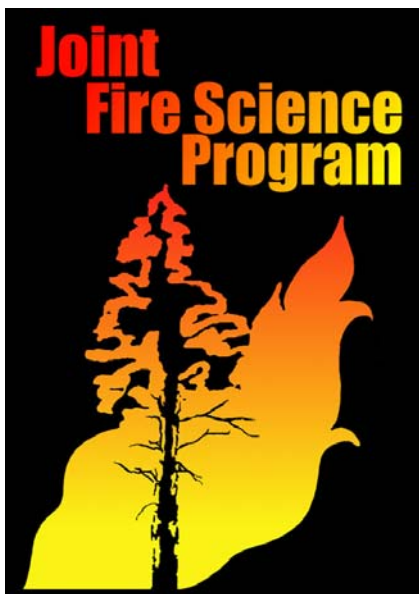


FINAL REPORT TO THE JOINT FIRE SCIENCE PROGRAM



**Project Title:
Effect of season of
prescribed fire and grazing
on understory plant
communities in a ponderosa
pine forest**

Project Number: 03-3-3-28

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Summary Finding

While historic range of variability concepts and some notable research studies suggest that frequent low-intensity surface fires should increase native understory plant abundance and richness in ponderosa pine forests, synergistic effects between frequent prescribed fire and cattle grazing indicate that the outcome under realistic management settings may be quite different. Data from our study suggest that goals for increasing native perennial plant abundance using repeated prescribed fire in this typical public-land-operational context would not be met because of present day environmental conditions and practices.

In our study, synergistic effects of cattle grazing and repeat burning tended to alter successional trajectories toward early seral and invasive exotic weed communities, reduce total plant cover, and negatively impact native perennial plant abundance. While potential impacts on native flora, fauna, and food web dynamics are conceivable, these changes can also have impacts regarding future fire behavior. In this real world context, it is unlikely that application of frequent prescribed fire alone will restore native plant communities. Only active mitigation such as post-fire native seeding and weed control would offer an opportunity to achieve ecological restoration goals. However, analyses of longer-term trends are needed to fully assess burning and grazing synergistic responses.

Background

Ponderosa pine is a major forest type of western North America and a key focus of prescribed fire and fuel reduction treatments. This is because the impacts of fire suppression policies are thought to be greatest in forests historically characterized by frequent low-intensity surface fire (Covington, 2000). Restoring native plant communities and increasing native plant diversity and abundance in ponderosa pine communities is often a secondary but common objective for the application of prescribed fire treatments.

However, prescribed fires now interact with present environment conditions that are very different than historical conditions. Fire is being returned to landscapes where exotic plants are often present and exotic livestock graze. Tree densities and fuel loadings are typically excessive, native species may have tenuous or declining populations and native seed banks may be lacking (Keeley et. al., 2003). In addition, prescribed fires may be applied temporally outside the historic range of variability. For example, prescribed fires in the Pacific Northwest are frequently conducted in the spring, but most historic fires probably burned in the summer or fall (Heyerdahl et al., 2001; Wright and Agee, 2004). Because species vary in the timing of peak sensitivity and response to burning, vegetation patterns in response to fire can differ by season of burn.

Land managers are now faced with the dilemma of reintroducing fire into dramatically altered landscapes. This is a major environmental challenge requiring the integration of

ecological science and concepts with the widespread application of prescribed fire treatments across the west. Information is needed to design fire prescriptions that will not only meet fuel reduction targets, but avoid further ecological degradation.

In 2002, we established 36 0.03 ha (20-m diameter) randomly placed cattle exclosures on four stands that were scheduled to be reburned as part of an ongoing season and interval of burn study. Unfortunately, grazing exclosure studies have produced inconsistent and questionable results concerning grazing effects on vegetation. This may be because many studies involve pseudoreplication, in which many small plots or transects were used on either side of a fence and statistical inferences were made about the grazing effect on the larger unsampled landscape. By using randomly placed grazing exclosures replicated in four different stands, we attempted to avoid this problem.

The study area is located northeast of Burns, Oregon, Emigrant Creek Ranger District, Malheur National Forest. Stands were at 1600 – 1700 m in elevation, with slopes ranging from 3 % to 50 %. Ponderosa pine is the dominant overstory tree in the study area, but western juniper (*Juniperus occidentalis*) and mountain mahogany (*Cercocarpus ledifolius*) also occur. Additional details on the study area can be found in Kerns et al. (2006) and Thies et al. (2005).

Our objective was to examine understory response to spring and fall 5-year interval reburns with and without cattle grazing. We collected vegetation data in 2002, prior to the reburns, and again in 2003 and 2004. Unless otherwise noted, we report results from data collected in 2004, two growing seasons after the reburns.

We analyzed five groups of understory species based on life-history traits:

- (1) **Short-lived exotics.** This species group was largely dominated by two very common short-lived exotics found in the study area: *Bromus tectorum* (cheatgrass) and *Cirsium vulgare* (bull thistle).
- (2) **Short-lived natives.** Common annuals and biennials in this group included *Collinsia parviflora* (blue eyed Mary), *Montia perfoliata* (miner's lettuce) and *Epilobium* spp. (fireweed).
- (3) **Perennial native forbs.** Common species in this group include *Achillea millefolium* (yarrow), *Crepis acuminata* (hawksbeard) and *Arnica cordifolia* (heart-leaf arnica).
- (4) **Perennial native grasses.** Common grasses in the study area included *Agropyron spicatum* (bluebunch wheatgrass), *Festuca idahoensis* (Idaho fescue) and *Sitanion hystrix* (bottlebrush squirrel tail).
- (5) **Perennial native sedges.** Two major sedges dominate this group - *Carex rossii* (Ross's sedge) and *Carex geyeri* (elk sedge).

Other functional groups (annual exotics, perennial exotics, annual grasses legumes, etc) were neither widespread nor abundant enough for separate analysis.

Our research addressed the following questions:

- (1) Is there a difference in total plant cover and richness based on season of burn and grazing?
- (2) For each species group, are there differences in cover among the three burn treatments and with and without grazing?
- (3) What factors (burn treatment, fire severity, overstory stand structure, substrate condition, and environmental heterogeneity) can be used to explain species compositional patterns?
- (4) How do these results and their implications vary by species group and their associated life-history traits?
- (5) What are the management implications due to the synergistic effects of prescribed fire and grazing?

Key Findings to Date

Fire Severity¹

- *Fire severity for the 5-year interval reburns was low² to moderate³, with more moderate severity conditions found in areas burned in the fall.*
 - No high severity areas were recorded.
 - Areas burned in the fall had significantly more moderate severity.
 - All spring plots were low severity.
- *Spatial coverage of the burns (% black) was the same for both the spring and fall.*

Prescribed Burn Impacts on Vegetation - Richness and Cover

- *In general, short term response to repeat burning reduced plant cover compared to preburn conditions. By 2004, two growing seasons after burning, although total plant cover had not returned to pre-burn levels, there was no significant difference in total cover among treatments.*
- *Exotic short-lived species such as bull thistle and cheatgrass were initially reduced by both spring and fall burning, but populations were rebounding by 2004, although there was no difference among treatments in 2004.*
- *Native short-lived species increased immediately after the burns, and compared to the control and spring burn units, areas burned in the fall had greater cover.*

¹ A fire severity classification system modified from DeBano et al., 1998 was used.

² Scorched litter, duff intact, woody debris charred or partially consumed, no change in mineral soil.

³ Litter consumed, duff deeply charred or consumed, underlying mineral soils not visibly altered, woody debris mostly consumed except for logs, which are deeply charred.

- *Compared to the control and spring, fall burn units had significantly taller grasses and less sedge cover.*
- *Compared to the control and fall, areas burned in the spring had significantly shorter grasses and less sedge cover.*
 - *Note that both spring and fall burning significantly reduced sedge cover as compared to the control.*
- *By 2004, there was no difference among burn treatments for:*
 - *Total species richness.*
 - *Native perennial forb cover.*
 - *Native perennial grass cover.*

Prescribed Burn Impacts on Vegetation - Species Composition

- *The slightly more severe fall burns had a greater impact on vegetation.*
 - *Fall burns were characterized by distinct plant communities dominated by native and exotic short-lived early successional species, including invasive weeds.*
 - *These patterns were a legacy from the 1997/98 burns, and the patterns were maintained by reburning.*
- *Areas burned in the spring were compositionally similar to areas that were not burned.*
- *Stand location, fire severity, season of burn, litter cover and depth, were important variables for explaining compositional patterns.*

Cattle Grazing Impacts on Vegetation - Richness and Cover

- *Grazing had a greater impact on plant cover compared to burning, as total plant cover was significantly reduced by grazing. Perennial forbs and sedges drove this pattern.*
- *While grazing had no impact on perennial grass cover, grazing significantly reduced grass height.*
- *Grazing increased short-lived native species cover.⁴*
- *By 2004, there was no difference among grazing treatments for:*
 - *Total species richness.*
 - *Short-lived exotic cover.*

⁴ Despite random plot placement, this pattern was present prior to application of the grazing treatments, thus results should be interpreted with caution.

- Native perennial grass cover.

Cattle Grazing Impacts on Vegetation - Species Composition

- *Unlike prescribed burning, particularly burning in the fall, grazing did not impact vegetation composition.*

Synergistic Burning and Grazing Effects

- *Repeated prescribed burning and cattle grazing altered successional trajectories toward early-seral native and exotic weed communities, reduced total plant cover, and negatively impacted native perennial plant abundance.*
- *Because both the spring and fall burning and grazing significantly reduced sedge cover, synergistic effects on sedges may be very significant.*
- *Because spring burning also reduced grass height, prescribed spring burning in conjunction with cattle grazing may have very significant impacts on native perennial grasses.*

Deliverable Crosswalk Table

Proposed Deliverable	Product Delivered	Status
2 Publications	NA	In progress – at least 1 submission planned in FY08 ⁵
Oral presentations at technical conferences	Presentation at an international conference - August 2005, Ecological Society of America, Montréal, Canada.	1 completed – more presentations planned
Annual progress report	Reports to JFSP, 2005, 2006	Completed
Final Report	Final Report to JFSP, August 31, 2006	Completed
Presentation of results to managers and scientists	5 Workshops: 2 hours presentation plus discussion to the Emigrant Creek Ranger District (Burns)	All workshops completed in the spring of 2006

⁵ See Future Work section.

	Ochoco/Deschutes NF (Prineville), Malheur NF (John Day); Willowa-Whitman (Baker City and Umatilla NF (Pendleton)	
Tours	Tour of all stands – JFSP board members invited, as well as officials from Region 6	Planned for Sept. 27 th , 2006

Future Work

Although field sampling ended for this project in 2004, we have continued to repair and maintain the grazing exclosures as needed. We have been also awarded additional funding from the Joint Fire Science Program to conduct the third iteration of the 5-year interval reburns (2007/2008). In conjunction with this, understory vegetation will be measured prior to the reburns in the summer of 2007 and two growing seasons later in 2009. Data collected in the summer of 2007 will also provide longer term information to assess plant patterns and publication of a comprehensive longer term analysis in 2008. Analysis of these longer term trends will provide better information to managers.

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