Policy Statement: Fire, Forest Management, and Communities

Approved August 2021

Introduction

While wildfire is an essential ecosystem process for many forests, recent large and high-severity wildfires have claimed lives, destroyed structures and communities, disrupted ecosystem processes and services, and negatively impacted economies. A complex web of interrelated factors at play over more than a century, including a warming climate and more frequent droughts, have caused many wildfires to become destructive even where they had played an ecologically beneficial role, historically. The accompanying literature review introduces research on this complex topic and provides references for some of the terms used in this policy statement.

This policy statement serves to guide the Forest Stewards Guild's engagement in national, state, and local policy discussions about wildfires and wildland fire management. It is based on the Guild's principles and our commitment to stewardship. Forest stewardship offers the potential to protect or enhance wildlife habitat, clean water, carbon storage, economic opportunity, and the inherent value of forests. We recognize that our forests exhibit broad ecological diversity and a commensurate range of management goals. Accordingly, forest stewards will incorporate local knowledge and objectives when adaptively implementing the following policy recommendations.

- **Promote stewardship of fire-adapted forests**. Depending on the landowner objectives and ecological condition, stewardship frequently entails active forest management such as pre-commercial thinning, fuels reduction, and timber harvests. In fire-adapted forests, stewardship likely includes restoration of fire as an ecosystem process, which includes the use of prescribed fire.
- **Recognize and embrace traditional ecological knowledge.** Indigenous peoples have been part of fire-adapted ecosystems since time immemorial. Their approaches to stewardship offer unique insights and tools for fire management today.
- **Promote the use of prescribed fire**. In the right settings, prescribed fire is a powerful tool for forest stewardship. The benefits of prescribed fire should be balanced with the risks such as the health and safety impacts of smoke.
- **Support the management of appropriate ignitions for ecological benefit.** Because more than a century of aggressive suppression of wildfires has contributed to the current wildfire threat, management of ignitions can be part of the solution in locations and at times when actively managing these fires will produce benefit with reduced risk.
- **Work collaboratively across jurisdictions**. Just as fire can move easily across ownerships, stewardship should be a collaborative effort involving all land managers and stakeholders.
- **Help build capacity and knowledge**. Effective collaboration on fire management requires building knowledge, experience, and capacity for fire management involving a wide range of

partners across agencies including federal, Tribal, state, and local partners and backgrounds including firefighters, resource managers, scientists, residents, students, and others.

- **Support the next generation.** Fire training, vocational, and other educational programs can expand the capacity, effectiveness, and safety of the next generation forest stewards.
- **Help people build resilient communities.** Fire adapted communities act before, during, and after fire to be more resilient to wildfire. Collaborative engagement, defensible space, land use planning, and other preparations complement stewardship in the wildlands to enable communities to better live with fire. Support for building resilience must be distributed in a socially responsible way to communities and individuals.
- **Prepare for post-fire impacts**. Large, high-severity wildfires leave a wide range of challenges in their wake such as erosion, flooding, deadwood that is fuel for future wildfires, regeneration failure, social disruption, and economic loss. Preparation for post-fire impacts should address the integrity of the forest ecosystem and connected human communities.

Fire, Forest Management, and Communities
Background and Scientific Literature Summary

Introduction

Although fire is an essential ecosystem process for many forests, recent large high-severity wildfires have claimed lives, destroyed communities, altered ecosystem processes and services, and negatively affected economies. A complex web of interrelated factors at play over more than a century, including a warming climate and more frequent droughts, have caused wildfires to become destructive even where they had played an ecologically beneficial role historically. **This summary of the scientific literature around fire, forest management, and communities serves as a companion to the Guild's policy statement.**

The problem

Fire Ecology

Many forests across the country are adapted to fire as an essential ecological disturbance. From longleaf pine forests in Florida to ponderosa pine forests in Washington, fire promotes health and resilience in many ecosystems. The fire regime in these forests varies from frequent low-severity fire to infrequent high-severity fire that replaces whole stands. Characteristics of forests adapted to frequent fire usually include widely spaced large trees with thick bark and a limited shrub layer. In many places, Native Americans used and managed fire. For example, Native Americans burned forests to achieve a range of objectives, such as hunting, crop management, increased plant yield, pest management, and warfare (Allen, 2002; Cooper, 1960; Fowler and Konopik, 2007; Stewart et al., 2002). At the same time, Native Americans managed their forest land to protect their communities from unwanted wildfire (Roos et al., 2021). Although many books have been written on the fire ecology of the United States, as background for the policy statement it is sufficient to recognize the importance of fire and the variety of fire regimes in forested ecosystems across the country.

Past Management

Colonization and population growth generally resulted in a significant reduction in the frequency of fire in fire-adapted ecosystems. For example, in the Southwest, logging, road building, livestock grazing, and fire suppression dramatically reduced the extent and frequency of fire in ponderosa pine and mixed conifer forests (Cooper, 1960; Covington and Moore, 1994; Evans et al., 2011). In the South, fire was more widely used even during the fire suppression era than in the West, with graziers often burning ranges in the spring into the mid-1900s. Still, densification of woodlands and tree encroachment into savannas is common across the South (Fowler and Konopik, 2007; Lafon, 2010). Across many Western forests, the extension of railroads provided access to markets that allowed for extensive grazing and logging. Livestock grazing removed grasses and facilitated the dense growth of tree seedlings that otherwise would have been eliminated by periodic low-intensity ground fires. At the same time, exploitive logging practices and the extension of railroads resulted in a series of epic forest fires, particularly in Lake States and western US forests that caused the loss of millions of acres of timber and the destruction of

entire towns. One such conflagration that burned much of the forest—and numerous communities—in northwestern Montana and northern Idaho in 1910 prompted the US Forest Service to adopt firefighting as central to its mission (Egan, 2009). In partnership with other federal and state forestry agencies, the US Forest Service pioneered an array of new early detection and suppression technologies that were successful over the following decades in reducing the number of acres burned (Pyne, 2019, 2015; Scarpino, 2011). An expanding road and trail network, which broke the continuity of fuels and kept fires from spreading, also improved access for firefighting (Dahms and Geils, 1997; Reed et al., 1996). Rapid detection and early suppression further reduced the area of forest burned in wildfires, of both human and natural origins (Pyne, 2019).

The removal of fire as an ecosystem process in combination with logging, grazing, and other management practices dramatically changed forest structure and composition. In general, forests adapted to frequent low-severity fires increased in density and homogeneity (Cocke et al., 2005; Gilliam and Platt, 1999; Levine et al., 2016; Parsons and DeBenedetti, 1979). In turn, these ecosystem changes have increased the threat of large high-severity wildfires that are fundamentally different from the low-severity fire common in the pre-settlement era (Haugo et al., 2019; Pyne, 2019). It is important to note that forests adapted to a fire regime of less frequent and higher severity fires, such as lodgepole pine in the interior West, have been less affected by land-use changes (Platt and Schoennagel, 2009).

Increased Threat of Destructive Wildfires

The number of large fires and the acreage burned by wildfires in the western U.S. has increased significantly in recent decades (Dennison et al., 2014). Moreover, the severity of wildfires has increased in both California and the southwestern U.S. (Miller and Safford, 2012; Singleton et al., 2019). These recent large wildfires, unlike their historical counterparts, have often resulted in large patches of high-severity fire that lead to flooding, mass wasting, and potential type conversion of the dominant vegetation (Hansen and Turner, 2019; Parks et al., 2019; Rodman et al., 2019).

At the same time, expanding populations and continued home building have resulted in many more people and structures that are at risk from fire in the wildland urban interface (WUI) (Spyratos et al., 2007). The most recent assessment estimated 190 million acres of WUI in the U.S. and 32% of the U.S. population (Martinuzzi et al., 2015). Not only is the WUI in the U.S. extensive, it is growing rapidly; the number of new houses in the WUI grew 41% and land area of the WUI grew 33% from 1990 to 2010 (Radeloff et al., 2018). The expansion of the WUI combines with the changing climate to increase the threat of destructive wildfire (Liu et al., 2015; Syphard et al., 2007).

Climate change

Recent warming and drying of the climate is already exacerbating wildfires (Higuera and Abatzoglou, 2021). The increase in fire severity and area burned by wildfires is likely to continue because of changes in the climate, particularly in the western U.S. (Abatzoglou and Williams, 2016; Hanan et al., 2020; Mueller et al., 2020). The climate is projected to be warmer and drier in the 21st century than it was during the 20th century, with rising spring and summer

temperatures, reduced snowpack and earlier snowmelts, and longer drier summer fire seasons (Dominguez et al., 2010; Michael Goss et al., 2020; Parks and Abatzoglou, 2020; Williams et al., 2019). Warming and drying also limit the ability of stands to regenerate and recover from high-severity wildfire (Davis et al., 2019; Kemp et al., 2019).

Wildfire suppression

Damage from wildfire to ecosystems and communities has increased, and so too have efforts to suppress wildfires. As discussed above, aggressive suppression of wildfires is one of the causes of the problem, creating a feedback loop that can encourage future fires (Calkin et al., 2015). In addition, the cost of wildfire suppression, which exceeded $2 billion in 2017, takes funding and personnel away from the US Forest Service's land management responsibilities. The huge investments in wildfire suppression and the liability connected to strategies other than full suppression create perverse incentives to continue to focus on full suppression of wildfires even when returning fire to fire-dependent ecosystems is an essential part of the solution (Yoder et al., 2004).

Post-fire

The increasing frequency of large severe wildfires results in significant post-fire issues for communities and ecosystems. Precipitation on areas burned by wildfire can cause erosion and flooding which may result in more damage than the wildfire itself (Bladon et al., 2014). Programs such as the US Forest Service Burned Area Emergency Response seek to reduce the negative impacts of erosion soon after a wildfire (Robichaud et al., 2010). Debris flows and flooding can continue to be a problem for years or even decades after wildfire events (Moody et al., 2013).

Wildfires that reburn the same area have also become more frequent. The increase in reburns highlights the importance of considering post-fire forest development, fuel accumulation, and the potential for another high-severity wildfire (Coppoletta et al., 2016; Passovoy and Fulé, 2006). One approach to reducing fuels and recovering some of the timber value lost to a wildfire is salvage, or post-fire, logging. Post-fire logging studies have identified a range of both positive and negative impacts from the practice depending largely upon the response variable considered (Kleinman et al., 2019; McIver and Starr, 2000). The ecological risks of salvage logging to soils, tree regeneration, wildlife, and ecological recovery indicates land managers should exercise caution (Lindenmayer et al., 2008).

The full range of post-fire issues such as the spread of invasive species, climate-driven regeneration failure, vegetation type change, and economic recovery for forest-dependent communities are well beyond the scope of this review, but they underscore the importance of a holistic approach to fire and forest management.

Towards solutions

The growing wildfire threat is driven by a complex combination of a century of land management decisions, expanding WUI, and a changing climate across an equally complex array of ecosystems. Therefore, there are no simple solutions. It is essential that we practice forest

stewardship, adapt our communities and lifestyles to forest fire, and generally appreciate that we must live with fire.

Forest management can help reduce the negative effects of wildfire through thinning, particularly when combined with prescribed fire. A meta-analysis of fuel treatment effectiveness showed that thin and burn treatments had positive effects in terms of reducing fire severity, tree mortality, and crown scorch (Kalies and Yocom Kent, 2016). Fuel treatments have been tested by wildfire and proved to reduce severity (e.g., Cochrane et al., 2012; Stevens-Rumann et al., 2013; Waltz et al., 2014) even under extreme conditions (Lydersen et al., 2017; Prichard and Kennedy, 2013). Of course, the specifics of any management effort must be guided by the forest conditions, local knowledge, and science. The traditional ecological knowledge of Native American Tribes is an important guide and resource for stewardship (Huffman, 2013; Lake, 2007).

Prescribed fire, particularly multiple controlled burns, can reduce the threat of high-severity wildfire in forests adapted to frequent fire (Harris and Taylor, 2017; Haywood, 2009; North et al., 2012). Prescribed fire can increase resilience to other stressors such as drought and insect outbreaks (Kane et al., 2019). Where and when it is safe to do so, management of wildfires can also benefit the forest and communities by utilizing natural ignitions to reduce fuel loads, open crowded canopies, and return fire to its natural role (Huffman et al., 2020; Meyer, 2015). Of course, there are a range of barriers to using prescribed fire (Schultz et al., 2018) and even with recent policy changes, management of wildfires for resource benefits is limited (Young et al., 2020).

Community wildfire mitigation and home hazard reductions are a necessary complement to forest management to reduce wildfire threat. The fire-adapted communities concept provides a framework for linking the wide range of WUI mitigation approaches while acknowledging that fire cannot be eliminated from fire-adapted ecosystems (FAC, 2021). Fostering fire-adapted communities is an on-going process that requires the collaboration of neighbors, homeowners, land managers, planners, and leaders. Support for building resilience must be distributed equitably to communities and individuals. For example, the Firewise program is a tool that can build on the power of neighbors encouraging neighbors to undertake mitigation efforts (Evans et al., 2015).

The rapid expansion of the WUI, continued warming and drying of the climate, and the increase in large high-severity wildfires mean that, to be effective, the pace and scale of fuel reduction and fire management need to expand as well (Haugo et al., 2015; Kolden et al., 2019; Vaillant and Reinhardt, 2017). At the same time, post-fire responses need to accelerate in proportion to the increase in high-severity fire. For example, reforestation can be essential to retain forests in areas where post-fire natural regeneration fails (North et al., 2019).

References

Abatzoglou, J.T., Williams, A.P., 2016. Impact of anthropogenic climate change on wildfire across western US forests. Proc. Natl. Acad. Sci. 113, 11770–11775. https://doi.org/10.1073/pnas.1607171113

Allen, C.D., 2002. Lots of lightning and plenty of people: An ecological history of fire in the upland Southwest, in: T.R.Vale (Ed.), Fire, Native Peoples, and the Natural Landscape. Island Press, Washington DC, pp. 143–193.

Bladon, K.D., Emelko, M.B., Silins, U., Stone, M., 2014. Wildfire and the Future of Water Supply. Environ. Sci. Technol. 48, 8936–8943. https://doi.org/10.1021/es500130g

Calkin, D.E., Thompson, M.P., Finney, M.A., 2015. Negative consequences of positive feedbacks in US wildfire management. For. Ecosyst. 2, 1–10.

Cochrane, M.A., Moran, C.J., Wimberly, M.C., Baer, A.D., Finney, M.A., Beckendorf, K.L., Eidenshink, J., Zhu, Z., 2012. Estimation of wildfire size and risk changes due to fuels treatments. Int. J. Wildl. Fire 21, 357–367. https://doi.org/http://dx.doi.org/10.1071/WF11079

Cocke, A.E., Fulé, P.Z., Crouse, J.E., 2005. Forest change on a steep mountain gradient after extended fire exclusion: San Francisco Peaks, Arizona, USA. J. Appl. Ecol. 42, 814–823. https://doi.org/10.1111/j.1365-2664.2005.01077.x

Cooper, C.F., 1960. Changes in vegetation, structure, and growth of southwestern pine forests since white settlement. Ecology 42, 493–499.

Coppoletta, M., Merriam, K.E., Collins, B.M., 2016. Post-fire vegetation and fuel development influences fire severity patterns in reburns. Ecol. Appl. 26, 686–699. https://doi.org/10.1890/15-0225

Covington, W.W., Moore, M.M., 1994. Postsettlement Changes in Natural Fire Regimes and Forest Structure -- Ecological Restoration of Old-Growth Ponderosa Pine Forests. J. Sustain. For. 2, 153–181.

Dahms, C.W., Geils, B.W., 1997. An assessment of forest ecosystem health in the Southwest. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Davis, K.T., Dobrowski, S.Z., Higuera, P.E., Holden, Z.A., Veblen, T.T., Rother, M.T., Parks, S.A., Sala, A., Maneta, M.P., 2019. Wildfires and climate change push low-elevation forests across a critical climate threshold for tree regeneration. Proc. Natl. Acad. Sci. U. S. A. 116. https://doi.org/10.1073/pnas.1815107116

Dennison, P.E., Brewer, S.C., Arnold, J.D., Moritz, M.A., 2014. Large wildfire trends in the western United States, 1984–2011. Geophys. Res. Lett. 41, 2928–2933.

Dominguez, F., Cañon, J., Valdes, J., 2010. IPCC-AR4 climate simulations for the Southwestern US: the importance of future ENSO projections. Clim. Change 99, 499–514.

Egan, T., 2009. The big burn: Teddy Roosevelt and the fire that saved America. Houghton Mifflin Harcourt, New York, NY.

Evans, A., Auerbach, S., Wood Miller, L., Wood, R., Nystrom, K., Loevner, J., Aragon, A., Piccarello, M., Krasilovsky, E., 2015. Evaluating the effectiveness of wildfire mitigation activities in the wildland-urban interface. Forest Stewards Guild, Madison, WI.

Evans, A.M., Everett, R., Stephens, S., Youtz, J., 2011. A comprehensive guide to fuels

treatment practices for mixed conifer forests: California, central and southern Rockies, and the Southwest. Forest Guild, Santa Fe, NM.
FAC, 2021. Fire Adapted Communities [WWW Document]. URL http://fireadapted.org/
Fowler, C., Konopik, E., 2007. The History of Fire in the Southern United States. Hum. Ecol. Rev. 14, 165–176.
Gilliam, F.S., Platt, W.J., 1999. Effects of long-term fire exclusion on tree species composition and stand structure in an old-growth Pinus palustris (Longleaf pine) forest. Plant Ecol. 140, 15–26.
Hanan, E.J., Ren, J., Tague, C.L., Kolden, C.A., Abatzoglou, J.T., Bart, R.R., KENNEDY, M.C., Liu, M., Adam, J., 2020. How climate change and fire exclusion drive wildfire regimes at actionable scales. Environ. Res. Lett. 16, 24051. https://doi.org/10.1088/1748-9326/abd78e
Hansen, W.D., Turner, M.G., 2019. Origins of abrupt change? Postfire subalpine conifer regeneration declines nonlinearly with warming and drying. Ecol. Monogr. 89. https://doi.org/10.1002/ecm.1340
Harris, L., Taylor, A.H., 2017. Previous burns and topography limit and reinforce fire severity in a large wildfire. Ecosphere 8. https://doi.org/10.1002/ecs2.2019
Haugo, R., Zanger, C., DeMeo, T., Ringo, C., Shlisky, A., Blankenship, K., Simpson, M., Mellen-McLean, K., Kertis, J., Stern, M., 2015. A new approach to evaluate forest structure restoration needs across Oregon and Washington, USA. For. Ecol. Manage. 335, 37–50. https://doi.org/http://dx.doi.org/10.1016/j.foreco.2014.09.014
Haugo, R.D., Kellogg, B.S., Cansler, C.A., Kolden, C.A., Kemp, K.B., Robertson, J.C., Metlen, K.L., Vaillant, N.M., Restaino, C.M., 2019. The missing fire: quantifying human exclusion of wildfire in Pacific Northwest forests, USA. Ecosphere 10. https://doi.org/10.1002/ecs2.2702
Haywood, J.D., 2009. Eight years of seasonal burning and herbicidal brush control influence sapling longleaf pine growth, understory vegetation, and the outcome of an ensuing wildfire. For. Ecol. Manage. 258, 295–305.
Higuera, P.E., Abatzoglou, J.T., 2021. Record-setting climate enabled the extraordinary 2020 fire season in the western United States. Glob. Chang. Biol. 27, 1–2. https://doi.org/10.1111/gcb.15388
Huffman, D.W., Roccaforte, J.P., Springer, J.D., Crouse, J.E., 2020. Restoration applications of resource objective wildfires in western US forests: a status of knowledge review. Fire Ecol. https://doi.org/10.1186/s42408-020-00077-x
Huffman, M.R., 2013. The Many Elements of Traditional Fire Knowledge: Synthesis, Classification, and Aids to Cross-cultural Problem Solving in Fire-dependent Systems Around the World. Ecol. Soc. 18. https://doi.org/10.5751/es-05843-180403
Kalies, E.L., Yocom Kent, L.L., 2016. Tamm Review: Are fuel treatments effective at achieving ecological and social objectives? A systematic review. For. Ecol. Manage. 375, 84–95. https://doi.org/http://dx.doi.org/10.1016/j.foreco.2016.05.021
Kane, V.R., Bartl-Geller, B.N., North, M.P., Kane, J.T., Lydersen, J.M., Jeronimo, S.M.A., Collins, B.M., Monika Moskal, L., 2019. First-entry wildfires can create opening and tree clump patterns characteristic of resilient forests. For. Ecol. Manage. 454. https://doi.org/10.1016/j.foreco.2019.117659
Kemp, K.B., Higuera, P.E., Morgan, P., Abatzoglou, J.T., 2019. Climate will increasingly determine post-fire tree regeneration success in low-elevation forests, Northern Rockies,

USA. Ecosphere 10. https://doi.org/10.1002/ecs2.2568
Kleinman, J.S., Goode, J.D., Fries, A.C., Hart, J.L., 2019. Ecological consequences of compound disturbances in forest ecosystems: a systematic review. Ecosphere. https://doi.org/10.1002/ecs2.2962
Kolden, C.A., Kolden, A., C., 2019. We're Not Doing Enough Prescribed Fire in the Western United States to Mitigate Wildfire Risk. Fire 2, 30. https://doi.org/10.3390/fire2020030
Lafon, C.W., 2010. Fire in the American south: Vegetation impacts, history, and climatic relations. Geogr. Compass. https://doi.org/10.1111/j.1749-8198.2010.00363.x
Lake, F., 2007. Traditional Ecological Knowledge to Develop and Maintain Fire Regimes in Northwestern California, Klamath-Siskiyou Bioregion: Management and Restoration of Culturally Significant Habitats. University of Oregon, Corvalis, OR.
Levine, C.R., Krivak-Tetley, F., van Doorn, N.S., Ansley, J.-A.S., Battles, J.J., 2016. Long-term demographic trends in a fire-suppressed mixed-conifer forest. Can. J. For. Res. 46, 745–752. https://doi.org/10.1139/cjfr-2015-0406
Lindenmayer, D.B., Burton, P.J., Franklin, J.F., 2008. Salvage logging and its ecological consequences. Island Press, Washington, DC.
Liu, Z., Wimberly, M.C., Lamsal, A., Sohl, T.L., Hawbaker, T.J., 2015. Climate change and wildfire risk in an expanding wildland–urban interface: a case study from the Colorado Front Range Corridor. Landsc. Ecol. 30, 1943–1957.
Lydersen, J.M., Collins, B.M., Brooks, M.L., Matchett, J.R., Shive, K.L., Povak, N.A., Kane, V.R., Smith, D.F., 2017. Evidence of fuels management and fire weather influencing fire severity in an extreme fire event. Ecol. Appl. 27, 2013–2030. https://doi.org/10.1002/eap.1586
Martinuzzi, S., Stewart, S.I., Helmers, D.P., Mockrin, M.H., Hammer, R.B., Radeloff, V.C., 2015. The 2010 wildland-urban interface of the conterminous United States. USDA Forest Service, Northern Research Station, Newtown Square, PA.
McIver, J.D., Starr, L., 2000. Environmental effects of postfire logging: literature review and annotated bibliography. USDA Forest Service, Pacific Northwest Research Station, Portland, OR.
Meyer, M.D., 2015. Forest fire severity patterns of resource objective wildfires in the southern Sierra Nevada. J. For. 113, 49–56. https://doi.org/10.5849/jof.14-084
Michael Goss, Daniel L Swain, John T Abatzoglou, Ali Sarhadi, Crystal Kolden, Park Williams, Noah S Diffenbaugh, 2020. Climate change is increasing the risk of extreme autumn wildfire conditions across California. Environ. Res. Lett.
Miller, J.D., Safford, H.D., 2012. Trends in wildfire severity: 1984 to 2010 in the Sierra Nevada, Modoc Plateau, and southern Cascades, California, USA. Fire Ecol. 8, 41–57.
Moody, J.A., Shakesby, R.A., Robichaud, P.R., Cannon, S.H., Martin, D.A., 2013. Current research issues related to post-wildfire runoff and erosion processes. Earth-Science Rev. 122, 10–37. https://doi.org/http://doi.org/10.1016/j.earscirev.2013.03.004
Mueller, S.E., Thode, A.E., Margolis, E.Q., Yocom, L.L., Young, J.D., Iniguez, J.M., 2020. Climate relationships with increasing wildfire in the southwestern US from 1984 to 2015. For. Ecol. Manage. 460. https://doi.org/10.1016/j.foreco.2019.117861
North, M., Collins, B.M., Stephens, S., 2012. Using fire to increase the scale, benefits, and future maintenance of fuels treatments. J. For. 110, 392–401. https://doi.org/10.5849/jof.12-021
North, M.P., Stevens, J.T., Greene, D.F., Coppoletta, M., Knapp, E.E., Latimer, A.M., Restaino,

C.M., Tompkins, R.E., Welch, K.R., York, R.A., Young, D.J.N., Axelson, J.N., Buckley, T.N., Estes, B.L., Hager, R.N., Long, J.W., Meyer, M.D., Ostoja, S.M., Safford, H.D., Shive, K.L., Tubbesing, C.L., Vice, H., Walsh, D., Werner, C.M., Wyrsch, P., 2019. Tamm Review: Reforestation for resilience in dry western U.S. forests. For. Ecol. Manage. 432, 209–224. https://doi.org/10.1016/J.FORECO.2018.09.007

Parks, S.A., Abatzoglou, J.T., 2020. Warmer and drier fire seasons contribute to increases in area burned at high severity in western US forests from 1985-2017. Geophys. Res. Lett. https://doi.org/10.1029/2020GL089858

Parks, S.A., Dobrowski, S.Z., Shaw, J.D., Miller, C., 2019. Living on the edge: trailing edge forests at risk of fire-facilitated conversion to non-forest. Ecosphere 10. https://doi.org/10.1002/ecs2.2651

Parsons, D.J., DeBenedetti, S.H., 1979. Impact of fire suppression on a mixed-conifer forest. For. Ecol. Manage. 2, 21–33. https://doi.org/http://dx.doi.org/10.1016/0378-1127(79)90034-3

Passovoy, M.D., Fulé, P.Z., 2006. Snag and woody debris dynamics following severe wildfires in northern Arizona ponderosa pine forests. For. Ecol. Manage. 223, 237–246.

Platt, R. V, Schoennagel, T., 2009. An object-oriented approach to assessing changes in tree cover in the Colorado Front Range 1938-1999. For. Ecol. Manage. 258, 1342–1349.

Prichard, S.J., Kennedy, M.C., 2013. Fuel treatments and landform modify landscape patterns of burn severity in an extreme fire event. Ecol. Appl. 24, 571–590. https://doi.org/10.1890/13-0343.1

Pyne, S.J., 2019. Fire: A Brief History, Weyerhaueser Cycle of Fire. University of Washington Press.

Pyne, S.J., 2015. Between Two Fires: A Fire History of Contemporary America. University of Arizona Press.

Radeloff, V.C., Helmers, D.P., Kramer, H.A., Mockrin, M.H., Alexandre, P.M., Bar-Massada, A., Butsic, V., Hawbaker, T.J., Martinuzzi, S., Syphard, A.D., Stewart, S.I., 2018. Rapid growth of the US wildland-urban interface raises wildfire risk. Proc. Natl. Acad. Sci. U. S. A. 115, 3314–3319. https://doi.org/10.1073/pnas.1718850115

Reed, R.A., Johnson-Barnard, J., Baker, W.L., 1996. Contribution of Roads to Forest Fragmentation in the Rocky Mountains. Conserv. Biol. 10, 1098–1106. https://doi.org/10.1046/j.1523-1739.1996.10041098.x

Robichaud, P.R., Ashmun, L.E., Sims, B.D., 2010. Post-Fire Treatment Effectiveness for Hillslope Stabilization. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

Rodman, K.C., Veblen, T.T., Chapman, T.B., Rother, M.T., Wion, A.P., Redmond, M.D., 2019. Limitations to recovery following wildfire in dry forests of southern Colorado and northern New Mexico, USA. Ecol. Appl. https://doi.org/10.1002/eap.2001

Roos, C.I., Swetnam, T.W., Ferguson, T.J., Liebmann, M.J., Loehman, R.A., Welch, J.R., Margolis, E.Q., Guiterman, C.H., Hockaday, W.C., Aiuvalasit, M.J., Battillo, J., Farella, J., Kiahtipes, C.A., 2021. Native American fire management at an ancient wildland–urban interface in the Southwest United States. Proc. Natl. Acad. Sci. 118, e2018733118. https://doi.org/10.1073/pnas.2018733118

Scarpino, P., 2011. America's Fires: A Historical Context for Policy and Practice. Technol. Cult. 52, 646–647.

Schultz, C., Huber-Stearns, H., Mccaffrey, S., Quirke, D., Gwen, R., Moseley, C., 2018.

Prescribed Fire Policy Barriers and Opportunities. Eugene, OR.
Singleton, M.P., Thode, A.E., Sánchez Meador, A.J., Iniguez, J.M., 2019. Increasing trends in high-severity fire in the southwestern USA from 1984 to 2015. For. Ecol. Manage. 433, 709–719. https://doi.org/10.1016/J.FORECO.2018.11.039
Spyratos, V., Bourgeron, P.S., Ghil, M., 2007. Development at the wildland-urban interface and the mitigation of forest-fire risk. Proc. Natl. Acad. Sci. 104, 14272–14276.
Stevens-Rumann, C., Shive, K., Fulé, P., Sieg, C.H., 2013. Pre-wildfire fuel reduction treatments result in more resilient forest structure a decade after wildfire. Int. J. Wildl. Fire 22, 1108–1117. https://doi.org/http://dx.doi.org/10.1071/WF12216
Stewart, O.C., Lewis, H.T., Anderson, M.K., 2002. Forgotten fires: Native Americans and the transient wilderness. University of Oklahoma Press., Norman, OK.
Syphard, A.D., Radeloff, V.C., Keeley, J.E., Hawbaker, T.J., Clayton, M.K., Stewart, S.I., Hammer, R.B., 2007. Human influence on California fire regimes. Ecol. Appl. 17, 1388–1402. https://doi.org/10.1890/06-1128.1
Vaillant, N.M., Reinhardt, E.D., 2017. An Evaluation of the Forest Service Hazardous Fuels Treatment Program—Are We Treating Enough to Promote Resiliency or Reduce Hazard? J. For. 115, 300–308. https://doi.org/10.5849/jof.16-067
Waltz, A.E.M., Stoddard, M.T., Kalies, E.L., Springer, J.D., Huffman, D.W., Meador, A.S., 2014. Effectiveness of fuel reduction treatments: Assessing metrics of forest resiliency and wildfire severity after the Wallow Fire, AZ. For. Ecol. Manage. 334, 43–52. https://doi.org/http://dx.doi.org/10.1016/j.foreco.2014.08.026
Williams, A.P., Abatzoglou, J.T., Gershunov, A., Guzman-Morales, J., Bishop, D.A., Balch, J.K., Lettenmaier, D.P., 2019. Observed Impacts of Anthropogenic Climate Change on Wildfire in California. Earth's Futur. 7. https://doi.org/10.1029/2019ef001210
Yoder, J., Engle, D., Fuhlendorf, S., 2004. Liability, incentives, and prescribed fire for ecosystem management. Front. Ecol. Environ. 2, 361–366. https://doi.org/10.1890/1540-9295(2004)002[0361:liapff]2.0.co;2
Young, J.D., Evans, A.M., Iniguez, J.M., Thode, A., Meyer, M.D., Hedwall, S.J., McCaffrey, S., Shin, P., Huang, C.-H., 2020. Effects of policy change on wildland fire management strategies: evidence for a paradigm shift in the western US? Int. J. Wildl. Fire. https://doi.org/10.1071/wf19189