Issue Summary

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YFF Review

Wildfire and Watersheds

A summary of a forum and workshop examining the environmental, social, and economic impacts of wildfire

A Yale Forest Forum Event

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Global Institute of Sustainable Forestry

New Haven, Connecticut

YFF Review

The *YFF Review* joins the GISF Website as an outreach tool to improve the accessibility of information on issues relating to forestland use and conservation. The purpose of the Review is to inform stakeholders about programs and activities sponsored by GISF. We hope that you will find the information in each *YFF Review* useful and stimulating. For more information on topics covered in this issue visit our website at www.yale.edu/gisf.

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Wildfire and Watersheds

A summary of a forum and workshop examining the environmental, social, and economic impacts of wildfire

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Contents

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Executive Summary

The number of large and costly wildfires has been increasing over the last several decades, culminating in the extreme fire seasons of 2000 and 2002. These fires not only alter forest structure and habitat values, but greatly impact communities, many of which depend on surrounding forests for municipal watershed infrastructure, drinking water quality, recreation, and tourism values.

The Global Institute of Sustainable Forestry (GISF) at the Yale School of Forestry and Environmental Studies (FES) conducted a research project with the goal of increasing knowledge about the environmental and societal costs of wildfires. Graduate students at FES investigated and summarized the kinds of wildfire impact data that is currently collected and available at national and state levels. Additionally, ten fires from different regions across the United States were examined in detail to determine their impacts on local communities and ecosystems. Results of this research are summarized in the GISF research paper "Assessing the Environmental, Social, and Economic Impacts of Wildfire," available at http://research.yale.edu/gisf/publications.

Education and outreach based on this research included a forum and workshop convened by the Yale Forest Forum on April 28 and 29, 2003. The forum, "Public Policy Tradeoffs in Forest Management, Fire Management, and Restoration of Fire-damaged Watersheds: Lessons from the Hayman (Colorado) Fire," examined the Hayman fire in detail from various environmental and societal perspectives.

The Hayman fire, the largest wildfire in Colorado's history, burned nearly 138,000 acres during the summer of 2002. This fire impacted local communities, extensive tracts of forestland, and Denver's drinking water supply. Five speakers discussed the Hayman fire from different perspectives: Carol Ekarius, Executive Director of the Coalition for the Upper South Platte, the local watershed group; Dr. Merrill Kaufmann, Ecologist with the US Forest Service, Rocky Mountain Research Station; Hamlet (Chips) Barry, manager of Denver Water, the municipal water supply company; Corbin Newman, National Fire Plan Leader for the US Forest Service; and Mike Harvey, District Forester with the Colorado State Forest Service. Dr. Ann Camp, from the faculty of the Yale School of Forestry and Environmental Studies moderated.

Carol Ekarius described impacts to local residents from the Hayman fire and discussed remediation projects undertaken by the Coalition for the Upper South Platte (CUSP). CUSP is a local watershed group that undertakes remediation projects on privately owned lands burned in the Hayman fire. These projects are funded through the Emergency Watershed Protection program, a 75% cost-share program run by the USDA Natural Resources Conservation Service.

Merrill Kaufmann provided the ecological and historical context for the Hayman fire. In the years prior to the fire, he had undertaken fire history studies in the Cheeseman Reservoir area. His research indicates that the forests burned by the Hayman fire historically developed under a mixed severity fire regime resulting in patches of heavy mortality within a matrix of lower severity and surface fires. Over several centuries, a mixed severity fire regime creates a vegetation mosaic dominated by low-density forests with small, patchy openings. Decades of excluding fires altered the structure and composition of the landscape, increasing the density of Ponderosa pine and allowing less fire-tolerant Douglas fir to establish. Increased tree densities and resulting closed canopy forest helped create conditions that allowed the Hayman fire to burn as a high severity crown fire. According to Dr. Kaufmann, active management, including thinning from below and creating openings in 15% to 20% of the forest, is necessary to restore the forest to conditions supporting its historical fire regime.

Chips Barry outlined the post-fire remediation efforts for Denver Water land surrounding the Cheeseman Reservoir. The Hayman fire severely burned 7,000 acres of Denver Water land. Sediment influx from burned areas has the potential to greatly decrease water quality for Denver and

surrounding towns. After the fire, two million yards of sediment were poised to move into the reservoir during the next rainfall event. Denver Water continues to lay out straw bales, contour-fell dead trees, and distribute seed and micronized polyacrylimides to hold the soil in place and facilitate vegetation regrowth. They also salvaged trees killed in the fire and used a hydroax to turn standing un-merchantable dead trees into mulch in an effort to reduce site fuel levels.

Corbin Newman discussed the Hayman fire within the context of the National Fire Plan. He explained that large fires, such as the Hayman, attract media attention because of their dramatic impact on people and natural resources. Media focus is primarily on suppression efforts and rarely explains how initial forest conditions lead to the fire behavior seen in fires such as the Hayman. Mr. Newman indicated that as a result of past land management decisions, many National Forests include large portions of the landscape where fires are likely to burn more severely than they did historically. The Forest Service and Department of Interior proposed the Healthy Forest Initiative, recently passed by Congress, as a way to reduce fire severity and restore forest structures that are less likely to support severe fire behavior. Through this initiative federal agencies will identify and aggressively manage high priority areas where forest restoration is most critical for the protection of people and ecosystems.

Mike Harvey described the suppression effort for the Hayman fire. Over the last decade, fire suppression costs have grown along with increased fire size. As the numbers of fires occurring in the wildland-urban interface have increased, many factors, including the presence of structures as well as threatened and endangered species, affect the strategies and tactics used in fire suppression.

On April 29th, the Yale Forest Forum sponsored a workshop "Developing Strategies to Collect and Utilize Critical Wildfire Information." Participants discussed the availability of information on wildfire impacts and its usefulness toward developing fire and suppression policies, risk assessments, and wildfire management strategies. The discussions highlighted the critical need for information that is synthesized at national, regional, and local levels. Participants agreed that the current national scale information is useful for describing general impacts such as the number of structures burned. Critically needed information not currently collected in a systematic way includes data that could be generated from case studies of individual fires. This information could be used to assess wildfire impacts at local scales where these impacts frequently resonate with the public and members of Congress. Participants suggested using the Forest Service condition class map to characterize the different fire regimes that occur within the United States. This map divides the country into three broad condition classes that characterize fire risk by vegetation type and time since the last fire.

Condition Class Map of the Lower-48 Continental United States showing location of fires analyzed in the GISF research report. The darkest areas are those with the highest degree of alteration from historic conditions.

Issue Introduction

Nearly every year for the past several decades, large wildfires burned portions of the continental United States. Especially large and costly wildfires occurred between 2000 and 2002, generating media attention and resulting in a flurry of political debates about wildfire and fire suppression policies. The fires instigating these debates consumed forest and rangeland vegetation, including important wildlife habitats. In some instances, homes, businesses and recreational facilities were destroyed. Anecdotal evidence of additional impacts from these wildfires includes reduction in tourism (an important part of the economy in some sectors), lowered property values, and damage to municipal watersheds.

While it is obvious that social, environmental, and economic impacts of increasingly large wildfires are enormous and varied, the only information routinely collected and dispensed by federal and state agencies is the number of acres burned, the number of structures destroyed, and the cost of fire suppression efforts. Data on indirect and continuing impacts of wildfire are rarely calculated; when they are, the information is nowhere systematically recorded. Restoration costs, changes to wildlife habitats, lost tourism revenue, damage to infrastructures, and human health effects are all important variables that are rarely available for inclusion in risk assessments or wildfire management policies.

Toward gaining a better understanding of the indirect costs to society from wildfires, the Global Institute of Sustainable Forestry (GISF) at the Yale School of Forestry and Environmental Studies summarized the kinds of information that exist about wildfire impacts at national, state, and local levels. Funding for this research was provided by a grant from the American Forest & Paper Association. Because so little information about wildfire impacts exists at national or state levels, GISF researchers examined ten wildfires that burned in the so-called wildland-urban interface in 2000, 2001 and 2002, and summarized their impacts. These case studies provide additional insight into the kinds of impacts that wildfires have on local communities. Results of this study are in GISF Research Paper "Assessing the Environmental, Social, and Economic Impacts of Wildfire," available at http://research.yale.edu/gisf/publications.

Research findings formed the basis for two supplementary activities addressing the indirect costs of wildfires: a forum held on April 28, 2003 and a workshop held the following day. The forum, "Public Policy Tradeoffs in Forest Management, Fire Management, and Restoration of Fire-damaged Watersheds: Lessons from the Hayman Fire," was convened to highlight and discuss one of the case study fires from several perspectives. The Forum focus was the societal and environmental impacts from a single wildfire, while the workshop addressed how fire impact information could assist local forest managers in planning for and recovering from large wildfires and inform policy decisions at local to national levels.

The Hayman fire, at 137,760 acres, is to date the largest recorded wildfire in Colorado history. During the summer of 2002 it burned within the Pike National Forest and on adjacent private lands within 20 miles of the Denver and Colorado Springs metropolitan areas. An estimated 38,000 people were evacuated from their homes and 133 residences burned. Some of the impacts of the fire are still being realized. The fire burned through the Upper South Platte watershed, with the highest burn severity (measured as the percentage of overstory trees killed) occurring adjacent to Cheeseman Reservoir, the source of Denver's drinking water. Post-fire erosion from burned forest poses an immediate threat to the reservoir and a concomitant decrease in drinking water quality. Costly remediation measures are necessary to ensure safe drinking water for Denver and surrounding municipalities.

The workshop's theme was "Developing Strategies to Collect and Utilize Critical Wildfire Impact Information". The workshop was attended by the forum speakers; staff and faculty of the Yale School of Forestry and Environmental Studies; graduate students from the Universities of Maine and Connecticut and the Yale School of Forestry and Environmental Studies; and representatives from the American Forest and Paper Association.

Presenter Summaries

"We have a watershed that is one of the fastest growing places in the country. So we are looking at a long-term situation [of fire risk] for our communities."

— Carol Ekarius

Carol Ekarius
Executive Director, Coalition for the Upper South Platte

The Upper South Platte is a 2,600 square mile watershed that provides about three quarters of Colorado's residents with at least some of their drinking water. This watershed is a biological jewel inhabited by every mammal found in Colorado; it spans from 6,000 to 14,000 feet in elevation, and includes Ponderosa pine, Douglas fir, mixed conifer, and lodgepole pine forest types. Montane forest occurs between 6,000 to 8,500 feet in elevation—where most of the housing development has taken place. Since 1996, 21% of the montane forest has burned; the other 79% is in a condition that makes fire inevitable.

Carol Ekarius is the executive director of the local watershed group, Coalition for the Upper South Platte (CUSP), formerly referred to as the Upper South Platte Watershed Protection Association. CUSP originated out of a meeting of stakeholders in 1996 convened by the Denver Water Board at a time when the South Platte River was being considered by the Forest Service for Wild and Scenic designation. The recenty enacted Safe Drinking Water Act included source water protection provisions and CUSP formed to look at water quality issues within the watershed. In 1998 CUSP incorporated as a 501(c) 3 nonprofit organization based on a Memorandum of Understanding between eleven local and state government units.

CUSP has been working on remediation projects with private landowners whose land was burned in the Hayman fire. Because of its experience as a watershed group, CUSP was contacted early on to assist with the Hayman Recovery Assistance Center; this center was the first one organized by the Forest Service for community outreach during and after large wildfires. The basis for the Assistance Center was to provide one-stop information shopping for the community. During the fire the Forest Service used suppression funds to operate the center; afterwards they looked to community groups to take over the recovery effort. CUSP was brought in by the Forest Service to coordinate community response to the fire.

One of the main services CUSP has provided to the community is coordinating and implementing volunteer remediation projects on private lands. So far CUSP has organized 21,000 hours of volunteer work, including sand bagging and contour felling to prevent erosion on slopes. Funding for these projects came from the Emergency Watershed Protection program, a 75% cost-share program available to private landowners through the USDA Natural Resources Conservation Service. CUSP also provided a toll free number for information about restoration efforts to the media and landowners.

Recent large forest fires have greatly impacted this region in many ways. Last summer the Pike National Forest was completely closed for 30 days. Such closures have an enormous economic effect on small, tourism-based communities. Restoring local forests, including restoring disturbance regimes, is necessary to ensure healthy local economies and communities.

Sediment running into the Cheesman Reservoir after the Hayman fire

"Now we've reached a threshold condition where these forests are highly vulnerable to catastrophic events, not just fire but insects, disease, and drought."

— Merrill Kaufmann

Merrill Kaufman
Research Forest Ecologist, USDA Forest Service, Rocky Mountain Research Station

Merrill Kaufmann described the ecological context for the Hayman fire. In the decade prior to the fire, his research team reconstructed the fire history of the forests surrounding Cheeseman Reservoir. This large area, about 7,500 acres, had almost no history of logging or grazing but did have a history of fire suppression. Forests dominated by ponderosa pine, like those surrounding Cheeseman Reservoir, were widely believed to have developed under a disturbance regime characterized by frequent, low severity fires. Kaufmann's research indicates that forests surrounding Cheeseman Reservoir historically developed under a mixed severity fire regime, where in some areas low and moderate severity fires killed understory trees, leaving overstory trees alive, and in other patches, high severity fires killed overstory trees. This fire regime created a different forest landscape structure than one maintained primarily by low severity fires; thus, different management is required to maintain the landscape pattern and underlying ecological processes.

Kaufmann illustrated the effects of a mixed severity fire regime using a timeseries of photographs taken early in the last century near Cheeseman reservoir. Observable changes in forest structure occurred after the effects of fire were removed. A 1905 photograph (taken 54 years after the last fire) shows scattered trees across a north-facing slope. The fire left surviving trees widely spaced. The pictures advance at ten-year intervals, with fire suppression as the only management activity. Tree density slowly increases. Recent photographs indicate tree densities have increased greatly over historical levels, with some areas having 10 to 20 times as many trees, and others 50 or 100 times as many trees as were there historically. These dense stands are at great risk for insect outbreaks, poor watershed conditions, and high severity crown fires rather than the mixed severity fires that occurred historically. Similar dense stands currently exist throughout much of the Colorado Front Range.

Throughout the Colorado Front Range many old growth ponderosa pine trees which had survived successive low and moderate severity fires were cut in the first decades of the 20th century. Younger trees that might have succumbed to fire were spared as fires were increasingly suppressed. Stands became densely stocked with pine and later Douglas fir established beneath the pine, creating a continuous canopy that allowed the Hayman fire to burn extensively as a crown fire. In some areas the fire burned 5,000 acres without leaving any surviving trees. The severity of the Hayman fire was very atypical of fires for the region—Kaufmannn's fire history research indicates that a fire as severe as the Hayman has not occurred in the past 800 years.

Forest restoration goals should reflect vegetation patterns that would naturally arise under a regional disturbance regime. For forests in areas having a frequent, low severity fire regime, forest managers can thin from below and use prescribed fire frequently to achieve the characteristic open park-like stands with an herbaceous understory. For a mixed severity regime, forest managers can likewise thin from below but also replicate historical patch structure by creating openings in 15% to 20% of the forest. Openings do not have to be completely clearcut; scattered trees can be left as long as canopy cover does not exceed 10%. Retaining and restoring old growth and using prescribed burns after thinning will prevent high densities of regeneration. Restoration of old growth ponderosa pine forest in areas devastated by crown fires will take decades to centuries, as the species can live for 450 to 500 years.

On the other hand, some forests did historically develop with a high-severity crown fire regime, including large portions of Yellowstone National Park. Ecologically, these forests may need no management intervention to restore forest structure. Nevertheless, protecting communities and homes adjacent to these forests may require management to reduce future fire severity.

"After a fire you get hydrophobic soil and decomposed granite conditions which in a big rainstorm leads to a massive movement of sediment downstream very quickly."

— Chips Barry

Hamlet (Chips) Barry
General Manager, Denver Water

Chips Barry addressed the effect of the Hayman fire on Denver Water and the lessons learned by the water utility. Throughout its history Denver Water avoided active forest management. This lack of active management, combined with a recent drought, increased the severity of the Hayman fire on water department land. Except for a small area that had previously been thinned, the Hayman fire severely burned 7,000 acres of Denver Water forestland surrounding the Cheeseman Reservoir.

Denver Water is one of the biggest water utilities in the West, utilizing water from 25% or more of the state of Colorado, and furnishing drinking water to a quarter of the population of Denver and surrounding suburbs. Denver Water owns 53,000 acres, making the utility one of the largest landowners in Colorado.

In 1996 the Buffalo Creek fire burned across Denver Water land. After the fire, in a single storm event over 3.5 inches of rain fell on the burned area, causing a massive movement of sediment downslope and into the reservoir. With this experience in mind, there was tremendous concern over the potential influx of sediment following the much larger Hayman fire, which created conditions whereby roughly two million yards of sediment could potentially flow into the reservoir following a large rainstorm. The lessons from the Buffalo Creek fire were that Denver Water's suppression and remediation efforts were not sufficient to ensure post-fire water quality, therefore, in the aftermath of the Hayman fire, Denver Water has hired foresters to manage their watershed.

As of spring 2003 there had yet to be a large precipitation event following the Hayman fire, so Denver Water took advantage of the respite to complete remediation projects. Fifty people worked in the burned area laying out straw bales, felling small trees along the contour of the land (contour felling), and distributing 220,000 pounds of grass and white oak seed. The decomposed granite bedrock does not readily support vegetation, so efforts were made to increase the chances of germination and regrowth that will eventually hold the soil in place. Denver Water partnered with Colorado State University to study the effectiveness of applying micronized polyacrylimides, which hold water, control dust, reduce erosion, and facilitate regrowth.

The water utility also conducted salvage sales to reduce the amount of standing burned timber that could fuel future fires. For burned trees with no commercial value, they used a hydroax, to reduce the trees to mulch; as of spring 2003 some 500,000 trees had been mulched, about one quarter of the number that will eventually be treated. On some tributaries leading into the reservoir, workers installed sediment traps, "leaky" dams intended to trap sediment instead of water. To better buffer the expected inflow of sediment, the Antero Reservoir was emptied into the Cheeseman Reservoir. While sediment levels entering Cheeseman Reservoir in the spring of 2003 were only slightly above pre-fire levels, these measures were implemented in anticipation of the huge influx of sediment that could occur during and after a large rain event.

Denver Water land is adjacent to a national forest. Differences in remediation efforts between the two ownerships are distinctly obvious. The Forest Service does not have the funds to implement similar remediation projects to the ones Denver Water has so far completed. Denver Water spent between four and five million dollars to treat 8,000 acres, whereas the Forest Service has 130,000 acres to remediate, but a budget of only ten to twelve million dollars.

"We will be establishing a more aggressive policy towards reducing densities ... to move the forest closer to those conditions where fire can play its normal role."

— Corbin Newman

Corbin Newman
National Fire Plan Coordinator, USDA Forest Service

Corbin Newman addressed federal fire policy from a practitioners' viewpoint. Often when people think about national fire policy their minds go to fire suppression. Large fires, such as the Hayman, attract the media's attention because they have such a dramatic impact on people and communities. Around 2,500 firefighters fought the Hayman fire and its suppression effort cost the federal government almost $32,000,000. Such fires are spectacular events that raise questions in people's minds about forest policy; however, frequently overlooked are the forest conditions that lead to severe wildfires and the federal policies that have contributed to those conditions.

For nearly a century, federal fire policy was one of complete suppression. The Forest Service has become so skilled at fighting fire that they are routinely asked for help in suppressing fires around the world. The policy of total fire suppression had unintended consequences; excluding fire altered forest compositions and structures, particularly in the intermountain west. Other changes in forest conditions occurred as a result of land management. Selective harvesting of large trees in dry pine forests along with fire suppression resulted in dense stands of small trees. In the last few decades urban development has been encroaching on forested areas. In some forest types fires burn as they historically did, but in many places fire severity has been greatly increased as a result of past management decisions. Unfortunately, development of the wildland-urban interface often occurs within the most altered forests, those now poised to burn severely.

The National Fire Plan was established to address these landscape-level changes and attempt to restore fire's ecological role on federal lands. Scientific research has shed light on historical fire regimes and resulting vegetation patterns but restoration is difficult because of the human presence throughout these forested ecosystems. The question that scientists and managers grapple with is how best to approach restoring these altered ecosystems toward a more sustainable condition.

Newman believes the Healthy Forest Initiative will be the vehicle for accomplishing this. The Healthy Forest Initiative [enacted by the United States Congress as the "Healthy Forest Restoration Act of 2003" *ed.*] is a combination legislative package and cooperative agreement between the US Forest Service and Department of Interior. Under this initiative, agencies will identify and aggressively treat high priority areas to better protect people and ecosystems. Without a reduction of tree densities in these high priority areas, large fires will continue to negatively impact communities and forests.

Currently, land management agencies are trying to create more public acceptance for management activities, including use of prescribed fire, within forested landscapes. In some parts of the country, such as Florida, controlled burning is widely accepted. In other regions fire and smoke are less universally accepted, limiting fire's use as a management tool. The future challenge for land managers is to find a way to gain public acceptance for forest management activities that restore fire to its normal, natural cycle.

"Structure protection increases the costs of fires and the presence of endangered species can affect the types of strategies and tactics available."

— Mike Harvey

Mike Harvey
District Forester, Colorado State Forest Service

Mike Harvey was assigned to the Hayman fire as the line officer for the state of Colorado. The line officer primarily provides guidance from the state to the fire management team. As with the Hayman fire, when national forest land is involved, the line officer also coordinates with the US Forest Service.

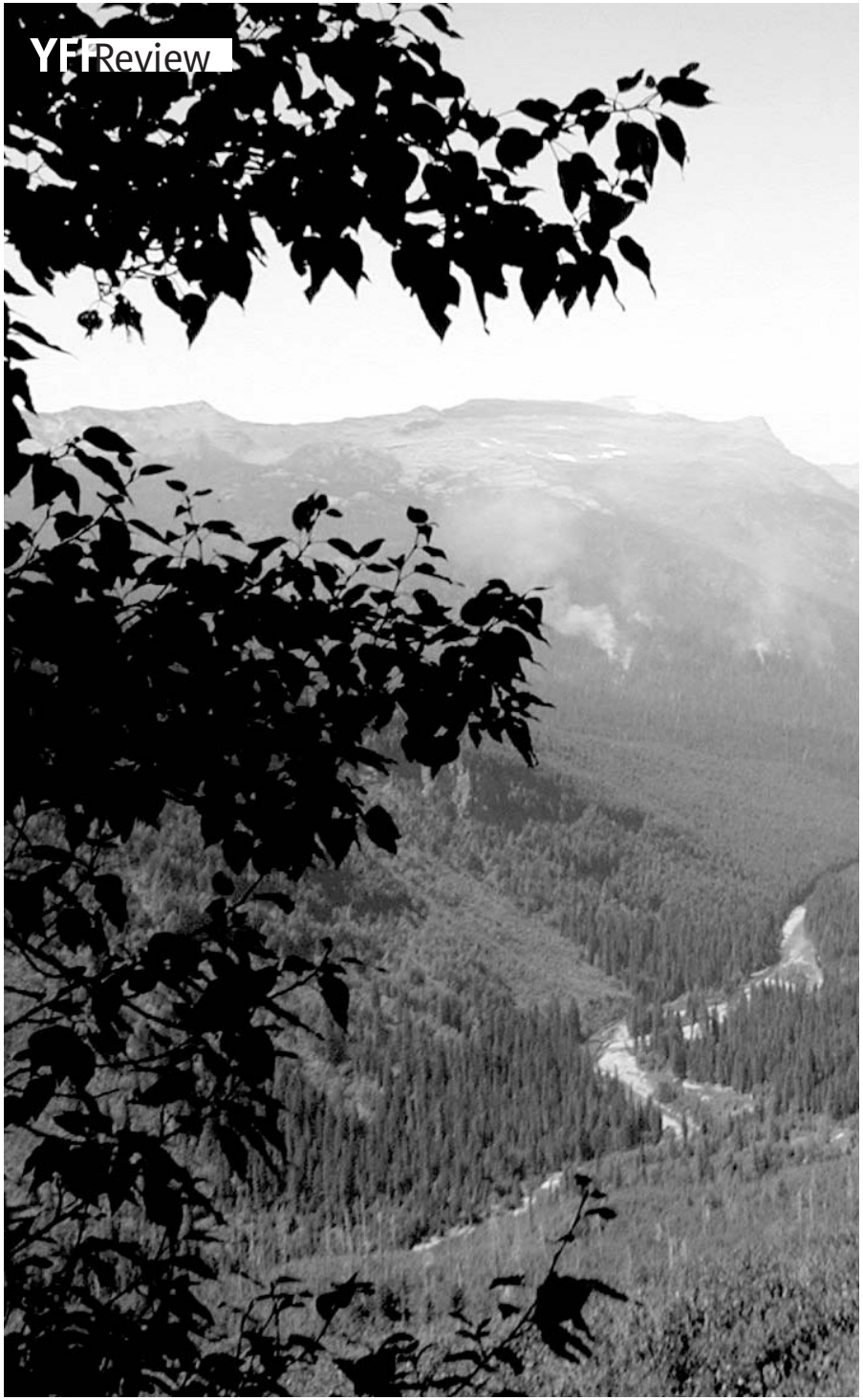
The state of Colorado has established mutual aid agreements, based on the "closest forces" concept. Regardless of jurisdiction, all agencies agree to participate in suppression efforts and not bill each other for a specified and agreed-on time period, for example, 24 hours. These agreements work fairly well for small fires but a large fire burning within the wildland-urban interface creates complexity. The Hayman fire spread very rapidly, driven by weather patterns and high amounts of fuel.

Suppression costs for fires are growing along with their size. The public has come to expect a full suppression effort for all fires. The presence of structures and endangered species complicates fire suppression strategies and tactics. The prior condition of the forest has a large effect on fire behavior and rate of spread. The high density of trees in the Denver region created forest health problems, including a mountain pine beetle infestation that continues to kill large numbers of trees in the wildland-urban interface, increasing susceptibility to severe wildfire behavior.

Active forest management is needed to restore the landscape around Denver and reduce future fire suppression costs; but barriers to forest management on public lands exist. Colorado has smoke restrictions that make it difficult to conduct prescribed burns. Thinning and other management activities can temporarily affect the aesthetics of treated stands, leading to public opposition. Education is needed to convince the public of the necessity of restoring natural fire regimes; however, even with public acceptance of forest management, other barriers exist. Colorado has lost most of its forest products industries and infrastructure, making it difficult to find markets for the small-diameter timber removed during thinning operations. In future restoration efforts, individuals, communities, and government agencies all have a role to play.

Denver air quality June 8, 2002

Denver air quality June 9, 2002



Workshop Summary

On April 29, 2003, the Yale Forest Forum sponsored a workshop titled "Developing Strategies to Collect and Utilize Critical Wildfire Information." The workshop was attended by the forum speakers; faculty and staff of the Yale School of Forestry and Environmental Studies; graduate students from the University of Maine, the University of Connecticut, and the Yale School of Forestry and Environmental Studies; and representatives of the American Forest and Paper Association. Mary Tyrrell, Director of Yale's Program on Private Forests, served as moderator. Discussion focused on the availability of information on wildfire impacts and the usefulness of this information for risk assessment and wildfire management.

The workshop began with a presentation of the GISF Research Paper "Assessing the Environmental, Social, and Economic Impacts of Wildfire." Workshop attendees were asked to comment on the paper and address the kinds of impact information that should be collected to help guide future forest and fire policy, especially at the federal level. Discussions brought up the need for information at a variety of scales, from national to local. National summary information is currently available for some impacts, such as the number of houses burned. Case studies of individual fires provide more detailed information and describe specific impacts to actual communities, which often resonate more closely with the public and members of Congress.

To characterize the variety of fires that burn in different regions of the country, participants suggested starting with the Forest Service condition class map, which divides the United States into three condition classes based on vegetation type and time since the last fire. Class 3 areas are considered at the highest risk for fire, although weather conditions such as drought are not taken into account. It was suggested that a more accurate description of the range of wildfire impacts could be developed from studying ten fires from each condition class.

Corbin Newman cautioned that collecting information is expensive; the Forest Service currently spends 20-30% of their budget on data collection. Any additional data collected must be needed and be useful

for informing future decisions. This comment led to a discussion on the most efficient way to collect data, and if the data collection and analysis should be solely the responsibility of the Forest Service or if there was a role for outside entities, such as academic institutions. Local watershed groups often have long-term information about sedimentation and water quality; this information can encompass timeframes that include pre and post fire years. Besides the need for national and local information, it was acknowledged that some categories of fire impact discussed in the research paper (tourism, public health, and transportation) are most effectively captured at the state level.

The group then debated the following question: How much and what type of ecological and social information is needed to make pragmatic decisions about fire risks and effects? Currently, Congress does not have much scientific information on fire's effects so decisions are often based on anecdotes. Using the condition class system described above as an example, the group wondered if the map could be used to determine areas that are the most overgrown and under-managed, and thus potentially highly vulnerable to wildfire.

At this time, condition class mapping for the United States has been completed only at a coarse scale. More detailed mapping is necessary to make it useful for making local forest management decisions. Detailed condition class mapping is predicted to take four years at $6 million/ year. It was suggested that the Forest Service partner with a nonprofit entity such as The Nature Conservancy to complete the project. Some of the analysis might be done using models that integrate fire risk and thinning options. Model output could then be visualized using a tool such as the Landscape Management System (LMS) to inform the public and Congress of fire risk and forest management options.

The discussion then turned to several related topics, including the long term environmental impacts of wildfires, how to implement timber stand improvement on public and private lands, the need to consider public input in decisions, and the gap between national policy and its implementation. The long-term environmental impacts of wildfires are very difficult to predict but potentially very large. Large fires outside historic ranges of variation can lead to semi-permanent changes in vegetation type, loss of soil productivity, and loss of old growth forest structure that could only be restored after centuries of forest development. Most fire history research focuses on relatively small areas, making it difficult to generalize across large landscapes. Fire researchers from different backgrounds (for instance forestry versus geography) use different terms and techniques in fire history studies, making it difficult to compare research in different regions. A review of the scientific literature on fire histories in different regions of the country would be useful. Research tangentially related to fire, such as post-fire landslides, should also be included in such a review.

Where timber stand improvement or other harvesting is recommended to restore a forest to conditions less susceptible to high severity fire a question arises regarding how it should be implemented on private versus public lands. Public and private lands have different constraints with respect to forest restoration. Some ecologists want to thin only small trees and brush in overstocked forests, but costs for this kind of restoration are extremely high. Stewardship contracts can sometimes be used to reduce the costs of such operations on public lands, but there are few markets for trees in small diameter classes.

The cost of removing unmerchantable timber also constrains work on most private lands. Private landowners with small acreages often do not undertake active forest management for either aesthetic or financial reasons. One suggestion was that communities raise property taxes for homeowners who don't follow Firewise recommendations; however, it was mentioned that those provisions are difficult to enforce. Merrill Kaurmann noted the FARSITE model, a fire behavior model developed by the Forest Service, indicates that treating only 20% of the landscape can control fire behavior on the rest of the landscape. The key is to treat areas where the

ecological and social costs are high. Publicly funded fire suppression has created high risk-high value areas concentrated in the wildland-urban interface. This problem might need to be addressed by private insurance companies. Another point that was made is this: it is very difficult to track forest management on private lands, but such information is needed to inform suppression decisions in the wildland-urban interface. Currently, the greatest potential for an active management program to control fire behavior would be in high risk–high value areas where there is public acceptance of forest management activities.

Ecologists and forest managers may think they know what should be done to restore historical fire regimes for specific forest types; it is nevertheless important that they consider public input. Environmentalists worry that fuel reduction operations will result in the repeal of environmental laws regulating logging on national forests. Forest managers need to address concerns that recent large fires in national forests are, at least in part, a result of past management decisions, including high grading and even-aged management. In many areas, forests vulnerable to fire result from a combination of fire suppression, grazing, and logging. Participants agreed that there should be some

venue for public input should Congress consider enacting categorical exclusions from environmental laws for fuel treatment projects.

Currently, some Americans are not comfortable with fuel treatment projects in national forests. Public education is needed to increase understanding of fire risk and management. Educational outreach could also engage the eastern part of the country in what is sometimes perceived as a western issue. The media could be instrumental in accomplishing some of this outreach, for instance the Weather Channel could profile fire weather during the summer to increase public awareness.

Many of the workshop participants observed a gap between national fire policy and its implementation on national forests. The National Fire Plan encourages the use of prescribed fire and “prescribed natural fire” but in reality very few fires are allowed to burn. Politics drive fire preparedness and response; there is great public pressure to suppress even ecologically beneficial fires. The National Association of Public Administration conducted a study that indicated that the Forest Service’s firefighting capacity is diminishing. Workshop participants suggested that perhaps there is an opportunity to implement thinning and forest management to control forest fires and reduce the level of suppression beyond the wildland-urban interface.

The workshop finished with a short discussion of where responsibility for data collection should lie: with federal/state agencies or academic institutions? The government can collect information over longer timeframes, but often this data is not completely integrated across agencies and published. Academics have more choice as to areas of study but may have funding constraints on undertaking research having long timeframes or with significant regional variations.

Workshop Recommendations

Impact data should be collected on both a national and case study basis.

The Forest Service condition class map should be revised to be accurate at a smaller scale. Greater detail is necessary to make decisions at a local level.

Research is needed on the long-term affects of large forest fires. These effects are difficult to predict but potentially very large.

A review of scientific literature on fire history studies would be useful for making connections across regions. Currently, most fire history studies are localized.

Timber stand improvement on public and private lands should be focused where the ecological and social risks are very high. Restoration should start in areas with public acceptance of active forest management.

Educational outreach is necessary to increase understanding of fire risk and management.

Federal agencies need to address the gap between national fire policy and implementation for prescribed fire and prescribed natural fire.

Resources for More Information

Forum Participants

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Resources for More Information

Coalition for the Upper South Platte
www.uppersouthplatte.org/

Colorado Department of Natural Resources
www.dnr.state.co.us/

Colorado Department of Public Health and Environment
www.cdphe.state.co.us/cdphehom.asp

Colorado State Forest Service
www.colostate.edu/Depts/CSFS/

Denver Water
www.water.denver.co.gov/indexmain.html

Hayman Fire Incident/Recovery Information
http://wildfires.nwcg.gov/colorado/hayman/index.shtml

Interim Hayman Fire Case Study Analysis
www.fs.fed.us/rm/hayman_fire/text/03romme/03romme.html

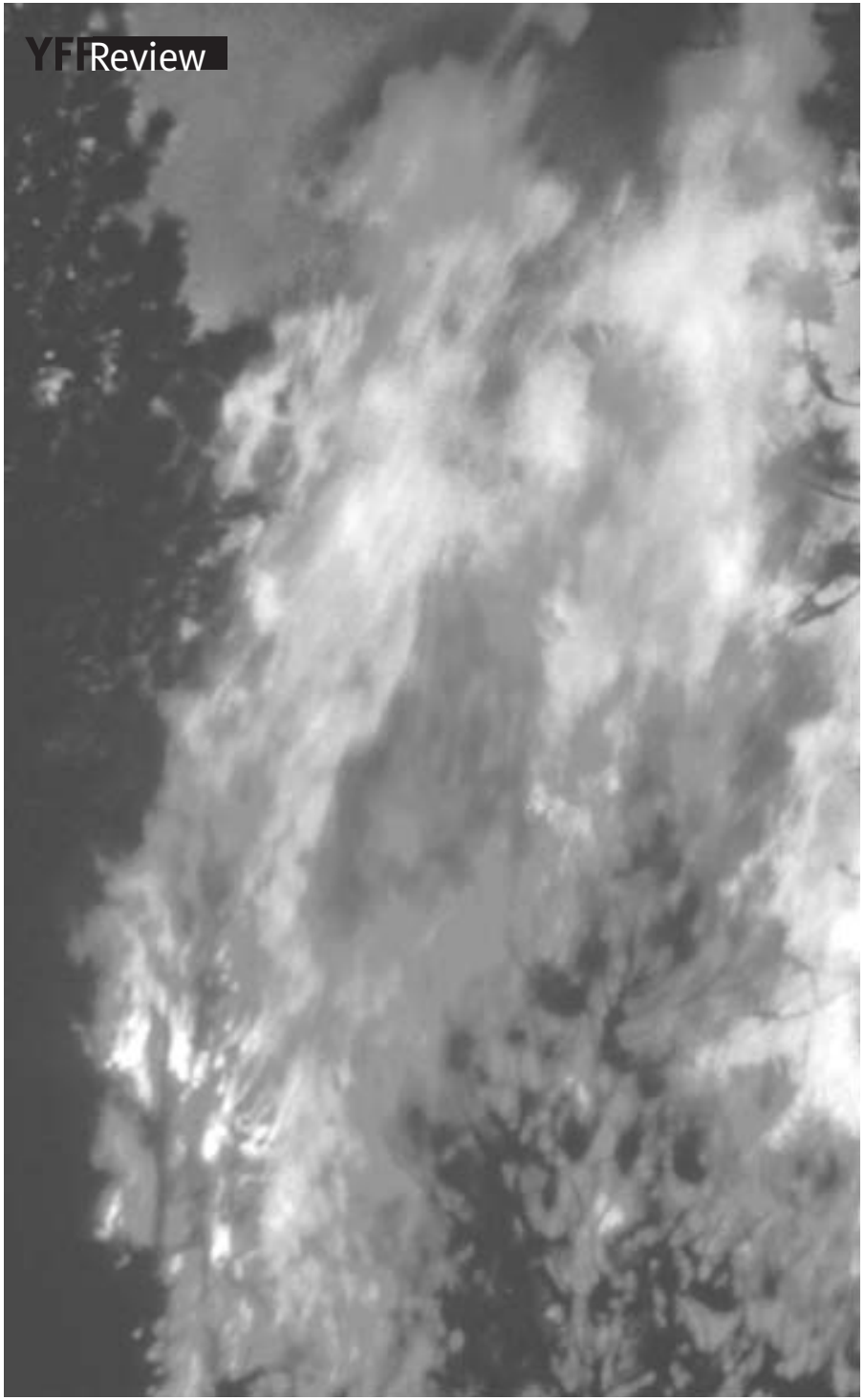
National Interagency Fire Center
www.nifc.gov

Natural Resources Conservation Service
Emergency Watershed Protection Program
www.co.nrcs.usda.gov/programs/ewp/ewp-index.htm

The Nature Conservancy – Fire Initiative
http://nature.org/initiatives/fire

Pike National Forest
www.fs.fed.us/r2/psicc/index.shtml

Southwest Colorado Fire Information Clearinghouse
www.southwestcoloradofires.org/



Additional Readings

Agee, J. K. 1993. *Fire Ecology of Pacific Northwest Forests.* Island Press. Washington, D.C. 493 p.

Burns, Sam, Marxha Porter-Norton, Marcella Mosher, and Tim Richard. 2003. *People and Fire in Western Colorado: Focus Group Attitudes, Beliefs, Opinions and Desires Regarding Wildfire in the Wildland-Urban Interface of Colorado's West Slope.* A Working Report. Prepared by Office of Community Services Fort Lewis College Durango, Colorado.

Butry, D.T., Mercer, D.E., Prestemon, J.P., Pye, J.M., and Holmes, T.P. 2001. What is the price of catastrophic wildfire? *Journal of Forestry* 99(11): 9-17.

Carle, D. 2002. *Burning Questions: America's Fight with Nature's Fire.* Praeger Press. Westport, CT. 298 p.

Cohen, J.D. 2000. Preventing disaster - home ignitability in the wildland-urban interface. *Journal of Forestry* 98(3): 15-21

Colorado Forestry Advisory Board. 2003. *2002 Report on the Health of Colorado's Forests.*

Colorado State Forest Service. 2003. *State of Colorado Wildfire Hazard Mitigation Plan for Fires in Calendar Years 2000 and 2001.*

Czech, B. 1996. Challenges to establishing and implementing sound natural fire policy. *Renewable Resources Journal* 14(2): 14-19.

DeBano, L.F., Neary, D.G. and Ffolliott, P.F. 1998. *Fire's Effects on Ecosystems.* Wiley and Sons, Inc. New York. download at http://www.psw.fs.fed.us/Tech_Pub/Documents/rp-230/rp-230-content.pdf

General Accounting Office. 2003. *Forest Service: Better Information Needed on Effectiveness of Emergency Stabilization and Rehabilitation Treatments.* GAO-03-430

General Accounting Office. 2003. *Forest Service: Information on Decisions Involving Fuels Reduction Activities.* GAO-03-689R

Mason, C. Larry et al. 2003. *Investigation of Alternative Strategies for Design, Layout and Administration of Fuel Removal Projects.* Rural Technology Initiative, College of Forest Resources, University of Washington.

Morton, Douglas C., Megan E. Roessing, Ann E. Camp, and Mary L. Tyrrell. 2003. *Assessing the Environmental, Social, and Economic Impacts of Wildfire.* Yale University School of Forestry and Environmental Studies, Global Institute of Sustainable Forestry GISF Research Paper 001.

National Academy of Public Administration. 2002. *Wildfire Suppression: Strategies for Containing Costs*. A Report by a Panel of the National Academy of Public Administration for the U.S. Congress and the Departments of Agriculture and the Interior. http://www.napawash.org/Pubs/FireSuppression_September_2002.pdf

Pyne, S.J., Andrews, P.L., and Laven, R.D. 1996. Introduction to Wildland Fire. John Wiley and Sons, Inc. New York. 769 p.

Schuster, E.G., Cleaves, D.A., and Bell, E.F. 1997. Analysis of USDA Forest Service fire-related expenditures 1970 - 1995. Pacific Southwest Research Station Research Paper PSW-RP-230

Society of American Foresters. 2004. *Preparing a Community Wildfire Protection Plan: A Handbook for Wildland-Urban Interface Communities.* Available at http://www.safnet.org/policyandpress/cwpp.cfm

USDA Forest Service. 2002. *Homeowners, Communities, and Wildfire: Science Findings from the National Fire Plan.* USDA Forest Service North Central Research Station General Technical Report NC-231. St. Paul, MN

Wise, C.R. and Freitag, C.M. 2002. Balancing accountability and risk in program implementation: the case of the National Fire Plan. Journal of Public Administration Research and Theory 12(4): 493-523.

The Yale Forest Forum (YFF) was established in 1994 by a diverse group of leaders in forestry to focus national attention on forest policy and management in the United States. The group convened the Seventh American Forest Congress (SAFC) to collaboratively develop and articulate a common vision of forest management to diverse stakeholders.

For over 100 years, the Yale School of Forestry and Environmental Studies (FES) has had a rich history in the pursuit of sustainable forestry. From the establishment of the School in 1901 Yale has played an integral role in the development of leaders who are prepared to confront the environmental challenges of the day.

Marsh Hall, home of GISF, on the Yale University campus

The School's Global Institute of Sustainable Forestry (GISF), housed in historic Marsh Hall, continues this rich tradition. Established by the Dean and a group of FES faculty members in 2000, GISF has launched new, innovative initiatives while coalescing and coordinating the many activities related to sustainable forest management at the School, including the School Forests and the Yale Forest Forum. The Institute was created to address the management and conservation of both domestic and international forestlands in a holistic and comprehensive fashion. In pursuit of these ideals, GISF has developed several formal programs including the Program on Private Forests, the Program on Forest Certification, The Forests Dialogue, the Program on Forest Physiology and Biotechnology, the Program on Landscape Management, and the Program in Tropical Forestry.

The Yale Forest Forum is now the convening body of the Global Institute of Sustainable Forestry. Through YFF, GISF often holds multiple events each week at the Yale School of Forestry and Environmental Studies, and hosts workshops and seminars held outside the School, involving stakeholders from all sectors.

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