

Appendix A

Understanding the Relationship between Fire and Chaparral

From Lombardo, K.J., T.W. Swetnam, C.H. Baisan, M.I. Borchert. 2009. Using bigcone Douglas-fir fire scars and tree rings to reconstruct interior chaparral fire history. *Fire Ecology* 5: 32-53.

Main Points

1. The southern California landscape was rich with fire from the early 1600s (and likely much earlier) to the mid 1800s. During this time we saw both localized fire events and landscape-sized events occurring. Large fires are a natural phenomenon of the southern California chaparral dominated landscape (1-3 per century).
2. By the early 1900s, many of the small fire events were absent from the record. Most of these small fires were likely the product of Native American activity. While small fires were frequent in the past, they did not effectively control or contain large events from occurring.
3. In limited cases, fire return intervals of less than 10-15 years were recorded by the same individual tree. Such short intervals, however, do not reflect what was happening on the broad landscape. The ecologic impact following those localized events is unknown. It is unlikely, however, that many of the chaparral species in those areas survived such frequent fire return intervals based on life history traits and modern day observations.
4. The presence of non-native species, such as grasses, has dramatically altered modern post-fire landscapes by quickly colonizing frequently burned areas.

Reconstructing Past Fire Regimes

Understanding the interactions between wildfire and native vegetation is critical to understanding how to manage the landscape for resource benefit. This is particularly true in our landscapes that are, or in some cases were, dominated by chaparral and coastal sage scrub species.

Fire plays a critical role in shaping these landscapes, however, while they are often referred to as “fire-dependent”, these suites of species are actually quite sensitive to fire at particular intervals. Using modern era records to understand what has occurred on our landscapes is certainly informative; however, prior to drawing any conclusions we must first acknowledge that the ecological events and processes in the modern era are heavily influenced by anthropogenic activities (e.g. grazing, logging, settlement, climate change, etc.). To eliminate some of these influences and elucidate past ecologies that may have functioned in a more natural state, we must look into the deep past.

Historical reconstruction of ecological processes and events is one of the best tools available to land managers who are interested in understanding how our systems operated

prior to advent modern day influences that have dramatically altered landscapes, species compositions and ecological processes. Present day managers can use the findings of these studies to establish natural baselines and guide restoration efforts whose aim is to re-create, as best as possible, fully functioning ecologies.

In the western United States, historic reconstructions that pre-date the 1800s, have been used extensively to establish the parameters for what is believed to be the natural operating state of the landscape. Native Americans have certainly had a degree of influence upon the American landscape for 1000s of years. We can't ignore the impact their land use and practices may have had on ecological processes and these impacts are embedded within the signals we detect in our modern day studies of the past. However, we do understand that their impacts were substantially lighter and spatially far less extensive than anything that has occurred in the past 200 years. So while we must always account for the potential impacts that these past anthropogenic practices may have played, we can examine historical records gleaned from natural data and begin to see how these landscapes may have operated with minimal human influence.

The Southern California National Forest Study

As a graduate student at the University of Arizona, I worked with Drs. Tom Swetnam and Don Falk on a reconstruction of fire histories in the southern California National Forests (Mark Borchert, a long standing USFS ecologist, was also a significant contributor to this study). The aim of our study was to document, examine and interpret the historical fire regime of the chaparral vegetation in these forest using Bigcone Douglas fir (BCDF) as a proxy species given that it is long-lived, able to withstand multiple fire events and relatively accessible in places. We only sampled stands that were completely surrounded by chaparral vegetation so that we could eliminate any influence on the BCDF fire record from fire that may have been more reflective of those originating and burning in mixed conifer stands.

In general, our results showed that fires, both big and small, were commonplace in the southern California forests from the 1600s to the mid 1800s. By the early 1900s, many of the smaller fire events were observed in the tree-ring record had ceased to exist. However, the large fire events that are familiar to many of us today, continued to occur. This was a common signal seen in Los Padres, Angeles and San Bernardino National Forests. While these results seem relatively cut and dry, detailed analysis and a clear understanding of the sampling techniques used to create tree-ring records, reveal a slightly more complicated story.

Below I have listed several distinct thoughts and interpretations that we believe are the main points to be taken from this work.

- The landscape was rich with fire from the early 1600s (and likely much earlier) to the mid 1800s. During this time we saw both localized fire events and landscape-sized events occurring. By the early 1900s, many of the small fire events were absent from the record. We believe that the absence of these types of events is due to the advent of fire suppression and the removal of Native Americans from the

landscape. Furthermore, this result signifies to us that large fires are a natural phenomenon of the southern California chaparral dominated landscape.

- While, small fires were frequent in the past, they did not effectively control or contain large events from occurring. Even in present day landscapes, wind-driven fire events (i.e. Santa Ana fires) can burn over, through and around recently burned landscapes that would be a deterrent to fires in normal weather conditions.
- We believe that the frequent fires of the past are a reflection of Native American burning practices meant as a means of landscape management and manipulation. Preliminary analysis suggests that fire frequencies reconstructed near known Native American settlements are higher than those reconstructed in areas not known to have been frequented by these peoples. However, further work needs to be done to provide a more robust understanding of the spatial and temporal patterns of Native American use of fire in this region.
- We generated mean fire return intervals (MFI) for both large and small sized fire events across all three forests. While these MFIs are often the most cited result from dendrochronology studies, they are often not used in the current context. For example, when a study cites a MFI of 10 years, in nearly all dendrochronology work, that refers to a fire of a certain size which has occurred somewhere within the sampled landscape once every ten years (on average). It does not mean that a fire occurs at the same point in a forest every ten years (on average). The ecological reality of those two situations is extremely different, especially in the case of chaparral.
- There were instances that we observed, in the tree-ring record, fires occurring at intervals of less than 10-15 years and were recorded by the same individual tree. In these limited cases, we do find that fires in southern California chaparral can occur at high frequencies. We don't know what the ecologic impact was following those events. Given what well-respected research has shown us, it is unlikely that many of the chaparral species in those areas survived the event based on life history traits and modern day observations. However, like the influence of Native Americans on fire regimes, we need to acknowledge the substantial impact the introduction of non-native species has had upon our landscapes. Prior to the mid 1800s, we lacked many of the now invasive non-native species that are abundant today. And those that were present were far more limited in their extent than in the present day. Unlike we see on the modern day landscape, when fire frequencies exceeded the ability of chaparral species to withstand closely repeated events, what followed was likely a barren landscape and not a field of aggressive, non-native species. These barren patches would slowly be colonized by native vegetation from surrounding areas or native species within the seedbank that survived the event. The ecological consequence was low, and would remain low to this day, if the suite of quick moving and ubiquitous non-native species were not present. That is certainly not the case

now and any benefits gained by short fire frequencies would quickly be negated by the advance of non-native species at the expense of native.

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