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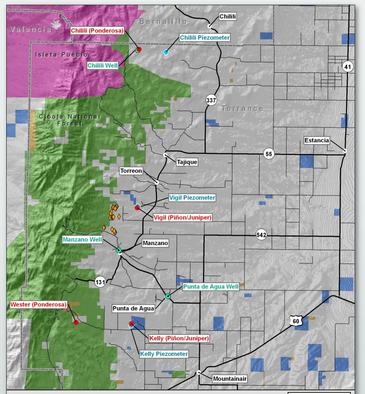
Estancia Basin Watershed Health and Monitoring Project

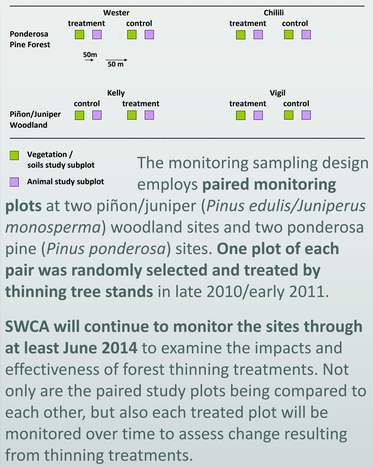
Claunch-Pinto, Edgewood, and East Torrance Soil and Water Conservation Districts and other members of the Estancia Basin Watershed Health, Restoration, and Monitoring Steering Committee

Introduction

- **The Estancia Basin Watershed Health, Restoration and Monitoring Steering Committee (Steering Committee) oversees forest thinning projects and monitoring of forest and watershed health in the Estancia Basin in coordination with the New Mexico Forest and Watershed Restoration Institute.** The primary goals of the Steering Committee are to improve forest health and create defensible space from wildfire. Funding for this project has been provided by the New Mexico Water Trust Board.
- **SWCA Environmental Consultants (SWCA) was awarded a contract in 2007 to conduct monitoring for forest thinning effectiveness on the eastern slopes of the Manzano Mountains for the Steering Committee.** SWCA finalized a comprehensive monitoring plan in March 2008 which is available online at the New Mexico Forest and Watershed Restoration Institute's website (http://www.nmfwri.org/images/stories/pdfs/Estancia_Basin_Monitoring/EstanciaBasinMonitoring.pdf)—that provides background information, research questions, and a discussion of methods relative to forest thinning and monitoring.
- **The principal goals of forest and watershed monitoring are to determine the effectiveness of standard prescribed forest thinning on soils, hydrology, water yield and quality, vegetation, and wildlife.** SWCA is responsible for planning and implementing forest thinning monitoring in order to evaluate these resources.
- **Data from permanent monitoring study sites provide information on rainfall, ambient and soil temperatures, soil moisture, soil surface profiles to assess erosion over time, soil surface stability, soil chemistry, bird and small mammal composition and relative abundance, and vegetation composition, structure, and cover.**

Study Sites and Methods





The monitoring sampling design employs **paired monitoring plots** at two piñon/juniper (*Pinus edulis/Juniperus monosperma*) woodland sites and two ponderosa pine (*Pinus ponderosa*) sites. **One plot of each pair was randomly selected and treated by thinning tree stands** in late 2010/early 2011.

SWCA will continue to monitor the sites through at least June 2014 to examine the impacts and effectiveness of forest thinning treatments. Not only are the paired study plots being compared to each other, but also each treated plot will be monitored over time to assess change resulting from thinning treatments.

A Piñon-Juniper Site

Non-thinned Control Plot

Thinned Treatment Plot

A Ponderosa Site

Non-thinned Control Plot

Thinned Treatment Plot

2007—2009
Pre-Treatment Data

2010—2011
Post-Treatment Data

2012—Onward
Continued Post-Treatment Data

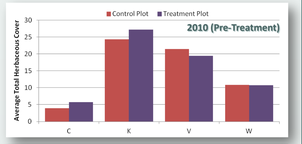
Variable	Method Used
Herbaceous Vegetation (canopy cover, species composition)	Line-intercept, quadrat, vertical structure
Trees and Fuels	Basal area, DBH, multiple crown measurements, dieback, tree mortality, ground surface fuel loads
Soils (chemistry, stability, movement, moisture, temperature)	Soil cores, USDA Soil Stability Test Kit, soil movement bridge, TDR soil moisture probe
Hydrology (surface runoff, streamflow, groundwater)	Parshall flume, stream piezometer, groundwater well
Weather (air temperature, soil temperature, soil moisture, precipitation)	Mini weather station
Wildlife (birds, small mammals, wildlife cameras)	Point count, repeat trap grid, automatic camera

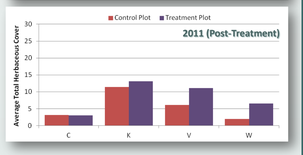
Results

Herbaceous Vegetation

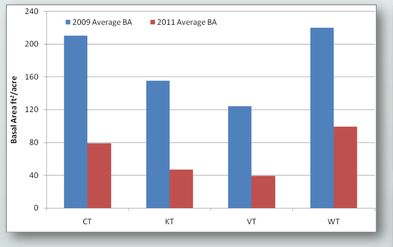
The graphs at right show the average herbaceous cover (grasses and forbs) for each Wildlife Plot from 2010 and 2011. Rainfall, plant growth, and cover were greater in 2010 than 2011. Despite drought conditions in 2011 herbaceous cover increased at one of the ponderosa sites and one of the piñon-juniper sites after thinning treatments. The Wester ponderosa site is the only site not grazed by livestock, and had the greatest herbaceous vegetation canopy cover in response to thinning.

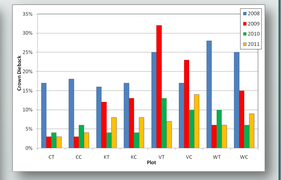
Study Plot
C – Control Plot
T – Treatment Plot
Piñon/Juniper Site
K – Kelly Site
V – Vigil Site
Ponderosa Pine Site
C – Chilili Site
W – Wester Site

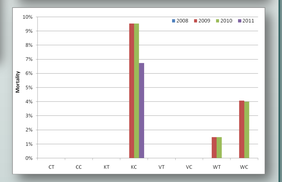




Trees



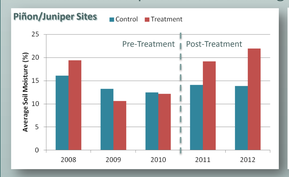


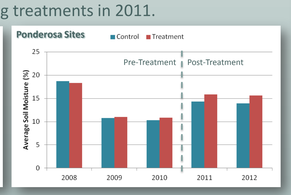


The graph above shows tree basal area from 2009 and 2011 for the treatment plots. Basal area was reduced by more than half at all sites after treatment in 2011. **The photographs are from the same location at the Vigil site treatment plot from 2008 to 2011.** The plot was thinned in 2011. **The graphs at right show crown dieback (top) and tree mortality (bottom) from 2008 to 2011 at all sites.** Crown dieback can be highly variable depending on tree size, position, and environmental factors such as drought, beetle infestation, and competitive stress. Only three plots experienced tree mortality; the data so far show no obvious relationship between crown dieback and mortality.

Soils

These graphs show the average soil moisture percentage for piñon/juniper sites and ponderosa sites from 2008 to 2012. All plots were acting in similar fashion prior to the thinning treatments in 2011.

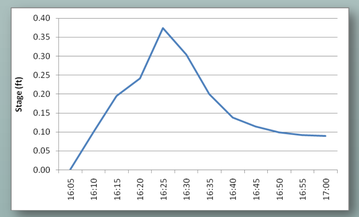


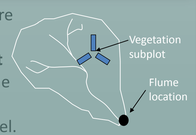


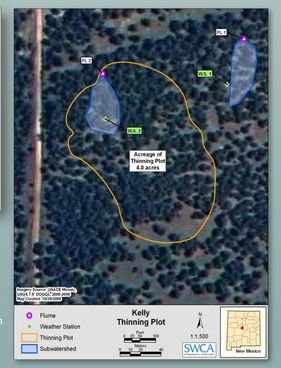
The difference between treatment and control plots is more pronounced at the piñon/juniper sites than at the ponderosa pine sites. This can likely be contributed to the decrease in canopy cover and the increase in ground cover in the form of wood chips.

Hydrology

Initial results from 2011 show the treated watersheds had higher peak flows and runoff ratios when compared to the controls. Whether or not these differences persist, and for how long will be revealed by future monitoring of flow events. **The graph at right is an example of a flow event which occurred during an August 20, 2011 storm event at the treated Chilili site.** This flow was recorded by a Parshall flume located at the base of the subwatershed for the plot. Piezometers and wells are also being used to monitor hydrology at the basin level.

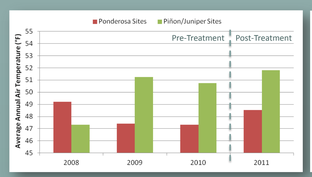


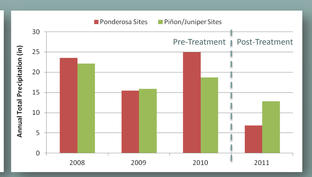




Weather

These graphs show the average annual air temperature (left) and the annual total precipitation (right) for the piñon/juniper and ponderosa sites from 2008 to 2011. Average annual air temperature increased overall for the piñon/juniper sites but not the ponderosa sites. Total annual precipitation decreased overall from 2008 to 2011, even through 2010 was a wetter year than 2009.

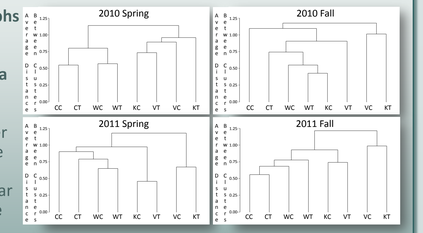




Results, continued

Wildlife

The photographs at left were taken with a wildlife camera at the Wester control plot in 2011. A mother elk and calf are shown at top, and a black bear at bottom. **The graphs above show cluster analysis dendograms for bird counts at all sites for spring and fall sampling in 2010 and 2011.** Bird communities were most similar to each other based on location, not treatment status—especially during spring breeding season—meaning the bird communities have not shown a response to thinning as of fall 2011.



Summary

Results from the 2011 first year of post-treatment monitoring data revealed some differences in parameter values between treatment and control plots that were not present prior to thinning.

- Tree and woody vegetation structure was greatly changed from the thinning treatments, resulting in **more open forest stands**.
- **Tree basal areas were reduced** on the treatment plots according to New Mexico State Forestry guidelines; Chilili pre-treatment basal area was 210 ft²/acre and was reduced to 80 ft²/acre, Wester basal area was 220 ft²/acre pre-treatment and 99 ft²/acre post-treatment, Kelly was 155 ft²/acre pre-treatment and 47 ft²/acre post-treatment, and Vigil was 124 ft²/acre pre-treatment and 39 ft²/acre post-treatment.
- Relatively few rainfall events and surface runoff events occurred. However, when flows did occur, the **treated watersheds had higher peak flows and runoff ratios** when compared to the controls. Future monitoring of flow events will reveal if this increased runoff on thinned sites persists and for how long.
- **Soil moisture was higher on treated plots** than control plots, especially during dry periods following rainfall events.
- **Herbaceous vegetation canopy cover was higher on half of the treated plots** compared to the control plots.
- Other parameters such as soil chemistry, soil surface erosion and surface stability, and bird communities have **not yet shown differences** between treatment and control plots.

Recommendations

This forest restoration monitoring study has shown that thinning of overgrown ponderosa pine and piñon/juniper woodlands has resulted in:

- **Decreased tree densities and wildfire fuel**
- **Increased surface water yield to the greater watersheds**
- **Increased soil moisture**
- **Increased herbaceous vegetation cover**
- **No change in soil surface erosion or soil surface stability during the first year of post-thinning treatments**

- **While many variables changed rapidly after thinning, monitoring will continue to see how those variables respond over a longer period of time**, and if other variables such as tree growth and health change too, especially as ongoing drought continues in the region.
- As climate change continues to occur, the effects of **persistent drought and reduced winter snowpack will likely have great negative effects** on forest and watershed health and function in the region. **Continued forest thinning will become even more important** as forest trees compete for less soil water and face increasing threats of widespread and severe wildfires.
- The importance of forest thinning as a resource management tool should become even greater over time. **We recommend that forest thinning be expanded to greater forested landscapes, and that thinning effectiveness monitoring also be expanded to understand and to monitor the effects of forest thinning treatments on greater forest watersheds.**

Acknowledgements

The **New Mexico Water Trust Board** provided funding for this project. The **Estancia Basin Watershed Health, Restoration and Monitoring Steering Committee** provided oversight and coordination of this project, in cooperation with the **New Mexico Forest and Watershed Restoration Institute and New Mexico State Forestry**. **Dierdre Tarr** of the **Claunch-Pinto Soil and Water Conservation District** and **Joe Zebrowski** from the **New Mexico Forest and Watershed Restoration Institute** provided valuable oversight and support. The **Kelly, Vigil,** and **Wester families** kindly offered access to their land to conduct forest thinning and monitoring research, along with the **Chilili Land Grant**, **Manzano Land Grant**, and the **Manzano Mountain Retreat**. **New Mexico State Forestry**, the **U.S. Forest Service**, the **U.S. Geological Survey**, and the **Claunch-Pinto, East Torrance,** and **Edgewood soil and water conservation districts** have all provided advice and support. **Vernon Kohler** and **Kelly Archuleta** from the Claunch-Pinto and Edgewood soil and water conservation districts have been assisting with field data collections. **Mike Matush** from the **New Mexico Environment Department, Surface Water Quality Bureau**, has been helpful in designing and installing stream monitoring stations. The **Estancia Basin Water Planning Committee** also contributed funding to install the new Chilili ponderosa pine monitoring study site.