Management of Redwood Forests Degraded by Sudden Oak Death

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Invasion by *Phytophthora ramorum*, the cause of sudden oak death, has degraded coast redwood (*Sequoia sempervirens*) forests in a broad region from Big Sur through Sonoma County. Even though infection by this pathogen in redwood is rare and relatively benign, disease impacts and ecosystem changes can be very severe in redwood forests. Many coast redwood stands harvested from circa 1850 to 1950 have had minimal post-harvest silviculture which has likely increased the prevalence of tanoak (*Notholithocarpus densiflorus*), the most severely impacted host tree. These forests have now experienced significant increases in canopy openness, understory stem density, and ground fuels. Although considerable time, effort, and funding have been directed at slow-the-spread actions, very little attention has been directed to rehabilitate coast redwood forests where tanoak mortality has resulted in a loss of > 25% of total basal area or a >50% loss of canopy cover.

We are conducting restoration-focused treatment in the Marin Municipal Water District (Marin County). A combination of mechanized mastication treatment and hand-crew pile-and-burn has been applied on approximately 15 ac areas for each technique. Pre-treatment data show impacted stands contained very high tanoak stem densities (> 800 stems ha^{-1}), and high levels of both coarse woody debris and fine fuels (> 50 Mg ha^{-1}). Post-treatment measurements show a dramatic decrease in standing small-tanoak stems and fuel levels, particularly in areas where pile burning has been completed. Mastication treatments increased forest floor carbon storage while levels in pile-burn treatments were unchanged. Additional post-treatment monitoring includes change in soil carbon storage, rates of greenhouse gas efflux rate, and soil water storage. Treatments will include follow-up treatment of tanoak resprouts and replanting with suitable species with low susceptibility to *P. ramorum* to recreate an overstory.

This experiment shows a dramatic initial benefit of combined fuels and disease treatments to immediately decrease fuels and restructure vegetation for greater fire resiliency. Robust estimates of treatment-duration, carbon balance, and water yield are needed to understand how these benefits compare to total treatment expenditures. This ongoing analysis will determine if similar treatments would be beneficial for application throughout redwood–tanoak forests heavily damaged by sudden oak death.