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January 16, 2020
Coconino National Forest
Attn: 4FRI Rim Country Planning Team
1824 South Thompson Street
Flagstaff, Arizona 86001

Dear 4FRI Executive Board and 4FRI Planning Team:

Thank you for the opportunity to comment on the Draft Environmental Impact Statement (DEIS) for the Rim Country area of the Four Forest Restoration Initiative (4FRI). The mission of the Ecological Restoration Institute (ERI) is to serve diverse audiences with objective science and implementation strategies that support ecological restoration and climate adaptation on Western forest landscapes. We participate broadly in the 4FRI Stakeholder Group, and have appreciated the partnership with the Forest Service 4FRI team over the last decade on the 4FRI projects. In particular, we acknowledge and appreciate the joint work in the last 18 months, that have resulted in changes in the management of ponderosa pine dwarf mistletoe, and an increased emphasis on collaboration, that is evident in the DEIS.

Five years ago, the 4FRI produced the 1st analysis area, at just under a million acres. The Rim Country analysis area expands planning to a footprint of over 1.2 million acres, and incorporates the complex topography and diverse habitats found on the eastern Mogollon Rim. The Forest Service deserves credit for undertaking this innovative and necessary approach in this bold effort to analyze and manage at the scale of the problems facing frequent fire forests.

The ERI staff have compiled comments on the Rim Country DEIS with the goal of strengthening the scientific information that supports restoration. In addition, we endorse the 4FRI Stakeholder Group comments on the Rim Country DEIS. We look forward to working with the Forest Service and the 4FRI Stakeholder Group to successfully restore ecological resilience to the forests of the Mogollon Rim. For any clarification of these comments please reach out the ERI.

RECOMMENDATIONS and COMMENTS:
The first two recommendations are applicable to the entire document. Recommendations 3–12 are referenced to specific effects findings, specialist reports or appendices.

1. **The ERI recommends** that the Forest Service consider including additional information across the entire document to improve the consistency among the introductory sections, effects analysis, and specialists reports. Specifically:
    a. **The ERI recommends** adding clarification of the project intent and better linkages among the terms restoration, resiliency and the natural range of variability, and where that specifically ties into your desired conditions. For example, the project reasoning is not clear in the introduction that to achieve resiliency, the project will restore systems to their natural range of variability. Literature suggests resiliency needs to be defined in terms of “resilient to x”, and that as a stand-alone term it lacks specificity. More detail is provided in the fire and silvicultural specialists report that make this clear but within the document summary and introduction, there is limited context or stated need for restoration that would help justify the project’s entirety. References:

i. **Seidle et al. 2016.** Searching for resilience: addressing the impacts of changing disturbance regimes on frest ecosystem services. Journal of Applied Ecology 53(1):120-129. Doi:10.1111/1365-2664.12511.
ii. **Waltz et al. 2014.** Waltz, A.E.M., M.T. Stoddard, E.L. Kalies, J.D. Springer, D.W. Huffman, A.J. Sanchez-Meador. 2014. Effectiveness of fuel reduction treatments: assessing metrics of forest resiliency and wildfire severity after the Wallow Fire, AZ. Forest Ecology and Management 335:43052.

b. **The ERI recommends** modifications to *Table 4. Acres of Cover Type,* to further clarify the scope of the problem and intent of the project. We recommend to include for each Cover type (Ecological Response Unit, ERU), additional information such as Fire Regime, and Existing Condition with a quantified (or qualified) status, as in "XX amount departed from natural range of variability". This information can be found in:
    i. **USDA Forest Service (Wahlberg et al, in draft 2017). Ecological Response Units of the Southwestern United States. Technical report available online http://fsweb.r3.fs.fed.us/eap/nfma/assessments>. Southwestern Region, Regional Office, Albuquerque, NM. 203 pp.**

c. **The ERI recommends** adding clarification and more consistent description of desired conditions in the introduction. It is understood that this project incorporates desired conditions across 3 National Forests, and multiple ERU's (Table 4). However, the introduction does not clearly define desired conditions at the broad landscape scale, and does not link desired conditions to the natural range of variability. Table 5 is oddly placed, and refers to specific, stand-level desired conditions, for the "…acres analyzed for mechanical thinning and prescribed fire treatments". At this point in the document, those treatments and ERU's haven't been, and would include pinyon and juniper woodlands, that should not be represented by the stand specific desired conditions found in Table 5.
    i. **Specifically, remove Table 5. Replace with a GENERAL summary of the ERU and/or Forest Plan desired conditions, and explain relationship to natural range of variability and resiliency.** The Forest Plan desired conditions are available in the Silviculture Specialist report in great detail. This recommendation is not to copy and paste the forest plans' desired conditions, but is for an introduction section and assessment on the broad, landscape desired conditions, that are common across these forests (they are all really similar). The mid-scale and stand-scale are not necessary in the introduction.
    ii. **Recommended references:** 1. Wahlberg et al. 2017 (cited above), and 2. The Nature Conservancy's The Nature Conservancy). 2006. Southwest Forest Assessment Project: Historical range of variation and state and transition modeling of historical and current landscape conditions for potential natural vegetation types of the southwestern U.S. The Nature Conservancy technical report available online <http://azconservation.org/projects/southwest_forest_assessment>, November 2013. TNC Arizona Chapter, Tucson, AZ.

d. **The ERI recommends** adding clarification and more consistent quantification of **scale** in the introduction and across all effects and specialists reports. While the intent of the CFLRP and the 4FRI project is to restore at landscape scales, the information provided on landscape-scale currently is inconsistent, with unclear desired conditions (limited to references to the 3 forest plans and the ERUs, see above recommendation regarding landscape scale desired conditions), and little explanation of the linkages from landscape to stand scales. The Silviculture, the Fire and the Wildlife specialist reports do acknowledge variable scales (Wildlife & Silviculture) and address landscape scale pattern and expected landscape change

with the project (Fire). It is understood that mechanical restoration happens at stand scales, but the silvicultural effects report in Vol 2 would be improved by explaining how the stand scale treatments feed into landscape desired conditions, specifically with regard to in desired conditions, existing conditions, and the post-treatment conditions. It is difficult to understand how things like openness, composition, structure, and tree group sizes will change across the landscape at different scales (but see below for specific recommendations in the Silvicultural effects and specialist reports).

    i. **The ERI acknowledges** this work is on-going with the 4FRI Planning Team and the SHG, including the ERI, and looks forward to continued shared work to better define metrics for restoration success across scales.

2. **The ERI recommends** adding citations to support the background and context in the introduction, effects analysis and specialists reports. There are numerous broad statements that need citations throughout the document. We provide citations in this document to support any recommended additions or modifications, and include suggested references for the general text found in the DEIS volumes and specialist reports.
    a. References at end of Volume 2 are not complete based on existing references in text; References in specialist reports are not complete and not in alphabetical order.

The recommendations below refer more specifically to the Vegetation Effects and Silviculture Specialist Report, including Condition-based Management, and the Flexible Toolbox Approach.

3. **The ERI recommends** that the Forest Service improve the ability to compare existing pre- and post-treatment conditions at landscape scales and by ERUs, including a comparison to desired conditions. While much effort and space are devoted to post-treatment conditions and distributions across multiple scales and for multiple categories, metrics analyzed are not linked to a broad, landscape desired condition.
    a. **NOTE: Comment referrals to specific parts of the Silviculture Specialist report will refer to figures as possible, as page numbers were not included on the downloaded version. The Effects report has text references to a different figure and table numbering, and some figures are not referenced in the associated text.**
    b. **The ERI recommends i**ncluding pre- and post-treatment maps with legend categories that better relate to the desired conditions expected. These maps could be binned into the same categories as the graphs (maps and graphs found as Figures 17 – 43 in Vol 1; also in specialist report). A restored forest has a range of stand metrics across the landscape; current maps of trees per acre (TPA), and basal area (BA) include color ramps that lump the desired ranges into one color category (TPA) or have the desired and undesired cutoffs within one color band (BA). We acknowledge a huge shift in the distribution of these stand categories, but map legends can be adjusted to show post-treatment outcomes that are more easily evaluated for heterogeneity.
4. **The ERI recommends** the use of two sets of metrics for forest structural attributes. Some metrics may work across scales, but scale can affect post-treatment ranges and means. Landscape metrics may include measures of canopy cover, and tree patch description (and openness, although openness is not as well characterized by historic reference literature); the stand level metrics as stated in the Silviculture Specialist's report are appropriate. If interspace is used in implementation, the FEIS should provide a clearly understood and repeatable method for estimating interspace as well as a crosswalk with the landscape level metrics, potentially canopy cover/opennessaaarewet.
    a. The ERI, with the SHG, is committed to continue to work on this, with the 4FRI Planning Team.

5. The ERI does not support the distinction of regeneration openings in ponderosa pine forests as there is little evidence for this pattern in historic reconstructions. **The ERI recommends**:
    a. Combining desired "regeneration openings" with desired interspaces to allow a better cross-walk to ecological regeneration process, including the ability to mimic historic forest age distributions (historic regeneration rates range between 0.4 to 3.6 trees per hectare per decade (Mast et al. 1999. Restoration of Presettlement Age Structure of an Arizona Ponderosa Pine Forest. Ecological Applications 9(1): 228-239), also see Bailey and Covington. 2002. Evaluating ponderosa pine regeneration rates following ecological restoration treatments in northern AZ, USA. Forest Ecology and Management 155: 271-278).
6. Condition-based management is presented in the Rim Country DEIS with the flexible toolbox approach (FTA) to better account for variability and changes in the landscape. The ERI is supportive of ways to incorporate change across a million acre landscape with a 20 – year implementation cycle. However, designing flexibility with a large stakeholder group, while following National Environmental Policy Act planning guidance is complicated, and does require careful presentation, explanation and clearly stated trigger points and measurable metrics. **The ERI recommends** the following to increase the clarity and accountability of the proposed Condition-based Management:
    a. **The ERI recommends** adding clarity to the mechanical treatments FTA description in the DEIS Vol 1, including specifically Figure 9 in DEIS Vol 1 (also Fig 95 in Section F of the Implementation Plan) and associated text. It is recommended to clearly identify the cover types, or treatment types that are not eligible for Flexible Toolbox, and the cover types and treatment areas that are available for flexible application. There were different levels of flexibility explained during small group sessions, but this is not clear in this diagram or the text. Please define decision matrix, decision matrix modifiers. The diagram chosen to represent this doesn't add clarity; a flow chart divides scenarios, but then lumps them back together.
        i. The ERI is committed to continuing to work with the 4FRI planning team to clarify these, and develop any additional "sideboards" that may increase trust with the stakeholder group.
    b. **The ERI recommends** that potential impacts of the mechanical treatments FTA be clearly explained and quantified in the FEIS. With maximum effects analyses accomplished, we understand there won't be more than the most intense treatments implemented. But would more acres of the less intense treatments be realized? Figures 17 – 41 quantify the change in forest structural attributes with proposed alternatives, but the graph figures include no error bars or range of responses. What is the variability that the FTA will create? How will you prioritize changes in treatment, and how would changes be spatially prioritized?
    c. **The ERI recommends** that the implementation check list include records of when and how the FTA was utilized.
    d. **The ERI reiterates a SHG recommendation** that the Forest Service allocate sufficient resources to develop an appropriate tracking system, with coordination at the Region, Forest, and District levels. We request that this tracking system be incorporated in the Final EIS (FEIS) Implementation Plan and: (a) effectively communicate how and where treatments acreages evaluated in the EIS will change across Forests and Districts; (b) ensure that treatment acreages do not exceed sideboards in the ROD (see above comment); (c) ensure consistent interpretation of decision criteria and treatment application over shelf-life of the Rim Country ROD with a mind toward staff turnover. Accurate tracking of what treatments

are actually implemented will be critical to the validity of the monitoring and adaptive management framework, and will ensure compliance with the ROD.

The recommendations below refer specifically to the **Fire Effects Specialist Report.**

7. The ERI appreciates the use of multiple scale analyses in the Fire effects report. Figures 75-79 were very helpful for comparisons across the alternatives. **The ERI has and continues to recommend** that landscape restoration begin with spatially explicit landscape assessments of existing condition, existing risk, and departure from desired condition. This would lead to the development of treatment opportunities. **We strongly recommend that the fire analysis and ranking of Huc 6's be incorporated into implementation prioritization exercises, to build a landscape resilient to uncharacteristically severe fire, in a strategic and efficient manner.**

    a. Understory Response. **The ERI recommends** that the Forest Service include additional information in the fire effects section that documents the effects of thinning and burning on understory species. Specifically information about how the plant community species composition resulting from a wildfire may be very different than that resulting from restoration treatments. Much of the information in the report relates to information gleaned from wildfires, which may provide an overestimation of understory production, depending on the severity of the wildfire. Since some of the area is slated for burn only treatments, it is important to display how much of an increase in production can be attributed to burning the vegetation without opening up the canopy.

    Below are a sampling of papers and theses outlining the understory response following restoration treatments and wildfires. Many of these papers contain research from within the proposed 4FRI area and may be useful for documentation purposes. While understory vegetation may increase following restoration treatments, it can be highly variable from year to year, depending on the amount of tree canopy that has been removed and yearly variation in precipitation.

Crawford, J.A., Wahren, C.-H.A., Kyle, S., Moir, W.H., 2001. Responses of exotic plant species to fires in Pinus ponderosa forests in northern Arizona. J. Veg. Sci. 12(2), 261-268.

Dodson, E.K., Fiedler, C.E., 2006. Impacts of restoration treatments on alien plant invasion in Pinus ponderosa forests, Montana, USA. J. Appl. Ecol. 43(5), 887-897.

Fornwalt, P.J., Kaufmann, M.R., Stohlgren, T.J., 2010. Impacts of mixed severity wildfire on exotic plants in a Colorado ponderosa pine–Douglas-fir forest. Biol. Invasions. 12(8), 2683-2695.

Kerns, B.K., Thies, W.G., Niwa, C.G., 2006. Season and severity of prescribed burn in ponderosa pine forests: implications for understory native and exotic plants. Ecoscience 13, 44-55.

Laughlin, D.C., J.P. Roccaforte and P.Z. Fulé. 2011. Effects of a second-entry prescribed fire in a mixed conifer forest. Western North American Naturalist, 71(4):557-562.

Laughlin, D.C., M.M. Moore, and P.Z. Fulé. 2011. A century of increasing pine density and associated shifts in understory plant strategies. Ecology, 92(3):556-561.

Laughlin, D.C., P.Z. Fulé, D.W. Huffman, J. Crouse and E. Laliberté. 2011. Climatic constraints on trait-based forest assembly. Journal of Ecology, 99(6):1489-1499.

McGlone, C.M., M. T. Stoddard, J.D. Springer, M.L. Daniels, P.Z. Fulé, and W.W. Covington. 2012. Nonnative species influence vegetative response to ecological restoration: Two forests with divergent restoration outcomes. Forest Ecology and Management, 285:195-203.

McMaster, M.A., 2010. Effects of Fire and Post-fire Seeding on Plant Communities in a Ponderosa Pine Forest. Unpublished master's thesis, Northern Arizona University, Flagstaff, Arizona.

Nelson, C.R., Halpern, C.B., Agee, J.K., 2008. Thinning and burning result in low-level invasion by nonnative plants but neutral effects on natives. Ecol. Appl. 18(3), 762–770.

Sabo, K.E., Sieg, C.H., Hart, S.C., Bailey, J.D., 2009. The role of disturbance severity and canopy closure on standing crop of understory plant species in ponderosa pine stands in northern Arizona, USA. For. Ecol. Manage. 257, 1656-1662.

Stoddard, M.T., C.M. McGlone, P.Z. Fulé, D.C. Laughlin, and M.L. Daniels. 2011. Native plants dominate understory vegetation following ponderosa pine forest restoration treatments. Western North American Naturalist, 71(2):206-214.

The following comments refer specifically to the **Range Specialist Report.**

8. **The ERI recommends** a more careful evaluation of range effects from the mechanical treatment and prescribed burning of almost 1 million acres. Grazing has long been shown to affect the understory composition, abundance and sustainability. The proposed treatments will alter ecosystems both creating disturbed habitat with increased risk of invasive plant establishment in the short-mid term, while result in increased understory production and diversity over the long term. Increased use of citations are recommended; many studies are summarized in the work done by Mitchell White, on and for the Apache-Sitgreaves N.F.
    a. White, M. R. 2002. Characterization of, and changes in the subalpine and montane grasslands, Apache-Sitgreaves National Forests, Arizona. Flagstaff, Arizona: Northern Arizona University. PhD Dissertation.
    b. White, M. 2008. Field guide to noxious and invasive weeds known to occur or are potentially occurring on the Apache-Sitgreaves National Forest. USDA Forest Service. MR-R3-01-2

9. **The ERI recommends** that the Forest Service include how post-treatment grazing timelines will incorporate site specific and weather variability in the document. The ERI acknowledges the use of rest from grazing practices following treatments (p. 5), and particularly if it's in the midst of drought (p. 21). While the White Mountains get a lot of moisture, there are drier habitats, and more expected droughts with predicted climate change impacts. According to Stevens (2004), "amount and distribution of precipitation in the Intermountain West is perhaps one of the most important factors in determining to what degree a range improvement project succeeds or fails during the establishment period. Above-average precipitation can result in some outstanding successful projects. Projects should be planned on the basis of average yearly precipitation. Below-average precipitation during years of establishment will change post-treatment management." Stevens (2004) recommends a period of two growing seasons for ponderosa pine and two to three years for most other ecosystems. If an area has been seeded, additional time may be required, perhaps up to three additional years, for the seeded species to establish. Periods of below average precipitation will also require additional time (see above).
        i. Stevens, R. 2004. Management of restored and revegetated sites. In: Monsen, Stephen B.; Stevens, Richard; Shaw, Nancy L., comps. 2004. Restoring western ranges and wildlands. Gen. Tech. Rep. RMRS-GTR-136-vol-1. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Pp. 193-198.

The following comments refer specifically to the **Botany Specialist Report:**

10. **The ERI recommends** a more careful evaluation of rare plant species for the RC EIS, in particular on the Apache-Sitgreaves National Forest. We recommend including in the specialist report the rationale for selecting species pp. 44-46. We recommend utilizing the AZ Game and Fish Department Heritage Database, and include additional resources here to help understand the rare listings that are known in the project area.
    a. Included here are species of concerns based on ERI research on the Apache-Sitgreaves.
        i. *Allium gooddingii*
        ii. *Castilleja mogollonica* - Endemic to southern Apache Co.
        iii. *Brickellia rusbyi*
        iv. *Gentianella wislizeni* - 3 collections in state. One in Greenlee Co.
        v. *Hieracium brvipilum*
        vi. *Heuchera glomerulata* - Several from Greenlee Co.
        vii. *Packera cardamine*
        viii. *Senecio quarens*
        ix. *Trifolium neurophyllum*
    b. Additionally, are there any agreements with USFWS on the species of concern that should be addressed in the Botany Specialist report?
    c. For future review, please add plant scientific names.
    d. The ERI seeks clarity on the use of Bebb's willow as a key monitoring need. There is the Arizona willow (*Salix arizonica*) that is G2 (imperiled) and S2 in Arizona, and may warrant extra monitoring; however Bebb's willow is more stable.
        i. Maschinski, J. 2001. Impacts of ungulate herbvivores on a rare willow at the southern edge of its range. Biological Conservation. 101:119-130.
    e. This paper is not cited, but is specific to the Apache-Sitgreaves National Forest: White, M. 2008. Field guide to noxious and invasive weeds known to occur or are potentially occurring on the Apache-Sitgreaves National Forest. USDA Forest Service. MR-R3-01-2

The following comments are specific to Appendix E: Adaptive Management and Monitoring, and replicate the comments submitted by the 4FRI Stakeholders.

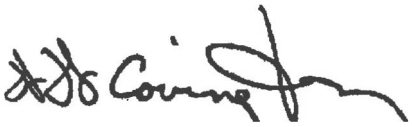
11. **Discussion of Concern:** The ERI agrees with the concerns and recommendations identified by the 4FRI Stakeholder Group. The ERI appreciates and supports the important role given to monitoring and adaptive management in the DEIS, as outlined in Appendix E (*Alternative 2 and 3 Monitoring and Adaptive Management Plan)*, and the important role given to implementation checklists in the DEIS, in Appendix D (*Alternative 2 and 3 Implementation Plan)*. We would like to emphasize the importance of maintaining this component in the FEIS, and request that a more detailed, robust monitoring program be outlined in the FEIS, as depicted in the 4FRI SHG Comments. The ERI is also prepared to contribute their expertise to achieve monitoring goals in the next 10 years.

The following comment applies to the Transportation section

12. **The ERI recommends** the transportation section (Page 304) should be expanded to cover accessibility, seasonality, and repair & maintenance.

Thank you for the opportunity to comment on the 4FRI Rim Country Area DEIS. The ERI is committed to restoration at a landscape scale and appreciates the Forest Service's efforts developing this innovative project. Please do not hesitate to draw on our expertise if we can be of service.

Sincerely,



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SUGGESTED PUBLICATIONS TO AGUMENT RC DEIS

Ecological Research – Journal Publications

Abella, S.R., and J.D. Springer. 2014. Effects of tree cutting and fire on understory vegetation of mixed conifer forests. *Forest Ecology and Management*, 335:281–299.

Bagdon, B.A., C.-H. Huang, A.J. Sánchez Meador, and S. Dewhurst. 2017. Climate change constrains the efficiency frontier when managing forests to reduce fire severity and maximize carbon storage. *Ecological Economics*, 140: 201-214.

Barrett, K.J., E.L. Kalies, and C.L. Chambers. 2012. Predator occupancy rates in a thinned ponderosa pine forest, Arizona: A Pilot Study. *Wildlife Society Bulletin*, 36(2):232-239.

DeWald, L.E., and K.M. Kolanoski. 2017. Conserving genetic diversity in ecological restoration: a case study with ponderosa pine in northern Arizona, USA. *New Forests*, DOI 10.1007/s11056-016-9565-1

Diggins, C., P.Z. Fulé, J.P. Kaye, and W.W. Covington. 2010. Future climate affects management strategies for maintaining forest restoration treatments, *International Journal of Wildland Fire*, 19(7):903-913.

Esch, B.E., A.E.M. Waltz, T.N. Wasserman, and E.L. Kalies. 2018. Using best available science information: determining best and available. *Journal of Forestry*, 116(5):473–480.

Fitch, R.A., Y.S. Kim, A.E.M. Waltz, and J.E. Crouse. 2018. Changes in potential wildland fire suppression costs due to restoration treatments in northern Arizona ponderosa pine forests. *Forest Policy and Economics*, 87:101–114.

Fulé, P.Z., J.E. Crouse, J.P. Roccaforte, and E.L. Kalies. 2012. Do thinning and/or burning treatments in western USA ponderosa or Jeffrey pine-dominated forests help restore natural fire behavior? *Forest Ecology and Management*, 269:68-81.

Hjerpe, E., Y.S. Kim, and L. Dunn. *2016*. Forest density preferences of homebuyers in the wildland-urban interface. *Forest Policy and Economics, 70:56-66.*

Honig, K.A. 2012. Simulating the effects of climate change and ecological restoration on wildfire behavior in southwestern ponderosa pine forests. *International Journal of Wildland Fire*, 21(6):731

Huffman, D.W., M.T. Stoddard, J.D. Springer, J.E. Crouse, and W.W. Chancellor. 2013. Understory plant community responses to hazardous fuels reduction treatments in pinyon-juniper woodlands of Arizona, USA. *Forest Ecology and Management*, 289:478-488.

Huffman, D.W., T.J. Zegler, and P.Z. Fulé. 2015. Fire history of a mixed conifer forest on the Mogollon Rim, northern Arizona, USA. *International Journal of Wildland Fire*, 24:680-689.

Huffman, D.W., M.T. Stoddard, J.D. Springer, J.E. Crouse. 2017. Understory responses to tree thinning and seeding indicate stability of degraded pinyon-juniper woodlands. Rangeland *Ecology and Management*, http://dx.doi.org/10.1016/j.rama.2017.01.008

Huffman, D.W., Sanchez Meador, A.J., M.T. Stoddard, and J.E. Crouse. 2017. Efficacy of resource objective wildfires for restoration of ponderosa pine (*Pinus ponderosa*) forests in northern Arizona. *Forest Ecology and Management*, 389:395-403.

Huffman, D.W., Crouse, J.E., Sánchez Meador, A.J., Springer, J.D., and M.T. Stoddard. 2017. Restoration benefits of re-entry with resource objective wildfire on a ponderosa pine landscape in northern Arizona, USA. *Forest Ecology and Management*, 408:16-24.

Hurteau, M.D., M.T. Stoddard, and P.Z. Fulé. 2011. The carbon costs of mitigating high-severity wildfire in southwestern ponderosa pine. *Global Change Biology*, 17:1516-1521.

Kalies, E.L., K.A. Haubensack, and A.J. Finkral. 2016. A meta-analysis of management effects on forest carbon storage, *Journal of Sustainable Forestry*, DOI: 10.1080/10549811.2016.1154471.

Kalies, E.L. and L.L. Yocom Kent. 2016. Tamm Review: Are fuel treatments effective at achieving ecological and social objectives? A systematic review. *Forest Ecology and Management*, 375: 84-95.

Kalies, E.L. and S.S. Rosenstock. 2013. Stand structure and breeding birds: Implications for restoring ponderosa pine forests. *Journal of Wildlife Management*, 77(6):1157-1165.

Kalies, E.L., and W.W. Covington. 2012. Small mammal community maintains stability through compensatory dynamics after restoration of a ponderosa pine forest. *Ecosphere*, 3(9): Article 78.

Kalies, E.L., B.G. Dickson, C.L. Chambers, and W.W. Covington. 2012. Community occupancy responses of small mammals to restoration treatments in ponderosa pine forests, northern Arizona, USA. *Ecological Applications*, 22(1):204–217.

Kurth, V.J, S.C. Hart, C.S. Ross, J.P. Kaye, and P.Z. Fulé. 2014. Stand-replacing wildfires increase nitrification for decades in southwestern ponderosa pine forests. *Oecologia*, 175(1): 395-407.

Laughlin, D.C., M.M. Moore, and P.Z. Fulé. 2011. A century of increasing pine density and associated shifts in understory plant strategies. *Ecology*, 92(3):556-61.

Laughlin, D.C., P.Z. Fule, D.W. Huffman, J. Crouse, and E. Laliberte. 2011. Climatic constraints on trait-based forest assembly. *Journal of Ecology*, 99(6):1489-1499.

Laughlin, D.C., R.T. Strahan, D.W. Huffman, and A.J. Sánchez Meador. 2016. Using trait-based ecology to restore resilient ecosystems: historical conditions and the future of montane forests in western North America. *Restoration Ecology*, doi: 10.1111/rec.12342

Laughlin, D.C., R.T. Strahan, P.B. Adler, and M.M. Moore. 2018. Survival rates indicate that correlations between community-weighted mean traits and environments can be unreliable estimates of the adaptive value of traits. *Ecology Letters*, 21(3).

Loberger, C.D., T.C. Theimer, S.S. Rosenstock, and C.S. Wightman. 2011. Use of a restoration-treated ponderosa pine forest by tassel-eared squirrels. *Journal of Mammalogy,* 92(5)1021-1027.

McGlone, C.M., M.T. Stoddard, J.D. Springer, M.L Daniels, P.Z. Fulé and W.W. Covington. 2012. Nonnative species influence vegetative response to ecological restoration: two forests with divergent restoration outcomes. *Forest Ecology and Management,* 285:195-203.

Roccaforte, J.P., D.W. Huffman, P.Z. Fulé, W.W. Covington, W.W. Chancellor, M.T. Stoddard, and J.E. Crouse. 2015. Forest Structure and fuels dynamics following ponderosa pine restoration treatments, White Mountains, Arizona, USA. *Forest Ecology and Management*, 337:174-185.

Roccaforte, J.P., A.J. Sánchez Meador, A.E.M. Waltz, M.L. Gaylord, M.T. Stoddard, and D.W. Huffman. 2018. Delayed tree mortality, bark beetle activity, and regeneration dynamics five years following the Wallow Fire, Arizona, USA: Assessing trajectories towards resiliency. *Forest Ecology and Management*, 428:20–26.

Rodman, K.C., A.J. Sánchez Meador, D.W. Huffman, and K.M. Waring. 2016. Reference conditions and historical fine-scale spatial dynamics in a dry mixed-conifer forest, Arizona, USA. *Forest Science*, 62(3):268–280.

Rodman, K.C. A.J. Sánchez Meador, M.M. Moore, D.W. Huffman. 2017. Reference conditions are influenced by the physical template and vary by forest type: A synthesis of *Pinus ponderosa*-dominated sites in the southwestern United States. *Forest Ecology and Management*, 404:316-329.

Schneider, E.E., A.J. Sánchez Meador, and W.W. Covington. 2016. Reference conditions and historical changes in an unharvested ponderosa pine stand on sedimentary soil. *Restoration Ecology*, doi: 10.1111/rec.12296

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