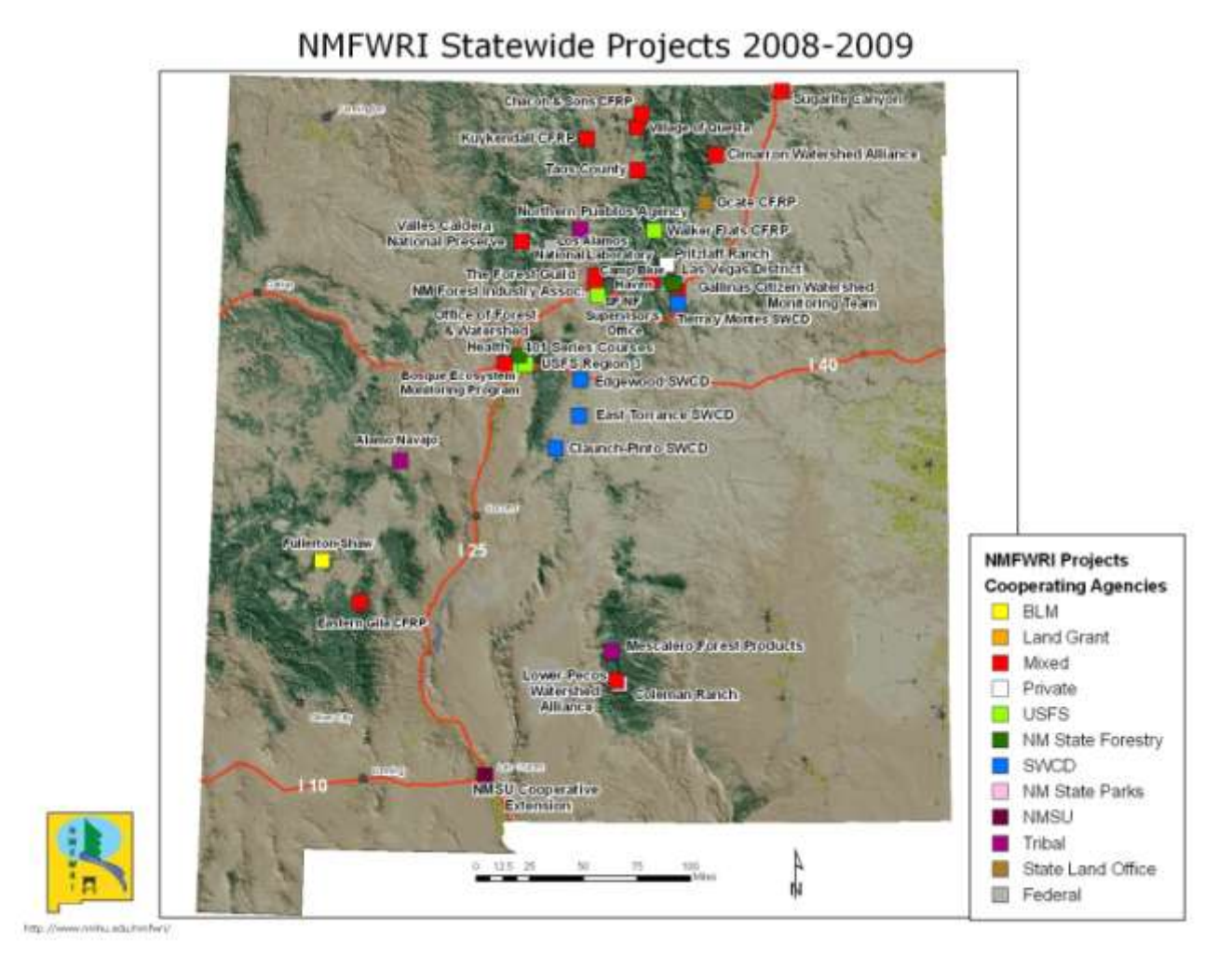
Forest Restoration and Water Savings: Myth or Reality?

Ken Smith

New Mexico Forest and Watershed Restoration Institute

Southwest Ecological Restoration Institutes

2008-2009 projects



Activities

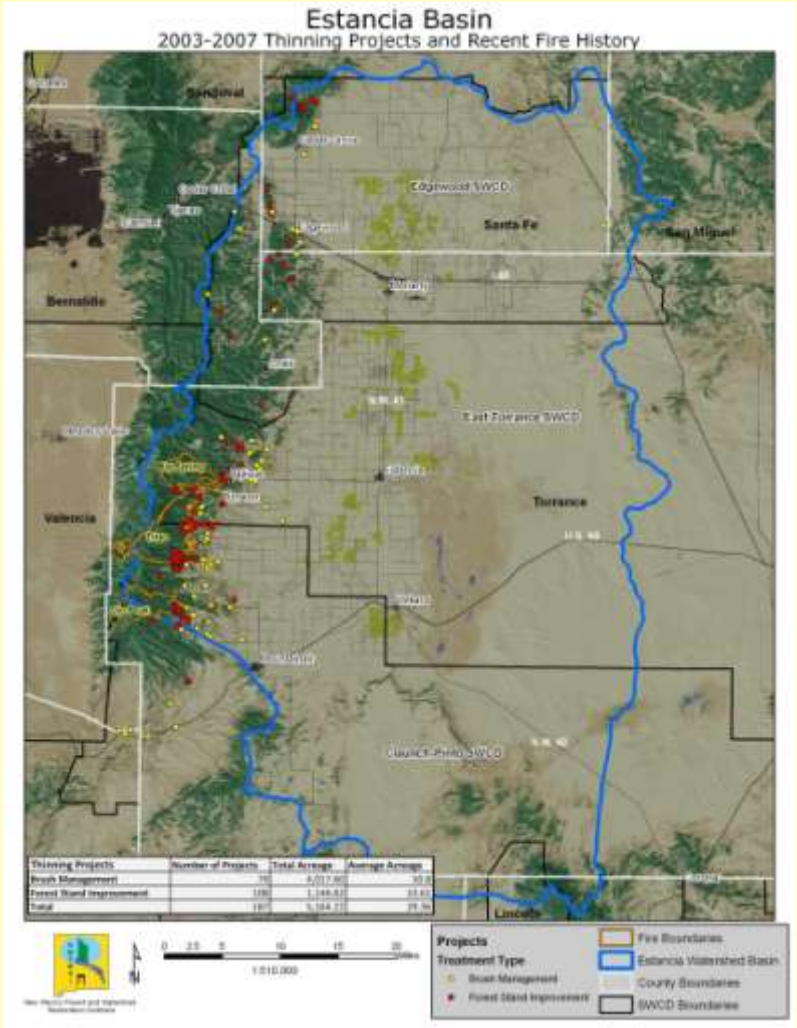
- Meet objectives in federal authorizing legislation

"Southwest Forest Health and Wildfire Prevention Act of 2004"

- Help New Mexican stakeholders achieve the recommendations in the Forest and Watershed Health Plan
- Respond to requests in the field

Pre- and post-treatment monitoring

Mapping and treatment prioritization



Forestry and natural resource education

Forest business and economics

Restoration and water savings

Site specific; consider a complex array of variables

- Soil depth, texture
- Slope position and aspect
- Precipitation regime
- Mix of species and rooting habits
- Tree crowns and precip interception rates
- Tree age, size, health
- Subsurface hydrogeology
- Water yield – stream flow vs groundwater

- Road building, soil compaction and water quality

Soil-tree-atmosphere Transpiration rates

- mature trees 3 – 300 gallons/tree/day (New Mexico trees at lower end of spectrum)
- Mesquite in Texas = 8 gallons per tree/day
- Mesquite stands = approx. 200,000 gallons/acre/year

Tree harvesting and water yield

- Bosch and Hewlett 1982
- 94 catchment experiments reviewed around the world
- Pine and eucalyptus forest – 40mm change in water yield (stream flow increase) per 10% change in forest cover

National Forest Water Yield Augmentation - Limited Opportunities Due to Operational Realities

- Larry Schmidt and Jennifer Wellman, Stream Systems Technology Center, Rocky Mountain Research Station 2/21/2002

- Opportunities to increase yield are generally limited to areas with precipitation greater than 16 in. (400 mm)

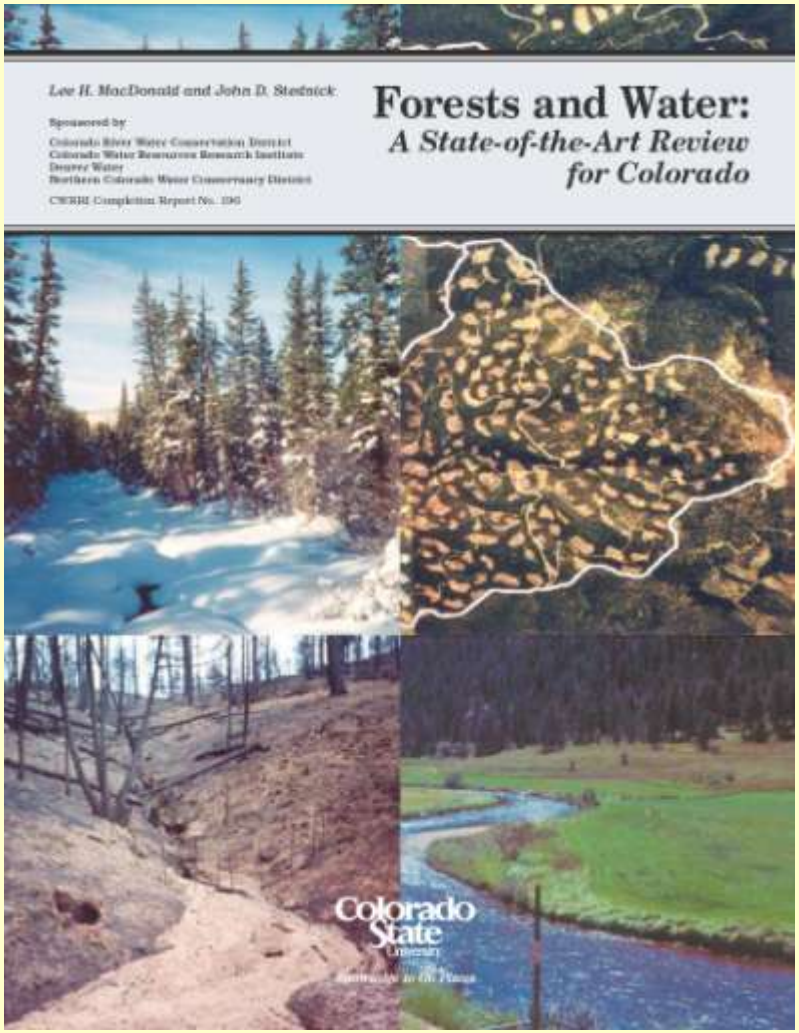
- Most research is based on comparisons of yield on paired watersheds of very small size

Schmidt and Wellman 2002

- Ponderosa Pine - Brown et al. (1974) noted increases in streamflow after clearcutting and thinning experiments in ponderosa pine forests near Beaver Creek, Arizona

- Piñon-Juniper - Most studies indicate that water yield increases from PJ management is poor

Regional Studies - Colorado

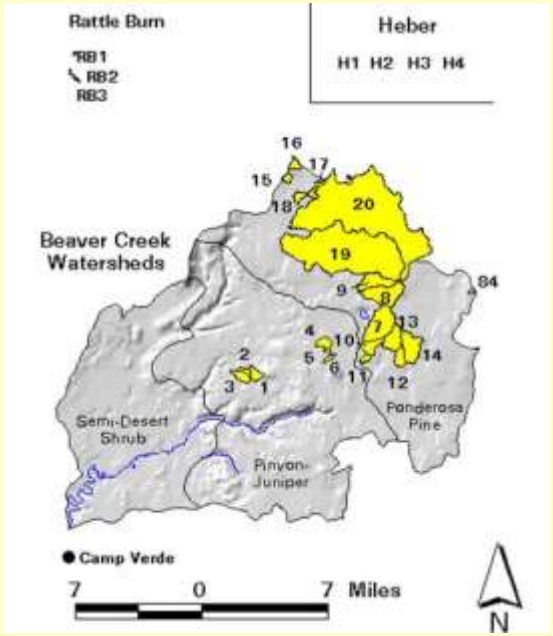


MacDonald and Stednick 2003

- Annual water yields in the higher elevation spruce-fir and lodgepole pine forests increase as basal area decreases.
- This increase in water yield after thinning is due to the reduction in winter interception losses and transpiration.
- Paired-watershed studies have shown that the reduction of forest canopy has a significant effect on peak spring flows and very little effect on summer low flows

Arizona

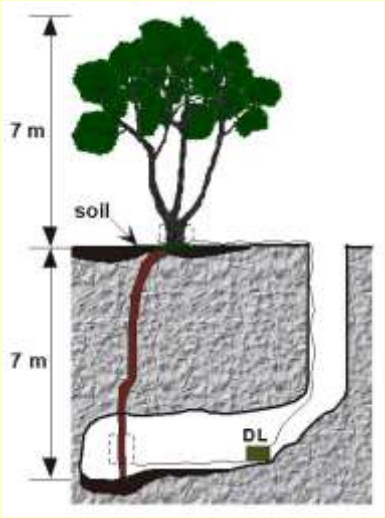
- Ffolliott and Thorud – Water Yield Improvement by Vegetation Management
- In Arizona, manipulation of PJ was not promising for increases in water yield
- Beaver Creek (Coconino NF)
- Stream flow increases in ponderosa forest after thinning



Texas

Texas

- Ashe juniper on Edwards Plateau
- How vegetation affects groundwater infiltration rates and groundwater yield
- During growing season, 24% of daily transpiration came from roots below 21 foot depth (in a cave) – Pockman et al. 2000
- Juniper roots seen in water holding caves at 60 feet

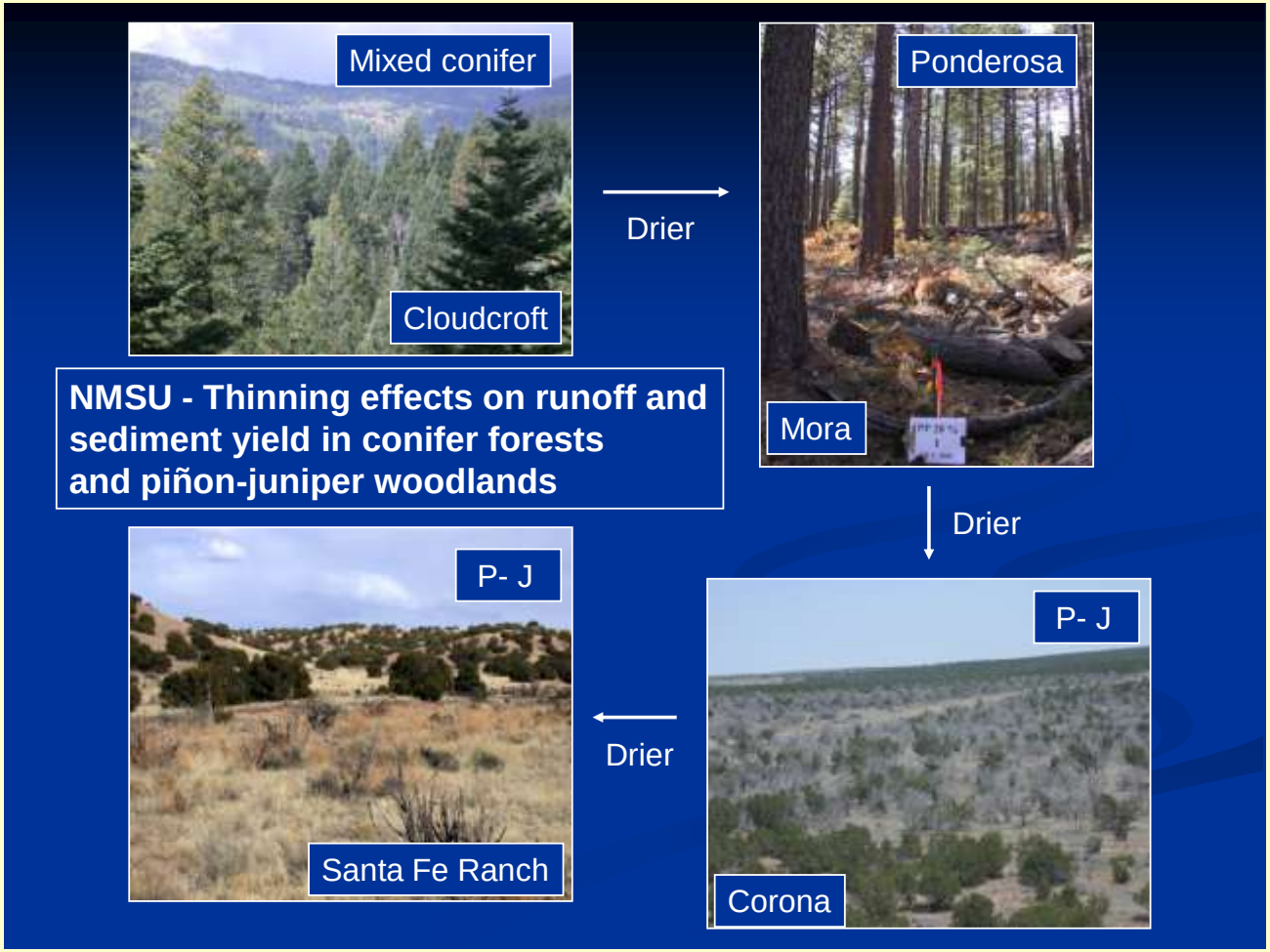


Texas – other juniper findings

- Hydrogen isotope data reveal juniper uses lateral (surface) roots during wet season and deep roots during dry season (McCole 2003)

- Increase in juniper density greatly affects tree interception/evaporation of rainfall (Owens 2008)

New Mexico - NMSU



NM EPSCoR - Hydrology

- Network of towers instrumented to estimate fluxes of water, energy, and CO_2 from riparian forests of the Middle Rio Grande
- Measure and compare water use of non-native and native vegetation
- Evaluate the water savings or loss due to the removal of non-natives and restoration of native riparian vegetation

Coonrod and McDonnell

Figure 4. 10-m Tower in Salt Cedar Stand, 25-m Tower in Cottonwood Stand

NM EPSCoR - Hydrology

- Dense, mixed native and non-native forests support the greatest ET rates
- Riparian forests dominated by one species (native or non-native) had lower ET rates than mixed forests
- Removal of saltcedar and cottonwood resulted in a water use reduction (similar ET compared to monospecific forests)

BEMP/Kim Eichhorst

- Along the Middle Rio Grande at various bosque (BEMP) sites
- monthly monitoring of groundwater after the removal of exotic vegetation (primarily Russian olive, saltcedar, and elm)

BEMP/Kim Eichhorst

- Four years after clearing (including sites with high success in exotic removal), there was no significant increase in the groundwater levels at all sites; conversely, groundwater levels continue to decline in some Albuquerque sites.

- At one of the Albuquerque sites, the annual decline in water table leveled off after clearing, (four years of no decline), which may very well be due to removal of exotics.

Estancia Basin

- Claunch-Pinto, East Torrance, Edgewood SWCD's
- SWCA, David Lightfoot
- Replicated sites in ponderosa and PJ
- Thinning responses – birds, soil moisture, surface H_2O flow, rodents, other variables

Santa Fe Watershed

Santa Fe findings

- Paired basin study conducted by Watershed West (funded by City of SF)
- Four years of pre-treatment calibration
- Two years of data collection after thinning
- Mean daily flows increased 50% in treated basin
- Turbidity no change pre- to post-treatment

- Sub-watershed variation – not possible to extrapolate findings to entire watershed treatment

Sacramento Mountains Hydrogeology Study

- NRCS, Bureau of Geology and Mineral Resources, NM Tech, NMSU, State Forestry, Lower Pecos Watershed Association, Coleman Family

Coleman Ranch

- Examination of how precipitation is partitioned and distributed in the sub-watershed
- How this partitioning changes in response to thinning
- Goal is to construct a hydrologic model to predict how ground water and surface water is affected by thinning

Personal experiences and unpublished data

- Personal observations of springs and creeks that flow once vegetation is removed

- Claunch-Pinto project
- Soil moisture measured down the 15 feet – correlate with juniper removal
- At depth, soil moisture increased where juniper removed

- Enviro-Logic – thinning no effects on recharge

Summary

- Ample evidence that in upland forests – thinning affects stream flow and water yield
- As plants respond – water yield subsides with time
- In PJ sites – thinning reduces interception – more water available for forbs and grasses, stream and surface flow altered but not increased
- PJ thinning affect groundwater? Dependant on rooting depth of trees – depth of groundwater

Upcoming events

Workshop Announcement:

New Mexico Forestry and Climate Change Workshop

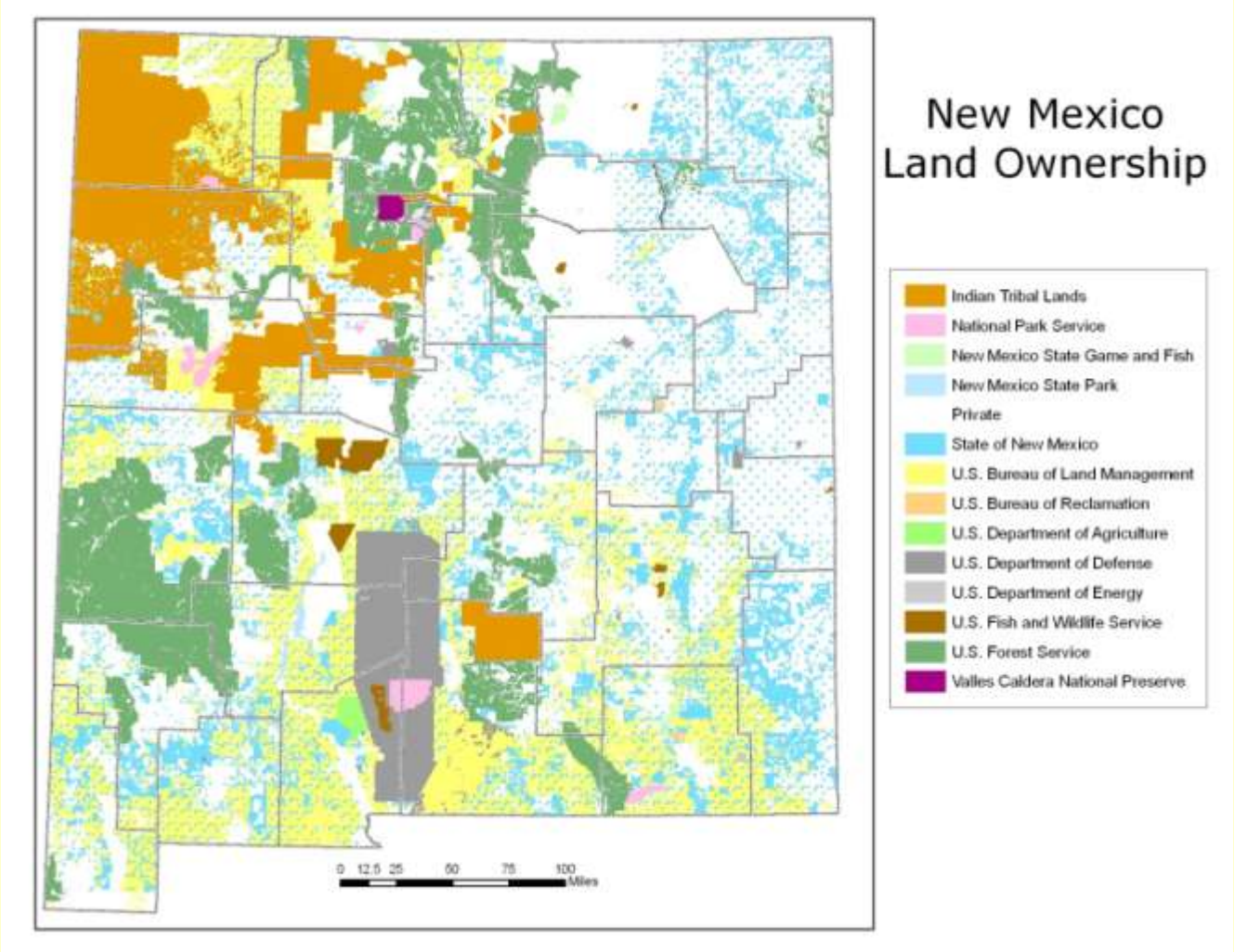
November 20, 2008
Albuquerque Grand Hotel
Albuquerque, New Mexico

Daylong workshop to provide information related to climate change's projected impacts on New Mexico's forests to incorporate into forest management decision making.

Audience: Forest managers and other natural resource professionals, researchers, landowners, students, activists, policymakers, and the interested public.

More info at www.forestguild.org/nmfccworkshop.html

A Final Note


New Mexico
Land Ownership
Indian Tribal Lands
National Park Service
New Mexico State Game and Fish
New Mexico State Park
Private
State of New Mexico
U.S. Bureau of Land Management
U.S. Bureau of Reclamation
U.S. Department of Agriculture
U.S. Department of Defense
U.S. Department of Energy
U.S. Fish and Wildlife Service
U.S. Forest Service
Valles Caldera National Preserve
0 12.5 25 50 75 100
Miles

The important boundaries