (Carpenter and others 1986; Cortner and others 1984). This last can be quite significant in shaping approval. Carpenter and others (1986) reviewed three previous studies and found that acknowledgement of beneficial effects was the most "pervasive" influence in approving various fire management methods. For example, when combined with age, belief that a fire had a beneficial effect increased likelihood of approval of prescribed fire 33 times (Carpenter and others 1986). McCaffrey (2002) found that more accurate understanding and higher risk perception decreased the strength of concerns about aesthetics, smoke, and fear of a burn getting out of control. In addition, experience with wildfire increased respondent support for the use of prescribed fire as a management tool.

In a recent survey of Florida, California, and Michigan residents, Winter and others (2002) found that support depended on citizen participation, duration of smoke events, effect on aesthetic quality of landscape, and whether the action was cost-effective. One of the most important variables in acceptance was trust, a belief in the credibility and competency of the agency to safely manage the burn.

Whether socio-demographic factors influence approval is not altogether clear. Carpenter and others (1986) found that different factors were relevant for different types of fire: none were correlated to attitudes on let burn policies; education and age were predictive for opinions on fires burning only underbrush; income and age were relevant for management burns; and age and gender predicted approval for prescribed burning, with older males and middle aged females most likely to approve. McCaffrey (2002) found that women were more concerned about smoke and about a burn getting out of control and that part-time residents were more likely to be concerned about postburn aesthetics and loss of control. In Oregon, Shelby and Speaker (1990) found no socio-demographic correlations. This was attributed to the wide level of support for the practice.

Thinning

Fewer studies have been done on the acceptability of thinning. Two studies indicate that thinning is preferred to prescribed burning, with 76 percent in each study preferring selective thinning to prescribed burning for reducing the fuel load (Shindler and others 1996; Shelby and Speaker 1990). Another study showed a fair knowledge of the role thinning can play in enhancing forest health with 90 percent able to identify its benefits for forest growth and fuel load reduction (Cortner and others 1984). In Oregon, those who favored getting an economic return from a forest were more likely to support thinning over prescribed burning (Shelby and Speaker 1990).

In Incline Village, over 75 percent of respondents found all thinning methods (except herbicides) at least somewhat acceptable (McCaffrey 2002). Hand thinning was the least controversial with 80 percent of respondents finding its use fully acceptable. Contrary

to some beliefs that timber harvest is a controversial option, salvage logging and selective timber harvest were both fully acceptable to roughly three-fourths of respondents. Thinning with heavy equipment and use of grazing animals had more mixed responses with roughly half finding the methods acceptable, one quarter finding them somewhat acceptable, and the remaining quarter either finding the methods not acceptable or were unsure. The higher percentage of respondents who felt the practices were only somewhat acceptable may reflect their concern over where and how the practice was used. Higher risk perception and experience were associated with greater acceptability of salvage logging and selective timber harvest. Older respondents were more likely to support for the larger scale methods of heavy equipment, salvage logging, and selective timber harvest. The one clearly unacceptable method was use of herbicides, with 50 percent finding them unacceptable and only 13 percent acceptable.

One factor unique to the Tahoe Basin that clearly influenced the degree of acceptability of certain practices was concern about the water quality of Lake Tahoe (McCaffrey 2002). This was cited particularly in regard to herbicides getting into the lake and concern about potential erosion from use of heavy equipment and grazing animals. This fact also may be a reason for the large proportion of residents who found timber harvest and salvage logging acceptable. In the Tahoe Basin any logging that takes place occurs under strict conditions in order to minimize potential erosion problems.

Education and Information

Many studies demonstrate a positive correlation between knowledge of fire issues and support for fire management strategies (Cortner and others 1990). Shelby and Speaker (1990) found that when forest managers gave the public specific information about the reasons, plans, and effects of doing prescribed burns there was a high level of acceptance. The most important information sources (in order) were newspapers and magazines, friends and relatives, and television. Cortner and others phone survey (1984), designed in part to educate, found that only a few minutes of exposure to information on prescribed burning could increase approval. The study also confirmed previous work showing a relationship between education, fire knowledge, and tolerance of various fire management practices. Carpenter and others (1986) found that approval of prescribed burning increased with specific information on fire activity and management and concluded the public could handle "a more sophisticated message than that fire is simply bad." McCaffrey (2002) found that more accurate understanding increased support for most practices, particularly in relation to prescribed burning where accurate understanding of the cause of the hazard was associated with better understanding of the ecological benefits of prescribed burning, support for its use, and less concern about loss of control.

However, while Michigan residents may have received fire hazard information, experience (actual or virtual via the news media) was found to be the main influence on perception. The study also found that while homeowners strongly supported education programs to reduce fire ignitions and generally recognized homeowner responsibility for defensible space, they placed little emphasis on educating homeowners on the topic (Winter and Fried 2000).

Despite the prevalent availability of information on wildfire hazard and defensible space, there is poor public use of it. Gardner and Cortner (1985) found that while individuals wanted information they were unaware of the available brochures. Loeher (1984) found that respondents tended to disregard information from fire departments and insurance companies because they had a low level of trust in them and the information they furnished.

The Incline study suggests one reason why there has been poor public use of available information as it found that effectiveness of educational efforts depended on the information source (McCaffrey 2002). General media sources were of questionable value—having either a limited affect, in the case of magazines and newspapers, or a negative influence, in the case of television. Educational materials on the other hand had a positive affect on risk perception and acceptance of more controversial aspects of prescribed burning. In addition, personal contacts increased support for more controversial aspects of various mitigation practices. The study also found that whether a human information source (such as a fireman) was perceived as a government contact or a personal contact was related to the type of practice involved. If respondent concerns were centered at a governmental (for example, salvage logging) or a more personal level (such as smoke), the parallel type of contact was most influential.

Social Impacts of Wildfire—Hayman Fire, Woodland Park, CO, Case Study: Preliminary Results

Woodland Park Colorado is a small town west of Colorado Springs on U.S. Route 24 and within a few miles of the Pike National Forest. The Hayman Fire burned to the southwest, west, northwest, and north of the town and approached within a few miles of it. While Woodland Park was never evacuated, it was on standby for evacuation frequently throughout the period of greatest fire activity. The information was

collected to support a larger study ongoing in Forest Service Region's 1 and 4, funded by the National Fire Plan, and whose purpose is to develop an improved understanding of social monitoring protocols for communities impacted by wildfire. The study comprised a brief, preliminary summary of the results of interviews conducted with 55 residents and knowledgeable "key informants" in and around the community of Woodland Park, CO, in the wake of the Hayman Fire. It was prepared on the basis of field notes and recollections of field researchers.

Summary of Emergent Themes from Respondent Interviews

Impacts: We began by asking respondents to talk about the local impacts of the fire *as they saw them*. For present purposes, we categorize them as generally positive or generally negative.

Positive: Respondents in this case study stated that the most positive impact resulting from the fire was the way the community (Woodland Park and the surrounding areas) "pulled together" and helped each other out. They often cited the example of donations of food and supplies for the firefighters as well as money for the volunteer fire departments. The shared experiences of preparing homes and subdivisions for the fire and the evacuation process created opportunities for people to get to know each other and work together. Respondents also cited other positive impacts such as an increased sense of community, the strength, consideration, and kindness of people; an awareness of the wildfire hazard and what needs to be done to improve the situation (thinning, road access) and an awareness of the volunteer fire departments and their needs. Some members of homeowners associations indicated that conflicts (regarding usage of common resources, membership fee for these resources, and so forth) among residents prior to the fire disappeared after the fire. They mentioned that now they had to tackle a common hardship together.

Some also cited positive or little impacts on certain sectors of the economy including lodging, service stations and convenience stores, restaurants, and grocery stores. These businesses supplied services not only to firefighting agencies, but also to evacuees. Some evacuees had to leave with little notice and did not have time or forgot to grab essentials such as toiletries or sufficient clothing. These supplies were purchased at local businesses and/or received through social service agencies.

Negative: The negative impact on the economy of the area and on individuals as well as the loss of natural resources was often mentioned. The tourist sector was hit especially hard. The area has many campgrounds, trails, and ORV areas. The forest was closed during and after the fire, drastically reducing the number of visitors. Parts of the forest have reopened, but negative publicity and perceptions about the area have kept people away. The concessionaire for the developed campgrounds on PSINF estimated that revenues were significantly lower this year. Flooding danger and resource damage will prevent some campgrounds from opening next year. In the long term, the concessionaire thought that return visits would be low due to the loss of natural beauty. A business owner who sells ORV and snowmobile equipment estimated that he lost 80 percent of his business. He is not sure if his business will survive the winter. "Making it through the winter" was a common theme. Respondents expressed concern that tourist/summer oriented businesses would not "make it through the winter" due to a loss in revenue.

The impact on the building and construction industry was apparently mixed. Some respondents said that this sector was hit hard, while someone in the contracting business said that he had more than he could handle.

Another financial impact was on the local volunteer fire departments. The loss of property tax revenue will severely impact the Mountain Communities Fire Department because most of the destroyed homes were in their district. The departments will also need to repair and replace equipment. Funds for this are available through several sources, including El Pomar (Statewide fund), local donations, and the Colorado State Forest Service.

Individuals, including volunteer firefighters, also suffered income losses because they were not able to work. There were a couple of anecdotes that some volunteer firefighters lost their "regular" jobs, although the employers claimed that it was not due to time lost to firefighting duties. Others were not able to work because they had been evacuated or had stayed to protect their homes. A few businesses, such as the Lutheran Valley Retreat and the concession campgrounds, placed out-of-work employees in jobs in other areas.

Impacts on physical health seemed generally to be minimal. A couple of respondents mentioned that they or relatives with asthma and other breathing problems had to leave the area. One elderly woman died from an asthma attack brought on by the smoke. The smoke was not persistent in the Woodland Park area and many said that there were only a few intensely smoky days.

The impact on mental/emotional health (at least in the short-term) appeared to be more pronounced. Many reported high levels of stress and anxiety due to the fire and evacuation. The concern over the loss of home and property, not being able to return after

being evacuated, the perception of misleading or inaccurate information, and the perceived insensitivity (at times) of law enforcement officers were often mentioned as stress inducers. Interviewees stated that they dealt with the stress by staying busy (for example, going to work, volunteering) and by staying informed. One evacuee stated that he and others in his subdivision "felt like criminals" because they had to sneak into their homes after being evacuated to get things and work on the property. In this area and others people were evacuated days or weeks before the fire actually reached their homes. People wanted the opportunity to go back for things they had forgotten and to "fireproof" their homes. Some of those who were escorted in after the area had burned claimed that they were locked in vans and not allowed to get out and look at their homes and/or retrieve belongings for more than a few minutes.

Residents who lost their primary home due to the fire are living through an on-going traumatic experience. Elderly people who planned to use their (now) burned vacation home as a primary residence after their retirement are also experiencing substantial grief. People who did not have fire insurance and "lost everything" expressed helpless and desperate feelings about their future. Younger people who lost their homes tended to express a greater resiliency, while retired people who "lost everything" said they felt desperate. As would be predicted from previous research and experience, people who lost their homes often expressed anger toward the USDA Forest Service and firefighters. Residents who lost their homes reported asking themselves "…why my house, but not others…why did they let my house burn?" One respondent stated that he is still having trouble with comprehending exactly what happened to him. A retired couple told the interviewer that the most difficult thing to deal with was to remember that their house used to exist. They expressed grief at having lost everything that they had accumulated. They stated that money simply could not buy back these memories.

For those who were evacuated for long periods, "not knowing what was going on" with their homes from day to day was "nerve-wracking and frustrating". Such people often expressed the complaint that they could not get updated, concrete, and reliable information during the fire.

Almost all people who incurred property damage expressed significant frustration about the reimbursement process they had to go through with their individual insurance companies. Overwhelming amounts of paperwork, along with remembering and listing lost belongings, were common complaints. Many such respondents also complained that their insurance companies were neither cooperative nor sympathetic concerning their losses.

Most Oft-Mentioned Impact: The loss of the forest resources and physical beauty of the area were most often mentioned. Also mentioned was the impact (positive and negative) on the economy. Flooding and erosion and a decline in real estate values were also frequently mentioned by those who did not incur any damage, while not surprisingly, the loss of houses and possessions was more frequently mentioned by those who incurred damages.

Attribution: We also asked respondents what they believed were the "fundamental causes" of the fire and its damage. Respondents generally attributed the fundamental causes to the drought and poor forest health or "lack of management." Contributing factors were high winds, lack of thinning, lack of prescribed burning, and failure to fully utilize all firefighting resources when the fire started. Most thought that the fire was inevitable and the ignition source itself was not important, saying that if the fire hadn't been started by an individual, something else such as lightning, a tossed cigarette, or a hot catalytic converter would have started it.

Most respondent who *did not personally incur any damage* thought that the fire had been fought effectively and that it was not controllable. Some were critical of the Forest Service and claimed that if the agency had been more aggressive at the beginning, the fire could have been controlled and kept small. Specific examples included the alleged failure of the Forest Service to call on and/or utilize local volunteer fire departments and the failure to use large bulldozers from Cripple Creek mining operations as well as the alleged failure to use National Guard slurry bombers stationed in Colorado Springs.

It is worth emphasizing again that critical comments concerning the USDA Forest Service were especially common among people who personally incurred property damage or lost a home. For these individuals, personal losses overwhelmed concerns about such things as firefighter safety. On the other hand, those who did not incur property damage tended to believe that firefighter safety should be a higher priority than protecting property. Again, this result is consistent with previous research on attribution and wildfire (Carroll and others 2000).

Restoration: We also asked respondents about ongoing resource restoration efforts in the wake of the fire. Respondents mentioned cutting of hazard trees, seeding, mulching, and erosion control as the things they noticed going on in the burned area. Most noted that the Forest Service couldn't do such work on private land. A few knew that money for restoration/rehab on private land was being transferred through HayRAC. Efforts on private land were thought to be less extensive due to the time, labor, and expense

involved. (The Natural Resource Conservation Service is heading up efforts on private land, but money is limited and resources are scarce, in part due to many fires this year and a resulting high demand for money and supplies). Some private landowners wanted to begin restoration and rehab efforts on their property but felt they could not do so productively until the Forest Service finished work on National Forest land, which was often sited above the private property in question.

Many noted that aspen, grasses and other plants have sprouted since the fire. It was noted that brush and small trees would make the area relatively green within 5 to 10 years, but many lamented that "not in my lifetime" would the large trees return.

Information: We also asked respondents about the adequacy, timeliness, and appropriateness of fire related information available from various government sources to them (1) before, (2) during, and (3) after the fire.

Prefire: (It should be noted that primary responsibility for "fire wise" programs in the study area rests with the Colorado State Forest Service, which did have active programs ongoing prior to the fire.) From the perspective of postfire respondents, prefire education and prevention information seemed, in retrospect, to be somewhat limited both in its scope and in the response by residents. Respondents mentioned receiving brochures or flyers in the mail. They also mentioned that the volunteer fire departments offered information at pancake breakfasts and at the fire stations. While most thought that the information was good and easy to understand, most admitted that they had not undertaken such measures prior to the fire event.

During: This topic requires some context. Previous research and past fire experience indicates that communication between agencies responsible for firefighting and residents of fire-effected communities is often problematic (Carroll and others 2000). This generally appears to be the case for a number of reasons. One reason is that the responsible agency is often in the position of being the bearer of bad tidings to residents. Another is that natural resource managers are trained to look at fire analytically, whereas, for residents, a threat to their house or beloved special places is a highly emotional and personal experience. Thus, what fire managers are trained to think and talk about in a fire situation is often quite different from what is on the minds of residents. Third, there is some research evidence to suggest that there is a "natural" psychological tendency for people who suffer tangible losses from disaster situations to look for a human agent to "blame". In wildfire situations, that agent is usually the entity charged with fighting the fire.

In this particular case, interviews with line Forest Service officers indicated that the forest supervisor, being aware of the inherent difficulties in communications involving a fire of the magnitude of the Hayman Fire, appointed a team of off-forest District Rangers to lead the Forest Service communication process for the fire. In addition the local County sheriff took it upon himself to personally notify residents who lost their homes. Nonetheless, as we will briefly describe below, the communication process was not without its difficulties from the perspective of at least some fire-affected residents.

Information sources used by residents during the fire included Web sites, neighbors, firefighters, public meetings, local television stations (Denver, Colorado Springs), the Red Cross, hearsay, radio scanners, and the Java Junction Coffee Shop.

Overall, respondents thought the quality of information from the above-mentioned sources during the fire was good. The Teller County Web site was highly praised, as was the information from Java Junction. This establishment turned into a gathering place for off-duty firefighters, and they passed on current information on fire suppression activities. A Web site that had satellite photos of the Hayman and other fires was also praised. Some opined that TV stations in Denver disseminated more reliable information than that those in Colorado Springs. Some also indicated that TV news often seemed to be overly dramatized.

Respondents tended to be somewhat critical of the nightly meetings sponsored by the Forest Service, saying that the information at these meetings was, at times, "inadequate" and "outdated." Some complained that the information was delivered in an impersonal manner. Some thought that the information was "controlled" and that there was little input from local sources such as Red Cross, the city of Woodland Park, and Teller County. Some pointed out that the nightly meetings were originally held for evacuees, but it turned out that many nonevacuees also attended.

A number of complaints regarding the quality of information were expressed by evacuees in particular. Typically, they wanted to know at a given point in time whether their houses still stood or when they could return to their homes. This type of information was not always available when it was desired, creating frustration on the part of evacuees. Final confirmation about whether one's house was burned often took more than a week, according to some people who lost their homes.

Post: At the time of the interviews, many respondents were often not aware of much of the information that had been disseminated after the fire regarding resource, economic, and health impacts. Sources included reports on TV and in newspapers; meetings on restoration work and flooding; a Forest Service publi-

cation called "Out of the Ashes," and newspaper/TV reports on volunteer rehab and restoration work days. The quality of this information was generally labeled as "good" by those who did see it.

Relationship with the Forest Service: Locals appear to have generally good relationships with the Forest Service. Some mentioned that there had been some anger over the cause of the fire (its alleged ignition by a Forest Service employee) but nothing that appears to be long-lasting. The inability of the Forest Service (the National Forest Systems branch) to work with private landowners on fire prevention and restoration was mentioned as a problem. One fairly persistent theme was the perceived need for the Forest Service to improve its existing working relationships with volunteer firefighters and other groups/agencies involved in fire prevention and control.

Community Capacity: For present purposes, community capacity can be described as the extent to which a community possesses the resources (broadly defined) and ability to allow it to cope with a disturbance event such as a fire. In the case of Woodland Park, community capacity can generally be described as high. Respondents pointed to the outpouring of donations and help for evacuees during the fire as one example of this. The effort to evacuate pets and livestock, the work of the Forest Fire Victims Task Force (which organized virtually over night and serves as a safety net for those without other resources to fall back on) and the leadership of Tracie Bennitt of Java Junction were also mentioned as an example of community capacity. The community was described as good, supportive, and compassionate. As one respondent stated: "Everybody pitched in and there was good energy."

Other Issues and Concerns: One expressed concern had to do with the potential evacuation of Woodland Park (something that nearly happened, but in the end was not needed) and whether that could have been done effectively and safely. For example, respondents reported rumors about the highway out of town being partially closed. The impact on the tourism sector was also mentioned.

Some mentioned that there were not enough places for pets and livestock that were evacuated. The animal shelter exceeded its capacity (15 dogs) and housed 54 dogs during the fire. Woodland Park Saddle Club was also full of horses and livestock. Some residents were forced to take their pets to their friends' houses in Colorado Springs or Denver.

Needs: There were no strongly expressed needs for goods and services related to local fire suppression capacity (although as we note above many felt the Forest Service could have used existing local capacity more effectively). Again, many mentioned the outpouring of donations that helped firefighters and evacuees. The Red Cross was oft cited as being "great" and meeting the immediate needs of many evacuees. There were concerns about where Woodland Park residents would go if the entire community had been evacuated.

There were suggestions that community meetings in the specific subdivisions that were on stand-by or near the fire would have been helpful rather than sole reliance on centralized meetings and "telephone trees." It was also suggested that off-duty law enforcement officers could have escorted evacuated homeowners back to their homes to retrieve more belongings during times that such homes were not under immediate threat.

One impact issue worth noting is the difference in circumstances faced between renters and homeowners in the wake of a fire. Renters appear to have been affected disproportionately harder than homeowners when their residences burned. Renters' insurance is not required as homeowners insurance generally is and thus is not common. Also, renters may be limited in the kinds of things they can or are willing do for fire hazard reduction around the house and property: landlords may not do anything or may restrict tenants from doing so.

One source of help for homeowners who face losses from disasters such as large wildfires is the Federal Emergency Management Agency (FEMA). FEMA has provided assistance for fire victims of the Hayman Fire. However, those who live in nontraditional residences such as recreational trailers or RVs (of which there were a number in the community) were not eligible to receive compensation from FEMA for the loss of their residence. Such people had to turn to the Forest Fire Victims Task Force or the Red Cross for assistance. One respondent who incurred damage to cattle, fencing, and grassland for her ranching business did not receive compensation from FEMA. The person could not operate her business this year because the permitted area was burned and there was no other place to graze the cattle. She complained that despite these damages she could not get any compensation.

On the subject of FEMA, there was considerable frustration expressed by County officials concerning notification of the accounting rules for compensating the County for fire-related expenses. The main complaint was that the County was not notified by FEMA until after the fact concerning the detailed information FEMA requires in order for the County to be eligible for compensation for various functions and expenses.

The Future: The final topic covered in respondents' interviews concerned their vision of the future for the forest, their family, and their community A future fire

in the unburned areas is a real possibility in the minds of many respondents. However, most feel the possibility of a fire within the perimeter of the burned area is low, as there "is nothing left to burn."

The fire experience has clearly increased awareness of wildfires and made a potential future fire more of a reality in peoples' minds. However, most respondents at the time of the interviews were not planning to take any particular actions to "firesafe" their homes and properties against future events. Explanations for a lack of such activities range from "the damage has already been done" to the aesthetic preference for trees near their homes. This is a subject clearly worthy of attention in a followup survey.

Many respondents who lost their homes stated that they planned to rebuild their homes again in the same spot. When they were asked whether they would put extra effort into fire prevention measures for their new house, many answered in the negative. The reason was that they loved to be surrounded by trees; therefore, thinning conflicted with their original purpose to build their house in such a setting.

Stakeholder Perceptions of Wildfire Risk Reduction Strategies, Fire Management Treatments, and Forest Conditions

The catastrophic fire season during the summer of 2000 spurred many groups and individuals to consider how best to reduce the risks associated with such events. One significant reaction to the fires of 2000 originated in Congress, which provided support for the USDA Forest Service within the context of a National Fire Plan to dedicate the resources necessary to develop and design approaches that can help prevent these problems in the future. A key element of the National Fire Plan goals was to involve local communities in the design and implementation of fire management plans. Traditionally, the Forest Service and other land management agencies have used technical expertise to determine the optimal fire management plan, informed the public that a certain treatment was going to be implemented and then accept comments on the proposed action. The objective of the study whose results are described in this section is to more proactively involve the public in determining the desired future condition of the forest landscape and how best to achieve that condition. The preliminary nature of this section provides a starting point for analyzing individuals' perceptions and actions regarding fire and fuels management issues.

Including the public in such decisions is a relatively new concept for public land management agencies. Many have argued that decisions regarding the management of forested landscapes should be left to forest professionals because such decisions require a detailed knowledge of technical material. Others believe that technical knowledge is only required to implement the decisions that are made and not to determine the desired condition of the forest. It is important to understand the role that the public can play in making decisions regarding the desired future condition of the forest landscape and how to achieve that condition. This project focuses on the question of how to include the public and the amount and type of information that is useful for meaningful public input into the decisionmaking process related to fire management issues.

To effectively implement a fire and fuels management strategy requires an understanding of how the public will react to the various strategy options. It is critical to design treatment options that are scientifically sound; however, it is also important to make sure that the public will support such actions. This section describes the results of two workshops on different approaches to forest and fuels management conducted with the residents of the Ridgewood Homeowners Association (RHOA). These sessions focused on the following topics:

- Baseline knowledge and experience with fire events
- Preferences toward various fuel treatment options
- Helpfulness and credibility of various information sources
- Risk perceptions regarding fire issues
- Risk reduction behaviors and strategies
- Fire and fuels management responsibility
- Characteristics of the RHOA participants

The RHOA is uniquely positioned to provide important insight into the affected public and its preferences on fire and fuels management issues. The RHOA is surrounded by the Manitou Experimental Forest, which is in the Pike-San Isabel National Forest. The residents of RHOA were evacuated for 8 days during the Hayman Fire and they have experienced several fires in the area prior to the Hayman. Based upon the RHOA's location and previous experience with fire events, we approached the community to participate in a long-term study designed to better understand the effect of information on fire and fuels management options as well as to better understand both the voluntary and involuntary risks that people face living in wildland urban interface.

In early June of 2002 (about 10 days before the Hayman Fire) 63 residents of the Ridgewood HOA (42 percent of the total residents of the RHOA) participated

in the first workshop. The primary focus during this phase of the study was on the impact of different amounts and types of information on residents' preferences for fire management of a specific forested area. To expand on the information collected during the workshop in June, we conducted the followup session with the RHOA in February 2003 (about 6 months after the Hayman Fire was contained). Thirty-two residents participated in this session (24 also participated in the June workshop). The February session was designed to collect preliminary information on the wildfire risk perceptions of wildland urban interface residents as well as some followup information from the June workshop.

The results of these workshops on homeowner risk information are presented in the following order. First, we present the results of the wildfire knowledge and expertise measures for these residents. Second, we discuss the helpfulness and credibility of various types of wildfire information sources for these residents. Third, the findings for a number of wildfire risk measures, including risk perception, risk vulnerability and risk severity are presented. Fourth, we take a comprehensive look at specific homeowner risk reduction behaviors and the possible motivating factors that influence homeowner decisionmaking, including their evaluation of the effectiveness of these behaviors and confidence in their ability to conduct these behaviors on their property. Fifth, we discuss the homeowner perceptions of the level of responsibility that they place on various entities for wildfire management and prevention. Sixth, we report a description of the homeowners' preferences for various forest treatment options both prior and since the Hayman Fire. Finally, a description of their demographics is presented to provide a more comprehensive picture of these wildland urban interface residents.

Knowledge and Experience

Ridgewood residents were asked to assess how well informed they were about wildfire risks to what extent they find wildfire information relevant, how motivated they are to learn more about the wildfire risks, and the type of information that they have used in the last year along with its respective degree of helpfulness. All measures were rated using a 7-point Likert scale with 1=not at all informed, relevant, motivated, helpful to 7=very informed, relevant, motivated, helpful. Residents assessed themselves as well informed (M=6.4 out of 7), information that they used as very relevant (M=6.8), and they are very motivated (M=6.5) to learn more about the connection between wildfire risks and undertaking defensive actions, even though they considered themselves to be "well informed." These three measures were highly correlated and were therefore combined into a composite measure, **perceived knowledge**. This measure of perceived knowledge will be used in subsequent analysis and discussion.

In addition to asking residents about their level of knowledge, relevance of the knowledge and willingness to learn more, we were also interested in their direct experience with wildfire. None of the residents had any structures on their property destroyed by the Hayman Fire although they were all evacuated for 8 days in late June 2002. In addition, 25 residents stated that they knew of people in other communities or areas that were impacted by wildfire. As expected, each participant indicated a strong awareness of wildfires and the risks that they face living in a location surrounded by a forest landscape.

Information and Credibility

The members of the RHOA that participated in February 2003 were asked their opinion regarding wildfire information sources and the credibility of these sources. Residents were asked to identify the sources of information regarding wildfire risks and rate the degree of helpfulness (1=not at all helpful to 7=very helpful). The most highly rated sources of information were the County and city fire departments and the Colorado State Forest Service (M=6.5 and 6.4, respectively). The USDA Forest Service, media reports, and Firewise community information were also rated as relatively helpful sources of information (M=5.4, 5.6, and 5.8, respectively). Finally, friends and neighbors were rated somewhat helpful as a source of information on wildfire risks (M=4.1). Other sources of information were identified but not by a significant number of homeowners.

Understanding the level of credibility that people attach to various individuals, organizations, as well as local, State, and Federal agencies can be helpful in identifying potential future strategies to communicate with the public. Residents were asked, based on their prior experiences with these entities, to rate the degree of credibility associated with the organization as an information source for issues surrounding wildfire (1=not at all credible to 7=highly credible). Table 21 presents the means for each set of social entities that residents felt were credible (or noncredible) sources of information regarding wildfire risks. Two additional sources of information were included by two residents: the Sheriff's department and Ridgewood HOA. Both were rated as extremely credible by the two individuals. Research reports and environmental organizations were rated somewhat less credible than all the other entities. Although bordered by Forest Service lands, the Ridgewood

Table 21—Creditable sources of information on wildfire risks as perceived by Ridgewood residents.

Social entities used as information sources	Mean credibility rating[1] (std. dev, n)
US Forest Service	5.0 (1.48, 20)
US Park Service	6.5 (.69, 28)
County/City Fire department officials	6.1 (1.4, 23)
Colorado State Forest Service	5.3 (1.2, 30)
Neighbors and Friends	5.4 (1.5, 20)
Research Reports	3.4 (2.1, 19)
Environmental Organizations	3.1 (1.5, 27)
Media Reports	6.3 (.58, 3)

[1]1 = not at all credible to 7 = highly credible.

residents rated the Forest Service as less credible than the Park Service, County and city fire officials, and media reports.

Risk and Vulnerability Perceptions

The third set of measures investigated residents' feelings of risk vulnerability, the perceived level of risk likelihood, and the perceived risk severity of wildfire. There were four measures of risk vulnerability, including the level of concern about the effects of wildfire, the seriousness of the consequences of wildfire, the degree of physical vulnerability to homeowners and their families, and the degree of vulnerability to their property and possessions. These variables were all rated using 7-point Likert scales anchored by 1=not at all concerned, serious and vulnerable to 7=very concerned, extremely serious, and very vulnerable. These four measures were highly correlated resulting in the creation of a composite measure of **perceived vulnerability**. The average evaluation of wildfire vulnerability was M=6.79, sd=.45. This demonstrates that even 6 months after the devastation of the Hayman Fire, residents still feel vulnerable to the potential impact of wildfire, both personally and with regard to their possessions and property.

Furthermore, a correlation analysis shows that perceived vulnerability and perceived knowledge are positively correlated (r=.399), demonstrating that those residents who feel highly vulnerable to the effects of wildfire are also those that consider themselves highly informed about wildfire issues. This might suggest that, despite having expertise in wildfire issues, homeowners believe that there are significant involuntary wildfire risks that influence their perceptions of vulnerability. Evidence of this concern was found during the session when residents indicated they felt very vulnerable (M=6.4, sd=.89) when they completed considerable defensible work and their neighbors did not do this work. This indicates that wildfire education is needed to address these sources of vulnerability.

Residents' perceptions of the likelihood of wildfire occurring near their home were measured using two scales. First, they were asked the likelihood of a fire happening near their home within the next couple of years (1=no chance to 10=certain to happen). Second, they were asked what the chance was of being impacted by a wildfire on a scale of 0 to 100 (where 0=no chance to 100=certain to happen). The scales were strongly correlated (r=.722), therefore, a composite measure of **risk perception** was created. This composite measure revealed that residents rated the likelihood of a wildfire occurring near their home at 77.9 percent. Both perceived vulnerability and risk perceptions were significantly correlated (r=.37), demonstrating the strong link between residents' beliefs about vulnerability and the high probability of a wildfire event occurring.

Additionally, homeowners were asked to rate the severity of the impact of a wildfire on their lives and property (1=no harm at all, 10=extremely devastating). Residents felt strongly that the consequences of a wildfire would be severe and very devastating (m=8.8, sd=1.1). A correlation analysis reveals that perceived vulnerability and perceived severity are correlated (r=.398), indicating that perhaps homeowners' perceptions of vulnerability stem from the strong beliefs that wildfires will have devastating consequences.

Homeowner Risk Reduction Behaviors and Strategies

To better understand the link between perceived risk, intended behaviors, and actual behaviors, the residents were asked what they have done or intended to do for a set of actions identified by the Firesafe council (see table 22 for the list of specific actions). The residents were asked to indicate their likelihood of performing certain defensible actions on their property (1=probably will not do to 5=already done). Additionally, the motivation for risk reduction behavior decisions was examined. Homeowners were asked to rate both the perceived effectiveness of doing a particular defensible action and their confidence in their ability to conduct the defensible action (1=not at all effective/confident to 7=very effective/confident, respectively). These measures, perceived effectiveness of the Firesafe actions and residents' confidence in their ability to conduct these Firesafe actions, focus on specific actions that residents can implement on their property. The confidence measures reflect the homeowner's ability to do the work themselves or to have the resources necessary to hire someone to undertake the task.

Table 22—Resident's beliefs about wildfire risk reduction activities.

Action	Behavioral Intention 1=prob. will not do 5=already done	Effectiveness of action 1=not at all eff. 7=very eff.	Confidence in action 1=not at all 7=very conf.
SPECIFIC ACTIONS [mean (sd)]			
Defensible space	3.7 (0.8)	6.3 (0.9)	6.7 (0.5)
Fire resistive plants	2.4 (1.6)	5.6 (1.1)	6.2 (1.3)
Fire resistant roof	3.2 (1.6)	6.3 (0.9)	6.0 (1.8)
Fire resistant decks	1.6 (1.8)	5.8 (1.3)	5.8 (1.8)
Clear dead branches	3.8 (0.8)	6.4 (0.7)	6.8 (0.5)
Home easily identified	3.7 (0.9)	6.5 (0.8)	6.6 (1.1)
Plant away from house	3.1 (1.5)	6.5 (0.7)	6.5 (0.9)
Plant away from power lines	3.3 (1.3)	6.2 (0.8)	6.5 (1.0)
Work with neighbors	1.6 (1.5)	5.8 (1.3)	5.8 (1.5)
Stack firewood away from house	3.8 (0.8)	6.4 (0.9)	6.9 (0.2)
Contact local FD	2.9 (1.6)	5.9 (1.0)	6.5 (0.9)
Average Rating		6.17	6.42
GENERAL ACTIONS			
Actions prevent fires		5.2 (1.6)	
Ability to avoid wildfires		3.0 (1.9)	
Average Rating		4.09	
Confident in your ability to protect self			4.6 (1.4)

In addition, residents were asked to rate the possibility of preventing wildfires from impacting them and if the risk of wildfire was easy for them to avoid (1=not at all possible/very difficult to 7=very possible/very easy). Residents were also asked more generally about the confidence in their ability to protect themselves and their property from the risk of wildfire (1=not at all confident to 7=very confident). This second set of effectiveness and confidence measures focused on more general actions related to wildfire. This is in contrast to the more specific Firesafe actions discussed previously. Both the specific and general measures of effectiveness and confidence provide a more detailed picture of what people elect to do and why they select some actions and not other actions. Also, information regarding which defensible actions homeowners undertook before and after the Hayman Fire was collected. Additionally, homeowners rated which defensible actions they planned on doing over the long run (1=not at all likely to 7=very likely). These questions were intended to determine if residents understood the importance of incorporating these defensible actions into their lifestyle while living in the wildland urban interface.

The specific measures of effectiveness described above were rated at M=6.17, SD=.68, while the second, more general set of effectiveness measures were rated M=4.09, SD=1.36 (see table 22). There is a significant difference between these two sets of response efficacy measures ($t=7.0$, $p<.01$), which can be attributed to the difference in the level of abstractness of the two sets. The first set focuses on the effectiveness of specific actions such as removing dead branches from your roof, putting in a fire resistant roof, whereas the second set focuses on more generalized actions such as the possibility of "preventing wildfire danger." Residents believed more strongly that specific behaviors can be effective to mitigate wildfire risks, but overall, the involuntary risks of wildfire are not as likely to be preventable.

The same process was conducted for the confidence measures as was described above for the effectiveness measures. Measures were taken of the confidence that residents held in their ability to conduct the specific Fire Safe actions. This set of measures had a mean rating of 6.42 (see table 22). The second set of confidence measures is a more general measure of residents' confidence in their ability to protect themselves

and their property from wildfire risks. This measure was rated by residents as 4.6 on a scale of 1 to 7 with 1=not at all confident in protecting myself and my property and 7=very confident in my ability to protect myself and my property. This can also be explained by the varying degrees of abstractness in the measures. Overall, residents believed that the various defensible actions were effective, and they were confident in their ability to implement these actions, although they were less certain about their overall confidence in their ability to protect themselves from the effects of wildfire.

The second step of the process investigated the connection between residents' likelihood to undertake a specific action with their belief in the effectiveness of this action and their confidence in their ability to conduct the action. Table 22 presents the mean ratings (and standard deviations) for all three sets of individual measures.

There was a significant, positive correlation between behavioral intentions and response efficacy for removing dead branches and brush from roof and chimney (r= .54) and stacking firewood away from any structure (r= .56). Therefore, the beliefs about the effectiveness of these mitigating actions likely influenced the decision to implement these behaviors. There was a significant, positive correlation between behavioral intentions and confidence in getting a fire safety check on your property (r= .56), planting trees away from any structures (r= .43), putting a fire resistant roof on structures (r= .675), and putting fire resistant undersides to decks and balconies (r= .50). As would be expected, residents who felt confident in their ability to carry out these actions were much more willing to actually implement them. This has important educational implications for fire prevention education.

There was a significant, positive correlation between the effectiveness of some fire reduction behaviors and the confidence that residents reported in engaging in these behaviors. The actions include developing a 30-foot minimum defensible space around one's structures (r= .46), planting low-growing, fire-resistive plants on one's property (r= .51), making sure that one's home is easily identifiable and accessible from main roads (r= .39), and clearing common areas with neighbors in the HOA (r=.75). Thus, residents believe that there is a strong link between the effectiveness of these actions in reducing the impact of fire and their confidence in being able to actually accomplish these actions.

Another piece of information critical to better understanding peoples' response to wildfire impacts came from determining what, if any, defensible actions were undertaken after the Hayman Fire. Residents were asked to write down any actions that they started after the fire and evacuation took place. These actions are listed in table 23.

Table 23 demonstrates that residents were motivated to take actions following the Hayman Fire, with 18 of 32 (57 percent) reporting having started at least one of the above defensible strategies since the Hayman Fire. Less than half of the residents, 14 of 32, (43 percent), report having completed all the respective actions prior to the Hayman Fire.

Another important inquiry is to understand the reasons why homeowners living in the wildland urban interface do **not** engage in various risk reduction behaviors. Residents were asked to explain why they would select "not to do this action" on their property. The results included eight actions that residents would not consider undertaking in the future. The results are summarized in table 24.

The behaviors the residents would continue (or intend to continue) to undertake on a regular basis as long as they continue to live in the wildland urban interface were also considered. The objective of this question was to determine if residents realized the importance of making these wildfire risk reduction

Table 23—Wildfire risk reduction activities undertaken by residents after the Hayman Fire.

Actions taken after the Hayman Fire	Number of Residents (n=32)
Removing trees from near structures	8
Clearing common areas	4
Putting in fire resistant undersides	2
Creating defensible space	11
Remove dead branches/brush from roofs	6
Stack firewood away from structures	5
Fire safety inspections	4
Making home easily visible & accessible from road	2
Nothing – already started everything before fire	14

Table 24—Resident's reasons for not engaging in wildfire risk reduction activities.

Actions not undertaken	Reason not undertaken	Number of undertaken residents (n=32)
Fire resistant plants	Did not need this type of protection	5
	Due to drought, do not need to plan anything	8
Fire resistant roof	Too costly	5
Fire resistant decks	Don't have this structure	3
	Too costly	10
Trees planted away from house	Trees hold too much value	5
Plants/trees away from Power lines	Trees are Aspens—fire resistant	2
Work with neighbors/HOA	Not necessary	7
	Don't see anything happening in the short run	2
Stack firewood away From house	House made of wood—makes no difference	1
Fire safety inspection/	Not needed	3

behaviors a part of their way of life while living in the wildland urban interface. They were asked to list each of the actions and the respective likelihood of doing it in the long run. Only two of the 33 (6 percent) residents did not list any actions that they would undertake over the long run. The other 31 residents listed at least three actions that they realized were critical for undertaking over the long run (see table 25). All actions were selected by at least two residents and all were rated 5 or above on a scale of 1=not at all likely to 7=very likely by the residents. This is a clear demonstration that residents understand, at least in principle, the importance of incorporating these wildfire risk reduction strategies into their lives.

To increase the understanding of residents' motivation for undertaking or not undertaking certain wildfire mitigation actions, they were asked to explain the biggest impediment to implementing risk reduction behaviors. Table 26 presents the varied responses from the RHOA.

Three responses in table 26 are of particular interest. These three measures are related to the "involuntary risk" dimension of mitigating wildfire risks: "can't fight nature," neighbors have done nothing, and USDA

Table 25—Residents' perceptions on critical long run wildfire risk reduction actions.

Risk reduction actions in long run	Number of residents selecting to undertake action
Create minimum 30 ft. defensible space	29
Plant low-growing, fire resistive plants	2
Put a fire resistant roof on your home	5
Put fire resistant undersides on decks/balconies	5
Remove dead branches from roof & chimney	19
Home is easily identifiable	7
Trees planted away from structures	19
Trees planted away from utility lines	7
Clear common areas	10
Stack firewood away from structures	16
Fire safety inspection of your home	2

Table 26—Impediments to implementing risk reduction activities.

Biggest impediment	Number of residents
Age of resident	2
Nature – "can't fight nature"	6
It takes too much time	4
Drought conditions	2
Neighbors have done nothing	4
US Forest Service has done too little	10
Lack of funds by state & federal agencies	2
Need place to haul slash	11
Cost of undertaking these actions	6
Lack of help to do these actions	7
"I" don't want to do it!!	2
Don't know what to do!!	1

Forest Service has done too little. In other words, these homeowners believe that their own actions will not make a significant difference in saving their lives, resources, and property from wildfire. Almost two-thirds of the participants (63 percent) have indicated that these involuntary aspects of wildfire risk influence their decision as to whether or not to undertake mitigating behaviors on their properties. This has important implications for the types of educational materials and messages that should be conveyed to homeowners in the wildland urban interface.

Responsibility

An increased understanding of homeowners' perspectives on who is responsible for reducing risks of wildfire is also of interest. This can provide insights regarding various aspects of risk, including voluntary and involuntary dimensions. Homeowners were asked how **responsible** (1=not at all responsible to 7=very responsible) should they, their homeowners' association, and the USDA Forest Service be for protecting their property (the resulting means were M=6.8, 5.3, and 6.2, respectively). Additionally, residents were asked to rate how vulnerable they would feel if they had finished considerable defensible space work but their neighbors had done nothing (in other words, involuntary risk). They rated this question on a scale of 1=not at all vulnerable to 7=very vulnerable (M=5.8). These measures represent: **voluntary risk** (that is, homeowners' responsibility), **involuntary risk – agencies** (Forest Service and HOA responsibility), and **involuntary risk – neighbors,** with associated means of 6.8, 5.8 (average of 5.3 and 6.1), and 5.8, respectively. Clearly, these residents feel very responsible for defending their own properties, yet there is considerable sentiment for *all* the neighbors (neighbors and agencies) to do their part as well.

A correlation analysis demonstrates that voluntary risks as well as involuntary risk associated with agencies are both significantly positively correlated with perceived effectiveness (r=.29 and .37, respectively). Thus, residents find a direct link between both their own sense of responsibility as well as the Forest Service and the HOA's responsibility for reducing risks and the degree of effectiveness of their own mitigating actions. The correlation between involuntary risk associated with neighbors' lack of actions is significant and positively correlated with perceived vulnerability(r=.43). Therefore, the idea of homeowners' involuntary risk may be one of the significant explanations for their feelings of vulnerability to the impacts and effects of wildfire. Finally, perceived knowledge and involuntary risk associated with neighbors is significantly correlated (r=.52). Thus, a higher level of knowledge about wildfire issues is once again linked with a higher level of vulnerability, perhaps stemming from involuntary risks of living in a neighborhood in the wildland urban interface with little being done by neighbors (including the Forest Service) to protect residents' lands.

Forest Treatment Tools

The last set of questions that residents answered was related to their preferences for various types and combinations of active fire and fuels management tools. These types of tools included prescribed fires, mechanical removal, and chemical treatment for insect infestations as well as the possibility of doing nothing at all. The residents of the RHOA were asked to rate their preferences in June 2002 prior to the Hayman Fire, and then a subset of the residents rated their preferences for the same tools in February 2003, 6 months after the Hayman Fire (1=least preferable to 7=most preferable). Table 27 presents the results for both sets of preference ratings.

The preferences for prescribed fire and prescribed fire in combination with mechanical removal have remained constant since the Hayman Fire. This group is somewhat supportive of using prescribed fire, though most prefer that the land managing agencies utilize mechanical removal alone. There are stronger preferences for mechanical removal since the Hayman Fire; preferences increased from 5.7 in June 2002 to 6.3 in February 2003. Since the fire, this subset of residents feels less favorable toward chemical treatments and any combination including chemical treatments. This group also has strong beliefs that "no active fire management" is not a preferred alternative, and this belief has remained stable throughout their devastating fire season

Table 27—Residents' preferences for fire and fuels management tools.

Management tool	Preferences (mean & std. dev.)	
	May 2002	Feb. 2003
	n=63	*n=24*
Prescribed fires	4.0 (2.0)	4.0 (1.8)
Mechanical removal	5.7 (1.4)	6.3 (.82)
Chemical treatment	4.9 (1.8)	3.6 (1.7)
Prescribed fires & mechanical removal	5.0 (1.9)	4.9 (1.8)
Prescribed fires & chemical treatment	4.2 (1.7)	3.2 (1.6)
Mechanical removal & chemical treatment	5.0 (1.7)	3.9 (1.8)
No active fire management	1.6 (1.2)	1.7 (1.8)

Characteristics of Ridgewood HOA Residents

Finally, Ridgewood residents were asked to provide the following demographic information: age, gender, education, location of primary residence, years lived in the area, part-time or full-time resident of the area, household income level, and their proximity to a National Forest. The average resident for the February 2003 sample is between the age of 55 and 64, has a college degree, has lived in the area for 10 years as a full-time resident, has a household income level of $75,000 or more, and lives within 1 mile of the closest National Forest or National Grasslands. The June 2002 sample is similar to the February group, although their age was somewhat younger, 45 to 54 years, and their average household income somewhat less, $50,000 to $75,000. Table 28 provides an overview of the demographic information.

Hayman Fire – 9 Months After: What Has Happened and What do People Think?

While much attention is paid to what happens during a wildfire, understanding what happens in a community after a fire is also important. Once the main firefighting resources leave, what happens? Immediately after a fire many express the resolution to take action. But how does this play out once the fire is no longer an immediate memory? How has the fire affected the community 9 months down the road? To gain an understanding of these issues, key informant interviews were conducted in February 2003 to assess what has happened around the area of Woodland Park in relation to community impacts, increased mitigation work, and rehabilitation efforts. Most specifically the interviews were interested in lessons that could be learned from the fire that might be applied to future fires. Due to the limited timeframe available for the study, interviews were limited to representatives of relevant government and nonprofit organizations. Hence, the ability to draw conclusions about specific changes in individual behavior was limited. However, all but one interviewee were local residents, and many had lived in areas directly affected by the fire and had been evacuated. The interviews indicate that while much has gone right postfire, there remains considerable frustration with what many see as the failure of Federal agencies to take advantage of local resources.

Although the fire left people on edge into November and there is some anticipation that this edginess will come back once fire season starts, for most people worries about the economy, war, and drought play a more prominent role. In general, the more serious physical and mental effects related to the fire were considered to mostly have played out, although there still remains a great deal of sensitivity about certain issues. Assessments of the degree of economic impact were varied. At a County level the financial effect was considered to be minor. Instead, small businesses and individuals appear to have borne the brunt of negative impacts. Certain businesses, particularly those that provided food during the fire or provide local services, were seen to have emerged reasonably well while many businesses that were tourist reliant have been hard hit. Local volunteer fire departments in general were not hurt as much as had been expected due to donations of money and equipment. However, one fire department, Mountain Communities, did suffer significantly. The majority of houses that were lost were in its district, and its future revenue base is likely to be reduced by almost half as a result of decreased property values. Even if all the houses are rebuilt and property values increase, the fire department is expected to suffer long-term financial constraints due to Colorado's Tabor Amendment which limits government revenue growth to that of the prior year multiplied by a factor based on state population growth and inflation.

Table 28—Demographics information for Ridgewood residents.

Demographic category, total number in sample	Number (February 2003) 32	Number (May 2002) 63
Age Groups:		
18-25	0	1
26-34	0	1
35-44	4	9
45-54	7	23
55-64	15	21
65 or older	6	8
Gender:		
Male:	16	33
Female:	16	29
Education Level:		
Some high school	0	1
High school	5	10
Some college	6	12
College degree	10	16
Postgraduate work	1	9
Graduate degree	8	14
Other (technical degree)	2	1
Primary Residence – Ridgewood HOA	32	61
Average Years lived in area:	9.7	9.8
Full-time residents:	32	61
Income level:		
Less than $15,000	0	1
$15,000 – 24,999	0	2
$25,000 – 34,999	1	2
$35,000 – 49,999	3	5
$50,000 – 74,999	10	17
$75,000 – over	14	30

At the County and community level, several activities are being undertaken to be better prepared. At this level, the long-term level of exposure to wildfire and associated damages combined with availability of resources provide a good impetus for action. Most efforts are based on weaknesses identified during the Hayman Fire. For instance, problems with communication have led to efforts to resolve compatibility issues that arose and to improve dependability of the communication system with establishment of more communication towers. During the fire the assessor provided GIS information and aerial photos of property in the fire area to both the Incident Command and local fire departments that had proven useful and plans were under way to provide these to each fire department at the beginning of the coming fire season. It was also suggested that the availability of GIS information, aerial photos, and detailed knowledge of individual property at the assessors office puts them in the best position to accurately identify as quickly as possible what property is lost to a fire. In future fires, this could hopefully minimize frustrations felt by some homeowners after the Hayman Fire who were given a seesaw of changing information as to whether their house had survived.

It was harder to tell the amount of activity being undertaken by individuals to be better prepared. Some interviewees felt little was being done while others thought there was increased interest. Some had expected more requests for technical assistance; others suggested that people were just doing it on their own without the need for assistance. Increased use of the mulching program, where homeowners could bring cut vegetation to a central drop off point, was cited by several interviewees as evidence that much work was being done. In addition, a number of local high school students are expecting to spend the upcoming summer working for local homeowners to put in defensible space measures. Conversely, several people had heard of homeowners who saw no incentive for putting in defensible space as they didn't care if their house burned if the land around it burned. One reason

suggested for less activity than expected was that those not burned out stopped going to public meetings before their focus turned to rehab and defensible space issues.

Most postfire activity involves rehabilitation of burned land. Given the area that was severely burned and the local soil type, erosion has been of particular concern in the Hayman area. Although a great deal has been done to rehabilitate burned areas on both public and private property, there was much dissatisfaction with its implementation. There were concerns by private landowners about investing a significant amount of money to prevent erosion on their land when nothing was being done on the public land above theirs. This concern parallels defensible space issues where landowners often argue that it is pointless to do any fuels management on their land if neighboring property owners do nothing. And as with trying to respond to such defensible space concerns, the extent of the lands the Forest Service manages constrains its ability to rapidly respond to each individual landowner who wants the Forest Service land adjacent to their property treated immediately. Despite these concerns, to date the bulk of private land rehabilitation projects have been assisted with Natural Resources Conservation Service (NRCS) contracts.

Another frustration with the rehab process is related to the matching funds NRCS provides private property owners for rehab work. Private property owners were told after the fire to go ahead with needed work, to keep the receipts and they would be reimbursed for 75 percent of the total. However, legislation providing the funding was not passed until the end of September and did not include authority for retroactive payment. Given that some homeowners were spending from $60,000 to $100,000 on rehabilitation, having to shoulder the full burden of the cost has forced some homeowners to finance the work via second mortgages or credit cards. Further, the May 8 cut-off of rehab funds—based on a 220 day clock from the day the agreement was signed—was seen as inappropriate given that little work can be done in the winter. Frustration was also expressed about conflicting information coming from the Forest Service and the NRCS about appropriate rehab methods and the degree of damage that required rehab work. Such contradicting messages from different Federal agencies did little to inspire trust among landowners.

General views on the role of the Forest Service varied – many felt that they had fought the fire well and done a good job with rehab while others were mistrustful of their actions: feeling that they did not do enough early on to fight the fire, not trusting that rehab was taking place, and suspicious of the continued closure of the forest. Notably, there was clear respect for individual Forest Service employees yet often a critical view of the Forest Service as an agency. Individuals were cited for their professionalism, knowledge, dedication, communication skills, and willingness to stay after meetings to answer questions. However, as an agency the Forest Service was often criticized for being arrogant, disdainful of local knowledge, obfuscating, and mired in red tape. The ability to differentiate individual Forest Service employees from the organization was shown in a reverse but similar manner in relation to Teri Barton, the Forest Service employee criminally charged with having set the Hayman Fire. Although there remains considerable animus toward Barton, it was generally felt that people recognized that her actions were done as an individual and not as an agency representative.

Much of this criticism revolved around treatment of volunteer fire departments during the fire. There was continued bitterness about the limited role that the Incident Command allowed local fire departments to have during the fire. The sense that they were being forced to stand on the sidelines while outsiders with no local knowledge took over did not go over well. It was felt that the Forest Service did not recognize or respect the professionalism of the volunteer fire departments, which in fact had the appropriate equipment and training for fighting a wildfire. They also had plenty of experience with the Incident Command System and with fighting wildfires, being involved in initial attack on numerous small fires during the course of each year. (One interesting question that was raised in this regard was the percent of initial attacks that are carried out by local fire departments versus the Forest Service.)

There was a strong sense that locals had a vested interest in stopping the fire and in protecting houses that the Forest Service did not have. Several interviewees pointed to the fact that many of the destroyed houses were lost to ground fires and could have been saved had the local fire departments been allowed to remain in threatened subdivisions. In addition, it was felt that local knowledge, such as location of in holdings and terrain intelligence, could have been valuable in firefighting efforts.

There was recognition that it was not a simple situation, that many people didn't necessarily understand the complexity and danger of what they were volunteering for, and that incident commanders had justifiable concerns about the training and knowledge of volunteer firefighters. In addition, the red card (required physical fitness testing for Federal employees before they can go on fires) issue was recognized and no easy solution was seen. Given that most volunteer firefighters tend to be "gray haired," it was argued that requiring a red card was seen as a reason to completely exclude the volunteer firefighters from helping, and this was viewed as arrogant and foolish.

The need to take advantage of what locals already know and are doing was seen as particularly important given the strong dislike for outsiders telling people what to do.

Hayman Recovery Assistance Center (HayRAC) and its Evolution into a Community Based Collaboration Network

The material in this section is adopted from the report, "Hayman Recovery Assistance Center: Interim Report of Incident Structure Model," by the Hayman Recovery Assistance Center Team, July 7, 2002.

Initial Formation of HayRAC: While failure to take advantage of local resources caused significant resentment, successful use of local resources also occurred and points to the benefits of taking advantage of local knowledge and experience. The most notable example of such a partnership was the creation and perpetuation of the Hayman Recovery Assistance Center (HayRAC). Started by the Pike San Isabel National Forests, Cimmaron and Commanche National Grasslands (PSICC) Acting Forest Supervisor as a multiagency one-stop assistance center, attention quickly turned to identifying ways to keep the organization active after suppression to coordinate postfire efforts.

The center was developed to help continue all the strong relationships that were developed previous to and during the intense time of the Hayman Fire. As one would expect with any incident of the Hayman Fire's complexity, the PSICC has been immersed in the aftereffects of the fire on the Forest, the communities, and the land. The Assistance Center allows the Colorado State Forest Service and the PSICC to develop their strategy to deal with the changed conditions they'll need to address in their program or work.

It was deemed important for the Center to immediately assist in community and public healing, natural resource recovery, and any related incidents such as flooding. The Center was to develop strategies for public participation and information sharing on the rehabilitation and restoration efforts in the short and long term. Facilitation of direct restoration efforts on private lands has been a priority for the Center.

Other specific immediate actions included:

- Facilitate recovery assistance and provide one-stop shopping for affected communities and individuals.
- Coordinate volunteer opportunities, recommend strategies for implementation, set up strategy for donations, and serve as a liaison with organizations to help identify donation opportunities. Identify potential partners and partnership opportunities. Pursue these aggressively.
- Provide information distribution and coordination for short-term restoration activities (Burned Area Emergency Rehabilitation (BAER) and Emergency Watershed Program (EWP) activities).
- Public and community awareness: Deliver key messages identified in the communication plan while there is a high interest; focus on defensible space and ecosystem restoration in dry forest types near communities.

In addition, key long-term objectives for the Center included:

- **Be a central source of information**.

The HayRAC will collect and distribute consistent information to assist individuals, communities, and businesses affected by the Hayman Fire. The information collected and distributed will include fire information, Burned Area Emergency Rehabilitation information, disaster recovery assistance information, defensible space information, volunteer coordination, and long-term restoration information. The Center's staff also will serve as a coordination point and information source to assist citizens needing support from other agencies not physically present at the Center.

Information about the Center's services will be distributed to the media as well as at community meetings and posted on the Center website at:

http://wildfires.nwcg.gov/colorado/hayman/index.shtml

- **Facilitate interagency recovery assistance to communities and individuals**.

HayRAC will coordinate information from local, State, and Federal agencies involved in developing strategies to provide the most effective public service to individuals, communities, and businesses affected by the Hayman Fire.

- **Provide a mechanism to coordinate interagency restoration and recovery efforts within the community**.

The HayRAC, in Castle Rock, will be designed to provide "one-stop shopping" for recovery and restoration information. The HayRAC will be staffed 7 days a week with representatives from public and nongovernmental service organizations to provide assistance to fire victims. In addition, a temporary/part-time Satellite Recovery Center will be established about an hour away in Woodland Park to provide similar services to those available through the Castle Rock office.

In addition, the HayRAC will facilitate coordination between restoration agencies to ensure timely, effective response to rehabilitation needs.

- **Collaborate with the public on the Forest's short- and long-term restoration needs, both within the burned area and outside the impacted area**.

HayRAC will provide critical information to the public and agencies regarding the Burned Area Emergency Rehabilitation Program. Providing this information will help ensure that rehabilitation efforts will promote and focus on achieving short- and long-term restoration needs.

HayRAC will use opportunities during community meetings and contacts at the assistance center, satellite center, and field contacts, and contacts with various agencies and nongovernmental organizations to understand how to collaboratively address restoration needs. From these sensing efforts, HayRAC will develop strategies to address needs that arise.

- **Coordinate and facilitate volunteer programs to support community and forest restoration efforts**.

HayRAC will facilitate a volunteer program that assists the local, State and Federal agencies in the coordination of donations, partnerships, and volunteerism.

- **Create an understanding in the community on how to prepare for and cope with wildland fire and possible flooding as a result of the fire.**

HayRAC will work cooperatively with private landowners, communities, local, State, and Federal agencies to ensure that the need for defensible space and general fuels reduction is well understood so that preparation for the next wildfire can begin immediately. HayRAC will also present an educational program in fire ecology and fire history so that participants understand the following:

- o What are natural and unnatural processes?
- o How aggressive fire suppression has contributed to the "problem."
- o Why fires are burning so hot, cost so much, and are destroying so many structures.
- o What needs to be done to reduce the impact of wildfires?
- o Who are the key players in finding national and local solutions?
- o What actions can people take to help develop those solutions?

In addition, HayRAC will develop a program to help landowners and communities prepare for rehabilitation and long-term restoration and raise awareness of flood potential and how to proactively prepare to deal with it.

The Coalition for the Upper South Platte Takes Over: HayRAC was established to communicate with agencies, communities and other entities associated with the fire recovery effort. Originally the Center worked under the direction of Pueblo Area Command. When Area Command was no longer needed, supervision was transferred to the Pike-San Isabel National Forest. The original organizational staffing was focused on individuals with communication, leadership, and organizational skills. As the organization evolved to meet the objectives, it became clear that there was a need to pass on responsibility for running the center. Using work done after the Bitterroot fires as a model, PSICC folks sought a local organization that could take over long-term administration. The Coalition for the Upper South Platte (CUSP) was identified as a group both willing to take on the task and with a mission that meshed well with HayRAC's rehabilitation and education goals.

CUSP was created in 1998 in part as a result of the 1996 Buffalo Creek fire which at the time was the largest in Colorado history (11,800 acres), and a subsequent large rain event that caused significant damage from flooding, erosion, and siltation. Forming in part due to a wildfire, forest health and fire management issues were a key part of the group's mission to improve the water quality and ecological health of the South Platte watershed from the beginning. In July, with the Hayman Fire not yet controlled, watershed stakeholders met to determine a path that would help heal the community and the land. To that end, they formed a Community Collaboration Network with overall goals of (1) expedite and enhance implementation of rehabilitation and recovery efforts from the Hayman Fire with emphasis on impacted communities; (2) expedite and enhance implementation of efforts to restore forest health to reduce the intensity and impacts of future fires; and (3) build an effective network that can more efficiently address community needs in future emergencies, including post-Hayman flooding and future fires. This effort merged with HayRAC, and CUSP, which was formally known as the Upper South Platte Watershed Protection Association, was asked to take on a leadership role in coordinating these efforts. CUSP agreed to provide:

a. Administrative support and assistance.

b. Point of contact and coordination of requests for assistance.

c. Project coordination for special projects identified by community stakeholders, such as coordinating volunteer work days on public and/or private lands

d. Database management for information including lists of clients (those impacted by the fires), volunteers, and so forth.

e. Fiscal host for grants, donations, or other funds.

f. Assistance to the community stakeholders to develop a memorandum of understanding that umbrellas all interested parties.

g. Technical expertise, information, services, and/or other resources as necessary to fulfill the purpose of this center.

In the beginning of August, CUSP began operating a HayRAC office, with 800-phone service for impacted individuals, agency personnel, the media, and volunteers calling for help, or to help. CUSP coordinated more than 40 volunteer events (6,000+ worker hours of volunteer time) in a 6-week period, and will continue to coordinate these types of events for the next several years. CUSP has sought and received funding to assist livestock owners with meeting hay needs. CUSP staff members have attended dozens of meetings with members of the public and public officials and have responded to dozens of media requests for information, as part of the public outreach needs. CUSP has facilitated the efforts of working committees that will address the long-term, collaborative efforts of the network.

Additionally, CUSP coordinates a fire recovery steering committee consisting of six subcommittees: Funding; Education; Volunteers; Emergency Preparation and Response-flooding; Water Quality/Erosion Control/Land Restoration/Natural Resource Protection; and Social Services and Outreach. Each of these subcommittees comprises local agency representatives, local congressional aides, private citizens, and County government representatives. These committees are meeting regularly to formulate strategies that address their particular theme.

Accomplishments as of February 2003: There has been impressive public interest in helping with postfire work, and HayRAC has played a vital role as a clearinghouse for volunteer efforts. They have organized 48 rehabilitation days using more than 3,100 volunteers putting in over 22,000 hours of work. Volunteers have been affiliated with a variety of organizations including school and church groups, Federal employees (as part of the Combined Federal Campaign), and corporations such as Coors, Toyota, AT&T Broadband, and REI. Notably, volunteers have not just been from the surrounding area but have been from out of Colorado and even from Brazil and Japan. Most of HayRAC work has been done on private land in tandem with the NRCS. but in spring 2003 the volunteers will start working on National Forest land.

HayRAC/CUSP's educational efforts are also important. Members work to promote knowledge of forest health and fire management issues with everyone they have contact with—from landowners to volunteers. In addition, the organization often helps mediate relations between individuals and Federal agencies by helping individuals better understand the functions and limitations of different government agencies, such as the fact that the Forest Service is not allowed to work on private land. Finally, the organization has performed a less formal but important function of listening. By providing a local nongovernmental forum for individuals who needed to talk about their frustrations, broken dreams, health issues, and so forth, CUSP has provided a vital outlet for the strong emotions created by such a catastrophic event.

Although the organization has had no problem finding adequate labor, adequate funding has been a different issue. Last summer's difficulties with fire funding meant that the Forest Service could only provide $20,000 of a promised $100,000. During the fall the organization survived in large part on personal resources. However, when it was finally announced in December that it would soon have to close its door due to funding issues, money began to come in from sources as diverse as the City of Aurora (which receives 90 percent of its water from the South Platte watershed), Phillip Morris, the National Forest Foundation, and singer/entertainer Jimmy Buffet. In addition a memorandum of understanding has been established with the Forest Service where HayRAC will be first in line for relevant excess property.

Other Interview Findings

Another local organization that has played a significant role in facilitating local adjustment to the fire is the Forest Fire Victims Task Force. Affiliated with a preexisting social service nonprofit, the organization had the knowledge and contacts to rapidly obtain funding and community trust. Its purpose was to provide assistance to individuals who needed help but did not fit within Federal guidelines. To date the organization has spent $135,000 helping 121 families by providing money to cover items such as lost wages, lodging, and food and clothing. Operating with an all volunteer staff of up to 70 people, the group has an impressive administrative cost rate of 0.09 percent. Not directly involved with Forest Service concerns, the groups only suggestion was that rather than waiting until the end of the fire to initiate a dialogue with local groups, such efforts should begin within the first 3 days of any major fire to allow the time necessary to organize and establish relationships needed to ensure a smooth transition when Federal resources pull out.

Several more general themes emerged from the interviews. The importance of the visual in understanding what was being done was continually noted. One of the more appreciated aspects of the public meetings during the fire was use of PowerPoint to show why it was so difficult to fight the fire. The influence of visual understanding was particularly

evident in relation to beliefs about how much rehabilitation work was actually being done on Federal lands. Because, as of July 2003, the forest continued to be closed (for reasons of safety and protection of rehab work) the only evidence the public can see of rehabilitation work is from the road. This was interpreted by some as a case of cosmetic whitewashing (rehab has only been done along roads) and by others as problematic only because it does not allow people to truly understand the level of effort agencies have actually engaged in.

Another repeated theme was concern with reinventing the wheel. Several interviewees commented that it sometimes felt like Federal agencies had never previously dealt with a wildfire or disaster. While locals wanted involvement and consultation both during and after the fire they wanted to do it by building on agency experience and not starting from scratch. One example involved the public consultation to prioritize rehabilitation efforts. It was felt that the meeting was too open-ended with no suggestions about best practices to start the discussion. Rather than arriving with a blank paper people wanted a list of potential issues to take into consideration. Another interviewee commented that was hard to believe that there was no already developed, generic computer program to track victims. It was suggested that it would make sense to have a standardized package developed that could be provided with every major incident

The effect of the large scale of the fire was also noted. The extended suppression time meant that incident commanders and staff were rotated out every 2 weeks. This left the community with no sense of continuity of contact, hindering communications and trust. It was suggested that at a minimum a community liaison remain in place for the duration of the fire. Comments also were made about the size and severity of the fire inducing a sense of fatalism in several homeowners. There also was criticism of coordination and resource issues that arose as a result of the split incident command between the northern and southern sections of the fire.

Toward the Development of Postwildfire Social/Economic Monitoring Protocols

Our team was unable to make much progress on developing the set of protocols suggested in our fourth analysis question area. We did develop independent first cuts at separate social and economic protocols. Both of these need considerable refinement and, ideally, they should be integrated to the degree possible in developing a final protocol. However, additional work is beyond the scope of this report. In what follows, we provide: (1) a summary of ongoing work taking place in Forest Service Regions 1 and 4 spinning off of the 2000 fires that will take us at least part way down the road on the development of a social monitoring protocol, and (2) a brief description of a possible framework for an approach for designing an economic monitoring protocol.

Design and Implementation of a Long-Term Social Monitoring Protocol for Community Impacts and Recovery/ Rehabilitation Needs Following a Catastrophic Wildfire Such as the Hayman

In response to the 2000 fires in the northern Rockies, Region 1 and Region 4 embarked on an effort to develop and evaluate a protocol for more monitoring the effects of wildfire on communities and the effectiveness of postfire recovery efforts. This project is still in the early phases of development and evaluation. Thus far, the R1/R4 research team has developed a draft, "Event-driven model of social impacts of wildland fire," and is currently conducting fieldwork and analyzing data collected during the summer of 2002 to evaluate this model as a framework monitoring for community/social dimensions of fire recovery efforts.

The draft model is described as "event-driven" to give consideration to all the different activities that occur prior to, during, and following a fire event. This event-driven model was selected as the heuristic device in order to (1) develop guidelines on what to monitor, (2) determine steps needed to gather needed information, and (3) expand our understanding of how agency actions before, during, and after a fire event affect communities. However, it is recognized that this model, like all models, is a simplified representation of reality, and that caution is warranted in applying it to model complex social impacts

An "event-driven" model was selected because it provides a structural view of the decisions that are made during a wildland fire emergency. By focusing on decisions and their consequences, an event-driven model indicates where changes in decisions and the decisionmaking process can reduce potential negative consequences on the community; likewise, it may show what decisions may be made that might lead to positive consequences for communities. For example, communities face a preparedness decision. While many communities may not have prepared themselves for a large-scale fire event, this lack of a decision is a decision itself. By working with these communities, agencies can have a positive impact.

Such an event-driven model must itself meet a number of criteria. First, it must consider the effects of the social and political context within which decisions are made. This context considers attitudes toward wildland fire, general social feelings, and perceptions

about fire suppression and management, and allocations of time and money to policies dealing with preparedness, suppression, and recovery actions. Second, the model must consider that actions occur at multiple scales and must be able to deal with those differing scales. To address multiple scales, the event-driven model focuses on the types of decisions that are made. Third, the model must consider the various disciplines involved in fire management and community decisions. There are multiple disciplines, including sociology, political science, management science, ecology, psychology, and so on. Again, the event-driven model proposed here deals with decisions and actions. The knowledge contained in different disciplines is viewed as contributing to the decision. Fourth, the model should consider the causes and contexts for decisions. In this case, the model attempts to show how decisions are linked in a fire event—thus addressing causes—and acknowledges the significance of context in influencing not only what decisions are made, but also in affecting the types of impacts that occur. Fifth, the model should acknowledge that a variety of responses and impacts occur. The model is focused on agency decisions that affect the community and thus is somewhat narrow in this sense. However, within the context of this goal, the model attempts to be inclusive.

The model contains four major components: (1) the context for fire management decisions; (2) decisions that occur prior to a fire event; (3) decisions that occur during a fire event; and (4) decisions that occur following the event. The decisions that occur within each of these four major components are influenced by other decisions; the experience with these decisions itself influences decisions made in events in the future. Specific decisions that contain implications for variables that might be monitored are shown in table 29. The following sections include discussion about each of the three major actions/decisions in the event driven model.

The next step in the development of the model is to identify indicators of effects and effectiveness for the different items listed in table 29. This will be done in

Table 29—Summary of agency actions that affect communities as suggested by an event-driven model of fire effects. The table lists types of items that might be monitored by agencies.

Before-Event Actions That Affect a Community

1. Community Preparedness (e.g., % firewise, fire suppression plans, development/zoning plans)
2. Federal Preparedness
3. Agency-Community Interactions (e.g., communication protocols, specificity, frequency, trained firefighters, certification of local equip operators, etc.)
4. Awareness (forest ecology, disturbance, fire & suppression strategies awareness, media training).
5. Neighborhood social capital (covenants, prep. events, fire suppression capital).

During-Event Actions That Affect a Community

1. Suppression Strategy and Tactics (direct attack versus property protection strategies)
2. Evacuation Alerts and Orders (who, where, when).
3. Entry restrictions (who, where, when)
4. The Use of Local Facilities, Resources and Supplies.
6. The Presence of Fire Crews and Emergency Personnel in the Community
7. Inter-organizational Relations and Information Management

Post-Event Actions That Affect A Community

1. Assessment
2. Reconstruction (Things – Infrastructure, homes businesses)
3. Restoration (Process – Rehab, stabilization, salvage)
4. Audit (Policy Change) – Monitoring, Prevention/Mitigation/ Preparedness (fuels, houses, subdivisions), Suppression (Strategies, priorities), Restoration

consultation with fire managers. The team will use this preliminary list of indicators to guide additional fieldwork and data collection. The data will be used to evaluate the completeness and usefulness of the indicators as tools that communities and agencies can use to evaluate and monitor community fire preparedness, effects of fire suppression efforts, and priorities and success of postfire recovery efforts.

A Framework for Anticipating and Understanding Economic Concerns Associated with Catastrophic Events Such as the Hayman Fire

Large-scale catastrophic events such as the Hayman Fire have many economic ramifications. These are as varied as the people and organizations and the economic relationships among them that make up what we call "the local economy." To a novice, a stream of concerns and opinions expressed about a myriad of economic topics by various persons and groups may seem spontaneous, random, and entirely unanticipated. But there are clear patterns in this seeming complexity. And persons charged with preparing for, managing, and coping with the reality of such events can exploit these patterns to anticipate what these concerns might be and who may raise them, and by doing so be prepared to act in a confident and informed manner. We present here a simple framework built from these patterns and relationships that can be used to anticipate the broad scope of economic concerns.

We seek a framework so that when we hear an expression of concern, for example, we can quickly appreciate the economic meaning of it. We can do this by noting who is expressing the concern, the role they are playing, and the temporal context in which they are saying it, and then matching the verbatim expression with a typology of economic meanings. The framework offered here is in the form of a series of matrices that highlight the relationships between typologies of economic topics and the principal actors or participants in a local economy. The universe of what we call "economics" is characterized by three broad topics: Economic Allocation, Economic Equity, and Economic Stability. Essentially all economic concerns are ultimately motivated by one of these general dimensions. Similarly, an economy is viewed as consisting of various types of actors: Businesses, State and Local Governments, Federal Government, and Individuals. The roles each of these plays include: Producers/Service Providers, Owners, and Consumers. Three phases of an event provide a crude temporal context: Preparedness, Management, and Coping. Table 30 provides detailed descriptions of these parts of the framework.

Table 31 is an example of the framework matrix for the Preparedness Phase and is organized as follows. Economic actors and the roles they play are arranged along the left side of the matrix as row headings. The three broad topics of the economic typology are the column headings. The row/column intersections illustrate specific instances in which a particular actor playing a particular role might express a concern relating to one of the economic topics. Knowing who is saying what and in what role points to the deeper economic meaning. Three important attributes of these row/column intersections should be noted. First, not every intersection necessarily makes sense in terms of indicating a meaningful relationship between actor and economic topic. The matrix is used to focus attention on the possible meanings. Examples are given where the relationship is relevant to large-scale events. Second, there are many literal variations in how concerns might be expressed relating to any specific row/column intersection in the matrix. For example, terms or phrases like "losses," "costs," or "hardship" may all be used to describe the same concern. Finally, the row/column intersections capture only the concerns of an actor's own self-interest. That is, transitive concerns of one actor about the economic behavior of another are not captured. The possibility that some communities actually gain from a catastrophic event is also not captured here. Tables 32 and 33 apply the same framework to the Management and Coping Phases, respectively.

Once more fully refined, the framework could be used in several ways although the foremost purpose would be to help mangers anticipate concerns that may be raised about an event and to illustrate how to find the deeper economic meaning of these concerns. In appreciating these deeper meanings, managers may more readily empathize with those who raise concerns and with the economists they might turn to for analysis and evaluation. Further, by anticipating these concerns, a path for addressing them may become clearer. For example, some economic concerns sure to be raised can be answered quickly by obtaining readily available current information. Others, once their deeper economic meaning is appreciated, may require more lengthy investigation, perhaps even long-term research. In these cases, it might prove prudent to establish in-place monitoring or assessment programs to acquire economic information prior to the time at which the concern is actually raised. As noted above, the refined framework may most importantly provide a simple tool both for being prepared for the economic concerns that will be expressed about large-scale events and being able to act on them in a confident and informed manner.

Table 30—Explanation of framework components

Framework components	Explanation
Actors	
Businesses	Private sector commercial and non-commercial firms that produce goods and services, including non-governmental organizations (NGOs), trade associations, and public enterprises
State and Local Governments	Various forms of sub-national governance such as State, municipal, county, township, and special districts
Federal Government	Federal governance, including land managing agencies
Individuals	Individual persons and groups of persons (e.g., families, communities, networks, associations)
Actor Roles	
Producers/Service Providers	Using land, labor and capital to create goods and services.
Consumers	Using goods and services.
Owners	Controlling real property and financial assets.
Economic Typology	
Economic Allocation	The efficiency with which resources are allocated among competing uses to greatest economic advantage.
Economic Equity	The fairness with which economic benefits and costs are distributed.
Economic Stability	The trends and rates of change in economic parameters like the prices of goods and services, the costs of financial services, employment, and economic growth or decline.
Temporal Phases	
Preparedness	A time period in which preparedness, planning, and prevention activities predominate.
Management	A time period during which the immediate needs of managing and addressing an event are paramount.
Coping	A time period in which the principal activities address the aftermath of an event.

Table 31—Framework for understanding economic concerns in the event preparedness phase.

		Economic topics of concern		
		Economic allocation	**Economic equity**	**Economic stability**
Economic Actors and Roles	**Businesses**			
	As Producers/Service Providers	**Market Perceptions** – Concerns about customer's perceptions of risk and danger resulting, e.g., in reduced visits.	**Tax Incidence** – Concerns about the fairness of tax and fee burdens.	**Financial Risk** – Concerns that risk premiums may affect access to capital.
	As Owners	**Risk** – Concerns about the costs of risk as in higher insurance costs.	**Tax Incidence** – Concerns about the fairness of tax and fee burdens.	**Financial Risk** – Concerns that risk premiums may affect access to capital.
	State & Local Governments			
	As Service Providers	**Protection & Safety Infrastructure** – Concerns about the cost of providing protection and safety services.	**Preparedness** – Concerns about the responsibility and accountability for preparedness planning.	**Financial Risk** – Concerns about pooling financial risk and providing sustainable funding.
	As Owners	**Protection Infrastructure** – Concerns about the cost of protecting assets.		**Reliable Supply** — Concerns about maintaining reliable supplies of goods and services, e.g., water, timber, clean air.
	Federal Government			
	As Service Provider	**Protection & Safety Infrastructure** – Concerns about the cost of providing protection and safety services.	**Preparedness** – Concerns about the responsibility and accountability for preparedness planning.	**Financial Risk** – Concerns about pooling financial risk and providing sustainable funding.
	As Owner	**Protection Infrastructure** – Concerns about the cost of protecting assets.		**Reliable Supply** — Concerns about maintainingreliable supplies of goods and services, e.g., water, timber, clean air.
	Individuals			
	As Producers/ Service Providers			
	As Consumers		**Tax Incidence** – Concerns about the fairness of tax and fee burdens.	**Financial Risk** – Concerns that risk premiumsmay affect access to capital.
	As Owners	**Risk** – Concerns about the costs of risk, e.g., higher insurance costs, defensible spaces.	**Tax Incidence** – Concerns about the fairness of tax and fee burdens.	**Financial Risk** – Concerns that risk premiums may affect access to capital.

Table 32—Framework for understanding economic concerns in the event management phase.

		Economic topics of concern		
		Economic allocation	**Economic equity**	**Economic stability**
Economic Actors and Roles	**Businesses**			
	As Producers/Service Providers	**Business Consequences** – Concerns about loss of business revenues.		
	As Owners	**Business Consequences**– Concerns about loss of business revenues and/or business assets, e.g., loss of structures.		
	State & Local Governments			
	As Service Providers	**Emergency Management Services** – Concerns about the costs of event management activities, e.g., suppression, damage control.		**Fiscal Accommodation** – Concerns about immediate access to financial resources.
	As Owners	**Asset and Infrastructure Consequences** – Concerns about losses to infrastructure and/or natural assets.		
	Federal Government			
	As Service Provider	**Emergency Safety Infrastructure** – Concerns about the costs of event management activities, e.g., suppression, damage control.		**Fiscal Accommodations** – Concerns about immediate access to financial resources.
	As Owner	**Asset and Infrastructure Consequences** – Concerns about losses to infrastructure and/or natural assets.		

Table 32—(Con.)

		Economic topics of concern		
		Economic allocation	**Economic equity**	**Economic stability**
Economic Actors and Roles	**Individuals**			
	As Producers/Service Providers	**Livelihood Consequences** – Concerns about job loss and/or income losses		
	As Consumers *As Owners*	**Asset and Infrastructure Consequences** – Concerns about infrastructure losses, e.g., homes.		**Fiscal Accommodation** – Concerns about immediate access to financial resources.

Table 33—Framework for understanding economic concerns in the event coping phase.

		Economic topics of concern		
		Economic allocation	**Economic equity**	**Economic stability**
Economic Actors and Roles	**Businesses**			
	As Producers/Service Providers	**Business Consequences** – Concerns about chronic loss of business revenues	**Indirect Business Consequences** – Concerns about chronic business losses via supply and/or demand links	**Market Image** – Concerns about customer's perceptions of damage resulting, e.g., in reduced visits.
	As Owners	**Business Consequences** – Concerns about rebuilding and/or reconstructing business volumes and/or business assets.	**Livelihood Consequences** – Concerns about job and/or income losses.	**Debt Burden** – Concerns about debt burden and effects on access to capital.
	State & Local Governments			
	As Service Providers	**Government Finance Consequences** – Concerns about tax revenue reductions, e.g., sales tax and user fee revenues.	**Coping and Recovery** – Concerns about the responsibility and accountability for economic planning, development, restructuring, and recovery.	**Sustainable Financing** – Concerns about funding sustainable methods of financing coping activities.

(con.)

Table 33—(Con.)

		Economic topics of concern		
		Economic allocation	**Economic equity**	**Economic stability**
Economic Actors and Roles	**State & Local Governments**			
	As Owners	**Restoration/ Rehabilitation/ Reconstruction** – Concerns about reduced productive capacity of natural assets, reconstruction and rehabilitation costs.		**Liabilities**— Financial liabilities for negligence or fault.
	Federal Government			
	As Service Provider	**Government Finance Consequences** – Concerns about tax revenue reductions, e.g., user fee revenues.	**Coping and Recovery** – Concerns about the responsibility and accountability for economic planning, development, restructuring, and recovery.	**Sustainable Financing** – Concerns about finding sustainable methods of financing coping activities.
	As Owner	**Restoration/ Rehabilitation/ Reconstruction** – Concerns about reduced productive capacity of natural assets, reconstruction and rehabilitation costs.		**Liabilities**— Financial liabilities for negligence or fault.
	Individuals			
Economic Actors and Roles	*As Producers/Service Providers*	**Livelihood Consequences** – Concerns about job and/or income losses	**Indirect Livelihood Consequences** – Concerns about job and/or income losses, environmental justice.	
	As Consumers		**Consumption Consequences** – Concerns about reduced opportunities, e.g., access to businesses, recreation opportunities.	
	As Owners	**Recovery Consequences** – Concerns about rebuilding and/or reconstructing costs.	**Indirect Wealth Consequences** – Concerns about loss of value, e.g., scenic quality imputed into value of home.	**Debt Burden** – Concerns about debt burden and effects on access to captial.

Summary and Conclusions

In the introduction to this report we discussed the complexity of the effects a catastrophic wildfire such as the Hayman has on human social and economic systems. We also pointed out that unlike many ecological effects of a wildfire, the geographic scale of influence for social/economic effects extends considerably beyond the area actually burned. Finally, we indicated that a complete catalog of all effects would be difficult to compile, partly because it will be many years before they all play out. As noted in the Hayman Analysis Interim Report on Ecological Effects, *"an 1851 fire"* near Cheesman Reservoir *"created treeless openings that were still present in 2002."* (Romme and others 2002). If this is any indication, no human alive during the Hayman Fire will live long enough to see the burned area recover to anything like it was prefire. Those who used this area have lost something and they will need to look elsewhere to replace it, and the local economies likely have lost the economic contributions those users made.

Our review only focuses on social and economic effects that manifested themselves during the fire or in the 6 months immediately following the fire. We addressed selected questions from four question areas:

1. How do we begin to get a handle on the various economic effects (both during and after the fire) associated with the Hayman Fire?
2. How have stakeholder positions toward fuel treatments been influenced by the fire; that is, what were they prefire and during the fire, and what are they now? How do stakeholders partition blame for the fire among various possible organizations, climatic conditions, and so forth? How do we work to build broad-based consensus on implementing fuels management treatments to reduce the risk of another Hayman Fire along the Colorado Front range in the future?
3. What have individuals, organizations, and communities learned from the Hayman Fire experience? How has the collaborative HayRAC project worked to facilitate the beginning of recovery for affected communities? What needs for additional education remain; for example, what does the general public need to know about forest management? How do we capitalize on the "teachable moment" that will exist only for a short while to get important lessons across? It appears there is a need to educate many on a wide variety of issues relating to natural resource management/wildfires. How do we institutionalize memories of lessons learned from the Hayman incident, especially in the face of a rapidly changing/growing population? In other words, how do we enhance community preparedness for future wildland fires?
4. How would we design and implement a long-term social and economic monitoring protocol for community impacts, recovery/rehabilitation needs, and risk preparedness following the Hayman Fire? What pieces of such a plan could be put into place in the near future?

We accomplished this by conducting four studies, one on economic and social effects of the fire, one involving prefire and postfire workshops with the Ridgewood Homeowners Association, one involving interviews with key informants in the Woodland Park area in August 2002, soon after the fire was suppressed, and one involving another set of interviews with Woodland Park area representatives of governmental and nonprofit organization members in February 2003, about 6 months after the fire was suppressed. Many findings are scattered throughout the report, and appendix II has a list of the more important ones. Next we present some of the more important conclusions.

Economic Effects

The economic aspects of a large-scale fire occurring in proximity to human populations, such as the Hayman Fire, are difficult to measure and highly variable. Some aspects are straight forward and relatively easier to measure, such as the actual suppression expenditures or property losses. Assessing other aspects, such as the effect on a regional economy, or changes in recreation and tourism, are easily confounded by other factors, such as general economic downturns or a shift of economic activity from one location to another.

While the Hayman Fire was not extraordinarily expensive when looked at on a cost per acre basis, the size of the fire made it one of the most expensive fires in the last several years. No fire in Colorado's history has cost as much to suppress. The $38 million spent by the Forest Service on the Hayman Fire was more than three times the average annual suppression expenditures (1992 through 2001) for all of Region 2. Adding expenditures by the State and the other Federal agencies, suppression expenditures totaled more than $42 million. In addition to the money spent fighting the fire, rehabilitation and restoration expenditures (already expended and planned) connected with the fire are expected to cost at least another $74 million. Looking at the distribution of suppression expenditures for the Federal agencies, a larger percentage of money was spent on the Hayman Fire for supplies and services, and a smaller percentage on personnel expenses, than is usually case, most likely due to the severity of the fire which hampered direct suppression efforts by firefighting crews.

Additional expenditures related to the fire totaled almost $2 million. These expenditures included FEMA reimbursements to Counties for roadblocks, traffic control, and evacuations, as well as administrative expenses for the State of Colorado connected with handling the billing for the Counties and other cooperators, and disaster relief by the American Red Cross.

The proximity of the fire to human populations led to a loss of 600 structures, including 132 residences. Real property losses were substantial, totaling $24 million, with a majority of the losses occurring in Teller County ($14 million) and Douglas County ($8 million). Total insured private property losses (which include the real property losses stated above) were considerably larger, estimated at $38.7 million. Loans and grants from SBA and FEMA for uninsured losses totaled almost $4.9 million. Additionally, damage to transmission lines was estimated at $880,000.

More difficult to measure are the effects on resource values (including tourism and recreation) and the regional economy. The fire closure order occurred during the busiest time of the tourist season. Concessionaires who manage the developed recreation sites within the affected Ranger Districts of the Pike-San Isabel National Forest reported a total decline in revenue in 2002 of $382,000 from 2001 levels. Representatives from all four non-Forest Service developed recreation sites outside the fire perimeter that we interviewed reported decreased visitation levels for the fire months of June and July 2002 relative to levels in June and July of 2000 and 2001. Outfitter and guide use on the affected districts in 2002 was at 75 percent of the 2001 level. However, it is possible that recreation losses occurring within the vicinity of the Hayman Fire were offset by gains to other areas of Colorado. Other resource loss estimates on the Pike-San Isabel were substantial, dominated by lost value from water storage capacity ($37 million) and timber ($34 million).

We found little evidence of a substantial economic decline in the Primary Impact Area—the four affected Counties during the months of the Hayman Fire. We developed a number of time series models to estimate regional economic activity in the absence of the Hayman Fire and compared those estimates with the observed levels of economic activity during the summer of 2002. Statistically significant differences between the observed economic activity and estimated values were relatively rare. However, there were substantially more significant negative differences than significant positive differences. This may indicate that, at least in some areas and sectors modeled, the Hayman Fire did decrease economic activity. That more substantial effects were not detected is probably due to (1) tourism-related sectors constitute a relatively small part of the economies in the Primary Impact Area and (2) the economies of the Primary Impact Area are large, complex, and able to withstand economic shocks.

Conclusions from the Wildfire Mitigation Adoption Literature

Findings from the fire studies mirror much of the general hazard thinking on mitigation and highlight certain variables to examine in understanding individual response specifically to the wildfire hazard. These studies confirm that increased awareness leads to higher risk perception but show a less clear link between high risk perception and engaging in mitigation. While most studies found over two-thirds of the population had done some type of mitigation, only the Santa Monica and the Incline Village studies found a significant positive association between risk perception and likelihood of putting in defensible space.

The studies also highlight the uncertain role of experience in shaping both risk perception and mitigation efforts. In Florida, intentions to take protective actions were negatively correlated with experience (Jacobson 2001). In both San Bernardino and Incline Village *actual* experience appeared to dampen awareness and risk perception but *secondary* experience increased awareness and risk perceptions levels and encouraged implementation of defensible space. Similarly, in Michigan direct (and negative) experience merely created skepticism for defensible space measures. However, in Santa Monica experience was positively related to awareness levels, and in Florida it was positively related to perceived risk and appeared to have led to increased implementation of defensible space.

These studies thus give some, albeit limited and dated, insights into public response to the wildfire hazard and mitigation measures. They also suggest the need for more research, including a better understanding of the roles of community action and of broader social factors and contexts on response to wildfire. Several studies are currently under way with National Fire Plan and Joint Fires Sciences Program funding that will provide a more indepth understanding of public response to the fuel hazard from both the individual and the community level. Some of the preliminary results include:

- Support for previous findings that greater understanding leads to more support for fire mitigation efforts (Shindler, Ryan, Vogt).
- The importance of trust in the implementing agency in garnering acceptance for fuel management practices (Shindler).
- Active fire mitigation partnerships can help build trust (Monroe and Nelson).

- Five landscape values are key in influencing acceptability of any vegetation modification: privacy, wildlife viewing, recreation, aesthetics, and the ideas of naturalness (Monroe and Nelson).
- The importance of use of existing networks and partnerships in facilitating active management (Jakes and others 2003).
- Educational materials need to be site specific (Monroe and Nelson).
- The importance of taking local ecology, history, and values into consideration in working with the public on fuels management issues.
- While practices such as thinning and defensible space may be familiar concepts to many, there is limited or inaccurate understanding of what the practices actually entail—often what individuals *think* a practice involves conflicts with their landscape values.
- The importance of use of existing networks and partnerships in facilitating active management.

Conclusions from Ridgewood Homeowner's Association Workshops

RHOA residents participated in two workshops, one held in June 2002 and the second held in February 2003 to gain insights into wildland urban interface resident's decisions, perceptions, and preferences regarding wildfire risk issues. Homeowner knowledge and experience, risk perceptions, preferences for forest treatment options, and homeowner risk reduction behaviors were investigated. Additionally, the underlying factors that potentially motivate homeowners' mitigating actions were also pursued.

The RHOA, located adjacent to the Manitou Experimental Forest on the Pike National Forest, comprises residents who have had notable experience with wildfire, are quite knowledgeable on these issues, and yet are still motivated to learn more. This group of homeowners recognizes the need for active management on the forest and realize the potential dangers that wildfire poses. The homeowners most preferred treatment option is mechanical removal (even more since the Hayman Fire). Second, they prefer prescribed fire in combination with mechanical removal, and finally they are somewhat neutral on prescribed fire. Interestingly, this preference has remained constant from before to 6 months after the Hayman Fire.

The degree of information "helpfulness and credibility" of various organizations and individuals provides additional insights into some of the reasoning behind these preferences for active treatments. According to these residents, the city and County fire departments are helpful and perceived as highly credible entities, while research reports and environmental organizations were not viewed as helpful or credible sources. The Colorado State Forest Service also gives out useful information, though it is only perceived as somewhat credible as an institution. The USDA Forest Service, bordering many of these residents' land, is viewed as providing somewhat helpful information and as less credible than the Park Service, County, and city fire departments, State Forest Service, and neighbors and friends. This could explain some of the trepidation associated with prescribed fire; the residents may view prescribed fire as something needed but not preferable because they know the Forest Service is the entity implementing the treatments. These sentiments for prescribed fire may also reflect the knowledge about the Forest Service employee who has pled guilty to starting the Hayman Fire. An avenue for future research would be to expand the treatment questions to include different agencies/entities carrying out the various treatment options and investigate the link between the entities' credibility and the homeowners' preferences for active treatment options.

The residents of the RHOA feel highly vulnerable to the effects of fire, highly susceptible to the consequences of fire, and residents also feel that there is a high probability (78 percent) that a wildfire will occur near their home in the near future. Yet, the measures of perceived efficiency for both specific and general risk reduction actions only explain a few of the homeowners' mitigating actions. Perceived effectiveness of Firesafe council actions and residents' confidence in their ability to carry out these Firesafe actions are highly correlated; therefore these residents feel that the mitigating actions are, for the most part, very effective and they also believe strongly in their ability to carry them out. The question then remains as to why there aren't more mitigating actions being implemented on homeowners' lands.

Almost two thirds of the homeowners state that involuntary impediments are deterrents to putting in place various risk reduction strategies. The residents' strong feelings of vulnerability from wildfire risks are enhanced by inaction of their neighbors, thereby negating the effect of homeowner risk reduction actions. The residents not only believe that they are responsible for defending their property, but also that all neighbors, including homeowners, the Forest Service, and the HOA, should be involved in mitigating these risks. If one player opts out, these homeowners feel that their vulnerability remains significant. It appears that a community response to wildfire mitigation, where all landowners "buy in" would be an effective avenue to reduce the risks of wildfire.

Based upon the information from the RHOA, there are numerous implications for mitigating the risks to wildfire. Information on wildfire issues should be

disseminated through city and County fire departments, which hold more credibility with homeowners. To effectively communicate risk reduction strategies with the RHOA the messages need to address the entire picture of reducing risks, including strategies that not only consider lands in the immediate vicinity of the homes, but also farther-removed lands that can perhaps impact the state of the wildfire (perhaps, crown fire to a ground fire). The land managing agencies, neighbors, and homeowners' association must all acknowledge their own part in reducing these risks. Education should focus on including the actions of the land managing agencies and other community projects so that homeowners feel it is truly community effort and that it is not something they are doing on their own. Additionally, to gain support for prescribed fire as a treatment option, the Federal, State, and local governments need to educate residents about the benefits of prescribed fire, and perhaps even the benefits of prescribed fire over mechanical removal.

The preliminary nature of the work to date must be considered in evaluating the generalizability of these findings. Although the RHOA's experience provides an excellent foundation to begin understanding the public's positions on fire and fuel's management they are by no means a representative sample from which to draw general conclusions. Continued work in this area which is being funded under the National Fire Plan, will focus on collecting similar data from groups and individuals that are more representative of the general public.

Conclusions From Postfire Interviews/ HayRAC

Postfire experience points to the importance of identifying and establishing relationships with preexisting community assets and organizations early on in a wildfire incident. This can help incorporate local knowledge into firefighting and rehabilitation efforts and establish a recovery base that will continue once emergency Federal agency personnel and resources have left the community. The success of HayRAC/ CUSP and the Forest Fire Victims Task Force occurred because they already had a local context and relationships that could be rapidly built on. Such partnerships should be developed as early as possible during the fire by the incident command, and several interviewees thought that they should be developed by local Federal officials well before any fire. Such up front collaboration was seen as a good way to systematize actions, increase efficiency, and decrease potential contention between locals and Federal agencies by building trust. While trust has been shown to be important in all natural resource management matters, it is particularly important with wildfires where a crisis brings in powerful outsiders to work in a community for a limited but highly emotional period of time.

There are clearly several areas where lack of public understanding of the complexities of wildfire management and rehabilitation contributed to a sense of discontent. For instance, while many evacuees expressed frustration with being forbidden to go back to their homes, there was little understanding of how thin law enforcement was stretched and that people were restricted from going back to houses not only just for safety reasons but also as the only manageable means of preventing burglaries in evacuated areas on a fire that size. Along with continuing to work to educate the public about forest health and fire management issues, it also appears worthwhile to include information about what is involved in firefighting and rehab efforts, including limitations. In this way when a major fire does occur, public expectations hopefully will be more realistic. The importance of the visual is worth noting in educational efforts. Because "appearance counts for a lot," efforts to explain what is being done should take this into account, suggesting that guided trips onto the closed forest to show rehab projects would be a worthwhile activity.

Nor should the educational process be one way. Federal fire managers need to work to better understand the actual capabilities and limitations of volunteer fire departments. There also appears to be room for increased interagency learning. While agencies have over time developed effective means of coordinating policy and actions during a fire, similar efforts need to be made with rehabilitation work, particularly between the Forest Service and NRCS. It was suggested that perhaps what is needed is a national, interagency, rehabilitation coordinator.

Finally, perhaps the best recommendation was provided by individuals working at HayRAC/CUSP who continually stated that, given the complexity and importance of rapidly developing effective solutions to minimize current and future wildfire damage, it is important to think out of the box as much as possible. Instead of relying on traditional and often engrained methods and approaches, the ability to be open to new and adaptive techniques and to meet locally identified needs will be critical.

We pointed out at the beginning of this report that the mix of social and economic effects of a large fire such as the Hayman, especially when it occurs within the wildland urban interface, is both a complex and far ranging story. Although this report is rather lengthy, it still only begins to tell this story in part because of the social and economic consequences of the Hayman Fire that will play out over time. Consequently, there will be ample opportunity for additional social and economic Hayman Fire analyses. We recommend that

these analyses be conducted because a more complete rendition of this story is needed for at least two reasons. First, there is much to be learned from the as yet untold portions of the story that will be applicable to future wildfire events. Second, the Hayman Fire has taken on national significance by becoming an example of a consequence of what is wrong with current forest management policy in this country. Consequently, the more we can learn from it, the more we can use the Hayman experience to inform future debates over both forest and wildfire management strategies.

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References

Abt, Robert, David Kelly, and Mike Kuypers. 1987. The Florida Palm Coast Fire: An Analysis of Fire Incidence and Residence Characteristics. *Fire Technology* 23(3):186-97.

Abt, R.C., Mike Kuypers and J.B. Whitson. 1990. Perception of Fire Danger and Wildland/Urban Policies after Wildfire. *Fire and the Environment: Ecological and Cultural Perspectives,* March 20-24, 1990, pp. 257-59.

Carpenter, Edwin H., Jonathan G. Taylor, and others. 1986. Targeting Audience and Content for Forest Fire Information Programs. *The Journal of Environmental Education*, 17(3):33-41.

Carroll, Mathew S.; Findley, Angela J.; Blatner, Keith A.; Mendez; Sandra Rodrigues; Daniels, Stephen E.; Walker, Gregg B. 2000. Social assessment for the Wenatchee National Forest wildfires of 1994: targeted analysis for the Leavenworth, Entiat, and Chelan Ranger Districts. Gen. Tech. Rep. PNW-GTR-479. Portland OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 114p.

Colorado Department of Labor (CDL). 2003. Unpublished Colorado employment and wage information. On file at: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula, MT.

Colorado Department of Revenue (CDR). 2003. Unpublished Colorado retail sales information. On file at: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula, MT.

Cortner, Hanna J., Philip D. Garner, and Jonathan G. Taylor. 1990. Fire Hazards at the Urban-Wildland Interface: What the Public Expects. *Environmental Management*, 14(1):57-62.

Cortner, Hanna J., Malcom J. Zwolinski, and others. 1984. Public Support for Fire-Management Policies. *Journal of Forestry*, 82(6):359-60.

Englin, J.; Loomis, J.; Gonzalez-Caban, A. 2001. The dynamic path of recreational values following a forest fire: a comparative analysis of states in the Intermountain West. Canadian Journal of Forest Research. 31:1837-1844.

English, Donald. 2003. [Personal communications]. January 29. Athens, GA: U.S. Department of Agriculture, Forest Service, Southern Research Station, Forestry Sciences Laboratory

Gardner, Philip D., and Hanna J. Cortner. 1985. Public Risk Perceptions and Policy Response toward Wildland Fire Hazards in the Urban/Rural Interface. *Fire Management: The Challenge of Protection and Use*, April 17-19, 1985, pp.153-72.

Gardner, Philip D., and Hanna J. Cortner. 1988. An Assessment of Homeowner's Perceptions of Wildland Fire Hazards: A Case Study from Southern California. In *Arid Lands—Today and Tomorrow,* Emily Whitehead, ed., Westview Press, Boulder, Colorado, pp.643-57.

Gardner, Philip D., Hanna J. Cortner, and Keith Widaman. 1987. The Risk Perceptions and Policy Response Toward Wildland Fire Hazards by Urban Homeowners. *Landscape and Urban Planning,* 14:163-72.

Gardner, Philip D. and L.P. El-Abd. 1985. *The Study of the Impacts of Severe Wildland Fires and Disaster Relief Program on Homeowners*, United States Forest Service, Riverside.

Incident Cost Accounting and Reporting System (ICARS). [Software]. 2002a. U.S. Department of Agriculture, Forest Service. Available: http://www.fs.fed.us/r6/fire/incident/ (February 2003)

Incident Cost Accounting and Reporting System (ICARS). 2002b. Unpublished ICARS database for the South Hayman. On file at: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula, MT.

Jacobsen, Susan K., Martha C. Monroe, and Susan Marynowski. 2001. Fire at the Wildland Interface: The Influence of Experience and Mass Media on Public Knowledge, Attitudes, and Behavioral Intentions. *Wildlife Society Bulletin*, 29(3):929-937.

Jakes, Pam J. , K Nelson, R Land, M Monroe, S Agrawal, L Kruger , and V Sturtevant. 2003. "Homeowners, Communities, and Wildfire: Science Findings from the National Fire Plan ." *Proceedings of the Ninth International Symposium on Social and Resource Management*, Pam Jakes. GTR NC-231. USDA Forest Service, North Central Research Station.

Kocis, S.M.; English, D.B.K.; Zarnoch, S.J.; Arnold, R.; Warren, L. 2002. National Visitor Use Monitoring Results: Pike-San Isabel National Forest and Comanche and Cimaron National Grasslands. U.S. Department of Agriculture, Forest Service, Region 2.

Loeher, Larry L. 1984. Fire Hazard: The Dimension of Resident's Attitudes. *Living in the Chaparral of Southern California,* held in Los Angeles, California, October 20, 1984, pp 51-62.

Loomis J.; Gonzalez-Caban, A.; Englin, J. 2001. Testing for differential effects of forest fires on hiking and mountain biking demand and benefits. Journal of Agricultural and Resource Economics 26(2):508-522

Machlis, Gary E.; Kaplan, Amanda B.; Tuler, Seth P.; Bagby, Kathleen A.; McKendry, Jean E. 2002. Burning questions: A social science research plan for Federal wildland fire management. Contribution Number 943. Idaho Forest, Wildlife and Range Experiment Station. Moscow ID 253p.

McCaffrey, Sarah. 2002. For Want of Defensible Space a Forest is Lost: Homeowners and the Wildfire Hazard and Mitigation in the Residential Wildland Intermix at Incline Village, Nevada. Dissertation, University of California at Berkeley, 300 pages.

McCrimmon, Katie Kerwin. 2002. Politics on front line at fires. Rocky Mountain News. [Denver, CO], June 15.

Missoula Area Economic Development Corp (MAEDC). 2002. Assessment of the economic impact of the wildfire disaster of 2000 on Montana's tourism and forest products industry. On file at: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula, MT.

Monroe, Martha (University of Florida) and Kristen Nelson (University of Minnesota) *Public perceptions of defensible space and the use of prescribed fire in the wildland-urban interface"* Research for North Central Research Station supported by the National Fire Plan

Moore, Ted. 2003. [Personal communication]. March 6, 2003. Pueblo, CO: U.S. Department of Agriculture, Forest Service, Pike-San Isabel National Forest.

National Wildfire Coordinating Group (NWCG). 1998. Fireline Handbook. NWCG Handbook 3. PMS 410-1. NFES 0065. On file at: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula, MT.

Office of Management and Budget (OMB). 1987. Standard Industrial Classification Manual, 1987. Springfield, VA: National Technical Information Service. 705 p.

Rice, Carol L. and James B. Davis. 1991. *Land-use Planning May Reduce Fire Damage in the Urban-Wildland Intermix*, General Technical Report PSW-127, Pacific Southwest Research Station, Berkeley, California.

Richardson, Valerie. 2002. Hot rhetoric shills tourism. Washington Times. [Washington D.C.] , June 24.

Ryan, Robert and Blanchard, Brian P. (University of Massachusetts)."Community perceptions of wildland fire risk and fire hazard reduction strategies at the wildland-urban interface in the Northeastern United States." Research for North Central Research Station supported by the National Fire Plan

Schuster, Ervin G.; Cleaves, David A.; Bell, Enoch, F. 1997. Analysis of USDA Forest Service fire-related expenditures 1970-1995. Res. Paper PSW-RP-230. Albany, CA; Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture, 29 p.

Shelby, Bo, and Robert W. Speaker. 1990. Public Attitudes and Perceptions about Prescribed Burning. In *Natural and Prescribed Fire in Pacific Northwest Forests,* John D. Walstad, Steven R. Radosevich, and David V. Sandberg, eds., Oregon State University Press, Corvallis, pp 253-59.

Shindler, Bruce (Oregon State University). *Public acceptance of fuels reduction and forest restoration practices: survey of citizens in communities adjacent to National Forests in Minnesota, Wisconsin, and Michigan*." Research for North Central Research Station supported by the National Fire Plan and for Joint Fire Science Program

Shindler, Bruce, Michelle Reed, Beth Kemp, and James McIver. 1996. *Forest Management in the Blue Mountains: Public Perspectives on Prescribed Fire and Mechanical Thinning,* Dept of Forest Resources, Oregon State University, Corvallis, Oregon.

U.S. Department of Commerce, Bureau of Census (USDC-BOC). 2003. Unpublished North American Industrial Classification System codes and titles. On file at: www.census.gov/epcd/www/naics.html

U.S. Department of Commerce, Bureau of Economic Analysis (USDC-BEA). 2003. Unpublished United States personal income and price deflator information. On file at: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula, MT.

Vogt, Chirstine (Michigan State University) Predicitng public acceptance of fuel management at the Lake State forest interface. Research for North Central Research Station supported by the National Fire Plan and for Joint Fire Science Program

Winter, Greg, and Jeremy S. Fried. 2000. Homeowner Perspectives on Fire Hazard, Responsibility, and Management Strategies at the Wildland-Urban Interface. *Society and Natural Resources,* 13:33-49.

Winter, Greg, Christine Vogt, and Jeremy S. Fried. 2002. Fuel Treatments at the Wildland-Urban Interface: Common Concerns in Diverse Regions. *Journal of Forestry*, 100(1):15-21.

Appendix I: Selected Budget Object Classification Codes

BOC	Description
1100	Personnel compensation
1101	Regular salaries and wages paid directly to civilian full-time, permanent employees located in the U.S. and its possessions
1121	Regular salaries and wages paid directly to civilian full-time employees in appointments established for a limited period of time, generally less than a year
1165	Hazard pay differential – payment above the basic rate because of assignments involving irregular or intermittent performance of duties that subject the employee to unusual hazards or physical hardships
1170	Overtime
1193	Casual Employee Time Reports employment. – Contract payments amounts paid to individuals on a contract or purchase order basis when only their personal services are supplied
1200	Personnel benefits
2100	Travel and transportation of persons
2200	Transportation of things – contractual charges incurred for the transportation of things and for the care of such things while in process of being transported. Includes postage used in parcel post and rental of trucks.
2300	Rent, Communication, and Utilities – User charges assessed for buildings and other rental space and charges for communications and utility services (Does not include rental of transportation equipment, which falls under with 2100 or 2200.
2400	Printing and Reproduction
2500	Other services – Charges for contractual services that are not otherwise classified. Also included are agreements with other cooperating agencies.
2540	Contractual services - Other
2541	Flying contracts
2550	Agreements – cooperative agreements between Forest Service and state agencies, or between permitters and private parties.
2551	Cooperating state agencies
2559	Other agreements
2570	Miscellaneous services – includes ADP data acquisition and motor pool services
2600	Supplies and materials – charges for commodities that are ordinarily consumed within 1 year, that are converted in the process of construction or manufacturing, or that are used to form a minor part of equipment or fixed property
3100	Equipment
4100	Grants, subsidies, and contributions
4200	Insurance claims and indemnities
4300	Interest and dividends

Appendix II: Selected Findings

Many of the findings contained in the body of this report are listed here by report topic area for easier reference.

Selected Economic Aspects of the Hayman Fire

Four general economic aspects of the Hayman Fire were investigated: suppression and rehabilitation expenditures, regional economic activity, property-related losses, and resource outputs and values.

1. Suppression and Rehabilitation Expenditures

1) FY 2002 was an extremely expensive fire season for Region 2. Over the last three decades, Region 2's annual fire suppression expenditures averaged $8 million (not counting FY 2002). Before FY 2000, only two years—FY 1988 and FY 1996—saw expenditures as high as $20 million.

2) FY 2002 was a record-breaking year. Expenditures spent fighting fires in Region 2 totaled $182 million, more than four times the amount spent in FY 2000, the next most expensive year.

3) Although the $38 million in Forest Service expenditures for the Hayman Fire accounted for only about 20 percent of this total, Region 2 spent more money on suppressing the Hayman Fire than the total yearly suppression expenditures in any year except FY 2000 or FY 2002.

4) In FY 2002, BAER expenditures in Region 2 reached $22 million, 29 times the 1996 to 2002 average, $14 million of which was attributable to the Hayman Fire.

5) The $38 million spent by the Forest Service on this fire for suppression amounts to about $273 per acre.

6) The Hayman Fire bill for suppression and Federal BAER expenses as of May 2003 comes to more than $66 million, with 64 percent associated with suppressing the fire and the other 36 percent for BAER

7) Expenditures by the Forest Service account for 89 percent of suppression expenditures and more than 99 percent of BAER expenses.

8) The final determination of financial responsibility between the Forest Service and the State of Colorado is determined through a cost-share agreement between the two agencies. Initial expenditures by the Forest Service are later allocated between the Forest Service and the state, mainly according to acreage, with a few exceptions, with 85 percent of the acres and, therefore, the expenditures being Forest Service responsibility and 15 percent state responsibility. When all adjustments have been made, expenditures should total approximately $32 million for the Forest Service and $7.3 million for the State of Colorado (the $5.8 million share of the initial Forest Service expenditures and $$1.5 million of additional expenditures by the state).

9) Region 2 accounted for 62 percent of Forest Service Hayman suppression costs and national contracts such as aviation and food service contracts accounted for 27 percent.

10) In addition to BAER projects, nearly $37 million in expenditures for other longer-term (1 to 5 year) rehabilitation and restoration projects are also planned by the Pike-San Isabel National Forest, including $13.7 million on projects connected with land and facilities and $9.9 million on reforestation

11) Other rehabilitation expenditures include $10.8 million in NRCS grants to state, County, and private landowners (including $3.2 million to Denver Water). In addition to the NRCS grant, Denver Water expects to spend another $2.1 million on rehabilitation, monitoring and lab work, and water treatment.

12) Other fire-related expenditures include $1.1 million in FEMA reimbursements to the affected Counties for roadblocks, traffic control and evacuations; $49,000 in administrative costs for the State of Colorado for administering the billing for the Counties and other cooperators, and an estimated $766 thousand in disaster relief by the American Red Cross for the Hayman Fire evacuees.

2. Regional Economic Activity

1) For the four Counties containing the Hayman Fire, Jefferson, Teller, Park and Douglas, (the Primary Impact Area), employment averaged about 280 thousand per month for the 17 months immediately preceding the fire; employment averaged 281 thousand for the next four months, the fire and postfire months. Wages averaged $869 million (2002$) per month for the months preceding the fire and only $843 million for the next four months. Retail sales averaged $1.281 billion (2002$) per month before the fire and $1.329 billion per month during and after the fire.

2) In the Primary Impact Area, wages paid in Eating and Drinking establishments averaged about $29.2 million (2002$) per month for the 17 months immediately preceding the Hayman Fire and $30.7 million for the next four months. A similar situation holds for wages in Lodging and Recreation establishments. Wages in Lodging averaged $3.3 million (2002$) per month for the months preceding the Hayman Fire and $3.7 million for the next four months. Wages in Recreation averaged $9.9 million (2002$) per month before the Hayman Fire and $11.6 million per month during and after the fire.

3) The monthly average employment levels in tourism-related sectors (Eating and Drinking, Lodging, and Recreation) in the Primary Impact Area, for the four-month period (June-September) during and after the Hayman Fire exceeds that for the 17 months before the fire.

4) Attempting to isolate the events and circumstances surrounding the Hayman Fire, we constructed numerous statistical models to control for national economic conditions, seasonal variation, and so on. Although we found some evidence of positive or negative influences on economic activity during the fire months (June and July) and during the postfire months (August and September), the evidence is weak and unconvincing.

3. Property-Related Losses

1) According to the assessors in the Primary Impact Area, real private property loss for the four County area was valued at $23,750,000 with an annual assessed value of $3,400,000, resulting in an annual loss of revenue to the Counties of approximately $238,000 per year.

2) Total insured private property losses were estimated at $38,700,000 (including the real property valued by the assessors at $23.7 million).

3) SBA and FEMA issued loans and grants for uninsured losses totaling $4,005,200 and $851,600 respectively.

4) Damage to power lines was estimated at $880,000.

4. Resource Outputs and Values

1) The Hayman Fire prompted a general closure order for three Ranger Districts (Pikes Peak, South Platte, and South Park Ranger Districts) of the Pike-San Isabel National Forest. The closure order began June 10, 2002 and continued until July 19, 2002 (a small portion of the Pike-San Isabel National Forest including five camping and recreation areas were reopened July 12, 2002). Furthermore, all areas within the Hayman Fire perimeter remained closed to recreation use, at least through March 2003.

2) The closure occurred during two of the busiest visitation months. On the Pikes Peak Ranger District, the months of June and July accounted for 46 percent of all developed site visitation in CY 2000 and 45 percent in 2001. On the South Platte Ranger District, June and July accounted for 37 percent of all developed site visitation in 2000 and 43 percent in 2001, while on the South Park Ranger District, 48 percent of all developed site visitation occurred in June and July for both 2000 and 2001.

3) Pikes Peak Ranger District had the most substantial decline from 2001 levels with visitation at 77 percent of the 2001 level during the prefire months, 15 percent of 2001 during the fire months, and 28 percent during the postfire months, with total year visitation at 28 percent of 2001 levels. South Platte district had visitation at 60 percent of 2001 levels during the prefire months, 12 percent of 2001 during the fire months, 41 percent during the postfire months, and total year visitation at 31 percent. South Park district was the least affected with visitation at 89 percent of the 2001 level during the pre- fire months, 32 percent during the fire months, and 80 percent during the postfire months.

3) A comparison of visitation totals for June and July of 2002 with results from June and July of 2001 showed a decline at all sites, with 2002 visitation at 62 percent of 2001 visitation for Florissant Fossil Beds National Monument, 79 percent for Eleven-Mile State Park, and 85 percent at the Pikes Peak Cog Railway and Toll Highway

4) On all three districts, total client days were substantially lower in 2002 than 2001, with aggregated outfitter and guide use in 2002 at 75 percent of the 2001 levels. Pikes Peak district was the least affected, with 2002 client days at 86 percent of 2001 levels, while South Platte and South Park districts were more substantially affected, with 2002 levels at 60 percent and 62 percent of prior year levels, respectively.

5) A total of 331 campground reservations on the Pike-San Isabel National Forest made within the Reserve America system were cancelled between the dates of June 10, 2002 and July 19, 2002 (the dates of the general forest closure associated with the fire). About one in four of the cancelled reservations were subsequently remade within the Reserve America system. Of these new reservations, 58 percent were made to alternative locations within the State of Colorado.

6) The Girl Scouts Wagon Wheel Council (Colorado Springs) camp was within one mile of the Hayman Fire. During the summer of 2002, they experienced two evacuation orders and were shut down for three weeks. Approximately 400 campers missed camp and had their fees fully refunded. The Wagon Wheel Council estimated their total losses at $110,000.

7) The Girls Scouts Mile High Council (Denver) camp is contained within the perimeter of the Hayman Fire. The camp was closed down during the initial closure order and has plans to first reopen in May of 2003. Fire effects within the camp were relatively minor considering the proximity of the fire, and property losses were estimated at $112,000.

8) The Lost Valley Guest ranch was shut down from June 9, 2002 through September 1, 2002. The ranch operated a modest fall season at 40 percent occupancy. The owner estimated total losses associated with property damage, lost income, and fire-related expenses at $1.9 to $2.0 million. In January 2003, booking for the 2003 season was 50 percent of normal, and the owner estimates the 2003 season to be down 20 to 25 percent from typical years.

9) Total resource losses were estimated at $50.2 million for a 150,000-acre fire, which adjusted to $47 million based on the actual size of the fire. Water storage was the single most important category representing 80 percent of total resource value losses.

10) Direct recreation infrastructure losses totaled $56,500 on the Pike-San Isabel National Forest. Fee losses from reduced concessionaire revenue in 2002 were estimated at $58,000. Additionally, four recreational residences burned resulting in a loss of annual revenue to the Forest Service of $2,250.

11) One-time losses to proposed timber sales were estimated at $36,750. Annual timber losses were estimated at $62,000 to $ 65,000 with a majority of these losses coming from the personal use Christmas tree program. Total salvage value was estimated at $159,500.

Individual Experiences

Next, we turn our attention to key findings from the studies that looked at individuals and their experiences.

Woodland Park, Colorado, Case Study: Preliminary Results

1) In terms of the social impacts of the Hayman Fire as perceived by Woodland Park case study, participants stated that the most positive impact resulting from the fire was the way the community (Woodland Park and the surrounding areas) “pulled together” and helped each other out.

2) In terms of negative impacts, the negative impact on the economy of the area and on individuals as well as the loss of natural resources, were mentioned often.

3) Finally, the loss of the forest resources and physical beauty of the area was most often mentioned impact, positive or negative.

4) In terms of beliefs about the fundamental causes of the fire held by Woodland Park case study, participants generally attributed the fundamental causes to the drought and poor forest health or “lack of management”. Contributing factors were high winds, lack of thinning, lack of prescribed

burning, and failure to fully utilize all firefighting resources when the fire started. Most thought that the fire was inevitable and the ignition source itself was not important, saying that if the fire hadn't been started by an individual, something else such as lightning, a tossed cigarette, or a hot catalytic converter would have started it.

5) Most participants who *did not personally incur any damage* thought that the fire had been fought effectively and that it was not controllable. On the other hand, critical comments concerning the USFS were especially common among people who personally incurred property damage or lost a home

6) Information sources used by residents during the fire included Web sites, neighbors, firefighters, public meetings, local television stations (Denver, Colorado Springs), the Red Cross, hearsay, radio scanners, and the Java Junction Coffee Shop.

7) Overall, participants thought the quality of information from the above-mentioned sources during the fire was good. The Teller County Web site was highly praised, as was the information from Java Junction.

8) Participants tended to be somewhat critical of the nightly meetings sponsored by the Forest Service, saying that the information at these meetings was, at times, "inadequate" and "outdated". Some complained that the information was delivered in an impersonal manner.

9) For opinions about relationships with the Forest Service by Woodland Park case study participants, locals appear to have generally good relationships with the Forest Service. Some mentioned that there had been some anger over the cause of the fire (i.e. its alleged ignition by a Forest Service employee), but nothing that appears to be long-lasting.

10) The inability of the Forest Service to work with private landowners on fire prevention and restoration was mentioned as a problem. One fairly persistent theme was the perceived need for the Forest Service to improve its existing working relationships with volunteer firefighters and other groups/agencies involved in fire prevention and control.

11) The Federal Emergency Management Agency (FEMA) has provided assistance for fire victims of the Hayman Fire. However, those who live in non-traditional residences such as recreational trailers or RVs (of which there were a number in the community) were not eligible to receive compensation from FEMA for the loss of their residence.

12) There was considerable frustration expressed by County officials concerning notification of the accounting rules for compensating the County for fire-related expenses, primarily because the County was not notified by FEMA until after the fact concerning the detailed information FEMA requires in order for the County to be eligible for compensation for various functions and expenses.

13) For issues pertaining to the future as perceived by Woodland Park case participants, the fire experience has clearly increased awareness of wildfires and made a potential future fire more of a reality in peoples' minds. However, most participants at the time of the interviews were not planning to take any particular actions to 'fire safe' their homes and properties against future events. Explanations for a lack of such activities range from "the damage has already been done" to the aesthetic preference for trees near their homes.

Ridgewood Homeowner's Association Study

In considering the following findings, it is important to keep in mind that the sample size used in this preliminary study is both small and nonrepresentative of the larger population of fuels reduction stakeholders who were impacted by the Hayman Fire. Future efforts funded by the National Fire Plan will extend this analysis to the broader Hayman population, as well as to the rest of the Colorado Front Range and the Forest Service's Southwestern Region (Region 3) of Arizona and New Mexico.

1) Residents perceive themselves as well informed, information that they used as very relevant, and they are very motivated to learn more about the connection between wildfire risks and undertaking defensive actions, even though they considered themselves to be 'well informed'

2) The most highly rated sources of wildfire risk information in terms of helpfulness, were the County and city fire departments and the Colorado State Forest Service. The US Forest Service, media reports, and Firewise community information were also rated as relatively helpful sources of information. Finally, friends and neighbors were rated somewhat helpful as a source of information on wildfire risks.

3) Even six months after the devastation of the Hayman Fire, residents still feel very vulnerable to the potential impact of wildfire, both personally and with regard to their possessions and property.

4) Those residents who feel highly vulnerable to the effects of wildfire are also those that consider themselves highly informed about wildfire issues. This might suggest that, despite having expertise in wildfire issues, homeowners believe that there are significant involuntary wildfire risks that influence their perceptions of vulnerability.

5) For example, when residents indicated they felt very vulnerable when they completed considerable defensible work and their neighbors did not do this work. This indicates that wildfire education is needed to address these sources of vulnerability.

6) Residents rated the likelihood of a wildfire occurring near their home at 77.9 percent. Both perceived vulnerability and risk perceptions were significantly correlated, demonstrating the strong link between residents' beliefs about vulnerability and the high probability of a wildfire event occurring.

7) Residents felt strongly that the consequences of a wildfire would be severe and very devastating. A correlation analysis reveals that perceived vulnerability and perceived severity are correlated, indicating that perhaps homeowners' perceptions of vulnerability stem from the strong beliefs that wildfires will have devastating consequences.

8) Overall, residents believed that the various Fire Safe defensible actions were effective, and they were confident in their ability to implement them, although they were less certain about their overall confidence in their ability to protect themselves from the effects of wildfire.

9) Resident's beliefs about the effectiveness of Fire Safe mitigating actions likely influenced the decision to implement these behaviors. Also, as would be expected, residents that felt confident in their ability to carry out these actions were much more willing to actually implement them.

10) There was a significant, positive correlation between the effectiveness of some fire reduction behaviors and the confidence that residents reported in engaging in these behaviors, including developing a 30-foot minimum defensible space around one's structures, planting low-growing, fire-resistive plants on one's property, making sure that one's home is easily identifiable and accessible from main roads, and clearing common areas with neighbors in the homeowner's association. Thus, residents believe that there is a strong link between the effectiveness of these actions in reducing the impact of fire and their confidence in being able to actually accomplish these actions.

11) Residents were motivated to take actions following the Hayman Fire, with 18 of 32 (57 percent) reporting having started at least one of the Fire Safe defensible strategies since the fire. Less than half of the residents, 14 of 32 (43 percent) report having completed all the respective actions prior to the fire.

12) Almost two thirds of the participants (63 percent) indicated that involuntary aspects of wildfire risk ("can't fight nature", neighbors have done nothing, and US Forest Service has done too little) influence their decision as to whether or not to undertake mitigating behaviors on their properties. This has important implications for the types of educational materials and messages that should be conveyed to homeowners in the wildland urban interface.

13) Residents feel very responsible for defending their own properties, yet there is considerable sentiment for *all* the neighbors (i.e., neighbors and agencies) to do their part as well.

14) Residents find a direct link between both their own sense of responsibility as well as the Forest Service and the HOA's responsibility for reducing risks and the degree of effectiveness of their own mitigating actions.

15) Homeowners' involuntary risk (arising from the failure of neighbors and agencies to undertake fuels reduction measures) may be one of the significant explanations for their feelings of vulnerability to the impacts and effects of wildfire.

16) A higher level of knowledge about wildfire issues is linked with a higher level of vulnerability, perhaps stemming from involuntary risks of living in a neighborhood in the wildland urban interface with very little being done by neighbors to protect residents' lands.

February 2003 Interviews with Key Informants

1) The interviews indicate that while much has gone right post fire, there remains considerable frustration with what many see as the failure of Federal agencies to take advantage of local resources.

2) Although the fire left people on edge into November and there is some anticipation that this edginess will come back once fire season starts, for most people worries about the economy, war, and drought play a more prominent role.

3) In general, the more serious physical and mental effects related to the fire were considered to mostly have played out, although there still remains a great deal of sensitivity about certain issues.

4) Assessments of the degree of economic impact were varied. At a County level the financial effect was considered to be minor. Instead, small businesses and individuals appear to have borne the brunt of negative impacts. Certain businesses, particularly those that provided food during the fire or provide local services, were seen to have emerged reasonably well while many businesses that were tourist reliant have been hard hit.

5) At the County and community level, several activities are being undertaken to be better prepared. At this level, the long-term level of exposure to wildfire and associated damages combined with availability of resources provide a good impetus for action. Most efforts are based on weaknesses identified during the Hayman Fire.

6) For instance, problems with communication have led to efforts to resolve compatibility issues that arose and to improve dependability of the communication system with establishment of more communication towers.

7) During the fire the assessor provided GIS information and aerial photos of property in the fire area to both the Incident Command and local fire departments that had proven useful and plans were underway to provide these to each fire department at the beginning of the coming fire season.

8) It was also suggested that the availability of GIS information, aerial photos, and detailed knowledge of individual property at the assessors office puts them in the best position to accurately identify as quickly as possible what property is lost to a fire. In future fires, this could hopefully minimize frustrations felt by some homeowners after the Hayman Fire who were given a seesaw of changing information as to whether their house had survived.

9) Increased use of the mulching program, where homeowners could bring cut vegetation to a central drop off point, was cited by several interviewees as evidence that much work was being done.

10) Conversely, several people had heard of homeowners who saw no incentive for putting in defensible space as they didn't care if their house burned if the land around it burned.

11) Although a great deal has been done to rehabilitate burned areas on both public and private property, there was much dissatisfaction with its implementation.

12) There were concerns by private landowners about investing a significant amount of money to prevent erosion on their land when nothing was being done on the public land above theirs. This concern parallels defensible space issues where landowners often argue that it is pointless to do any fuels management on their land if neighboring property owners do nothing.

13) Another frustration with the rehab process is related to the matching funds NRCS provides private property owners for rehab work. Private property owners were told after the fire to go ahead with needed work, to keep the receipts and they would be reimbursed for 75 percent of the total. However, legislation providing the funding was not passed until the end of September and did not include authority for retroactive payment, leaving some homeowners who from $60,000 to $100,000 to shoulder the full burden of the cost via second mortgages or credit cards.

14) Further, the May 8th cut-off of rehab funds—based on a 220 day clock from the day the agreement was signed—was seen as inappropriate given that little work can be done in the winter.

15) Frustration was also expressed about conflicting information coming from the Forest Service and the NRCS about appropriate rehab methods and the degree of damage that required rehab work. Such contradicting messages from different Federal agencies did little to inspire trust among landowners.

16) General views on the role of the Forest Service (Forest Service) varied – many felt that they had fought the fire well and done a good job with rehab while others were mistrustful of their actions: feeling that they did not do enough early on to fight the fire, not trusting that rehab was taking place, and suspicious of the continued closure of the forest.

17) Notably, there was clear respect for individual Forest Service employees yet often a critical view of the Forest Service as an agency. Individuals were cited for their professionalism, knowledge, dedication, communication skills, and willingness to stay after meetings to answer questions. However, as an agency the Forest Service was often criticized for being arrogant, disdainful of local knowledge, obfuscating, and mired in red tape. The ability

18) Much of this criticism revolved around treatment of volunteer fire departments during the fire. There was continued bitterness about the limited role that the Incident Command allowed local fire departments to have during the fire. The sense that they were being forced to stand on the sidelines while outsiders with no local knowledge took over did not go over well.

19) There was a strong sense that locals had a vested interest in stopping the fire and in protecting houses that the Forest Service did not have. Many of the destroyed houses were lost to ground fires and could have been saved had the local fire departments been allowed to remain in threatened subdivisions. In addition, it was felt that local knowledge, such as location of in holdings and terrain intelligence, could have been valuable in firefighting efforts.

20) However, there was recognition that it was not a simple situation, that many people didn't necessarily understand the complexity and danger of what they were volunteering for and that incident commanders had justifiable concerns about the training and knowledge of volunteer firefighters.

21) In addition, the red card issue was recognized and no easy solution was seen –given that most volunteer firefighters tend to be "gray haired"—it also was argued that using this as a reason to completely exclude them from helping was arrogant and foolish. The need to take advantage of what locals already know and are doing was seen as particularly important given the strong dislike for outsiders telling people what to do often found in areas prone to wildfire and efforts are being made to rebuild these relationships.

22) There has been impressive public interest in helping with postfire work and HayRAC has played a vital role as a clearinghouse for volunteer efforts. To date they have organized 48 rehabilitation days using over 3100 volunteers putting in over 22,000 hours of work. To date most of HayRAC work has been done on private land in tandem with the NRCS but this coming spring the volunteers will start working on USFS land.

23) HayRAC/CUSP's educational efforts are also important. Member's work to promote knowledge of forest health and fire management issues with everyone they have contact with—from landowners to volunteers.

24) In addition, the organization often helps mediate relations between individuals and Federal agencies by helping individuals better understand the functions and limitations of different government agencies, such as the fact that the Forest Service is not allowed to work on private land.

25) Although the organization has had no problem finding adequate labor, adequate funding has been a different issue. Last summer's difficulties with fire funding meant that the Forest Service could only provide $20,000 of a promised $100,000. During the fall the organization survived in large part on personal resources. However, when it was finally announced in December that it would soon have to close its door due to funding issues money began to come in from sources as diverse as the City of Aurora (which receives 90 percent of its water from the South Platte watershed), Phillip Morris, the National Forest Foundation, and Jimmy Buffet. In addition an MOU has been established with the Forest Service where HayRAC will be first in line for relevant excess property.

26) Another local organization that has played a significant role in facilitating local adjustment to the fire is the Forest Fire Victims Task Force. Affiliated with a pre-existing social service non-profit, the organization had the knowledge and contacts to rapidly obtain funding and community trust. Its purpose was to provide assistance to individuals who needed help but did not fit within Federal guidelines.