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Abstract:

Vast areas of ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.) forest in the western United States have become unnaturally dense because of relatively recent land management practices that include fire suppression and livestock grazing. In many areas, thinning treatments can re-establish the natural ecological processes and help restore ecosystem structure and function. Precipitous global climate change has focused attention on the carbon storage in forests. An unintended consequence of fire suppression has been the increased storage of carbon in ponderosa stands. Thinning treatments reduce standing carbon stocks while releasing carbon through the combustion of fuel in logging machinery, burning slash, and the decay of logging slash and wood products. These reductions and releases of stored carbon must be compared to the risk of catastrophic fire burning through the stand and releasing large quantities of carbon to the atmosphere to more fully understand the costs and benefits – in carbon terms – of forest restoration strategies.

This study examines the effect of a restoration thinning treatment on the carbon stock of a ponderosa pine forest. The total pre-treatment above-ground carbon stock was 48,880 kg C ha⁻¹ and the post-treatment stand had 36,420 kg C ha⁻¹. The carbon stock in trees across the stand ranged from 28,560 to 67,560 kg C ha⁻¹ pre-treatment and from 11,970 to 55,510 kg C ha⁻¹ post-treatment. 8240 kg C ha⁻¹ was removed from the site and sold to the wholesale firewood market (plot values ranged from 4890 to 12,310 kg C ha⁻¹), 91 kg C ha⁻¹ was released from the combustion of fuel in harvesting operations and trucking, and the processing of the firewood required carbon released 33 kg C ha⁻¹. The burning of slash piled on site released 4140 kg C ha⁻¹ (plot values ranged from 2920 to 6900 kg C ha⁻¹). We estimated that in a stand-replacing fire, the treated stand would release 2410 kg C ha⁻¹ less to the atmosphere than the untreated stand. However, the thinning treatment resulted in stand structural changes that make the stand less likely to support a crown fire and therefore more likely to avoid the carbon releases associated with crown fires, even under extreme fire conditions. On balance, the thinning treatment released 3114 kg C ha⁻¹. If the wood removed from the site had been used in longer-lasting products, the thinning could have resulted in net carbon storage on the order of 3351 kg C ha⁻¹.