COLORADO FOREST RESTORATION INSTITUTE

Annual Report 2007

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Summary of Deliverables:

Deliverable from approved FY2007 Workplan	Outcome
Project 1 Capacity Building, Deliverable 1: A peer-reviewed annual report	Present report
Project 2, Outreach products for Colorado Deliverable 1: A CFRI webpage that provides information for application in restoring Colorado forests	http://www.cfri.colostate.edu/index.htm
Project 2, Outreach products for Colorado Deliverable 2: A series of publications	Seven working papers listed in this report, and several other publications
Project 2, Outreach products for Colorado Deliverable 3: A coordinated program of outreach	Short courses and stakeholder interactions listed in this report
Project 3 Fire risk and restoration issues in pinyon-juniper woodlands, Deliverable 1: An updated assessment of historic conditions	White paper published; http://www.cfri.colostate.edu/docs/PJSynthesis.pdf
Project 3 Fire risk and restoration issues in pinyon-juniper woodlands, Deliverable 2: in-the-field collaborations with land managers; a working paper on impacts of treatments in pinyon-juniper woodlands; and 1 short course for land managers	A variety of in-field consultations; working paper published (link); Short courses in La Junta and Durango

Background

Colorado has 23 million acres of forests, with federal lands comprising about 2/3 of the forested area. Over 200,000 private land owners control 9 million acres. Forest landscapes in Colorado are complex mosaics of forest types and ownerships, with nearly 1 million people living in the “red zone” area with high risk of catastrophic fires, largely as a result of unnatural changes in our forests. Direct costs for fire suppression totaled over $200 million since 2000. The total cost of 500,000 burned acres is much greater than the suppression costs alone, including damaged forests, watersheds, communities, and lives. Declining forest health may decrease the diversity of species in Colorado forests, increase the risks of outbreaks of insects and diseases, and reduce the flow of rivers that provide water to all the states of the southwest. These issues led Congress to pass the Southwest Forest Health and Wildfire Prevention Act in 2004, authorizing establishment of forest restoration institutes in Colorado, Arizona, and New Mexico.

The Colorado Forest Restoration Institute (CFRI) was established in 2005 in the Warner College of Natural Resources (WCNR), with the mission to restore the health of Colorado forests and reduce severe wildfires. Our goal is to provide the best-available science in forest ecology, restoration, and management, in ways that are readily usable by the diverse group of land owners and managers in Colorado. CFRI helps federal, state, and private land owners develop and implement the strategies of the Healthy Forest Restoration Act, National Fire Plan, and the Forest Service’s Strategic Plan.

Organization

The Colorado Forest Restoration Institute is a unit within the Warner College of Natural Resources, and also a member of the Southwest Ecological Restortation Institutes (SWERI) chartered by the Governors of Colroado, Arizona, and New Mexico. The Director of CFRI reports to the Dean of the WCNR, and is reponsible for overall operations of the Institute, including budgeting, planning, administration, and generating products.

The activities of CFRI are developed in response to stakeholder discussions, coallated into an annually updated “Colorado Forest Restoration Needs Assessment.” An oversight process has been developed to meet the requirements of the Southwest Forest Health and Wildfire Prevention Act. The USDA Forest Service’s Southwest Regional Forester convenes an Executive Team (with multi-agency state and federal representatives) to approve annual workplans developed in collaboration with another multi-agency Development Team. The CFRI also engages in forest restoration that go beyond the defined responsibilties of the Act, using other funding sources.

2007 Support

Federal funding of $200,000 was provided through the USDA Forest Service. The Colorado State Forest Service and Warner College of Natural Resources provided 6 months of support for the Associate Director of Outreach, and 3 months of support for the Director. The Forest Service funding for the FY2007 workplan became available more than halfway through the fiscal year, so actual expenditures (and deliverables reported here) continued into calendar year 2008

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CFRI worked with the Uncompahgre Plateau Project (a place-based collaboration) to develop general goals and objectives for the Uncompahgre Plateau, as well as leading a volunteer effort to determine historical stand structure as a basis for restoration prescriptions. The information gathered by the volunteers will be used by the USDA Forest Service in an EA for the restoration program. CFRI will also collaborate with UPP on developing multi-party monitoring pre- and post-treatment) as the mountainside stewardship project develops.

1. Workshops

A. “Colorado Forest Collaboration Workshop”, February 2007. This first meeting of place-based forest collaboration groups from across Colorado highlighted the experience of the various partnerships; identified indicators of partnership success; explored successes and problems; and developed key ideas that can be adapted for the success of future partnerships.
B. “Woody Biomass Facility Heating Conference”, June 2007 (cosponsored by CFRI). presenting opportunities for using wood as an economical and environmental alternative to non-renewable fossil fuels in facility heating applications. Helped develop the Governor’s New Energy Economy initiative, and featured presentations on biomass harvesting and utilization, wood chip combustion

and heating technologies, sources for financial and technical assistance and a tour of the Boulder County Parks and Open Space biomass heating facility and forestry chipping operations.

C. "Can Forests Meet Our Energy Needs? The Future of Forest Biomass in Colorado", February 2008 (cosponsored by CFRI). Workshop pulled in people from across the Rocky Mountains and provided information on biomass energy issues, including state of current and future developments. Senators Allard and Salazar provided keynote presentations.

2. Training/shortcourses

A. Training course for Colorado State Forest Service foresters, February 2007 and Feb. 2008; including information on forest health, insect issues, and fire (about 30 attendees, 2 day session each year).

B. Issues and Opportunities for Forestry Consultants and Contractors, February 2007; 20 participants learned about a range of current forest issues, including opportunities for developing capacities to implement forest restoration.

C. Semester long course for forestry students in the Warner College of Natural Resources on implement restoration treatments (spring 2007, 8 students), including a project with the town of Blue River to evaluate forest health issues on 1800 acres of town-owned land.

D. Training session on Insuring our Future, for Forest Landowners, Harvesters, Wood Processors, in Salida, Colorado, March 2008. CFRI helped sponsor this gathering of industry, landowners and agency representatives to network and exchange ideas on ways to utilize local timber sale material. A total of 72 people attended this one-day event.

E. Shortcourse: Pinyon Juniper Ecology and Management, May 2008, La Junta. 26 people; repeated in June 2008 in Durango, with 28 participants.

F. Workshop on Making Connections, Granby (June 2008). CFRI cosponsored this gathering of industry, landowners and agency representatives to network and exchange ideas on ways to utilize local timber sale material. 50 people attended this one-day event..

3. Practitioner-focused publications

What's Happening in Colorado's Aspen Forests? Gradual, long-term changes and recent widespread death of aspen trees. A collaborative report from CFRI, the Colorado State Forest Service, and

the USDA Forest Service's Rocky Mountain Region and Rocky Mountain Research. http://www.cfri.colostate.edu/docs/aspen_change.pdf

Historical and Modern Disturbance Regimes of Piñon-Juniper Vegetation in the Western U.S. Piñon-juniper vegetation covers some 100 million acres in the western U.S., where it provides economic products, ecosystem services, biodiversity, and aesthetic beauty in some of the most scenic landscapes of North America. There are concerns, however, that the ecological dynamics of piñon-juniper woodlands have changed since Euro-American settlement, that trees are growing unnaturally dense, and that woodlands are encroaching into former grasslands and shrublands. Yet surprisingly little research has been conducted on historical conditions and ecological processes in piñon-juniper vegetation, and the research that does exist demonstrates that piñon-juniper structure, composition, and disturbance regimes were very diverse historically as well as today. This working-paper was developed by more than a dozen scientists across the West highlights areas of broad agreement as well as those requiring more site-specific information. http://www.cfri.colostate.edu/docs/P-J_disturbance_regimes_short%20synthesis_5-07.pdf

**Historical and Modern Disturbance Regimes, Stand Structures, and Landscape Dynamics in Piñon--Juniper Vegetation of the Western US."* This is a white-paper providing the full, detailed background from the collaborative assessment summarized in the working paper above. http://www.cfri.colostate.edu/docs/PJSynthesis.pdf

Forest Restoration Guidelines in Ponderosa Pine on the Front Range of Colorado. A working paper from CFRI and CSFS, providing a state-of-knowledge foundation for forest managers, in part adapted from work at ERI in Flagstaff.
http://www.cfri.colostate.edu/docs/guidelines_web.pdf

Ponderosa Pine Photo Series. A photo guide for appraising downed woody masticated fuels in interior ponderosa pine forests on the Colorado Front Range. A visual guide to help in planning restoration prescriptions (from CFRI, CSFS, and Front Range Fuel Treatment Partnership). http://www.cfri.colostate.edu/docs/Ponderosa_Pine_Photo_Series_Final.pdf

Kennedy Gulch Prescribed Burn Fuel Modeling and Smoke Management. The Kennedy Gulch prescribed burn demonstrated the wide variety of fuel loading found on masticated areas. This working paper documented smoke management aspects for forest managers (from CFRI, CSFS, and Front Range Fuel Treatment Partnership).
http://www.cfri.colostate.edu/docs/Fuel_Modeling_and_Smoke_Management.pdf

**Reducing Barriers to Use of Prescribed Fire in Privately Owned Forests"* A white paper exploring the full range of issues that could be addressed to increase the use of fire on private lands.
http://www.cfri.colostate.edu/docs/Barriers_to_prescribed_fire.pdf

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Floyd, M.L., W.H. Romme, D.D. Hanna, M. Winterowd, D. Hanna, and J. Spence. 2008. Fire history of piñon-juniper woodlands on Navajo Point, Glen Canyon National Recreation Area. Natural Areas Journal 28(1):26-36.

Raffa, K.F., B.H. Aukema, B.J. Bentz, A.L. Carroll, J.A. Hicke, M.G. Turner, and W.H. Romme. 2008. Cross-scale drivers of natural disturbances prone to anthropogenic amplification: the dynamics of bark beetle eruptions. BioScience 58:501-517 (doi:10.1641/B580607).

Kashian, D. M., W. H. Romme, and C. M. Regan. 2007. Variation in quaking aspen dynamics and decline in the northern Colorado Front Range, U.S.A. Ecological Applications 17:1296-1311.

Binkley, D. 2008. Age distribution of aspen in Rocky Mountain National Park, USA. Forest Ecology and Management 255:797-802.

4. Other interactions with stakeholders

Associate Director for Outreach Bob Sturtevant served on the Front Range Fuels Treatment Roundtable (2007-2008)

Montrose field trips, working with the Uncompahgre Plateau Project to develop restoration goals and objectives, and a Mountainside Stewardship approach to forest restoration (May, November 2007; April, June, August 2008)

Discussed forest health issues with staff at Rocky Mountain National Park (Jan. 2007)

Participation in USFS-sponsored workshop in Tucson to identify and prioritize the major research needs related to forests, fire, insects, and climate change in the western U.S. (Feb. 2007)

Presentation to Club 20 (a western slope community/business organization) in Grand Junction (March 2007)

Participated in meeting with Boulder County Commissioners about forest restoration issues (March 2007)

Field tour and visit with managers of pinyon-juniper woodlands in south-central New Mexico to learn more about their ecosystems and to share findings and conclusions of the PJ synthesis projects (March 2007)

Participated in Albuquerque on developing restoration principles for pinyon-juniper vegetation in New Mexico (March 2007)

Participated in SWERI conference on watershed restoration at the Sevilleta Long-term Ecological Research site (Aug. 2007)

Served on panel to evaluate restoration proposals for funding by the Colorado Forest Restoration Program (collaborative projects funded with a total of $1 million; August 2007)

Participated in NPS workshop on Climate Change Impacts on Rocky Mountain National Park (Nov. 2007)

Presentation on Colorado forest health issues for the annual meeting of the Colorado Chapter of the Wildlife Society in Denver (Jan. 2008)

Lectures as part of Rocky Mountain National Park's public lecture series on forest health issues (February, July 2008)

Participated in statewide workshop on Sudden Aspen Decline (SAD) in Durango (Feb. 2008)

Keynote address on Colorado forest restoration for the High Altitude Restoration Workshop in Ft. Collins (Mar. 2008)

Presentation for Loveland Mountain Club on Colorado Forest Health issues (April 2008)

Presentation at USFS Workshop on Historical Ecology, Washington DC (April 2008)

Lecture at Front Range Community College on Community Wildfire Protection (April 2008)

Front Range Fuels Treatment Partnership field trip in Boulder County (May 2008)

Visited the manager of Banded Peak Ranch to discuss development of a forest restoration monitoring program (June 2008)

Consulted with CSU's Center for the Environmental Management of Military Lands on pinyon-juniper woodland issues at the Department of Defense's Pinyon Canyon Maneuver Site (June 2008)

Training in wildfire issues for insurance underwriters (June 2008)

Summary Report: Colorado Forest Collaboration Workshop
Glenwood Springs
February 27-March 1, 2007

Management of public forest lands in the 1970s and 1980s was based in part on intricately designed and engineered planning systems, based on laws, regulations, and computer-based optimization programs. These efforts led to major problems, and a new collaborative approach took shape in the late 1990s. Unlike the detailed designs of earlier schemes, partnerships and collaborations developed without command-and-control plans. The new approach involved dealing with personalities, varied land ownership, and areas of common interest and frequent disagreement; marginal decisions were based on the collective learning from the partners' experiences, rather than forecast years in advance by a computer system. The importance collaborative partnerships is increasing, and the Colorado Forest Collaboration Workshop will shared the experiences of forest partnerships from across Colorado.

Action items endorsed at the workshop:

1. State-level representation is vital to inform the legislature and governor about forest issues. The collaborative groups would support the creation of some sort of advisory council at the state level. The collaborative groups would like to see a state-wide council of some sort that could raise the profile of forest issues in Colorado. Such a council is being discussed by Jeff Jahnke, Brian McPeek, and Tom Fry; the collaborative groups support this idea, and would like to be engaged in the development.

2.   More interactions among collaborative groups would be very useful. Key goals would include:
   - A. One-day workshops on special topics; we should develop the first education/skills workshop for the fall of 2007, focusing on either the developing the economics for expanding restoration work, or the economics of supporting collaborative groups.
   - B. We should use the place-based focus of the collaborative groups for a rotating (annual?) series of meetings among the groups. Some recurring themes could be:

     What are we learning from our experiences on the ground? How can we use this new learning to build into larger projects? Field trip to kick the dirt, see what worked and what didn't. What are the risks and how do we assess them?

     The first meeting might be hosted in Trinidad by the Culebra Range Community Coalition (if they could); or the Uncompahgre Plateau Partnership in Montrose; or Colorado Mountain College in Leadville (as a forestry forum) .
   - C. An (informal?) advisory group should be set up with one member of each collaborative group, for discussing and developing interactions among groups.

3. Collaboration depends on the flow of information, and we should develop ways for information to flow among the collaborative groups. Ideas include some sort of a listserv (Sam Burns' regional website might handle this; listservs can also be set up through of the "My Fire Communities" feature of the Fire Learning Network.

For more information, contact Dan Binkley, Colorado Forest Restoration Institute, 970 491 6519, dan@cnr.colostate.edu

Table 1. Summary information for forest collaborations in Colorado

Collaboration Group	Contact	Objectives	Date Established	Key Products and webpage
Building Bridges Northwest Colorado Council of Governments	Gary Severson NW CO Council of Governments P.O. Box 2308 Silverthorne, CO 80498 970.468.0295 / fax 970.468.1208	The development and coordination of a process where elected officials, community leaders, and federal land and resource decision level personnel can share information and collaborate with each other regarding multi-jurisdictional policy and direction will enable all jurisdictions to participate in "boundaryless" planning.		Blue River restoration project; Forest fuels reduction project; Social impact assessment for ski area expansion http://www.nwc.cog.co.us/
Coalition for the Upper South Platte	Coalition for the Upper South Platte PO Box 490 Hartsel, CO 80449; Hayman Recovery Assistance Center, PO Box 726 Lake George, CO 80827 800-420-9110; 719-748-0033 719-302-2852 fax	Protect a watershed that covers approximately 2,600 square miles of central Colorado	1998	Collaborative planning Newsletter Volunteer projects http://www.uppersouthplatte.net/
Culebra Range Community Coalition	Tom Perry 719-868-3331 barniranch@aol.com 6614 State Highway 12 Weston, CO 81091	To restore forest health, improve wildlife habitat, reduce risk of unnatural fire, and facilitate small diameter timber based businesses.		Resource inventory Forest health education workshops Fires history study http://www.cooperative conservationamerica.org/
Public Lands Partnership and Uncompahgre Plateau Project	Pam Motley PLP/UPP PO Box 1027 Delta, Colorado 81416 970.249.9677	The Public Lands Partnership strives to be a catalyst, promoting public education and awareness of economic and environmental issues related to public lands, and to provide a local forum for airing different sides of natural resource issues.	1992	Uncompahgre Plateau Project Living History Project Logger Demonstration Project Rancher Habitat Project http://upproject.org/UPP/PLP.html www.UPProject.org

Collaboration Group	Contact	Objectives	Date Established	Key Products and webpage
Front Range Fuels Treatment Partnership	Dave Hessel Colorado State Forest Service 303-635-1597 dhessel@lamar.colostate.edu John Bustos 970-295-6674 jbustos@fs.fed.us	The goal of the strategy is to enhance community sustainability and restore fire-adapted ecosystems through identification, prioritization and rapid implementation of hazardous fuels treatment projects in the Front Range of Colorado.	2003	Collaborative planning Fuels Treatment Cross-Boundary Management Research http://www.frftp.org/
Lake County Forest Project	Jessica Clement 719-486-1420 jclement@cnr.colostate.edu	To provide community understanding of the surrounding forest, to create a Community Wildfire Protection Plan, and to sustain collaborative effort through economic development of forest products.	2002	Community collaboration, and to explore sustainable economic opportunities tied to forests
Northwest Colorado Stewardship	Helen Littrell The Keystone Center 1-800-574-8157, ext. 5825 support@nwcos.org	Seeks to engage a wide diversity of local interests in working together to find solutions to previously intractable natural resource management issues.	2003	integrated fire management plan update of the BLM Resource Mnt plan habitat restoration design http://www.nwcos.org/
Ponderosa Pine Partnership	Carla Harper 970-565-6061 Phil Kemp 970-882-7296 Sam Burns 970-247-7193 260 Center of SW Studies Fort Lewis College 1000 Rim Drive Durango, Co 81301	Improving the condition of ecosystems, and sustaining valuable, small, rural, timber industries necessary for forest restoration	1993	Collaborative planning and management; Adaptive management; Restoration ecology; Small diameter forest products research http://ocs.fortlewis.edu/SWCommunityForestry/
Office of Community Services -Fort Lewis College `	Ken Francis, Director francis_k@fortlewis.edu (970) 247-7310 Sam Burns Burns_s@fortlewis.edu 970-247-7193 260 Center of SW Studies Fort Lewis College 1000 Rim Drive Durango, Co 81301	OCS assists local communities, students, and faculty to improve academic, social, and ecological well-being of the Four Corners region.		Lessons learned from 4-corners project; Biomass networking; Sustainable development; Southwest Community Forestry Caucus; Collaborative Forest Planning; Collaborative Fire Planning; http://ocs.fortlewis.edu/SWCommunityForestry/

Collaboration Group	Contact	Objectives	Date Established	Key Products and webpage
North Park Natural Resources Community Group	Beth Metzger, North Park Natural Res Com Group, P.O. Box 223 Walden, CO 80480 (970) 723-8606 npnrcg@yahoo.com	Working together for the wise utilization of natural resources while creating and sustaining healthy lands and communities and providing opportunities for the people of Jackson County.	2004	Collaborative planning; Small diameter utilization feasibility studies Stewardship contracting
Four Corners Sustainable Forestry Partnership, and Colorado Wood Utilization and Marketing Program	Tim Reader, Colorado State Forest Service, PO Box 7233, Durango, CO 81301, Phone: 970-247-5250 treader@lamar.colostate.edu	The Partnership highlights the linkages between healthy forest ecosystems and healthy communities. It received funding from 1999-2003 by special Congressional request through the USDA, Forest Service Economic Action Programs. General interest in the region in promoting biomass energy	1997	Demonstration Grants Program Evaluation Report http://www.rmrs.nau.edu/fourcornersforests/
Harris Park Fuels Management Project	Greystone Environmental Consultants Attn: Harris Park Environmental Analysis Team 5231 South Quebec Street Greenwood Village, Colorado, 80111 harrispark@greystone.us	The proposed project (which will treat 7000 to 10000 acres) is part of a larger, 38,975-acre interagency effort to address wildland fire hazards across agency boundaries in the Platte Canyon and Elk Creek Fire Protection Districts, from Conifer to Bailey. Treatments could include both mechanical treatment and prescribed burning, and would be expected to begin as early as 2005 continuing for as long as five years.	2004	http://www.fs.fed.us/r2/psicc/spl/harrispark_fuels.shtml
Healthy Landscape Partnership, 8 counties in SW Colorado	John Moore USFS-GMUG 2250 Highway 50 Delta, CO 81416 970-874-6698 jmoore06@fs.fed.us	Under development, with the intent to empower local communities to engage in restoration treatments, using the Partnership as a network	2006	

Collaboration Group	Contact	Objectives	Date Established	Key Products and webpage
Northern Colorado Bark Beetle Cooperative	Jan Hackett Colorado State Forest Service 3843 Laporte Ave. Fort Collins, CO 80523-5060 970-491-7287 Jan.Hackett@ColoState.EDU Gary Severson NW CO Council of Governments P.O. Box 2308 Silverthorne, CO 80498 970.468.0295 / fax 970.468.1208	To develop a comprehensive program to address ongoing and projected forest mortality, and resulting impacts. Partnership with USDA Forest Service, Colorado State Forest Service, counties and communities	2006	Final Assessment Strategy http://www.fs.fed.us/r2/fhm/bbcoop/final_strategy_assessment.pdf; http://www.fs.fed.us/r2/fhm/bbcoop/

Table 2. Matrix of Colorado Forest Collaborative Groups (plus multi-state Quivira Coalition) . PLP = Public Lands Partnership, UPP = Uncompahgre Plateau Project, CUSP = Coalition for the Upper South Platte, Lake CWPP =Lake County CWPP, NCBBC = Northern Colorado Bark Beetle Cooperative, FRFTP = Front Range Fuel Treatment Partnership, CRCC = Culebra Range Community Coalition, QC = Quivira Coalition.

		PLP	UPP	CUSP	Lake CWPP	NCBBC	FRFTP	CRCC	QC
Organization Structure	**501-c-3 designation**	X	X	X				X	X
	Formed by								
	Agencies								
	USFS		X	X	X	X	x		
	BLM		X		X	X			
	other		X		X	X	CSFS,NPS	X	
	Academia					X			
	CSU				X	X	X		
	Ft. Lewis								
	Community (geographical)								
	concerned citizens	X		X	X	X			X
	local govts	X		X	X	X			
	local landowners	X		X	X	X	X		
	local businesses	X			X	X	X		
	single interest groups	X		X		X	X		
	multiple interest groups	X		X		X	X	X	
	agencies/local	X		X	X	X	X		
	local organizations		X (PLP)			x			
	Funded by								
	agencies/govt funding		X	X	X	X	X		
	academia/govt funding		X				X		
	local govts	X		X		X	X		
	individual memberships			X				X	X
	philanthropic grants	X		X					X
	other			X					X
	Governance								
	board election	X		X					X
	appointment		X	X					

consensus		X	X		X	X		
democratic/majority rules	X		X	X			X	
volunteer task force				X			X	

		PLP	UPP	CUSP	Lake CWPP	NCBBC	FRFTP	CRCC	QC
Organizational Focus	**Education & conflict resolution**	X		X	X	X	X		X
	Planning Ecological Restoration								
	site specific	X	X	X	X	X	X	X	X
	landscape level	X		X	X	X	X		X
	Implementing Ecological Restoration								
	site specific	X	X	X	X	X	X	X	X
	landscape level		X	X	X	X	X		X
	Monitoring and Adapting Restoration			X		X	X	X	X
	Projects implemented	X	X	X	X	X	X	X	X
	Address economic viability issues	X		X		X	X		X
Outcomes	**Completed Projects**			X	X	X	X	X	X
	Ongoing Projects	X	X	X	X	X	X	X	X
	Web page			X	X		X	X	X
	Studies and Research Findings			X		X	X		X
	Other outreach products			X		X	X		X
Resources that group has developed and can share (tools and experiences)	**Administrative Tools**								
	Memoranda of understanding			X			X		X
	Service worker contracts			X		X			
	Consulting contracts			X		X			X
	Performance measures			X		X	X		
	Web sites and links			X	X		X	X	X
	Educational Materials				X				X
	CWPP Document				X		X		
	Analysis Tools								
	Habitat modeling								
	Economic modeling			In development					
	Monitoring protocols			In development					X
	& indicators								X
	Surveys --								X
	ecological/wildlife								

	ethnographic/cultural					X			
Resources the group needs	**Administrative**				X	X	X		
	Analysis				X	X	X		
	Financial				X	X	X	X	

Historical Forest Structure on the Uncompahgre Plateau: Informing restoration prescriptions for mountainside stewardship

Prepared by the Colorado Forest Restoration Institute, Colorado State University, Ft Collins, CO 80523
August 2008

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Acknowledgements: The valuable data and insights in this report developed from the collaborative efforts of dozens of people, coordinated through the Uncompahgre Plateau Project (http://www.upproject.org/). We thank everyone who participated in the early discussions, the field trips, the development of restoration guidelines, and especially in the collection of field data.

Background

Change is fundamental to healthy forests. The seasonal cycle of tree growth begins before snows have melted from mountain landscapes, with roots growing to obtain water and nutrients to support the flush of springtime leaves that will provide the sugar to fuel the growth of summertime wood. Changes from one year to the next are typically subtle, often taking decades before we notice how much bigger the trees have grown, or how many small trees died as neighboring trees grew larger. Some years see very rapid changes, when huge numbers of trees die as a result of wind storms, insect or disease outbreaks, and fire. These slow and rapid changes are part of the development of all forests.

Some forest change is very predictable, at a broad scale. We know that young forests can support thousands of trees per acre, but that growth of the dominant trees will suppress the smaller trees, driving gradual thinning of the forest. A group of one thousand young Englemann spruce trees may have only ten surviving trees after 300 years have gone by. Other forest change is completely unpredictable. A rare downslope storm with 100 mile-an-hour winds coming from the east toppled centuries-old spruce-fir forests across thousands of acres in the Routt National Forest in 1997.

Many other types of change in forests fall between extremes of largely predictable and completely unpredictable. We can't predict when a wildfire will occur, but we do know how the fuel structure of a forest will influence fires in relation to various weather conditions. We know that the risk of a major outbreak of spruce bark beetles increases as spruce/fir forests develop old-growth conditions, even though not all old-growth spruce/fir forests will experience major beetle outbreaks.

Forest management and stewardship apply our understanding of these types of ecological changes to develop healthy forested landscapes that are resilient to change while contributing to the human communities that benefit from the forests' production of water, wood, forage, wildlife, recreation, and beauty.

Some of the forests of the Uncompahgre Plateau experienced new sorts of changes in the 19th and 20th centuries. Intensive livestock grazing developed in the late 1800s, particularly after the Utes were forced to leave the Plateau. Large predators were extirpated. Logging was heavy in some areas. These novel changes followed on the heels of an intense wildfire in 1879 that swept across much of the Plateau. Current conditions on the Plateau are a legacy of natural changes as well settlement-related changes, and management decisions about the future forests of the Plateau need to be informed by insights on historical forest conditions.

The Uncompahgre Plateau Project (http://www.upproject.org/) spearheaded an effort to develop forest restoration goals and objectives, with an aim toward enhancing the resiliency, diversity and productivity of the native ecosystem in the Uncompahgre Mesas area of the Uncompaghre Plateau, using best available science and collaboration. The Colorado Forest Restoration Institute (CFRI, http://www.cfri.colostate.edu/) developed this assessment of historical stand structure to provide the background for prescribing forest restoration treatments as part of a mountainside stewardship approach for the Plateau.

Approach

The forests of the Plateau would have shown a wide range of forest structure across the landscape and over time. During most periods, some forests would be recovering from the effects of moderate or severe fire in recent decades while other forests would be shaped by centuries of competitive interactions between trees and impacts of insects and diseases. Ideally we would like to document the variety of forest structures over the past 1000 years across the entire Plateau, but this information doesn't exist. A feasible goal was characterizing the typical forest structures in the late 1800s, realizing that the specific details of any single location and time would not represent all locations and other times. Our approach for the Uncompahgre Plateau was based on a great deal of experience around the Southwest in the detective work of reconstructing historical stand structure (see Allen et al. 2002, Friederici 2003 for general background). For example, Moore et al. (2004) used contemporary clues in 15 ponderosa pine stands to determine forest structure a century in the past. They measured the number and sizes of surviving trees, and used increment cores to determine the past sizes of the living trees. Not all trees survived the century, so stumps, snags, and logs were also measured for the reconstruction. Not all trees present a century ago would leave clues; small trees in particular may have died and decomposed without any noticeable trace. Moore and colleagues examined this potential problem by comparing their reconstructions with actual stand maps (from 1909 to 1913), and they found that about 90% of the trees either survived or left measurable clues that would allow accurate reconstruction.

We chose 1875 as a target year for reconstructing forests on the Uncompahgre Plateau, because we felt that most trees present in 1875 would have left clues detectable in the present, and because this predated the widespread fire of 1879 and the major impacts of settlement. Some major limitations to this approach are highlighted in the text box on the next page.

A total of 26 plots were located on and near 25 Mesa, clustered in 9 locations (Figure 1). Eleven of the plots were placed in stands dominated by ponderosa pine with few other conifers (though some had large amounts of aspen that died within the past few decades), and fifteen were in mixed conifer. We avoided portions of the Mesa without ponderosa pine, including meadows, pure aspen stands, and spruce-fir stands. The plots were 0.5 to 1.0 acres in size (300' to 330' long by 66' to 132' wide). The locations and diameters of living trees were recorded for large trees that predated 1875. Some large trees were younger than 1875, and some small trees established before 1875; in these cases, judgment was made based on tree morphology, and in some cases on tree cores. The location and diameter of stumps, snags, and logs were also recorded, based on whether they appeared to be old enough to have been present in 1875. A guess was also made about how long each stump, snag or log had been dead. All diameters of living and dead trees was projected back to 1875, based on the general trend between diameter and tree age found on two dozen large trees that were cored (tree diameter was reduced by 0.1 inches for each year back to 1875; this is a crude approximation, but in the right ballpark).

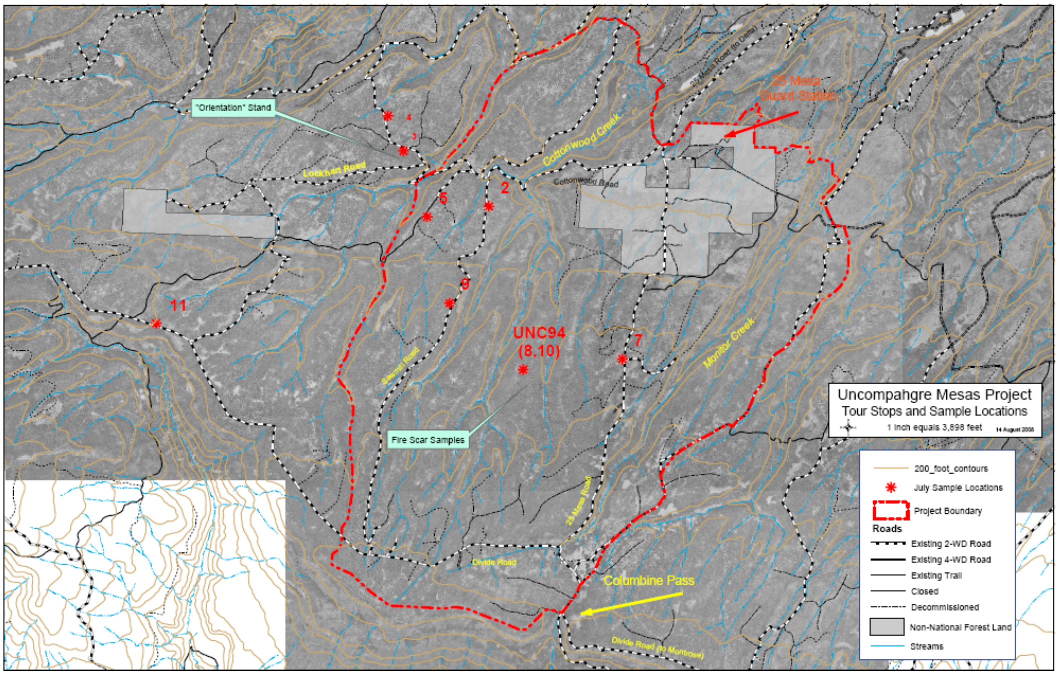


Figure 1. Map of the 25 Mesa unit, with locations of stands sampled to determine forest structure in 1875.

Limitations on Detecting and Using Historical Forest Structure

Our reconstruction of forest characteristics from the late 1800s should be generally useful for developing forest restoration prescriptions, but several fundamental limitations need to be stressed:

1. The condition of a stand at a single point in time is like a single frame from 2-hour movie; the snapshot may be accurate, but it does not trace the sweep of the plot through the movie. The forests of 1875 were not the same as in 1775 (during the Little Ice Age) or 1075. The UP forests in 1875 were shaped in part by previous fires (including widespread fires in 1842), and the fires of 1879 led to dramatic (natural) changes across the Plateau. In particular, we think aspen trees and stands likely expanded greatly after 1880, so an accurate reconstruction from 1905 would likely have far more aspen in the forests of the Plateau than one from 1875. The data from stand reconstruction are only useful if placed into a broader context.

2. We have no local assessment of how well clues about forest structure persist on the Plateau. For moderate-to-large ponderosa pine trees, we expect about 90% of the trees present in 1875 would still be alive or would be detectable as stumps, snags, or logs. We expect some other species would not be as reliable in leaving clues; small to moderate stems of subalpine fir and aspen may decompose well enough in a century that our field sampling missed them. This is such a large problem we did not attempt to estimate historical aspen quantitatively.

3. We sampled a total of 23 plots (one-half to one-acre in size) on 25 Mesa, clustered in 9 areas. This sampling intensity allows us to describe typical conditions for 1875 on 25 Mesa, but some areas of unusually high or low density forests were likely present but not encountered in our sampling.

Results for Ponderosa Pine Type

Ponderosa pine forests show great variation from Mexico to Canada, in density of trees, species composition, long-term dynamics, and fire regimes. Ponderosa forests on the Uncompahgre Plateau in 1875 also showed a range of structures and conditions, especially in relation to elevation. Lower, drier sites developed fairly open stands of ponderosa pine; in some cases the understory may have been dominate by Gambel oak shrubs, where other areas had meadow vegetation (Figure 2). Historical records do not describe how prevalent each type was in the 1800s, and any residual clues would require intensive research to unearth. The landscape patterns probably depended on local fire occurrence and intensity. Brown and Shepperd (2003) provided a preliminary assessment of fire history on the Plateau, and concluded that a fire return interval of 10-15 years may have been common (although not all areas would burn in the same year, and not all stands with a fire would have experience fire across the entire stand). The period of 1780-1840 may have had notably less fire activity than 1500-1780; and major fires spread across much of the Plateau in 1842 and 1879. Our search for fire scars *(fill in results from Jed and Carissa…)*

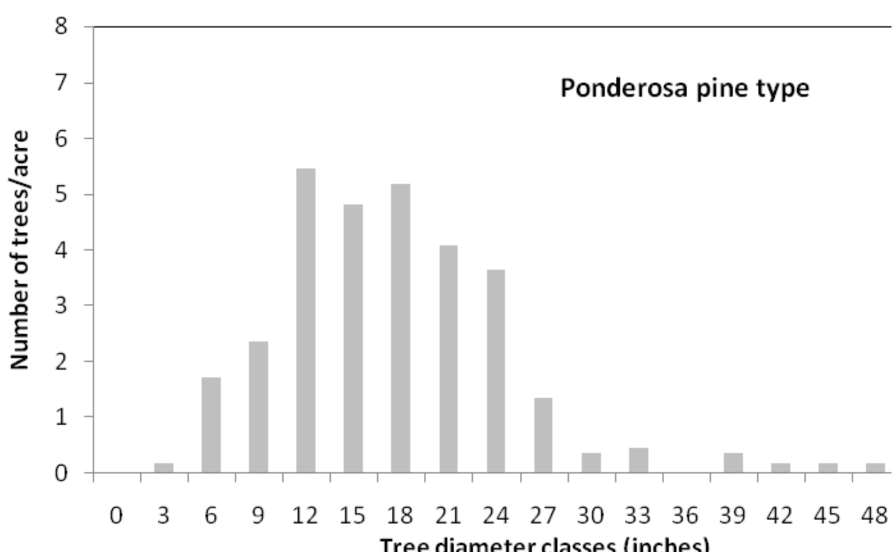
Above the drier ponderosa pine forests, aspen trees were a major component of the forests. Low densities of ponderosa pine trees occurred in clumps, with aspen filling much of the space between pines (Figure 3; see the table at the end of the report for plot totals). In the absence of fire for 125 years, many of the aspen trees died and large numbers of conifers (pine, Douglas-fir, and spruce) have created a midstory and understory in the forests.

Figure 2. In 1875, most (all?) of the lower elevation ponderosa pine forests had low density of trees, clumped within a mosaic of meadows or Gambel oak. We don't know how dominant the meadow type or shrub type was; historical records are not very helpful, and any hidden clues still on the landscape would take intensive research to find.

Figure 3. In 1875, moister sites with ponderosa pine trees had substantial amounts of aspen. The aspen cover in most of these forests has declined, as evidenced by large numbers of decaying aspen logs. Some locations have increases densities of younger pine, Douglas-fir

Our survey of 11 ponderosa pine plots found an average of about 55 ft^2/acre basal (range of 20 to 90 ft^2/acre), with about 55 trees/acre (range of 30 to 90 trees/acre). The actual density of the forests might have been somewhat higher in 1875, as some smaller trees may died and decomposed leaving little clue. This is particularly a problem for aspen trees; given the widespread presence of aspen stems in many ponderosa-pine type stands. The forests in 1875 could have had many aspen trees that died (after the 1879 fire, or more gradually) and decomposed. Across all plots, the average forest structure was

Figure 4. Average diameter distribution of trees in ponderosa pine stands in 1875.



characterized by a few large pines (including some greater than 3 feet in diameter), a relatively even distribution of medium-size trees (1-2 feet in diameter), and relatively few small trees. Again, more small trees may have been present in 1875, leaving no trace to be detected 125 years later.

The spatial arrangement of trees was generally clumped, with trees aggregated at distances of less than about 75 feet. The spatial pattern at larger distances was either random, or uniform. A uniform distribution means that clumps would be spread out uniformly through the stand, but the spacing of the trees themselves would tend to be clumped (see the patterns in Figure X at the back of this report). We note that no plot showed a uniform distribution of trees; a silvicultural prescription to maximize wood growth would space trees uniformly, a pattern without historical precedence. All stands had a clumped or random structure, with meadows, oak patches, or aspen occupying patches of 0.1 to 0.25 acres. The landscapes may have had larger open areas; we anchored our plots in locations with at least some large ponderosa pine trees, so larger meadows in 1875 would not have been included in our survey.

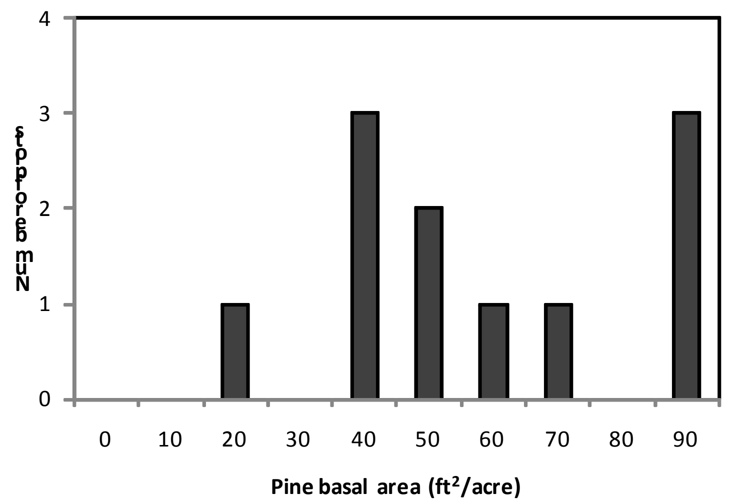


Figure 5. 1875 Distribution of basal area of the ponderosa pine plots (black bars), and the basal area of ponderosa pine trees that occurred in the mixed-conifer plots (gray

Results for Mixed Conifer Type

Most of the mixed conifer type on the Uncompahgre Plateau includes at least some large, old ponderosa pine trees (or stumps). We were particularly interested in knowing whether these stands would have been mixtures of species in 1875, or if the presence of large numbers of other trees (many in younger age classes) indicates a type conversion as a result of absence of fire. The results showed the plots were largely mixed conifer in 1875 (Figures 6, 7), with ponderosa pine comprising only about 40% of the total stand basal area (range of 3% to 83%). Total basal area averaged about 70 ft^2/acre (range of 25 to 130 ft^2/acre), with 60 trees/acre (range of 30 to 110 trees/acre).

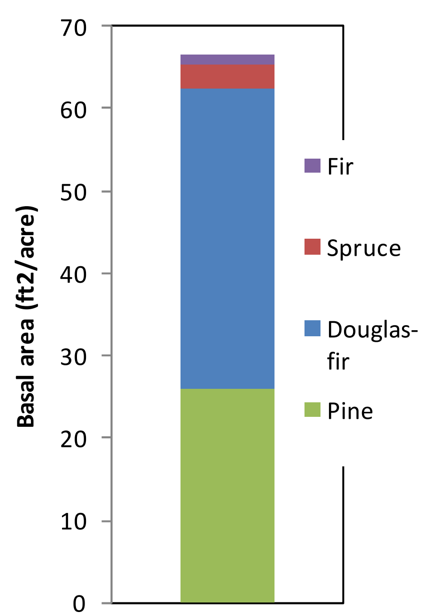


Figure 6. Average basal area by species for the mixed-conifer plots in 1875.

The distribution of tree sizes in 1875 showed a classic inverse-J pattern, for trees >9” diameter (Figure 7). The low number of small trees could represent a decline in establishment of trees in the two decades prior to 1875, but more likely our sampling did not account for small trees that died and decomposed in the past century.

Figure 7. Dry mixed conifer forests in 1875 were typically dominated by Douglas-fir (pictured here), ponderosa pine, and varying amounts of spruce, subalpine fir, and aspen. High variation in species composition, tree density and tree sizes in 1875 are largely consistent with high variation across the landscape now; although low basal area stands, and major

About half of the mixed conifer stands had less than 50 ft^2 of basal area in 1875, not counting for a likely minor contribution of small trees, and perhaps major contribution of aspen trees (Figure 8). The spatial arrangement of trees was also clumped, as in the ponderosa pine type. At distances of less than about 75 ft., trees tended to be clumped. At great distances, tree arrangement was random or uniform (indicating a uniform distance between clumps of trees of about 150 feet).

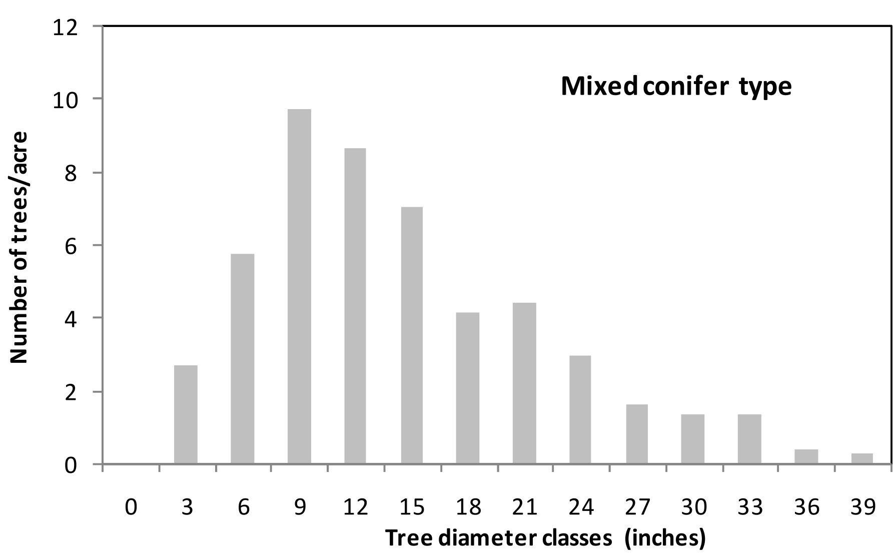


Figure 8. The average diameter distribution in mixed conifer plots showed a classic inverse-J pattern, for trees larger than 6” in diameter. Smaller diameter classes are probably underrepresented in our sampling, as small trees that were present in 1875 may have died and

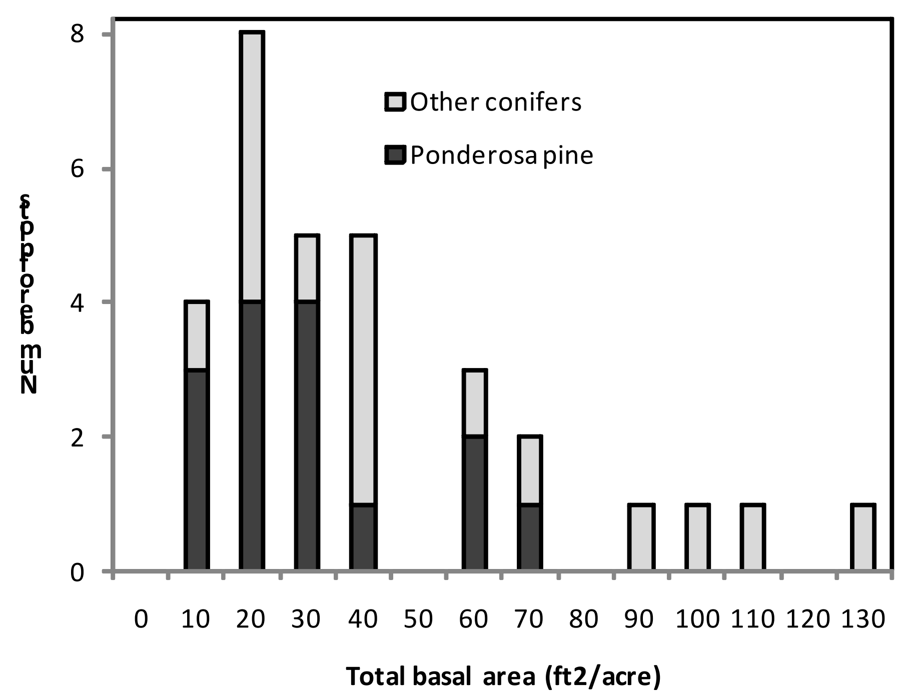


Figure 9. Most mixed conifer forests had less than 70 ft2/acre basal area in 1875.

Risks in the absence of restoration

The forests of the Uncompahgre Plateau will continue to change, even without restoration treatments. Some changes may be slow, such as the gradual (but perhaps accelerating) death of aspens as conifer basal area increases. Others may be rapid, such as sudden aspen decline, and stand-replacing wildfires like those of 1879.

Some key risks should be highlighted. One of the largest is a risks of conversion of ponderosa pine forests to oakbrush, especially following a stand replacing canopy fire that would kill the current pine trees and remove the sources of seeds for forest recovery. This risk declines above the lowest elevations; the presence of extensive aspen clones might lead to a post-fire landscape with major increases in aspen forests at intermediate elevations.

A more subtle risk faced by the current forests is the gradual (but accelerated) death of the remaining old ponderosa pine trees. The ability of large, old trees to withstand drought, bark bettles, and other stresses is lowered by high densities of surrounding, younger trees. A large (and unknown) proportion of the remaining 200+ year-old ponderosa pine trees are likely to die in the next few decades in the absence of major restoration treatments.

A third risk is the decline of aspen trees mixed with dense pine forests. Many stands show the remains of large numbers of aspen trees that have been outlived by old conifers and more-recently established conifers. Restoration treatments that lower conifer density would benefit aspens (where clones are present). The response of aspen may depend substantially on fire return intervals; periods near the

Key points for restoration on the Plateau

- Mission: To enhance the resiliency, diversity and productivity of the native ecosystem in the Uncompahgre Mesas area of the Uncompaghre Plateau, CO using best available science and collaboration.
- Restore ecosystem structure, composition and function. The protection and restoration of ecosystem structure, composition and function encourages viable populations of all native species in natural patterns of abundance and distribution.
- Using passive and active management techniques, vegetation communities should be moved toward conditions that are more consistent with their historical ranges of variability.
- The establishment and maintenance of more natural patterns of vegetation diversity and abundance are integral to ecological restoration.
- Restore ecological processes. Natural processes, including fire, insect outbreaks, and droughts, are irreplaceable shapers of the forest… A key priority should be to restore stands to a more natural condition and to reduce the risk of unnatural crown fires both within stands and across landscapes.
- Preserve old or large trees while maintaining structural diversity and resilience… the largest and oldest trees (or in some cases the trees with old-growth morphology regardless of size) should be protected when feasible from cutting and crown fires, focusing treatments on excess numbers of small young trees where this condition is inconsistent with HRV conditions.
- Treatments should focus on achievement of spatial forest diversity by managing for variable densities.
- Reestablish meadows and open parks.
- Manage herbivory. Grass, forbs, and shrub understories are essential to plant and animal diversity and soil stability. Robust understories are also necessary to restore natural fire regimes and to limit excessive tree seedling establishment. Where possible, defer livestock grazing after treatment until the herbaceous layer has established its potential structure, composition, and function. The partnership will seek to work with the Colorado Division of Wildlife to manage big game populations to levels that will contribute to

shorter end of the historical trends (5-10 years) would probably result in notably less aspen than longer intervals (15+ years). Even large aspen trees are relatively susceptible to stand-replacing fires, but we have little insight on the ability of sapling-size aspens to survive relatively low-intensity surface fires. Investigations will be needed on aspen response to fire-return interval.

In the mixed-conifer forests, the presence of a diversity of tree species almost guarantees moderate or high rates of change. Mortality may be accelerated by high densities of shade-tolerant trees, and susceptibility of large trees to diseases and insects may be high. Tree mortality often causes concern among foresters and the public, but both gradual and rapid rates of tree death can be part of the normal development of a forest landscape.

So what are the risks of not applying restoration treatments in mixed conifer forests? Our stand reconstruction surveys did not provide evidence that current forest conditions are outside the range that would have been common in the 1800s. Current stand basal areas are 50% or more beyond those from the reconstruction; part of this may be real, with greater tree density and size than in the past. However, we could not reconstruct historic aspen basal area, and some of the apparent increase in basal area of conifers may be a natural result of deceasing aspen basal area during normal forest succession. The current range of basal area across the landscape probably overlaps that from the 1800s, though low-basal area stands may be less common now.

Mixed conifer forests may be considered to be extremely resilient. If western spruce budworms kill many of the Douglas-fir trees (alone or in combination with Douglas-fir beetles), surviving spruce or aspen trees ensure the continuation of the forest. A stand replacing fire would result in rapid development of widespread aspen stands. This high ecological resilience does not imply that any and all changes to mixed conifer forests would be equally desirable. A wide range of management options would be feasible for mixed conifer forests, each with varying influences on future forest changes (and risks).

Suggestions for restoration

The goals and objectives for forest restoration on the Uncompahgre Plateau provide several key points for the context of recommendations for restoration treatments (see box).

Ponderosa pine forest type. Very little (if any) of the Plateau's forest of ponderosa pine retain the structure that was most common in 1875. Our stand reconstructions indicated that much of the landscape would have had forests with 20 to 90 ft^2/acre in a clumped distribution, interspersed with small (0.1 to 0.5 acre) meadows. Larger meadows were probably more common as well, though our field work was not aimed to determine changes in meadows. Most of the Plateau's ponderosa pine forests have basal areas beyond the upper limit that was common in the 1800s; and the landscape is almost completely lacking the type of ponderosa pine forest that would have been most common in 1875. We expect that the majority of the ponderosa pine stands on the Plateau will not receive restoration treatments, so we recommend restoration prescriptions aim to restore the forest conditions that are most rare on the Plateau.

Harvesting and restoration treatments should aim to produce relatively low basal area forests (perhaps 20-50 ft^2/acre), dominated by large trees (along with a similar number (but low basal area) of saplings and medium size trees, somewhat clustered (with clump diameters of 20 to 100 feet) with small meadows between clumps. The size of units to be treated should be as large as feasible, as historic disturbances that shaped forests would have occurred at scales of hundreds to thousands of acres. However, entire units need not be treated uniformly; variation in density, size of meadows, and other features can be varied across a unit. In particular, intentional variations in treatment intensity within units will provide great learning opportunities from the monitoring program.

The focus of the prescription should be on creating the desired forest condition, rather than a prescription defining which trees may or may not be removed. Prescriptions should include retention of most or all of the largest trees in treated stands, and removal of most (but not all) the small diameter trees. However, no arbitrary cap on maximum harvest tree size (such as 18" and larger) should be used; size-cap based prescriptions would prevent restoration goals in some stands.

Several issues about the subsequent development of the restored forests will need attention. Retaining the value of the restoration treatments will depend on the re-establishment of a normal fire regime (or the less-likely alternative of frequent mechanical treatments). No single fire return interval would be appropriate. An initial fire within a few years of the harvesting treatment would be useful; subsequent surface fires at 5 to 20 years intervals might be ideal.

The response of Gambel oak to the restoration treatments will need to be monitored, and this monitoring would be most informative if applied to plots that received varying levels of overstory removal and fire intervals.

Mixed conifer forest type. The value and opportunities for forest restoration are different in the mixed conifer portions of the Plateau. Unlike the ponderosa pine type, where very few (if any) acres remain within the historical range of variation, most acres of mixed-conifer forests may be within historical ranges. This major difference results from the inherently broader range of historic variation of mixed conifer forests, and perhaps partially from a longer fire-return interval resulting fewer "missed fires" in the past century.

Even though individual acres may not be outside historical conditions, the patterns at the scale of the Mesa or Plateau may indeed be unusual. Very few acres have burned on the Plateau in the past Century, so the proportion of the landscape in young, post-fire conditions is near zero. Would this have occurred in the past? We know that some fires tended to burn across much of the Plateau (such as the fires of 1842 and 1879), so some uniformity in forest age across large portions may not be unusual.

This wide range of typical forest conditions means that restoration prescriptions can be even more varied than in ponderosa pine forests. Recent post-fire forests are rare, and silviculture aimed at restoring stand-replacing fire could serve restoration goals. In particular, selective harvesting of high-value trees could provide the opportunity for developing ambitious fire breaks that would allow a prescribed fire of stand-replacing intensity.

The diversity of species would also allow prescriptions to foster some species over others. For example, if the future is expected to be hotter and drier, then ponderosa pine or aspen might be favored over blue spruce. We caution that not only is future climate unknown, the changes may not be uniform; a warmer climate could also be associated with a wetter conditions. More importantly we cannot predict how the complex ecological interactions between tree species, their pests and pathogens, and with other tree species. We expect that increasing diversity across the landscape through increased harvesting and burning to create currently rare, post-fire forests. Aiming to favor one particular species in a diverse forest would be risky and perhaps not valuable.

In mixed conifer forests, restoration goals may not constrain forest management choices based on other resource objectives. A management goal might be to increase the portion of the plateau in a young, post-fire condition because this forest type is very rare;

Monitoring

No forest restoration program would be complete without characterizing forest characteristics before treatment, and following the forest changes after treatment. A monitoring program needs to be designed in advance, including clear plans for establishing control areas (receiving minimal treatment), various treatment alternatives (such as broadcast fire with varying levels of prior harvest). CFRI would be anxious to work with the UP Project and the Ouray District to develop and implement pre- and post-treatment monitoring.

Table 1. 1875 forest structure on 25 Mesa.

Plot	All species		Ponderosa pine		Douglas-fir		Spruce		Subalpine fir		Aspen	
	Stems/ acre	Basal area (ft2/ acre)	Stems/ acre	Basal area (ft2/ acre)	Stems/ acre	Basal area (ft2/acre)	Stems/ acre	Basal area (ft2/acre)	Stems/ acre	Basal area (ft2/acre)	Stems/ acre	Basal area (ft2/acre)
1a	32	40	32	40								
1b	46	51	46	51								
2a	19	36	19	36								
2b	19	47	19	47								
2c	36	41	14	18	12	17	10	6				
3a	44	87	44	87								
3b	22	70	20	70			2	2				
3c	14	32	14	32								
4	34	87	34	87								
5a	57	84	57	84								
5b	35	41	35	41								
7a	41	78	17	28	17	9			2		5	12
7b	99	96	10	7	70	85			19	7		
7c	51	85	17	17	34	65			2	3		
7d	70	52	24	15	44	36	2	1				
8a	109	79	64	66	30	14	15					
8b	30	58	8	24	8	30	14	4				
9a	66	128	18	35	48	93	0	0				
9b	53	60	15	25	18	23	11	12				

9c	68	80	48	52	12	21	8	7				
9d	44	69	18	51	26	19	0	0				
UNC 69a	37	24	26	14	4	7	7	2				
UNC 69b	86	33	40	17	7	1	35	12	2	2		
11a	77	107	4	3	65	99	4	6	0	0	4	2
11b	18	37	12	27	6	10						
11c	18	45	4	7	14	37						

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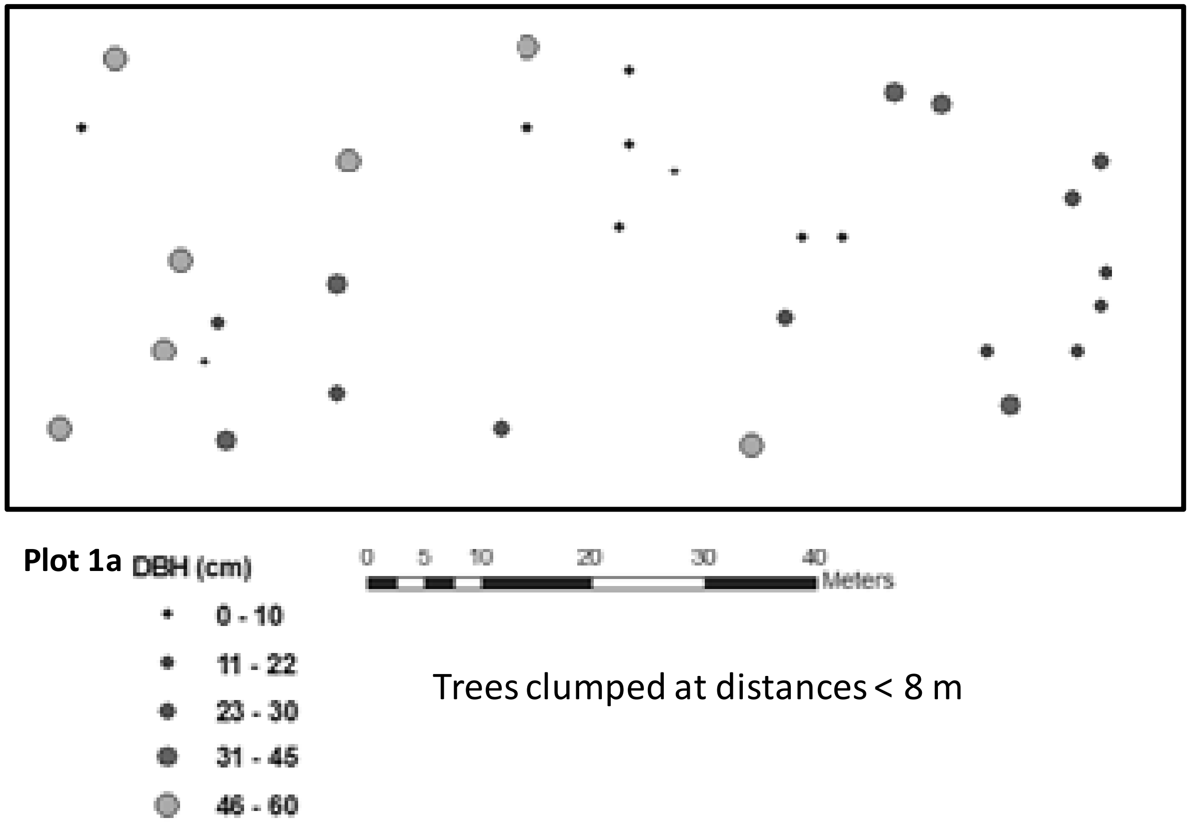
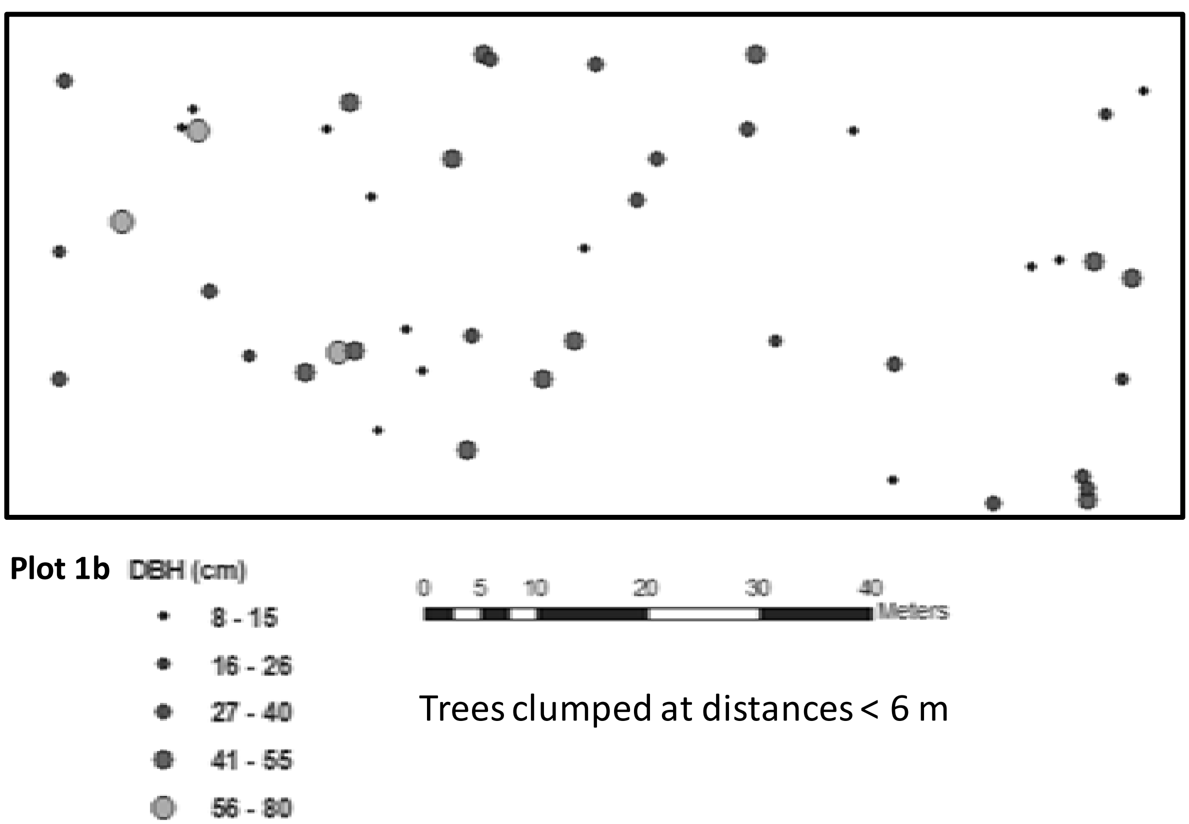
Figure X. Spatial arrangement of trees in ponderosa pine type plots.





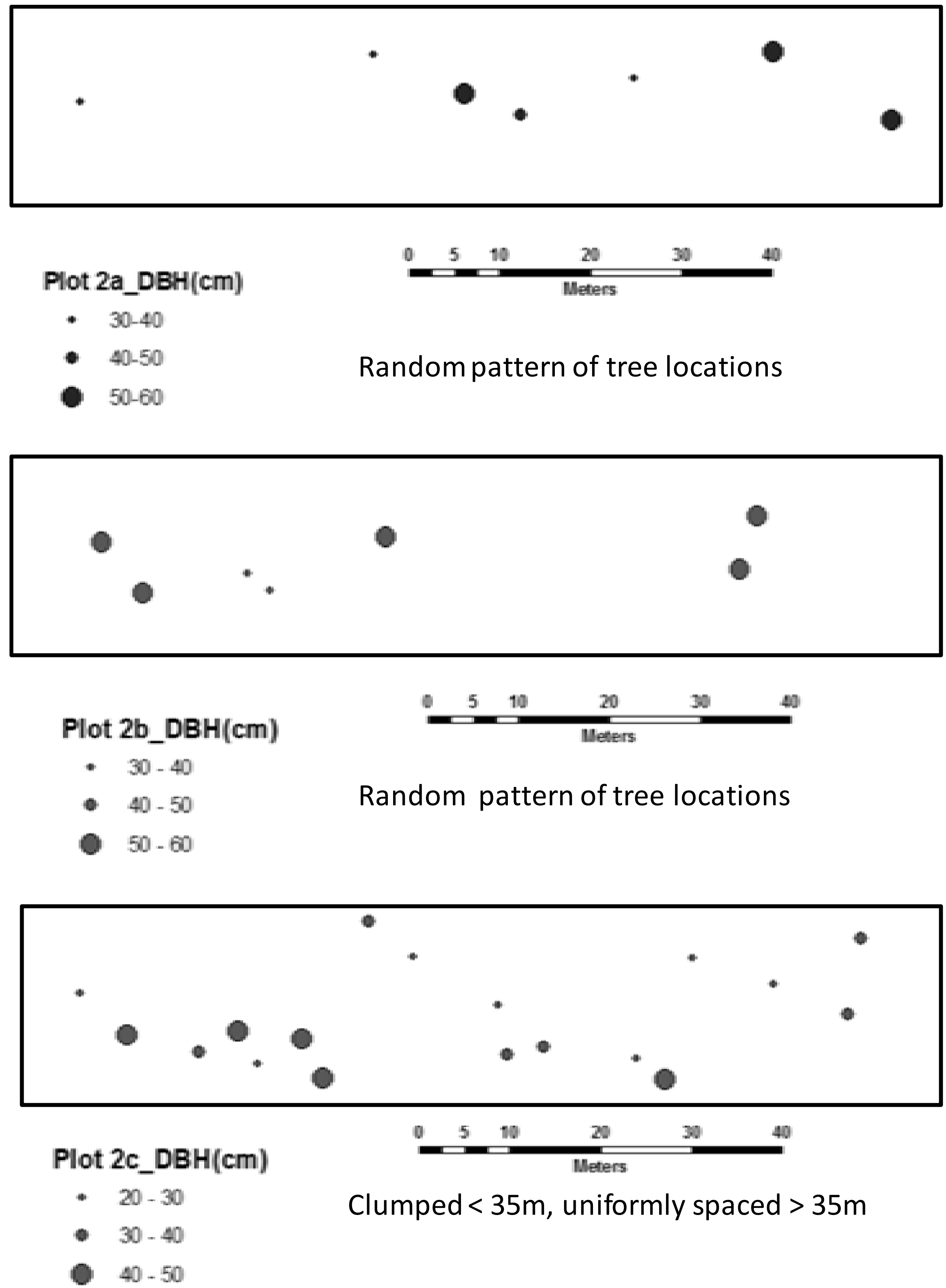


Figure X (continued). Spatial arrangement of trees in ponderosa pine type plots.