CENTER *for* BIOLOGICAL DIVERSITY

THE JOHN MUIR PROJECT *of* EARTH ISLAND INSTITUTE

15 July 2013

Re: Draft Natural Range of Variation (NRV) Reports for Yellow Pine and Mixed-conifer Forests (2013), and Red Fir Forests (2013)

To Whom It May Concern:

The Center for Biological Diversity and the John Muir Project offer the following comments regarding the Draft Natural Range of Variation (NRV) report for yellow pine and mixed-conifer (YPMC) forests, authored by Hugh Safford (dated May 20, 2013), and the NRV report for red fir (no author listed). The full citations for the studies referenced herein are either in the draft NRVs themselves, or in our previous comments on the draft Science Synthesis and Bioregional Assessment. We would be happy to send pdfs of any studies cited herein, upon request.

YELLOW PINE AND MIXED-CONIFER

The draft NRV does not address science which consistently finds that the assumption of a progressive increase in fire severity with increasing time-since-fire is incorrect.

The NRV (pages 19, 21-22, 36) suggests that, due to fuel accumulation, the more fire-suppressed YPMC forests burn predominantly at higher-severity, and burn more severely than non-suppressed forests, relying upon condition class ratings based upon fire return interval departure (FRID). However, the NRV does not address the fact that the scientific studies that have empirically investigated this question have consistently found this to be inaccurate and, instead, have found that long-unburned forests do not experience progressively higher fire severity with increasing time-since-fire.

Six empirical studies have been conducted in California's forests to assess the longstanding forest management assumption that the most fire-suppressed forests (i.e., the forests that have missed the largest number of fire return intervals) burn "almost exclusively high-severity", as the 2004 Sierra Nevada Forest Plan Amendment Final EIS (Vol. 1, p. 124) presumed. These studies found that the most long-unburned (most fire-suppressed) forests burned mostly at low/moderate-severity, and did not have higher proportions of high-severity fire than less fire-suppressed forests. Forests that were not fire suppressed (those that had not missed fire cycles, i.e., Condition Class 1, or "Fire Return Interval Departure" class 1) had levels of high-severity fire similar to, sometimes lower than, and sometimes higher than, those in the most fire-suppressed forests. The findings of these six studies are detailed below:

1)

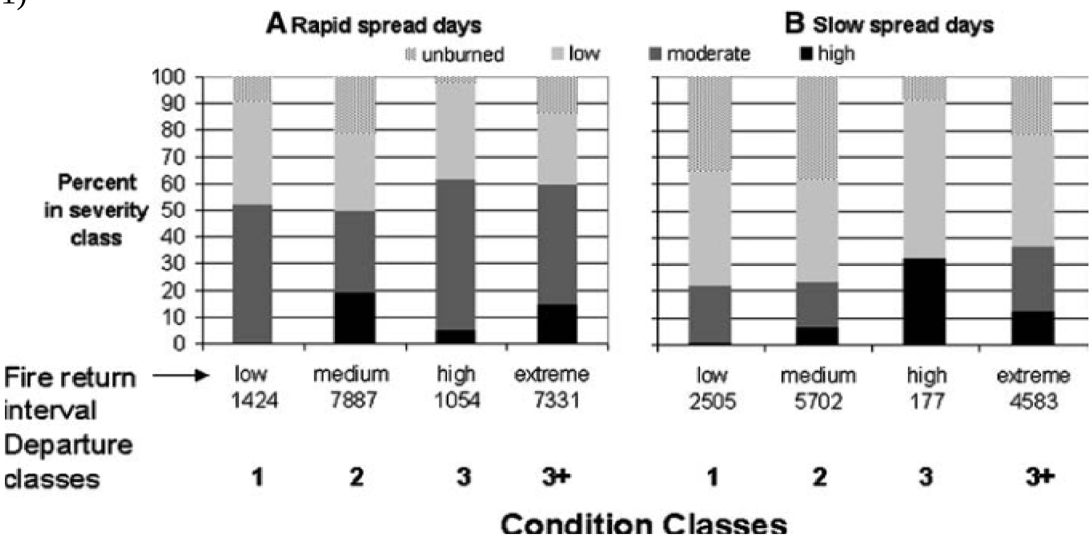

Figure 5 from Odion and Hanson (2006) (*Ecosystems*), based upon the three largest fires 1999-2005, which comprised most of the total acres of wildland fire in the Sierra Nevada during that time period (using fire severity data from Burned Area Emergency Rehabilitation (BAER) aerial overflight mapping), showing that the most long-unburned, fire-suppressed forests (Condition "Class 3+", corresponding to areas that had missed more than 5 fire return intervals, and generally had not previously burned for about a century or more) experienced predominantly low/moderate-severity fire.

2)

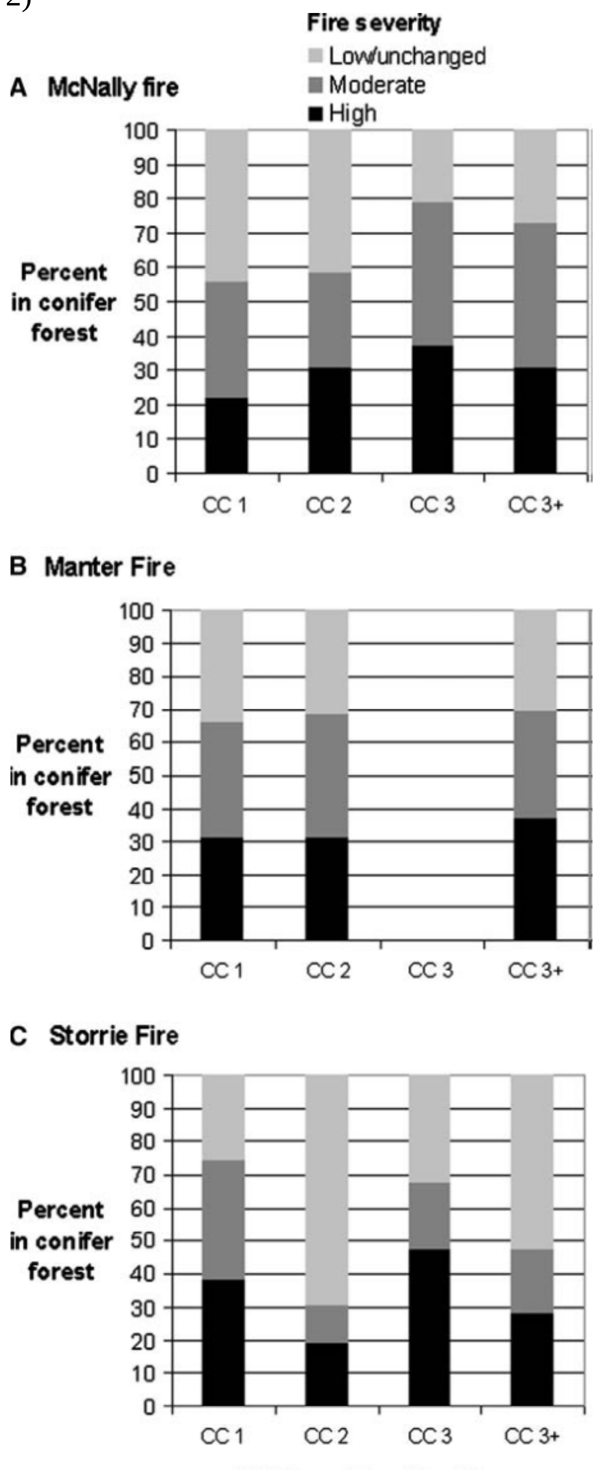

Figure 1 from Odion and Hanson (2008) (*Ecosystems*) (using fire severity data from satellite imagery for the same three fires analyzed in Odion and Hanson 2006), showing that the most long-unburned, fire-suppressed forests (no fire for a century or more) burned mostly at low/moderate-severity, and had levels of high-severity fire similar to less fire-suppressed forests (in one case, even less than Condition Class 1).

3) van Wagtendonk et al. (2012) (*Fire Ecology*), analyzing 28 fires from 1973-2011 in Yosemite National Park, found the following:

> "The proportion burned in each fire severity class was not significantly associated with fire return interval departure class…[L]ow severity made up the greatest proportion within all three departure classes, while high severity was the least in each departure class (Figure 4)."
>
> The most long-unburned, fire-suppressed forests—those that had missed 4 or more fire return intervals (in most cases, areas that had not burned since at least 1930)—had only about 10% high-severity fire (Fig. 4 of van Wagtendonk e al. 2012).

4) Odion et al. (2004) (*Conservation Biology*), addressing numerous wildland fires covering a 98,814-hectare area in 1987 in the California Klamath region, found that the most fire-suppressed forests in this area (areas that had not burned since at least 1920) burned at significantly lower severity levels, likely due to a reduction in combustible native shrubs as forests mature and canopy cover increases:

> "The hypothesis that fire severity is greater where previous fire has been long absent was refuted by our study…The amount of high-severity fire in long-unburned closed forests was the lowest of any proportion of the landscape and differed from that in the landscape as a whole ($Z = -2.62$, $n = 66$, $p = 0.004$)."

5) Odion et al. (2010) (*Journal of Ecology*), empirically tested the hypothesis articulated in Odion et al. (2004)—i.e., that the reduction in fire severity with increasing time-since-fire was due to a reduction in combustible native shrubs as forests mature and canopy cover increases—and found the data to be consistent with this hypothesis.

6) Miller et al. (2012a) (*Ecological Applications*), analyzing all fires over 400 hectares 1987-2008 in the California Klamath region, found low proportions of high-severity fire (generally 5-13%) in long-unburned forests, and the proportion of high-severity fire effects in long-unburned forests was either the same as, or *lower than*, the high-severity fire proportion in more recently burned forests (see Table 3 of Miller et al. 2012a)

The draft NRV misrepresents historic fire regimes in YPMC in the Sierra Nevada region by characterizing them as low-severity or low/moderate-severity, or by misleadingly defining "mixed-severity" fire

On page 18, the NRV asserts that the natural, historic fire regime in YPMC is low/moderate-severity, which the NRV defines as "mixed-severity". However, "mixed-severity" fire regimes are characterized by a combination of low-, moderate-, and high-severity fire, not just low/moderate-severity (Halofsky et al. 2011), and the NRV does not address an abundance of scientific data documenting substantial high-severity fire effects in YPMC forests prior to the effects of fire suppression and logging in the Sierra Nevada management region (see discussion below).

<u>The draft NRV does not address one of the most important metrics: whether there is more or less high-severity fire now than there was historically in YPMC, in terms of high-severity fire rotation interval.</u>

The NRV (pp. 21-27) discusses in detail comparisons between current and historic fire in terms of high-severity fire proportion, and fire rotation in general, but avoids any discussion comparing current to historic high-severity fire rotations—i.e., the average annual amount of current versus historic high-severity fire. Miller et al. (2012b) found that the high-severity fire rotation intervals for Sierra Nevada eastside yellow pine and mixed-conifer forests since 1984 was 257 and 199 years, respectively, and suggested that, on the eastside, rotation intervals should not be shorter than this in these forest types. However, Miller et al. (2012b [Table 3]) found that, on the westside of the Sierra Nevada, yellow pine and mixed-conifer forests have high-severity fire rotations that are much too long: 859 and 1,106 years, respectively. In the Cascade-Modoc area of the Sierra Nevada management region, Miller et al. (2012b [Table 3]) found that high-severity fire rotations in yellow pine and mixed-conifer were even longer since 1984: 1,177, and 1,587 years, respectively. Miller et al. (2012b) specifically noted that, in YPMC on the westside and Cascade-Modoc portions of the Sierra Nevada management region, current "high-severity rotations may be too long", and are "uncharacteristic", indicating that more high-severity fire should be allowed in YPMC in these areas through managed wildland fire (Miller et al. 2012b, pp. 15-16). These areas of YPMC, in which current high-severity fire rotations are uncharacteristically long, represent 1,724,690 hectares, or 76%, of the total 2,259,336 hectares of YPMC forest in the Sierra Nevada management region (Miller et al. 2012b, Table 3).

There are a number of scientific sources indicating high-severity fire rotation intervals in unlogged, pre-suppression YPMC forests. Bekker and Taylor (2001 [Figure 2f]) found approximately 50% to 60% of the mixed-conifer forest in an unlogged area of the southern Cascades in California experienced high-severity fire over a 76-year period (1864-1939) prior to effective fire suppression in that area, indicating a high-severity fire rotation interval of 150-200 years. Collins and Stephens (2010), in a modern "reference" forest condition within YPMC forests in Yosemite National Park, found that 15% of the forest experienced high-severity fire over a 33-year period. This equates to a high-severity fire rotation of 223 years. Similarly, Stephens et al. (2007 [Table 5]) estimated overall historic fire rotation intervals of 12 and 20 years in YP and MC forests, and modeled an average of 5% high-severity fire. This equates to high-severity fire rotation intervals of 240 to 400 years in YPMC. Minnich et al. (2000) found a high-severity fire rotation interval of 300 years in YPMC reference forests of Baja California, Mexico (forests that had not been managed, or subjected to fire suppression policies). Further, Odion and Hanson (2013) found that stand-initiating fire has declined by about fivefold since the 1920s in the Sierra Nevada and eastern Oregon Cascades in forests dominated by YPMC.

Thus, in the great majority of YPMC forests in the Sierra Nevada management region, high-severity fire is outside the natural range of variation, but very much on the low/deficit side, and the draft NRV fails to acknowledge this key issue.

The draft NRV presents incomplete data and analysis regarding current versus historic high-severity fire proportion, and omits discussion of numerous studies that contradict the assertions and assumptions in the draft NRV

The draft NRV (pp. 22-27) claims that, historically, high-severity fire proportion was only about 5-15% in YPMC forests of the Sierra Nevada management region, suggesting that historic fire severity was considerably lower than it is today.

However, the draft NRV, in this key section, fails to acknowledge the dramatic role that current, ongoing fire suppression plays in current proportions of fire severity, given that fire suppression disproportionately suppresses the lowest severity fires that are easiest to suppress. In another section, further down in the document, the draft NRV (p. 35) acknowledges that the Forest Service successfully suppresses 98% of small, slow-moving (and, therefore, generally low-severity) fires before they reach 300 acres in size. Mathematically, there is no question that this must necessarily substantially skew the proportion of high-severity fire higher, simply by eliminating most of the low-severity fire that would otherwise have occurred. The draft NRV misleads by failing to mention this, and by implying that any difference in high-severity fire proportion between the present and historic times is simply due to fuel accumulation and, consequently, forests that burn more severely due to fire suppression in past decades, as opposed to high-severity fire proportions being skewed in each particular year by crews that disproportionately suppress what they are most able to suppress: lower-severity fires. This also indirectly suppresses larger, higher-severity fires that might otherwise occur but were never allowed to grow beyond 300 acres.

The draft NRV (p. 26) cites Stephens et al. (2007) for the proposition that the average proportion of high-severity fire effects in historic YPMC forests was only about 5%, but fails to note that this was a matter of pure guesswork in Stephens et al. (2007), and was not based upon any empirical data set. The draft NRV (p. 27) also cites a Forest Service technical report, Quigley et al. (1996), for the proposition that historic YPMC eastside forests in Oregon and Washington had 10-15% high-severity fire on average, but fails to divulge that more recent, and far more comprehensive, studies find that historic high-severity fire in YPMC forests of the eastern Cascades represented 37% of fire effects (Hessburg et al. 2007), and another study found that historic dry YPMC forests in the eastern Oregon Cascades (abutting the northern boundary of the Sierra Nevada management region) had an average high-severity fire proportion of about 20% (Baker 2012 [Table 5]). The draft NRV (p. 27) cites a modeling study, Mallek et al. (in review), for the proposition that historic YPMC forests had 6-12% high-severity fire on average, but this study was based on "presumed presettlement conditions" (draft NRV, p. 27), not empirical data like Hessburg et al. (2007) and Baker (2012).

The draft NRV (pp. 25-26) acknowledges that Beaty and Taylor (2001) found approximately 38% high-severity fire in historic mixed-conifer forests of the western slope of the southern Cascades in the Sierra Nevada management region, but then attempts to dismiss these results, implying that these results were influenced by "mining, logging, and grazing", and altered fire patterns from late 19th century settlers (draft NRV, p. 25). However, Beaty and Taylor (2001) was conducted in a Research Natural Area (RNA) that had not been managed, unlike many other areas in the region, and Figure 2 of Beaty and Taylor (2001) shows that fire activity did not decline in the area due to fire suppression until the mid-1920s, thus their assessment of fire severity 1883-1926 pre-dated the effects of fire suppression. Moreover, Figure 2 of Beaty and Taylor (2001) shows that, contrary to the implication in the draft NRV, fire activity was not higher in the late 19th century than in the early 19th century in that area (generally, it was slightly higher in the early 20th century, actually). Further, the draft NRV (p. 25) attempts to dismiss the Beaty and Taylor (2001) results by implying that fire severity cannot be inferred by the methods used by Beaty and Taylor (2001) ostensibly because Beaty and Taylor (2001) used the number of "emergent trees" per hectare. On the contrary, the high-severity category in Beaty and Taylor (2001) was defined as areas in which fewer than 10 trees per hectare survived fire (less than 10 emergent trees per hectare)—i.e., where, at most, 4 trees per *acre* survived fire. Even in relatively sparse areas with only about 20 trees per acre, this would equate to at least 80% mortality, which is within the standard high-severity fire definition. Quite simply, there is no sound evidentiary basis for the draft NRV's attempt to dismiss the results of Beaty and Taylor (2001). In addition, the draft NRV does not discuss the fact that Bekker and Taylor (2001) and Bekker and Taylor (2010) found that the majority of fire effects were high-severity in unlogged pre-suppression mixed-conifer forests.

The draft NRV (p. 25) cites Show and Kotok (1925) to assert that only 5% mortality occurred on average in historic fires in YPMC. However, this is misleading. First, Show and Kotok (1925, p. 3) made this statement only in the context of describing "the lightest surface fire"—not average overall fire effects in these forests. Second, in footnote 2 of page 3, Show and Kotok (1925) state that, out of 12,000,000 acres of California YPMC forest, 2,000,000 acres, or about 17%, was in an early-successional stage of montane chaparral due to high-severity fire—and that does not even include the areas that had high-severity fire but still retained some dominant, surviving trees.

The draft NRV (p. 25) is similarly misleading with regard to Leiberg (1902), claiming that this study found only 8% high-severity fire. However, this figure in Leiberg (1902) pertains only to areas with 100% mortality from fire. Leiberg (1902) specifically mapped high-severity fire patches over 80 acres in size in unlogged forests, prior to fire suppression, where he defined this category as 75-100% timber volume mortality (this would equate to even higher levels of basal area mortality). In these unlogged forests, within mixed-conifer forest, the 75-100% timber volume mortality represented about 20% of fire effects—and that does not include the patches under 80 acres (Hanson 2007).

In addition, the claimed "reference" high-severity fire proportions in Figure 6 of the draft NRV are not based on empirical data but, rather, on modeling assumptions based on historic fire frequencies. This limitation is not clearly stated in the legend for Figure 6, or in the text.

Further, while the draft NRV (p. 24) acknowledges that high-severity fire is defined by 75% or greater mortality from fire, the draft NRV then misleadingly suggests that current studies, using satellite imagery, use a 95% or greater mortality threshold, citing Miller et al. (2009a, 2009b, 2012). However, the high-severity fire threshold used in these studies equated to an RdNBR value of 641 (see also Miller and Thode 2007). Hanson et al. (2010), analyzing the actual field plot validation data used for these studies, found that the regression curve in Miller et al. (2009b) substantially overstates percent basal area mortality at the higher RdNBR values (no goodnessof-fit test was conducted in Miller et al. 2009b to ensure that the curve fit the actual data), and that an RdNBR value of 574 equates to only about 61% basal area mortality, and an RdNBR of 800 equates to about 83% mortality, and even lower mortality levels if saplings and pole-sized trees are excluded (Hanson et al. 2010, Table 1). Moreover, the overwhelming weight of scientific literature defines high-severity fire as approximately 75-100% mortality or, in some cases, 70-100% mortality (e.g., Hessburg et al. 2007).

The draft NRV presents incomplete data and analysis regarding current versus historic high-severity fire patch size, and omits discussion of numerous studies that contradict the assertions and assumptions in the draft NRV

The draft NRV (pp. 27-28) claims that current high-severity patch size on national forest lands in the Sierra Nevada is 12.2 hectares (more than the 4.2 hectare average in Yosemite National Park, which has allowed active fire for decades), citing Miller et al. (2012b), and claims that high-severity patch sizes are increasing, citing Miller et al. (2009b). However, the draft NRV omits discussion of contrary scientific evidence. Hanson and Odion (in press), analyzing a much larger fire severity data set than that used in Miller et al. (2009b), Miller et al. (2012b), or in Miller and Safford (2012), found that mean high-severity patch size was less than 3 hectares currently, and was not increasing (see discussion of Hanson and Odion in press below).

The draft NRV (pp-. 27-28) also claims that high-severity patch size has "risen" since pre-fire suppression times but, to support this proposition, cites one source from another region (Minnich et al. 2000), and none from the Sierra Nevada region. Different regions may have considerably different distributions in high-severity patch size and, moreover, different methods to estimate high-severity patch size can produce considerably different results within a region. In the absence of pre-suppression high-severity patch size data in the Sierra Nevada region, and current high-severity patch size data using the same or comparable methods, the conclusions made by the draft NRV simply are not valid. In addition, the draft NRV fails to acknowledge the mathematical impact of suppressing the vast majority of the small, generally lower-severity fires. As discussed above, the draft NRV acknowledges (p. 35) that 98% of fires under 300 acres are suppressed currently on national forest lands. This must necessarily have a large impact on the distribution of high-severity patch size, likely skewing the distribution high by eliminating most of the smaller, lower-severity fires that tend to have smaller high-severity fire patches. Thus, this is not an issue of fires burning at unnaturally severe levels on national forest lands, due to fire suppression and other forest management in past decades, but rather, a function of fire suppression in any given year (which could be addressed simply by letting more fires burn—i.e., increasing managed wildland fire, as recommended by Miller et al. 2012b).

Further, the draft NRV (p. 28) implies that large high-severity fire patches over 100 or 500 hectares did not occur historically, while such patches have become a "regular occurrence" now. In order to make this suggestion, the draft NRV did not address well-known sources that mapped, described, and/or photographed large high-severity fire patches in YPMC prior to fire suppression. For instance, Bekker and Taylor (2010) documented a 1,684-hectare mixed-conifer forest area that burned mainly at high-severity in 1889 in a remote, unmanaged area. Leiberg (1902 [see map following page 18]) mapped numerous large high-severity fire patches—many exceeding 5,000 hectares—in unlogged YPMC areas prior to fire suppression (see also Hanson

2007, Figure 3.1). Show and Kotok (1924) documented numerous large high-severity fire patches in YPMC, finding that, historically, within ponderosa pine and mixed-conifer/pine forests of the Sierra Nevada, high-severity crown fires, though infrequent on any particular area, “may extend over a few hundred acres” in patches [p. 31; see also Plate V, Fig. 2, Plate VII, Fig. 2, Plate VIII, Plate IX, Figs. 1 and 2, and Plate X, Fig. 1], with some early-successional areas, resulting from high-severity fire patches covering 5,000 acres (over 2,000 hectares) in size or more [pp. 42-43]. The authors distinguished high-severity fire patches of this size from more “extensive” patches occurring in the northern Rocky Mountains [p. 31], where high-severity fire patches occasionally reach tens of thousands, or hundreds of thousands, of acres in size, and noted that patches of such enormous size were “almost” unknown in Sierra Nevada ponderosa pine and mixed-conifer forests. Within unlogged areas, the authors noted many large early-successional habitat patches, dominated by montane chaparral and young, regenerating conifer forest, and explained that such areas were the result of past severe fire because: a) patches of mature/old forest and individual surviving trees were found interspersed within these areas, and were found adjacent to these areas, indicating past forest; b) snags and stumps of fallen snags, as well as downed logs from fallen snags, were abundant in these areas; c) the species of chaparral found growing in these areas are known to sprout abundantly following severe fire; and d) natural conifer regeneration was found on most of the area [p. 42], often growing through complete chaparral cover [p. 43].

Similarly, surveys conducted in unlogged forests prior to effective fire suppression (USFS 1910-1912) documented common occurrence of large high-severity fire patches in YPMC. Surveys were conducted within primary forest to evaluate timber production potential in 16.2-ha (40-acre) plots within each 259.1-ha (640-acre) section in ponderosa pine and mixed-conifer forest on the westside of the Stanislaus National Forest, using one or more 1.62-ha transect per plot. Surveyors noted that surveys for individual tree size, density and species were not conducted in areas that had experienced high-severity fire sufficiently recently such that the regenerating areas did not yet contain significant merchantable sawtimber. Surveyors noted that the dominant vegetation cover across the majority of many 259.1-ha sections was montane chaparral and young conifer regeneration following high-severity fire. For example (from a typical township in the data set): a) T1S, R18E, Section 9 (“Severe fire went through [this section] years ago and killed most of the trees and land was reverted to brush”, noting “several large dense sapling stands” and noting that merchantable timber existed on only four of sixteen 16.2-ha plots in the section); b) T1S, R18E, Section 14 (“Fires have killed most of timber and most of section has reverted to brush”); c) T1S, R18E, Section 15 (same); d) T1S, R18E, Section 23 (“Most of timber on section has been killed by fires which occurred many years ago”); T1S, R18E, Section 21 (“Old fires killed most of timber on this section and most of area is now brushland”).

The draft NRV omits discussion of studies showing that fire severity is not increasing in the Sierra Nevada currently

Hanson and Odion (in press, 2013) conducted the first comprehensive assessment of fire intensity since 1984 in the Sierra Nevada using 100% of available fire intensity data, and, using Mann-Kendall trend tests (a common approach for environmental time series data—one which has similar or greater statistical power than parametric analyses when using non-parametric data sets, such as fire data). They found no increasing trend in terms of high-intensity fire proportion, area, mean patch size, or maximum patch size. Hanson and Odion (in press, 2013) checked for serial autocorrelation in the data, and found none, and used pre-1984 vegetation data (1977 Cal Veg) in order to completely include any conifer forest experiencing high-intensity fire in all time periods since 1984 (the accuracy of this data at the forest strata scale used in the analysis was 85-88%). Hanson and Odion (in press, 2013) also checked the results of Miller et al. (2009) and Miller and Safford (2012) for bias, due to the use of vegetation layers that post-date the fires being analyzed in those studies. Hanson and Odion (in press, 2013) found that there is a statistically significant bias in both studies ($p = 0.025$ and $p = 0.021$, respectively), the effect of which is to exclude relatively more conifer forest experiencing high-intensity fire in the earlier years of the time series, thus creating the false appearance of an increasing trend in fire severity. Interestingly, Miller et al. (2012a), acknowledged the potential bias that can result from using a vegetation classification data set that post-dates the time series. In that study, conducted in the Klamath region of California, Miller et al. used a vegetation layer that preceded the time series, and found no trend of increasing fire severity. Miller et al. (2009) and Miller and Safford (2012) did not, however, follow this same approach. Hanson and Odion (in press, 2013) also found that the regional fire severity data set used by Miller et al. (2009) and Miller and Safford (2012) disproportionately excluded fires in the earlier years of the time series, relative to the standard national fire severity data set (www.mtbs.gov) used in other fire severity trend studies, resulting in an additional bias which created, once again, the inaccurate appearance of relatively less high-severity fire in the earlier years, and relatively more in more recent years. The results of Hanson and Odion (in press, 2013) are consistent with all other recent studies of fire severity trends in California's forests that have used all available fire intensity data, including Collins et al. (2009) in a portion of Yosemite National Park, Schwind (2008) regarding all vegetation in California, Hanson et al. (2009) and Miller et al. (2012a) regarding conifer forests in the Klamath and southern Cascades regions of California, and Dillon et al. (2011) regarding forests of the Pacific (south to the northernmost portion of California) and Northwest.

Further, the draft NRV (p. 33) attempts to dismiss McKenzie et al. (2004), who predicted decreasing future fire in California's forests due to climate change, by claiming that they failed to account for California's dry summers. This mischaracterizes McKenzie et al. (2004), who specifically based their projections on summer precipitation, which they estimated would increase (see p. 894 and Fig. 1 of McKenzie et al. 2004). Nor is the draft NRV's claim credible that McKenzie et al. (2004) can be dismissed because they combined southern California's forests with those of the Sierra Nevada and southern Cascades of California, given that the forests of southern California comprise only about 5% of the total.

<u>The draft NRV presents incomplete data and analysis regarding current versus historic overall fire size, and omits discussion of numerous studies that contradict the assertions and assumptions in the draft NRV</u>

The draft NRV (pp. 28-29) asserts that average annual fire size is much higher now than it was historically, with historic average fire size at about 295 hectares (versus 1,400 hectares currently) and implies (p. 35) that there were few if any large fires over 50,000 acres historically.

However, the draft NRV fails to acknowledge, as a matter of mathematics, the major role of fire suppression, within any given year, in heavily skewing the average annual fire size, given that

98% of fires less than 300 acres are suppressed (draft NRV, p. 35). Instead, the draft NRV seeks to imply that fires are larger now due to fuel accumulation—a situation that the draft NRV implies should be addressed through logging, rather than by letting more fires burn.

Moreover, the draft NRV (p. 29) tangentially admits that large fires occurred historically, in the southern Cascades, but suggests that this is due to gentle/simple topography, and an absence of rock outcroppings and large streams to halt the spread of fire. However, no citation to any scientific source is cited to support this claim, and the only citation is to a personal communication with Carl Skinner. This speculation on the part of the draft NRV is directly contradicted by the scientific evidence. For example, Bekker and Taylor (2010) noted that their study area, northwest of Lassen National Park, had extensive fires in 1829, 1864, and 1829, and that two other study areas many kilometers away had extensive fires in the same years: Beaty and Taylor (2001) (southwest of Lassen National Park); and Taylor et al. (2008) (within Lassen National Park, and northwest of the Park). While this does not necessarily mean that it was all one large fire in these years, it would be very strained to suggest that they were anything other than very large fires that likely covered most of this portion of the Sierra Nevada management region in these years. In addition, this landscape has tremendous topographical variation, including steep slopes, and many rock outcroppings, lava fields, large streams, meadows, and other landscape features that break up or halt the spread of fire (see Beaty and Taylor 2001 [Figure 1], Bekker and Taylor 2010 [Figure 1], and Taylor et al. 2008 [Figure 1, showing a large portion of the study area covering Lassen National Park, which has all of these complex landscape features in abundance]).

Further, the draft NRV's implication (p. 35) that fires over 50,000 acres did not occur in the early 20th century (or before) is misleading, since it is well known that fire perimeter mapping was inconsistent at best back to 1910, and more consistent mapping did not begin until after the 1930s generally. This should be acknowledged.

The draft NRV does not address numerous studies, and misleadingly combines size categories, in order to claim that current snag densities are higher than historic densities

The draft NRV (pp. 64-67) claims that current snag densities are higher than historic snag densities. There are two major problems with this claim. First, in order to suggest this, the draft NRV generally combines snag size classes, and includes small snags down to 6 inches in diameter in the current snag density data, rather than assessing current versus historic densities of the larger snags that are most important to wildlife (15-20" dbh, and >20" dbh, or 15-24" and >24" dbh). Second, the draft NRV omits discussion of well-known studies showing much higher levels of historic/reference snags than the draft NRV assumes. For instance, the draft NRV omits discussion of: a) Barbour et al. (2002), who found 18.5 snags/hectare over 40 cm in diameter (about 8 snags per acre over 16 inches dbh), including 6.24/ha >76 cm dbh (2.5 per acre 30 inches in diameter or larger), in reference old forests of the Lake Tahoe basin—with snags representing 16% of all stand basal area; b) Stephens et al. (2008), who found 43 snags/hectare (about 17 per acre), representing about 22% of the total stand basal area, in reference forests in a natural, active, fire regime in YPMC forests of the Sierra San Pedro Martir, Baja, California; and c) Maloney and Rizzo (2002, Figures 2 and 3), who analyzed stand structure in 8 plots each 15 meters in diameter in each of 13 transects within YPMC forests of the Sierra San Pedro Martir, for a total of 0.565 hectares in each transect, or approximately 7.3 hectares total, and found approximately 250 snags over 50 cm dbh across the total survey area (see Fig. 3), or about 34 snags/hectare over 50 cm dbh (about 14 snags per acre 20 inches in diameter or larger).

The draft NRV (p. 67) states that, based upon FIA data, there are currently 37 snags/hectare over 15 cm dbh (about 15 snags per acre over 6 inches in diameter), which the draft NRV claims is much higher than reference/historical conditions, citing Youngblood et al. (2004) (the draft NRV, on this page, mistakenly cites this as Youngblood et al. 2009), Stephens (2004), and Harrod et al. (1998). However, the figure in Youngblood et al. (2004) pertains only to "overstory" snags (dominant and codominant)—not to sapling-sized snags as small as 6 inches in diameter. Stephens (2004) is not listed in the references section, but it appears that the draft NRV meant to cite Stephens et al. (2004), which was conducted in the Sierra San Pedro Martir forests. However, as discussed above, the most current data in these same forests indicates much higher snag densities—especially large snag densities—than the 4.4/hectare reported in one portion of these forests by Stephens et al. (2004). And, Harrod et al. (1998) was not actual historical/reference data but, rather, was merely a modeling exercise, and was based upon the assumption that the forests were very low density (and, thus, assumed very little competition between trees), "open and parklike" forests in the eastern Cascades. However, actual data from more recent studies has concluded that open and parklike structure represented a minority of these forests historically, and most were denser (Hessburg et al. 2007, Baker 2012). By combining very small snags with large snags in the presentation of the current snag density in YPMC, the draft NRV creates a misleading picture of high (or too high) snag densities, when in reality the opposite is true, certainly for larger snags. As Christensen et al. (2008 [p. 40]) found: "every survey units averaged fewer than two large snags ≥ 20 inches d.b.h. per acre". This is less than the large snag densities found in reference forests, as discussed above. Christensen et al. (2008 [Table 27]) specifically found, for mixed-conifer and ponderosa pine forests, an average of only 1.4 snags per acre 20-39 inches in diameter and only 0.25 per acre over 39 inches in diameter (mixed-conifer and ponderosa pine combined), currently.

<u>The draft NRV presents inaccurate information on mortality rates in YPMC</u>

The draft NRV (p. 47) cites van Mantgem et al. (2009) somewhat misleadingly. The raw data in van Mantgem et al. (2009) (obtained directly from the authors) do not indicate a reduction in large trees (e.g., those 60-90, or >90 cm dbh) in YPMC over time in Sierra Nevada forests, and the largest size class category presented in van Mantgem et al. (2009) was >40 cm dbh (i.e., over 16 inches dbh). The van Mantgem et al. (2009) data are consistent with old stands self-thinning their understories in the long absence of significant fire.

<u>The draft NRV omits discussion of important data sets that contradict the NRV's assumption that historic forests had very low seedling/sapling and shrub density and cover</u>

The draft NRV (p. 60) expresses the following assumption about historic understory density: "[t]he general understanding is that presettlement YPMC forests generally supported very low densities of saplings and small trees due to frequent fire". The same assumption is stated on pages 67-68, based upon selectively chosen quotes and anecdotal notes about particular locations. However, the text on pp. 67-68 only discusses seedlings, not saplings. The USFS

1911 Stanislaus data set (USFS 1910-1912) recorded average sapling density on 72 ponderosa pine forest sections (and some mixed-conifer) (each section one square mile in size), with an average density of 102 saplings per acre (252 per hectare) in sections noted as having no previous logging. This is not consistent with the draft NRV's assumption of "very low" densities of saplings historically. Moreover, the 1911 Stanislaus data set also recorded percent shrub cover on 57 sections (each one square mile) in ponderosa pine forests (and some mixed-conifer), with an average of 28% shrub cover in unlogged sections within forested areas with merchantable timber. In a total of 35 sections, surveyors recorded the proportion of the one-square-mile section comprised by montane chaparral areas (which often included natural conifer regeneration in the seedling, sapling, and/or pole-sized successional stage) with no merchantable timber. These montane chaparral areas represented 12,200 acres out of a total of 22,400 acres, or about 54%. As discussed above, in many of these montane chaparral areas, the visible signs of past high-severity fire were still evident, and surveyors specifically recorded large high-severity fire patches.

The draft NRV's section on current versus historic tree density (pp. 55-58) is also misleading and incomplete. This section concludes that current tree densities (trees generally over 10 cm dbh) are over twice the historic densities, with the summary information presented in Figures 14 and 16. However, this is based primarily upon two studies from less productive eastside forests in the Lake Tahoe Basin (Taylor 2004, Taylor et al. in press), a modeling study (North et al. 2007) that attempts to guess what historical tree density would have been in one small area (but, in particular, density of understory and lower-canopy trees in the 1860s could not be reliably determined because many of these trees have since died due to competition or fire, and have long since decayed into soil), and two studies from a small subset of a 1910-1912 Forest Service data set on the Stanislaus National Forest (Scholl and Taylor 2010, Collins et al. 2011). As noted above, these study areas experienced substantial mixed- and high-severity fire in the years and decades prior to the 1911 surveys. Moreover, there were two other study areas in this survey, and both had far higher forest density levels, in terms of recorded board feet per acre (often 3-10 times higher), than the study sites chosen in Scholl and Taylor (2010) and Collins et al. (2011). Further, the draft NRV cites Lydersen et al. (in press) (which is now published as Lydersen et al. 2013), representing that this study found 328 trees/hectare >10 cm dbh in the historical forests versus 755/hectare in 2007/2008 (draft NRV, Figure 14). However, this is misleading. What Lyderson et al. (2013 [Table 1]) actually found was that the historical forests contained numerous non-forested inclusions, representing early-successional habitat after natural disturbance, and that the forested "clumps" had 1,001 to 1,172 trees/hectare >10 cm dbh, which is not significantly different from current densities in the forested areas. What has changed is that, due to fire suppression, there are now fewer early-successional "gaps" in that particular study area, making the overall stand-scale tree density higher. By neglecting to report that, when comparing historical forested areas to current forested areas, the tree density was very high in both time periods, and was not significantly different, and by also neglecting to adequately disclose that 53% of the trees over 10 cm dbh in the historic forests were between 10 and 25 cm dbh (Lydersen et al. 2013 [Table 1]), the draft NRV misrepresents the data by inaccurately implying that historical stands were open and parklike, with relatively few smaller trees. In addition, the draft NRV (pp. 55-58, and Figs. 14 and 16) fails to adequately discuss the fact that Collins et al. (2011) found that moderate-severity burned areas had tree densities similar to historical densities in their study area.

The draft NRV omits discussion of important data on historic species composition in YPMC

The draft NRV (pp. 77-83) relies upon VTM plot data from the 1930s to suggest that white fir and incense-cedar proportion has increased, while yellow pine proportion has decreased; however, Bouldin (2009) found that the VTM plots were biased, and tended to be selectively placed in the denser, more commercially valuable stands, which at that time would tend to have favored selection of the most prized timber species, ponderosa pine and sugar pine. The draft NRV (pp. 77-82) also notes that historic USGS surveys often found that fir and cedar dominated historic YPMC forests, but attempts to dismiss this by suggesting that many of these areas had been logged, with pines removed more than fir or cedar. However, Leiberg (1902) specifically noted areas that were logged versus unlogged in YPMC. On the westside of the Sierra Nevada, Leiberg (1902) presented data for four such areas: Feather River, South Fork, Between Lexington Hill and Strawberry Valley; Yuba River; American River, North Fork; and American River, Middle Fork. In these areas, the average proportion of yellow pine and sugar pine combined was 34% (the remainder being mostly fir and cedar). On the eastside, two unlogged areas (Feather River, Middle Fork, east of Last Chance Valley, and Feather River, Middle Fork, central portion) had an average of 74% yellow pine (the remainder being fir and cedar). Leiberg (1902) described these unlogged mature/old forest areas as being a mix of heavy/dense forests, moderately dense forest, and open/sparse forests.

Moreover, the draft NRV (pp. 77-83) neglects to note that Stephens (2000), evaluating late-19th-century field data from the USGS on the west slope of the central and southern Sierra Nevada, found that, in "average" YPMC forests, ponderosa/Jeffrey-pine and sugar pine combined comprised about 50% of the basal area, and in "large" (old-growth) YPMC forests, ponderosa/Jeffrey-pine and sugar pine combined comprised only 27% of the basal area (the rest dominated by fir and cedar).

The draft NRV omits discussion of studies that predict decreased future fire

The draft NRV, in numerous places throughout the document, discusses a few studies that predict increased future fire in Sierra Nevada forests, based generally on assumptions of hotter, drier future conditions. However, there are also studies that predict less future fire due to anthropogenic climate change, due generally to warmer/wetter conditions and/or reductions in pyrogenic vegetation. These studies include Krawchuk et al. (2009) and Gonzalez et al. (2010) (as well as McKenzie et al. 2004, discussed above). Increasing precipitation patterns have been documented by Mote (2003) and Hamlet et al. (2007).

RED FIR

Omissions regarding past fire severity patterns

The draft NRV (p. 13) mentions the analysis in Hanson (2007), finding that, in unlogged areas mapped as 75-100% timber volume mortality by Leiberg (1902), red fir forests had 29% high-severity fire (Hanson 2007, Table 3.3), but does not mention that numerous large high-severity fire patches were mapped (some were hundreds, even thousands, of hectares in size) (Hanson 2007, Figure 3.1), and the draft NRV (pp. 13-14) erroneously assumes that most of the high-severity fire mapped by Leiberg (1902) was from the settlement era. In fact, Leiberg (1902) specifically noted that the bulk of the high-severity fire in the 19th century pre-dated settlers (see Leiberg 1902, p. 41). Moreover, the draft NRV (pp. 12-13) does not discuss the fact that Bekker and Taylor (2001, Figure 2f) found that, historically, the upper-montane forests dominated by red fir had about 55% high-severity fire effects in the southern Cascades of California (within the Sierra Nevada management region) (and, as discussed above, this serves well as a reference condition because the area was remote and unlogged, and because fire occurrence did not begin to decline until well into the 1920s—after the time period for the fire severity data).

Omissions regarding future fire severity patterns and predictions

The draft Red Fir NRV cites to Miller et al. (2009) and Miller and Safford (2012) for the proposition that high-severity fire is increasing slightly in some respects in red fir forests. However, as discussed in detail above, a more comprehensive and more recent study found that fire severity is not increasing in Sierra Nevada forests currently, including higher-elevation forests. Further, the draft NRV discusses studies by Westerling et al. (2011) and Lenihan et al. (2008) predicting that wildland fire will increase in Sierra Nevada forests, if conditions get hotter and drier. However, as discussed above, other studies predict that fire will decrease, if conditions get warmer and wetter, and/or if pyrogenic vegetation is reduced (Krawchuk et al. 2009, Gonzalez et al. 2010). Actual trends have been toward warmer and wetter conditions (Mote 2003, Hamlet et al. 2007, Crimmins et al. 2011, North 2012).

Inconsistencies with established ecological data and principles with regard to natural heterogeneity and complexity

The drart NRV (p. 18) cites Kane et al. (in review) for the assertion that high-severity fire decreases complexity in red fir forests, and increases "fragmentation". Because Kane et al. (in review) is not available, it is not possible to determine whether these statements were taken directly from the study. Regardless, it is well established in the ecological literature that structural complexity occurs not merely at the stand, or sub-stand, scale but, in addition, at the larger landscape scale. Thus, larger high-severity fire patches increase complexity and natural heterogeneity, and enhance beta diversity, and the highly biodiverse complex early seral forest created by high-severity fire cannot be considered "fragmentation", ecologically, unlike clearcutting, which eliminates structural complexity and habitat features (Whittaker 1960, Odion et al. 2010, Perry et al. 2011, Swanson et al. 2011, Donato et al. 2012, DellaSala et al. in press).

Omissions regarding mortality patterns

The draft NRV (pp. 19-20) cites van Mantgem et al. (2009) for the proposition that tree mortality is increasing; however, as discussed above, the raw data for van Mantgem et al. (2009) do not show an increase in mortality in mature/old trees in the Sierra Nevada.

Omissions regarding tree density

The draft NRV (pp. 19-20) cites to a number of studies that used VTM data from the 1930s to compare early 20th century tree density to current density. However, as discussed above, the VTM plots were biased (Bouldin 2009), and the plot locations are unknown, making it impossible to conduct an historical versus current assessment in the same plots. This should be acknowledged.

Omissions regarding snag density

The draft NRV (p. 22) cites North et al. (2002) for the proposition that current red fir snag basal area is 12.4 square meters per hectare, and cites Stephens (2000) for the proposition that historic red fir snag basal area was about 4.5 square meters per hectare. However, North et al. (2002) was conducted in one very small study site in the southern Sierra Nevada, and current snag densities in red fir at the landscape scale are not nearly as high as those estimated in North et al. (2002). There are only 4.1 snags per acre 20-39 inches in diameter (only about 10 per hectare 50-99 cm dbh), and only 0.7 per acre 40 inches in diameter or larger (only about 1.7 per hectare 100 cm dbh or larger), in upper-montane fir-dominated forests (forests dominated by red fir) currently (Christensen et al. 2008, Table 27). This equates to only about 5 square meters per hectare of snag basal area—similar to the estimates from Stephens (2000).

Sincerely,

Chad Hanson, Ph.D., Director
John Muir Project of Earth Island Institute
P.O. Box 697
Cedar Ridge, CA 95924
530-273-9290
cthanson1@gmail.com

Justin Augustine
Center for Biological Diversity
351 California St., Suite 600
San Francisco, CA 94104
415-436-9682, ext. 302
jaugustine@biologicaldiversity.org