Response to Comment on "Prescribed Fire As a Means of Reducing Forest Carbon Emissions in the Western United States"

We appreciate Mr. Meigs' and Dr. Campbell's interest in our recent paper (*1*). As stated in our paper and noted by Meigs and Campbell, managing surface fuels with prescribed fire requires repeated application. Previous research has shown that these cumulative prescribed fire emissions can be greater than a one-time wildfire (*2*). Meigs and Campbell conclude that this potential, coupled with our use of satellite detections of wildfire over the 2001−2008 time period as a basis for comparing prescribed fire and wildfire emissions on a one-to-one basis makes our upper-bound estimate of emissions reduction from prescribed burning misleading. It appears their assessment of our research stems from a misunderstanding of our use of the term "fire severity" and a faulty assessment of the assumptions made in our modeling.

Meigs and Campbell state that "high-intensity fire is by nature infrequent". We use the term "high-severity" in our paper, not "high-intensity". As noted by Keeley (*3*), "fire severity" and "fire intensity" are often used interchangeably, which is incorrect because fire intensity is a measure of energy output and severity is a measure of fire effects. While high-intensity fire may or may not be "by nature infrequent", high-severity fire can be frequent because of the impacts on regenerating vegetation (*4*). Furthermore, we note that high-severity fire can transition a forest from a sink to a source (*5, 6*). If, as reported by McGinnis et al. (*4*), a subsequent fire occurs before the regenerating trees are tall enough, mortality can be high, prolonging the net ecosystem productivity (NEP) recovery time.

Meigs and Campbell presume the following requirements for the results of our study to be valid: omnipotence with regard to the timing and location of wildfires, the ability to prescribe burn those areas prior to wildfire occurrence, complete effectiveness of prescribed burned areas eliminating wildfire, and no escape of prescribed fires. While our sensitivity analysis did use land area burned by fire over the 2001−2008 period as a basis for comparison, our conclusions are not dependent on these assumptions. A number of studies have estimated that the proportion of the landscape that must be treated, if treatments are strategically placed, to reduce wildfire size is only a small fraction of the total landscape (*7, 8*), thus predicting wildfire location and timing and implementing prescribed burns over those entire areas is not necessary. Furthermore, research examining fire occurrence in an area that has been allowed to burn freely for three decades indicates that fire is self-limiting in spatial extent and fire effects because of fuel accumulation rates (*9*), thus the assumption of prescribed fires completely eliminating wildfire is not necessary. With regards to no escape of prescribed fires, an assumption we did not make in our study, we are not aware of any published estimates of this rate, but anecdotal evidence would suggest this is rare.

We do not "champion" any particular position with regard to forest restoration or prescribed burning. We state that "prescribed burning could reduce CO_2 and other emissions from fires in dry forest types" and the "prescribed burning is a potential way to manage CO_2 fluxes". One of the goals of our study was to constrain the potential emissions reductions that could be achieved with prescribed fire. Given that much less biomass is consumed in a prescribed fire than in a high-severity wildfire in dry forest types, the upper bound in emissions reduction we calculated is quite realistic. While quantifying the cumulative emissions from prescribed burning would provide further insight, it would be difficult to accomplish with any accuracy at this scale because the burn frequency required to manage fuels is dependent on site-specific variables. While we agree that this is a future research need, what also remains to be quantified at this scale is the impact of fire severity on NEP and indirect fire emissions, since previous studies at smaller scales suggest that high-severity fire results in substantial reductions in NEP that can transition a forest from sink to source for several decades (*5, 6*).

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