RESEARCH ARTICLE

DID THE 2002 HAYMAN FIRE, COLORADO, USA, BURN WITH UNCHARACTERISTIC SEVERITY?

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ABSTRACT

There is considerable interest in evaluating whether recent wildfires in dry conifer forests of western North America are burning with uncharacteristic severity—that is, with a severity outside the historical range of variability. In 2002, the Hayman Fire burned an unlogged 3400 ha dry conifer forest landscape in the Colorado Front Range, USA, that had been the subject of previous fire history and forest age structure research. We opportunistically leveraged pre-existing data from this research, in combination with post-fire aerial imagery, to provide insight into whether the Hayman Fire's patterns of high-severity, stand-replacing fire effects were uncharacteristic. Living old overstory trees were well distributed and abundant in the landscape before the Hayman Fire, despite the fact that some stand-replacing burning had been a component of the landscape's histori-

RESUMEN

Existe un considerable interés por evaluar si incendios recientes en bosques de coníferas de áreas secas del oeste de Norte América se están quemando con una severidad poco característica, es decir si esta severidad está por fuera de su rango de variabilidad histórica. En 2002, el incendio Hayman quemó 3400 ha de bosques secos de coníferas en la cordillera frontal de Colorado, EEUU, que había sido objeto de investigaciones previas sobre su historia de fuego y sus características de edad y estructura. Nosotros aprovechamos la oportunidad para impulsar una investigación con datos pre-existentes, en combinación con imágenes aéreas satelitales post-fuego, para tener una visión sobre si los patrones de alta severidad y efectos de reemplazo total de rodales del incendio Hayman fueron no característicos (fuera de su rango histórico de variabilidad). Los árboles viejos, dominantes del dosel superior, estaban bien distribuidos y eran abundantes antes del incendio Hayman, a pesar del hecho que algún incendio de reemplazo del rodal

cal mixed-severity fire regime. Of 106 randomly selected stand polygons that were sampled for the age of the oldest living overstory tree prior to the fire, 30 % contained only trees ≤200 yr, while 70 % contained at least one tree >200 yr and 29 % contained at least one tree >400 yr. Following the Hayman Fire, only 5 % of the polygons contained any living trees; these polygons were all immediately adjacent to the reservoir in the center of the landscape. At most, 4 % of the polygons contained one or more trees >200 yr post fire, and 3 % contained one or more trees >400 yr. The nearly complete loss of old trees, most of which were located in areas with evidence of past non-stand-replacing burning, leads us to conclude that the amount and extent of stand-replacing burning within the Hayman Fire were uncharacteristic for this landscape over at least the last two to four centuries.

había sido un componente del paisaje en un régimen de fuego histórico de severidad mixta. De los 106 polígonos de rodales elegidos al azar que fueron muestreados por edades de los árboles más viejos previos al fuego, el 30 % presentó árboles ≤200 años, mientras que el 70 % presentó al menos un árbol >200 años, y 29 % presentó al menos un árbol >400 años. Después del incendio Hayman, solo un 5 % de los polígonos presentaban árboles vivos; esos polígonos, estaban todos inmediatamente adyacentes al reservorio en el centro del paisaje. Cuanto mucho, 4 % de los polígonos tenían uno o más árboles >200 años post fuego y 3 % tenían uno o más árboles >400 años. La pérdida casi completa de árboles añejos, la mayoría de los cuales estaban ubicados en áreas con evidencias de incendios pasados poco severos, nos lleva a concluir que la cantidad y el grado de extensión de incendios de reemplazo de rodales en el incendio Hayman fueron no característicos en este paisaje por al menos los dos a cuatro últimos siglos.

INTRODUCTION

Dry conifer forests across western North America have experienced considerable wildfire activity in recent decades (Westerling *et al.* 2006, Miller *et al.* 2009, Dillon *et al.* 2011, Miller and Safford 2012, Westerling 2016). Many of these recent wildfires burned with high severity across a sizable portion of their footprint, creating vast stand-replacing patches devoid of surviving overstory trees. In the United States, for example, Colorado's 2002 Hayman Fire, Arizona's 2011 Wallow Fire,

and California's 2013 Rim Fire—among the largest and most severe wildfires known to have occurred in their respective states—each created stand-replacing patches many thousands of hectares in size (Finney *et al.* 2003, Waltz *et al.* 2014, Steel *et al.* 2015). Western dry conifer forests that burned with stand-replacing severity in recent wildfires have often had deleterious post-fire ecological responses, such as increased soil erosion, diminished tree regeneration, and elevated exotic plant invasions relative to forests that burned less severely (Benavides-Solorio and MacDonald

2001, Keyser *et al.* 2008, Fornwalt *et al.* 2010, Chambers *et al.* 2016), generating concern that stand-replacing burning threatens their sustainability.

The historical range of variability (HRV) is widely viewed as a useful concept for characterizing the range of properties and processes that sustained ecosystems in the past, and for identifying potential threats to sustainability due to recent departures from past conditions (Morgan *et al.* 1994, Landres *et al.* 1999, Keane *et al.* 2009). Thus, there is considerable interest in evaluating whether the fire severity patterns of recent wildfires in Western dry conifer forests—and high-severity, stand-replacing patterns in particular—have departed from HRV. Numerous studies in these forests have documented historical (typically defined as prior to Euro-American settlement) fire regimes that consisted primarily of low-severity wildfires, with little or no stand-replacing burning, as well as primarily of mixed-severity wildfires, sometimes with a substantial stand-replacing component (e.g., Baisan and Swetnam 1990; Fulé *et al.* 1997, 2005; Brown *et al.* 1999, 2008, 2015; Fulé and Covington 1999; Everett *et al.* 2000; Beaty and Taylor 2001; Sherriff and Veblen 2006, 2007; Iniguez *et al.* 2009; Scholl and Taylor 2010; Heyerdahl *et al.* 2012; Williams and Baker 2012; Sherriff *et al.* 2014; Stephens *et al.* 2015). Yet, few studies have contrasted historical and current patterns of stand replacement. One such study was conducted by Harris and Taylor (2015) for a 2125 ha dry conifer forest landscape in Yosemite National Park, California, USA. The authors found that none of their pre-existing plots contained evidence of historical stand-replacing burning, yet 24 % of them experienced stand-replacing or nearly stand-replacing burning in the 2013 Rim Fire, due to increased forest density following more than a century of fire exclusion. Additional studies such as this are needed to gain a more thorough understanding of how the stand-replacing component of recent wildfires compares to that of historical ones.

Dry conifer forests of Colorado's Front Range, USA, have experienced numerous wildfires in recent decades, paralleling trends observed across the West (Graham *et al.* 2012). Although it is widely held that these forests were historically regulated by mixed-severity fire regimes at all but the lowest elevations (e.g., Brown *et al.* 1999, 2015; Sherriff and Veblen 2006, 2007; Williams and Baker 2012; Sherriff *et al.* 2014), uncertainty remains regarding whether the patterns of stand-replacing burning of recent wildfires have departed from HRV. In 2002, the Hayman Fire burned across an unlogged 3400 ha dry conifer forest landscape that had been the subject of previous fire history and forest age structure research (Figure 1; Brown *et al.* 1999; Kaufmann *et al.* 2000, 2001; Huckaby *et al.* 2001). We opportunistically leveraged overstory tree age data from this past research—in particular, the ages of the oldest trees within sampled stands, which give some indication of how long the stands have persisted without complete stand-replacing disturbance—in combination with post-fire aerial imagery, to calculate metrics describing the age, abundance, and distribution of the oldest trees before and after the fire. We then interpreted these metrics in the context of the landscape's fire history to provide insight into whether the stand-replacing component of the Hayman Fire was uncharacteristic relative to fires that burned in the past.

METHODS

Study Area

Our study area was the 3400 ha Cheesman Lake landscape, both before and after the 2002 Hayman Fire (Figures 1, 2). The Cheesman Lake landscape is located approximately 60 km southwest of Denver, Colorado, USA, and encompasses Cheesman Lake, a 350 ha reservoir on the South Platte River. The landscape has been owned by Denver Water (or its predecessors) since the early 1890s. Elevations
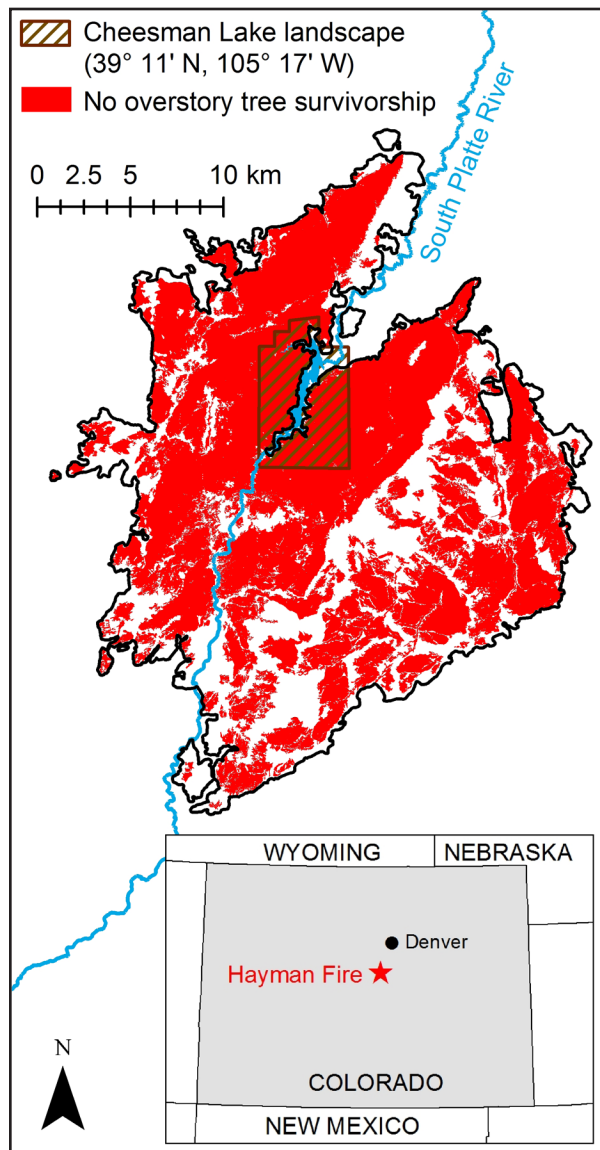
Figure 1. The location of the Cheesman Lake landscape within the 2002 Hayman Fire, Colorado, USA. Areas in red represent post-fire patches that were devoid of surviving overstory trees, and were derived from aerial imagery taken in 2013 (adapted from Chambers *et al.* 2016). The inset shows the location of the Hayman Fire within Colorado.

range from 2100 m to 2400 m. Annual precipitation averages about 38 cm at nearby Manitou Experimental Forest. Soils are primarily gravelly coarse sandy loams derived from Pikes Peak granite. Forest overstories prior to the Hayman Fire were generally dominated by ponderosa pine (*Pinus ponderosa* Lawson &

C. Lawson) on south-facing slopes, and by ponderosa pine and Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) on north-facing slopes (Kaufmann *et al.* 2000). Diverse communities of graminoids, forbs, and shrubs characterized the pre-fire forest understory (Fornwalt *et al.* 2003, 2009).

Prior to the Hayman Fire, the Cheesman Lake landscape had been only minimally impacted by land use activities such as logging and livestock grazing (Kaufmann *et al.* 2000; Fornwalt *et al.* 2003, 2009). Deliberate protection from such activities made the landscape unique relative to surrounding lands on which logging and livestock grazing had been intense, particularly in the decades immediately following Euro-American settlement in the late 1800s. Some logging occurred during dam construction from 1894 to 1905, but it was largely restricted to areas now below the waterline of the reservoir. Upon completion of the dam, a fence was constructed around the landscape to prevent trespassing from loggers and livestock and to limit recreation.

In contrast to the landscape's land use history, its fire history prior to the Hayman Fire was generally reflective of surrounding lands. An eight-century-long fire history constructed from tree-ring data showed that this landscape historically experienced a mixed-severity fire regime (Brown *et al.* 1999). Widespread wildfires (burning ~1000 ha or more of the landscape) occurred every 27 yr to 128 yr before Euro-American settlement and averaged 59 yr between events. Less extensive wildfires were more frequent, such that a wildfire occurred somewhere on the landscape every 1 yr to 29 yr and every 9 yr on average. The severity of widespread wildfires varied from low to high, with stand-replacing patches estimated to be no larger than about 100 ha (Brown *et al.* 1999, Kaufmann *et al.* 2000, Romme *et al.* 2003). This range of severity was especially apparent during the 1851 fire year (Brown *et al.* 1999). The year 1851 was an extremely dry year that followed the longest period with-

Figure 2. The Cheesman Lake landscape 13 yr following the 2002 Hayman Fire. This photograph was taken from near the north end of the property. Living trees are apparent only adjacent to the reservoir. Photograph by P.M. Brown.

out a widespread wildfire on the landscape, and burning in this year is thought to have created more and larger patches of stand-replacing fire effects than other historical wildfires. A fire suppression policy has been in place since the early 1900s, and the landscape did not experience a widespread wildfire from 1851 until the 2002 Hayman Fire.

The Hayman Fire was ignited on 8 June 2002. Driven by low relative humidity, strong winds, and heavy and continuous fuels, the Hayman Fire ran ~30 km on 9 June, burning predominately with stand-replacing effects (Bradshaw *et al.* 2003, Finney *et al.* 2003). The Cheesman Lake landscape is estimated to have burned in the latter half of this day (Finney *et al.* 2003). Less extreme weather conditions arrived on 10 June and persisted for much of the next three weeks, and fire severity patterns were somewhat more spatially heterogeneous. The Hayman Fire was contained on 2 July, after having burned more than 52 000 ha of predominately dry conifer forest. Approximately 83 % of the Cheesman Lake landscape is within the Hayman Fire perimeter (MTBS 2015); unburned portions of the landscape are comprised primarily of the reservoir and land immediately adjacent to it.

Data Collection and Analysis

Our study leverages the pre-fire overstory tree age dataset of Huckaby *et al.* (2001), which was collected to characterize the age structure of the oldest living overstory trees in the Cheesman Lake landscape. To derive this dataset, the landscape was first manually mapped by drawing polygons around areas with homogeneous overstory tree canopy cover and tree size distributions (i.e., stands) on 1:6000 color-infrared print aerial imagery taken in 1996. The polygons were digitized and orthorectified, and approximately 10 % of them were randomly selected for field sampling. Approximately five living overstory trees (>10 cm diameter at breast height) that appeared to be the oldest, or to represent the oldest cohort, were cored in each polygon in 1999 at ~35 cm above the ground. The oldest trees were identified by the distinctive morphological characteristics that develop with age (Huckaby *et al.* 2003). The presence of visibly fire-scarred trees was also noted for each polygon during field sampling. In the laboratory, germination dates of sampled trees were determined by crossdating cores with an existing ring-width chronology to obtain dates for the innermost tree-rings (Stokes and Smiley 1968, Brown *et al.* 1999), using an overlay

of concentric circles to estimate pith dates from the innermost dates when the core did not intercept the pith (Applequist 1958), and adjusting pith dates for the approximate time required to grow to coring height (5 yr to 18 yr depending on species and site productivity; Kaufmann *et al.* 2000).

We used ArcMap 10.2 (Environmental Systems Research Institute, Redlands, California, USA) and 1 m resolution orthorectified color digital aerial imagery taken in 2013 to "revisit" the 106 sampled polygons that were >0.25 ha and that were fully within the Hayman Fire perimeter (mean polygon area of 2.85 ± 0.44 ha; Figure 3; MTBS 2015, NAIP 2015). We estimated the percent of each polygon that burned with stand replacement by dividing the polygon's stand-replaced area, determined using the "measure" tool in ArcMap, by its total area. Only contiguous areas of complete overstory tree mortality >0.25 ha were considered in our estimates of stand replacement. Smaller areas of mortality were viewed as pockets of severe fire (i.e., torching of a single tree or small group of trees) within larger patches of lesser fire severity, and were disregarded.

We used the stand-replacement estimates in combination with the tree age dataset to calculate metrics describing the pre-fire and post-fire age, abundance, and distribution of the oldest living trees, and we compared pre-fire and post-fire values using repeated measures analysis of variance in SAS 9.4 (PROC GLIMMIX; SAS Institute Inc., Cary, North Carolina, USA). We conservatively assumed that sampled trees died only if the entire polygon experienced stand-replacing effects. This assumption was necessary because we did not know the full age structure for the polygons, nor the exact locations of the sampled trees. Tree ages were calculated for 2002, the year of the Hayman Fire.

RESULTS

A total of 502 living overstory trees were successfully aged by Huckaby *et al.* (2001) across the 106 polygons analyzed here, with 47% of the trees >200 yr at the time of the 2002 Hayman Fire, and 11% of the trees >400 yr. The oldest tree encountered was a >600 yr ponderosa pine, which germinated around 1395. All polygons contained living trees. Of the 106 polygons, 30% contained only trees ≤200 yr, 70% contained one or more trees >200 yr, and 29% contained one or more trees >400 yr (Figures 4, 5). The distance between a sampled polygon and the nearest polygon with one or more trees >200 yr and >400 yr averaged 132 m and 304 m, respectively (Figure 6). Visibly fire-scarred trees were noted in 4% of the polygons in which all trees were ≤200 yr, in 44% of polygons in which one or more trees was >200 yr, and in 63% of polygons in which one or more trees was >400 yr.

The Hayman Fire burned with complete stand replacement in 95% of the polygons, killing all overstory trees within them. The remaining 5% of the polygons experienced 50% to 90% stand replacement. All polygons with surviving trees were within 50 m of Cheesman Lake.

At least 96% of the trees sampled prior to the Hayman Fire, and 93% of the trees >200 yr, did not survive the burn. The >600 yr ponderosa pine was among the trees that perished in the fire. Following the fire, 1% of the 106 polygons contained living trees that were all ≤200 yr (a 32-fold reduction relative to pre-fire values; $P < 0.001$), 4% contained one or more trees >200 yr (an 18-fold reduction; $P < 0.001$), and 3% contained one or more trees >400 yr (a 10-fold reduction; $P < 0.001$; Figures 4, 5). The average distance between a sampled polygon and the nearest polygon with one or more trees >200 yr increased 11-fold to 1453 m post fire ($P < 0.001$), and the average distance between a sampled polygon and the nearest polygon with one or more trees >400 yr increased 5-fold to 1522 m ($P < 0.001$; Figure 6).
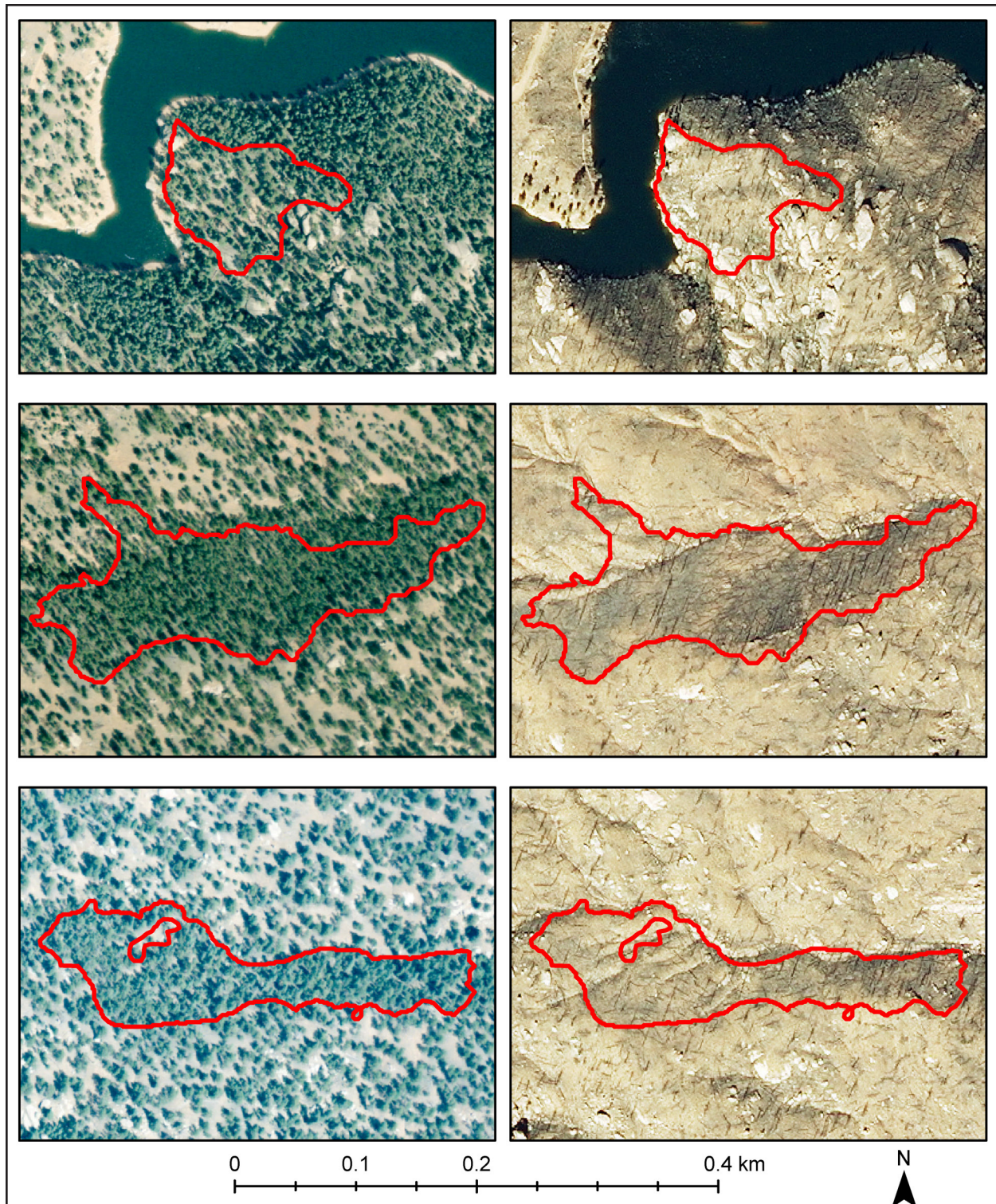
Figure 3. Example polygons at the Cheesman Lake landscape that experienced 100 % stand replacement in the 2002 Hayman Fire. Pre-fire aerial imagery (left) was taken two months before the fire, and post-fire imagery (right) was taken in 2013.
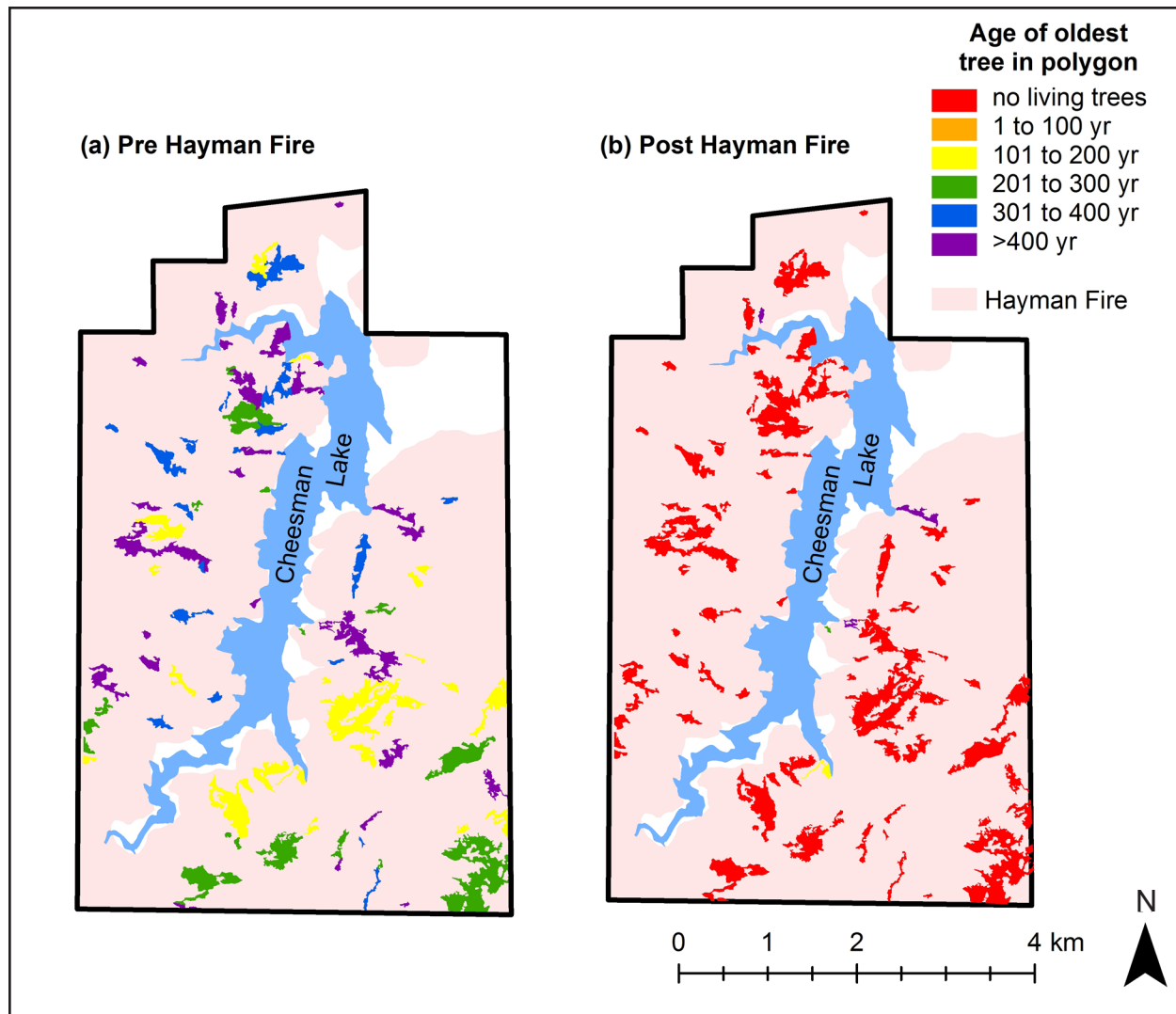
Figure 4. The Cheesman Lake landscape, with the age of the oldest living overstory tree in 106 polygons (a) before and (b) after the 2002 Hayman Fire.

DISCUSSION

The eight-century-long fire history developed by Brown *et al.* (1999) demonstrated that historical wildfires at the 3400 ha Cheesman Lake landscape left behind many surviving overstory trees, and the Huckaby *et al.* (2001) dataset corroborated this finding. Prior to the Hayman Fire, living old trees (i.e., >200 yr) were well distributed and abundant. More than two-thirds of the sampled polygons contained one or more trees >200 yr, and nearly a third had one or more trees >400 yr. The pres-

ence of old trees in these polygons indicates that at least two to four centuries had passed since completely stand-replacing fire last occurred there, while the presence of visible fire scars in most of them indicates that one or more non-stand-replacing fires had burned there over that same time. Yet Brown *et al.* (1999) also found that some high-severity, stand-replacing burning was a component of the landscape's historical mixed-severity fire regime, as has likewise been found for other dry conifer forest landscapes across the broader Colorado Front Range and western North
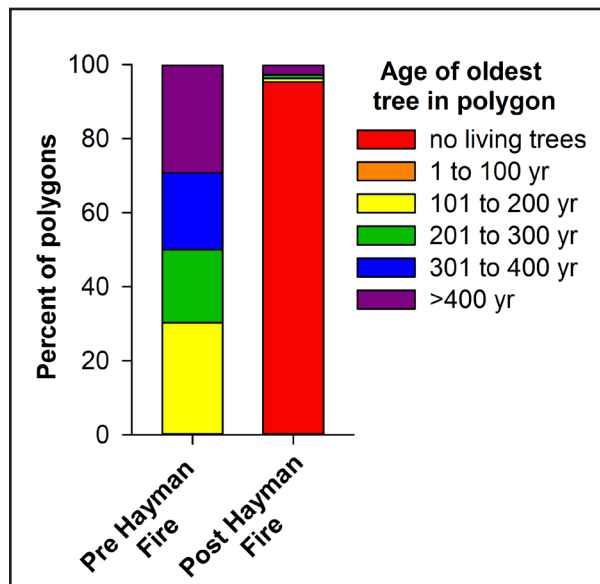
Figure 5. Ages of the oldest living overstory tree in 106 Cheesman Lake polygons, before and after the 2002 Hayman Fire.
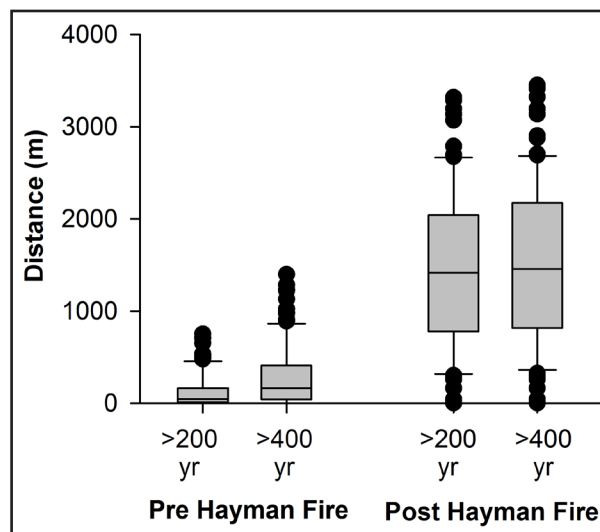

Figure 6. Box-and-whisker diagrams depicting the distance (m) from each of the 106 Cheesman Lake polygons to the nearest polygon with one or more living overstory trees >200 yr and >400 yr, before and after the 2002 Hayman Fire. Diagrams show medians, 25th and 75th percentiles (boxes), 10th and 90th percentile (whiskers), and outlier (points) distances.

America (Beaty and Taylor 2001; Sherriff and Veblen 2006, 2007; Iniguez *et al.* 2009; Hey-

erdahl *et al.* 2012). Historical stand-replacing patches, estimated to be up to about 100 ha in size, were particularly concentrated in the southeast portion of the Cheesman Lake landscape and were a result of burning in the extremely dry year of 1851 (Brown *et al.* 1999, Kaufmann *et al.* 2000, Romme *et al.* 2003). This portion of the landscape also contained most of the pre-fire polygons in which the oldest tree was ≤200 yr, probably also indicating stand-replacing burning in the nineteenth century (fires in the twentieth century were largely eliminated due to fire exclusion).

While some stand-replacing burning occurred historically at the Cheesman Lake landscape, the amount and extent of historical stand-replacing burning pales in comparison to that within the 2002 Hayman Fire. The Hayman Fire caused complete overstory tree mortality in 95 % of the polygons, with surviving trees only found in polygons immediately adjacent to the reservoir. If the 30 % of polygons found to contain only trees ≤200 yr prior to the Hayman Fire are treated as evidence of stand-replacing burning in the nineteenth century, then the Hayman Fire was responsible for over 3-fold more stand-replacing burning than all the fires in that century combined. Although our polygon data were not contiguous across the 3400 ha Cheesman Lake landscape, they nonetheless suggest that as much as 2700 ha of it burned as one large, stand-replacing patch—a patch size more than an order of magnitude larger than the maximum stand-replacing patch size estimated to have occurred in the past. Moreover, a Hayman-Fire-wide analysis of post-fire aerial imagery showed that about 70 % of the fire's >52 000 ha footprint is without surviving trees, that about 60 % of this treeless area is in patches >100 ha, and that the Cheesman Lake landscape is in the center of a treeless patch >20 000 ha in size, suggesting that much of this fire may have likewise burned in an uncharacteristically severe manner (Chambers *et al.* 2016). Recent wildfires in dry conifer forests of Arizona, Cal-

ifornia, and New Mexico have similarly burned with a stand-replacing component that appears to be unprecedented in the historical record (O'Connor *et al.* 2014, Guiterman *et al.* 2015, Harris and Taylor 2015).

It should be noted that our finding regarding the Hayman Fire's severity contrasts with the finding of Sherriff *et al.* (2014), which indicated that the Hayman Fire burned in a manner consistent with HRV. While there are likely several explanations for this discrepancy, a principal one may be related to differences in how fire severity was classified. Sherriff *et al.* (2014) put low-severity fire regimes and fire effects, in which burning resulted in no to low overstory tree mortality, in a dichotomy with higher-severity regimes and effects, in which burning resulted in a greater level of mortality. They found that approximately 70 % of the Hayman Fire's footprint historically experienced higher-severity fire, on par with the percent of the footprint that actually experienced higher-severity fire. Yet, by utilizing such a broad higher-severity class, they are unable to detect long-term changes in severity occurring within it, such as increases in stand-replacing burning. Utilizing this broad higher-severity class also provides only limited insight into post-fire ecological responses, as responses for forests that burned with stand-replacing effects are often very different than those for forests that burned with lesser severity. Post-fire tree regeneration in Western dry conifer forests, for instance, has been found to be markedly less abundant in areas with no surviving trees than in areas with some surviving trees, because regeneration is largely dependent on surviving trees for seed sources (Keyser *et al.* 2008, Chambers *et al.* 2016).

The uncharacteristic severity of the Hayman Fire and other recent wildfires in Western dry conifer forests is likely the product of multiple factors. Primary among them is the increase in forest density and homogeneity due to a century or more of fire exclusion (Fulé *et al.* 1997; Brown *et al.* 2008, 2015; Scholl and Taylor 2010; Stephens *et al.* 2015). Indeed, only one wildfire of any notable size after Euro-American settlement had been documented for the Cheesman Lake landscape prior to the Hayman Fire: a 1963 wildfire that affected around 20 ha before it was suppressed (Brown *et al.* 1999, Kaufmann *et al.* 2000). Detailed tree age data from other studies conducted in the landscape, as well as paired historical and recent photographs, document the dramatic increase in tree density due to the suppression of this and countless other ignitions during the period after Euro-American settlement (Kaufmann *et al.* 2000, 2001). Changing climate has also been cited as a driver of recent increases in wildfire frequency and size, and may be contributing to increases in severity as well (Westerling *et al.* 2006, Westerling 2016). The Colorado Front Range experienced a record drought during the months prior to the Hayman Fire, creating antecedent conditions conducive to severe burning (Bradshaw *et al.* 2003). Moreover, fire weather during the day that the Hayman Fire impacted the Cheesman Lake landscape was extreme, with relative humidity at the landscape's Remote Automated Weather Station reaching as low as 5 %, and wind speeds averaging 24 km hr^{-1} to 32 km hr^{-1} and gusting up to 72 km hr^{-1} (Bradshaw *et al.* 2003, Finney *et al.* 2003). Nonetheless, the Hayman Fire's severity may have been moderated had forests been more open and heterogeneous, both within the landscape and on surrounding lands; the creation of such conditions via fuels reduction and restoration treatments has been widely shown to reduce fire severity in Western dry conifer forests, even under extreme weather conditions (e.g., Pollet and Omi 2002, Finney *et al.* 2005, Arkle *et al.* 2012, Safford *et al.* 2012, Waltz *et al.* 2014).

The loss of many old trees from the Cheesman Lake landscape is also notable from a conservation standpoint, as old trees, once abundant throughout Western dry conifer forests, are now rare due to past logging (Smith and Arno 1999, Kaufmann *et al.* 2000, Young-

blood *et al.* 2004). Moreover, old trees are highly valued for the many ecological and cultural roles they play, including the provision of unique wildlife habitat, the sequestration of carbon, and scenic enhancement (Carey and Johnson 1995, Law *et al.* 2003, Luyssaert *et al.* 2008, Owen *et al.* 2009, Mazurek and Zielinski 2010). Uncharacteristic stand-replacing burning has similarly impacted other Western dry conifer forest landscapes with high concentrations of old trees, and such burning is considered to be one of the most significant threats to their continued persistence (Spies *et al.* 2006, Kolb *et al.* 2007, Harris and Taylor 2015). Prioritizing fuels reduction and restoration treatments for the remaining landscapes in which abundant old trees are still embedded may help minimize additional losses of these rare yet valuable landscape features (Spies *et al.* 2006, Kolb *et al.* 2007, Hood 2010, Lindenmayer *et al.* 2014).

CONCLUSIONS

Living old trees were well distributed and abundant in the 3400 ha Cheesman Lake landscape before the Hayman Fire, despite the fact that some stand-replacing burning had been a component of the landscape's historical mixed-severity fire regime (Brown *et al.* 1999, Huckaby *et al.* 2001). The nearly complete loss of old trees, many of which were located in areas with evidence of previous non-stand-replacing burning, leads us to conclude that the Hayman Fire's amount and extent of stand-replacing burning was unprecedented for the landscape over at least the last two to four centuries. This increased severity was likely the product of forest densification and homogenization across the landscape and the surrounding area after Euro-American settlement (Kaufmann *et al.* 2000, 2001), as well as of the extreme fire weather prior to and during the day that the landscape burned (Bradshaw *et al.* 2003, Finney *et al.* 2003). Furthermore, our study leads us to question the utility of severity classification systems juxtaposing low-severity with higher-severity burning, especially when examining long-term changes in fire severity for dry conifer forests historically regulated by higher-severity burning (e.g., Sherriff *et al.* 2014); such classification systems cannot account for changes occurring within the broad higher-severity class, such as increases in stand-replacing effects. Due to the opportunistic nature of our study, it was conducted in only one portion of one wildfire, and thus our ability to make broad inferences is limited. Nonetheless, this study makes a valuable contribution to the growing body of literature evaluating whether recent wildfires in Western dry conifer forests are burning in an uncharacteristic manner.

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