

Special Issue:
**FOREST CHALLENGES
TODAY AND TOMORROW**

2007 Report on the Health of Colorado's Forests



February 2008



The 2007 Report on the Health of Colorado's Forests comes at a time when unprecedented changes are occurring in our natural environment. Never before have we experienced forest health issues of such multitude and magnitude. The health of our forests has immediate and long-term impacts on our communities and economies. Now, more than ever, what is happening to our forests affects all of us, from cities and suburbia, to rural dwellers.

Because this is a critical time for our forests, this year's report provides a look into our future forests and how Colorado's people and forests overlap. It is a forward-looking document that will help guide our decisions and policies.

Bringing a broad spectrum of forest health issues to light is the purview of this report. Taking action is the responsibility of Colorado's citizen and government leaders. Our actions will shape future forests, and thus the benefits that forests provide us.

Please contact the Colorado State Forest Service office nearest you if you are interested in learning more about forestry and what you can do to help restore and protect our forests. Now is the time to move forward, toward healthy and diverse future forests.

Sincerely,

Jeff Jahnke
State Forester
Colorado State Forest Service



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Executive Summary

Colorado's forests are on the cusp of dramatic change. This report provides a look ahead at issues that are likely to impact Colorado's forests and the benefits they provide – benefits such as clean water, clean air, diverse wildlife habitat, thriving recreation-based economies, and quality of life.

Declining forest health and extended wildfire seasons linked to climate change are pressing issues in Colorado. Forest fragmentation and development also are detrimental to the state's forests. Additionally, decades of fire suppression has left a legacy of unnaturally dense forests in some areas. This has increased the need to invest in programs that will help protect lives, property, and vulnerable resources from potentially catastrophic wildfires that result from accumulated fuel build-ups.

Because much of Colorado's forest lands are old and unmanaged, they are

prone to insect and disease epidemics, and wildfires. Although Colorado's forests are disturbance-driven and should naturally be characterized by diversity in age and size, past decisions have resulted in forests that are homogenous at a landscape level, making them vulnerable to widespread damage.

In recent years, Colorado's forests have experienced several large-scale insect infestations, from ips beetles in the piñon forests of southwestern Colorado to mountain pine beetles in northern lodgepole pine forests. In both cases, the infestations have or will result in tree mortality rates that exceed 90 percent. And Sudden Aspen Decline (SAD) more than doubled in Colorado from 2006 to 2007, increasing from 139,000 to 334,000 acres.

Spruce beetle likely will be Colorado's next statewide forest insect challenge, and outbreaks are expanding in many locations

Thirty Colorado teachers learn about fire and forest ecology at the Fire Ecology Institute for Educators in July 2007. The 1,240 acre New Castle Fire, which burned northwest of Glenwood Springs in June 2007, provided a fresh fire example, complete with wood-boring insects that start post-fire recovery.



Ingrid Aguayo



USFS

In the coming decades, Colorado likely will experience longer and more severe wildfire seasons, issues with water quality and quantity, and reduced snow quality for skiing and other winter sports.

throughout Colorado. In addition, the presence of western balsam bark beetle and root diseases, which are native to subalpine fir forests, has increased during the past decade or two.

Threats to urban and community forests also are on the rise. Salts used to de-ice roads continue to weaken roadside trees such as maples, lindens, and elms. And black walnut mortality is killing urban walnut trees in several Colorado cities and towns. Although there have been no confirmed cases of emerald ash borer in Colorado, foresters are concerned about this exotic insect, which has the potential to kill many of the 4 million native and planted ash trees in the state.

Tamarisk and other invasive trees such as Russian-olive also threaten Colorado's riparian forests. Although this represents only about 1 percent of the state's total forested area, these forests provide essential benefits disproportionate to their size and are critical to the livelihood of Colorado's agricultural communities.

In addition to specific current conditions, broader challenges likely will

affect Colorado's forests over the next 10-15 years and beyond. Climate change, forest fragmentation, and fire suppression will continue to disrupt the state's forests in many ways.

Natural resources are among Colorado's most valuable assets and are worthy of protection and stewardship. Increasingly, Colorado's forests need to be managed to address contemporary and emerging issues including forest health, wildfire, carbon sequestration, potential climate change, and biomass energy. Management also must ensure the continuance of the broad array of ecosystem services upon which the public's welfare depends. These goals cannot be attained by a hands-off, leave-it-to-nature approach. They require careful planning, collaboration, and action.

Although the challenges Colorado's forests face may be daunting, they are not insurmountable. They do, however, require consensus and political resolve to fix. Ensuring the continuation of the benefits that our forests provide, and that Coloradans depend on, is critical to Colorado's future.

Colorado's Forests Today

Forests enhance water quality by filtering contaminants, absorbing and storing excessive nutrients, and reducing flooding.



Ingrid Aguayo

Forests benefit Coloradans in many ways. However, climate change effects, fragmentation and development of forestlands, and ecological impacts from fire suppression put these benefits at risk. Protecting our forests can help ensure that they continue to provide benefits through time.

Forest Benefits

In addition to providing water that helps produce our food, forests also reduce air pollution and strengthen the state's recreation-based economy. In other words, forests contribute to quality of life for all Coloradans. Colorado is synonymous with the great outdoors, offering recreational possibilities so varied and plentiful that they attract visitors from all over the world.

Clean Water

Most of the water that Coloradans use flows from forested watersheds. These forests play a critical role in the state's water supply. Tree roots slow down runoff, allowing water to seep into the ground. This recharges soil moisture and maintains groundwater. Forest cover also protects snow and prevents it from melting prematurely. Colorado is considered a *headwaters* state, because snowmelt from the Rockies provides drinking and agricultural water to several other states.

Promoting healthy forests is an excellent investment in preserving the state's high-quality water supply. Healthy forests reduce the potential after-effects of extreme wildfires, such as clogged reservoirs and damaged water facilities. This benefit is even more vital when considering the growing demands on the finite sources of water in the West.



Clean Air

Clean air is another essential benefit forests provide. Forests absorb chemicals such as nitrogen oxide, sulfur dioxide, and carbon monoxide. They also reduce greenhouse gases by using atmospheric carbon dioxide during photosynthesis.

Economic Benefits

A ski area exemplifies forests managed for recreation to yield economic benefits. Many ski runs were developed by creating clearcuts between areas of protective trees that shelter skiers and snow from wind. According to a 2004 Economic Impact Study by Colorado Ski Country USA, skiing brings \$2 billion per year to Colorado.

In addition to sustaining recreation-based economies such as skiing and hunting, forests attract tourists seeking opportunities to view wildlife and Colorado’s fall colors, which generates significant revenue for the state.

Forest Benefits at Risk

The continued ability of our forests to provide valuable assets such as those detailed above is increasingly threatened by residential development, effects from climate change, and wildfire.

The condition of Colorado’s forests elevates these threats. Many of the state’s forests are old and lack the resiliency of young stands, which represent our future forests.

Because much of Colorado’s forests are old, unmanaged and fire-prone, they are less resilient to the effects of insects and wildfires. These disturbances can compromise the state’s water supply and threaten other benefits our forests provide. Although Colorado’s forests are disturbance-driven and should naturally be characterized by diversity in age and size, past decisions have resulted in forests that are homogenous



Ingrid Aguayo

at a landscape level, making them vulnerable to widespread damage.

There is a clear need for action and coordinated efforts to safeguard and improve the benefits that forests provide. By strategically managing more of the state’s forests, they will be more resilient to the increasing pressures they face today and tomorrow.

“The threat of high-severity wildfire to critical Front Range watersheds and the drinking water of Front Range communities is unprecedented.”

– from the Pinchot Institute’s report
*Protecting Front Range Forest Watersheds
from High-Severity Wildfires*

Colorado’s forests currently lack age diversity, a key component of forest health and resilience.



What is Forest Management?

Forest management includes planned activities that improve and protect forest health, reduce wildfire danger, and produce other forest benefits. Harvesting timber, removing poor quality and low-value trees, forest thinning, and prescribed fire are all examples of forest management. Other management activities, such as regulating development within fire-prone forest types, may be equally effective in improving the condition of some forests.



USFS

Removing beetle-killed trees reduces fire hazards and allows sunlight to nurture the next forest.



Hans Rinke

Young pine and aspen thrive in an area where beetle-killed trees were removed in 1999.

Insect and Disease Activity Update

Bark beetle outbreaks are normal in Rocky Mountain forests. Like mountain pine beetle, episodic outbreaks of spruce beetle have occurred for centuries in Rocky Mountain forests. Blowdowns often trigger local spruce beetle outbreaks.

However, two features of the current outbreaks appear to be unprecedented: (i) mountain pine beetle is now killing lodgepole pine at higher elevations than previously seen; and (ii) several different species of bark beetles are undergoing outbreaks at the same time, simultaneously affecting several different forest types

and regions of the state. Both of these phenomena appear to be linked to the warmer temperatures that have affected forests throughout the state. Aging forests, which are present in most regions, also play a role.

Most of Colorado's lodgepole pine, aspen, and spruce/fir forests are older and less resilient. Forest insects and diseases thrive in older forests, and are responsible for the some of the dramatic changes seen in Colorado's forests today. But insects and diseases are common symptoms of older forests.

Other forests, such as ponderosa pine, have become overgrown as a result of fire suppression and lack of forest management.



These forests are more likely to be damaged by wildfire than in the previous century when low-intensity fires burned through them more regularly.

To generate a landscape-level overview of forest insect and disease trends over time, aerial surveys of Colorado forests are conducted every summer. Aerial surveying provides forest managers, elected officials, and other stakeholders an up-to-date approximation of recent conditions.

The aerial survey is a joint effort between the U.S. Forest Service and the Colorado State Forest Service. Acre estimates of insect and disease activity used in this report were derived from the 2007 aerial survey.

Mountain Pine Beetle

Mountain pine beetle continues to dramatically alter lodgepole pine forests in Colorado's high country. More than 980,000 acres of pine forests were infested in the state in 2007. Routt, Jackson,

Pitkin, Grand, Summit, Eagle, Lake, and Park counties have experienced the most significant activity. Mountain pine beetle activity is also increasing in lodgepole stands on the Front Range, and likely will cause impacts similar to what we have seen on the west side of the continental divide.

Current mountain pine beetle populations are growing rapidly. Some surveyed areas have shown as much as a one-hundredfold increase in the number of infested trees per acre. A two- or three-fold increase in the number of infested trees in an area is more typical in mountain pine beetle outbreaks. Entomologists speculate that winds carrying beetles from nearby areas are contributing to this phenomenally high rate.

Foresters predict that most of the older lodgepole pine forests in Colorado will be infested by mountain pine beetle before this insect epidemic ends. In some areas, nearly 100 percent of the mature lodgepole pines have already been killed.

Willow Creek Pass, 2005 and 2007



Tom Troxel



Tom Troxel

Although proactive forest management would not have stopped the current mountain pine beetle epidemic, it would have resulted in more young forests that are resistant to mountain pine beetle.



Jen Chase

In 2007, managers at SolVista ski area invested in a major tree-spraying campaign along ski runs to prevent further beetle-kill. Preserving protective tree cover helps reduce the melting and blowing snow that disrupts snow management efforts.

Mountain pine beetles also have been found attacking and killing spruce trees within and adjacent to heavily infested lodgepole pine stands. It is not known how well mountain pine beetle survives in spruce trees, but mountain pine beetle galleries, larvae, and newly formed adult beetles have been found in spruce trees. Researchers are in the process of determining whether any mature pine beetles will emerge from these spruce trees and, if so, whether the beetles are viable. Oftentimes, spruce beetle infestations also are found in the base of spruce trees attacked by mountain pine beetles.

Spruce Beetle

Spruce beetle likely will be Colorado's next statewide forest insect challenge. Spruce beetle outbreaks are expanding in many locations throughout Colorado. They may be less noticeable than mountain pine beetle because the outbreaks often occur in higher, more remote locations, and the trees fade slowly over several years. This also can make spruce beetle outbreaks more difficult to detect and map from the air.

Typically, spruce beetle outbreaks are triggered by windstorms that blow down trees over a large area. Spruce beetles breed first in the windthrown trees and then move into standing large old trees. When spruce beetle epidemics occur, spruce trees as small as four inches in diameter can be attacked.

Spruce beetles currently take two years to mature in Colorado's forests, but warmer temperatures in the spruce forests of southern Utah have allowed some spruce beetle populations in that region to shift to a one-year life cycle. If such a shift occurs in Colorado, the severity and rate of expansion of spruce beetle outbreaks could dramatically increase.

More than 97,700 acres of Colorado's spruce forests were infested with spruce beetle in 2007. Active spruce beetle

The Future Forest?

Poor genetic material can populate the next forest when smaller, unhealthy trees are left on-site after the larger, beetle-infested trees are removed. Additionally, mature trees infected with dwarf mistletoe will infect and weaken young seedlings.



Jen Chase



Bill Ciesla

A large-scale spruce beetle epidemic may have significant impacts on the state's ski areas, the upper reaches of which are all in spruce/fir forests.

outbreaks are occurring in and near blowdown areas including the Grand Mesa, the Greenhorn areas of the Wet Mountains, the Baylor Park area in Garfield County, the Steamboat Springs area, Wolf Creek Pass, and numerous other settings in southwestern Colorado. In northern Colorado, much of the older spruce from Rabbit Ears Pass north to Wyoming has been killed on the Routt National Forest.

Aspen Decline

Sudden aspen decline (SAD) is a newly described decline involving synchronized, rapid mortality of the aspen *overstory* on a landscape scale. SAD is most severe at low elevations, on drier sites such as south- and west-facing slopes, and in open stands with mature trees.

SAD more than doubled in Colorado from 2006 to 2007, increasing from 139,000 to 334,000 acres. In Colorado's national forests, SAD acreage more than tripled.

Damage is worst in the southwest and northwest portions of the mountains. In some areas, more than 10 percent of the aspen cover type is affected.

The greatest concern regarding SAD is how it affects aspen root systems. Because aspen regenerates almost exclusively by *suckering*, or root sprouting, their root systems represent future aspen forests. Long-term impacts of SAD will be determined by how extensively root systems are affected.

Although aspen regeneration is most successful following disturbance such as wildfire or cutting, some root systems are not responding to these disturbances and are in poor condition. The U.S. Forest Service recently established paired plots (declining and healthy) in southwest Colorado that will allow quantification of root sprouting, the condition of root systems, crown condition, and other variables.

Overstory trees are the tallest trees in the forest. Understory trees are the smaller trees growing beneath them.



Aspen decline on the Gunnison National Forest north of Paonia, Colo.



Jim Worrall

Maintaining and increasing tree cover is a cost-effective way to improve urban infrastructure.

Evidence points to the recent drought and warm temperatures as important inciting factors. In addition to elevation and slope direction, predisposing factors include aspen stands with mature trees. Because many old stands occur in Colorado’s unmanaged aspen, much of the landscape is potentially susceptible.

Subalpine Fir Decline

Western balsam bark beetle and root diseases are native to subalpine fir forests and have been present for millennia. However, Colorado’s subalpine forests have experienced increased activity during the past decade or two. Cumulative effects of these disturbance agents, known as subalpine fir decline, have led to hillsides of dead overstory trees. In 2007, 350,500 acres of high-elevation forests throughout the state were affected by this decline.

Urban and Community Forests

Communities, too, have forests. Trees along streets, in yards and parks are called urban or community forests. These forests enhance Coloradans’ quality of life by:

- Purifying air and improving water quality
- Reducing runoff during storms
- Saving energy by modifying temperature extremes
- Decreasing noise pollution
- Improving aesthetics
- Providing urban wildlife habitat
- Raising property values

According to an American Forests report, urban forests in Colorado’s northern Front Range metro area reduce the need for stormwater management facilities by 50.1 million cubic feet, valued at \$44 million in one-time costs, or \$3.2 million in annual savings over a 30-year period. The report also estimates that trees in the northern Front Range metro area remove 2.2 million pounds of pollutants every year, valued at \$5.3 million annually.



Like naturally occurring “wild” forests, urban forests require care to maximize tree benefits. Regular maintenance such as proper watering, pruning, and pest monitoring and control all help ensure that the trees planted in our cities and towns remain assets rather than liabilities.

Threats to Urban Forests

Roadside Salts

Many urban trees are stressed from the long-term effects of drought. Additionally, salts used to de-ice roads continue to weaken roadside trees such as maples, lindens, and elms. Chloride levels are highly elevated in some of the trees that have “scorched” brown leaves and needles.

Black Walnut Mortality

Black walnut mortality is caused by the walnut twig beetle and a fungus complex. Walnut twig beetles, which are relatively new to Colorado, traditionally attack stressed trees, infesting branches and twigs. Recently, however, they have been detected in the trunks of large-diameter trees in properly irrigated locations.

Black walnut mortality is killing urban walnut trees in several Colorado cities and towns. In 2007, Colorado Springs reported that almost all of its walnut trees were killed. The City of Boulder identified 250 black walnut trees on public and private land that must be removed by February 2008 to prevent further losses. Denver also is seeing an increase in this threat to urban forests. Colorado State University experts are conducting research about how black walnut mortality spreads and how to prevent further losses.

Emerald Ash Borer

Emerald ash borer, an insect native to northern China, continues to concern Colorado’s forestry officials. Prior to 2002, the emerald ash borer had not been seen outside of Asia. But, in 2002, it was



Ingrid Aguayo

The effects of magnesium chloride, a common road de-icer, on aspen.

identified in southeast Michigan and has since killed more than 20 million ash trees in Michigan, Ohio, and Indiana.

Although there are no confirmed cases of emerald ash borer in Colorado, the exotic insect has the potential to kill many of the 4 million native and planted ash trees in the state. Forestry officials have prepared prevention and contingency plans in case this forest insect is discovered in Colorado. Education efforts are underway to discourage importation of out-of-state-firewood because transport of infested wood is one of this insect’s primary means of spreading into new areas.

Urban forests provide key benefits to Coloradans, and they need protection and care. As Colorado’s urban and suburban areas continue to grow, more tree cover is needed to reduce stormwater runoff and improve air quality. Increasing the number of urban trees will enhance the environment and quality of life in Colorado communities. Additionally, planting different types of trees in community forests can help prevent major losses when exotic insects are introduced.



Carol O'Meara

Black walnut mortality caused by the walnut twig beetle and fungus complex in Boulder.



Russian-olive, shown on the left side of photo, and tamarisk, shown on right, have infested the Purgatoire River near Trinidad, Colo.



The Tamarisk Coalition

Riparian Forests

The contributions of Colorado’s riparian forests, which grow along rivers, streams, and creeks, sometimes are overlooked. These forests consist primarily of cottonwood, willow, and shrub species.

Colorado has 232,000 acres of riparian forests. Although this represents only about 1 percent of the state’s total forested area, these areas provide essential benefits disproportionate to their size. Benefits include maintaining water quality and quantity, recharging ground water, and reducing erosion. Native trees and shrubs along waterways help filter water, prevent flooding, remove excess nutrients, and provide excellent wildlife habitat.

Active management is occurring on the Eastern Plains and throughout Colorado to protect riparian forests. One example is an effort to reduce tamarisk, also known as salt cedar. Tamarisk is a small non-native tree/shrub that has invaded Colorado’s waterways. Tamarisk’s extensive root system, which can reach a depth of 100 feet, uses available water and its leaves deposit a salt residue on the soil’s surface. Because native species cannot survive when high salt levels are present, tamarisk out-competes and quickly replaces native cottonwoods, willows, grasses, and forbs. Salt cedar and other invasive trees such as Russian-olive compromise the livelihood of Colorado’s agricultural community by consuming valuable water required for farming and ranching.

According to the Tamarisk Coalition, more than 50,000 acres of tamarisk infest the Colorado, Arkansas, and Purgatoire rivers and their tributaries. The Coalition estimates that tamarisk consumes approximately 75,000 acre feet of water annually in these rivers and tributaries. This is above and beyond what native vegetation would use. Seventy-five thousand acre feet of water can supply enough potable water to support 187,000 households every year. Tamarisk has taken hold in additional waterways in the state, but infestations have not yet been quantified.

Several projects already are underway to control Colorado's significant tamarisk problem, and continued perseverance can help ensure success. Informational websites, such as www.tamariskcoalition.org, also are an effective tool in the effort to protect and restore the state's riparian forests.

From waterways to mountains and cities, Colorado's forests provide invaluable benefits to the state's residents. However, human interference with natural processes, such as spreading invasive species and interfering with fire's natural role, has compromised the state's forests. Working to remedy the troubles incurred by humankind's actions in forested systems is both responsible and prudent. Often this is best accomplished by mimicking nature and replacing invasive species with native vegetation.

Salt Cedar: Drinking Colorado's Waterways Dry



Shelly Van Landingham

Members of Volunteers for Outdoor Colorado apply herbicide on recently cut salt cedar at the Boggsville Historic Site on the Purgatoire River near Las Animas, Colo. If a herbicide is not applied after tree-cutting, the invasive tree would resprout and continue to consume vast amounts of water and deposit salt in the soil. The final stages of this project involve planting, monitoring, and maintaining native species.

Forest Challenges: Today and Tomorrow

“Climate change is our generation’s greatest environmental challenge.”

– Gov. Bill Ritter

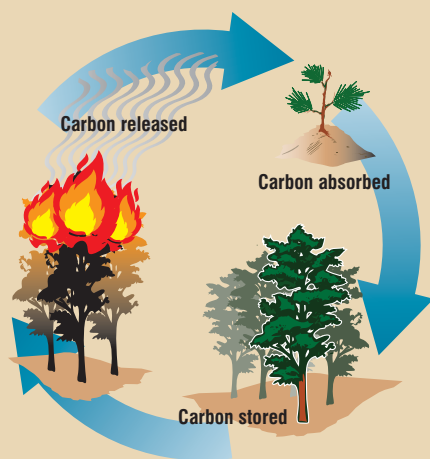
In addition to specific current conditions, broader challenges likely will affect Colorado’s forests over the next 10-15 years. Climate change, forest fragmentation, and fire suppression are three prominent issues that will continue to disrupt the state’s forests in many ways. Warmer temperatures already have lengthened fire seasons in the West and extended the range of the mountain pine beetle. Ever-increasing human use of the forest has resulted in forest fragmentation and increased firefighting costs. And the struggle to balance the ecological value of fire with the need to protect homes and communities continues to make fire suppression a critical management issue. If left unaddressed, these challenges will affect Coloradans’ health and safety through wildfire and water supply issues.

Climate Change

Climate is the variability of temperature and precipitation over a period of time for a particular area. Climate change, including warming temperatures and altered precipitation, can result from increased greenhouse gases such as carbon dioxide. The largest sources of carbon emissions in the United States are power generation and vehicle emissions.

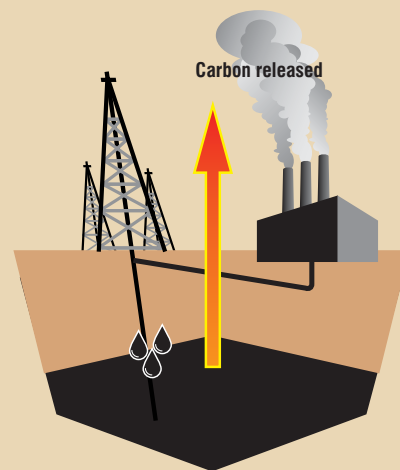
According to Colorado State University researchers, the most important variable in determining forests’ total carbon loss is the pre-fire landscape carbon content. This is related to past forest management and disturbance history, as well as fire behavior. When drought and high-intensity fires occur, total regional carbon losses from forest fires in the western U.S. represent significant amounts of released carbon.

The Natural Carbon Cycle vs. Carbon Released from Fossil Fuels



The Natural Carbon Cycle

The natural carbon cycle between vegetation and the atmosphere does not add new carbon over time. Even when wildfires “produce” a large amount of atmospheric carbon, this carbon is then used by rapidly growing seedlings.



One-Way Carbon Release

Using underground fossil fuels releases carbon that was sequestered, or fixed, eons ago. Once fossil fuels are burned, most of the resulting carbon remains in the atmosphere. A very small percentage is absorbed by oceans over hundreds of years.

Impacts on Colorado's Forests

Colorado's forests likely will experience increased wildfire seasons, exacerbated insect outbreaks, and reduced snow quality for skiing and other winter sports in the coming decades. Although climate models lack consensus regarding the amount of precipitation, most project that precipitation will become more erratic, with dry periods, as well as more intense rain and snow events.

A U.S. Forest Service report estimates that a temperature increase of 6.3° F in the Rocky Mountains will shift suitable growing environment for forest vegetation types approximately 2,000 feet upslope or 200 miles further north. Foresters are unsure what this may mean for Colorado's iconic aspen forests growing on the state's western mesas, because the land elevation is low, which precludes aspen migration.

Wildfire

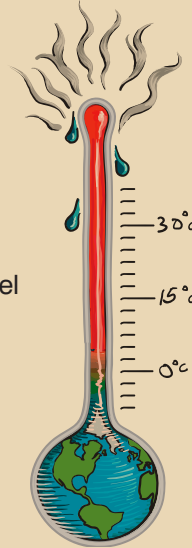
Wildfire is part of Colorado's natural forest system. However, it can pose major threats to people, homes, businesses, local economies, and drinking water supplies.

In the West, longer wildfire seasons, extreme wildfire conditions, rising numbers of large and severe wildfires, and increasing burned areas already occur. This strongly correlates with warming and drying trends, and likely will worsen as temperatures continue to rise. Additionally, because historical fire regimes have been disrupted, many of Colorado's forests are even more susceptible to climate change effects.

Increased wildfire severity and precipitation falling on burned areas is likely to have detrimental effects on the state's water supply.

Is Climate Change Real?

"Warming of the climate system is now unequivocal," said Dr. Susan Solomon, at the release of the report by the Intergovernmental Panel on Climate Change in February 2007. She presented findings from "The Physical Science Basis," produced by 600 scientists from 40 countries. In addition to co-chairing the IPCC Working Group I, Solomon is a Senior Scientist at the National Oceanic and Atmospheric Administration in Colorado.



The IPCC and Former Vice President Al Gore were awarded the Nobel Peace Prize in October 2007 for their climate change research and outreach efforts.

Gradual temperature and drought increases can result in abrupt changes in wildfires. In 2007, Colorado had a less-than-average fire season in terms of acres burned, but other western states such as Idaho and Utah had record-breaking seasons. Even veteran firefighters witnessed phenomenal fire behavior they had not previously seen. Already, extreme fire conditions in the West have made traditional firefighting techniques less effective. Under future drought and high-temperature scenarios, fire suppression tactics likely will need to be changed.



Forest fragmentation is the breaking up and loss of continuous forest land to other uses such as building lots and roads.

Forest Insects

In Colorado, nearby states, and Canada, warmer winters and drought have allowed insects such as mountain pine beetles to proliferate at alarming rates and move further north and higher in elevation than previously seen. In areas of southwest Colorado, bark beetles in piñon pine caused 90 percent die-off a few years ago. In both cases, winters have been too warm to inhibit the growing bark beetle populations.

Implications of Climate Change on Colorado's Forests

Although many projects aimed at protecting Colorado's communities and natural resources from wildfire currently are underway, the problem is immense.

Increasing fuels reduction projects is imperative in order to protect communities and critical watersheds. These efforts should include strategic information and education campaigns that foster action among all stakeholders.

Forest Fragmentation and Development

Colorado currently has 4.3 million residents and, according to the U.S. Census Bureau, was the eighth-fastest growing state in the U.S. in 2006. Growing populations can put pressure on forests and jeopardize the benefits that forests provide. Sound forest management and proactive planning for growth can help mitigate the negative impacts of human use on our forests.

Residential Development

Forested watersheds provide high-quality water that is used by residents, farmers, and ski areas. Loss of protective forest cover due to development can increase runoff following storms, increase soil erosion, reduce groundwater infiltration, and increase sedimentation in streams. Such damage degrades water quality and fish habitat.

Residential development causes fragmentation, or parcelization, of large, contiguous forest areas into smaller, disconnected tracts. It also results in an increase in the number of individual owners. When residential development occurs on forest lands, it not only reduces the amount of forest cover, it also increases demand for and costs of wildfire protection; fractures wildlife travel corridors and habitats; and produces a corresponding increase in per-acre forest management expense and complexity.

Colorado's Powder: From Lush to Slush?



CSFS

With warming temperatures, the quality of snow is expected to change from dry, lush powder to wetter, heavy slush.



The Wildland-Urban Interface

When residential development occurs on the forest fringe or other fire-prone areas, it is known as the wildland-urban interface (WUI). These dangerous residential fire zones put firefighters more at-risk. Even experienced and highly qualified firefighters have been killed or had near misses while fighting fires in the wildland-urban interface.

The WUI involves areas of mixed ownerships and multiple jurisdictions, resulting in an array of political, social, and economic challenges. Dispersed homes are harder to defend from wildfire, especially when the homes do not have a defensible space.

Defensible space is a buffer zone of reduced vegetation around a home that reduces fire hazards and gives firefighters space to do their jobs.

Protecting the wildland-urban interface is the nation's fastest-growing firefighting expense. Currently, suppressing wildfires in the WUI accounts for 85 percent of firefighting costs in the United States. Protecting life and property in these areas is expensive because fire managers must take aggressive stands on the ground and from the air.

As more people own land and live in forested areas, it becomes more difficult and expensive to treat that area and keep it healthy. Researchers from the Pacific Northwest found that mechanical fuels reduction treatments were three to four times as expensive if they occurred in the wildland-urban interface. And it is harder to gain consensus about forest management actions among multiple landowners. Prescribed fire, in particular, can be a painstaking endeavor in developed



CSFS

landscapes because of the extremely high complexity involved in burning near homes. The high levels of communication required between landowners and firefighters also is challenging.

Rural Sprawl

A 1972 Colorado law exempts developers from county subdivision requirements if the parcels they're selling are 35 acres or larger, thus the 35-acre ranchette was born. However, these lower densities are more difficult to protect from wildfire. They also require the installation and maintenance of more roads and necessitate more driving to and from communities where services are offered.

Low-density development takes more land to house fewer people, greatly increases traffic and pollution from additional driving, and impacts wildlife. In addition to fragmenting wildlife habitat and travel corridors, increased rural development threatens and endangers wildlife species. Subdividing large ranches into ranchettes is a growing trend throughout Colorado.

In addition to increasing the demand for wildfire protection, development in fire-prone areas also requires more roads and services. This adds to the financial burden of all Colorado taxpayers.

More than half of new rural housing in Colorado is in the wildland/urban interface.



GIS in Land Use Planning

By overlaying the effects of human activity on the landscape, a geographic information system (GIS) shows how these activities altered the land over time. For example, the wildland-urban interface has grown by more than 50 percent since 1970 and has increased human activity in wildfire-prone areas.

GIS can be an invaluable tool in planning developments that minimize the human imprint on the landscape. Ouray County officials are considering a GIS analysis that shows different land use plans. Dispersing homes on larger lots significantly reduced wildlife habitat and agricultural land, and increased the number of miles driven by up to five times. More clustered housing had far fewer impacts.

In recent years, state and local efforts have prevented hundreds of thousands of acres from being developed. However, Colorado's open spaces are disappearing at three times the rate of the national average. A Colorado State University study projects that wildland-urban interface areas will double in the state over the next two decades.

Implications of Forest Fragmentation and Development on Colorado's Forests

Apart from the tangible effects of wildlife habitat loss, impaired water quality, and reduced timber production, loss of forested landscapes has other social consequences for our increasingly urbanized population. As more forest land is permanently converted to non-forest land uses, fewer Coloradans will be able to enjoy the natural beauty of our forest landscapes and experience the personal renewal gained by spending leisure time there.

Growth in Colorado is a fact of life. How that growth is planned, however, should be evaluated for the long-term. The cumulative effects of pollution from increased driving and forest fragmentation may adversely affect current and future generations of Coloradans.

Fire Suppression

Colorado has two major fire suppression issues. The first is the legacy of unnatural, dense forests in some areas because of past fire suppression. The second is the need to protect lives, property, and vulnerable resources from fires that occur as a result of accumulated fuel build-ups. Balancing ecologically beneficial wildfires with community protection is imperative.

A century of fire suppression, often without additional management to replace the beneficial effects of fire, has allowed a build-up of fuels that threaten communities and economies when wildfires occur. Additionally, fire suppression has resulted in age homogeneity in high country forests, creating continuous, older forests that sustain beetle populations. Intense wildfires that burn in built-up, continuous fuels can cause extensive damage to property and water supply systems.

Compounded with climate change, the state's forests are almost certain to experience increased wildfires and wildfire effects, with more severe impacts on landscapes.

Colorado's history of land development and fire suppression has led to an increase in the cost and complexity of wildfire suppression. This seemingly self-perpetuating cycle of fuel build-ups,

A Colorado State University analysis (D. Theobald and W. Romme, 2007) projects that the state's wildland-urban interface areas will increase from 715,500 acres in 2000 to 2,161,400 acres in 2030, a 300 percent increase.



greater wildfire risk, and higher stakes can be broken. Proactive tools such as forest thinning and fuels reduction can help move Colorado toward healthier forests, safer citizens, and more effective protection of natural resources.

In 2007, Colorado's wet spring, prepared firefighters, and early engagement of single engine air tankers helped keep fires small. However, another big fire season is certain to occur in Colorado. Less active fire seasons today lead to greater fire potential tomorrow. Without wildfire mitigation, fuel

loads increase every year. When fires burn in areas of built-up fuels, they can threaten communities, water supplies, forests, and other natural resources.

Fire suppression is necessary to protect life and property. However, not all fires should be suppressed. This only leads to larger fires in the future. It also prevents fire from playing a role in maintaining ecosystems in which fuel accumulations have not yet reached unsafe levels. See *Appropriate Management Response* on page 27 for more information.

Wildland-Urban Interface: Burning up the Budget?

While increasing numbers of homes in the wildland-urban interface raise firefighting costs, paying for firefighting is a national burden. As decisions are being discussed in Washington about how to deal with this growing issue, many have suggested that local jurisdictions should assume more of the costs for fighting wildfires.

Nationwide, almost half of the U.S. Forest Service budget is spent on fire suppression. This leaves little funding to provide for the stewardship of our nation's forests, which benefit all Americans, whether rural or urban. They are places where watersheds can be protected and enhanced to provide clean water, improve air quality, and contribute to carbon sequestration. However, when funds intended for forest stewardship are used for fire suppression, National Forests can grow unhealthy, and they can become liabilities instead of assets.



A single-engine air tanker fights a wildfire near the Cameo exit of Interstate 70 in western Colorado in the summer of 2007.

CSFS

Today's Solutions for Tomorrow's Forests

“One of the best ways to address climate change is to use more wood, not less. Every wood substitute, including steel, plastic and cement, requires far more energy to produce than lumber.”

– Patrick Moore, former Director of Greenpeace International

Natural resources are among Colorado's most valuable assets and are worthy of protection and stewardship. Breaking down seemingly insurmountable challenges into achievable pieces requires coordination and cooperation among all stakeholders. Addressing these challenges will require land managers and other stakeholders to work at landscape and local scales.

Although it may seem counter-intuitive to cut trees to promote forest health, when properly done, mimicking nature through well-planned disturbance truly benefits forests. This, then, helps maintain the benefits forests provide over time. Because wood is a renewable resource, using wood in place of petroleum and other non-renewable carbon sources has a beneficial environmental impact. Additionally, healthy forests are more efficient at sequestering carbon than unhealthy forests, and will benefit the global climate.

Forests Countering Global Warming

People can use forests to address climate change by:

- Using sustainably managed wood products in construction
- Using forest biomass in bioheating
- Strategically placing trees around homes and urban communities to reduce energy use

A substantial amount of carbon remains stored in forest products that are harvested and manufactured for use in construction, furniture, and other wood products. This carbon does not contribute to climate change until the wood either decomposes or is burned.

Forests have a role in combating climate change. Using biomass from forests as a means of heating can reduce the use of fossil fuels that contributes to excess carbon dioxide.

Reducing Carbon Emissions through Sustainable Forestry

Carbon Absorbed or Reduced





Young, growing forests take up more carbon than old, less vigorous forests.

Urban forests also are part of the solution to global warming. According to an American Forests report, the direct shade that trees provide to residential homes in Colorado's northern Front Range metro area saves \$3.5 million annually.

Industry Infrastructure

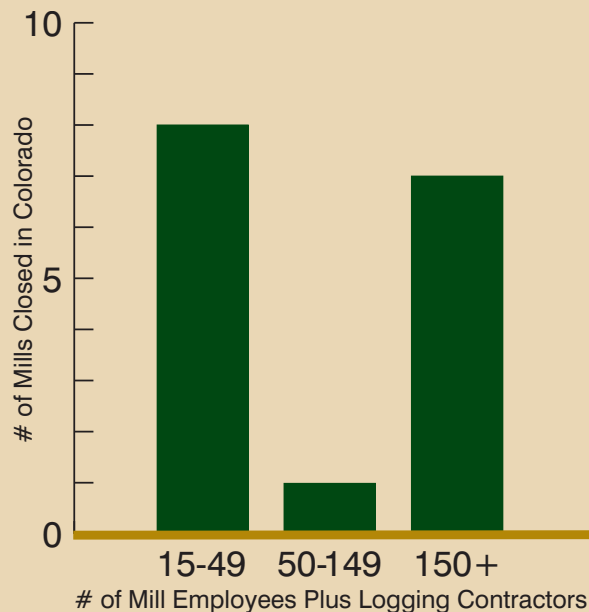
Colorado has never had a large forest industry. The state's modest-growing timber is not like that of the Pacific Northwest or the hardwoods in the East. In the late 1800s and early 1900s, trees were cut for mining props and railroad ties. Later, local wood was used for 2x4s and other building materials. Currently, however, only about 5 percent of Colorado's annual net forest growth is harvested. So every year, the state's forests are becoming more overcrowded.

Significant energy expenditures, primarily in the form of fossil fuels, are involved in importing nearly all of Colorado's wood from out of state or out of the country. Therefore, producing more wood in Colorado for local use would help reduce greenhouse gas emissions, provide opportunities for the development of small businesses, and promote effective forest management.

According to the Colorado Forestry Association, forest inventory of saw timber more than tripled in Colorado's National forests from 1909 to 1997.

Colorado Lumber Mills Closed Since 1980

Since 1980, 16 of Colorado's medium- to large-sized lumber mills closed. Today, 22 mills remain in the state that employ more than 15 people, including logging contractors. Of these, only five employ more than 50 people.





“It’s just a tragedy to have to pay \$3 for a doggone 2x4 when millions of board feet of material are lost to fires and disease and waste every single year.”

– Granby resident in the “Colorado Community Response to Bark Beetles” survey conducted by the University of Illinois.

Woody biomass heats the Boulder County Open Space facilities in Longmont.

More than 60 percent of residents who responded to a survey taken in Eagle, Summit, Grand, Jackson, and Routt counties support small-scale timber processing and niche marketing. Approximately 30 percent support large-scale timber processing.

Although sustainable harvesting is a good way to regenerate forests and add diversity to the landscape, forest harvesting has decreased since the 1970s. Today, at least 90 percent of all wood products used in Colorado are imported from other states or foreign countries.

In addition to the lack of social acceptance, funding shortfalls constrain successful implementation of high-priority management objectives in Colorado’s forests. Without adequate wood-processing facilities, it is not cost-effective to remove trees.



Dan Bihn

Woody Biomass

The Front Range Fuels Treatment Partnership Roundtable identified 1.5 million acres that require treatment on the Front Range to protect communities and restore forest health. Approximately \$15 million per year would be required to meet this objective on both federal and non-federal land over a 40-year period, far more than the \$6 million per year that has been available.

One way to reduce the cost of land treatments is to find an economically viable use for the materials removed. The utilization of woody biomass for bioheating is a particularly promising solution to address the fuels build-up in Colorado’s Front Range forests. Branches, small trees, and other woody debris can be burned in wood-fired boilers to produce heat for schools, libraries, government offices, and other local facilities. This practice can reduce forest treatment costs by up to 40 percent and provide a unique way to connect local communities with natural resources. The Colorado State Forest Service, in collaboration with the Colorado Wood Utilization and Marketing Program at Colorado State University, is working with communities to identify and pursue local opportunities for putting woody biomass to use.

These are just some of the beneficial solutions that have been identified to address the critical issues related to declining forest health and increasing wildfire risk in Colorado. Additional solutions are likely to evolve, and steps can be refined as new wood utilization technologies emerge and outreach efforts spur action. Moving people from awareness to action is critical to the success of long-term forest stewardship.

On-the-Ground Successes

Although it can be challenging, collaboration is valuable, especially in areas where people have demonstrated a strong interest in working together across boundaries to address forest health and/or fire issues. Many consider collaboration vital to creating diverse, healthy forests over time.

Reducing Hazardous Fuels on Colorado's Front Range

The Front Range Fuels Treatment Partnership (FRFTP) was formed after the disastrous fire season of 2002, the worst in Colorado's recorded history. The FRFTP is a dynamic partnership comprised of federal, state, and local governments, land-management agencies, private landowners, conservation organizations, and other stakeholders. The purpose of the Partnership is to reduce wildland fire risks through sustained fuels treatment along Colorado's Front Range to enhance community sustainability and restore fire-adapted ecosystems over a 10-year period.

To identify large areas where treatment needs are of greatest concern, Partnership agencies conducted a large-scale rapid assessment of hazardous fuel conditions along the Front Range based on areas of low to very high hazard, risk, and values. The assessments indicate that approximately 510,000 acres are high priority for treatment; 440,000 acres on National forests, and 70,000 acres on private land.

From 2003-2006, Partnership agencies treated a total of 86,515 acres, primarily within the wildland-urban interface. Treatment decisions were based on county fire plans, Community Wildfire Protection Plans, and other critical planning documents that identified areas with very high hazard, risk, and values.



Kristin Garrison

The Partnership has received national attention as a model for successful collaboration that results in on-the-ground accomplishments.

The Partnership continues to treat high-priority areas with funding received primarily through competitive grants.

The Firewise Council of Southwest Colorado

Forest landowners and forested communities must assume responsibility for stewardship and fire mitigation on their properties and in their neighborhoods.

However, many residents don't believe that they will be affected by fire. Social research revealed that effective communication



Members of a State Wildfire Inmate Team establish a permanent fireline on Denver Water land near Deckers for future prescribed fire projects. The project was done under the auspices of the Front Range Fuels Treatment Partnership.



Boyd Lebeda

The Colorado State Forest Service reduces hazardous fuels on state land in northern Colorado through prescribed fire.

often is the missing link in prompting landowners to take action to mitigate fire hazards. Different methods of community outreach, including word of mouth, are vital to fostering community interest in wildfire hazard mitigation. One successful effort that incorporates these tools is the Firewise Council of Southwest Colorado.

The Firewise Council of Southwest Colorado is a collaborative community effort whose purpose is to mitigate the threat of wildfire to homes, lives, and property. Since its inception in 2003, this grassroots regional initiative has been creating safer communities in La Plata, Montezuma, and Archuleta counties by placing particular emphasis on educational outreach and advocacy, and influencing on-the-ground wildfire mitigation projects. The Council is housed by the San Juan Mountain Association, a non-profit organization, and funded by grants, donations, and volunteer support.

Interested citizens are encouraged to participate in this community initiative comprised of fire departments and districts, the Colorado State Forest Service, the San

Juan Public Lands Center (U.S. Forest Service and Bureau of Land Management), the Office of Community Services at Fort Lewis College, private landowners, homeowners associations, businesses, non-profit organizations, and other interested stakeholders.

The Neighborhood Ambassador program is the Council's key mechanism for information dissemination. The program began in December 2004 to teach local citizens about wildfire issues. Those who receive training share information with their neighbors about emergency preparedness, defensible space, and the importance of wildfire mitigation. The 54 ambassadors currently active in the three counties volunteered more than 2,500 hours in 2007, delivering information about wildfire mitigation to more than 400 residents. As a result of their efforts, more than 85 landowners have done mitigation work on their properties and seven neighborhoods are developing Community Wildfire Protection Plans.

Community Wildfire Protection Plans

Local wildfire protection plans can take a variety of forms, based on the needs of the people involved in their development. A Community Wildfire Protection Plan (CWPP) may address issues such as wildfire response, hazard mitigation, community preparedness, and structure protection.

The process of developing a CWPP can help a community clarify and refine its priorities for the protection of life, property, and critical infrastructure in the wildland-urban interface. It also can lead community members through valuable discussions regarding management options and implications for surrounding watersheds.

As of Nov. 30, 2007, 76 CWPPs were completed in Colorado, and an additional 33 plans were being developed. Most CWPPs cover multiple communities.

2007 Forestry Legislation

In 2007, the Colorado State Legislature passed three important forestry-related bills and a resolution in the first session of the 66th General Assembly. The bills encourage local leaders to use various tools to develop solutions that address forest health issues in their communities.

PROVIDING STATE LEADERSHIP

House Bill 07-1130, Community-Based Forest Restoration

Rep. Dan Gibbs / Sen. Joan Fitz-Gerald

This legislation authorizes the use of up to \$1 million per year over 5 years for a cost-share grant program aimed at community-based forest restoration projects in Colorado. These projects protect critical water supplies and address related forest health challenges in Colorado. The state's contribution to any one project may not exceed 60 percent of the total project cost. Gov. Ritter signed the bill in May 2007.

The \$1 million in grant funding, which was provided by the Colorado Water Conservation Board, will allow the 12 grant recipients to treat 13,420 high-priority acres

to help protect watersheds, communities, and other critical infrastructure throughout Colorado. In addition, grant funds are leveraging more than \$2.8 million of additional cash and in-kind match.

A technical advisory panel evaluated 46 grant applications and recommended projects for funding. The panel was comprised of representatives from the Colorado Department of Natural Resources, U.S. Forest Service, Bureau of Land Management, Colorado State University, Wilderness Society, Rocky Mountain Research Station, a town mayor, and the Colorado Timber Industry Association.

LOCAL OPPORTUNITIES

House Bill 07-1168, Forest Improvement Districts

Rep. Al White / Sen. Joan Fitz-Gerald

This bill authorizes a municipality or county to propose to its voters the formation of a Forest Improvement District through which the municipality or county could tax itself to raise money for priority forest improvement projects. With this bill,



Jonathan Bruno

In 2007, the Coalition for the Upper South Platte, in cooperation with Teller County, operated a slash drop-off site in Divide, Colo., with grant funding provided by HB-1130. Without sites that take tree branches and other wood waste, hazardous fuels reduction projects can be even more costly and difficult.



Katherine Timm

Forest landowners participate in a FireWise workshop in Teller County to learn what they can do to help protect their communities from wildfire and improve the health of their forest lands.

renewable energy and are authorized to lease such lands for renewable energy development. Renewable energy includes biomass, which is defined as “nontoxic plant matter consisting of agricultural crops or their byproducts, urban wood waste, mill residue, slash, or brush.”

ENCOURAGING FEDERAL INITIATIVE

Senate Joint Resolution 07-006, Stewardship Contracting in Colorado

Sen. Joan Fitz-Gerald / Rep. Dan Gibbs

This resolution urged the federal government to be proactive in addressing forest health conditions on public lands in Colorado. Upon its passage in February 2007, SJR 07-006 was sent to Colorado Gov. Bill Ritter and Mark Rey, United States Department of Agriculture Undersecretary for Natural Resources and the Environment, to send a clear message that decision-makers want increased forest management on federal lands in Colorado.

In the bill, the Colorado General Assembly urged the U.S. Forest Service and the Bureau of Land Management to collaborate with the Colorado State Forest Service and other stakeholders to implement up to three long-term stewardship contracts on public lands in the State of Colorado. Stewardship contracts are 10-year contracts designed to accomplish forestry work that allows contractors the opportunity to trade goods such as firewood or logs for services such as forest restoration and/or wildfire risk reduction efforts. Stewardship contracts can help accomplish much needed forestry work despite the state’s low-value timber and wood products, and a lack of locally based forest-products industries.

local communities have an opportunity to address forest health issues while maintaining local control. A local board of directors would be created to manage Forest Improvement District projects, and to oversee and administer funds created by the District.

Forest Improvement District revenues could be used for such purposes as implementing a hazardous fuels project to protect a community. Revenues also could be used to establish financial incentives for landowners to mitigate wildfire risks on their properties, develop Community Wildfire Protection Plans, engage in community outreach efforts, or match funds for grants related to bioheating.

RENEWABLE ENERGY

House Bill 07-1145, Renewable Energy on State Lands

Rep. Michael Merrifield / Sen. Ken Gordon

Directors of the State Board of Land Commissioners will survey their lands to determine the potential to develop

Actions and Strategies for Healthy Future Forests

Following are a range of ideas that could help Colorado's forests and the people who depend on them.

- Remove excess fuels, reduce tree densities in uncharacteristically crowded forests, and use prescribed fire to promote the growth of native plants and reestablish desirable vegetation and fuel conditions.
- Strategically place burning and fuels reduction treatments on the landscape where they are more likely to reduce fire spread toward communities and sensitive watersheds.
- Increase outreach efforts regarding the carbon footprint of locally produced wood versus imported wood.
- Thin and create some openings in areas where fire historically burned more frequently.
- Patch or clear cut areas where fire burned less frequently but more intensely (high country) to create openings.
- Remove dead and dying trees to allow for the growth of the next forest and reduce the fuels available for fire.
- Introduce cutting and/or fire into old aspen stands to mimic natural disturbance.
- Introduce prescribed burning in some beetle-kill areas to protect communities, hasten regrowth, and help protect watersheds.
- Increase support for the development and implementation of Community Wildfire Protection Plans.
- Increase subsidies and incentives for local wood production and utilization. Government subsidies can stimulate economies and benefit Coloradans.
- Provide additional financial and technical support for ongoing



Jen Chase

ecological restoration programs around the state, especially those where past fire suppression has created unnatural stand structures and fire hazards.

- Implement regulations to establish and maintain specific forest densities and fuel loads on forested urban-interface property.

Appropriate Management Response to Wildfires

Appropriate Management Response is a way of responding to wildfires and is an important element in strategic forest management involving an evaluation of current and likely conditions and a response tailored to those conditions. Rather than moving immediately to a full-scale, full-suppression approach, Appropriate Management Response can employ less aggressive control actions. It also can allow fires to provide ecological benefit where fires are not immediately threatening resources.

While implementing an Appropriate Management Response, the full spectrum of tactical options, from monitoring a fire at a distance to intensive suppression actions, are available. During the initial response to any wildland fire, firefighters will manage the fire to achieve the most effective, efficient, and safest possible outcome.

Point protection, shown above in the 2002 Big Fish Fire Use Fire outside Meeker, Colo., is increasingly undertaken in Appropriate Management Response fires. Sprinklers and protective wrapping are examples of point protection.

Conclusion

Public and private forests provide diverse benefits such as clean water, wildlife habitat, wood products, recreation opportunities, range for livestock, and wilderness areas. Increasingly, these forests need to be managed to address contemporary and emerging issues including forest health, wildfire, carbon sequestration, potential climate change, and biomass energy. Management also must ensure the continuance of the broad array of ecosystem services upon which the public's welfare depends. These goals cannot be attained by a hands-off, leave-it-

to-nature approach. They require careful planning, collaboration, and action.

Although the challenges Colorado's forests face may be daunting, they are not insurmountable. They do, however, require consensus and political resolve to fix. Ensuring the continuation of the benefits that our forests provide, and that Coloradans depend on, is critical to Colorado's future. The forests that our children and grandchildren inherit will be shaped by the decisions we make and the actions we take today.

Fall colors comprised of beetle-killed lodgepole pines and aspen trees paint the landscape on Berthoud Pass.



Ingrid Aguayo

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www.tamariskcoalition.org

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“Since both growth and mortality on national forests greatly exceeds harvest resulting in a build-up of fuels, it would be prudent to consider treatments and incentives aimed at fuel reduction and using excess biomass for societally-needed products and energy production.”

– Dr. John A. Helms’ testimony before the Senate Energy and Natural Resources Committee Hearing on Impacts of Global Climate Change on Wildfire Activity in the United States, Sept. 24, 2007

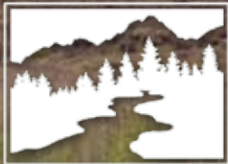




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