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Supplementary material

Effect of mastication and other mechanical treatments on fuel structure in chaparral

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Detailed comparison of treatment types

All mechanical treatment types, in this study of southern California chaparral, significantly altered fuel structure and composition in comparison with untreated vegetation. Fuel structures and composition, however, exhibited significant differences by treatment type. Initial treatments of crushing and mastication had similar downed-woody fuel masses, as was expected, because no fuel was actually removed from the site. The cover and depth of those fuels, however, were significantly different between treatment types and can be attributed to the processes that created them. Downed-woody fuels in crushed treatments were broken by a large steel cylinder that crushes live-woody vegetation *in situ*. Similar fuels in masticated treatments, in comparison, were essentially grabbed and shredded by steel teeth and then dispersed across the ground surface. These mechanical differences allow for deeper fuel depths in crushed treatments and greater downed-woody cover in masticated treatments. Crushed treatments also had significantly more fuel in the 100-hour fuel size class, which was most likely the result of being broken by the weight of a steel cylinder, in comparison to being shredded by steel teeth.

In recent years, retreatment of previously treated areas by re-masticating them has become more common as initial crushing and mastication treatments age and lose their altered canopy structure. These second-entry re-mastication treatments, while not statistically different from single-entry masticated treatments in average downed-woody fuel mass, had significantly less average downed-woody fuel cover, shorter average fuel depths and higher fuel loading in the 10-hour size class. The process of re-treating or re-shredding some of the already masticated fuel particles creates smaller particles, which in effect shifts fuel mass from the larger size classes to the smaller size classes. These new, smaller particles condense more easily and thus also result in shorter depths. In contrast, downed-woody fuel mass is increased during re-treatment by the addition of live-woody shrub regrowth that occurred between the first and second entry. This addition of downed-woody fuel, however, was likely balanced by decomposition and the churning of some portion of the old fuel particles into the soil by the machinery during the second treatment.

Masticated treatments that were prescription burned, in contrast, were significantly different from all other treatment types due to an overall decrease in downed-woody fuel mass by consumption, which inherently also decreased downed-woody fuel depth and cover. The resultant fuel load, which on average was about one-eighth of the fuel load observed in masticated treatments, was proportionally dominated by the 1- and 10-hour fuel size classes. We would assume that pre-fire fuels in the smaller size classes would be consumed first and, thus the incidence of high proportions of small fuel size classes following fire are likely either new additions from the canopy or residual particles left on site from the incomplete combustion of larger fuel size classes.

While fuel treatments were distinctly different in their downed-woody fuel characteristics, conversely, they had statistically similar live-woody fuel characteristics. One minor exception was that crushed treatments exhibited significantly shorter average live-woody heights than masticated treatments. Crushed treatments were predominantly found in *A. fasciculatum* dominated stands, which in general are shorter in stature than most other chaparral types. Masticated treatments were dispersed more evenly across all of the vegetation types and as such, had a significantly higher average live-woody height.

Herbaceous fuels, which are not typically a common component of mature untreated chaparral, were greatly increased across all treatment types in this study. While the overall increase in herbaceous fuels did not contribute heavily to overall total fuel bed loads, there were noteworthy differences in their presence between treatments and vegetation types. Live-herbaceous fuels, while not statistically different in average mass between treatments, exhibited significantly lower cover in masticated treatments. These treatments had the highest average cover of downed-woody debris and a deeper than average downed-woody fuel depth. The combination of these two factors increased the potential 'mulching effect', which inhibits herbaceous plant germination and growth. This same relationship was also identified by Kane *et al*. (2010) and Wolk and Rocca (2009), who found negative correlations between herbaceous plant presence and both the cover and depth of masticated debris.

The same trend was observed in our analysis by vegetation type. Treated *Arctostaphylos* and *Quercus* dominated stands had the highest average downed-woody debris covers and above average downed-woody fuel depths coupled with lower than average live-herbaceous cover and mass. In contrast, higher than average live-woody cover was also coupled with lower than average live-herbaceous fuel cover in treated *Ceanothus* and *Quercus* stands. Treated stands of *A. sparsifolium,* which had substantially lower than average live-woody cover, revealed the opposite trend and exhibited the highest live-herbaceous cover. These results suggest that, while the accumulated downed-woody debris may have a mulching effect, the canopy cover of a given vegetative community will also be a determining factor in the presence of herbaceous fuels.