

# **INITIAL UNDERSTORY VEGETATION RESPONSE TO MECHANICAL MASTICATION FUEL TREATMENTS: BALANCING BIODIVERSITY AND FIRE HAZARD REDUCTION**

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## **INTRODUCTION**

Managing ecosystems of the Western U.S. for multiple goals can often be conflicting, requiring land managers to make decisions that balance tradeoffs between desired and actual outcomes. The need for balancing fuels management goals with ecological goals in fire-prone environments provides a scenario where tradeoffs often need to be considered. Evaluation of these tradeoffs between biodiversity conservation and reduction of wildfire hazard requires information that can better inform land managers as to the consequences and benefits of fuels management actions.

Mechanical mastication is an increasingly popular method of fuels management in treating non-commercial shrub and/or small tree layers. Mechanical mastication involves the use of a boom or front-end mounted rotating blade or drum that shreds standing, live, woody material. By shredding these fuels, mastication reduces the midstory fuel height, but generates higher surface fuel loading (15.3 - 63.4 Mg/ha) of smaller (1 and 10 hr) time-lag classes (Kane *et al. In press*). Compression of the fuel bed may moderate fire behavior, but subsequent fire effects from burning elevated surface fuel loads may be substantial. To mitigate potential negative fire effects, supplemental treatments, such as incorporating the masticated wood into the soil or prescribed fire can be utilized, but all involve tradeoffs. Exposure of mineral soil may provide habitat for both herbaceous and understory species, however combined with fire could also result in recruitment of shrubs with fire-stimulated seeds, thereby reducing the longevity of the mastication treatment.

The purpose of this research was to evaluate the initial understory vegetation response to mastication treatments including mastication only, mastication followed by incorporation into the soil, and mastication followed by prescribed burning, in order to determine which treatments maximized diversity and cover of desirable understory

species while minimizing regrowth of shrub species targeted by the mastication treatment.

## METHODS

The study site was located on the Plumas National Forest in the Challenge Experimental Forest, located in the northern Sierra Nevada, CA (elevation approx. 900m). The site was characterized by an even-aged overstory of young, *Pinus ponderosa* (mean dbh = 25.5cm) with a dense midstory of shrubs and small hardwood trees. Within this site a randomized complete block design was established, consisting of four blocks each with four treatments: 1) mastication only (MAST); 2) mastication and incorporation (MAST/INC); 3) mastication and prescribed burning (MAST/RX); and 4) a no treatment control (CONTROL). All mastication was conducted between Dec. 2002 - Mar. 2003 with a boom-mounted rotary blade masticator (Slashbuster®) mounted on an excavator. Prescribed burning of all MAST/RX units was completed using strip head fires during May and June 2005. Incorporation in MAST/INC units was accomplished by partially tilling masticated material into the upper soil horizons.

Each approximately 0.5 hectare unit contained 5 (MAST, MAST/INC and CONTROL) or 10 (MAST/RX) systematically placed gridpoints within each unit. At each gridpoint, four-1m<sup>2</sup> vegetation quadrats were established in each of the four cardinal directions, one meter away from the gridpoint. Within the vegetation quadrat all vascular plant species were identified and assigned a cover class value (1= <0.25%, 2= 0.25-0.49%, 3= 0.5-0.9%, 4= 1.0-1.9%, 5= 2.0-4.9%, 6= 5.0-9.9%, 7= 10.0-24.9%, 8= 25.0-49.9%, 9= 50-74.9%, 10= >95%). In addition, non-native herbaceous and all shrub individuals were counted in each quadrat to estimate density and shrub heights were recorded to the nearest 10 cm. Species richness was calculated by a simple count within each quadrat.

Analysis of the data was performed using an ANOVA in NCSS (Hintze 2006) to test the treatment effect on species richness, total plant cover, non-native plant density and cover, and shrub density, height and cover. Some variables were square root transformed to meet the assumptions of normality and homoskedasticity. Treatment was considered as a fixed variable with block as a random variable. When significant treatment effects were found ( $\alpha = 0.05$ ), multiple comparisons between treatments were made using the Tukey-Kramer multiple comparison test.

## RESULTS AND DISCUSSION

No significant differences in non-native species richness, total understory cover, shrub cover, herbaceous cover or non-native species cover were detected among the treatments. The lack of treatment differences in cover values may be best attributed to the rapid post treatment growth of the understory plant species. In other instances, there was a significant treatment effect on the density of native shrubs ( $F= 28.44$ ,  $P<0.0001$ ) in which the MAST/INC and MAST/RX treatments contained greater (>240%;  $P<0.05$ ) densities (20.5 stems/m<sup>2</sup>) of native shrubs compared to the CONTROL and MAST

treatments. A potential explanation for the reduced density of native shrubs within the MAST treatment contained significantly fewer native shrub individuals may be due to the increased surface fuelbed depth and cover of masticated fuels which may suppress native shrub seedling germination. In addition, ground disturbance caused by tilling the surface soil in the MAST/INC treatment and prescribed fire in the MAST/RX treatments are probable explanations to the higher shrub density values in these treatments.

A significant treatment effect was found for native understory species richness ( $F = 8.51, P < 0.01$ ) and native shrub richness ( $F = 6.86, P < 0.01$ ). Both MAST/INC and MAST/RX contained significantly more (+13%) native species than in the MAST and CONTROL areas. In addition, native shrub species richness was significantly greater in the MAST/RX treatment (+30%) than in either the CONTROL or MAST treatments. Increases in native understory and shrub species richness are likely due to the increased amount of light or the increased mineral soil exposed within these treatments.

As expected, shrub height was significantly reduced in the MAST/RX treatment compared to all other treatments ( $F = 6.69, P < 0.01$ ). While this has short-term fire hazard implications, the proliferation of post-fire seedling germination will likely result in greater shrub height in the coming years, contingent upon density-dependent mortality and seedling survival rates.

## SUMMARY AND CONCLUSIONS

Ecologically sound fuels management actions are often desired, but ecological and fuels-based management goals may not be synchronous. The MAST treatment generated heavy loadings of woody fuel on the surface, which may inhibit the germination and establishment of shrubs, but also reduced richness of native understory species. Fuel treatments where the masticated material was partially removed by incorporation into the soil or prescribed burning, resulted in greater understory species establishment, but also resulted in higher abundance of fire-stimulated shrubs. The MAST/RX treatment removed the most fuel, but heat from the fire resulted in greater shrub density and higher levels of overstory tree mortality (Knapp and others, this proceedings). None of the mastication treatments investigated provide for an ecological and fuels management panacea. Instead evaluation of tradeoffs will be necessary to aid managers in determining the best management practices for ecosystem management in fire-prone environments.

## References Cited

- Kane, J.M., E.E. Knapp and J.M. Varner *In press*. Variability in loading of mechanically masticated fuel beds in Northern California and Southwestern Oregon. In: Andrews, P. L.; Butler, B.W., comps. Proceedings RMRS-P-41. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.
- Hintze, J.L. 2006. Number Crunching Statistical Systems, Kaysville, Utah, [www.ncss.com](http://www.ncss.com).