Fire Scar Historical Reconstructions: Accurate or Flawed

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Tree fire scars are used to reconstruct past fire occurrence. These historical reconstructions are often used to guide current forest management on federal lands.

Trees charred but not killed by past fires often form scars where the cambium and inner layers were burnt by fires. A researcher can count the growth rings between scars and calculate the historic fire rotation for the area.

Many assume that western forests are outside of their "normal" density and appearance or what is termed "historic variability". They assume this is due to several factors including logging of old growth trees, fire suppression, and livestock grazing. Due to this past mismanagement, we are told that forests are "overgrown" "decadent" and ready to burn.

Not to dismiss effects of the kind of management that largely continues unabated today, including on-going logging, grazing, and fire suppression, but whether the current forest stand condition is that far from historic conditions is a matter of increasing debate. There is some concern that fire scar reconstructions are biased towards shorter fire intervals. And in some cases, pollen/charcoal records from lakes, air photo interpretation, sediment flows recorded in landslides and rivers, and use of General Land Office surveys, among other methods, sometimes call into question the veracity of fire scar conclusions.

Timber harvesting is no longer done just to provide timber companies with profits or consumers with wood. Now lumber companies are involved in a much more noble enterprise —they are logging the trees to "restore" the presumed forest "health."

The scientific basis for "restoration" is based to a large extent on fire scar studies. These studies suggest that the drier forests composed of lower elevation ponderosa pine and Douglas fir burned frequently and thus kept density low with "park-like" open stands of mostly larger trees.

Recent studies using different methods have started to question this well-established story-line. These studies are finding that the intervals between fires is much longer than previously suspected, and that mixed to high severity blazes (where some to many of the trees are killed) were likely common (defined as occurring hundreds of years apart) even in the lower elevation dry forests.

Keep in mind the discussion is focused on lower elevation forests since higher elevation forests like lodgepole pine, fir and spruce are characterized by much longer fire intervals, which have not experienced fuel buildups to any significant degree due to fire suppression, grazing, or timber harvesting.

PROBLEMS WITH FIRE SCAR METHODS

The major method for determining the fire history of an area is to find trees with scars created by fires. If the tree is not killed by the blaze, it may develop a scar that can be counted in the tree rings. This record of past fires is then used to determine the "fire rotation" or the time it takes to burn an area equivalent to one's study area.

There are four major flaws associated with traditional fire scar studies. These methodological flaws contribute to a bias toward shorter fire rotations—in other words, they tend to overstate the effect of fire suppression on forests because it appears that we are seeing more years between successive fires than we did in the past. If the fire rotation were judged to be longer, however, then much of what is being characterized as unhealthy forest may be perfectly normal and healthy.

The first flaw is targeted sampling. A researcher walks through the forest looking for areas with an abundance of fire-scarred trees. The trees in this area are then sampled and used to determine the fire history for the area.

In the 1930s the bank robber Willy Sutton was asked why he robbed banks. Sutton is reputed to have replied with the self-evident "because that is where the money is." In a sense that is how fire researchers have gathered their data on fires—they sample in places with a lot of fire scars.

The problem with targeted sampling is that it's non-random. It's like going into a brewery to poll people about whether they like beer.

Places with an abundance of fire scars tend to have naturally low fuel loadings and frequent fires. But these sites may not be representative of the surrounding landscape such as north facing slopes or valley bottoms which may be wetter or have higher productivity and, thus, longer intervals between blazes.

In fact, the reason non-sampled areas lack significant numbers of fire-scarred trees is often that all trees were killed in high severity fires, but the omission of such areas from fire history studies leads to the false conclusion that such blazes are unusual in dry low-elevation forests.

The second flaw is composite fire scars. Most fire studies add up all the fire scars recorded into a "composite" timeline. As one fire scientist suggests, all this does is count fires.

The problem with this technique is that the more scars you find and count over bigger and bigger areas, the shorter the fire interval becomes and the riskier your assumption that any fire recorded by one tree burned throughout the entire study area, even though some trees didn't scar in the fire event.

To give one hypothetical example of how this counting fire might skew the results, let's pretend we have a 1000-acre study area. In that study area, we find evidence for at least one fire every year between 1900 and 2000 or a fire interval of 1 year. However, if each of those fires only burned 1 acre then in a hundred years at most only 10% of the 1000 acres would have been burned. At that rate, the fire rotation would be 1000 years.

Now the above example is an extreme hypothetical situation, but one can see how important it is to recognize that not all fires are equal. You can have many fires that may burn only a small area and have a small influence on the larger forest ecosystem. Most of the ecological "work" of fire is done by the infrequent but larger blazes. And nearly all of these are mixed to high severity blazes.

Recognizing this problem, some fire researchers now use various "filters" to counter this issue. For instance, they may only include fire scars recorded the same year on 3 or more trees. Still, this may not solve the problem because you may find three fire-scarred trees close together, thus be the result of a single small burn.

Unless scarred trees are sampled positioned geographically throughout the study area, even filters will not eliminate the upward bias in the frequency of fire in a given study area.

In other words, your composite may suggest a fire burned within your study area once every 20 years or whatever, but if most of these blazes burned only a few trees, then it is not accurate to conclude that the fire burned the entire area.

How frequent are fires that burn most or all of a large study area? These larger blazes may be far less frequent and take decades to centuries to burn most or all of the study area. Since the critical issue for the forest is the occurrence of the occasional blaze that burns most, if not all, of the entire study area, the fire rotation is the important number to focus on, not the number of fires.

The third flaw is an emphasis on the AVERAGE fire interval rather than the DISTRIBUTION of fire intervals. If you read fire studies carefully they will usually note the longest interval without any recorded fire. Often this is a significant period of many decades. Why is this important? Because the average person hears that there were fires, ON AVERAGE, every 10-20 years and assumes that fires operate like clocks on a regular schedule.

Fires are not clocks. Fires burn in episodic groups usually dictated by periodic droughts that are controlled by shifts in offshore currents like the Pacific Decadal Oscillation, thus tend to be grouped together in certain drought-prone decades. The DISTRIBUTION of a fire interval shows clearly that there are always relatively long periods with little fire, even though the AVERAGE fire return interval might be 10-20 years.

Why is it important that we consider historic distributions of fire intervals rather than average fire intervals? Because the common assumption is that if the fire interval averages 10-20 years, fires would keep tree density low and reduced fuel build up. However, if there are also extremely long fire intervals of 50-80 years or more associated with the DISTRIBUTION of fire intervals, then there may not be an “abnormal” buildup of fuel or increase in tree density, and nothing is out of the ordinary at all.

Finally, the fourth major flaw is that traditional fire-scar studies have not been map based. Why is a map of the distribution of trees with scars important? It is only through such mapping that one can determine whether a scarred tree was in the middle of an extensive low-severity fire or at the edge of a high-severity patch. One must look at the age distribution of the surrounding trees to gain real insight into the kind of fire that the scarred tree recorded. This is what the more progressive fire ecologists are beginning to do, and they are finding that many fires in dry forest types are severe fires that burn relatively small areas within a larger fire perimeter, just like ALL fire we see burning in the same forest locations today.

Due to these flaws and errors in interpretation, many fire scar histories (but not all) misrepresent the fire regime associated with an area. If the period between fires was occasionally very long, then our forests may not be far out of their historic variability and may be well within that range of variation. If so, they do not require “restoration” because they are not out of balance.

The fact that we are seeing more and larger fires fit perfectly with the pattern that is expected under current climatic conditions. In other words, if you have drier weather conditions, with high temperatures, low humidity, and high winds, you will get more fires. You will get larger fires.

The prevailing climatic conditions are driving most of the apparent change in fire frequency and severity. For instance, the Southwest is in the grips of a drought that hasn’t been seen in five hundred years. Not surprisingly, there are fires now burning across the region bigger and more intense than any seen in the past. However, Paleo fire studies confirm that such large fires may not be abnormal when compared to the fires that burned similar severe droughts occurred in the past centuries.

MANAGE FOR ECOLOGICAL PROCESS NOT SOME HISTORIC STAND STRUCTURE

Finally, there is too much emphasis on “restoring” stand structure (in other words the presumed appearance) of forests rather than allowing natural ecological processes to occur on the landscape.

Keep in mind that all forest structure and plant composition is strongly influenced by climate. What fire scar reconstructions tell us is what the forest conditions were like several hundred years ago, not what is shaping forests of today.

It is more critical to accept and promote natural processes like beetle outbreaks, wildfires (including stand replacement blazes), and other natural ecological agents than to try to create some presumed historic forest structure that never existed in a steady state (and at taxpayer expense)!

If natural ecological processes are permitted to occur on our public lands, then the forest will sort out the kind of appearance and structure that is appropriate for current climatic conditions. Critics will claim that a do-nothing approach outside the WUI will only lead to conversions of our forests to some other vegetation type, but the evidence for widespread type conversions is fairly limited at this time.

Even if there is a conversion say from forest to brush or grasslands, that is what the climate of today is creating. We cannot stop such climatic driven changes.

This is not to suggest that all historical reconstructions from fire scar studies are wrong—but it does suggest that most forest scar studies outside the pure ponderosa pine forests of the Southwest (and that’s most conifer forests in the West) are probably biased to some degree. Many of the logging proposals in the West are likely based on flawed assumptions about fire ecology and historic conditions.

Plus, given climate change, attempting to “reconstruct” historic conditions may be a fool’s errand since vegetation including tree cover are largely controlled by climate. With warming and drying climate, the historic forest composition may no longer be viable.

Before any “restoration” logging is accepted as necessary; the underlying assumptions should be carefully evaluated to make sure they are not skewed towards fire rotations that do not characterize the area accurately.