Multiple Habitats
29. Prescribed Burns

DEFINITION

Prescribed burns are fires that are intentionally set in a controlled manner in accordance with specified weather limitations, laws, policies, and regulations. Prescribed burns are used by management teams with fire expertise to restore health to fire-dependent ecosystems. They are also used to reduce fuel loads to prevent ecosystem and community damage from catastrophic wildfires (USFS 2016, NWCG 2023). Cultural burning has been used by Indigenous people in the United States from time immemorial (Lake 2021). As a result of excessive fire suppression starting in the late 1880s, many ecosystems that relied on fire have been deprived of regular burning crucial to maintaining their ecosystem health. A primary goal of prescribed burning is to bring the fire-adapted ecosystem back to a fire regime consistent with the historical regime (Greco 2018). The Joint Fire Science Program defines a fire regime as "the general temporal and spatial patterns of fire behavior and effects within a particular vegetation type or ecosystem" (Sommers et al. 2019). Prescribed fire as a fuel treatment alongside forest thinning is an effective approach to reducing catastrophic wildfires.

TECHNICAL APPROACH

The National Wildfire Coordinating Group (NWCG) provides *Standards for Prescribed Fire Planning and Implementation* (2022b). These interagency standards offer directions and guidance for prescribed fire planning and implementation for the Department of the Interior's (DOI's) Bureau of Land Management (BLM), Bureau of Indian Affairs, National Park Service, Fish and Wildlife Service (USFWS), and the US Department of Agriculture (USDA) Forest Service (USFS). This document will outline the steps required to conduct prescribed fire on public lands. It is also important to note that combining prescribed burning with thinning projects is critical to achieve many positive outcomes (Hedges 2009).

1. **Determine if the site is a fire-adapted ecosystem that could benefit from prescribed fire (Avitt 2023):** Two web-based tools that can aid in site suitability determination are LANDFIRE and the Interagency Fuel Treatment Decision Support System (IFTDDS) (DOI 2015). LANDFIRE may require more experience with various geographical information systems and fuels data, while the IFTDDS is more user-friendly for those with less technical expertise.

2. **Create a prescribed burn plan:** This process can take up to 12 months to complete (Avitt 2023). Prescribed fire planning and implementation is site-specific, so although there are general guidelines for approaches, each site will differ (Greco 2018). Factors influencing the plan include fuel moisture, forest stand characteristics, historical data, terrain, soil type, and elevation. The plan should also state what type of burn will be conducted (Stubbendieck et al. 2007; Avitt 2023). The two primary types of prescribed burning used are pile burning and broadcast or understory burning. *Pile burning*

refers to burning fuels in a slash pile created from woody debris and vegetation that are not useful for other purposes (Figure 29.1; James 2011, DFPC 2015). These piles are often left to dry out for a few years before they are burned. *Broadcast* or *understory* burning refers to fire being applied to a larger area to burn debris, saplings, and other surface fuels to create less hazardous fuel loads (Figure 2, Rau n.d., BLM n.d.). Within this plan, it is important to include a prescription for thinning treatment to prepare the site for the burn to make fuel management as effective as possible (USFS n.d.b). A long-term study conducted by the USFS, the Lick Creek Demonstration/Research Forest, found that fuel reduction and restoration are most successful when cutting and burning are combined (Hood et al. 2020).

3. **Conduct the burn when conditions match to the burn window described in the burn plan:** The *burn window* refers to when all the environmental, weather, and projected fire behavior model conditions illustrated in the burn plan are met (Avitt 2023). To ensure all conditions are met, a before-action review can be helpful to define what might lead to the project's failure and improve the strategy prior to implementation. The burn can be conducted when the burn window conditions are met and the proper personnel are available. Everyone working on the burn must be adequately trained and carry current qualifications to participate in or lead a

Figure 29.1 Pile burning in Kaibab National Forest

Photo courtesy Kaibab National Forest

Figure 29.2 Understory burning in a grassland at Las Cienegas National Conservation Area

Photo courtesy Dan Quintana, BLM Fuels Program Manager

prescribed burn. Unless local agreements specify otherwise, these qualifications must meet PMS 310-1 standards, which define the criteria wildland firefighters must meet to engage with fire (NWCG 2022).

4. **Monitor the burn, patrol the perimeter, and mop up:** *Prescribed fire monitoring* is the process of repeated observation of weather, fire behavior, fuels, and smoke dispersal throughout the project (NWCG 2022). A prescribed burn requires patrolling the perimeter until the prescribed burn is completely out to ensure the fire does not escape (BLM). Mopping up is required to extinguish or remove burning material to ensure the fire will not spread outside the control lines. Mop-up will include cold trailing (feeling the ground with the back of a bare hand to ensure there is no residual heat), spotting smoke along the perimeter, and exposing heavy fuels to ensure no residual burn (Rizza et al. 2022). Exposing heavy fuels is necessary because there is often heat remaining underneath logs and stumps. Firefighters will employ the same tactics to ensure there is no heat near the control line (USFS n.d.a).

5. **Conduct outcome, technical, and action reviews:** These reviews aim to continually improve prescribed fire programs through individual and organizational learning. Agency administrators will determine which outcome reviews are necessary, but two types are always required if the burn does not follow what was planned: Declared Wildfire Reviews and Air Quality NOV Reviews. The other suggested reviews are Technical On-Site Peer Review, which evaluates the burn plan before and as the burn is being conducted, and the After Action Review, where the crew/team discusses the desired versus actual outcomes and what lessons were learned. More details about the necessary reviews can be found in the NWCG Standards for Prescribed Fire Planning and Implementation (NWCG 2022).

OPERATIONS AND MAINTENANCE

Prescribed burning (and often, associated thinning) will need to be repeated over time to maintain effectiveness. The number of years between fire treatments will differ based on the type and age of a forest.

FACTORS INFLUENCING SITE SUITABILITY

Because prescribed burn site attributes are extremely region-specific, it is essential to reference information specific to each site. Resources like LANDFIRE and IFTDDS can aid in regional decision-making surrounding fuel treatment. Some general site attributes are outlined as follows.

- ✓ **Community buy-in:** Many people are afraid of prescribed burns and do not understand the full benefits of conducting them. It is essential to be transparent about burn plans and create space for education to gain community support. With community support, it is easier to get this work completed (Brenner et al. 2014).
- ✓ **Wildland–urban interface:** The *wildland–urban interface* (WUI) is where a fire-adapted ecosystem and people intersect. Conducting prescribed burns in the WUI is important because this area has the most potential for infrastructure loss and threats to human safety (Cobb 2020).
- ✓ **Wildfire hazards:** An area with potential for extreme wildfire behavior or other hazards is a good location to conduct a prescribed burn in order to mitigate these potential hazards (Greco 2018).
- ✓ **Fire-adapted ecosystems:** Every ecosystem is different, so knowing what the fire needs are within a specific site is essential. Within the United States, the West, Southwest, Great Plains, and Southeast are all considered fire-adapted regions that can significantly benefit from prescribed fire (Avitt 2023).
- × **Strict air quality regulations:** A site adjacent to communities with already compromised air quality or strict air quality guidelines may not be suitable for a prescribed burn (NWCG 2018).
- × **Burn window limitations:** Some regions have minimal burn windows, which makes it challenging to conduct prescribed burns (Avitt 2023).
- × **Sandy soils:** Prescribed fire should be used on sandy soils only with extreme caution because of a higher likelihood of erosion (Stubbendieck et al. 2007).

TOOLS, TRAINING, AND RESOURCES FOR PLANNING AND IMPLEMENTATION

Name and Link	Resource Type	Year	Authors/ Authoring Organization	Geography	Description	Resource Includes: Design/Construction Guidance?	Resource Includes: Site Selection?	Resource Includes: Monitoring Guidance?	Resource Includes: Example Projects?
Standards for Prescribed Fire Planning and Implementation	Guidebook	2022	NWCG	National	This report outlines the required standards for DOI and USDA for any prescribed burn activity.	✓	✓	✓	—
Prescribed Fire Template, PMS 484-1	Document	2021	NWCG	National	Provides a template of the information needed to implement a prescribed burn plan.	✓	—	—	—
Facilitating Prescribed Fire in Northern California through Indigenous Governance and Interagency Partnerships	Journal Article	2021	Tony Marks-Block and William Tripp	Written for California but much of the information is broadly applicable	Discusses how to facilitate an expansion of prescribed burning with Indigenous groups and federal agencies	✓	—	—	✓
Indigenous Fire Stewardship: Federal/ Tribal Partnerships for Wildland Fire Research and Management	Journal Article	2021	Frank Kanawha Lake	National	Describes the relationship and knowledge that Indigenous tribes bring into the fire space, how to integrate Indigenous knowledge, and how to decolonize the wildland fire space.	✓	✓	—	—
Confronting the Wildfire Crisis	Guidebook	2022	USFS	National	This strategy outlines the USFS's interagency approach to confronting the wildfire crisis. It touches on collaborative burn strategies more broadly.	✓	✓	—	—

Name and Link	Resource Type	Year	Authors/ Authoring Organization	Geography	Description	Resource Includes: Design/Construction Guidance?	Site Selection?	Monitoring Guidance?	Example Projects?
Habitat Management Fact Sheet: Prescribed Burning	Document	2005	Indiana Division of Fish and Wildlife	Written for Indiana but much of the information is broadly applicable	This is a step-by-step guide to conducting a prescribed burn from start to finish, with habitat management as the primary goal. It also offers specific technical guidelines.	✓	✓	✓	—
Colorado Prescribed Fire Planning and Implementation Policy Guide	Guidebook	2019	Colorado Division of Fire Prevention and Control	Written for Colorado but much of the information is broadly applicable	Provides a guide to planning and implementing a prescribed burn and reviewing the burn after it is complete.	✓	✓	✓	—
Southeast Prescribed Fire Initiative	Website	2023	Southeast Regional Partnership for Planning and Sustainability	Southeast United States	The website contains materials that provide information on liability, burning in longleaf stands, and training needs, among other resources.	✓	✓	✓	✓
National Interagency Prescribed Fire Training Center (NIPFTC)	Training	2023	National Advanced Fire and Resource Institute	National	This website contains training programs to prepare fire managers from different government agencies to conduct safe and effective prescribed burns.	✓	—	✓	—
LANDFIRE: Landscape Fire and Resource Management Planning Tools	Website	2023	USFS, DOI	National	Provides agency leaders with vegetation and wildland fire/fuel information to enable strategic fire planning.	✓	✓	✓	✓
Interagency Fuel Treatment Decision Support System	Website	2023	USFS, DOI	National	Web-based application designed to help land managers with fuel treatment planning and analysis.	✓	✓	✓	✓

Name and Link	Resource Type	Year	Authors/ Authoring Organization	Geography	Description	Resource Includes: Design/Construction Guidance?	Resource Includes: Site Selection?	Resource Includes: Monitoring Guidance?	Resource Includes: Example Projects?
NWCG Prescribed Fire Summary and Final Complexity Worksheet	Document	2022	NWCG	National	Helps to enable effective risk management when conducting prescribed burns.	✓	—	—	—
Colorado Pile Construction Guide	Guidebook	2015	Colorado Division of Fire Prevention and Control	Written for Colorado but much of the information is broadly applicable	This guide helps managers in the process of slash pile construction and burning.	✓	✓	—	✓
Lake States Fire Science Consortium	Website	2011	Joint Fire Science Program	Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York	This website provides information to fire managers in the states surrounding the great lakes.	✓	✓	—	✓
Grassland Management With Prescribed Fire	Document	2007	University of Nebraska Lincoln	National (grassland focused)	This document gives an overview of how to use prescribed fire for grassland management in the United States.	✓	✓	—	—

LIKELY BENEFITS AND OUTCOMES

Primary objectives for each strategy are highlighted.

Climate Threat Reduction

- **Reduced wildfire risk:** Prescribed burns reduce hazardous fuel loads, decreasing the potential for catastrophic fires (Greco 2018). Because dense vegetation can create increasingly intense wildfires as a result of fuel connectivity, prescribed burns are a valuable tool in reducing these fuel loads in a controlled manner (Mississippi Forestry Commission n.d.).
- **Improved air quality:** Air quality is improved as a result of prescribed burns because of the reduced risk of catastrophic fire (EPA 2021). Fires release particulate matter, including hazardous PM2.5 particulates, and gaseous compounds. Prescribed fires are required to follow a smoke management program under state-specific guidelines and, if conducted properly, "the smoke exposure will not exceed air quality standards or affect sensitive populations" (Jaffe et al. 2020). In addition to generally fewer fuels being consumed in a prescribed burn as compared to a wildfire, it was found that prescribed burns resulted in less PM2.5 emissions per kilogram of fuel consumed (Lui et al. 2017).

Social and Economic

- **Public health and safety:** Prescribed burns can improve public safety and reduce public risk as a result of catastrophic wildfire reduction (Greco 2018, Avitt 2023). With many people currently living in the WUI, prescribed burns can reduce the impact of naturally occurring wildfires in these areas (Cobb 2020). The public health risk also decreases after prescribed burning as a result of less smoke and particulates in the air as compared to wildfires (Burke et al. 2020; Lui et al. 2017).
- **Property and infrastructure protection:** Prescribed burns reduce property and infrastructure damage because of decreased catastrophic wildfire potential (Warnell et al. 2020).
- **Jobs:** Expanding prescribed fire programs can create more job opportunities within the wildland fire space. With the Bipartisan Infrastructure Law (BIL) dedicating funding to wildland fire efforts, there is an opportunity to hire more professionals to work on fuel treatment projects, such as prescribed burning (Coulter 2023).
- **Firefighter safety:** Prescribed burns can create spaces for firefighters to practice fighting wildfires safely and effectively (USFS n.d.b).

Ecological

- **Native plants:** Prescribed burns can allow species dependent on fire to thrive (Greco 2018). A forest or landscape that consists of fire-dependent species will also lead to less catastrophic wildfires (Warnell et al. 2020).
- **Supports wildlife:** Prescribed burns can benefit endangered species' habitats and other wildlife (Greco 2018). Healthy forests generally allow for improved wildlife

populations. These benefits are often species-specific and targets should be specified in any prescribed burn plan (Avitt 2023).

- **Enhanced soil health:** Soil rejuvenation is an ecological benefit of prescribed burning as a result of the reduction in intense wildfires that cause excessive nutrient loss. Prescribed burns also aid in the return of nutrients from vegetation into the soil (Mississippi Forestry Commission n.d.).
- **Invasive and nuisance species management:** Prescribed fires can decrease the spread and effects of invasive species, insects, and diseases that frequently plague forests and other landscapes (USDA n.d.).
- **Improved water quality:** In many parts of the country, water quality depends on trees and organic material covering the ground adjacent to water sources such as reservoirs or streams. Because extreme wildfires can completely remove all trees, ground cover, and soil nutrients, this often leads to erosion and poor water quality (Avitt 2023).

BARRIERS AND SOLUTIONS FOR PRACTITIONERS

Common Barriers

Several barriers are common across many of the nature-based solutions strategies; these are described in more detail in Section 1 of the Roadmap. Additional notes about the barriers specific to prescribed burns are included here.

- **Expense:** The estimated costs of a prescribed burn range between $100 and $1,000 per acre (Burke et al. 2020). In the 2021 fiscal year, the DOI spent $220 million on fuel management; this will increase with the introduction of new legislation (DOI 2015). In the 2024 fiscal year, the DOI budget request is $1.33 billion for wildland fire and hazardous fuels mitigation (DOI 2023). The BIL and the Inflation Reduction Act will provide additional federal funding for wildfire prevention, which includes hazardous fuels management (The White House 2021, 2022). However, reacting to wildfires is much more expensive than prescribed burns or other fuel treatments—from 2011 to 2020, federal agencies spent more than $1.4 billion on fighting wildfires per year, not including the cost of property damage, loss of civilian life, or adverse effects to the ecosystem (Bishop 2023).
- **Capacity:** Many fire managers have expressed that one of the key barriers to implementing prescribed fires is the lack of capacity during burn windows. Typically, this capacity limitation refers to the lack of trained personnel (Schultz 2017).
- **Public opinion:** Prescribed burns are not always accepted by the general public, and there is valid reasoning for this distrust. It is crucial to encourage public engagement and education pertaining to fuel management. Maintaining a positive image and engaging with the public effectively and positively is essential (Brenner et al. 2014).
- **Conflict with other land uses**

- **Regulation:** Prescribed burning is heavily regulated in the United States, dating back to the US government preventing Indigenous people from conducting cultural burns (Long et al. 2021). In 2022, the USFS banned prescribed burns for a 90-day review (Moore 2022). The strict regulations on prescribed burns can lead to less burning than is deemed necessary, but being aware of the regulations in each region can allow one to take advantage of burn windows available. Restrictions on prescribed burning are site-specific and can even vary by county (Oldham 2023).
- **Lack of effectiveness data**

Economic

- **Cost of escaped fire:** The cost of an escaped prescribed burn that turns into a wildland fire can be severe. An extreme example of this is the cost of the Calf Canyon/Hermits Peak Fire, which will end up costing federal agencies at least $3.95 billion in damages (FEMA). To combat this, it is crucial to follow the burn plan and maintain monitoring efforts (NWCG 2022). Escaped fire is rare—the USFS reported that 99.84% of their prescribed burn projects go according to plan (Moore 2022).

Community

- **Smoke/air quality:** Smoke can negatively impact communities by degrading the air quality in the area (Greco 2018). To ensure proper smoke dispersal, it is crucial to only burn within the burn window and continue monitoring smoke throughout the entire burn (NWCG 2022). Although the effects of smoke from wildfires are typically worse than prescribed burns, it is important to acknowledge the effects that particulates, specifically PM2.5, from prescribed burns have on human health (Haikerwal 2015).
- **Threats of loss of property/life if fire escapes:** There is always a potential threat to property or lives if the prescribed burn project does escape. While this is uncommon, it is crucial to follow the burn plan and monitor effectively to ensure this does not happen and, if it does, the proper people are notified (NWCG 2022, Moore 2022).
- **Liability:** If something goes wrong or the fire escapes, federal agencies and/or the burn boss can be held liable resulting in financial, time, and mental health burdens. There are different types of liability, but the most common for prescribed burns is simple negligence liability (Berger n.d.).
- **Danger to firefighters:** Although hazard pay does not extend to prescribed burns, they can still be volatile and endanger wildland firefighters. Prescribed burns can increase the risk of disease through smoke and particulate exposure and can result in an escaped wildfire, which has further implications for firefighter danger (Grassroots Wildland Firefighters n.d.).

Ecological

- **Burn window limitations:** Not all regions that require prescribed burns have enough burn windows to properly conduct enough burning to be maximally effective. In many parts of the country, climate change is decreasing the number of burn opportunities due to atmospheric, wind, humidity, and temperature constraints (Kupfer et al. 2020).

- **Pile burning:** Burning slash piles as a means of fuel management, typically after a thinning project, can have long-term negative impacts on forest ecology, particularly on soils. If not correctly built (i.e., too large or too many heavy fuels), burning slash piles can lead to similar impacts on soil chemistry that are observed in extreme wildfires (decreased levels of total carbon and nitrogen) (Johnson 2010). Pile burning is still one of the most effective forms of fuel management, so managers using pile burning as a management method should be aware of rehabilitation efforts that are site-dependent (Mott et al. 2021).
- **Biodiversity loss:** In the Western United States, as a result of burning outside of the natural fire season, species that have adapted to fire may not be as well adapted to burns happening in fall or spring. In the Eastern United States, these same wildlife concerns are less of an issue because the prescribed burn season matches the natural fire season. To maintain biodiversity, managers can vary the timing of prescribed burns within the same region. However, it is important to note that most species are resilient to prescribed burns (Knapp et al. 2009).

EXAMPLE PROJECTS

Name and Link	Location	Leading Organizations	Techniques Used	Size, acres	Cost	Duration	Project Description	Climate Threats Targeted	Lessons Learned or Adaptive Management
Prescribed Underburning in Southwest Oregon	Southwest Oregon	**BLM**	Cross-collaboration with federal agencies, broadcast burn with perimeter monitoring, strip-firing techniques	36	$300 to $700 per acre	Not provided	This project was on private land managed for both timber and ecosystem purposes. A 12-person BLM crew conducted the burn.	High-severity fires, restore ecosystem processes	The burn did reduce the potential for devastating wildfires, but there were also a series of commercial and noncommercial thinning operations performed before the burn. The burn killed some trees, which allowed for more patches in the forest, a desired outcome in this case.
Animas City Mountain Prescribed Burn	Durango, CO	**BLM**	Ignition operations that are consistent within ponderosa pine and oak brush ecosystems, establish a black line to create a secure edge and light the units back toward the black line	652	Not provided.	2 to 3	This project had a plan consisting of 21 elements. The mountain was divided into seven units to properly and safely complete the burn project.	High-severity fires, improve forest health and wildlife habitat	The project description details alternative plans in case there was too much smoke or the fire was burning too hot. They also outlined monitoring efforts.

Name and Link	Location	Leading Organizations	Techniques Used	Size, acres	Cost	Duration	Project Description	Climate Threats Targeted	Lessons Learned or Adaptive Management
Lower North Fork Prescribed Fire	Conifer, CO	Colorado State Forest Service	Ignition operations, spot fire monitoring, declaring a wildfire after a prescribed burn has escaped	4,140	Total not provided($18 million was allocated from the state to the victims. [Claims Journal 2014])	12 (May 22–April 2, 2012 [NASA 2012])	This project was a well-known prescribed burn incident that led to a declared wildfire, leading to three deaths and 25 homes damaged or destroyed (NASA 2012).	Reduce fuels, high-severity wildfires.	This burn was conducted in 2012 and is an example of why prescribed burn operations must be adaptable. In this case, the weather forecast held extreme winds, and the burn did not burn as much fuel within the burn perimeter as expected, so the increased wind allowed for an escape.
Lathrop Bayou Prescribed Fire	Florida panhandle	**BLM, USFWS**	Using fire to reduce hazardous fuels, aerial ignition with limited ground support	536	Not provided	1 to 2	This project was designed to reduce severe wildfires, increase public safety, improve habitat for red-cockaded woodpeckers, and promote growth of wildflowers(BLM 2020). The reduction of hazardous fuels was necessary because the area was heavily impacted by Hurricane Michael.	Hazardous fuels, high-severity wildfires	Not provided

Bolding indicates DOI affiliates.

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