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Response of soil microbial community structure and C cycling functions to forest fuel mastication treatments

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Perceived wildfire risk from hazardous forest fuels across the western US has led to the rapid implementation of fuel reduction operations, including mastication (e.g. forest fuel chipping and chunking). Mastication treatments often double forest floor mass and thickness, which alter soil microclimate and carbon (C) inputs. The objective of this study was to determine plot- and field-scale effects of forest fuel chipping treatments on soil microbial communities, C and N cycling activities, and C pools in a Colorado ponderosa pine forest. We hypothesized that chip amendments to the forest floor would enhance soil fungal biomass and recalcitrant C decomposition activity, resulting in altered distribution of soil C between labile and stable fractions. For the plot study, pine chips were added in March 2004 to replicate plots to achieve treatment depths of 0, 5, or 10 cm of chips on the forest floor. The field study consisted of three treatments established in July 2004 along three 500-m long transects: forest thinning with slash removed, forest thinning with slash chipped and spread to $\sim$2 cm depth, and non-treated soil. In 2007, soil samples were collected from plot and field treatments for analysis of total microbial biomass, microbial C and N mineralization potentials, fungal biomass, beta-glucosidase and phenol oxidase enzyme activities, and soil C pools (total organic C, dissolved organic C, particulate organic matter C, and mineral-associated C). Three years post application, fungal biomass C was significantly greater in plots which received 10 cm of chips to the forest floor, with over twice as much fungal biomass under the 10-cm chip depth treatment compared to the control (non-treated) soil. Carbon mineralization activity was lower in plots which received chips,

and N mineralization activity was lowest in the 10-cm chip depth treatment. For the field study, soils from non-treated and thinned-plus-chipped transects had greater fungal biomass and lower C and N mineralization activities compared to the thinned-only treatment soils. Based on the results obtained so far, we conclude that chip additions to the forest floor have the potential to increase fungal biomass C, and that chip additions may prevent loss of soil fungal biomass following whole-tree harvesting. Moreover, soils with greater fungal biomass have greater potential to sequester C and immobilize N compared to soils with lower fungal biomass.