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Concerning

Mountain Pine Beetles—Strategies to Protect the West

Madam Chairwoman and Mr. Chairman, thank you for the opportunity to come before these subcommittees and to discuss the impacts of mountain pine beetles on national forests in the West, and strategies for protecting infrastructure and resources from the hazards resulting from millions of acres of dead trees. I am the Regional Forester for the Rocky Mountain Region (Colorado, Wyoming, South Dakota, Nebraska, and Kansas) and with me is Dr. Barbara Bentz, Research Entomologist with the Rocky Mountain Research Station. Thank you for inviting us here today.

The Big Picture

Outbreaks of bark beetles, which are occurring in numerous forest ecosystems across western North America, are the biggest in recorded history.[1] Although western forests have experienced regular infestations throughout their history, the current outbreaks are notable for their intensity, extensive range, and simultaneous occurrence in multiple ecosystems. These beetles are not only attacking forests where they have traditionally been found, but are thriving in some places where widespread infestations have not previously been recorded[2]. The unusual extent of the outbreaks has prompted concern that this loss of trees may impair ecosystem functioning and reduce the ability of our forests to provide future wildlife habitat, to protect watershed quality, to store carbon and to be a source of timber and recreational opportunities. In the western United States, beetle-killed trees cover nearly 8 million acres of the Northern Rockies, the Southwest, and dry forests in the Northwest[3]

The Bark Beetle

Mountain pine beetles (*Dendroctonus ponderosae),* a native insect to North America, have co-evolved over thousands of years with their host trees in western North American forest ecosystems and have been a regular force of change in western North America forest ecosystems. Native insects, including bark beetles, are among the greatest forces of natural change in forested ecosystems of North America. Every few decades, depending on weather and

[1] Bentz, et. al. (2009)Bark Beetle Outbreaks in Western North America: Causes and Consequences, Bark Beetle Symposium, Snowbird, Utah.
[2] Bentz, et. al. (2009)Bark Beetle Outbreaks in Western North America: Causes and Consequences, Bark Beetle Symposium, Snowbird, Utah.
[3] USDA–APHIS. 2008; Western Forestry Leadership Coalition, 2009

local forest conditions, bark beetle populations increase and infest large areas of conifer forest. In doing so, they play an essential role in forest's natural cycle of growth and regeneration.[4]

In a one-year life cycle, bark beetles bore through the bark of pine trees and chew galleries in the inner bark, where they lay their eggs. The beetles carry the spores of blue-staining fungi. As the fungi develop and spread into the tree sapwood, they interrupt the flow of water to the tree crown—and the hatched larvae feed on the tree sapwood. The combined effects of the larvae and the fungi kill the tree. When the larvae grow into adult beetles, they emerge from the bark to attack more trees.[5]

Bark beetle epidemics resulting in acreages of dead trees are natural, cyclic events. Historically, bark beetles have not destroyed entire forests, and can serve as positive forces of change that redistribute nutrients and growing space[6]. Since 2000, the mountain pine beetle affected millions of acres across the Western United States. In 2007, aerial surveys detected about 4 million acres where mountain pine beetles were actively killing trees. *(In 2008, aerial surveys detected 6.42 million acres of forests affected – data is as yet unpublished, but has been gathered by the Forest Service Health and Technology Enterprise team)* The mountain pine beetle epidemic in the central Rocky Mountains is larger than any previously recorded in the area and is expanding rapidly.[7] However, in the absence of tree ring reconstructions or other spatially

[4] Bentz, et. al. (2009)Bark Beetle Outbreaks in Western North America: Causes and Consequences, Bark Beetle Symposium, Snowbird, Utah.
[5] USDA Forest and Disease Leaflet 2, *Mountain Pine Beetle*, 1989, reprinted 1990
[6] Bentz, et. al. (2009) Bark Beetle Outbreaks in Western North America: Causes and Consequences, Bark Beetle Symposium, Snowbird, Utah.
[7] Major Forest Insect and Disease Conditions in the United States 2007. USDA Forest Service, FS-919. March 2009.

detailed information on historical mountain pine beetle outbreaks in Colorado, we do not know if similar outbreaks occurred in the same locations or habitats prior to the past 150 years. [8]

A panel of experts at a recent symposium, "Bark Beetle Outbreaks in Western North America: Causes and Consequences," suggested that two major factors appear to be driving the current outbreaks: 1) forest history and host susceptibility, and 2) changing climatic conditions, especially elevated temperatures and drought.

A "Perfect Storm"

At the landscape scale including lodgepole forests, a mosaic of stand ages and types helps reduce the susceptibility to mountain pine beetles at one time[9]. Over the past couple of centuries, fire exclusion and natural and human caused disturbances such as stand-replacing fires and mining-era timber cutting have contributed to the existence of large areas of old trees that are very similar in age and size.[10] Many lodgepole pine forests are greater than 80 years-old and thus are relatively even-aged, and are therefore highly susceptible to bark beetles and fire. The size of these old trees makes them an ideal food source for the bark beetles. Increasing winter temperatures associated with climate change are fostering increased survival of bark beetle populations. (Sustained cold winter temperatures are needed to kill bark beetles.)[11] The West's changing climate – rising temperatures and decreasing precipitation – has created weather conditions that are ideal for bark beetle outbreaks. Beetles are extremely sensitive to changes in

[8] W.H. Romme, J. Clement, J. Hicke, D. Kulakowski, L.H. MacDonald, T.L. Schoennagel, and T.T. Veblen, *Recent Forest Insect Outbreaks and Fire Risk in Colorado Forests: A Brief Synthesis of Relevant Research*, p. 3.
[9] Koch, Peter (1996) Lodgepole Pine in North America. Forest Products society, volume 1, P 314.
[10] 2006 Report on the Health of Colorado's Forests, available at http://csfs.colostate.edu/pdfs/06fhr.pdf
[11] Bentz BJ, Régnière J, Fettig CJ, Hansen EM, Hayes, JL, Hicke JA, Kelsey RG, Lundquist J, Negrón J, Progar R, Seybold SJ, Vandygriff JC (2008) Climate Change and Western US Bark Beetles: Rapid Threat Assessment. Prepared for the Western Wildland Environmental Threat Assessment Center; http://www.fs.fed.us/wwetac/projects/PDFs/RTA_Bark_Beetle.pdf

temperature[12]. Longer, warmer summers have extended reproductive and growth periods, and fewer cold snaps and higher winter temperatures have allowed bark beetles to survive in winter spring and fall.[13] The prolonged drought across the West has also weakened trees and made them more susceptible to bark beetle attacks. Entire forests full of drought stressed trees, combined with a rapidly expanding bark beetle population combine to fuel exponential beetle population growth.[14]

The primary difference between previous beetle outbreaks and the current epidemic is people now live, work and recreate throughout the lodgepole pine ecosystem. Dozens of communities surrounded by dead trees are at risk of wildfire. This area includes world-class ski resorts such as Vail, Breckenridge, and Winter Park. In addition, the forest products industry infrastructure needed to help address some of the potential public health and safety impacts is nearly nonexistent within Colorado. These important differences along with the scale of infestations, requires approaches to reduce the safety threats to people while ensuring that the forests that replace these dying forests are diverse and resilient to change across the landscape.

I'll use the outbreak in northern Colorado and southern Wyoming as a case study of what the Forest Service is facing with large bark beetle infestations throughout the West. The beetle infestation has spread at a rapid rate over the last ten years. Forest Service entomologists forecast that in the next two to five years, if the infestation continues at this intensity and rate of

[12] Bentz, B.J., J.A. Logan, and G.D. Amman. 1991. Temperature dependent development of the mountain pine beetle (Coleopter:Scolytidae), and simulation of its phenology. The Canadian Entomologist 123: 1083-1094.
[13] Bentz, et. al. (2009) Bark Beetle Outbreaks in Western North America: Causes and Consequences, Bark Beetle Symposium, Snowbird, Utah.
[14] Bentz, et. al. (2009) Bark Beetle Outbreaks in Western North America: Causes and Consequences, Bark Beetle Symposium, Snowbird, Utah.

spread, as much as 90 percent of the mature lodgepole will die. The results of our forest health and protection 2008 aerial survey show that we have some level of infestation in most of the lodgepole in the Rocky Mountain Region, coupled with heavy mortality. It is clear that we can't stop this current infestation. Thinning stands has proved ineffective. Spraying carbaryl, an insecticide, is environmentally safe when properly applied, and can be effective in small, high-value areas such as campgrounds, but is far too expensive to use at the forest scale. Pheromone traps are similarly ineffective in reducing the rate of the spread of such a large infestation. Verbenone, a repelling pheromone, failed in the presence of large beetle populations.[15]

When it became apparent that we could not suppress the infestation, we changed our focus from prevention to reducing risks to public safety and infrastructure to restoration of the forest to include a mosaic of tree species and ages classes that may be more resilient to the stresses of climate change into the future.

Public Hazards

Several critical hazards to public safety are posed by dead trees: local fire hazards in times of drought, threats to water supplies, and falling dead trees along utility corridors, roads, trails, and other infrastructure.

Wildfire Implications

[15] Pogar, R.A. (2005) Five-Year Operational Trial of Verbenone to Deter Mountain Pine Beetle (*Dendroctonus ponderosae*; Coleoptera: Scolytidae) Attack of Lodgepole Pine (*Pinus contorta*) Environmental Entomology 34(6):1402-1407. 2005

The relationship between bark beetle outbreaks and subsequent fire at the larger landscape scale is not yet fully understood[16]. Outbreaks in the recent years have provided scientists with excellent opportunities to conduct studies and gather new information about the role of bark beetles in western forests, but much research remains to be done.

At the stand level, both crown and surface-fire hazards[17] change through time after a bark beetle outbreak in a stand of living trees[18]. The fire hazard is high in the period one to two years after pine trees die since the dead needles are retained in the tree's crown, stocking the canopy with dry, fine fuels that can ignite quickly during weather conditions conducive to fire.[19] As the trees lose their needles, the fire risk in the crowns of the trees decreases as fire doesn't spread through standing dead trees with no needles very quickly. Surface fire hazard increases again as dead trees begin to fall and create a heavy fuel bed with young trees growing up through the tangle of down logs[20]. In dry, hot, windy weather conditions, fires burning in heavy surface fuels can move fast, burn extremely hot, and be very resistant to control[21]. An additional significant

[16] Bentz, et. al. (2009) Bark Beetle Outbreaks in Western North America: Causes and Consequences, Bark Beetle Symposium, Snowbird, Utah.
[17] The term Fire hazard as used here refers specifically to the state of fuels in a given stand – independent of variables such as temperature, wind, and precipitation that influence fuel moisture content and fire occurrence.
[18] Bentz, et. al. (2009) Bark Beetle Outbreaks in Western North America: Causes and Consequences, Bark Beetle Symposium, Snowbird, Utah.
[19] Page, W.; Jenkins, M. 2007. Mountain pine beetle-induced changes to selected lodgepole pine fuel complexes within the intermountain region. Forest Science 53(4):507-518.
Page, W.; Jenkins, M. 2007. **Predicted Fire Behavior in Selected Mountain Pine Beetle–Infested Lodgepole Pine**. Forest Science 53(6):662-674
Hawkes, B. 2008. Effects of the mountain pine beetle on fuels and fire behaviour. *In* Mountain Pine Beetle: From Lessons Learned to Community-based Solutions Conference Proceedings, June 10–11, 2008. *BC Journal of Ecosystems and Management* 9(3):77–83.
http://www.forrex.org/publications/jem/ISS49/vol9_no3_MPBconference.pdf
Jenkins, M., Hebertson E., Page, W. and Jorgensen C. 2008 Bark beetles, fuels, fires and implications for forest management in the Intermountain West. Forest Ecology and Management 254 (2008) 16–34
[20] Bentz, et. al. (2009) Bark Beetle Outbreaks in Western North America: Causes and Consequences, Bark Beetle Symposium, Snowbird, Utah.
[21] Barrows, J. 1951. Fire Behavior in the Northern Rocky Mountains. Station Paper No. 29. USDA Forest Service, Northern Rocky Mountain Forest and Range Experiment Station, Missoula MT. 133 pages

concern is the safety of our firefighters. Large areas of fallen trees limit escape routes for crews, severely limiting our ability to deploy firefighters in these areas[22]. .

Water

The value of water flowing from our public forests is enormous and is a matter of national significance. Forest Service Hydrologists estimate that the forests of the Rocky Mountain Region contain the headwaters for much of the western United States; people in 177 counties in 13 states rely on water from the National Forests of the Rocky Mountain Region. Thirty-three million people live in these counties[23]. Forest Service management analysis indicates that people in Phoenix, Tucson, San Diego and Los Angeles who get their tap water from the Colorado River get one quart of every gallon from the National Forests of the Rocky Mountain Region.[24] The economic value of water flowing from the National Forests of this region numbers in the billions of dollars.[25]

By themselves, insect outbreaks are unlikely to cause erosion or degrade water quality because they do not disturb the forest soil. Unpaved roads and high-severity wildfires can cause much greater effects on runoff, erosion, and water quality. Regardless of whether or not caused by beetle infestations, massive tree mortality can affect watershed quality and quantity[26]. Live trees in high-elevation watersheds provide shade and shelter that help to maintain the winter snow

[22] Alexander, M and Stam, J. 2003. Safety Alert for Wildland Firefighetrs: Fuel Conditions in Spruce Beetle Killed Forest of Alaska. Fire Management Today 63 (2) 25.
[23] US Census 2000

[25] Brown, T.C.; Hobbins, M.T.; Ramirez, J.A. 2008. *Spatial distribution of water supply in the coterminous United States*. Jour. Amer. Water Resoure. Assn. 44(6):1-14. Dec. 2008.
[26] Bentz, et. al. (2009) Bark Beetle Outbreaks in Western North America: Causes and Consequences, Bark Beetle Symposium, Snowbird, Utah.

pack and prevent quick runoff during the spring melt and summer storms. While beetle killed trees do not produce the same level of erosion as a wildfire, large numbers of bark beetle-killed trees within a watershed increase the risk of rapid snow loss and can enhance annual stream flow[27].

A wildfire burning in the heavy fuels close to the soil that result from a large-scale infestation can literally bake the soil, sterilizing the soil and sometimes leaving a water-repellent surface that sheds rain, leading to severe gully erosion, debris flows into reservoirs and streams, and flood damage. We experienced these effects after the Hayman Fire in central Colorado in 2002. After the Buffalo Creek Fire in 1996, Strontia Springs Reservoir filled with sediment that washed off burned areas after heavy rains, and the South Platte River was running brown with mud.

Falling Dead Trees

Falling dead trees are an immediate hazard. In the beetle-infested area of northern Colorado and southern Wyoming, over 900 miles of trails and 3500 miles of roads are lined with dead trees that will fall. More than 21,000 acres of developed recreation sites—such as campgrounds and picnic areas—have hazard trees.

Powerlines and communication sites are also threatened by hazard trees. There are more than six thousand acres of right-of way corridors for authorized transmission and distribution lines in the

[27] Bentz, et. al. (2009) Bark Beetle Outbreaks in Western North America: Causes and Consequences, Bark Beetle Symposium, Snowbird, Utah.

area affected by bark beetle infestation in northern Colorado and southern Wyoming.[28], Forest Service resource specialists have estimated this represents over 1000 miles of transmission lines. Dead trees lining transmission corridors can fall on lines, starting wildfires and disrupting power supplies to cities and towns—potentially for days.

Strategies to Protect the West

The scale of the bark beetle infestation and its threats to public safety and infrastructure requires a concentrated response. We established the Bark Beetle Incident Management Team in 2007 to plan and coordinate mitigation work on the National Forests in Colorado and Wyoming most affected by the outbreak—the Medicine Bow-Routt, Arapaho-Roosevelt and White River.

The team produced a five-year strategic plan in 2007, developed in coordination with collaborative groups such as the Colorado Bark Beetle Cooperative—a group comprising federal, state, local, and non-profit members. The plan identifies over 240 projects over the next six years—over 100 thousand acres of treatments involving timber removal of dead or beetle-infested trees, stewardship projects to remove low-value trees, fuel treatments to reduce wildfire hazard, preventive spraying in high-value developed areas, and removal of hazard trees that can fall on infrastructure and people.[29] Regional funding was refocused to enable a sharp ramp-up in work on the national forests affected by the infestation.

[28] Figure derived from data in the Forest Service Special-Use Database System, Region 2.
[29] 2007 Bark Beetle Incident Implementation Plan (updated in 2009), http://www.fs.fed.us/r2/bark-beetle/index.html
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The three forests treated more than 24,000 acres in 2008. Fourteen thousand of these acres were fuel reduction in the wildland urban interface. Ten thousand acres included fuels treatment outside the wildland urban interface, hazard tree removal for public safety and infrastructure protection, spraying some trees in high-value areas such as campgrounds to keep some green trees on the landscape, and timber sales to capture economic value. . The forests removed hazard trees from 31 recreation sites, and this year the forests are removing hazard trees from an additional 40 sites.

On May 18, 2009 I met with regional utility companies to discuss steps needed to facilitate extensive removal of hazard trees within and outside of the authorized right-of-way of power line corridors. Current permits, easements, memorandums of understanding, and other types of authorizations allow utilities to remove trees that pose an imminent hazard to the safe operation of power line facilities, and I have notified the companies in writing that they may immediately remove them. However, cutting and removal of dead trees in a wider corridor than the currently authorized right-of-way width to provide long-term protection of power lines will require environmental analysis under the National Environmental Policy Act. We have formed an interdisciplinary team, selected a team leader, and started this analysis. We anticipate it will be completed by fall.

We’re making significant strides in protecting infrastructure, using the Colorado Good Neighbor Authority, the Wyden Authority, and the authorities provided by the Healthy Forest Restoration Act to the extent possible. There is much still to do to restore a forested landscape after this infestation of beetles runs its course. This work will encompass engagement with the public to

plan for and implement forest restoration projects that may result in a more diverse mosaic of tree species and ages.

The Next Forest

Future forests in the Rocky Mountain West will likely look very different from the vast landscapes of old lodge-pole pine one sees today. We're thinning some stands and conducting salvage harvest of dead lodgepole while leaving understory spruce and fir to grow. (Lodgepole will regenerate naturally—it doesn't have to be planted in most areas.) We're also conducting aspen regeneration cuts to stimulate aspen clones to produce new, vigorous growth, and we're removing conifers from aspen stands to prevent conversion to conifer type.

The effects of climate change are becoming apparent on the forests and grasslands, [30] and must be factored into our planning. The changing dynamics of current outbreaks make management decisions even more difficult. One important aspect of future forest management will be an evaluation of multiple approaches across a range of spatial scales and outbreak severity levels. Many areas will regenerate naturally following a bark beetle outbreak and require no action. In some areas land managers may want to consider the creation of a diverse forest through modifications to species and age classes at a regional scale. Some ecosystems that have highly susceptible forest conditions may benefit from actions to reduce stand density. This is

[30] CCSP. May 2008. Executive Summary in *Synthesis and Assessment Product 4.3 (SAP 4.3): The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States,* p. 3, P. Backlund, A. Janetos, and D. Schimel, lead authors. A report by the U.S. Climate Change Science Program (CCSP).

particularly true in lodgepole and ponderosa pine stands where research has shown that thinning can reduce susceptibility[31].

There are many areas where we are not removing dead trees due to the following: steep slopes, the area is congressionally designated Wilderness, economic feasibility, or for other reasons. In some areas where we don't undertake active management, spruce and fir are already present as understory saplings and will be released to grow as overstory lodgepole pines fall. Where appropriate, fire may play a more active role on the landscape creating a diverse landscape of openings and ages. In the longer term, a bark beetle outbreak that kills many of the conifers may be beneficial to aspen stands, if aspen clones were present before the beetle outbreak. If aspen is not present, then composition of the forest will not change and the conifers that survive—including smaller trees and less susceptible species—will increase their growth rates and replace the large conifer trees that were killed by beetles.[32]

The Challenge: Timber Industry in Decline

The forest products industry is a primary partner in accomplishing work integral to sustaining the health, diversity, and productivity of the National Forest System, and can help us in our work to mitigate the risks of the bark beetle infestation and moving beyond it to restore our forests. The Forest Service recognizes the impact a depressed market is having on the forest products industry in Colorado and Wyoming, and much of the West. We are working to modify down payment and periodic payment requirements, as well as taking other actions to free up capital for

[31] Fettig, Christopher J.; Klepzig, Kier D.; Billings, Ronald f.; Munson, A. Steven; Nebeker, T. Evan; Negron, Jose F.; Nowak, John T. (2007) The effectiveness of vegetation management practices for prevention and control of bark beetle infestations in coniferous forests of the western and southern United States. Forest ecology and management. 238(1-3): 24-53

[32] W.H. Romme, J. Clement, J. Hicke, D. Kulakowski, L.H. MacDonald, T.L. Schoennagel, and T.T. Veblen, *Recent Forest Insect Outbreaks and Fire Risk in Colorado Forests: A Brief Synthesis of Relevant Research*, p. 12.

purchasers. We are carefully reviewing timber sale design criteria to ensure that projects are economically viable. New forest products businesses are starting up. Two new pellet mills in northern Colorado are using beetle-killed trees to produce pellets for wood stoves. Some dead trees are being used for house logs, furniture, and decorative items. These businesses and others that constitute a viable and diverse forest industry complete with a skilled workforce are important in assisting the Forest Service conduct active forest management in an efficient and cost-effective manner.

That concludes my prepared statement. I'll be happy to take any questions you may have.