Ecological Restoration Institute

Fact Sheet: Unsupported inferences of high-severity fire in historical dry forests of the western United States: A response to Williams and Baker

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Unsupported inferences of high-severity fire in historical dry forests of the western United States: A response to Williams and Baker

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Introduction

A recent study in *Global Ecology and Biogeography* (Williams and Baker 2012, hereafter W&B) described the historical conditions of forest structure and fire regimes on four large landscapes in Arizona, Colorado and Oregon. W&B used notes made by land surveyors who worked in these landscapes in the late 1800s and early 1900s, a period before many impacts of modern land uses, such as large-scale fire control, took place. Based on these data, W&B developed an interpretation of past conditions in ponderosa pine and dry mixed conifer forests that differs from previous research. W&B asserted that these forests historically included relatively high densities because of past fire regimes of moderate to high severity fires. Natural regeneration following such fires would lead to numerous, small and similar aged trees. W&B concluded that current management practices of thinning small trees and using low-severity prescribed burns would damage forests, rather than restore them. The inferences drawn by W&B about past forest ecology contrast sharply with those reported by numerous previous researchers, who used tree-ring and historical data to show that dry forests had predominantly surface fire regimes with relatively open, uneven-aged forests. A group of 18 forest ecologists, concerned about the lack of scientific support for the conclusions by W&B, wrote a response (Fulé et al. 2013). This fact sheet summarizes the key issues of our response. A rebuttal to the response was published by Williams and Baker (2014).

Issue No. 1: *Fire Severity*

General Land Office (GLO) surveyor in Oregon, in an undated photograph courtesy of the Bureau of Land Management.

The land surveyors for the General Land Office (GLO) marked trees around the corner points that delineated square miles and quarter-miles. Calculations can be applied to these tree lists to estimate the forest density, species, and diameters of the trees at the time of the survey. However, W&B made a major leap from reconstructions of *forest structure* to infer details of the historical *fire regime*. They argued that 1) tree size is related to tree age, and 2) trees established after severe fires. Thus wherever small trees made up a certain proportion of a tree list, they interpreted this result to mean that a severe fire had burned at that point within approximately the last century. By assembling all the GLO points that met thresholds of "severe" or "moderate" burning, they concluded that relatively high percentages of past landscapes had burned with "higher-severity" fire, ranging from 38% on the Mogollon Plateau, Arizona, to nearly 98% on the Front Range in Colorado.

In response, we noted that tree size is not a strong predictor of tree age, especially for many of the species in the study, because growth is affected by many other factors. The second argument, that trees establish after fire, is true but incomplete. Trees also establish after many other disturbances in the forest: insect outbreaks, windstorms, or droughts. Trees often fail to establish after fire, sometimes for decades or indefinitely. Early reports by foresters consistently refer to predominantly surface fire behavior in dry forests, even while noting severe burning in higher-elevation forests. Fire regime studies based on fire scarred trees and tree-ring dating within the landscapes studied by W&B also show mostly low-severity burning. In sum, a portion of the small-diameter trees that were present in the forest at the time of GLO surveys may have become established as the result of a patch of severe fire. But tree regeneration recorded on GLO plots is likely to have established through multiple pathways. Additionally, tree size is not reliably linked to time since a severe fire. For these reasons, we argue that W&B's conclusion of abundant "higher-severity" fire in the past is not supported by the evidence.

ISSUE NO. 2: *Historical vs. Current Fire Severity*

Comparing their reconstruction of past fire severity to percentages of area burned at different severities in modern fires, W&B conclude that the modern occurrence of large, severe wildfires is 'not unprecedented, and has not increased, relative to the historical record'. This conclusion is not supported by the evidence for two reasons: 1) the methods for estimating past fire severity based on tree size are not reliable, as described in Issue No. 1, and 2) there are fundamental differences between the classification of severe fire in the W&B reconstruction (70% or more of trees killed) vs. the modern classification. Modern fire severity classification, taken from the Monitoring Trends in Burn Severity (MTBS) project (www.mtbs.gov), includes tree mortality as *one factor in a multi-variable assessment* based on satellite imagery. It is not appropriate to compare percentages of severity between entirely different systems. Furthermore, the scale of high severity disturbance is important to consider. A fire that left 30% of the trees alive across a landscape would be called "severe" by W&B, but dry forests are resilient to that level of disturbance, particularly if the losses were small diameter trees, with less ecological impact. In contrast, modern high-severity fires have large, contiguous patches of severe burning that expose soils to erosion and eliminate seed sources for the future.

ISSUE NO. 3: *Comparisons with Other Studies*

W&B said that they found it "surprising" that dry forests "commonly thought to have been open and park-like" were heterogeneous and relatively dense, a finding that they interpreted as indicating high fire severity in the past. Their approach was to group together GLO data from relatively dry ponderosa pine and pine-oak forests with wetter and denser mixed conifer forests, after which they compared the results to a selected list of other forest reconstructions from dry pine sites only. However, had W&B compared the GLO data with other studies using the same forest types, they would have found the densities were similar.

GLO surveyors in Oregon, 1923. *Photo courtesy of the Bureau of Land Management*

Why is this important?

Understanding the long-term processes of an ecosystem is important for its restoration and protection. Therefore the contribution of a large historical data set by W&B is welcome. Furthermore, there are many points of agreement about past variability in forest structure and fire regime; we explicitly note that there is ample evidence that past forests were heterogeneous and that all fire regimes include a mosaic of low- to high-severity burning. However, W&B made an unsupported leap in logic from tree diameters on GLO plots to inferring high past fire severity that is not consistent with other empirical evidence. Their study methods were consistently biased toward interpretations of higher fire severity. As a result, we disagree with their conclusion that current attempts to reduce forest fuels and fire severity have "negative consequences." In fact, dry western forests are documented to be two to ten times denser than in the late 1800s. These forests are vulnerable to even larger severe fires in drought and warming climate. The weight of scientific evidence indicates that conserving these ecosystems and the valuable services they provide to society is not consistent with the modern pattern of increasingly larger and more severe wildfires. Following the recommendations of W&B would be an experiment we cannot afford to conduct.

References

Fulé, P.Z, T.W. Swetnam, P.M. Brown, D.A. Falk, D.L. Peterson, C.D. Allen, G.H. Aplet, M.A. Battaglia, D. Binkley, C. Farris, R.E. Keane, E.Q. Margolis, H. Grissino-Mayer, C. Miller, C. Hull Sieg, C. Skinner, S.L. Stephens, A. Taylor. 2013. Unsupported inferences of high severity fire in historical western United States dry forests: Response to Williams and Baker. *Global Ecology and Biogeography*. DOI: 10.1111/geb.12136.

Williams, M.A., and W.L. Baker. 2012. Spatially extensive reconstructions show variable-severity fire and heterogeneous structure in historical western United States dry forests. *Global Ecology and Biogeography* 21: 1042–1052.

Williams, M.A., and W.L. Baker. 2014. High-severity fire corroborated in historical dry forests of the western United States: response to Fulé et al. *Global Ecology and Biogeography*. DOI: 10.1111/geb.12136.

This Fact Sheet summarizes information from the following publication:

Fulé, P.Z, T.W. Swetnam, P.M. Brown, D.A. Falk, D.L. Peterson, C.D. Allen, G.H. Aplet, M.A. Battaglia, D. Binkley, C. Farris, R.E. Keane, E.Q. Margolis, H. Grissino-Mayer, C. Miller, C. Hull Sieg, C. Skinner, S.L. Stephens, A. Taylor. 2013. Unsupported inferences of high severity fire in historical western United States dry forests: Response to Williams and Baker. *Global Ecology and Biogeography*. DOI: 10.1111/geb.12136.

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