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NEW PAPER - THE CARBON BALANCE OF REDUCING WILDFIRE RISK 10-YEARS AFTER TREATMENT

0 COMMENTS

In some forests, frequent fire is a natural part of the system and serves many different purpos frequent-fire forests of the US, we have been putting out fires for the better part of a century. Re natural disturbance has allowed more trees to grow and a build-up of dead plant material in understory. These changes have increased the risk of large and severe wildfires. Research by Leroy and colleagues has demonstrated a steady rise in the area burned by wildfire in recent decades climate continues to change it is likely to keep increasing.

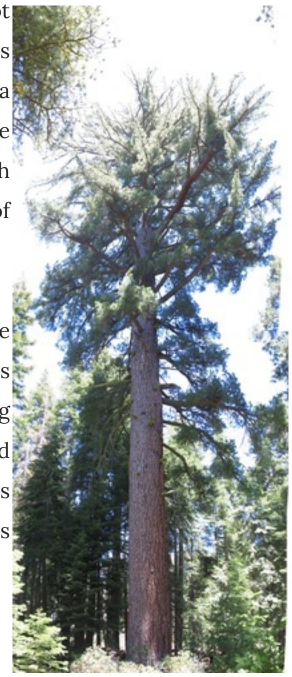
People are concerned about wildfire for several reasons. In the US we spend $1-2 billion per y wildfires. The costs go even higher when we account for property loss due to wildfire. Smoke fr contains all kinds of chemicals that are bad for human health, in some cases requiring people living fires to remain inside their homes. On top of the factors that influence people, wildfires can have s significant impacts on the ecosystems they burn. Most recently, we have been paying attention to carbon from wildfires because trees help regulate our climate by removing carbon dioxide (a gree from the atmosphere.

One of the issues with reducing the risk of large, hot fires is that it requires harvesting trees (remova and prescribed burning (sending carbon back to the atmosphere). And if we want to maintain redu and avoid the need to continually thin forests, regular burning will be required. These factors crea conundrum. Forests are helping fight climate change by storing carbon. Large wildfires are on the i they emit carbon to the atmosphere. To reduce the risk of large wildfires we have to remove c forests and send some of it back to the atmosphere through regular burning.

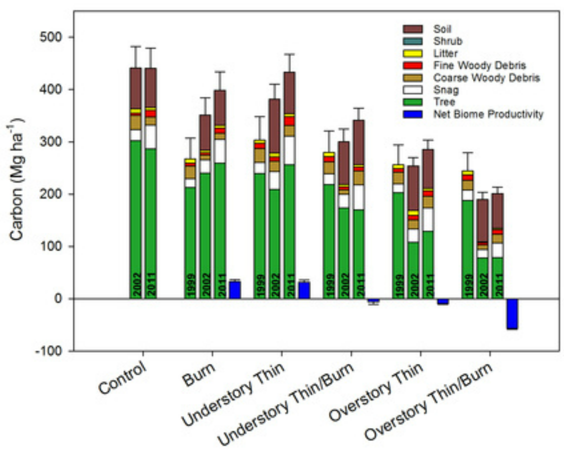
This leads us to the central question of our recent paper led by Morgan Wiechmann – how does balance of these treatments change over time? To answer this question, we used data from th Experiment collected for ten years following several different thinning and burning treatments.

We had already used the pre- and immediately post-treatment data to figure out that cutting dow burning the forest causes a decrease in carbon stored in the forest (you can read about that here). wasn't a surprise to anyone, you have to know where you are to figure out where you are going and know where you've been to figure out how you got there. Enter our most recent work, funded by th Science Program.

There were some findings that were no big surprise. We know big trees store a lot of carbon. Some of the biggest at Teakettle weigh as much as 16 average sized cars and about half that weight is carbon. So, no big surprise that when you cut down a bunch of big trees, it is going to take a while to grow more big trees and recapture that carbon in the forest. But the two most interesting things this research uncovered had to do with the carbon balance of fire emissions and the effects of treatments on carbon stored the in the remaining big trees.



We know from previous work that before we started putting out fires, Teakettle burned on average about every 17 years and that a majority of the carbon was stored in big trees. By quantifying the carbon that was recaptured by the growing trees over the 10-year period, we figured out that when we just used prescribed fire, tree growth pulls out of the atmosphere about twice as much carbon as was emitted during the fire. This suggests that if we restore regular fire and burn this forest every 17 years or so, forest carbon will continue to increase.



Mean and standard error of C pools pre-treatment (1999), immediately post-treatment (2002) and 10-years post-treatment (2011) in Mg C ha-1. Ten-year net biome productivity (solid blue bar) is the 10-year net ecosystem productivity minus C removed and emitted during treatment implementation in Mg C ha-1. Soil and shrub C values are not included in the pre-treatment (1999) C stocks.

Nate Stephenson and colleagues recently demonstrated that a big tree can add a small tree worth of carbon in a single year of growth. That fact is what makes understanding what the big trees are doing important. In this study we found that the treatments affect different species of big trees in different ways. We had expected that treatments that included burning would have a bigger effect on fir trees because they are intolerant of fire when they are young and we expected pine trees to do well because they have thick bark that protects them from the heat. White fir, which is by far the most common species at Teakettle, had a small decrease in one thin-and-burn treatment and a small increase in the other. Sugar pine increased quite a bit in the thin-only treatments, held steady in the burn-only, and decreased in the thin-and-burn treatments. So much for expectations…

However, that made us think about why a species like sugar pine, that is supposed to be adapted to fire, is getting killed by prescribed fire and why a species like white fir that is considered intolerant of fire wasn't all that impacted by burning treatments. What we think is going on is that white fir has thin bark when it is young and small and thick bark when it is old and big. So, the whole fire intolerance idea may very well be a function of age and size. What we think is happening with the big sugar pines is that after 100+ years without fire, the amount of dead needles at the base of the big trees provides fuel for the fire to sit and smolder. This is kind of like slow-roasting a marshmallow, when you put it next to the fire the outside is gooey and then it firms up when you roast it. Well, underneath that thick pine bark you've got all the tissue that carries water and nutrients. When a fire smolders for long enough at a high enough temperature the conductive tissue gets cooked and kills the tree. Thus, another conundrum – we know fire is important in Sierran mixed-conifer forest (you can watch a video about it here), but putting fire back into the forest is killing some of what we are trying to protect.

Fortunately all is not lost. In some of these treatments we cut down a bunch of medium-sized trees. If we account for the fact that some big ones may die when we bring fire back, we can a leave of few more medium-sized trees that will grow into big trees. And when big trees die, they don't evaporate into thin air. All that carbon stays on the site for a while because it takes some time for the wood to decompose. Big dead trees are also important wildlife habitat. With all the bugs that move in, they can become a buffet for woodpeckers and as they decompose and cavities form, a number of animals will call them home.

Circling back to the big question - how does the carbon balance of these treatments change over time? – we found that the treatments that included only burning or only thinning small trees recaptured the carbon that was lost from treatment in ten years. The treatment that included thinning small trees and burning still had less carbon than it did initially, indicating that we need to keep some more medium-sized trees. The treatments that harvested big trees still have a carbon debt from treatment. This work provides additional evidence that we can restore these fire-prone forests without having too big an impact on the climate, as long as the trees keep growing.

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