Multi-Party Monitoring for the Uncompahgre Plateau Collaborative Forest Landscape Restoration Project

(A living document—periodically updated)

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Updated February 2024 • CFRI-2402

USDA

COLORADO FOREST RESTORATION INSTITUTE
COLORADO STATE UNIVERSITY

Uncompahgre Partnership

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Background on the Uncompahgre Plateau Collaborative Forest Landscape Restoration Project

The Forest Service and partners for the "Uncompahgre Plateau Collaborative Forest Landscape Restoration Project" (Uncompahgre CFLRP) are working to enhance the resiliency, diversity, and productivity of a priority landscape in the Rocky Mountains. The Plateau is located within five counties on the Western Slope of Colorado and includes key watersheds that feed the Colorado River. Cooperative relationships on the Western Slope of Colorado have been developing over the past 15 years beginning with the formation of the Public Lands Partnership and Uncompahgre Partnership (UP) in the mid-1990s. Strong bonds and trust have been created among community members, public land managers, environmentalists, academia, agency researchers, recreation groups, local governments, energy industry, ranchers, timber companies, and the general public. The Uncompahgre CFLRP builds on this history of landscape-scale collaborative stewardship and applies a science-based ecosystem approach to restore vital forest health to the communities of westernColorado.

The Uncompahgre CFLRP is informed by evolving science, creates jobs while supporting local industry, reduces fuels, and ultimately restores a landscape that will support large-scale beneficial fire. Adaptive management based on locally-informed science-based evidence guide our actions, and monitoring is fundamental to improving our work. We aim to eventually reduce forest management expenditures (including wildfire suppression costs); support local industry; and promote new economic opportunities. Thisproject develops active management of forests and rangelands, and creates greater resiliency to natural andman-caused disturbances; this progress will be particularly important if future climates shift toward warmer,drier conditions.

The Uncompahgre CFLRP encompasses 160,000 acres of the Grand Mesa, Uncompahgre, and Gunnison (GMUG) National Forest managed by the USDA Forest Service from 2010 through 2020. These treated areas will influence fire risks across 555,300 acres of the Plateau (out of a total 1.5 million acres). Treatments will include: prescribed burns, mechanical treatments, timber harvesting, invasive species treatments, re- vegetation with native seed, trail and road relocations to reduce sediment, riparian restoration, and improvements for Colorado River cutthroat trout. Multi-party monitoring efforts are proposed for 68,000 acres.

As of 2016, most of the mechanical treatments have been done in the 17,000 acre Uncompahgre Mesas Forest Restoration Project – the first "NEPA-ready" project (projects that have completed environmental analysis requirements under the National Environmental Policy Act) to be implemented under the Uncompahgre CFLRP. Implementation of treatments in the 130,000 acre Escalante Project are ongoing. Wealso have a native seed program with many species of grasses and forbs ready to apply to the landscape; an existing and active invasive species eradication program; a Travel Management Plan; and Fire for Resource Benefit Plan in place We still retain the largest remaining forest products company in the State, Montrose Forest Products, to make this effort economically possible.

Previous NFS restoration efforts on the Uncompahgre Plateau have been limited and concentrated around private inholdings and infrastructure to provide fuels reduction, WUI protection benefits and mule deer habitat enhancement. In addition, several weed management areas have been intensively treated for invasive species, including spotted knapweed, yellow star thistle, and others. In 2004, National EnvironmentalPolicy Act (NEPA) analysis for Spring Creek/Dry Creek Landscape was completed and fulfilled a variety of on- the-ground restoration and vegetation management treatments. These combined treatments, totaling 20,000 acres on National Forest System (NFS), Bureau of Land Management (BLM), and private lands, represent a major success for active management at ambitious scales. The work supported by the Collaborative Forest Landscape Restoration Program (CFLRP) has built on this success to dramatically enhance the future forests, woodlands, and rangelands of the Uncompahgre Plateau on a landscape scale.

Goals and Objectives for the Uncompahgre Plateau Collaborative Restoration Project

Collaborative efforts dating back to the late 1990s have led to the development of a set of six goals for improving the future landscapes of the Uncompahgre Plateau:

1. Enhance the resiliency, diversity and productivity of the native ecosystem on the Uncompahgre Plateau using best available science and collaboration.
2. Reintegrate and manage wildfire as a natural landscape scale ecosystem component that will reduce the risk of unnaturally severe or large crown fires.
3. Restore ecosystem structure, composition and function to encourage viable populations of all native species in natural patterns of abundance and distribution.
4. Preserve old or large trees while maintaining structural diversity and resilience; the largest and oldest tress (or in some cases the trees with old-growth morphology regardless of size) should beprotected when feasible from cutting and crown fires, focusing treatments on excess numbers ofsmall young trees where this condition is inconsistent with Historical Range of Variability (HRV) conditions.
5. Reestablish meadows and open parks and re-establish grasses, forbs, and robust understory communities.
6. Manage herbivory. Grass, forbs, and shrub understories are essential to plant and animal diversity and soil stability. Robust understories are necessary to restore natural fire regimes andto limit excessive tree seedling establishment. Where possible, defer livestock grazing after treatment until the herbaceous layer has established its potential structure, composition, and function. Project partners will work with Colorado Parks and Wildlife to manage big game populations to levels that will contribute to successful restoration treatments.

Specific treatment objectives for the major vegetative communities within the project area as well as examples of proposed types of projects include:

Sagebrush. Restoration treatments are needed to improve the understory, increasing available forage for both wildlife and domestic livestock. The GMUG will work closely with the CDOW to target key Gunnison sage-grouse habitat areas as well as take advantage of biomass potential of pinyon-juniper in reestablishingkey openings. Nearly 2400 acres of sagebrush treatments, mostly with mechanical treatments, have been completed by 2016; additional treatments will continue in the future.

Pinyon-Juniper (PJ). The PJ cover type is currently the largest cover type on the Plateau. A comparison between 1937 and 1994 showed that PJ expanded into areas formerly dominated by shrublands and grasslands, and the density of PJ stands has increased. These changes have decreased the amount of available forage for both wildlife and domestic livestock and have degraded habitat for Gunnison sage- grouse. The landscape restoration project has reduced fuels and enhanced the patchy mosaic of vegetationtypes (and ages) by masticating trees on approximately 5000 acres. The treatment units have also been designed to reduce invasion into other cover types. Additional treatments will continue in the future.

Mountain Shrub (MS) (oak/service berry/mountain mahogany). Mastication projects with some follow-up prescribed burning have been completed on over 12,600 acres to mimic natural fire disturbances, and resultin a patch mosaic with 10 to 15 percent of MS in early seral stage; work on an additional 1500 ac is planned for the future. The resulting mosaic will improve forage and grazing and also limit the size of large crown fires when they occur.

Ponderosa Pine (PP). Restoration in the PP cover type will reduce tree density by cutting large numbers of small-diameter trees relative to larger trees; improve spatial heterogeneity; protect old-growth ponderosa pine; increase long-term structural diversity (within stands and across landscapes); and create fuel conditionsthat reduce the likelihood of uncharacteristically sever fires, by reestablishing the high-frequency, low- intensity historic fire regime. Both commercial and noncommercial treatments will be accomplished with mechanized equipment. Post-harvest prescribed fire will be used as part of our strategy to reintroduce fire as an active part of the landscape. We will design treatments to reduce surface and ladder fuels, create conditions favorable to the growth of grasses, forbs, and shrubs, and then to continue using wildfire as a management tool to maintain these ecosystems. More than 15,200 acres are completed, and more treatments are planned for the future.

Mixed Conifer (MC) (Ponderosa Pine/Aspen/Douglas Fir/Blue Spruce/Engelmann Spruce/Sub-alpine Fir). Restoration treatments in the MC cover types will reduce tree density and develop more open conditions characterized by multi-age structure and multi-species tree composition. Treatments will increase diversity of forest structures within stands, including variety in spatial arrangement of residual trees and developmentof small (0.1 to 0.5 acre) meadows. Because the future is expected to be hotter and drier, treatments will create conditions favorable to Douglas-fir, ponderosa pine, and aspen regeneration over blue spruce. Prescriptions will generally favor the perpetuation of aspen on the landscape by encouraging regeneration. Both commercial and noncommercial treatments will be accomplished with mechanized equipment. Most areas will receive follow-up broadcast burning. The fire regime in the cooler, moister mixed-conifer forest was undoubtedly a less-frequent mixed severity regime; fire in places would creep through mixed conifer forest, consuming little fuels and killing only small trees while in other areas torching and killing groups or patches of large trees. The reduction in surface, ladder and canopy fuels will result in a lower risk of stand- replacing fire and will create the conditions necessary to reinitiate the historically safer, mixed-severity fire regime. Over 5000 ac of restoration projects have been completed by 2016, including the Unc Mesas Projectand treatments along Western power lines; over 6,000 acres of MC treatments are planned for the future.

Aspen. There is an urgent need to treat aspen stands. Only one-fourth of the stands are younger than 90 years which are predominantly 80 to 120 years old and therefore less resilient to Sudden Aspen Decline (SAD). SAD is a relatively recent phenomena, not described by regional insect and disease experts until 2007. Foresters estimate that approximately 37% of the aspen cover type on the Plateau is impacted by SAD; aboutone-fourth of the standing aspen trees on the Plateau are dead. Mortality is having the greatest impact on medium-size trees (3-9" DBH; this combines with the dramatically low rates of establishment of new aspen trees to create a high risk of major reductions in aspen on the Plateau. Young aspen trees are rare across thePlateau, as are young stands of aspen. SAD stands on the Plateau continue to decline, but SAD stands are notcurrently increasing and healthy aspen regeneration is occurring across the landscape. Approximately 7700 ac acres of NFS aspen projects have been implemented, and an additional 3300 are planned. Restoration treatments in other vegetation types will also favor aspen.

Spruce-Fir (SF). The Plateau has very few young spruce-fir forests; historically we expect young (<75 years) stands would have comprised 20 to 70% of the spruce-fir forests of the Plateau (varying in response to major fires across decades). Although any single acre of spruce-fir forest would not be outside the historical range of variation that would have been common for spruce-fir forest, the overall landscape of the Plateau is probably well outside historical conditions. The near-absence of young spruce-fir forests results in a low diversity in age, size and seral conditions, with large implications for wildfire spread and insect/pathogen outbreaks. The potential for biomass utilization and stewardship contracting are excellent, providing both anopportunity for restoring a missing part of the forest landscape and provided funds (from commercial harvests) to help offset the cost of restoration work in the ponderosa pine and mixed-conifer. More than 2600 ac of SF treatments have been implemented, and an additional ~1400 are planned.

Approach to Multi-Party Monitoring

Monitoring is a vital component of our landscape restoration approach. It allows the partners to assess how effective restoration treatments achieve our objectives, and whether any unintended outcomes (such as proliferation of noxious weeds) developed. We have developed a "multi-party" approach to monitoring that ensures high quality information that supports high confidence among all collaborators. The four key pieces of our monitoring approach are:

1. Collaborative development of goals and specific objectives for each major project;
2. Collaborative design of general approaches to monitoring, leading to detailed designs by appropriate experts and stakeholders on behalf of all collaborators;
3. Conducting field measurements; sometimes these are performed by agency personnel as part of normal operations, and other times by combinations of agency personnel, outside experts, and stakeholder volunteers.
4. Synthesis of monitoring data to inform all collaborators about what we have learned, and to support insightful discussions about what we might modify to improve our restoration work.

Our multi-party monitoring approach has evolved as we gain experience working together. Baseline data isrecorded prior to treatments. Monitoring will continue periodically over 15 years, following completion. Permanent transect markers are established to continue monitoring efforts indefinitely. Colorado Forest Restoration Institute (CFRI) will compile, analyze and store the monitoring data.

Many important details will need to be developed and addressed throughout the year, so we will use a Monitoring Jam Session for operational details. The Jam Session will include key Agency personnel, the Colorado Forest Restoration Institute, and other key people needed for particular projects. The Jam Session discussions will be very transparent, with prompt communication to all stake holders about issues, decisions, etc.; everyone's input is welcome at all times, though no one is asked to volunteer for all the time-demandingtasks. Additionally, a winter stakeholder meeting and summer field trip aid in prioritizing the monitoring program of work.

Some projects related to landscape restoration were described in previous years and are now complete, suchas the monitoring of Aspen Browsing that was led by Dan Binkley and Bill Romme (Colorado State University)and Tim Garvey (USFS-GMUG). For 2016, available funding supported work on 16 projects (see other UP documents for details):

- Uncompahgre Mesas Monitoring Plots/Montrose HS Forest Internship Program
- Invasive Species
- Riparian habitat improvement
- Travel Management
- High resolution airborne imagery/Spatial analysis for Unc Mesas and Escalante
- Economic monitoring ofrestoration projects
- Native seed monitoring
- Sanborn Park Fuel Reduction Monitoring Project
- Gambel oak understory monitoring
- Applied Silvicultural evaluation for spruce patch-cuts
- General Land Office survey analysis
- Dominguez Creek Stream temperature monitoring
- Plateau Elk Monitoring
- Delta High School Internship programs
- Norwood High SchoolInternship programs
- North Uncompahgre prescribed burning monitoring

Completed Project: Forest structure on Unroaded Mesas

Leadership people
Steve Hasstedt (CSU and USAF), Dan Binkley (CSU)

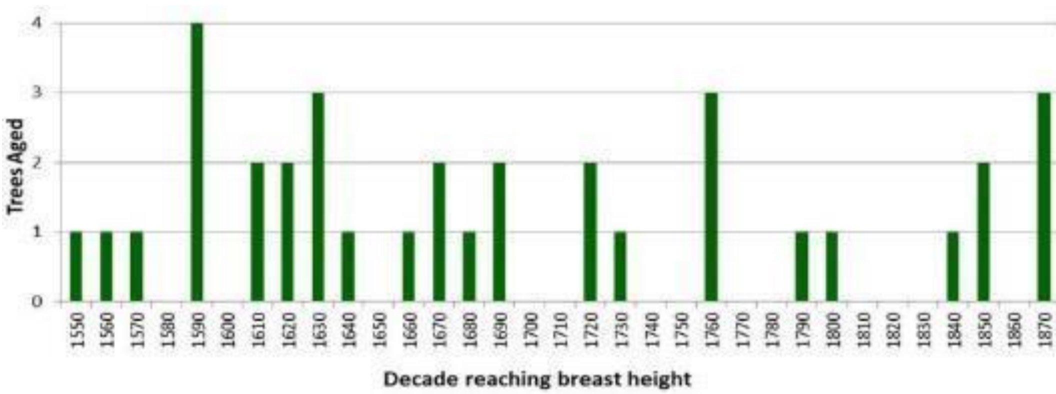
Overall goals and objectives
To determine the current and historical structure of forests on three unlogged mesas (Free, Motley, Goodtimes), including the importance of soil depth in determining fire impacts and the presence of large "legacy" conifers.

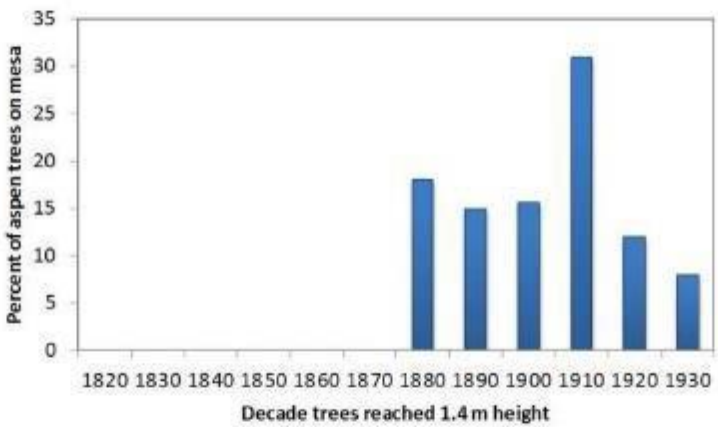
Objectives for 2013 monitoring
Determine ages of trees across the mesas, and develop insights about historical fire timing and severity.

2013 Findings
- 80% of plots on soils less than 6" deep had one or more heritage tree, compared with 20% of the deep soil plots; heritage trees are much more likely to be found on shallow soils.
- Many of the larger trees predate the known fire years of 1842 and 1879, indicating that fire intensity did not reach stand-replacing levels at the scale of the unroaded mesas (~250 acres).
- The current spatial pattern of surviving heritage trees shows that most of the area remained within 50 m of surviving conifers after the 1879 fire. This spatial pattern is important for providing seed for post-fire tree establishment.
- Aspen trees did indicate stand-replacing fire intensity with the 1879 fire (and perhaps earlier fires, but the 1879 fire removed any evidence for aspen stems).

Key questions to be examined
1. Are heritage trees largely restricted to areas of shallow soil, where low biomass accumulation would have led to lower severity fires, allowing higher survival?
2. What was the dominant fire regime for these mesas?

Protocol





Spatial scale of the area under consideration
The ponderosa pine and dry mixed-conifer forests on the eastern side of the Plateau.

General approach
Systematic plots covering the mesas, determining the species, size, and ages of dominant, oldtrees.

Locations to be assessed
Primarily the three unroaded mesas, with some ancillary plots on Sawmill, Love, and KelsoMesas.

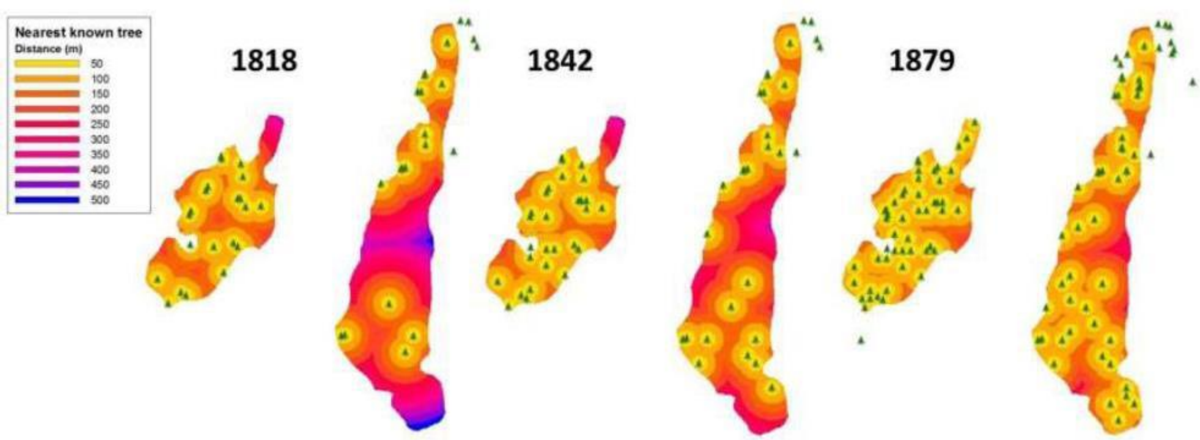
Measurements to be taken at each location Species, size,
and ages of dominant, old trees

People engaged in measuring (agency, volunteers, etc.)

Steve Hasstedt, Dan Binkley

Data management plans
Xcel spreadsheets

Data archiving plans
Copies of the data will be stored on the UP and CFRI websites.



Plan for communicating findings to collaborators, line officers
The results of the study will form the core of Steve Hasstedt's PhD dissertation, and will be published in scientific journals. The results have been shared with UP collaborators as theydeveloped, including a draft report to support the EA for the Escalante Project.

Completed Project: Aspen Browsing

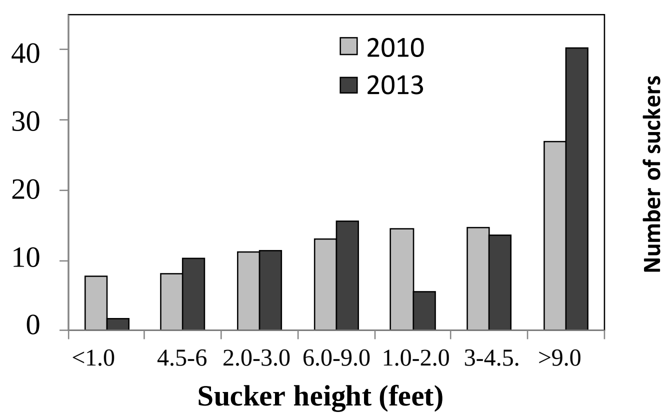
Leadership people
Dan Binkley (CSU), Bill Romme (CSU), Tim Garvey (GMUG)Overall goals and objectives:

Overall goals and objectives
1. Determine how substantial the effects of browsing on aspen regeneration (to tree-size recruitment)
2. Determine to what extent browsing impacts result from cattle versus deer and elk?
3. Determine the pattern of browsing impact across the Plateau, and are there any apparent explanations for the pattern (elk populations within local areas; season of use by elk or cattle;basic site factors (such as elevation, forest type, conifer basal area)
4. Determine how recent patterns of aspen regeneration differ over the course of the past 200years? Does aspen regeneration improve in the future, both inside and outside exclosures?

Objectives for 2013 monitoring
1. Follow up monitoring of aspen regeneration in exclosures set up in 2010

Key questions to be examined
See #1-4 under goals and objectives

2013 Findings
The heights of aspen suckers inside the fenced exclosures did not differ very muchbetween 2010 and 2013 (with 4 growing seasons), even for the locations where browsing on aspen suckers appeared moderate or heavy outside the exclosures (see figure). At this point our conclusion isthat browsing does not appear to hold back height growth on aspen suckers over the majority of the Plateau.



Objectives for 2014 monitoring
Perform a thorough assessment of plots inside and outside the exclosures, as well as thetransect plots through the forest.

2014 Findings
- Browsing intensity varies greatly across the plateau, from almost none to almost 100%
- Browsing is preventing growth into tree-sized aspen in a few places on the plateau, butnot very many places.
- Across the plateau, most aspen stems are increasing in height very slowly or not at all—regardless of whether they are being browsed or not, or whether they are inside exclosures or not. The only places

where growth is relatively rapid is in recent burned areas and clearcuts.

- In recent clearcuts, aspen are somewhat denser and are growing somewhat faster inside exclosures than outside exclosures—but even outside the exclosures, aspen density and growth are adequate to re-stock the stands.

Pattern in height change 2010-2014:	Forest Type	% Browsed in 2012	Other Events
Inside increased, outside decreased	***Pure aspen***	***43***	***n/a***
Inside increased, outside decreased	***Pure aspen***	***43***	***n/a***
Inside increased, outside decreased	***Pure aspen***	***31***	***n/a***
Inside increased, outside decreased	***Pure aspen***	***31***	***n/a***
Inside no change, outside decreased	Pure aspen	58	n/a
Inside increased, outside no change	Pure aspen	86	n/a
Inside increased, outside no change	Aspen - pine	90	n/a
Inside increased, outside increased	***Aspen mixed conifer***	***21***	***Mechanical thinning***
Inside increased, outside increased	***Aspen mixed conifer***	***30***	***Canopy mortality***
Inside increased, outside increased	***Aspen mixed conifer***	***25***	***n/a***
Inside no change, outside no change	***Aspen - pine***	***15***	***n/a***
Inside no change, outside no change	***Pure aspen***	***19***	***n/a***

- Overall, browsing by elk, deer, and cattle is not a threat to aspen regeneration, except in a few select locations. We may need more fire and/or more harvesting if we want to regenerate more aspen on the UP.

Protocol:

Spatial scale of the area under consideration: entire Plateau where aspen trees occur.

<u>General approach</u> Multiple approaches:

A. Plateau-wide survey with prism cruises (in 9 plots/ triangle location) to determine aspen size and age structure.
B. Plateau-wide survey to quantify aspen regeneration (vertex plots of prism triangles)
C. Various exclosures to determine ability of aspen suckers to develop into tree-size classes, in intact stands (pure aspen, aspen-conifer) and SAD-affected stands (pure aspen, aspen-conifer)
D. Exclosures established in the past in clearcuts will be measured to demonstrate the impacts of browsing on aspen regeneration.

<u>Locations assessed</u>

A. Over 60 triangle plots were chosen randomly across the Plateau for aspen size/age/regeneration quantification; report completed in 2011.
B. Twelve exclosure sites, chosen to represent pure aspen and aspen/conifer types, with and without substantial recent death of overstory aspen.

<u>Measurements to be taken at each location</u>

A. Triangle plots: aspen basal area and stem DBH (both living and dead); qualitative aspen regeneration for 9 points of each triangle; measurement of aspen sucker numbers by height class in 3 fixed-area plots in each triangle location.
B. At each of 12 exclosures, measure number of aspen suckers by height classes inside and outside, early and late in the growing season; measure aspen suckers by height class in 6 plots along a

transect extending from each exclosure to document browsing impacts (and if possible, time of browsing).

People engaged in measuring (agency, volunteers, etc.)
Summer 2013: Bill Romme, Dan Binkley

Data management plans
Data entered and analyzed in Excel spreadsheets; synthesized and reported by Dan and Bill

Data archiving plans
Copies of master data sets will be stored with Dan, with Bill, with the Ouray District, and with CFRI.
Copies of photos from each exclosure will be stored in the same locations

Plan for communicating findings to collaborators, line officers
Presentations at annual UP collaborative meeting (2016)
Summary report/CFRI publication with major findings (4 pages) (expected 2017) Scientific journal article in 2017

Completed project: Historical conditions for pinyon/juniper woodlands

Leadership people
Bill Romme (CSU)

Overall goals and objectives
Through a literature review, determine PJ and sagebrush historical patterns and vegetative conditions on the Uncompahgre Plateau, identifying important gaps where follow up field workwill be important.

Objectives for 2013 monitoring
Collect necessary literature and information, begin synthesis.

Key questions to be examined
1. What are the ranges of historical conditions that characterized pinyon/juniper woodlands and sagebrush shrublands?
2. What geographic features influenced the historical differences in community distributions? How much change has occurred in these communities in the past century?
3. What key issues and risk warrant consideration for the future of the Plateau?

2013 Findings
- There is variation in pinyon-juniper and sagebrush vegetation across the Uncompaghre Plateau
- Historical dynamics, in particular the role of fire, drought, and insects, played importantroles in influencing different "types" of PJ and sagebrush vegetation
- There were various kinds and magnitudes of change in the past century in the various "types" of PJ and sagebrush vegetation
- Details suggested priorities for additional information needs

Protocol
Spatial scale of the area under consideration
Lower elevations of the Uncompahgre Plateau.

General approach
Compile and assess available information from a variety of sources.

Locations to be assessed
No field sites

Measurements to be taken at each location
None

People engaged in measuring (agency, volunteers, etc.)
Bill Romme

Data management plans
Not applicable

Data archiving plans
Not applicable

Plan for communicating findings to collaborators, line officers

Results were communicated at collaborator meetings (2014) Results communicated as a report:
Pinyon-Juniper Ecosystems on the Uncompaghre Plateau: Assessment of our current knowledgeand information needs (2014) (https://cfri.colostate.edu/wp-content/uploads/sites/22/2017/12/2014_02_UP-PJ-Assessment-Romme_Feb-2014.pdf)

Completed Project: Citizen Scientist Webpage

Leadership people
Greg Newman, CSU and NREL

Additional People
Russell Scarpino, CSU and NREL

Overall goals and objectives
Develop a website in support of community based monitoring activities among a wide array of stakeholders across the Uncompahgre Plateau. The goals are to:

1. support high school student weed mapping and monitoring activities as desired by the team and that may include Montrose High School (Rusty George, teacher),
2. support community-based citizen science monitoring activities for forest health monitoring as desired by stakeholders, and
3. ensure that all monitoring data are easily entered into the web portal, that they can easily be visualized and areupdated as new data are submitted, and that these data can easily be downloaded in a variety of formats and in such a way to facilitate vetting of these data and eventual submittal to USFS data management systems (e.g., NRIS, Terra Grid, etc.).

Objectives for 2013 monitoring
Ensure basic weed mapping data entry forms are in place for spring 2014 monitoring activities.

Objectives for 2014-2017

- Improve Project Profile performance
- Develop a My Profile page so that individual monitor can see statistics about their contributions Automate data export for common fire prediction software formats

2013 findings and progress

- Current website / project page (a project within the citsci.org system) can be seen here: http://www.citsci.org/cwis438/Browse/Project/Project_Info.php?ProjectID=331
- We have developed the ability for Leigh and/or high school teachers (e.g., Rusty George) to create weed monitoring data entry sheets. At this time it is up to project managers to definewhich species they would like students to map and monitor and to themselves create their own data sheets as needed for such monitoring.
- We added the ability for project managers to be able to define “pre-defined monitoring
- locations” so that project members/participants can easily pick a location they monitoredfrom a drop down of pre-defined locations defined by the project manager.
- We added the ability for project managers to invite project members by entering in the
- email address of trained members; the system automatically register’s the new user, createsa password for them that they may change, adds them as an approved data contributor for the specified project, and sends them an email with their login and assigned password (this works much like an eVite system).
- We improved the performance of the project profile map of all project data to support anunlimited number of observations and draw them all quickly. Our approach was to draw clustered points when total number of observations exceeds 10,000 and then make it so one clustered point becomes many points when the user zooms in on the map.

- We are finishing the design of a customizable data analysis and visualization tool that we hope to be available May 2014 that will enable project managers to create custom analyses/visualization by selecting from the data measurements they have identified for their volunteers to measure and then selecting as dependent and independent variables forgraphs.

2014-2017 findings and progress

- New project page (a project within the citsci.org system) can be seen here: http://www.citsci.org/cwis438/Browse/Project/Project_Info.php?ProjectID=331 and hasbeen optimized for improved performance
- We developed a new My Profile page that provides real-time statistics for volunteer forest health monitors to instantly be able to see the total number of observations, locations they monitor, and number of measurements they have made and submitted to CitSci.org. The page also lists the projects of which they are a member of and offers a variety of privacy andother related options.
- Automated export of data in useful formats for common fire modeling software is not yetcomplete and requires additional funding.

Key questions to be examined
Can trained community members collect and submit quality forest health monitoring data?

Protocol:

Spatial scale of the area under consideration
The Uncompahgre Plateau

General approach
Agile website development approach

Locations to be assessed
Weed monitoring plots (TBD)
Forest health monitoring locations (TBD)

Measurements to be taken at each location
Presence/absence of noxious weeds and percent ocular cover
Forest health monitoring data including fuels, biomass, DBH, etc.

People engaged in measuring (agency, volunteers, etc.)
Volunteers and high school students

Data management plans
Available upon request

Data archiving plans
Available upon request

Plan for communicating findings to collaborators, line officers
Online approaches (transparent and freely open)

Completed project: Landscape Scale Monitoring, Fire Risk

Leadership people

Megan Matonis, Justin Ziegler, Dan Binkley (CSU), Carmine Lockwood, Tammy Randall-Parker(USDA Forest Service)

Overall goals and objectives

1. Enhance the resiliency, diversity and productivity of the native ecosystem on the Uncompahgre Plateau using best available science and collaboration.
2. Reintegrate and manage wildfire as a natural landscape scale ecosystem component that will reduce the risk of unnaturally severe or large crown fires.
3. Restore ecosystem structure, composition and function.
4. Preserve old or large trees while maintaining structural diversity and resilience.
5. Reestablish meadows and open parks and re-establish grasses, forbs, and robust understory communities.
6. Manage herbivory. Robust understories are necessary to restore natural fire regimes and tolimit excessive tree seedling establishment.
7. Evaluate the landscape-scale changes brought about by restoration treatments, including boththe local scale (treated stands) and landscape scales (such as fire propagation potentials).

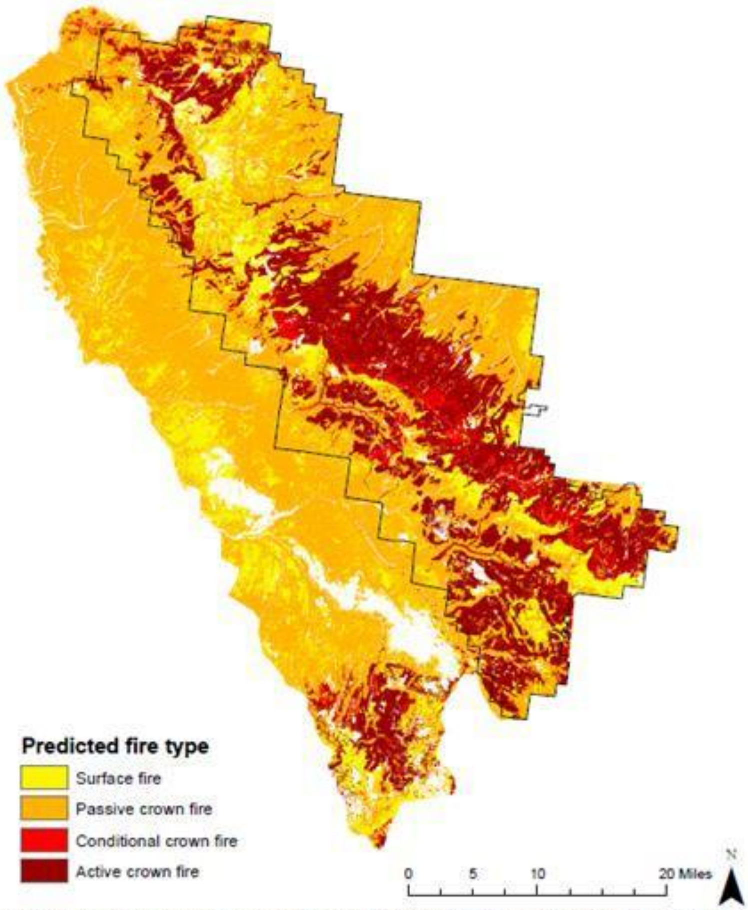
Our initial guiding questions include:

1. How can stand-level restoration treatments, and other stand treatments, be used to interrupt the spread of fires?
2. How extensive are invasive weed problems across the Plateau, and how can their spread be contained (and reversed) across the landscapes?
3. How is vegetation changing in relation to disturbances (treatment, roads, fires, climate change)? We have a lot of interesting data but we are not developing an integrated set oflandscape-scale insights from the information.
4. We know that fire was more frequent and extensive on the Plateau prior to 1880. The UP collaborators agree that an increased role of fire is a key goal for landscape-scale restoration, but how much more fire (and what sorts) do we need?
5. How resilient are the functional processes of the Plateau's ecosystems? Are historical andcurrent conditions sustainable if the climate sifts?
6. What is missing from the plateau? Is the Plateau lacking in young forests? The 2005 GMUG assessment likely has a majority of the information we need, but then we need to create aclear interpretation of this information for our landscape goals.
7. How effective are various treatments at achieving stand-level goals, and at influencing landscape-level issues?
8. What are the implications of our current populations of deer, elk and livestock for the future ecosystems of the Plateau, and how will restoration activities impact the ability of the ecosystems to support animals?

Objectives for 2013 monitoring

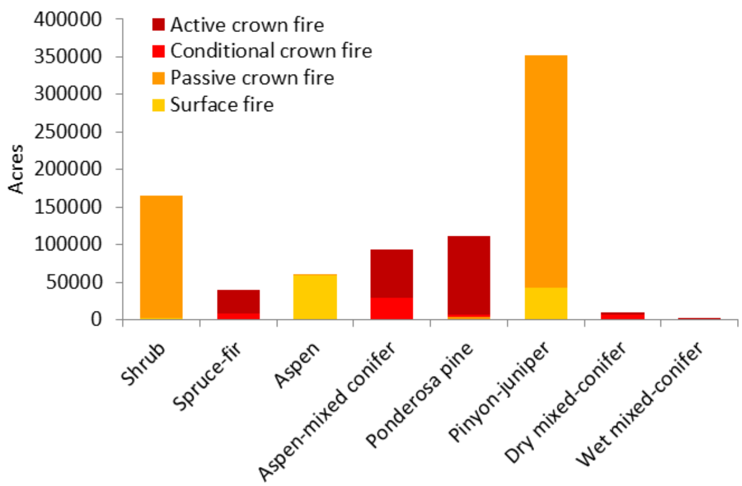
To improve the spatially explicit representation of fire risk for the Plateau using a variety of firemodels.

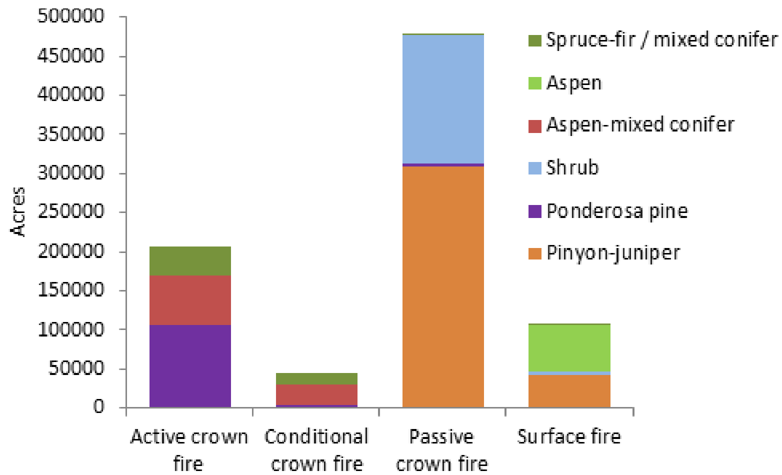
2013 Findings:



Predicted fire behavior across the Uncompahgre Plateau under 97th-percentile weather conditions.

One of the major concerns for landscape scale restoration is the severity of potential fires, andpropagation across the Plateau. The NEXUS model was parametrized to assess the current riskof surface fir and crown fires across the Plateau:





Over 871,200 acres on the Uncompahgre Plateau are capable of propagating active crown fire based on predictions from NEXUS (see Appendix B for details). In addition, about 189,000 acres are predicted for conditional crown fire, 2,022,400 acres for passive crown fire, and 776,400 acres for surface fire. This analysis excluded grasslands, riparian vegetation, and developed portions of the Plateau.

The conditions that the collaborators would like to avoid (and therefore serve as indicators) aresummarized as:

Ponderosa pine and dry mixed-conifer forests:

- Active crown fires are likely across >300 contiguous acres or in patches >30% of burnunits under 90th percentile weather conditions.
  Spatial / temporal scale: Landscape / 10 years
- We are overly cautious with prescribed fires. We fail to burn in over half of the units we mechanically treat, and when we do burn, we burn areas smaller than historical fires (about <500 acres).
  Spatial / temporal scale: Landscape / 10 years
- We implement treatments that fail to reduce crown fire hazards. We leave ladder fuelscovering >30% of the stand, and crown continuity remains high because we didn't create treeless openings (0.25 to 0.5 acres) across the stand.
  Spatial / temporal scale: Stand / 2 to 3 years post-treatment
- Prescribed burning kills >10% of residual ponderosa pine and Douglas-fir trees >8" dbh.
  Spatial / temporal scale: Stand / 1 week
- Post-fire browsing by livestock and wildlife reduces regeneration to less than 50 aspensuckers / acre in stands capable of supporting aspen.
  Spatial / temporal scale: Stand / 3 years

Spruce-fir forests:

- Young, regenerating forests in spruce-fir occupy less than 10% or more than 30% of thearea due to natural or management-induced disturbances (i.e., insects, fire, or cutting).*Spatial / temporal scale:* Landscape / 10 years
- Over 80% of our treatments in spruce-fir forests are very unlike historical disturbances,creating numerous, small forest patches with linear boundaries. We fail to experiment

with alternatives to this approach, such as the judicious use of prescribed fire to create young spruce-fir forests.
Spatial / temporal scale: Landscape / 10 years

- Post-fire browsing by livestock and wildlife reduces regeneration to less than 50 aspen suckers / acre in stands capable of supporting aspen.
Spatial / temporal scale: Stand / 3 years

Piñon-juniper forests and woodlands:

- Prescribed burns in piñon-juniper woodlands behave very unlike historical fires, burning at low severity (<75% mortality) and across small areas (<50 acres).
Spatial / temporal scale: Landscape / 10 years
- Natural start or prescribed fires in piñon-juniper escape into proposed habitat for the Gunnison sage-grouse, burning >5 acres.
Spatial / temporal scale: Landscape / 10 years
- The number and cover of weedy species in unseeded, burned areas and unseeded control areas are allowed to expand unchecked into seeded, burned areas.
Spatial / temporal scale: Stand / 1-5 years post-treatment

All vegetation types:

- We fail to inform future planning efforts with lessons learned from fires on the Plateau and experiences shared by others in similar forest types.
Spatial / temporal scale: Landscape / 10 years
- We implement prescribed burns that escape from control and/or produce smoke exceeding State regulations. *Spatial / temporal scale*: Landscape / 1 week
- We indiscriminately suppress natural start fires without considering benefits to ecosystems, firefighter safety, and avoided suppression costs. We proceed without a rapid case-specific assessment of hazards and risks (e.g., fuel loads, public support, damage to property, etc.)
Spatial / temporal scale: Landscape / 10 years
- Post-fire tree planting homogenizes conditions and sets the stage for dense forests in the future. Less than 30% of the planted area receives micro-site and/or dispersed group planting.
Spatial / temporal scale: Stand / 3-5 years post-treatment
- Restoration treatments fail to prevent continual growth of annual expenditures on fire suppression.
Spatial / temporal scale: Landscape / 10 years

Protocol:

<u>Spatial scale of the area under consideration</u>
The entire Uncompahgre Plateau

<u>General approach</u>
Use existing vegetation maps (LANDFIRE, National Land Cover Dataset, and FSVeg) to parameterize fire models and simulate fire risks. Four fire models were used to compare their predictions: FlamMap, NEXUS, Crown Fire Initiation & Spread (CFIS), and Fuel Characteristic

Classification System. After initial exploration, we focused on model results from NEXUS becausethey fell between the predictions of CFIS and FlamMap and aligned more closely with expert opinions of potential fire behavior on the Plateau. We did not opt for FCCS because LANDFIRE data on FCCS fuelbeds are incomplete for the Plateau, and we lack alternative sources of data tocustomize FCCS fuelbeds.

For the broader issues of landscape-scale monitoring, further discussion is needed. Using fire models to look at potential spread with and without treatments at watershed-scales would befruitful

<u>Locations to be assessed</u>
The entire Plateau for fire modeling, 11 sites in aspen, ponderosa pine, and spruce-fir forests forfuel measurements.

<u>Measurements to be taken at each location</u>N
o new measurements at this time
In 2013, the following measurements were taken:

- Crown base height
- Fuel loads (tons/acre) of duff, litter, 1-hr, 10-hr, 100-hr, and 1000-hr fuels
- Density of ladder fuels (trees with dbh < 4 inches)
- We used the Canopy Fuel Calculator (Cruz et al. 2013) to calculate canopy fuel loads andcanopy bulk density from field data.

We used these fuel measurements to validate fuel models used by NEXUS and test customizedfuel beds in FCCS.

<u>People engaged in measuring (agency, volunteers, etc.)</u>
No field measurements at this time
CFRI undergraduate field techs and FIPS high school interns helped collect fuel load data in2013.

<u>Data management plans</u>
Under development; likely based on using USDA Forest Service FACTS database

<u>Data archiving plans</u>
Under development; likely based on using USDA Forest Service FACTS database; additional dataarchiving with CFRI is likely.

<u>Plan for communicating findings to collaborators, line officers</u>
A broad suite of approaches will be used, including field trips, an annual meeting that coversprogress and develops plans, various reports and outreach products.

Completed project: Monitoring of national indicators

Leadership people
Megan Matonis (CSU), Leigh Robertson (UP), Barry Johnson (USFS), Clay Speas (USFS)

Overall goals and objectives
1. Identify desired and/or undesirable future conditions on the Uncompahgre Plateau for the four national monitoring indicators: wildfire, watersheds, wildlife, and invasive species.
2. Design a monitoring framework to track and report these indicators over the next 10 years.

Key questions to be examined
1. What key features of the landscape does the Uncompahgre Partnership want to restore over the next 10 years?
2. What outcomes do we want to avoid related to wildfire, watershed condition, invasive species, and wildlife habitats / populations?
3. What is the least amount of information we need to effectively monitor our movement away from undesirable conditions and/or towards desired conditions for wildfire, watershed, invasive species, and wildlife indicators?
4. What ongoing monitoring projects can we leverage to address the national indicators? What additional data collection is needed?

Objectives for 2013 monitoring
Create four working groups to tackle each of the four national indicators. Develop draft goals and protocols for the national indicators. Share products with the Uncompahgre Partnership for feedback.

2013 Findings
Wildfire indicators—the wildfire working group used local knowledge of fire behavior and vegetation cover to update LANDFIRE data. They used this updated dataset and the fire behavior model NEXUS to assess crown fire risk across the Plateau. The group also summarized data on the extent of natural, historic fires in ponderosa pine forests to inform undesirable future conditions for wildfire. See more details in the summary of Landscape Scale Monitoring.

The conditions that the collaborators would like to avoid (and therefore serve as indicators) are summarized as:

Ponderosa pine and dry mixed-conifer forests

Conditions we seek to move away from / avoid through management:

Undesirable condition #1: Active crown fires are likely across >300 contiguous acres or in patches >30% of burn units under 90th percentile weather conditions.
Spatial / temporal scale: Landscape / 10 years

Undesirable condition #2: We are overly cautious with prescribed fires. We fail to burn in over half of the units we mechanically treat, and when we do burn, we burn areas smaller than historical fires (about <500 acres).
Spatial / temporal scale: Landscape / 10 years

Undesirable condition #3: We implement treatments that fail to reduce crown fire hazards. We leave ladder fuels covering >30% of the stand, and crown continuity remains high because we didn't create treeless openings (0.25 to 0.5 acres) across the stand.
Spatial / temporal scale: Stand / 2 to 3 years post-treatment

Undesirable condition #4: Prescribed burning kills >10% of residual ponderosa pine and Douglas-fir trees >8" dbh. *Spatial / temporal scale:* Stand / 1 week

Undesirable condition #5: Post-fire browsing by livestock and wildlife reduces regeneration to less than 50 aspen suckers / acre in stands capable of supporting aspen.
Spatial / temporal scale: Stand / 3 years
Spatial / temporal scale: Stand / 3 years

Spruce-fir forests

Conditions we seek to move away from / avoid through management:

Undesirable condition #1: Less than 10% or more than 30% of the area occupied by spruce-fir is in young, regenerating forests due to natural or management-induced disturbances (i.e., insects, fire, or cutting).
Spatial / temporal scale: Landscape / 10 years

Undesirable condition #2: Over 80% of our treatments in spruce-fir forests are very unlike historical disturbances, creating numerous, small forest patches with linear boundaries. We fail to experiment with alternatives to this approach, such as the judicious use of prescribed fire to create young spruce-fir forests.
Spatial / temporal scale: Landscape / 10 years

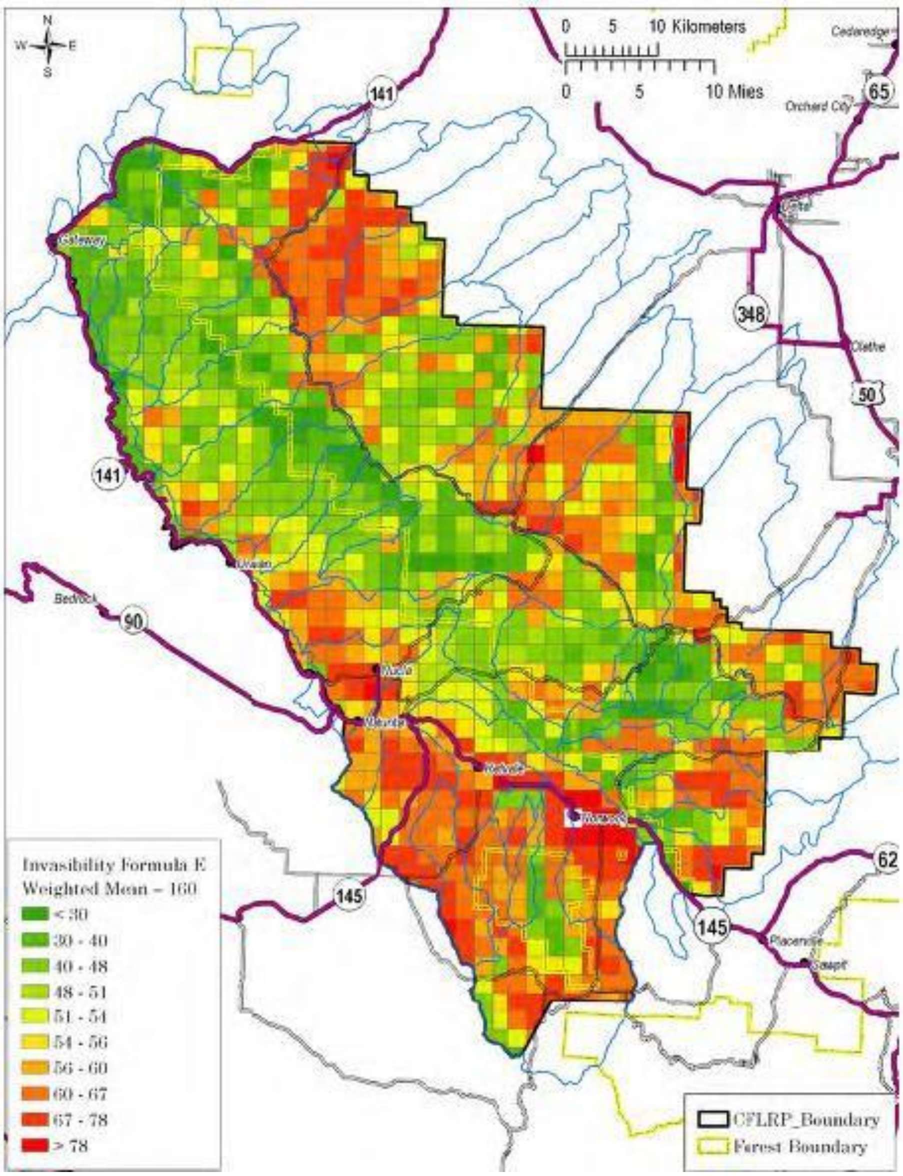
Undesirable condition #3: Post-fire browsing by livestock and wildlife reduces regeneration to less than 50 aspen suckers / acre in stands capable of supporting aspen.
Spatial / temporal scale: Stand / 3 years

Watershed indicator—improving the condition of watersheds is important to the Uncompahgre Partnership, but it is not the top focus of our restoration projects. The watershed working group decided not to use the Watershed Classification and Assessment Tracking Tool (WCATT) because the tool is too coarse to show changes in watershed conditions based on the projects we have planned. They propose summarizing data we already collect regarding riparian restoration, travel management, and forest restoration.

Wildlife indicator—the wildlife working group is proposing a habitat-based approach for the wildlife national indicator. They decided that many wildlife-related goals in the Forest Plan and other GMUG documents are unrealistic and too difficult to monitor (e.g., "Self-sustaining populations of Gunnison sage-grouse thrive on areas of suitable habitat"). Returning forests to more natural, historic conditions should increase the diversity of habitats on the Plateau and benefit bird, ungulate, rodent, and feline species.

Invasive species indicator—the invasive working group created maps with the location of invasive plants and the relative risk of invasion across the Plateau. This information can help us prioritize treatments and focus ongoing monitoring in high-risk locations.

Invasibility index in 2 x 2 km square grids across the Uncompahgre Plateau:



Protocol:

Spatial scale of the area under consideration

Wildlife and wildfire indicators—the entire Uncompahgre Plateau, with data summarized by foresttype.

Watershed and invasive species indicators—the entire Uncompahgre Plateau, with data summarizedfor each HUC6 watershed.

General approach

Wildfire indicators—Use NEXUS and updated LANDFIRE data to monitor changes in crown fire hazards across the Plateau. Assess pre- and post-treatment crowning index for forest restoration projects. Mapthe location of prescribed burns and compare their extent and distribution to data on natural, historic fires in different vegetation types.

Watershed indicator—Summarize data we are already collecting for riparian areas, travel management, and invasive species across the Plateau.

Wildlife indicator—Use pre- and post-treatment monitoring at the stand and landscape scale to informthe wildlife national indictor, as well as data collected on native Cutthroat Trout as part of ongoing riparian monitoring. Historic reconstructions of forest structure and compositions can inform general targets for restoration projects that improve wildlife habitat.

Invasive species indicator—the invasive working group developed an "invasibility index" to identify locations on the Uncompahgre Plateau with the greatest risk from invasive plants. Data on vegetationcover, aspect, slope, elevation, and road density are combined to create a relative score of invasibilityranging from 9 to 98. The group also developed maps of invasive species occurrence using data from the Forest Service and Bureau of Land Management. Species assessed include Russian knapweed, spotted knapweed, whitetop, several invasive thistles, oxeye daisy, hound's-tongue, yellow toadflax, sulfur cinquefoil, and tamarisk.

Locations to be assessed

Wildfire and wildlife indicators—the entire Plateau, with a focus on restoration treatment areas.

Watershed indicator—the entire Plateau, with a focus on areas with decommissioned roads andriparian restoration.

Invasive species indicator—Locations with a high invasibility index and treatment areas.

Measurements to be taken at each location

Wildfire and wildlife indicators—Forest structure (basal area, trees per acre), the spatial arrangementof trees, and estimates of surface fuels.

Watershed indicator—See summary of monitoring for Riparian Restoration, Travel Management,Invasive Species, and Landscape Scale Monitoring.

Invasive species indicator—the location and cover of invasive species.

People engaged in measuring (agency, volunteers, etc.)

High school students with the Forestry Internship Program and Riparian Monitoring Program.Forest and rangeland staff for the Forest Service.
Citizens involved with the Uncompahgre Plateau.
Students and field technicians with the Colorado Forest Restoration Institute.

Data management / archiving plans

Under development; likely based on using USDA Forest Service FACTS database; additional data archiving with CFRI is likely.

Plan for communicating findings to collaborators, line officers

We will summarize data for each of the four indicators as part of the 5-year and 10-year report to the Washington Office of the Forest Service.

Completed Project: Travel management

<u>Leadership people</u>
Loren Paulson

<u>Overall goals and objectives</u>
Conduct monitoring of the rout-by-route travel implementation on the Grand Valley RangerDistrict.

<u>Objectives for 2013-2016 monitoring</u>
Field crews will conduct inspections of all signs placed on existing “system” roads and trails to ensure all routes are marked in accordance with travel management decisions. All non-system routes will be inspected to ensure that previous signage, barriers and/or obliteration efforts arestill in place and effective. Overall, all routes, signs, kiosks and maps will be reviewed to ensurethat travel opportunities and restrictions are clear and concise to the public. Attached is a copyof “Travel Monitoring, Pg. 1” which the crews will complete to document the above objectives.

In addition, district personnel will also conduct visitor contacts and surveys during high use periods such as holiday weekends and throughout the fall hunting seasons. In addition to documenting the amount and type of recreation use the district receives, this survey will also document the district’s efforts towards education and the public’s understanding and opinionsof the current travel management regulations. The second page of the “Travel Monitoring” form as been attached to demonstrate the information that is being collected.

<u>2013-2016 Findings</u>
Overall, the monitoring and surveys completed in 2013 show a continued increase in the public’sknowledge and compliance with existing travel management regulations across the Northern part of the Uncompahgre Plateau.

Travel Management - Daily Diary & Patrol Log

(Front Page) Track daily work accomplishments associated with the implementation of travel management plans.
(Back Page) Documentation of education & enforcement efforts (public contacts) and the responses received.

Daily Diary – Travel Implementation Accomplishments

Unit/General Location: Date: Personnel:

	Non System Routes (Level I - IV decommission)								**System Routes**							**Other**				
Specific Area (Area Description and/or Route #'s)	Total # of Routes Inspected	# of Routes that need Work to reduce impacts	# of Signs (Carsonites) Installed		# of Routes Obscured		# of Barriers Installed		# of System Route Sign Units Inspected	# of Route Signs Installed		# of Travel Mgmt (open to - Closed to) Signs / Placards		# of Devices (gates, posts, etc.) to implement restrictions		Travel Kiosks Installed		Kiosk Maps & Info		# of Incident Reports
			New N	Rplc R	New N	Rplc R	New N	Rplc R		New N	Rplc R	New N	Rplc R	New N	Rplc R	New N	Rplc R	New N	Rplc R	
Comments & Additional Needs:																				
Comments & Additional Needs:																				
Comments & Additional Needs:																				
Comments & Additional Needs:																				
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Comments & Additional Needs:																				
Totals:																				

N = New R = Replaced or Repaired

Note: A parent map(s) should be kept on each unit to track the total routes/signs monitored to reduce double counting.

Protocol:

<u>Spatial scale of the area under consideration</u>

The Northern portion of the Uncompahgre Plateau encompassing approximately 250,000 acres of lands administered by the Grand Valley Ranger District.

<u>General approach</u>

Crews will inspect and document efforts involved in the signage and other on-ground travel management devices throughout the year. District personnel will also document visitor contacts to assess the public's awareness and opinions of existing travel regulations.

<u>Locations to be assessed</u>

All routes (system and non-system) across the Northern portion of the Uncompahgre Plateau.

<u>Measurements to be taken at each location</u>

Document existing conditions and efforts taken to correct any deficiencies, i.e. replaced sign, installed barrier, etc.

<u>People engaged in measuring (agency, volunteers, etc.)</u>

The district "OHV crew" are primarily responsible for the on-ground monitoring and correction of signs and other necessary work on routes. The entire district recreation staff are involved with conducting visitor contacts and documentation of those efforts.

<u>Data management plans</u>

Continue to review monitoring reports and provide an overall total of achievements such as the total number of routes inspected, number of signs replaced and number of visitors contacted.

<u>Data archiving plans</u>

All data recorded throughout the year will be kept at the Grand Valley Ranger District Office.

<u>Plan for communicating findings to collaborators, line officers</u>

A summary of the information collected for each year will be provided as necessary.

Patrol Log – Field Contact Documentation

General Location:______________ Date:__________ Personnel:______________

Specific Location Route # - Mileage	Contact Type		Total # of PEOPLE	# PPL From:			Types & Number of Equipment					Was TM Info provided? (Discuss or handouts)		Were Person(s) previously aware of Travel Regs?				Did person(s) provide feedback to Travel Regs?		If Travel Mgmt feedback provided… Response to existing TM regulations		
	Camp	Field		CO	Out of State	Full Size Veh's	UTV	ATV	MO	MB	HO	Y	N	Y	N	Some what S	Not determined ?	Y	N	Positive P	Negative N	Undecided or Neutral U
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Completed Project: High resolution airborne imagery for the Escalante Project area

Leadership people
Dan Binkley and Michael Lefsky (CSU), John Musinsky (NEON-AOP)

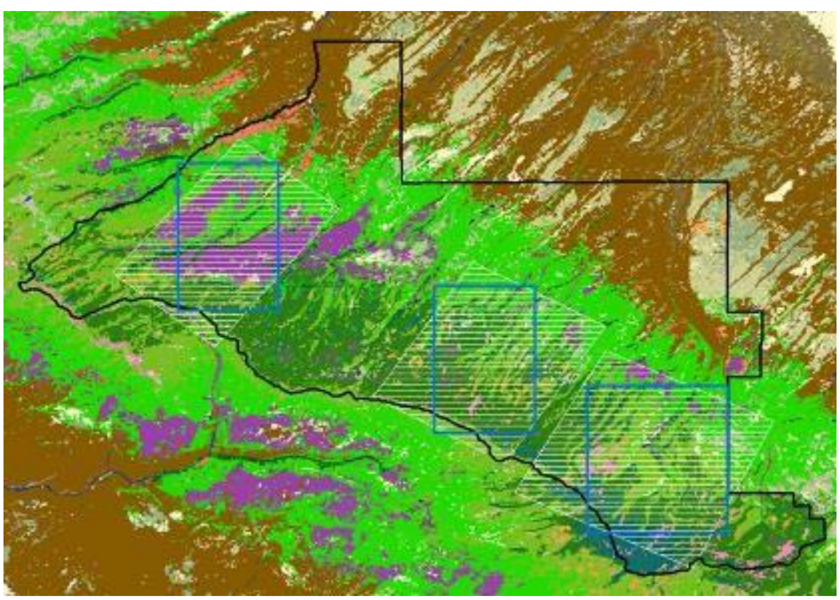
Other leadership people
Kristen Pelz (CFRI), Jeff Cannon (CFRI)

Overall goals and objectives
To obtain state-of-the-art data on the composition and structure of the forests and landscape of the Escalante Project area, using the Airborne Observation Platform of the National Environmental Observation Network. The AOP provides high-resolution images; multi-spectral data; and LIDAR (height) data at 1-3 m scale resolution. Our goal is to have very high precision information on forest composition and structure, and to follow changes after forest restoration (including information to allow for simulation of fire behavior).

Objectives for 2013 monitoring
To obtain AOP characterization for three large portions of the Escalante Project area, and interpret forest composition and structure.

Key questions to be examined
1. Which tree species comprise the forests within each area?
2. What is the vertical fuel structure of the forest?

2013 Findings
The AOP flew one-third of the planned area (three blocks outlined in blue) in the summer of 2013, covering parts of Love Mesa and Lockhart Mesa. This project was not implemented due to unforeseen logistical and operational changes. In lieu of the NEON imagery, the collaborative group approved using an aerial imagery analysis to gauge changes in horizontal forest structural patterns resulting from treatments. This analysis provides information to address the Uncompahgre CFLRP restoration goal #5: “Reestablish meadows and open parks and re-establish grasses, forbs, and robust understory communities.”



Protocol:

Spatial scale of the area under consideration
Three large areas of the Escalante Project area

General approach
Obtain coverage when possible, beginning in 2013 and continuing into the future, and tointerpret current forest composition and structure, as well as changes over time.

Locations to be assessed
Three large blocks in the Escalante Project area (see map above)

Measurements to be taken at each location
High resolution imagery, hypspectral coverage, and LIDAR – all combined for each 1 (to 3) m pixel to provide an information system that allows almost any sort of question to be asked in aspatially explicit context.

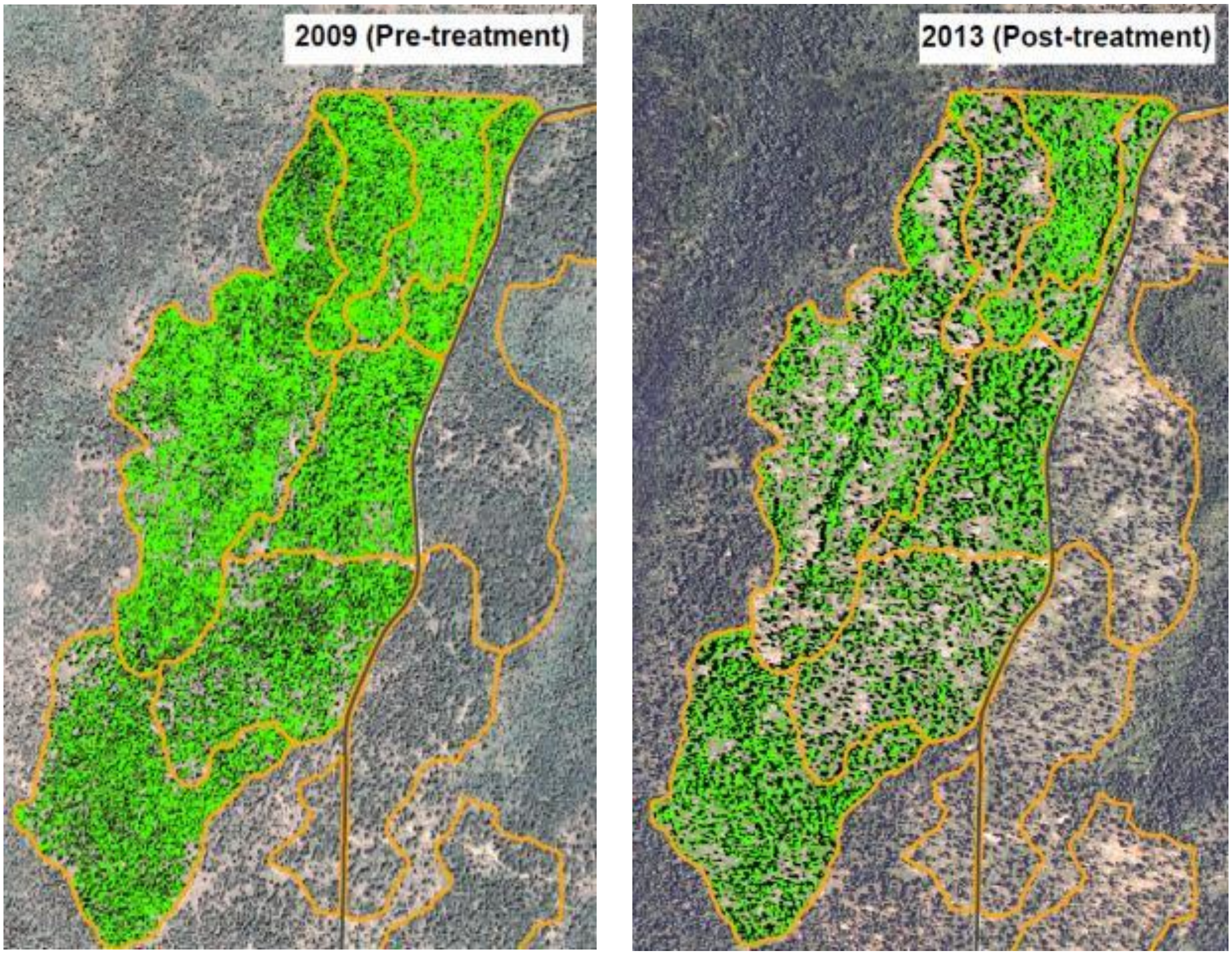
People engaged in measuring (agency, volunteers, etc.)

Dan Binkley, Michael Lefsky, John Musinsky

Objectives for 2014 monitoring:
To gauge changes in horizontal forest structure al patterns resulting from treatments.

Key questions to be examined
Quantify tree spatial pattern to ensure post-treatment forest condition goals aremet.

<u>2014 Findings</u>



Pre- (top) and post-treatment (bottom) aerial imagery of Unc Mesas project area. We analyzedcanopy cover in all units outlined in orange here in 2015.

Pictures above show classified canopy (bright green) in a subset of stands along the Delta-Nucla Road. Our analysis of pre- and post-treatment canopy cover showed desirable trends (see table below). The coverage of coniferous canopy has been reduced, and the number of distinct canopypatches has increased. The complexity of forest canopy cover has increased in some ways: the number of patches, distance between patches, and range of distances between patches have increased. However, the range of patch sizes decreased and the edge density did not change significantly. In the table, asterisks represent significant differences between pre and post treatment metrics. Underlines show where the change was in the desired direction.

Metric		Time	Mean	Std Dev	Max	Min
***Canopy cover as % of unit**	PLAND	*Pre*	**52**	12	76	35
		Post	**25**	11	52	11
***Patch density (patches / 100 hectares)**	PD	*Pre*	**1,305**	954	3,464	102
		Post	**3,244**	2,872	15,707	850
***Largest Patch Index (Largest canopy patch as % of unit)**	LPI	*Pre*	**36.8**	23.5	75.5	2.5
		Post	**3.8**	4.9	21.1	0.1
Edge density (meters / ha)	ED	*Pre*	675	241	1,136	335
		Post	700	133	929	435
***Mean patch area (ha)**	AREA	*Pre*	**0.12**	0.17	0.74	0.01
		Post	**0.01**	0.01	0.06	0.00
***Range of patch areas (ha)**	AREA_RA	*Pre*	**7.7**	11.2	52.0	0.5
		Post	**0.6**	0.7	2.1	0.0
***Euclidian nearest neighbor distances (m)**	ENN	*Pre*	**5.3**	0.7	5.0	5.9
		Post	**6.4**	0.2	5.4	7.5
***Range of Euclidian nearest neighbor distances (m)**	ENN_RA	*Pre*	**6.8**	3.2	12.2	2.0
		Post	**16.4**	7.9	38.5	7.2

Protocol:

Spatial scale of the area under consideration
Unc Mesa project area

General approach
Spatial analysis of forest cover using NAIP imagery and FRAGSTATS spatial analysis package.

Measurements to be taken at each location
In 2015, CFRI used National Aerial Imagery Program (NAIP) imagery to quantify spatial pattern offorest cover. This imagery is collected every four years, and is publically-available. We use the ENVI software package (Exelis Visual Information Solutions) to delineate areas of coniferous canopy, shadow, herbaceous ground cover and bare soil (e.g. unpaved roads) from the imagery. The reflected wavelengths of these cover types are relatively unique and allow for the mapping of forest cover.

After mapping, the spatial distribution of coniferous forest canopy patches (groups of trees with continuous canopy) in a matrix of bare-ground and herbaceous groundcover (gaps between trees)can be quantified using FRAGSTATS (McGarigal et al. 2012), a program developed to analyze spatial patterns of landscape. Metrics such as the percent cover, largest patch index, edge density,patch size, patch density, patch perimeter-to-area ratio, and Euclidean nearest-neighbor distancecan quantify forest cover patterns to make comparisons among different forests and monitor treatment effect through time.

NAIP imagery will be collected in the spring, summer, and fall of 2016; stay tuned for an update in 2017 regarding the spatial heterogeneity and complexity of forest openings following 2015- 2016 treatments.

People engaged in measuring (agency, volunteers, etc.)

Kristen Pelz (CFRI)

Data management plans
Data will be archived at CFRI.

Data archiving plans
Copies of the study results will be stored on the CFRI website.

Plan for communicating findings to collaborators, line officers

The results will be presented at UP meetings, including one or more field trips.

Objectives for 2017 monitoring

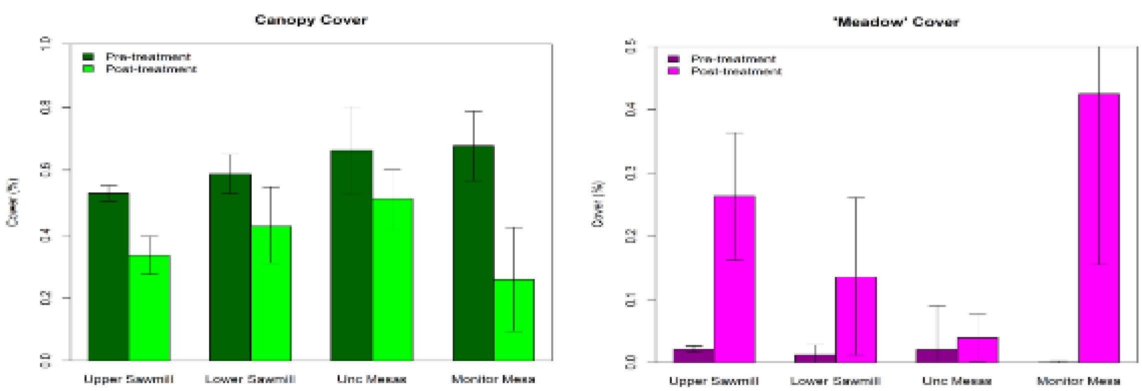
Analyze aerial imagery to evaluate changes in forest spatial structure from restoration treatments with an emphasis on identifying and measuring characteristics of meadows. Comparison of spatial pattern results to information on historic spatial patterns based onreconstruction of forests of the CFLRP focal area.

Key questions to be examined

Characterize changes in pre- and post-treatment spatial patterns including changes in:

1. canopy cover
2. meadow cover
3. Density, size, and shape characteristics of meadows

2017 Findings



Overall, canopy cover was reduced from 62 to 41% following treatments, but varied considerably. Coverage of meadows increased from 1.5% to 16% cover over all treatments. The number of meadows increased from 0.1 per acre (1 meadow every 10 acres) to 0.5 per acre (5 meadows every 10 acres) following treatments. Meadow size also increased following treatments from 0.08 acres up to 0.25 acres. This change was most pronounced in the Monitor Mesa treatment units and less pronounced in the Unc Mesas treatment units. Historical forests on the Uncompahgre may have contained "meadows" which covered over 65% of forested area,due to the much lower historical density of trees which allowed for connectivity between gaps and greater gap sizes. It should be noted that different methods were used to estimate coveragein these studies, so direct comparisons between results from remote sensing and stand reconstruction methodologies should be interpreted with caution.

Table 1. Pre- and post-treatment measurements of canopy cover and meadow cover, mean density, size, and shape index. Shape index is calculated as an area-weighted mean according to gap size. All result summaries areweighted by the area of treatment units.

Treatment	Area (ac)	Canopy Cover (%)		Meadow Cover (%)		Meadow density (per acre)		Mean Meadow size (ac)		Meadow Shape Index*	
		Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Upper Sawmill	392	52.4%	34.3%	2.099%	25.247%	0.181	0.704	0.102	0.392	1.18	2.24
Lower Sawmill	879	59.2%	40.9%	1.122%	16.031%	0.089	0.553	0.116	0.230	1.12	1.67
Unc Mesas	561	64.0%	51.2%	2.524%	4.590%	0.130	0.289	0.063	0.122	1.13	1.30
Monitor Mesa	359	74.8%	34.9%	0.051%	24.363%	0.006	0.683	0.012	0.391	1.02	2.00
Overall	2,190	61.8%	41.4%	1.480%	16.115%	0.102	0.534	0.083	0.258	1.13	1.73

Protocol:

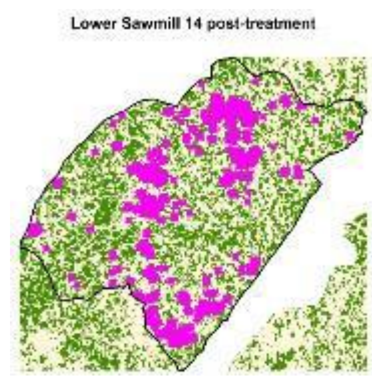
Spatial scale of the area under consideration

Unc Mesa project area including (1) Unc Mesas treatment, (2) Upper Sawmill, (3) Lower Sawmill, and (4) Monitor Mesa units.

General approach

Classification of 2011 and 2015 NAIP imagery using supervised classification and custom algorithms to identify and measure meadow characteristics developed in R statistical language.





Measurements to be taken at each location

CFRI used National Aerial Imagery Program (NAIP) imagery to quantify spatial pattern of forest cover. This imagery is collected every four years, and is publically-available. We use ESRI ArcMapsoftware to delineate areas of coniferous canopy, shadow, and openings from the imagery. The reflected wavelengths of these cover types are relatively unique and allow for the mapping of forest cover. Shadows were classified using thresholding of the NDVI band. Meadows (continuous regions > 80 ft. minimum diameter) were identified using a distance-to-edge algorithm. Mean canopy cover and coverage of meadows was calculated for each unit. Meadow attributes including mean meadow density, size, and shape index were quantified for each unit.

People engaged in measuring (agency, volunteers, etc.)

Jeff Cannon (CFRI)

Data management plans

Data will be archived at CFRI.

Data archiving plans

Copies of the study results will be stored on the CFRI website.

Plan for communicating findings to collaborators, line officers

The results will be presented at UP meetings, including one or more field trips.

Completed Project: Sanborn Park Fuel Reduction Monitoring Project

Leadership people

Corey Robinson, USFS Norwood Ranger District (temporary contact)

Overall goals and objectives (extracted from the Decision Notice)

1. Reduce hazardous fuels in the wildland urban interface around Sanborn Park and along the Western Area Power Administration's power lines.
2. Protect from destructive wildfire the wildland urban interface around Sanborn Park andalong the Western Area Power Administration's power lines.
3. Initiate a progressive change, so that over time, unplanned fires can be used more effectivelyover a larger percentage of the landscape during hotter and drier conditions without exceeding the desired fire severity.
4. Reduce risk to grazing permittees by achieving a desired range of fire associated benefits while allowing them to plan their out-year grazing based upon the implementation scheduleof planned projects.
5. Create vegetation conditions that are more resilient to wildfire and epidemic insects and diseases.
6. Reduce threats to life and property from destructive wildfire and epidemic insects and diseases.

Objectives for [2013] monitoring (multi-year monitoring project)

1. Determine whether goals are being met in the Sanborn Park area.
2. Determine whether aerial seeding by native species is effective at reducing soil loss and reducing influence of noxious weeds.

2013-2016 Findings

1. Based on three transects re-measured in 2013, the project was very successful at meeting fuels reduction, destructive fire prevention, permittee risk reduction, resiliency, and insect-disease risk reduction goals
2. Mastication was more effective than rollerchopping.

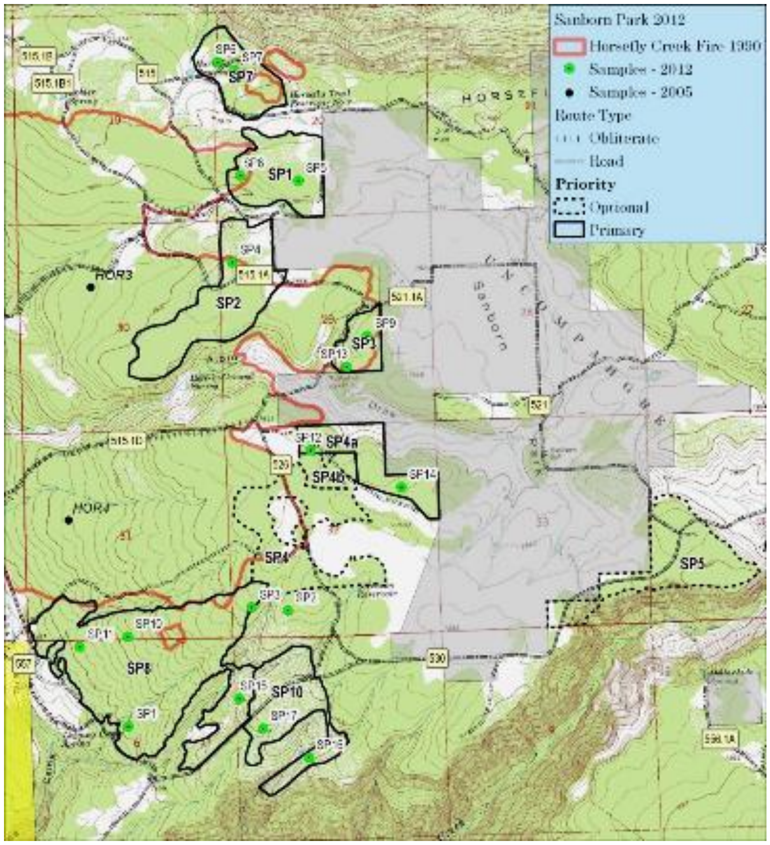
Key questions to be examined: (in future)

1. Determination that project met goals will take more sampling across whole area.
2. Determination of success of aerial seeding, since aerial seeding had not yet begun by the endof the 2013 season.
3. Follow up sampling post-Rx burning will determine multi-treatment success

Protocol:

Spatial scale of the area under consideration

Ten treatment units, over 1,170 acres total (Fig.below)



General approach

Subjective sampling, to characterize stands treated, “subjective with nopreconceived bias” (Mueller-Dombois and Ellenberg 1974).

Locations to be assessed

Seventeen pre-treatment samples (Figure above).

Measurements to be taken at each location

Standard cover-frequency transect (metric), 30 m long with 20 Daubenmire microplots evenly spaced in each – cover by each plant species in microplots (estimate cover within circular plot with 30 m diameter); cover by each natural layer;cover by ground cover categories (bare soil, litter and duff, etc.). Transects permanently markedon the ground. Consistent protocol for photos (around 30 photos for each transect).

People engaged in measuring (agency, volunteers, etc.)

Three agency employees, twovolunteers.

Data management plans

Summarize cover by species and ground cover for each transect, display in association table. Individual document for each transect, showing photographs, coverdata, and summary statistics.

Data archiving plans

Norwood District office, Forest Service corporate data bases.

Plan for communicating findings to collaborators, line officers

Final report to be preparedfollowing Rx fire.

Project name: Applied silvicultural evaluation for spruce patch-cuts

Leadership people
Seth Ex (Colorado State University), Todd Gardiner, (GMUG)

Overall goals and objectives
This monitoring work will yield insights into tree seedling establishment and future composition of the forest following group selection treatments in the wet mixed conifer stands that cover a considerable portion of the Uncompahgre Plateau. This work has two main objectives: 1) determine appropriate opening sizes and slash treatments for group selection regeneration treatments on the Uncompahgre Plateau to foster natural regeneration of Engelmann spruce from seed, 2) evaluate how the same factors affect survival of planted seedlings. To meet these objectives, we planted seedlings and sowed seed in sets of plots with various levels of slash retention arrayed at increasing distances from the edge of openings within the Columbine timber sale using a replicated, randomized, complete block design. We also distributed a set of temperature sensors across the set of locations and levels of slash retention to determine whether these factors alter microsite temperatures in a way that is meaningfully related to seedling establishment.

Key questions to be examined
This study is designed to yield immediate insights into how opening size and slash treatment affect natural and artificial regeneration of trees in openings on the Uncompahgre Plateau. It will continue to yield insights over time as we re-visit plots in subsequent years and monitor multi-year seedling survival and growth.

Objectives for [2015] monitoring (multi-year monitoring project)
Our objectives in year 1 of this project were to establish permanent plots, plant seedlings and sow seeds, monitor seed germination and survival over the first growing season, and evaluate planted seedling survival and height growth at the end of the first growing season. We met all of these objectives.

Objectives for [2016] monitoring (multi-year monitoring project)
Our objectives in year 2 of this project were to re-measure plots at the beginning and end of the growing season, and to collect over-winter and second growing season temperature data from sensors. We met these objectives.

Objectives for [2017] monitoring (multi-year monitoring project)
Our objectives in year 3 of this project are to re-measure plots as in years 1 and 2 as well as re-monument permanent plots. Logical next steps for this project in year 3 are to relocate temperature sensors to smaller openings within the Smokehouse timber sale to collect temperatures over the growing season, and to install seed traps in the same openings to quantify seed pressure. We should also consider fall cone collection to support a second paired sowing / planting trial of Engelmann spruce, Douglas-fir, and ponderosa pine in Smokehouse openings.

Objectives for [2018] monitoring (multi-year monitoring project)
Our objectives in year 4 will be to re-measure the original set of plots within the Columbine timber sale as before, collect temperature data, and collect samples from seed traps. If we move forward with a second, multi-species paired sowing / planting trial in openings within the Smokehouse timber sale we could establish that study in year 4.

Protocol:

Spatial scale of the area under consideration
The spatial scale of this study is confined to the Columbine (2015-present) and Smokehouse (planned 2017 onward) timber sales.

General approach

Repeated measurement of permanent plots within a randomized, replicated experiment.

Locations to be assessed

Openings within timber sales in mesic spruce-dominated stands on the Uncompahgre Plateau.

Measurements to be taken at each location

Repeated measurement of seedling number and height (for planted seedlings), download of temperature data from sensors. Collection of samples from seed traps from 2017 onwards.

People engaged in measuring (agency, volunteers, etc.)

Numerous graduate and undergraduate students at CSU. Ryan Davy installed the permanent plots in the Columbine openings as part of his thesis work.

Data management plans

Data are in spreadsheets that are stored on redundant hard drives in the Silviculture Lab at CSU. Analysis of the first 2 years of data is complete and a manuscript is in preparation.

Data archiving plans

Data will be archived at CFRI.

Plan for communicating findings to collaborators, line officers

Findings have been presented at several CFLRP and SBEADMR stakeholder meetings and field trips. We will continue to use these venues to update collaborators and line officers. We will circulate a summary of second year results in spring 2017 ahead of their anticipated publication.

Microsite conditions in a low-elevation Engelmann spruce forest favor ponderosa pine establishment during drought conditions

Edward M. Hill, Seth Ex

Due to a changing climate, there is concern about the viability of high-elevation species at their lower-elevation range. There is concern that the more drought-adapted species could potentially encroach into higher elevations, thus changing the species distribution. Adaptive management is an important management tool that could help address future concerns of species migration by helping to facilitate regeneration using different silvicultural tactics. The Ed Hill and Seth Ex study took place in Southwest Colorado on the Uncompaghre Plateau on a recently harvested site (Hill & Ex, 2020)(figure 1). For this site, the high-elevation species are primarily spruce with ponderosa pine at lower elevations.

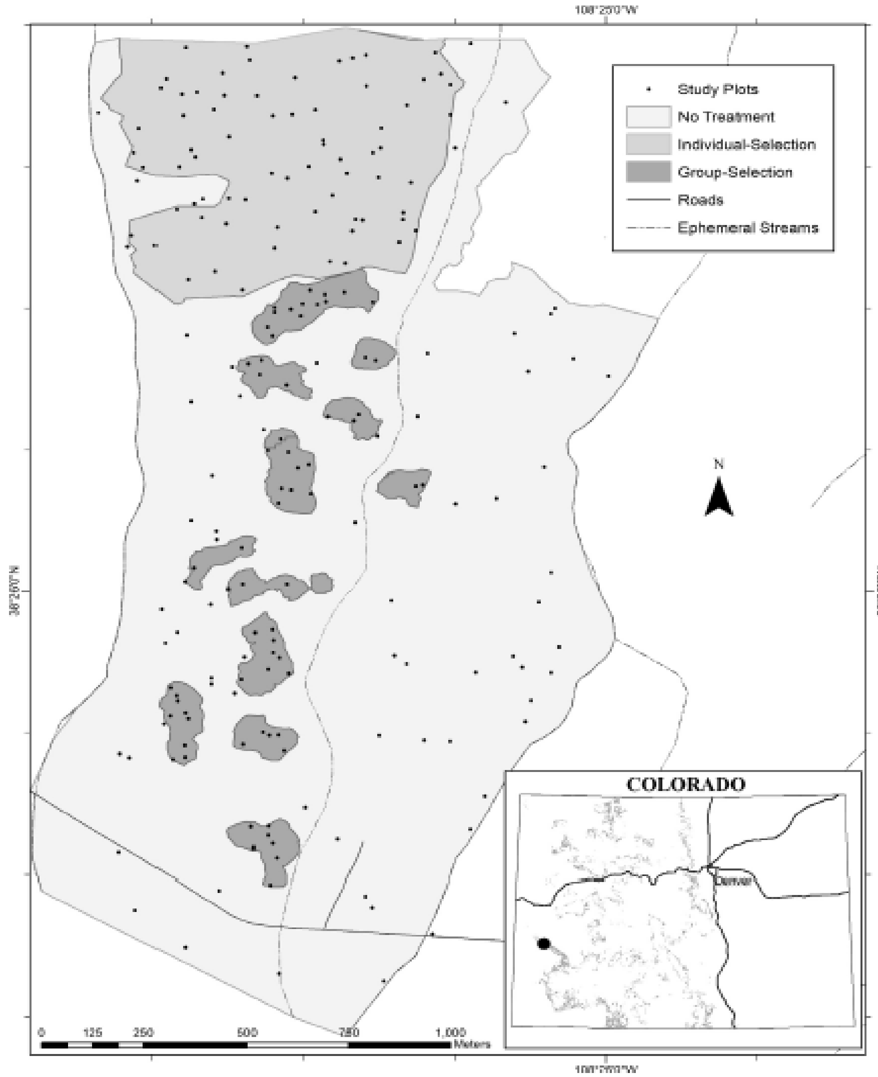


Fig. 1. The study was located on the Uncompahgre Plateau in southwest Colorado (black circle, locator map). Gray detail on the Colorado locator map shows area of overlap in predicted Engelmann spruce habitat declines and ponderosa pine habitat increases (Mathys et al., 2014). The study area was established in a recently harvested timber sale area. In the harvest area (data via Todd Gardiner, personal communication, April 11, 2018), dark shading indicates group-selection treatment openings and medium shading indicates individual-tree selection treatment area. No treatment (unharvested) areas are indicated by light shading. Elevation of the area ranges from 2,714 to 2,805 m, and slopes are largely < 10% with northerly aspects. Plots in our study are indicated by circles; two seedlings of each species were planted at each plot location, one with coarse woody debris shelter and one without. All data, unless otherwise indicated, were retrieved from the USDA NRCS Geospatial Data Gateway (USDA NRCS, 2018).

In the Hill & Ex paper, they used a planting study to evaluate the microsite conditions that support the first-season survival and root growth of both spruce and ponderosa trees. The study assessed different microsite conditions such as species responses to varying canopy cover, regeneration treatments, and varying shelter from coarse woody debris. Additional variables included seedling size, vegetation and litter cover, soil moisture and depth, and competition from previously established tree regeneration. A summary of the microsite variables can be seen in Table 1. The study found that the survival of ponderosa pine was almost two times higher than the survival rate of Engelmann spruce on the site (figure 5). Additionally, they found that coarse woody debris shelters improved the probability of survival by about 357%, with spruce success rates being slightly higher. They found that canopy cover had little to no effect on the survival rates for both species, but slightly inhibited spruce while increasing survival rates for ponderosa slightly. This is the opposite of what was expected for these species. In this study, they found that smaller seedling heights improved the probability of survival for both species by 179% and that pine root growth was 150% greater in open versus more closed canopy microsites and limited shelter from coarse woody debris.

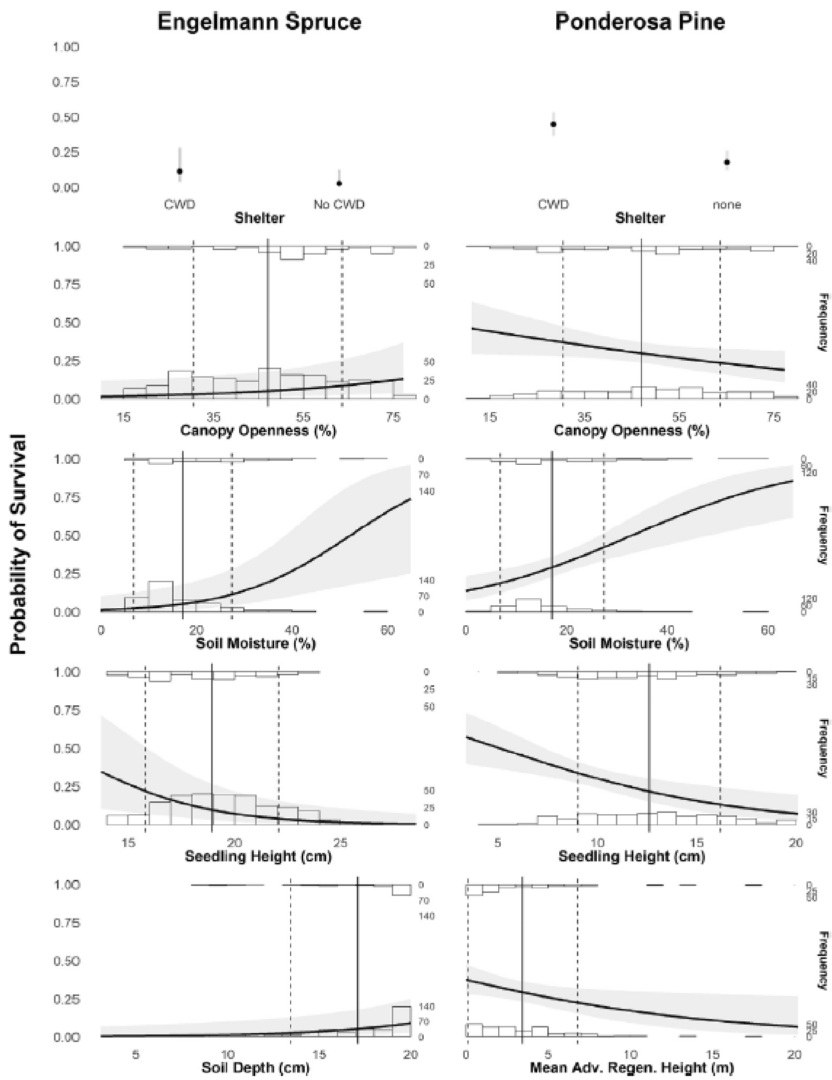


Fig. 5. Predicted mean effects of microsite variables in the final selected survival models for Engelmann spruce (left column) and ponderosa pine (right column). Covariates for both species include coarse woody debris shelter treatment (CWD shelter or no shelter), canopy cover (% canopy openness), seedling height at planting, and percent soil moisture (GWC). The Engelmann spruce final survival model also included soil depth, and the ponderosa model also included mean height of surrounding advanced regeneration trees ("Mean Adv. Regen. Height"). Predictions were made across observed values of each variable. Predicted survival is indicated by the solid black line (points for CWD shelter effects), and gray bands (bars for CWD shelter effects) on either side of the line show 95% confidence intervals for predicted mean survival. Frequency distributions (frequency on secondary y-axis) of observed survivorship are displayed with histograms for each continuous covariate. Vertical black lines indicate the mean (solid) and one standard deviation (dashed) of observed values for each continuous covariate, aiding interpretations of model effects. All effects were significant.

Table 1
Summary characteristics (mean ± SD) for microsite variables considered for survival models of both species. Bolded and italicized figures indicate a significant difference across canopy strata for each reported microsite variable; corresponding superscripted letters indicate associated pairwise differences between canopy strata for each reported microsite variable, where strata sharing the same letter are not significantly different.

Canopy Stratum	Plots	Basal Area (m^2 ha^{-1})	Canopy Cover (% openness)	Coarse Woody Debris shelter size (cm)	Soil Moisture* (%)	Soil Depth (cm)	Bare Soil (%)	Litter/Debris (%)	Vegetation** (%)	Mean Adv. Regen. Height† (m)	Adv. Regen. Count†
No harvest	69	***25.12 (± 10.72)***[a]	***28.56 (± 7.84)***[a]	16.51 (± 4.77)	***14.21 (± 5.45)***[a]	17.56 (± 3.21)	10.22 (± 18.22)	61.52 (± 24.68)	***47.61 (± 28.71)***[a]	***4.99 (± 3.57)***[a]	***23.73 (± 13.61)***[a]
Individual-tree selection	68	***14.45 (± 8.59)***[c]	***49.89 (± 8.33)***[c]	16.32 (± 5.51)	***16.98 (± 9.75)***[b]	16.76 (± 3.81)	9.34 (± 15.31)	71.03 (± 23.49)	***36.99 (± 26.87)***[b]	***2.40 (± 2.49)***[b]	***8.84 (± 10.69)***[b]
Group-selection	69	***4.13 (± 4.58)***[b]	***62.90 (± 9.26)***[b]	15.40 (± 3.73)	***20.22 (± 13.30)***[b]	17.01 (± 3.96)	9.42 (± 15.71)	66.09 (± 23.12)	***36.59 (± 27.61)***[b]	***2.96 (± 3.31)***[b]	***12.22 (± 15.68)***[b]

* Estimated by gravimetric water content.
** Vegetation is a summation of cover measurements for graminoid, forb, shrub, and moss life-forms.
† Sample sizes for advanced regeneration ("Adv. Regen.") were 60 for no harvest, 69 for group-selection, and 57 for individual-tree selection overstory types.

From this study, they concluded that regeneration efforts in the future should consider more drought-adapted species as viable supplements to moisture-dependent species to improve forest reliance in climate-related issues in the future. The authors suggest that ponderosa may be better suited to the lower-elevation Engelmann spruce forests as they are better suited for warmer and drier conditions due to climate change. Lastly, the authors suggest that shelter from coarse woody debris should be considered when planting trees as this can help to increase tree survival rates.

Citations

Hill, E. M., & Ex, S. (2020). Microsite conditions in a low-elevation Engelmann spruce forest favor ponderosa pine establishment during drought conditions. *Forest Ecology and Management*, *463*, 118037. https://doi.org/10.1016/j.foreco.2020.118037

Completed Project: General Land Office survey analysis

Leadership people

William L. Baker (University of Wyoming)

Overall goals and objectives

1. Input into GIS the section-line and section-corner data from the original land surveys conductedon Forest Service land on the Uncompahgre Plateau, which were mostly done in 1881-1902.
2. Reconstruct historical forest structure (tree density, basal area, tree diameters) and fire severity proportions (low, moderate, high) in ponderosa pine forests and mixed-conifer forests. Acquire and use ancillary early historical reports and photographs.

Key questions to be examined

1. Early settlers and early scientific documents reported severe fires burned large areas on the Plateau in the early 1800s, in 1879, and in 1900; do the land-survey records support the occurrence of these fires and allow them to be reconstructed and mapped?
2. If large, infrequent, severe fires occurred historically on the Plateau in the 1800s, what is the legacy of these fires in today's forests? Are forests still recovering from these 1800s fires?
3. How variable was historical forest structure across the large land area covered by the land surveys?
4. How large were the trees at the time of the surveys—were old forests with large trees common?
5. What are the ecological implications of findings from the land-survey records for restoration?

Objectives for [2016] monitoring (multi-year monitoring project)

Complete input and analysis of the land-survey data for US Forest Service land on the Plateau

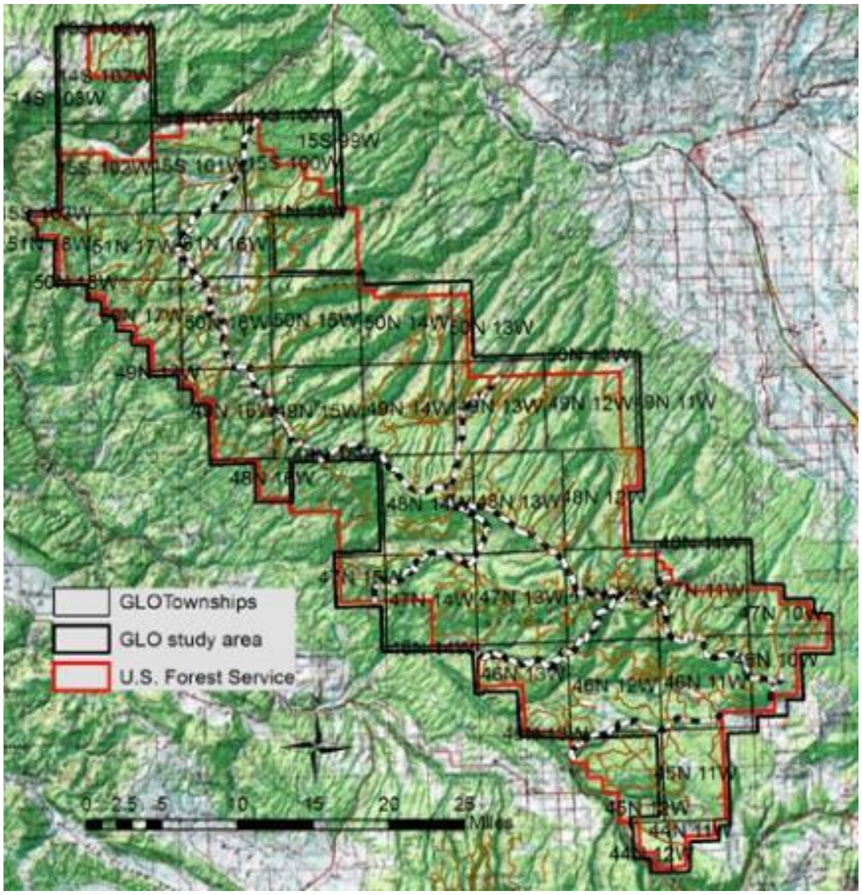
Objectives for [2017] monitoring (multi-year monitoring project)

Complete a report on the findings from the analysis of land-survey records on the Plateau

Protocol:

Spatial scale of the area under consideration

About 561,000 acres, mostly US Forest Service land on the Plateau



<u>General approach</u>
Data were entered for the Forest Service land on the Plateau, then analyzed in GIS

<u>Locations to be assessed</u>
The whole of the area mapped as "GLO study area" above.

<u>Measurements to be taken at each location</u>
Section-line data, which include a list of the dominant canopy trees or other vegetation in orderof abundance along with understory trees and shrubs also in order of abundance. Also recordedare entry and exit locations into and out of forests.

Section-corner data, which include information on up to four bearing trees at each section corner and two bearing trees at each quarter corner. Information includes the species of trees,their diameter, the distance from the corner and the azimuth to the tree from the corner.

<u>People engaged in measuring (agency, volunteers, etc.)</u>
Early land surveyors recorded the data in field notebooks, which were scanned by the BLM. Iextracted the data from the field notebooks and entered them into GIS.

<u>Data management plans</u>
Data have been input into shapefiles in ArcGIS 10.

Data archiving plans:
Data will be archived with the Colorado Forest Restoration Institute (CFRI) at CSU

Plan for communicating findings to collaborators, line officers:
A document outline of the methods and results for this study can be found on CFRI's website:
https://cfri.colostate.edu/wp-content/uploads/sites/22/2017/12/2015-UP-CFLR-GLO-Summary.pdf

Completed Project: Dominguez Creek Stream temperature monitoring

Leadership people
Matthew Dare (USFS GMUG)

Overall goals and objectives
The GMUG NF began an intensive stream monitoring campaign in 2011 and the project is ongoing. Data from across the Forest were integral to the completion of predictive stream temperature models developed by the Forest Service's Rocky Mountain Research Station (RMRS). Big Dominguez Creek was one of more than 40 streams included in thesampling array. Within the larger stream temperature sampling project we deployed several temperature sensors in Big Dominguez Creek to evaluate changes in stream temperature.

Key questions to be examined
How does maximum summer stream temperature change aswater flows downstream in Big Dominguez Creek?

Objectives for annual monitoring (multi-year monitoring project)
Annual monitoring includes one permanent stream temperature sensor deployed in Big Dominguez Creek. The sensor is visited and data are uploaded every other year. Data will be periodically sent to RMRS, who planto recalibrate the stream temperature models every 5 years.

Protocol:

Spatial scale of the area under consideration
The entire GMUG National Forest. Predictivemodels recently completed by the Rocky Mountain Research Station apply to all perennial streams in Colorado. More information on the models, including the spatial data, can be foundat:https://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.html (accessed February 6, 2017)

General approach
We maintain an array of stream temperature sensors at 40-50 locations across the GMUG National Forest. The sensors measure stream temperature every 30 minutes and store the data. We visit each sensor every 1-2 years and upload data and replace the sensorif necessary. Sensors are glued to large boulders. Sensors can be deployed seasonally using a wooden anchor and PVC housing.

Locations to be assessed
All perennial stream on the GMUG NF, including Big Dominguez Creek.

Measurements to be taken at each location
Stream temperature measured every 30 minutes.

People engaged in measuring (agency, volunteers, etc.)
GMUG staff. In 2014 a student fromDelta High School studied stream temperature in Big Dominguez Creek.

Data management plans
All temperature data are archived in corporate databases as well asserver drives. Data are periodically transmitted to RMRS for model calibration.

Data archiving plans

All data are stored on server drives and corporate databases.

Plan for communicating findings to collaborators, line officers

Completed stream temperature models are applicable to all perennial streams in Colorado. The data will be integral to several phases of the Forest Plan revision process. Additionally, stream temperature data have been used to evaluate streams on the Uncompahgre Plateau for suitability for native Cutthroat Trout introduction and management.

Completed Project: Delta High School Internship program

Leadership people

Matthew Dare (USFS GMUG), Luke Holguin (USFS Norwood and Ouray Ranger District)

Overall goals and objectives

Continue the successful internship program at Delta High School. Each year we "employ" a students to participate in a 6-week program during which they learn about careers in public lands management and conduct independent scientific investigations.

Key questions to be examined

Questions change from year to year based on agency needs and student interests.

Objectives for [2016] monitoring (multi-year monitoring)

Two students from Delta High School participated in the program in 2016.

Objectives for [2017] monitoring (multi-year monitoring)

TBD; however, we intend to include Norwood High School in the 2017 program.

Objectives for [2018] monitoring (multi-year monitoring)

TBD

Protocol:

Spatial scale of the area under consideration

the Uncompahgre Plateau.

General approach

Approximately 3 weeks of job shadowing with USFS personnel followed by approximately 3 weeks of guided research. Guided research projects are coordinated and supervised by USFS personnel and a High School Science teacher.

Locations to be assessed

Various locations on the Uncompahgre Plateau.

Measurements to be taken at each location

TBD

People engaged in measuring (agency, volunteers, etc.)

Agency personnel participate in job shadowing experiences each year. Additionally, we have coordinated involvement of Colorado Parks and Wildlife personnel in the past. We will continue to involve CPW personnel based on their availability. Each high school selects two students to participate in the program.

Additionally, the school district identifies a teacher-mentor to participate in the program and mentor the students. In 2016, the Delta program was lucky to have Kevin Dunbar participate as the teacher mentor. Mr. Dunbar is a science teacher at Cedaredge High School and he has expressed interest in returning to serve as the teacher-mentor in 2017.

Data management plans

All data are stored on server drives and uploaded to appropriate corporate databases.

Data archiving plans

All data are stored on server drives and uploaded to appropriate corporate databases.

Plan for communicating findings to collaborators, line officers

Students present their findings to USFS personnel and CFLRP stakeholders at the conclusion of each year's internship (July).

Completed Project: Norwood High School Internship program

Leadership people
Luke Holguin (USFS Norwood and Ouray Ranger District), Matthew Dare (USFS GMUG)

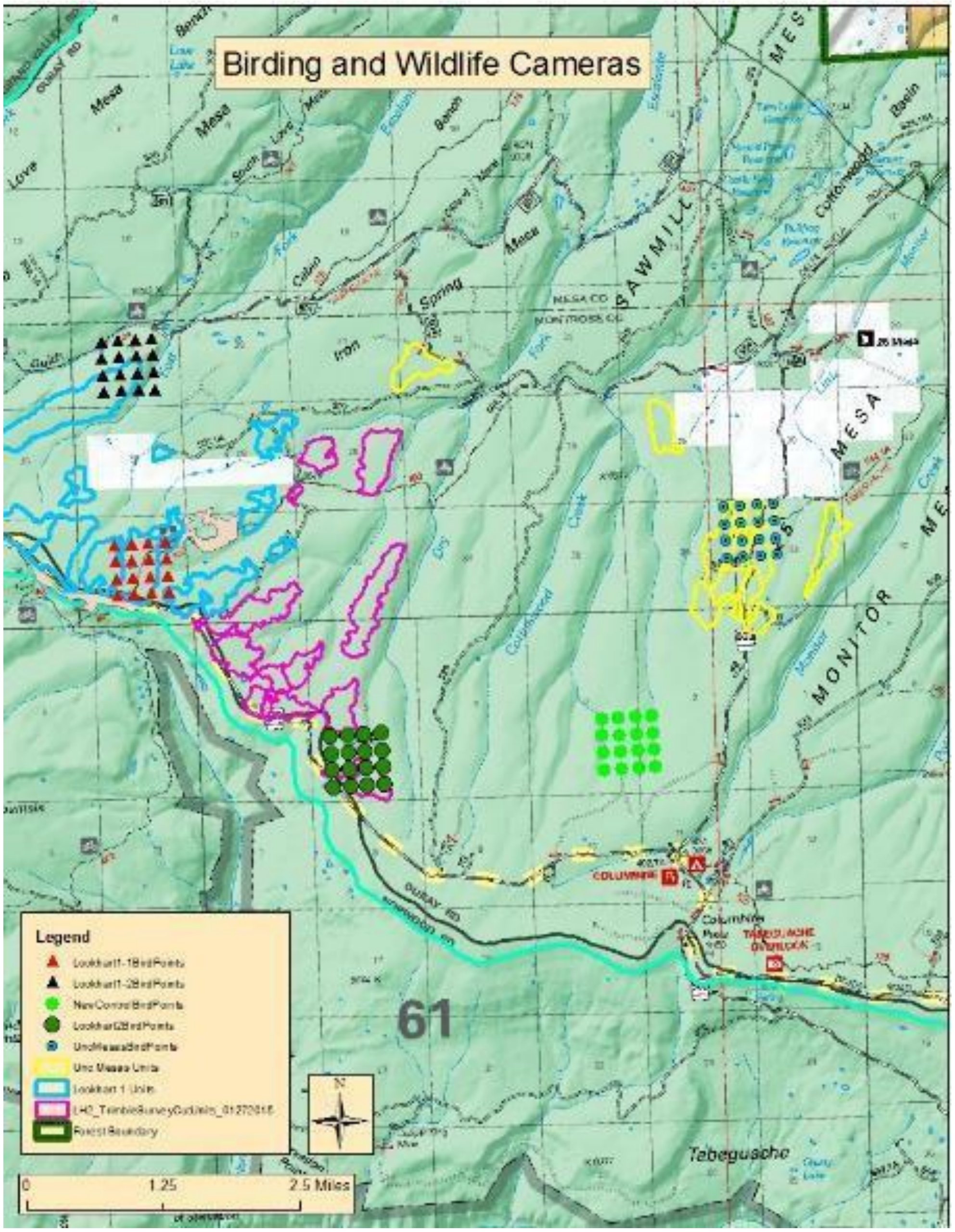
Overall goals and objectives
This year we are also opening the opportunity to Nucla and Telluride High Schools. The goal is to complete 5-8 separate birding locations using the Integrated Monitoring in Bird Conservation Regions protocol. Along with the birding, trail cameras are setup within the birding areas to detect mammal use of the as well. The objective is to introduce the students to the Forest Service and have them assist the Forest with gathering data on birds and mammals.

Key questions to be examined
How do the restoration activities affect bird and mammal density and diversity over the long term.

Objectives for [2016] monitoring (multi-year monitoring project)
Norwood High School did not participate in the internship program in 2016 as no applications were received.

Objectives for [2017] monitoring (multi-year monitoring project)
Open the opportunity to Nucla and Telluride High Schools to increase our applicant pool and draw interested applicants from the two other area high schools. We hope to complete 5-8 birding and camera locations. We have pre-treatment data from 2014 and 2015. In 2016 restoration activities began in our monitoring areas.

Objectives for [2018] monitoring (multi-year monitoring project)
Continue gathering and analyzing data. Depending on the progress of the restoration activities we may be able to see some post-treatment differences in our birding and camera data.



Protocol:

Spatial scale of the area under consideration

Our focus is in the Escalante RestorationArea on the Ouray Ranger District on the Uncompahgre Plateau.

General approach

Approximately 3 weeks of job shadowing with USFS personnel followed byapproximately 3 weeks of guided research. Guided research projects are coordinated and supervised by USFS personnel and a High School Science teacher. For the birding the studentscamp at Columbine campground which puts them in closer proximity to the birding areas.

Thirty minutes before sunup the students and FS personnel are at the birding locations andgenerally finish around 11 am. Data is compiled and analyzed after all areas have been completed.

Locations to be assessed

Lockhart 1 and Lockhart 2 restoration areas represent the pre- treatment data. Uncompahgre Mesas project represents an area that has already been treated. We have one control area at this point. Three additional areas will be identified and couldinclude additional controls and or the Long Creek and 7N restoration areas.

Measurements to be taken at each location

Vegetation characteristics are gathered at each birding location (16 per site). All birds seen or heard at each location and the distance to observer are recorded. In 2017 we may also gather hare pellet data and may establish a photopoint at one of the birding locations. Photos taken from the trail cameras are also analyzed.

People engaged in measuring (agency, volunteers, etc.)

Two high school interns. Luke Holguin,and other agency personnel. We will be seeking volunteers from local Audubon chapters and The Bird Observatory of the Rockies.

Data management plans

We are in the process of outreaching to the Bird Conservancy of theRockies to partner with the Forest Service in our efforts. The Integrated Monitoring in Bird Conservation Regions protocol was developed by them and their expertise in analyzing and assisting with the monitoring would be very valuable.

Data archiving plans

All data are stored on server drivers and uploaded to the appropriatecorporate databases.

Plan for communicating findings to collaborators, line officers

Students present their findingsto USFS personnel and CFLRP stakeholders at the conclusion of each year's internship (July).

Completed Project: Sage-oak mastication and hand-thinning monitoring

Leadership people: Marin Chambers (CFRI), Eric Freels (USFS GMUG), Arian Brazenwood (CSU), Ed Hill (CSU), Seth Ex (CSU)

Overall goals and objectives: The purpose is to assess how Gambel oak and understory species respond to cutting and mowing treatment in sagebrush systems.

Key questions to be examined:

1. How does understory vegetation respond to mowing treatment of Gambel oak in sage-oak systems in western Colorado?
2. How do Gambel oak and sagebrush regenerate following mowing treatments, compared to hand-cutting and stem retention treatments?
3. How does mowing affect ground fuels, particularly fine and coarse wood?

Protocol:

Spatial scale of project

Dominguez Creek area on the north end of the Uncompahgre Plateau in Western Colorado

General approach

In 2018, paired plots were established in the Dominguez Creek area on the north end of the Uncompahgre Plateau in Western Colorado. Each pair of plots includes a control (un-mowed or uncut) plot, and a plot that would be either hand-cut, mowed, or treated with a stem-retention cut. The plots were measured prior to treatments in early summer of 2018, were treated later that summer, and then were re-measured in summer 2019.
Mowing was contracted by the USFS Grand Valley Ranger District. The contract specified that the treatments should remove 85-100% of the trees and shrubs that were not sagebrush. Some "savannah-style" oak, with a heightened crown and Diameter at Root Collar (DRC) greater than 10 inches, were left un-mowed as they are rare on the landscape and provide important habitat. Savannah style oak with a smaller DRC were treated in order to have a greater size range available to study. The goal of the mowing treatments was to maintain sage parks for grouse habitat by removing Gambel oak, pinyon pine or juniper trees in the area.

To compare the effects of different kinds of treatment, some plots were treated with hand-cut and stem retention treatments. Gambel oak, along with the taller shrubs in the plot, were cut manually with a chainsaw and pruners, with the intent being to mimic the effects of mowing. The stem retention plots were similarly cut, but one or more stems were left intact. The stems that were left met certain criteria of being dominant or co-dominant, and healthy or in good form relative to the patch (Figure 4). The number of stems retained was determined by how many could fit into the patch area, with the distance between them equal to the height of the dominant oak stems in the patch. Because treating plots with hand tools is laborious and relatively expensive, the hand-cut treatment is not a proposed treatment option. The purpose of hand-cutting plots was to control for the effect of mastication equipment when evaluating the stem retention treatment.

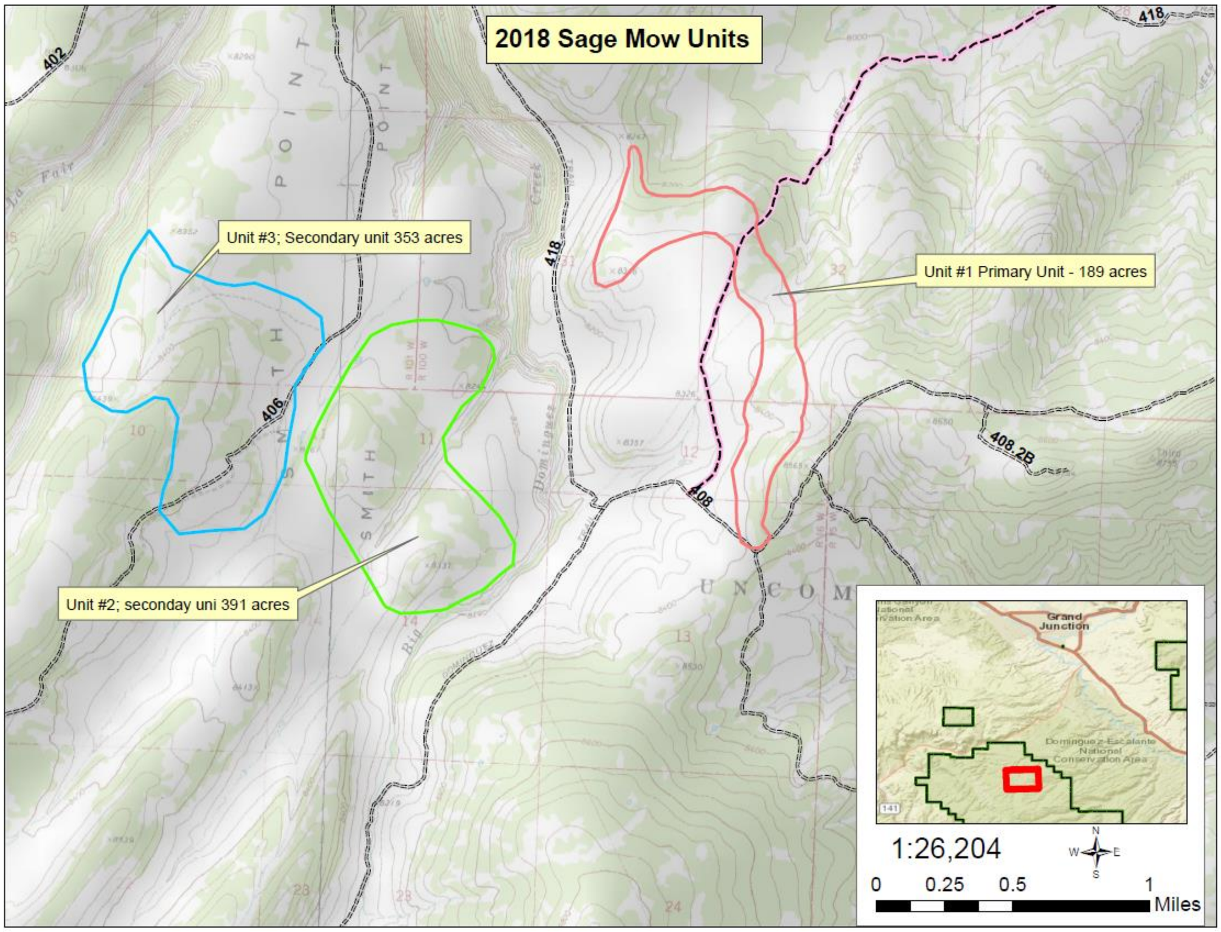


Figure 2: Map of mowing units in the Dominguez Creek area.

Findings

Post-treatment monitoring after one year illustrated that shrubs and graminoids were heavily impacted by mowing while forbs were not. Shrub cover, which included sagebrush, serviceberry (*Amelanchier alnifolia*), wild rose (*Rosa sp.*), and chokecherrry (*Prunus virginiana*) was reduced by nearly half after mowing (Figure 5). While Gambel oak was the target of mowing treatments, the equipment is not precise enough to keep sagebrush and other shrubs from being mowed. Longer-term observation of these treatments is needed to understand shrub recovery, as there is a dearth of information on this ecosystem in the literature. Graminoid cover decreased by more than half after treatment while forb cover nearly quadrupled. The increase in forb cover could be due to exotics coming in following disturbance. We did not measure understory plants to the species level due to capacity constraints so are unable to provide a clear explanation of an increase in functional groups. Based on qualitative observation, the dominant forbs were silver lupine (*Lupinus argenteus*), small-leaf pussytoes (*Antennaria parvifolia*), bracken fern (*Pteridium spp.*), and milkvetch (*Astragalus spp.*). The large decrease in graminoids is difficult to explain, as studies of understory vegetation following mowing treatments suggest that herbaceous cover - of both forbs and graminoids - increases following mowing in sagebrush systems (Davies et al., 2012). A limitation of our study is that two different observers were measuring plant cover during the separate (pre- and post- treatment) monitoring campaigns which may have resulted in some level of human error. Additionally, in hand-cut and stem retention treatments, woody debris tended to be coarser than what the masticator produced in the mowed treatments, and that debris could restrict herbaceous growth.

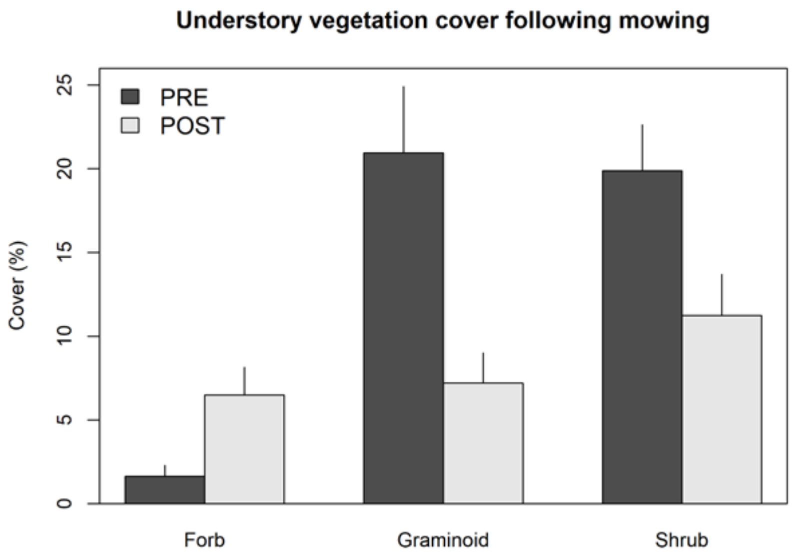


Figure 5: Bar plots depicting mean (
±1 standard error of the mean) understory vegetation cover (%) by functional group in mowed stands only (shrub is composed of various mountain shrubs including sagebrush species, serviceberry, and chokecherry, but does not include Gambel oak).

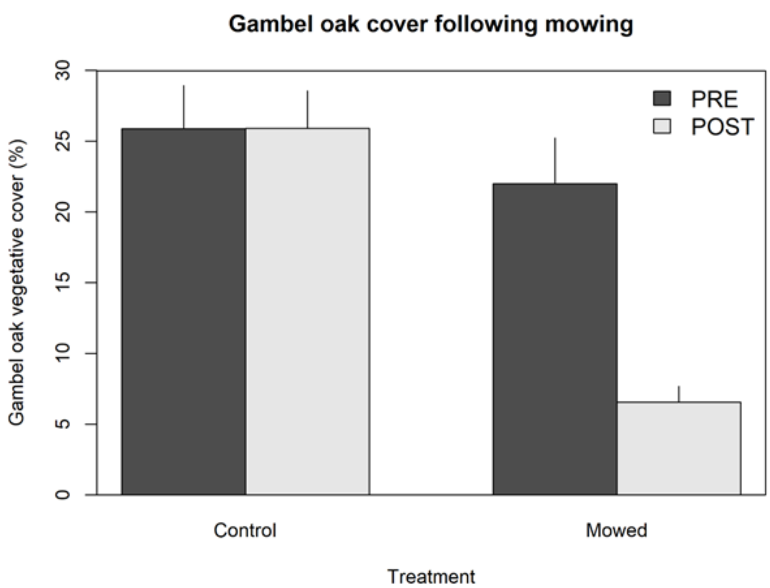


Figure 6: Bar plots depicting mean (±1 standard error of the mean) vegetative cover (%) of Gambel oak pre- and post- treatment in control and mowed stands.

Gambel oak regenerated vigorously following mowing and hand-cut treatments, and regenerated less vigorously following stem retention treatment. The mowing treatment decreased cover of Gambel oak (which included larger diameter and regenerating stems) by over two thirds- from 22.0% to 6.6% cover - in treated plots (Figure 6). However, Gambel oak more than doubled in density following mowing (Figure 6 & 7). In hand-cut plots, Gambel oak density doubled following treatment. Plots that received the stem retention treatment (where individuals were cut with a chainsaw leaving one or more dominant stems intact) had a 44% increase in density, which is the smallest increase of the treatments. None of these treatments could effectively remove Gambel oak from an area, and all of them caused an increase in regeneration density. Cutting and mowing treatments can temporarily alter the structure of the landscape, but the effects are unlikely to last more than 10 or 15 years (Kaufmann et al., 2016). Where the goal is to limit oak encroachment long-term, mechanical treatments of Gambel oak may be counterproductive. However, they can be effective for short-term changes to stand structure, and for creating heterogeneity on the landscape. These data suggest that the stem retention treatment encourages oak individuals to allocate more resources toward the dominant stems and less toward new sprouts. If this trend continues, then stem retention treatment could be used to accelerate the development of savannah style oak islands. Longer term monitoring of treated plots would yield more information on growth trends. For the three treatments, regenerating stems were all below 24 inches in height one year after treatment (Figure 8).

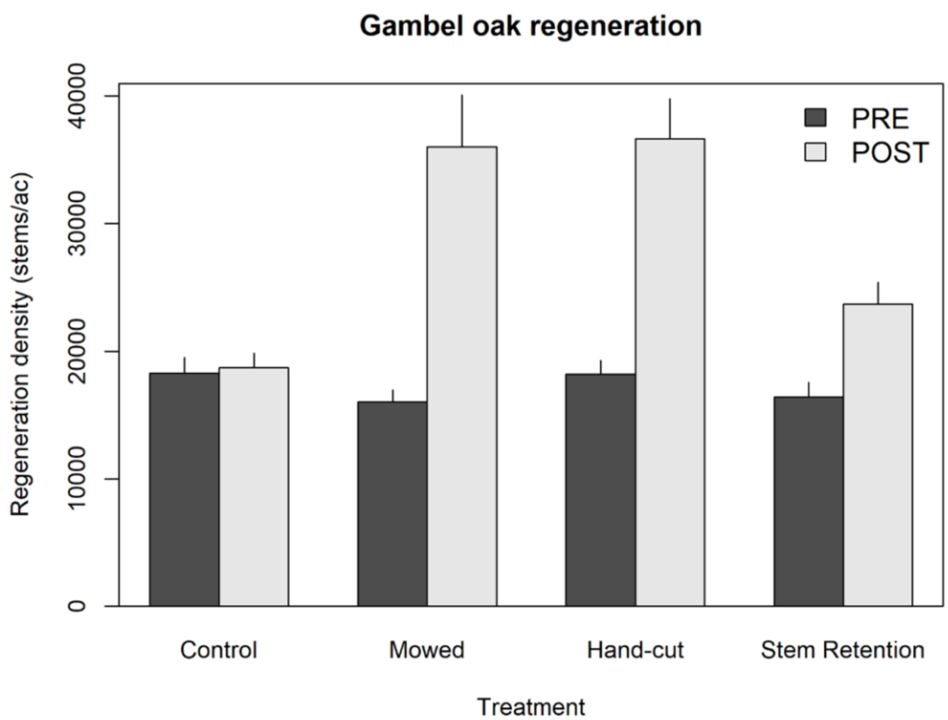


Figure 7: Bar plots depicting mean (±1 standard error of the mean) Gambel oak regeneration density in control, hand-cut, mowed, and stem retention plots pre- and 1 year post- treatment.

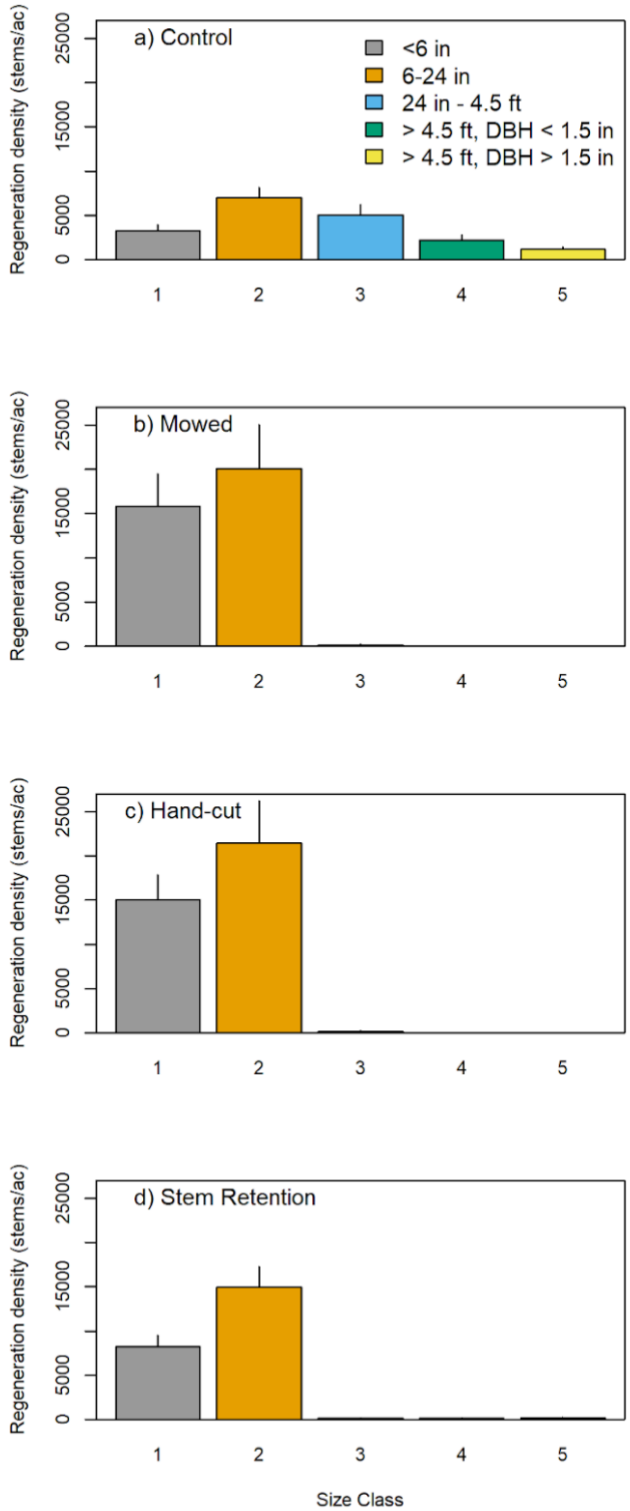


Figure 8: Bar plots depicting mean (±1 standard error of the mean) Gambel oak regeneration density by size class in control, mowed, hand-cut, and stem retention plots. Sample sizes range from 12-15.

Compared to Gambel oak, sagebrush regeneration is much slower following treatment. In the control plots, the density of sagebrush nearly doubled (Figure 9). Some increase in sagebrush density would be expected in control plots, but it is difficult to explain this enormous increase. As previously mentioned, two different observers collected data between pre- and post- treatment, which likely resulted in a measurement error. In all treated plots, the density of sagebrush decreased. The hand-cut treatment had the largest decrease, resulting in sagebrush density one third of pre-treatment density. Mowed and stem retention treatments both resulted in sagebrush density being reduced by approximately half. Studies have found that sagebrush responds slowly to disturbances such as mowing (Davies et al., 2012). Sagebrush stems in the hand-cut and stem retention treatments were generally taller than in the mowed treatment (Figure 10). Because of the precision a chainsaw has relative to a large mower, stem retention treatments allow for less damage to sagebrush.

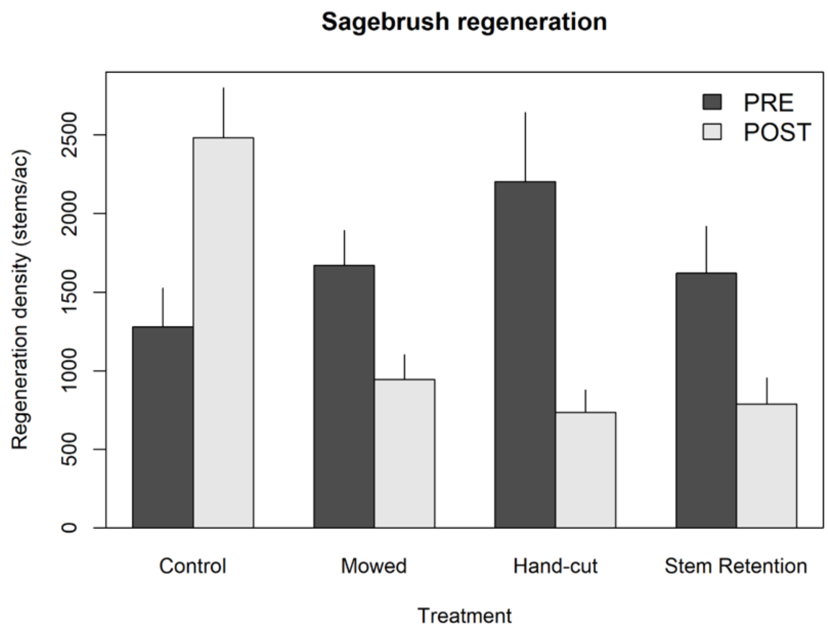


Figure 9: Bar plots depicting mean (±1 standard error of the mean) sagebrush regeneration density (stems/ac) in control, hand-cut, mowed, and stem retention plots pre- and 1 year post- treatment.

In mowed plots, there was a large increase in cover of woody debris, particularly in fine wood (Figure 11). Gambel oak plots had minimal cover of fine and coarse wood pre-treatment, with no coarse wood the first year and 1.3% cover of coarse woody debris post-treatment. Fine woody debris increased from 3.3% to 52.9% cover between pre- and post-treatment. Because mowed areas have fairly continuous woody debris, they may be more likely to carry groundfire, which may increase fire hazard potential in sagebrush ecosystems where Gambel oak has been mowed, at least in the short term following mowing. Ground fuel cover was not measured in stem retention or hand-cut plots due to capacity constraints. Little research exists on the effect of fine woody debris on understory vegetation in this system. In nearby piñon-juniper systems, mastication treatments that reduced overstory cover and increased woody debris caused increases in cover of grasses, forbs, and shrubs, with notable increases in non-native richness and cover (Coop et al., 2017).

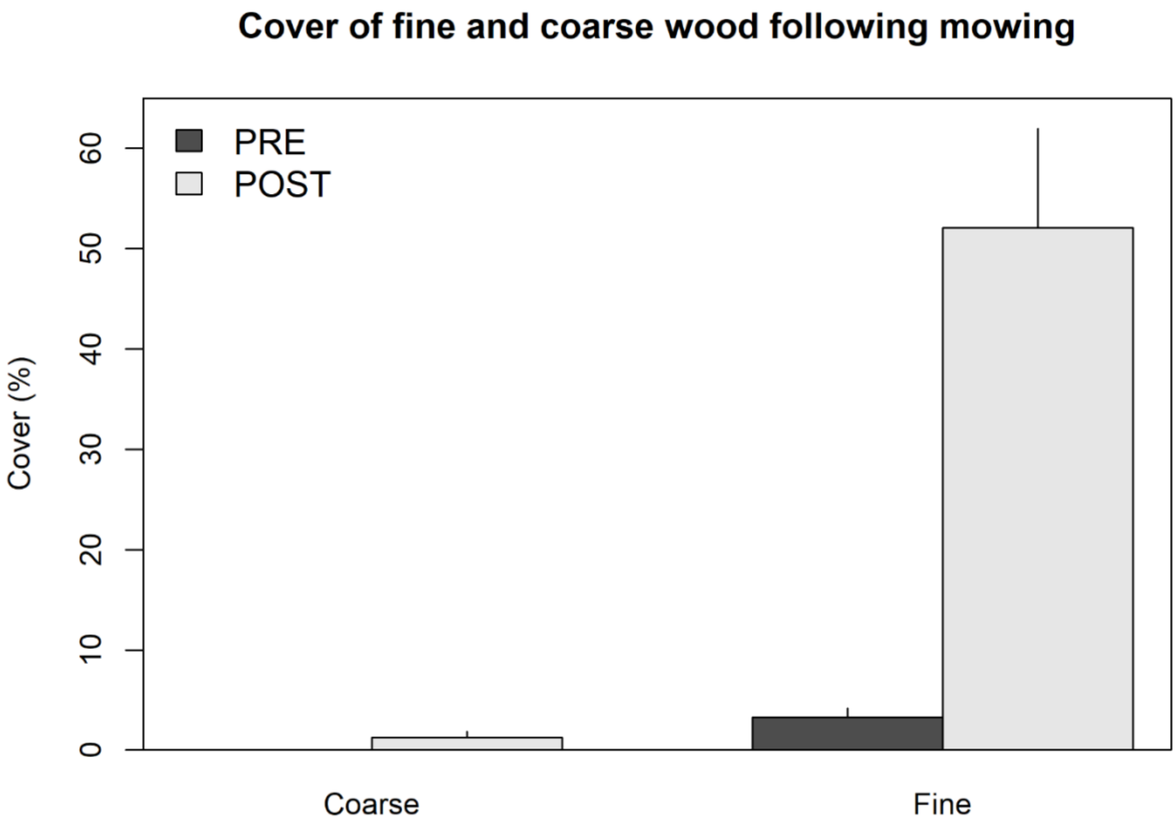


Figure 11: Bar plots depicting mean (±1 standard error of the mean) coarse and fine wood cover pre- and post-mowing treatments. Woody debris with a diameter >3" is considered coarse, and anything smaller than that is considered fine.

Pending funding, a four- or five-year post-treatment visit may take place in 2022 or 2023. The 2019 visit captured conditions one year following treatment, and another revisit will provide better insight into understory and regeneration trends in this little-studied system.

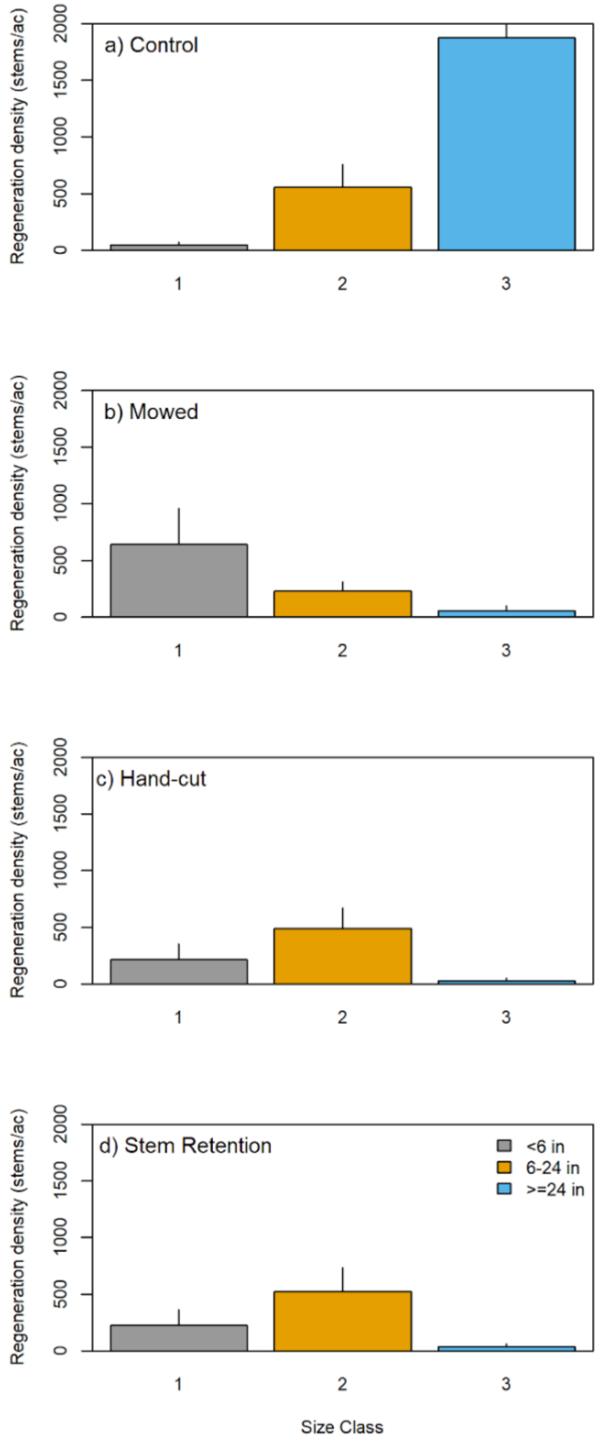


Figure 10: Bar plots depicting mean (±1 standard error of the mean) sagebrush regeneration density by size class in control, mowed, hand-cut, and stem retention plots. Sample sizes range from 9-14.

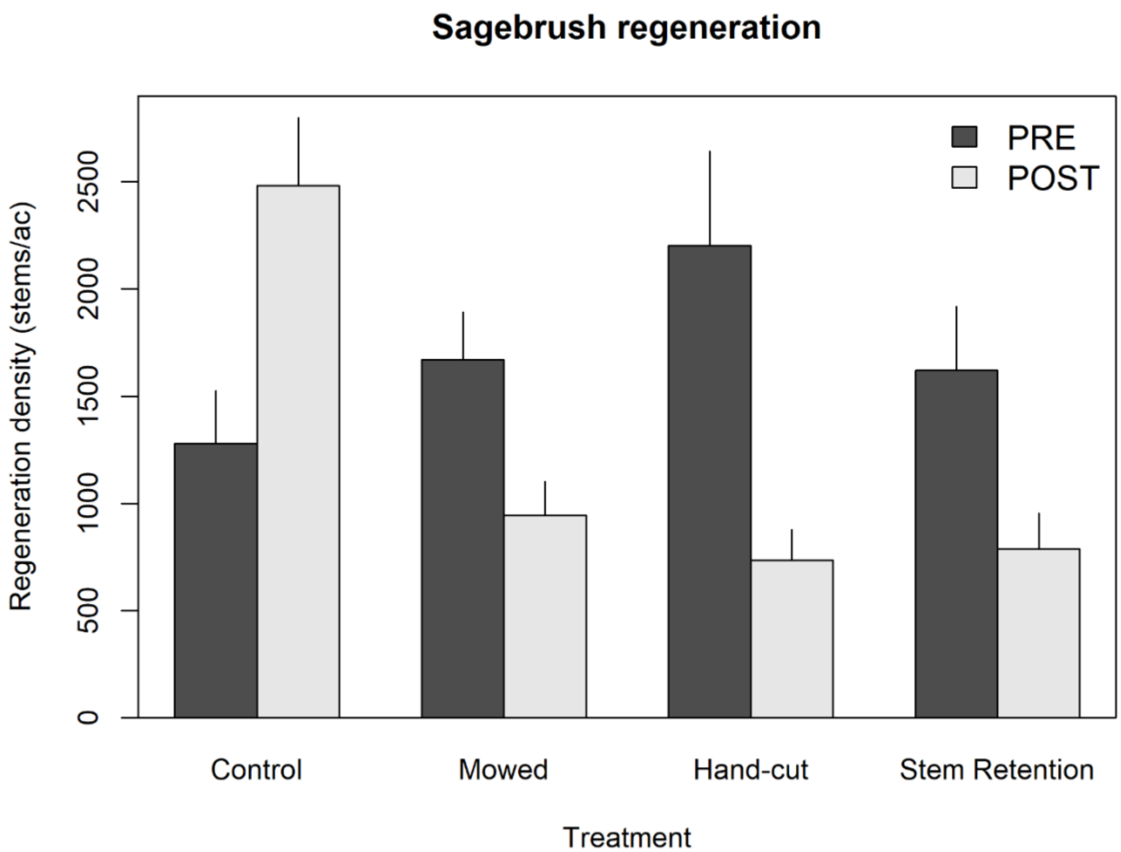


Figure 9: Bar plots depicting mean (±1 standard error of the mean) sagebrush regeneration density (stems/ac) in control, hand-cut, mowed, and stem retention plots pre- and 1 year post- treatment.

<u>People engaged in measuring (agency, volunteers, etc.)</u>
Marin Chambers (CFRI), Eric Freels (USFS GMUG), Arian Brazenwood (CSU), Ed Hill (CSU), Seth Ex (CSU), various CSU student field technicians.

<u>Data management plans</u>
Data is archived at CFRI.

<u>Data archiving plans</u>
All data are stored on CFRI server drivers and uploaded to the appropriatecorporate databases.

<u>Plan for communicating findings to collaborators, line officers</u>
A document outlining this study can be found on CFRI's website (https://cfri.colostate.edu/wp-content/uploads/sites/22/2024/02/SageOakSummaryReport_Weimer_Chambrs_CFRI2401.pdf).

Project name: Uncompahgre Mesas Monitoring Plots (Forest condition assessment)/ Montrose High SchoolForestry Internship Program (FIP)

Leadership people
Todd Gardiner (USDA Forest Service), Marin Chambers (Colorado Forest Restoration Institute), Montrose High School Forest Internship Program crew leader (Lyle Motley)

Other Leadership People
Rusty George (Montrose High School)

Overall goals and objectives
Restore ecosystem structure, composition and function.For ponderosa pine type forests, these goals include:

- 20 to 90 ft^2/acre, often clumped (20-100 ft. radius) with mini-meadows; uneven-age structure, fostering old, large trees.
- For mixed-conifer type forests, these goals include:
- 25 to 130 ft^2/acre basal areas; clumped in some places (20-100 ft. radius), but not everywhere;some mini-meadows (0.1 to 0.5 acres), uneven-age structure, favoring Douglas-fir, ponderosa pine, and aspen regeneration

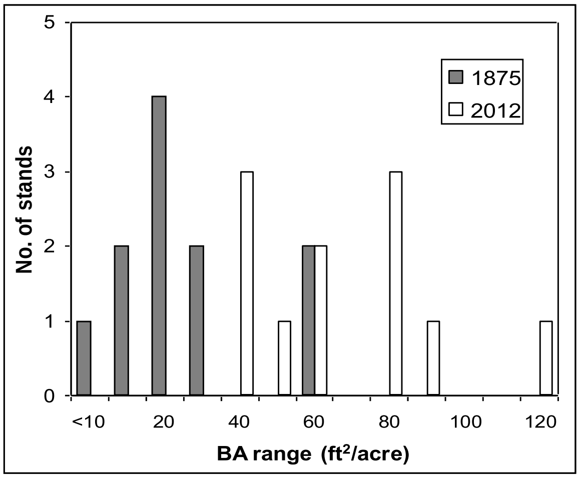
Create opportunities for high achieving high school students to gain vocational skills and provide experiences working in forestry, ecological science, and natural resources while gaining high qualitypre- and post-treatment data for forest condition assessments.

Key questions to be examined
1. Did treatments move the ecosystems toward the restoration goals?
2. Were any unintended consequences important (such as invasive weeds)?
3. How might the efficiency and effectiveness of the treatments be improved in the future?

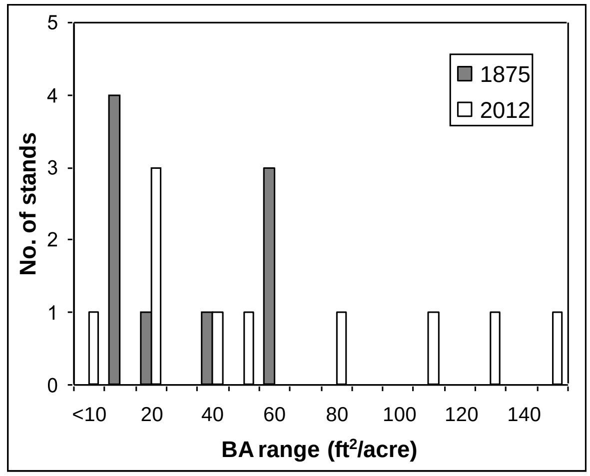
Objectives for 2013 monitoring
The objectives this year include continued use of the “forensic forestry” protocol from the historical reconstruction work to 1) assess the Unc Mesas treatments relative to historical forest structure, and 2)provide additional historical reconstructions to support the expansion in the Escalante Project. We alsowill assess the value and limitations of the rapid approach for multi-party assessments of historical stand structure by comparing the basic insights from the UP protocol with research-grade characterizations of plots undertaken by Peter Brown of the Rocky Mountain Tree Ring Laboratory.

2013 findings
Additional rapid-assessment/forest forensic plots within the Escalante Project area showed similar results to plots from the Unc Mesas areas. Historical forests were characterized by much lower basal areas, with substantial areas in small meadows. The mechanical treatments in the Unc Mesas units recreated stand structures that were well within the historical ranges (see photos next page). Low basal area in mixed conifer stands in 2012 were all locations dominated by aspen, and we do not have away to reconstruct historical aspen basal area.

We sampled 18 stands in the Front Range of Colorado using our rapid-assessment/forest forensic protocol, centering each plot on a plot previously sampled by Peter Brown. Dr. Brown’s research-gradeassessment included directly aging cores from living and dead trees, whereas the UP approach cores some trees and estimates others. Our comparison of methods will be completed early in 2014.



Distribution of conifer basal area 1875 and 2012 in ponderosa pine stands.



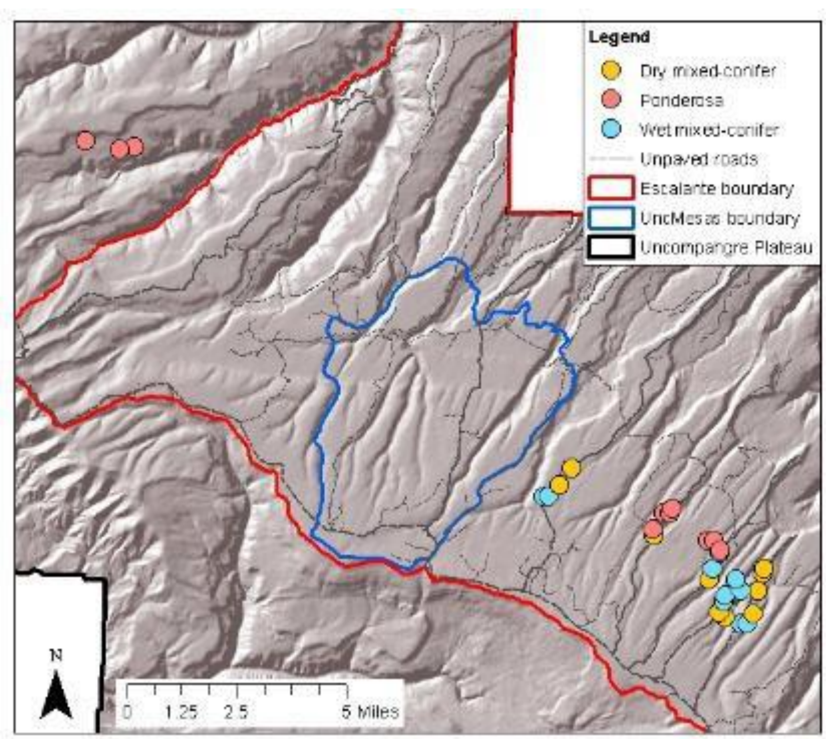
Distribution of conifer basal area 1875 and 2012 in dry-mixed conifer stands.

Protocol:

Spatial scale of the area under consideration

Originally 17,000 acres for Unc Mesas, now expanded to over 135,000 acres for the Escalante Project. We have assessed forest structure in over 30 stands located within or nearby the Escalante Project area:

General approach



Active restoration treatments envisioned for up to half (or more) of the Unc Mesas area (and expanding to the Escalante Project Area), substantially modifying landscape-scale structure andfunction (including fire hazard)

Locations assessed

12 new plots were added in the Escalante Project area, giving us about 50 plots to inform us onhistorical stand structure.

18 plots were measured in the Front Range for the method comparison.

Measurements taken at each location
Stem-mapping of live post-treatment trees
Mapping of signs of historical (1875) forest structure for the historical condition plots

People engaged in measuring (agency, volunteers, etc.)
Dan Binkley (CSU), Megan Matonis (CSU), Matt Tuten (USDA Forest Service), and UP collaborative volunteers

Objectives for 2014-2015 monitoring
Use Rapid Assessment (RA) plots to assess changes in basal area and species composition, fuels and expected fire behavior, understory and forest floor cover following treatments. Integrated the Forest Internship Program (FIP) high school student crew as primary data collectors. Pre-treatment monitoringserves as baseline for change post-treatment. See overall objectives and key questions above; additionally, regeneration plots were added to the study design to better assess long term forest resilience to treatments.

Protocol:

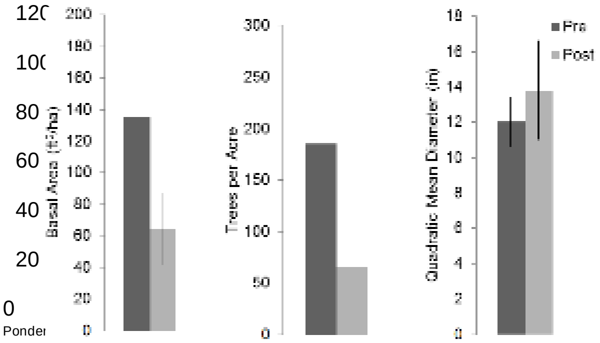
Spatial scale of the area under consideration
152,000 acres between Unc Mesas and Escalante Project.

General approach
Used Rapid Assessment plots to measure variables. Regeneration plots were 1/100th acre in size, allregenerating tree species and heights were recorded.

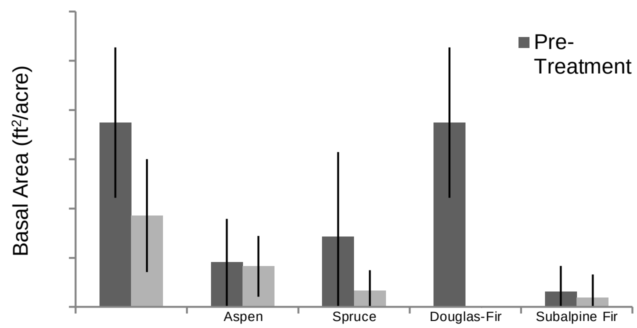
Measurements taken at each location
Plot characteristics (slope, aspect, GPS coordinates); Tree (species, status, DBH, CBH class, standing class); regeneration data (species, size classes, counts); Fuel loadings (1, 10, 100, 1000 hr, litter and duffdepths, shrub type, heights, and widths along transect); aerial cover of graminoids, forbs, shrubs, and other forest floor variables in Daubenmire plots

People engaged in measuring (agency, volunteers, etc.)
Kristen Pelz (CFRI), Rusty George (Montrose High School), Collen Trout

2014-2015 findings
Treatments have reduced the basal area and trees per acre, and have increased the quadratic mean diameter slightly. Stands also met the objective of retaining ponderosa pine and aspen, while removing non-pine conifer basal area. The reduction in basal area and removal of the more shade-tolerant conifers has led to more open stand conditions, which will provide more light for understory plants andshade-intolerant tree regeneration.

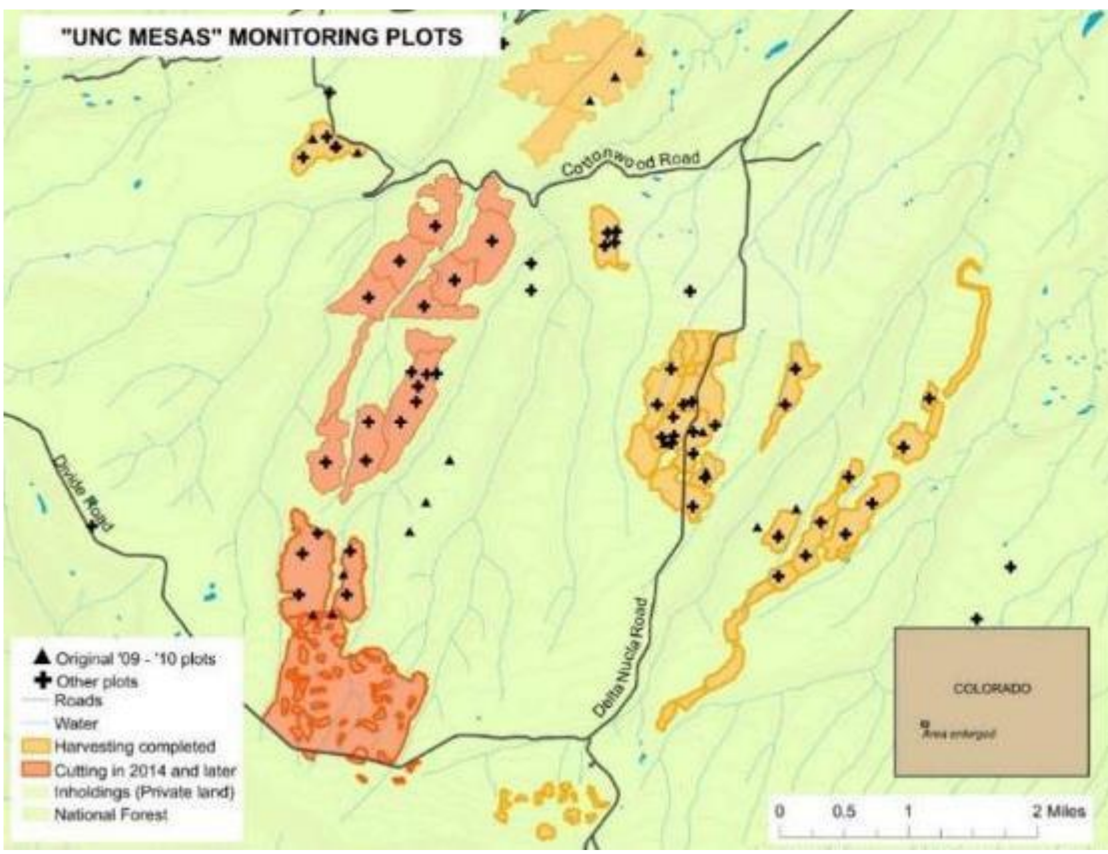


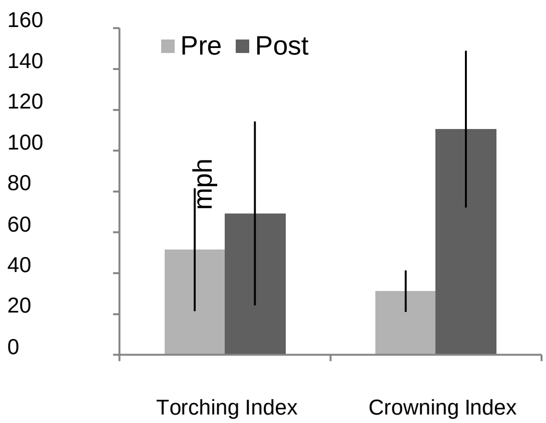
Mean (± standard deviation) basal area, trees per acre, and quadratic mean diameter before and after treatment.



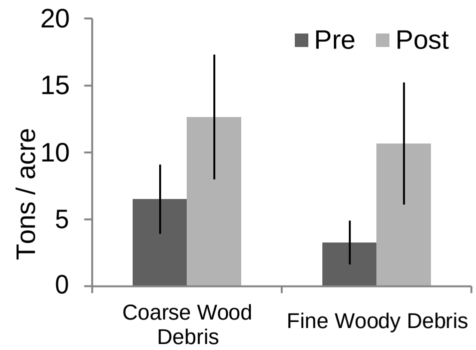
Mean (± standard deviation) of basal area by species before and after mechanical treatment.

Canopy fire hazard has been reduced in treated stands. Ladder and canopy fuels were reduced and surface fire is predicted to burn in all monitored stands (under 90th percentile weather conditions). Torching, and particularly Crowning, Indices increased suggesting active crown fire is much less likely in





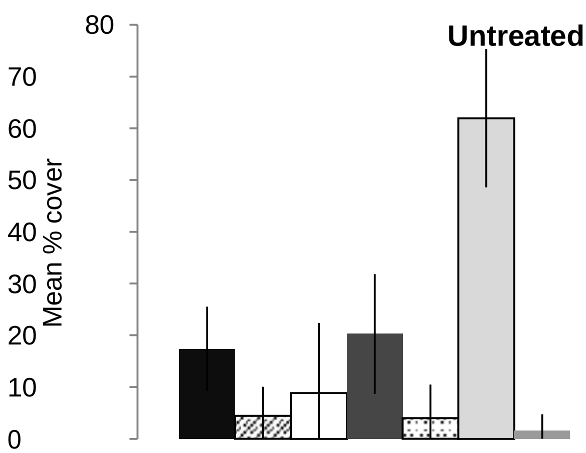
Mean (± standard deviation) Torching and Crowning Indices before and after treatment.

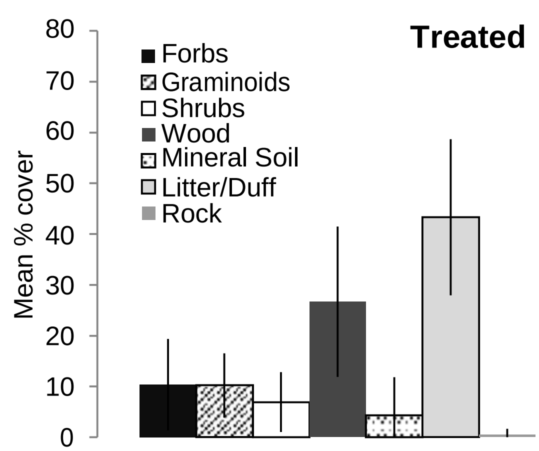


Mean (± standard deviation) coarse and fine woody debris in stands before and after treatment. Coarse woody debris is > 3 inches in diameter. Fine woody debris all smaller dead woody material.

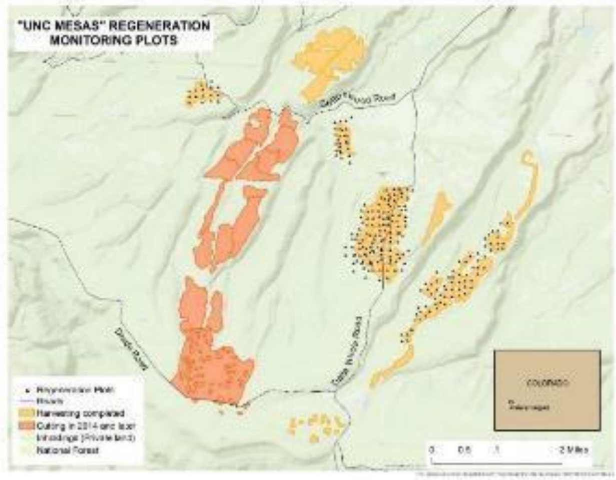
these stands now than before treatment. (Torching and Crowning indices are the wind speeds needed to sustain canopy fire; the higher the wind speed, the less likely crown fire is to occur. "Torching" is used to describe fire that moves from the surface into the crown of a single tree. Fire that moves fromtree crown to tree crown is called "crowning" fire.) Despite the reduction in canopy fire hazard, woodysurface fuels doubled following treatment. Prescribed fires are planned to help reduce surface fuel loads.

Mean cover (± standard deviation) of forest floor in treated and untreated areas measured in 2014. Litter, duff, and woody material are the dominant substrate following harvest. There was concern thattreatments would lead to too much soil disturbance; however, mineral soil is about 5% cover in both treated and untreated units. Forbs, graminoids (grasses and sedges), and shrubs cover less area in treated than untreated stands, but plant cover will likely increase with time since treatment.





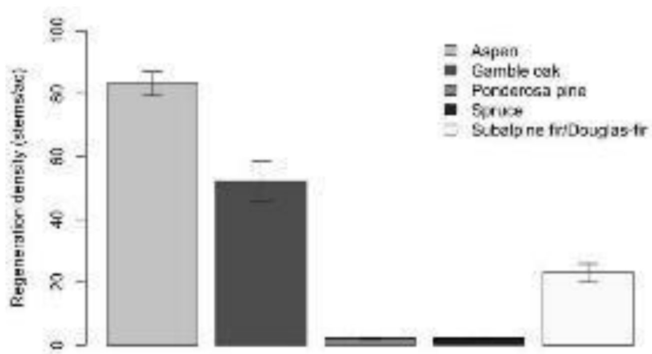
Tree regeneration is occurring and is dominated by aspen and oak, both species that can reproduce through re-sprouting. Subalpine fir/ Douglas-fir seedlings were present at low densities (<25 stems / acre), some of which may have been present prior to mechanical harvesting. Ponderosa pine and spruce species were regenerating at very low (<5 stems/ac) densities. Figure 5 (below) shows mean (± standarderror) regeneration densities by species averaged across monitoring area.



Tree regeneration was measured in 1) uncut- and-unburned (untreated) areas, and 2) cut; 3)cut-and-burned; 4) uncut-and-burned treatment areas.

Untreated areas were dominated by aspen, Gambel oak and subalpine fir/Douglas-fir with very little pine or spruce regeneration. Cut areas were dominated by high densities of regenerating aspen and Gambel oak, with verylow densities of regenerating pine and spruce.In 2015, Gambel oak was the dominant regenerating species in cut-and-burned areas.

However, further monitoring is needed to make meaningful inferences as only 5% of plots were located in cut-and-burned areas, and 1% of plots occurred in uncut-and-burned areas. The majority of plots were located in cut (62%) and uncut-and- unburned (untreated) (32%) areas. Therefore, remeasuring or adding plots following prescribed burningin 2016 will further inform regeneration across different treatment types.



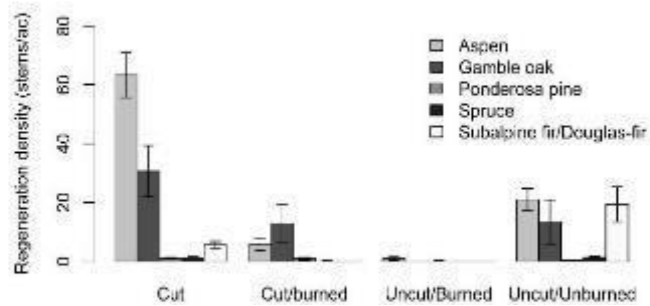
Mean (± standard error) regeneration density by species.

On the one hand, the increase in aspen and Gambel oak addsplant diversity in the project area and across the landscape which, in turn, adds diversity of habitat for wildlife. On the other hand, this increase could inhibit the development of Ponderosa pine stands or meadows; Gambel oak may also increase fire hazard. Monitoring the effect of fire on aspen and Gambel oak across the project area will inform what might be expected with future forest conditions

Right: photos ofthe pre- (at left) and post-treatment (at right) conditionsof a monitored stand. Larger conifer trees and aspen were retained.

<u>Objectives for 2016-2017 monitoring</u>
See overall objectives and key questions above; addition of pre- prescribed burn treatment plots added along with photo- points for before and after treatment visualaids.

<u>2016 findings</u>
Data collection primarily focused on pre- treatment areas; findings will be reported in2017 following post-treatment data collection.

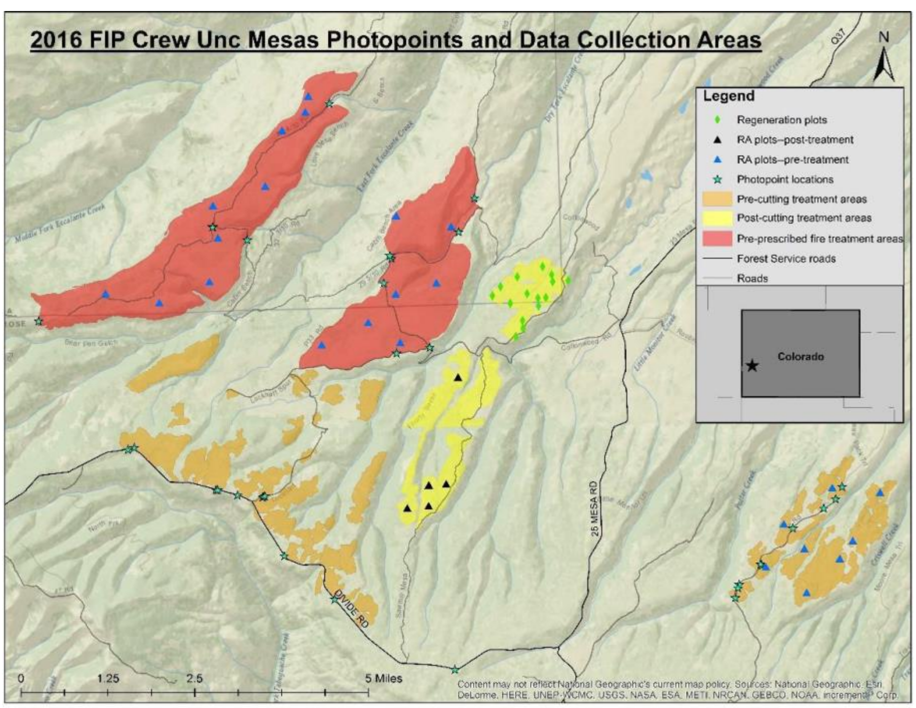


Mean (± standard error) regeneration density by species across a) cut; b) cut and burned; c) uncut and burned treatment areas and d)uncut and unburned (untreated) areas.

Protocol:

<u>Spatial scale of the area under consideration</u>
152,000 acres between Unc Mesas and Escalante Project.

<u>General approach</u>
Used Rapid Assessment plots to measure variables. Regeneration plots were 1/100th acre in size, all regenerating tree species and heights were recorded. Photo-points established along roads adjacent totreatment areas, GPS coordinates and notes taken to match post-treatment photos in 2017-2018.



Examples of photos at photo-points established in 2016. Photos are taken near a road or have clear permanent markers (i.e. trail sign, boulder). Post-treatment photo will attempt to recreate this same photo, illustrating post-treatment or post-burn conditions.

Measurements taken at each location
Plot characteristics (slope, aspect, GPS coordinates); Tree (species, status, DBH, CBH class, standing class); regeneration data (species, size classes, counts); Fuel loadings (1, 10, 100, 1000 hr, litter and duff depths, shrub type, heights, and widths along transect); aerial cover of graminoids, forbs, shrubs, and other forest floor variables in Daubenmire plots.

People engaged in measuring (agency, volunteers, etc.)
Marin Chambers (CFRI), Lyle Motley (Olathe High School)

Data management plans
Data are stored as Excel files and .jpg photo files at Colorado Forest Restoration Institute

Data archiving plans
Data will be archived at CFRI

Plan for communicating findings to collaborators, line officers
Finding are presented to collaborators and line officers during field trips on the Plateau, and during meetings. See most recent monitoring reports at https://cfri.colostate.edu/projects/collaborative-forest-landscape-restoration-project-2/uncompaghre-plateau-collaborative-forest-landscape- restoration-program/up-cflrp-products-and-links/

Project name: Invasive Species

Leadership people
Clare Hydock (USFS GMUG Supervisor's Office)

Overall goals and objectives:
To minimize invasive species on the Plateau, through early identification and treatment of new hotspots, and sustained efforts to impede expansion from other sites.

Objectives for annual monitoring
1. Continue with weed monitoring/treatment programs as in previous years
2. Focus on assessing road, treated stands to determine impact of restoration on invasive weeds Record spatial locations and percent cover of Colorado Listed Noxious Weed populations and other species of management concern using NRIS Data Recording Protocols for Invasive Species Management.

Results (2012 – 2016)
The stated goal is 6,800 acres of treatment with at least 80% efficacy over 10-years. We are currently at 4,098 acres treated with an average efficacy of 81%.

	Acres Treated			
Fiscal Year	CFLRP Funding	All Other Funding	Acres Monitored	Percent Efficacy
2012	789.5	801.7	351.8	82
2013	830.9	214	632.9	81
2014	758.5	34.5	687.6	81
2015	792.5	0.3	682.4	80
2016	918.4	1132.9	666.2	81
Totals	4,089.8	2,183.4	3,020.9	81 (average)

Key questions to be examined
1. Where are critical invasion hotspots?
2. How do restoration treatments affect success of invasive species?
3. How might restoration treatments be modified to reduce invasive risks?

Protocol:
Spatial scale of the area under consideration
The entire Uncompahgre Plateau and the Naturita Division

General approach
Ocular monitoring during routine travel on the Plateau
Soliciting observations from livestock permittees and others

Locations to be assessed
Phase 1:
100% inventory of high probability infestation areas in the Sawmill and Uncompahgre Mesas Contract Areas within 100 feet of:
- All National Forest System roads (with exception of Delta Nucla Road)
- National Forest System Trails
- Existing decommissioned roads
- Any identified existing old skid trails or landings
- Fence lines

- Large Meadows
- Low slope drainages impacted by harvesting/thinning or burning in Unc Mesa/Sawmill Mesa Contracts
- Ditches

Phase 2:
100% inventory of entire contract units:
- Where significant weed populations have been identified
- Harvested Units (Unit 7, Unc Mesas Stewardship Contract Area)

Measurements to be taken at each location
Location, species, and notes on extent

People engaged in measuring (agency, volunteers, etc.)
USDA Forest Service staff; county weed experts; permitees; other volunteers

Data management plans
Spatial Survey
- Locations of weed populations will be surveyed with GPS receivers. The center of isolated individual weeds smaller than 0.1 acres shall be recorded as point features and a radius of the infestation area will be recorded on the attribute data sheet.
- Larger distinct populations will be recorded using a track file to survey the areal extent of the weed population.
- Survey units and/or contract units will serve as the spatial location for widely dispersed populations with very low cover (i.e. less than 3% cover).
- A unique spatial identifier will be associated with each distinct weed population. These identifiers will be compiled and indexed using NRIS business rules after survey completion for incorporation into the NRIS invasive weed population database.
- Shapefiles of weed populations indexed with NRIS compatible identifiers will be created from GPS and track and point files and uploaded into the NRIS enterprise database.

Attribute Data
- All required data fields from the NRIS Data Recording Protocols for Invasive Species Management will be completed for each identified weed population
- NRIS Data Recording Protocols for Invasive Species Management data forms will be used for data recording purposes
- Spatial attribute identifiers will be recorded ~~the data forms~~ for each and every distinct weed population surveyed.
- This data will be uploaded into attribute fields of the NRIS invasive plant database.

Standards
- Data will be recorded at accuracies less than ±30 feet.
- NRIS Data Recording Protocols for Invasive Species Management will be followed to the greatest extent possible. Any deviation from the protocol will be recorded and discussed with monitoring work crew members as soon as possible.

Data archiving plans
Data uploaded into NRIS invasive plant database; copy also stored in GMUG database

Plan for communicating findings to collaborators, line officers
Summary report in the annual CFLRP Accomplishment Report
Presentation at annual UP CFLRP collaborators meeting

Project name: Riparian restoration

(National Forest Foundation article: http://www.nationalforests.org/blog/post/50/science-and-engineering-apprenticeship-providing-students-a-hands-on-education)

Leadership people
Clay Speas and Barry Johnston (USDA Forest Service). Teacher from Delta School District

Overall goals and objectives
To assess the current condition and trend of streambanks, channels, and streamside vegetationTo determine if livestock grazing management strategies and other land management actions are making progress toward achieving the long-term restoration goals and objectives for streamside riparian vegetation and aquatic resources.

Objectives for 2012 monitoring:
Implement MIM protocols for initial assessment of two reaches of Dominguez Creek Provide summer internships for local high school students, informing them about career potential in natural resources.

2012 Findings

Baseline long-term indicators for vegetation were established on both MIM reaches. Greenline vegetation composition is moderate similar to potential natural vegetation. Early seral species such as bull rush and dandelion still occur with most of the greenlinedominated by late seral species including several species of sedge. Floodplain vegetation composition is low similarity to natural vegetation composition along both reaches. The level of bare soil and presence of early seral species are the primary factors affecting ecological status. Woody species along reach 1 are also experiencing heavy browse resulting in few plants being in excess of 4 feet in height.

2013 Findings

High School students from Delta High School collected data using the Multiple Indicator Monitoring (MIM) protocol along two sections of Dominguez Creek. Pre- and post- grazing data have been collected along both reaches. Short-term indicators (stubble height, streambank alteration, woody species use) and long-term indicators (streambank erosion, greenline species composition, floodplain vegetation composition,woody species age distribution, streambed substrate and residual pool depth and pool frequency) are being collected. At the end of the 2013 grazing season, stubble height was reduced by approximately 60% at both reaches but Forest Plan standards were still achieved. Season-end use on willow was 60% along reach 1 and 25% along reach 2.

Streambank alteration increase from less than 5% pre-grazing to 15-20% post grazing. Greenline vegetation compositions along both reaches indicate a moderate similarity to potential natural vegetation composition. Floodplain vegetation composition is low similarity to natural vegetation composition along both reaches. To date, the prescribedgrazing system has not been adequately implemented leaving season end vegetative conditions below objective resulting in a decline in long-term vegetative indicators alongreach 1 and stagnant vegetative conditions long reach 2.

2014-2016
In the 2013 study plan students decided to defer monitoring to once every 3-4 years since capturing changes in long-term indicators from year-to-year is not feasible. In 2017,long-term indicators will again be collected and compared to baseline conditions established in 2012 and 2013.

Key questions to be examined:

1. What is the current condition of the riparian ecosystems in each reach? What factors have contributed to any observed problems?
2. What management opportunities need further work to achieve restoration goals?

Protocol:

Spatial scale of the area under consideration

Initially the project focuses on two reaches of Dominguez Creek, with plans to expand to other riparian systems on the Uncompahgre in the future.

General approach

Using the MIM protocol, the project will assess seven indicators of long-term riparian condition:

1. Greenline composition
2. Woody species height class
3. Streambank stability and cover
4. Woody species age class
5. Greenline-to-greenline width
6. Substrate
7. Residual pool depth and pool frequency

Protocol details can be found in: http://www.rmsmim.com/Portals/2/MIMdoc.pdf

Locations to be assessed

Two reaches of Dominguez Creek

Measurements to be taken at each location

(7 indicators above)

People engaged in measuring (agency, volunteers, etc.)

Clay Speas, Barry Johnston (thru a volunteer agreement)

Delta High School or Cedaredge High School teacher and students

Data management plans

Excel spreadsheet (part of MIM protocols)

Data archiving plans

Data will be archived in the GMUG database

Plan for communicating findings to collaborators, line officers

Students will present findings to the CFLRP Monitoring Group

The results will be presented at UP meetings, including one or more field trips.

Project name: Economic monitoring of restoration projects

Leadership people
Tony Cheng, Kathy Mattor, Torston Lund Snee, and Hannah Bergemann (CFRI/CSU)

Overall goals and objectives

1. Job creation, biomass utilization, and meaningful collaboration were identified as primary goals of the Uncompaghre Plateau Collaborative Forest Landscape Restoration Project. The socioeconomic monitoring of the UP-CFLRP will be conducted as a project-level assessment of task orders completed in calendar year 2012, and will identify the economic contributions and summarize wood utilization, community attitudes, and collaborative outcomes that resulted.
2. Outreach mechanisms relevant to forest management and wildfire preparedness and mitigation will be identified and recommendations will be made based on their effectiveness.

Objectives for monitoring
The UP-CFRLP socioeconomic monitoring will:

1. Quantify economic contributions to local communities that result from UP-CFLRP task orders in calendar year 2012, and identify the extent to which economic goals of the UP-CFLRP were met
2. Measure the types and amounts of wood utilization that resulted from these task orders
3. Measure public attitudes toward forest management practices, particularly toward mechanical treatments and prescribed fire
4. Describe collaborative outcomes for the development and implementation of the UP-CFLR project
5. Provide recommendations for future monitoring efforts

2013 Findings
This excerpt from the Uncompahgre CFLRP 2013 Socio-economic Monitoring Report summarizes key findings:

Table 2. Economic Contributions of UP CFLR Task Orders in 2013

	2013
Employment (Full and part time jobs)	1.16
Labor Income	$46,275
Value Added (GDP)	$100,021

In 2013, 328 acres were implemented by private contractors. One-hundred percent of the wood material harvested was utilized by local wood production facilities.

Key questions to be examined:
What impact have the restoration activities on the UP had on the economies of surrounding communities?

Protocol:

Spatial scale of the area under consideration
The entire Uncompahgre Plateau.

Locations to be assessed
All restoration treatment areas implemented as USDA Forest Service contracts to private enterprises.

Measurements to be taken at each location
Collection and analysis of monitoring data will include:

- Economic contribution and wood utilization surveys
- Use of the relevant literature and interviews of community members and collaborative stakeholders to assess community attitudes and collaborative outcomes
- Input-output analysis of survey results to determine the economic and employment impacts of UP-CFLR task orders

People engaged in measuring (agency, volunteers, etc.)
Tony Cheng, Kathy Mattor, Torston Lund Snee, and Hannah Bergemann

Data management plans
Data files and models kept on secure, password-protected network drive at Colorado State University.

Data archiving plans
Copies of the study results will be stored on the CFRI websites.

Plan for communicating findings to collaborators, line officers
Results will be communicated at collaborator meetings, and in CFRI reports. Agency colleagues will be routinely brought up to date through frequent conversations as well.

Project name: Native Seed Monitoring at Calamity Basin

Leadership people

Julie Grode, Grand Valley Ranger District

Overall goals and objectives (from Decision Memo)

1. Help to maintain and improve browse and forage quality for big game, wild turkey and sagebrush associated species
2. Help to reduce natural fuel loading
3. Make browse species such as Gambel oak more available to big game by lowering the canopy level and stimulating new growth of desirable browse species
4. Facilitate improved distribution of big game species and domestic stock through the project area by creating a mosaic of structural stages and size classes of vegetation
5. Increase acreage of sagebrush by opening up mature piñon-juniper stands
6. Maintain existing mule deer habitat and sage-associated species by treating the encroaching piñon-juniper
7. Maintain existing stands of ponderosa pine
8. Reduce the natural fuels within the project area, to lower the risk of large catastrophic wildfires
9. Promote forest stand resilience by diversifying age classes across the landscape

Objectives for 2013 monitoring:

1. Measure success in meeting management goals.
2. Determine effectiveness of aerial seeding with native species before treatment.

2013 Findings: (summarized from the report[1])

1. The treatments were completed in May, 2012, during and after which there was a severe drought on the northern Uncompahgre Plateau. During the spring and summer of 2012 there was over three months without any measurable precipitation in this area. When the precipitation did come, it was too late for many herbaceous plants, and many apparently died. Shrubs experienced widespread mortality. The winter of 2012-2013 was mild, and there was little rain until mid-July 2013 – thus the drought lasted over a year.
2. In the treatment areas in July, 2013, Shrub cover ranged 7 – 29%, averaging 14.6%, mostly Gambel oak (*Quercus gambelii*)[2] and Utah serviceberry (*Amelanchier utahensis*), both of these sprouting from the root crown.
3. Some of the sagebrush had been damaged by heavy equipment during the treatment, but it seems to be recovering somewhat.
4. Graminoid cover was much more than expected given the drought conditions that preceded my sampling. Graminoid cover ranged 6 – 53%, averaging 20.0%. Species such as prairie junegrass (*Koeleria macrantha*) and mountain brome (*Ceratochloa marginata*) were often conspicuous, both of these in the seed mix (Table 1). But species not in the mix were also conspicuous, such as needle-and-thread (*Hesperostipa comata*) and bottlebrush squirreltail (*Elymus elymoides*). Seeding before the mastication apparently had a beneficial effect; but the moisture-holding capacity of the mulch produced by mastication was also beneficial.
5. There was noticeable cheatgrass (Anisantha tectorum) at most of the transects. Cheatgrass cover is now at relatively low levels, but it must be remembered that it is a spring annual, and the last two springs have been very dry, not favorable for this species. We can expect more cheatgrass cover in years with normal late winter and spring moisture.
6. The three forbs in the seed mix were not observed along any of the transects, although a few isolated plants of each were seen as I walked through the treatment units. It may be that these plants will appear later. Forb cover was fairly low, ranging 3 – 27%, averaging 7.3%.

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[1] Johnston 2013

[2] Plant species names follow Weber and Wittmann 2012.

Key questions to be examined (Recommended Further Work)

1. Resample these transects and retake all photos next year and five years after the treatment.
2. Consider establishing a few transects in untreated areas to serve as a control.
3. Co-sponsor a symposium or workshop on management of Gambel oak, to include discussion of treatment options, fire history, and fire behavior.

Protocol:

Spatial scale of the area under consideration

Three treatment units, totaling about 120 acres (Fig. 1).

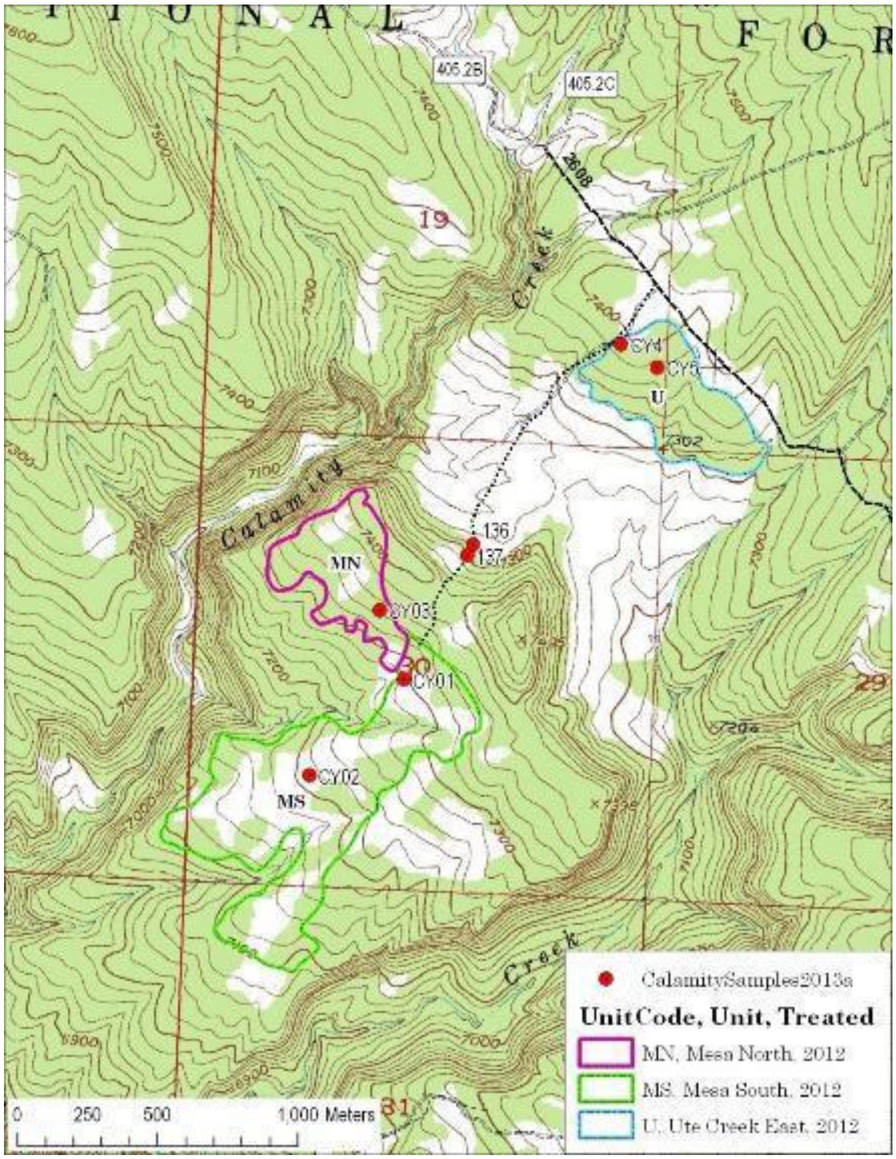


Figure 1. Units treated in 2012 as part of the Calamity Basin 2 Project.

General approach

Subjective sampling, to characterize stands treated, "subjective with no preconceived bias" (Mueller-Dombois and Ellenberg 1974).

Locations to be assessed

Five locations within the areas treated, nine transects.

Measurements to be taken at each location

Standard cover-frequency transect (metric), 30 m long with 20 Daubenmire microplots evenly spaced in each – cover by each plant species in microplots (estimate cover within circular plot with 30 m diameter); cover by each natural layer;cover by ground cover categories (bare soil, litter and duff, etc.). Transects permanently markedon the ground. Consistent protocol for photos (around 30 photos for each transect).

People engaged in measuring (agency, volunteers, etc.)

1 agency person

Data management plans

Summarize cover by species and ground cover for each transect, display in association table. Individual document for each transect, showing photographs, coverdata, and summary statistics.

Data archiving plans

Grand Valley District office, Forest Service corporate data bases.

Plan for communicating findings to collaborators, line officers

Regular reports (Johnston 2013).Initial report has been delivered to Grand Valley Ranger District.

Literature Cited

Johnston, Barry C. 2013. Report on monitoring for the Calamity Basin 2 Mastication Project 2012. Reportto Grand Valley Ranger District, Grand Junction, Colorado. Gunnison, Colorado: Grand Mesa, Uncompahgre, and Gunnison National Forests, 19 pp. September 24, 2013. Plus individual reports oneach of the nine transects.

Mueller-Dombois, Dieter; and Heinz Ellenberg. 1974. Aims and methods of vegetation ecology. 547 pp. New York, NY: John Wiley and Sons.

Weber, William A.; and Ronald C. Wittmann. 2012. Colorado flora: Western Slope, Fourth Edition. 532pp. Boulder, CO: University Press of Colorado.

Project name: Gambel oak understory response to mechanical treatments

Leadership people

Marin Chambers (Colorado Forest Restoration Institute), Eric Freels (USFS-Grand Valley Ranger District)

Overall goals and objectives

Gambel oak treatments in the La Fair project area were implemented in August of 2016 to improve wildlife browse and reduce ladder fuels in areas where ponderosa pine is interspersed with Gambel oak understory. The area was mechanically treated in the form of mowing; prescribed fire is planned for the area in 2017-2018. The goals for treatments were to:

1. Thin ponderosa pine stands by mastication and burning in order to improve stand growth and health of the pine stand. This will maintain this timber component for potential future harvests and wildlife habitat.
2. Promote the growth of understory forbs and shrubs in treated stands.
3. Reduce the threat of a catastrophic wildfire to the forest and to adjacent private lands.
4. Reduce the threat of pine beetle infestation within the ponderosa pine stands.
5. Improve growing conditions for shrubs, grasses and forbs in the understory and enhancing the available forage for big game species and the livestock that utilize this area.

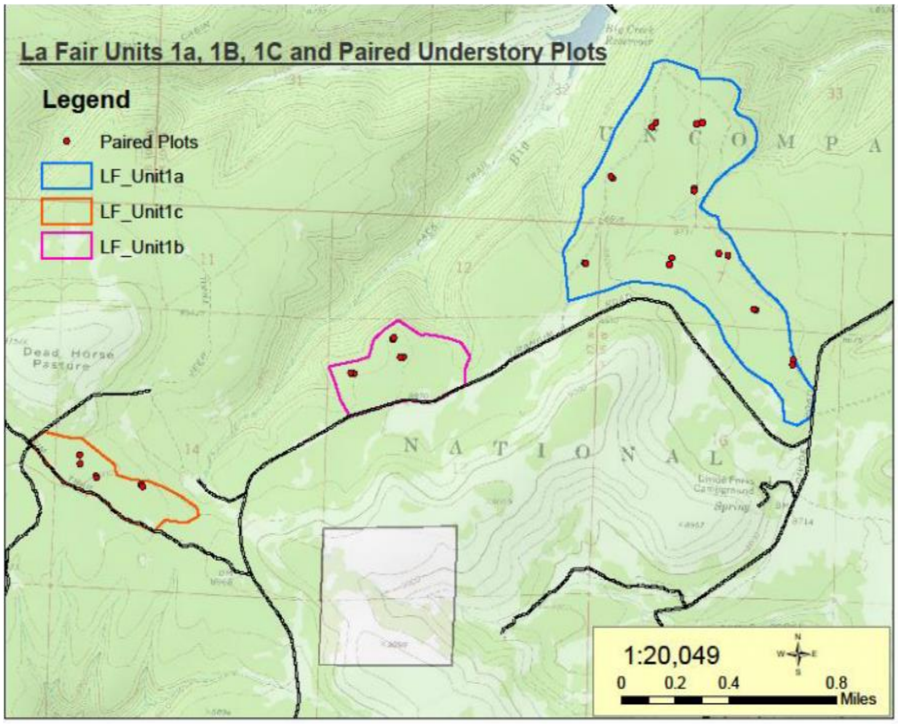
Gambel oak is a major component species which has contrasting management concerns as it is both important wildlife habitat and a hazardous ladder fuel. Understory vegetation response to the removal of Gambel oak is important for wildlife managers to ensure the overall improvement of browse potential of many understory grass, forb and shrub species. However, little is known about understory vegetation response to Gambel oak treatments (cutting, mowing, or prescribed burning); thus, treatments aimed at reducing Gambel oak may or may not actually improve wildlife browse potential. Locally-relevant information on Gambel oak management is greatly needed to understand understory vegetation response to cutting and prescribed burning treatments in this species, in addition to resprouting potential of this species to better understand treatment longevity and success.

Key questions to be examined

1. How does understory vegetation respond to treatments (mowing or prescribed burning) of Gambel oak?
2. What is the growth response of Gambel oak following treatments in terms of density and growth of sprouts?
3. What influence does Gambel oak treatment have on conifer regeneration?

Objectives for [2016] monitoring (multi-year monitoring project)

Establish pre-treatment paired plots across all La Fair project units, where data will be collected on regenerating and overstory stems of Gambel oak, understory vegetation (to species level), other ground cover variables, and abiotic conditions. For each paired plot, one will be mowed and the other will be retained as a control plot.



Above: Map of La Fair treatment areas 1A, 1B, 1C, and paired plots (red dots) in the northern Uncompaghre Plateau. Unit 1a: 320 ac; Unit 1b: 150 ac; Unit 1c: 54 ac

Objectives for [2017] monitoring (multi-year monitoring project)
Return to paired plots following treatments and collect post-treatment data. CFRI will collect, retain, and analyze data, and provide a report for either the monitoring jam session in fall 2017 or for the 2018 annual meeting.

Objectives for [2018] monitoring (multi-year monitoring project)
If prescribed burning is successful in 2017-2018, CFRI will return to collect post-prescribe burning data in all paired plots. This could also occur in 2019 if prescribed burning is not completed until 2018 and if funding allows.

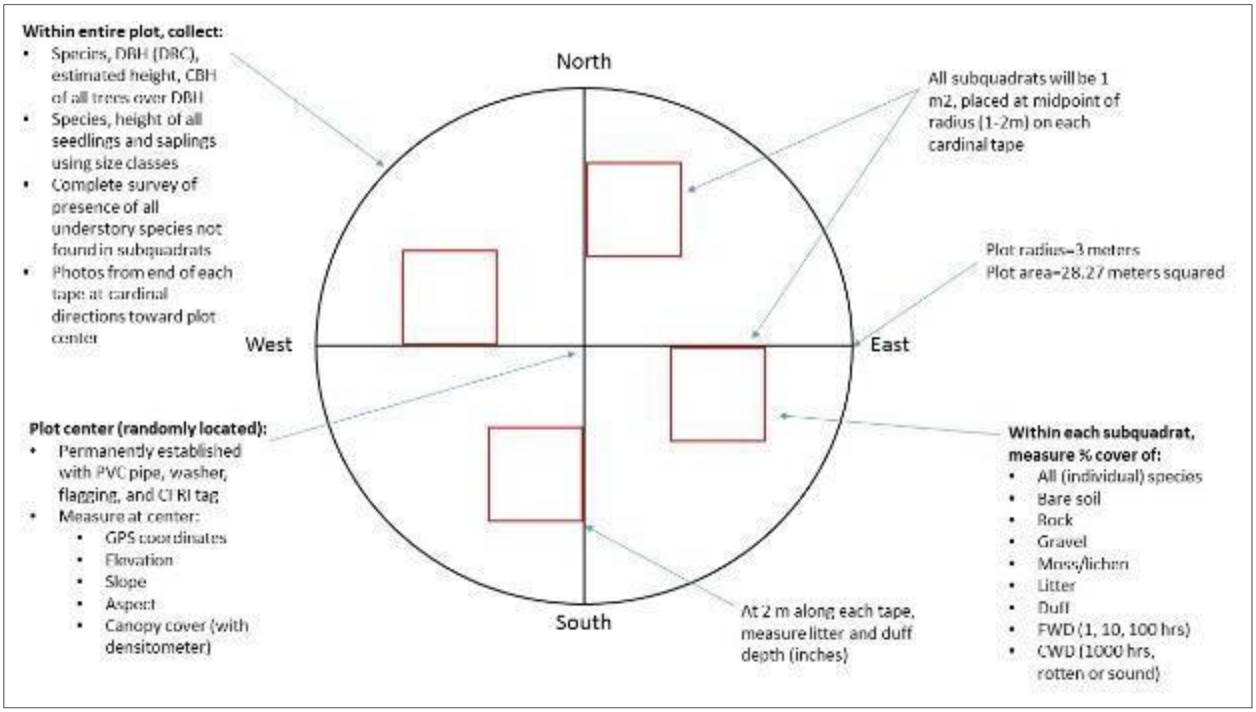
Protocol:

Spatial scale of the area under consideration
Three treatment units, over 500 acres total (Fig. below)

General approach
Paired plot sampling design

Locations to be assessed
Gambel oak patches within La Fair treatment units

Measurements to be taken at each location
Within 3m radius circular plots, regenerating and overstory stems of Gambel oak and other tree species were measured. Understory vegetation (by species cover and abundance), other ground cover variables, and abiotic conditions of each paired plot were also measured (see plot depiction below).



Plot depiction (below). Transects were placed along cardinal directions 3 m from a permanently established plot center. Tree species height, DBH, CBH; tree seedlings and saplings species and size class; and understory species presence were measured for the entire plot. Within 1 m^2 subplots centered on each transect, understory species and forest floor cover wasrecorded. Plot-level topographic variables, such as elevation, slope and aspect, were measured at plot center.

<u>People engaged in measuring (agency, volunteers, etc.)</u>

Marin Chambers and field crew (CFRI),Eric Freels and field crew (USFS-Grand Valley Ranger District)

<u>Data management plans</u>

Data collected, entered into excel spreadsheets, archived, andanalyzed by CFRI.

<u>Data archiving plans</u>

Colorado Forest Restoration Institute, Colorado State University

<u>Plan for communicating findings to collaborators, line officers</u>

Regular/yearly reports. 2016report is in preparation; 2017 report will include results.

Project name: Wildlife Cameras

Leadership people
Luke Holguin (USFS Norwood and Ouray Ranger District)

Overall goals and objectives

The goal is to measure wildlife densities and diversity within ourrestoration areas. Objectives are to continue the camera monitoring within the Escalante Restoration area on the Ouray Ranger District and identify new areas where we can gather wildlife data with the trail cameras.

Key questions to be examined
How restoration activities affect the presence of wildlife preand post treatment.

Objectives for [2016] monitoring (multi-year monitoring project)
These cameras were deployedwithin the Escalante Restoration area on the Uncompahgre Plateau. These cameras are directly tied to our Norwood High School Internship Program bird monitoring using the Integrated Monitoring in Bird Conservation Regions protocol.

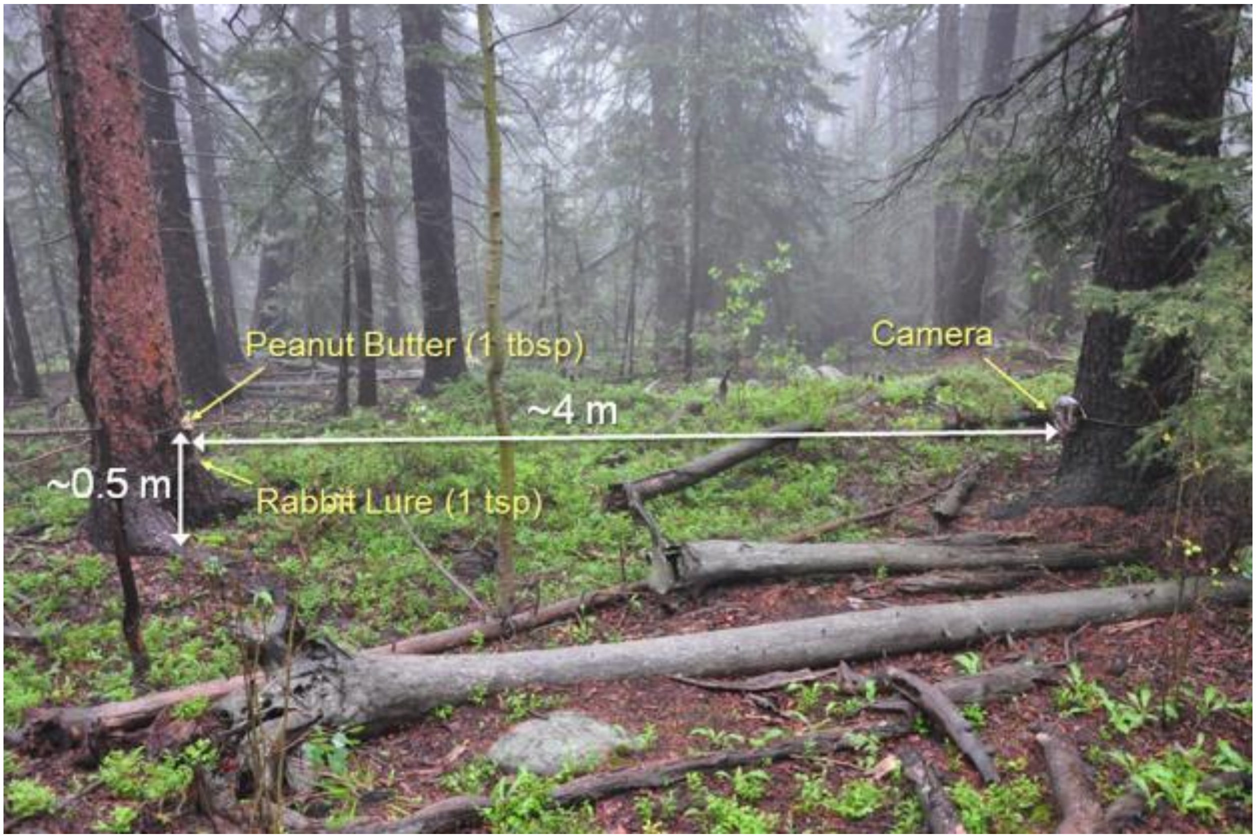
Objectives for [2017] monitoring (multi-year monitoring project)
Continue with our 2016 objectives. We also deployed the cameras in January on Dry Mesa to begin gathering data onwildlife in our mule deer habitat restoration activities.

Objectives for [2018] monitoring (multi-year monitoring project)
Continue with 2016 and 2017efforts. Identify new areas in which to use the cameras to monitor wildlife.

Protocol:

Spatial scale of the area under consideration
Our focus is in the Escalante RestorationArea on the Uncompahgre Plateau.

General approach
We follow a protocol developed by Jake Ivan who used the cameras and birding data to identify changes in bird and mammal diversity and densities related to the spruce beetle epidemic. Cameras are set out for at least 6 weeks. Peanut butter and rabbit lureare used to attract wildlife in the vicinity of the cameras to investigate and get their picture taken.



Locations to be assessed
Lockhart1, Lockhart 2, Unc Mesas, and Dry Mesa.

Measurements to be taken at each location
None. The cameras will do the work.

People engaged in measuring (agency, volunteers, etc.)
Norwood High School Interns, LukeHolguin.

Data management plans
All data are stored on server drives and uploaded to appropriatecorporate databases.

Data archiving plans
All data are stored on server drives and uploaded to appropriatecorporate databases.

Plan for communicating findings to collaborators, line officers
Students present their findings toUSFS personnel and CFLRP stakeholders at the conclusion of each year's internship (July).

Completed Project: Plateau Elk Pilot Study: Recruitment and Habitat Use Monitoring

Leadership people

Mat Alldredge (Mammals researcher, Colorado Parks and Wildlife) and Brad Banulis (Wildlife Biologist, Colorado Parks and Wildlife)

Overall goals and objectives

Elk calf recruitment has been observed to be declining across southern Colorado over the last 10-20 years through annual aerial classification flights. Our overall goal is to determine what is limiting juvenile elk recruitment in southwestern Colorado and how to improve elk recruitment. In addition, determine how elk utilize habitat on the Uncompahgre in relation to habitat type, travel management, hunting seasons, and habitat treatment and stand improvement projects.

Key questions to be examined

1. What are elk pregnancy rates on the Uncompahgre Plateau?
2. What are juvenile elk survival rates?
3. What is limiting pregnancy rates or juvenile survival?
4. How do elk move in relation to roads, seasonal recreation, and hunting seasons across the Uncompahgre?
5. What is limiting pregnancy rates or juvenile survival?
6. How do elk utilize habitat treatments and stand improvement projects?

Objectives for [2016] monitoring

Develop research study proposal, acquire funding and purchase satellite GPS collars.

Objectives for [2017] monitoring

Capture adult female elk in the winter. Determine pregnancy status and if pregnant fit with satellite GPS collar and VIT (vaginal implant transmitter). Monitor elk movements via GPS data. When VITs released, capture newborn calves and fit with satellite GPS collar to monitor movements and monitor survival. Determine cause specific mortality of cows and calves when needed.

Objectives for [2018] monitoring

Capture adult female elk in the winter. Determine pregnancy status and if pregnant fit with satellite GPS collar and VIT (vaginal implant transmitter). Monitor elk movements via GPS data. When VITs released, capture newborn calves and fit with satellite GPS collar to monitor movements and monitor survival. Determine cause specific mortality of cows and calves when needed. Start to analyze data and determine if pregnancy rates or calf survival are limiting juvenile recruitment and then develop long term research project to address identified issues and test hypotheses to correct issues.

Protocol:

Spatial scale of the area under consideration

The initial focus of the elk capture and collaring efforts will occur in smaller landscapes of the entire Uncompahgre Plateau. In GMU (Game Management Unit) 62, elk will be captured on winter range from Government Springs Road north to Roubideau. In GMU 61, elk will be captured on the south end from Sanborn Park Road north to Tabeguache Creek and then on the north end from Mesa Creek north to the Unaweep Canyon. Calf capture will be determined by where elk migrate to calving areas and summer range.

General approach

Capture adult female elk in the winter. Determine pregnancy status and if pregnant fit with satellite GPS collar and VIT (vaginal implant transmitter). Monitor elk movements via GPS data. When VITs released, capture newborn calves and fit with satellite GPS collar to monitor movements and monitor survival. Determine cause specific mortality of cows and calves when needed. Start to analyze data and determine if pregnancy rates or calf survival are limiting juvenile recruitment and then develop long term research project to address identified issues and test hypotheses to correct issues.

Locations to be assessed

Specific location monitoring will be determined by movements of collared elk.

Measurements to be taken at each location

People engaged in measuring (agency, volunteers, etc.)

Colorado Parks and Wildlife staff will attempt to capture elk on the ground when conditions allow as well as contracting with a helicopter capture company to capture elk more randomly within the area of interest. Seasonal temporaries will be hired to help capture and monitor elk calves. Volunteers will be incorporated in to capture operations to help with data collection and managing capture logistics. It is also probable that this research will turn into a graduate research project.

Data management plans

Data archiving plans

Plan for communicating findings to collaborators, line officers

Data will be summarized annually to assess annual pregnancy rates and juvenile survival. In addition, GPS data will be analyzed annually to look at seasonal home ranges and habitat use in relation to hunting seasons and seasonal recreation activity. At the completion of the 2 year pilot study, a more thorough analysis will take place of all data to develop a long term research project to address identified questions from pilot study. An annual report can be provided.

Mat Alldredge, CPW researcher, and Brad Banulis, CPW Wildlife biologist, measuring elk loin thickness as a gauge of overall body condition.

Project name: North Uncompahgre Prescribed Burning Monitoring

Leadership people

Eric Freels (USFS Grand Valley Ranger District), North Zone FMO and Module (temporary contact)

Overall goals and objectives

The goals of monitoring RX or managed fires is to determine the effects of the fire. Photo points are a great tool to compare vegetation before and after fire is introduced into the system. These points can be visited over a period of time to also evaluate the response of the vegetation.

Protocol

Spatial scale of the area under consideration

General approach

Locations to be assessed

Measurements to be taken at each location

People engaged in measuring (agency, volunteers, etc.)

Data management plans

Data archiving plans

Plan for communicating findings to collaborators, line officers

Pitch Fire

Grand Mesa, Uncompahgre, Gunnison National Forest
Fire Effects Monitor Observations
June 15 – 25

Monitoring Report form 2016 fire