Use of Prescribed Fire in Forest Management

A Position of the Society of American Foresters

Originally developed and adopted on July 31, 2021. This position statement will expire in 2026, unless, after subsequent review, it is further extended by the SAF Board of Directors.

Purpose

To clarify the increasingly complex opportunities and challenges associated with the use of prescribed fire for specific forest management outcomes, including: (1) fuels management and associated wildland fire risk reduction, and (2) ecosystem restoration and maintenance for sustaining our nation's forest resources.

Scope

The purposeful use of fire across land ownership classifications, where planned and approved, including both manager-ignited burning practices and the use of wildland fire as permitted under pre-determined operational plans.

Position

The Society of American Foresters (SAF) supports and promotes the expanded use of prescribed fire in meeting multiple forest management objectives associated with wildfire risk reduction, ecological restoration and maintenance, and sustainable production of goods and services. Fire has played a fundamental role in North American landscapes, including forests, for millennia. Today, prescribed fire is an important part of our forest management "toolbox" in meeting multiple landowner objectives, including: (1) reducing fuels and mitigating associated wildfire risk in both post-harvest and older stands; (2) helping prepare sites for artificial and natural regeneration following harvest; (3) regulating forest vegetation composition and structure over time, including invasive and exotic species; and (4) stimulating broad ecosystem responses through the disturbance itself (e.g., nutrient cycling and hydrology) and subsequent stand and environmental conditions (e.g., vigor and insect/disease resistance, and habitat quality). SAF supports the policies and funding for the research and workforce development needed to implement prescribed fire consistently and safely. Prescribed fires must be planned by trained and experienced professionals who document measurable objectives, prescribe details for achieving those objectives, implement effectiveness monitoring, and have accountability for results; federal agencies must appropriately disclose their analyses of prescribed fire effects in public documents.

Issue

Foresters have traditionally viewed prescribed fire as burning operations designed to achieve relatively simple, singular land management objectives (e.g., site preparation, rangeland clearing or pile burning), ignited by qualified managers during select, narrow weather conditions over relatively small areas with adequate personnel for containment (Tappeiner et al. 2015). This view reflects broad, social/cultural concerns over the destructive nature of fire, as well as specific concerns over the chance of a fire escaping containment (and its associated liability across ownerships); air quality and smoke management; and the general lack of public acceptance of fire and smoke (Pyne 1982). Such a limited approach to prescribed fire, however, inflates its costs per acre and fails to address new pressing issues for forest management and wildfire risk reduction (NCWFMS 2014).

Fire is an ancient and effective tool in treating landscape fuels broadly and can be used in coordination with other progressive land management approaches (i.e., mechanical and chemical treatments). Fire as a natural disturbance process is fundamentally consistent with the restoration and maintenance of resistant and resilient landscapes, with their associated biotic communities and product bases that will meet long-term societal needs (Knapp et al. 2009). It is often excluded from forestlands, unfortunately, when used as a management tool on adjacent lands (e.g., rangelands); similarly, prescribed fire operations within forestlands are often limited to property boundaries. Opportunities exist for larger-scale coordination of prescribed fire operations across ecotones and political boundaries, public (inter-agency) and private, and the sharing of expertise and resources for mutual benefit consistent with tenets established in the *National Cohesive Wildland Fire Management Strategy* (NCWFMS 2014).

Forest management has become more complex since the early 1900s, with fuels management increasing in importance significantly over the last decades. Current fuel hazards are high across many landscapes and ownerships and is a major driver of wildfire severity, concurrent with longer and drier fire seasons and more humans acting as ignition sources and victims (Parks et al. 2018). Fire suppression strategies and tactics are increasingly ineffective as fuels accumulate, fire seasons lengthen, wildfire behavior intensifies, and human communities expand (Westerling et al. 2006; North et al. 2015). There is growing recognition of the need for more and larger-scale prescribed burning, both manager-ignited burning on planned units as well as the management of fire intensity and spread during wildfire management/ suppression efforts (NCWFMS 2014). This latter strategy acknowledges that (1) full suppression strategies are not always the safest and most effective response to wildfire; and (2) when pre-planned, many land management objectives can be met with wildfire. Appropriate pre-planning for prescribed fire includes clearly stated objectives for burning, stakeholder notifications, measures to protect timber and other natural/cultural resources, and effectiveness monitoring.

Background

Prescribed Fire History and Trends

Fire has been used for millennia by North American peoples to form and manage their landscapes in order to meet basic needs (Pyne 1982; Taylor et al. 2016; Marks-Block et al. 2021). Together with lightning ignitions, fires have been estimated to have burned tens to hundreds of millions of acres of

forests, woodlands, savannas, and rangelands in complex, self-sustaining patterns. Euro-American settlement largely put an end to such practices, beginning in the 1600s in the eastern US and progressing west through the late 1800s. Since the initiation of fire suppression/exclusion, fuels have been allowed to unnaturally accumulate in areas left unmanaged, without harvests and without prescribed fire (CPFC 2018; see SAF Position Statement on Wildland Fire Management). This has been a key factor in the increasing size and severity of wildland fire over the last several decades (NIFC 2021) when combined with a warming climate, drought, longer fire seasons, and more ignitions across the landscape (Westerling et al. 2006; IPCC 2021; see SAF Position Statement on Forest Management, Carbon and Climate Change).

The *National Cohesive Wildland Fire Management Strategy* (NCWFMS 2014) recommends expanded use of prescribed fire as an effective, cost-efficient tool to manage for hazardous fuels reduction and restore ecosystem composition, structure, and function in areas with fire-adapted or fire-dependent vegetation. Regular prescribed burning can maintain resistant and resilient landscape conditions as part of ongoing silvicultural and rangeland management practices designed to regenerate and maintain desired site conditions, and a host of associated ecosystem services (e.g., biodiversity, wildlife habitat and water).

Nationally, land managers currently burn around 10 million acres each year (CPFC 2020), a 28% increase since 2011. Sixty percent of these acres are in the Southeast, where the use of prescribed fire benefits from low fuel loading, favorable weather patterns (e.g., humidity recovery), gentle topography, and is more socially and culturally accepted given its history of burning. Nationally, however, current levels of prescribed fire are well short of historic levels. We need a significant increase (four- to ten-fold) over much of the nation in order to meet forest and woodland management objectives. Vast, federally owned, semi-arid western forests and woodlands have been identified as having the greatest current need and potential for increased fuels treatment acreage (Steblein et al. 2021).

Fuel Disposal and Site Preparation Following Harvest

Harvesting activities (partial to complete) in most forest types and regions generally increase the amount of fine surface fuels following those stand entries, or “activity fuels” (Tappeiner et al. 2015). Fuel disposal choices vary among the range of even-aged and uneven-aged management regimes, with complete overstory removal (i.e., clearcutting) driving the highest potential activity fuel loads and greatest need for fuel disposal and site preparation prior to stand regeneration. Across the entire treatment spectrum, however, managers may need to reduce some level of surface fuels for both seedbed preparation, regeneration, and future wildfire risk reduction.

Even-aged management approaches typically focus on fuel reduction (slash disposal) at the time of site preparation and stand regeneration. Mechanical, chemical, and prescribed fire tools are most widely available and economically viable in such larger, open post-harvest sites. For example, aerial and motorized ignitions of large harvest units allow for very low per-acre costs for fuels reduction and site preparation. Such scalable operations provide near-term benefits in terms of plant-ability, as well as natural regeneration for some stand types, plus long-term benefits for site productivity (nutrient cycling), species diversity, and fuels reduction.

Once planted or otherwise regenerated, young trees can be quite vulnerable to fire damage given their smaller diameters, thinner bark, and proximity of their crowns to the ground surface and any subsequent fire. Therefore, the intensity of site preparation and control of subsequent vegetation (i.e., regrowing fine fuels) are fundamental to creating and expanding a safe temporal window for

plantations. Once trees are of a sufficient size to resist damage from low-intensity surface fire, under-burning stands may be included in silvicultural prescriptions.

Under-burning for Fuel Management and Wildfire Risk Reduction

Under-burning can be an appropriate silvicultural tool for both even- or uneven-aged stands of trees when most of the desired, residual trees within a stand are likely to survive prescribed surface fire at a planned/modeled intensity (Tappeiner et al. 2015) and/or where the probability of future unplanned ignitions are high (e.g., military training grounds and traffic corridors). In this way, prescribed fire becomes one tool for regulating stand density and structure, with its associated future fuel production, arrangement, and flammability. This extends well beyond simply managing current accumulated surface fuels. Surface fire is essentially the only way to efficiently remove fine surface fuels, particularly in semi-arid forested regions where decomposition rates are insufficient to remove accumulated biomass (Steblein et al. 2021).

Consumption of surface fuels during a prescribed under-burning is crucial to altering future wildfire behavior (intensity, flame height, and rate of spread) under extreme fire weather conditions, and resultant impacts on stand structure and composition (see SAF Position Statement on Wildland Fire Management). Prescribed fire can also reduce the amount and continuity of ladder fuels (i.e., materials that connect surface fuels/fire with aerial/crown fuels), raise crown base height in general, and reduce live crown fuels, reducing the potential for surface fires to transition into crown fires.

Landscape Resilience, Forest Health, and Ecosystem Services in General

Prescribed fire is often paired with various forms of forest thinning or partial harvest and other vegetation management practices, in order to create and sustain a wide range of healthy and productive stand conditions (composition, structure, and function). For example, longleaf pine restoration and maintenance in the Southeast often utilizes frequent prescribed fire (two- to three-year return intervals for under-burning) with implications for endangered species habitat; oak-pine stands are supported by less frequent under-burning that is crucial for many cultural plants. Ponderosa pine management in the West similarly benefits from periodic (five- to ten-year interval) prescribed under-burning to reduce fuels, helping to achieve resistant and resilient structure and composition as well as providing broad ecosystem services (Knapp et al. 2009). Burning lodgepole pine stands, or slash following their harvest, promotes regeneration of that forest type, as with other early-seral sprouting species like aspen. Wildfires and prescribed fires play a significant role in regenerating jack pine stands and creating habitat for Kirtland's warblers. Prescribed fire can be utilized to favor oak regeneration in eastern and central hardwood forests, though it has been underutilized, leading to major oak regeneration failures in these forests (Dey and Schweitzer 2018).

Resistance and resilience of current and future forests can be enhanced through prudent pro-active forest management of existing tree species and stands, including restoration of structure and composition when current conditions are outside a range of desired conditions (NCWFMS 2014; Tappeiner et al. 2015; Steblein et al. 2021). For example, there are millions of acres of dense, fire-excluded dry forest types in the West needing some fuel reduction treatment (chemical, mechanical, and/or prescribed fire) in advance of severe fire seasons and inevitable wildfire (see SAF Position Statement on Forest Management, Carbon and Climate Change). Such treatments allow for marginal, progressive adjustment of forest conditions, which are largely consistent with professional forestry standards but can be more quickly implemented in anticipation of emerging, rapid climatic shifts.

Current Socio-economic Limitations to Prescribed Fire, and Challenges Going Forward

Limitations to prescribed fire vary over regions and forest types across the US, but can be broadly classified into workforce, complexity, risk aversion, perceived economic impact, and smoke management issues (Schultz et al. 2018). While there are real costs and damages associated with prescribed fire in forests, not all fire damages trees or associated forest resources (Tappeiner et al. 2015; Dey and Wiedenbeck, 2021). Some regions of the country lack sufficient workforce capacity to address the complexity of prescribed burning, particularly in forests with abundant fuels accumulations requiring mechanical treatment prior to burning. In areas of the West, work schedules are challenged by very short burn windows that are limited by winter/spring moisture on one side and the wildfire season and fire crew assignments on the other. Successful prescribed fire operations require qualified/certified personnel working within established guidelines and procedural frameworks involving careful implementation; many areas have private land assistance programs to aid with planning and implementation of these operations.

A small percentage (less than two percent) of prescribed fires escape containment; most of those instances result in minor consequences, but there have been several major escapes historically that significantly influence political and managerial decision making. States have different regulations and structures given their histories, as well as different interpretations and applications of negligence laws. The current managerial decision space is heavily skewed to short-term, risk aversion (i.e., “fear of liability”) rather than broader, long-term decisions about wildfire risk management. Extreme risk aversion tends to make the wildfire problem worse over time (Fischer et al. 2016), however, and a comprehensive evaluation of escape risk (Weir et al. 2019) does not support such a perception of risk.

Mixed-land ownership patterns create a need for cross-boundary communication and coordination, and raises issues of shared resources, costs, and liabilities (Schultz et al. 2018). A single landowner has the simplest path to planning and implementing prescribed fire operations, but the future of prescribed fire will include large acreages burned over multiple landowners who share boundaries and risks. Any objective to reduce vast accumulated fuels across landscapes prior to severe wildfires will require collaboration.

Using prescribed fire is sometimes perceived as a net-negative economic impact given managerial cost and little measurable benefit, if not forest damage. For example, damage (e.g., “cat-facing”) can occur to valuable species in hardwood timber stands, including oak and walnut overstory trees. These losses are minimized in mesic stands, while xeric stands experience higher losses, especially as fire intensity increases (Mann et al. 2020). Similarly, char is a contaminant in some forest product markets. Negative economic impacts of prescribed burning can be minimized with adequate planning and implementation.

Finally, prescribed fire is often limited in scope by the reality of smoke production and management, public perceptions about smoke, and air quality non-attainment zones for ozone (Ellison et al. 2021). Prescribed fire is only one input of particulates into such airsheds, and often competes with other pollutant sources for permission. Air quality is undoubtedly an important human health issue; however, prescribed fire smoke can be preferable to the quantity and quality of wildfire smoke in terms of subsequent human impacts. Policy work is ongoing to modernize smoke management rules for prescribed fire operations planning and implementation. There are few practical alternatives to burning for the removal of fine surface fuels across landscapes. And fire and smoke in one form or another will be inherent to forests and forestry.

References

Coalition of Prescribed Fire Councils, Inc. (CPFC). 2018. *National Prescribed Fire Use Survey Report*. www.prescribedfire.net.

Coalition of Prescribed Fire Councils, Inc. (CPFC). 2020. *National Prescribed Fire Use Survey Report*. www.prescribedfire.net.

Dey, D. and C. Schweitzer, 2018. "A Review on the Dynamics of Prescribed Fire, Tree Mortality, and Injury in Managing Oak Natural Communities to Minimize Economic Loss in North America." *Forests*. 9 (8): 461. https://doi.org/10.3390/f9080461.

Dey, D. and J.K. Wiedenbeck, 2021. "Saving Eastern Oak Forests: Prescribed Fire Impact on Timber Quality." *Rooted in Research.* Issue 4. Available online at: https://www.nrs.fs.fed.us/rooted/4.

Ellison, A., H. Huber-Stearns, S.S. Frederick, M.R. Coughlan, S. McCaffrey, and C.S. Olsen. 2021. *Perceptions of Wildland Fire Smoke: Literature Review and Synthesis*. Ecosystem Workforce Program Working Paper No. 103.

Fischer, A.P., T.A. Spies, T.A. Steelman, C. Moseley, B.R. Johnson, J.D. Bailey, A. Ager and others. 2016. "Wildfire Risk as a Socioecological Pathology." *Frontiers in Ecology and the Environment* 14 (5): 276–284.

"Forest Management, Carbon, and Climate Change," Society of American Foresters, last modified May 2, 2020, https://www.eforester.org/Main/Issues_and_Advocacy/Statements/Forest_Management_and_Cli mate_Change.aspx.

IPCC. 2021: *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press.

Knapp, E. E., B.L. Estes, and C.N. Skinner. 2009. *Ecological Effects of Prescribed Fire Season: A Literature Review and Synthesis for Managers*. Gen. Tech. Rep. PSW-GTR-224. Albany, California: USDA Forest Service, Pacific Southwest Research Station. https://doi.org/10.2737/PSW-GTR-224.

Mann, D.P., J.K. Wiedenbeck,, D.C. Dey, and M.R. Saunders. 2020. "Evaluating Economic Impacts of Prescribed Fire in the Central Hardwood Region." *Journal of Forestry*. 118 (3): 275–288. https://doi.org/10.1093/jofore/fvaa004.

Marks-Block, T., F.K. Lake, R. Bliege Bird, and others. 2021. "Revitalized Karuk and Yurok Cultural Burning to Enhance California Hazelnut for Basketweaving in Northwestern California, USA." *Fire Ecology* 17 (6). https://doi.org/10.1186/s42408-021-00092-6.

National Interagency Fire Center (NIFC). 2021. Fire Information. Available online at: https://www.nifc.gov/fireInfo/nfn.htm.

NCWFMS. 2014. *The National Strategy, The Final Phase in the Development of the National Cohesive Wildland Fire Management Strategy*.

North, M. P., S.L. Stephens, B.M. Collins, J.K. Agee, G. Aplet, J.F. Franklin, and P.Z. Fulé. 2015. "Reform Forest Fire Management." *Science*, 349 (6254), 1,280–1,281. https://doi.org/10.1126/science.aab2356.

Parks, S.A., L.M. Holsinger, M.H. Panunto, W.M. Jolly, S.Z. Dobrowski, and G.K. Dillon. 2018. "High-severity Fire: Evaluating its Key Drivers and Mapping its Probability Across Western US Forests." *Environmental Research Letters* 13 (4): 044037.

Pyne, S. 1982. *Fire in America: A Cultural History of Wildland and Rural Fire*. Princeton, New Jersey: Princeton University Press.

Schultz, C., H. Huber-Stearns, S. McCaffery, D. Quirke, G. Ricco, and C. Moseley. 2018. "Prescribed Fire Policy Barriers and Opportunities: A Diversity of Challenges and Strategies Across the West." *Ecosystem Workforce Program Working Paper No. 86*.

Steblein, P.F., Loehman, R.A., Miller, M.P., Holomuzki, J.R., Soileau, S.C., Brooks, M.L., Drane-Maury, M., Hamilton, H.M., Kean, J.W., Keeley, and others. 2021. "U.S. Geological Survey Wildland Fire Science Strategic Plan, 2021–26." *USGS Circular* 1471. https://doi.org/10.3133/cir1471.

Tappeiner, J.C., D.A. Maguire, T.B. Harrington and J.D. Bailey. 2015. *Silviculture and Ecology of Western US Forests, 2nd Ed*. Oregon State University Press, Corvallis, OR. ISBN 978-0-87071-803-8.

Taylor, A.H., V. Trouet, C.N. Skinner, and S.L. Stephens, 2016. "Socioecological Transitions Trigger Fire Regime Shifts and Modulate Fire-Climate Interactions in the Sierra Nevada, USA, 1600-2015 CE." *Proceedings of the National Academy of Sciences*, 113 (38), 13,684-13,689. https://doi.org/10.1073/pnas.1609775113.

Weir, John R., Urs P. Kreuter, Carissa L. Wonkka, Dirac Twidwell, Dianne A. Stroman, Morgan Russell, and Charles A. Taylor. 2019. "Liability and Prescribed Fire: Perception and Reality," *Rangeland Ecology and Management* 72 (3), 533–538. https://doi.org/10.1016/j.rama.2018.11.010.

Westerling, A.L, H.G. Hidalgo, D.R. Cayan, and T.W. Swetnam. 2006. Warming and earlier spring increase western U.S. forest wildfire activity. *Science*, 313(5789):940–943.

"Wildland Fire Management," Society of American Foresters, last modified April 2019, https://www.eforester.org/Main/Issues_and_Advocacy/Statements/Wildland_Fire_Management.aspx