Pinyon-Juniper/Shrublands Successional Trends: Implications of Long-Term Changes for Woodland Management

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Although we now have a good idea of the patterns of woodland expansion for the Great Basin as a whole, these woodlands have never had the detailed inventories necessary for their intensive management and treatment. These inventories are necessary to understand the types and distribution of woodland variability.

Although they can give the appearance of simplicity, these woodlands are highly complex.

They are first highly variable in the associated perennial species present in their understory communities.

Depending on location there are:
- Different species and subspecies of sagebrush present
- Different species of deep rooted perennial grasses present
- Different species of perennial forbs present

The different combinations of these perennial plant species indicate significant differences in how a site should be managed, and in how it will respond to treatment.
Woodland sites also differ widely in climate, elevation, topography, aspect, slope, geology, and soils, all of which affect productivity.

Differences also affect the procedures available for effective management, and the options available for treatment to minimize the negative impacts.

Central to an understanding of the underlying variability of Great Basin woodlands is also an understanding of how the woodlands have changed over the last 100 to 150 years, and how they will continue to change over the next 50 to 100 years.

These ongoing changes have direct affects on the possibilities for management, and on the options for, and the outcomes from treatment.
Great Basin Study
Sites for the
Changing Fire
Regimes Study
Funded by the Joint
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Comparisons of Community Types Sampled, and Comparison of Relative Abundance of Pre-Settlement (age oldest tree > 140 yrs.) and Post-Settlement (age of oldest tree < 140 yrs.) plots for the Changing Fire Regimes Study in Nevada and Utah.

A Joint Fire Sciences Program Funded Project
Rates of Tree Establishment By Decade for Three Study Sites

A Joint Fire Sciences Program Funded Study
Tree establishment patterns on Southern Nevada Mountain Top Pinyon-Juniper Woodland Sites

Clover Mountains Permanent Plots

Mount Irish Permanent Plots

Pinyon Pine
n=304

Pinyon Pine
n=299

Date (10 year bins)
Tree establishment patterns in Underdown Canyon, Shoshone Mountains, Nevada
Average tree age plus 95% C.L. by crown diameter class for four Great Basin data sets.

- Juniper Mountain Transect
- Shoshone Transect
- East Tintic Transect
- Underdown Canyon

Sampled 2001 - 2002
Pattern of Understory Decline Over Time With the Increase in Pinyon/Juniper Dominance

Tree Dominance =

- Low
  - Phase 1
- Mid
  - Phase 2
- High
  - Phase 3

Graph showing:
- Total Tree Leaf Bio. Weighted Avg. Age of Pinyon
- Total Understory Leaf Bio. (kg)

Pictures:
- Picture 1: Graph showing the decline in understory leaf biomass with increasing tree dominance.
- Picture 2: Graph showing the increase in total tree leaf biomass with increasing tree dominance.
Picture 1. Upper Underdown Canyon, Shoshone Mountains, Nevada, June 1973
North Kern East Chaining

Mostly Phase I, some Phase II on hillside.

1971

Mostly Phase III, some Phase II on hillside

2008
Blythe Springs Chaining

Mostly Phases I and II, with some Phase III on hillside

1971

Mostly Phase III, with some Phase II on hillside

2008
Underdown Canyon, Shoshone Mountains, NV Pre-Treatment Data (40 plots of 0.10 ha)
Pattern of Increase in One-Hour Live Fuels With Increasing Relative Tree Dominance in the Underdown Canyon Demonstration Area, Shoshone Mountains, NV

Underdown Canyon Demonstration Area Fuels

Phase 1 | Phase 2 | Phase 3

Total One-Hour Live Fuels (kg/ha)

Relative Tree Percent Cover

- Low Elevation Plots
- Mid Elevation Plots
- High Elevation Plots
Distribution of the Study Plots Between Low, Mid, and High Tree Dominance for the Changing Fire Regimes Study

Upper Underdown Canyon, NV 1973

Upper Underdown Canyon, NV 2005

Shoshone Mountains

E. Tintic Mountains

Percent of Total

41% 40%

49% 47%

10% 13%

Low Mid High

Tree Dominance Level
Cathedral Burn, White Pine Range, Nevada, Mid-June, 2008 (Burned Mid-July 2007)
Jackass Burn, Sweetwater Mountains, Nevada-California, Late August, 2009 (Burned 2006)
Cheatgrass and Tumble Mustard Dominate a Phase III Expansion Woodland Site Four Years After Wildfire

Burn Site is located on the East Side of Mount Como, Pine Nut Mountains, Nevada
Marking Corral Site Treatments Late July, 2009: Mechanical (Foreground), Prescribed Burn (Background). Treated late August, 2006 (SageSTEP Project, Joint Fire Sciences)
Marking Corral Mechanical, Phase I, July 2009
Treated Late August, 2006 (JFS SageSTEP Project)
Marking Corral Mechanical Phase III, July 2009
Treated Late August, 2006 (JFS SageSTEP Project)
Marking Corral Burn, Phase III, July 2009
Treated Late August, 2006 (JFS SageSTEP Project)
For planning management and treatment there are three types of woodland sites.

1. Sites where all the trees should be removed to delay the rate of tree re-establishment as much as possible. This is about 20% of the total current woodland area.

   These are sites that are highly productive and represent areas with valuable habitat, and important watershed characteristics and forage. Tree removal will also break up large, contiguous stands, potentially reducing the size of wildfires.

2. Sites where no trees should be removed (or possibly only young trees filling in the stands). While these sites are common, they are not abundant, representing about 5%+ of the current woodland area.

   These are sites that are usually old-growth, or are otherwise sites of low productivity, such as on steep slopes, or shallow or sandy soils. Overall, they are not economical to try to treat.
3. The remainder, about 75% of the current woodland area, can possibly be managed in multiple ways.

Currently about 20% of this area is in tree dominated, Phase III expansion woodlands that are at or near maximum biomass and fuel loads.

About 50% of this area is in Phase II expansion woodlands. These woodlands average about half the maximum biomass. Phase III biomass will probably not be present for another 40 to 50 years.

The remaining about 30% is in Phase I expansion woodlands that only average about 25% of maximum biomass. For sites with adequate tree density, maybe another 80 to 100 years to reach Phase III.

Different Phases of woodlands can respond differently to different types of treatments. Results from the SageSTEP Marking Corral site provides examples.
In the woodlands of Nevada and western Utah there are currently about 100,000+ acres a year moving into Phase III woodlands.

As this happens the potential for wildfire or insect attack is rapidly increasing across large areas of the landscape.

Treatment of many of these sites involves both tree removal to reduce the potential for both wildfire and insect attack, while simultaneously limiting the expansion and dominance of exotic annual or perennial invaders.

The use of mechanical removal procedures in Phase III woodlands, along with seeding could provide for an increased presence and growth of herbaceous perennials, potentially improving the resilience of the site to a follow up treatment by prescribed fire.
Following chaining there was about eight to ten years, and sometimes longer, of increased presence and growth of herbaceous perennials, potentially improving the resilience of the site to a follow up treatment by prescribed fire.

Results from these long-term chaining studies also indicate a possible rotation time for repeating biomass harvests in these woodlands.

Also, the combination of the trees left behind, and the release of the understory, seems to help control the expansion and dominance of exotic annuals.

An indication of tree growth following a harvest treatment can be seen in the patterns of tree survival and growth following treatment on the older chainings. An average for the chainings studied in eastern Nevada was the removal of about 95% of the tree dominance, but that left about half the original density.

This can be seen in the paired pictures between 1971 and 2008 for N. Kern E. and Blythe Springs Chainings that follow in the next two slides.
North Kern East Chaining

1971
Chained in 1969

2008
39 years of re-growth of trees surviving chaining
Nearing the end of Phase II
1971
Chained in 1958

2008
50 years of re-growth of trees
surviving chaining
Now in Phase III

Blythe Springs Chaining
From SageSTEP Network data the trees 5” basal diameter and larger in Phase III expansion woodlands comprise:

1. about 93% of the stand biomass
2. about 40% of the tree density

The harvest for biomass of trees from Phase III woodlands that are 5 inches and greater basal diameter harvests 93% of the biomass and also nearly all the habitat for insects such as sawfly, needle scale and bark beetle.

The remaining trees will have both accelerated growth, and still represent twice the density needed to redominate the site.

Based on the tree growth rates from chaining studies, reaching Phase III dominance, and harvestable biomass levels, would again be possible in a minimum of 50 to 60 years on more productive sites.
Because of the rapidity with which the woodlands are currently changing, the best landscape level results might occur if initial treatments are concentrated on two areas.

1. Those areas where all trees should be removed to provide fire breaks, as well as needed habitat and watershed improvement.

2. Selective tree removal in the existing Phase III woodlands using the 5” rule.

Strategically locating both treatments to maximize the reduction in the size of potential wildfires.