USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Rocky Mountain Research Station
Science You Can Use *in Photos*
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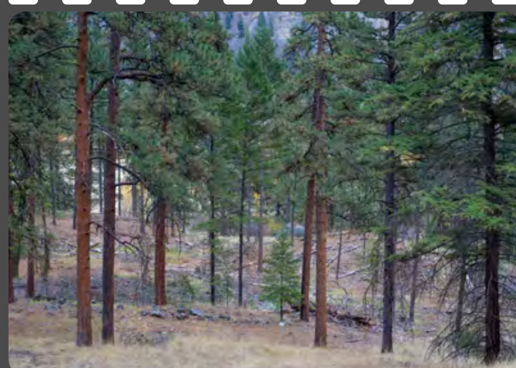
What do we know about forest treatments and fire? Photos and long-term studies help us understand.

Fire regimes in nearly all dry conifer forests in the western United States now vastly differ from past conditions, with many forests susceptible to uncharacteristic high-severity fire effects threatening human communities and degrading forest ecosystems. These forests historically experienced fire frequently, on the order of once every 3 to 30 years. Fires shaped the structure of the forest and the mix of plants. Forest treatments often aim to reduce the severity of future fire and improve the health and resilience of forests. But how do these treatments differ from each other? And how do these treatments change a forest over time?

Long-term forest studies—and the photographs taken at these sites over many years—help us understand the dynamic nature of forests and how different types of fire and other forest management affect the trajectory of forests. Studies conducted over many decades by Forest Service scientists and collaborators in dry conifer forests across the West provide important comparisons about the differences in forest treatments and how fire interacts with forests that have been managed or not. This *Science You Can Use — in Photos* showcases photo comparisons from dry conifer forests from sites across the entire western United States that historically experienced fire on a frequent and recurring basis.


2010 (untreated)


2011 (after thinning)


2015 (after Rx burn)


2015 (after wildfire)

Location: Sinlakehin Wildlife Area, Washington.
Treatments: Photo series is of the same forest stand over time. From left to right: Ponderosa pine and Douglas-fir stand untreated (taken in 2010), thinned (taken in 2011), followed by broadcast prescribed burn (taken in 2015). In 2015 the Lime Belt wildfire burned through the previously thinned and burned stand (taken in 2015).
What we learned: Forest treatments (the combination of thinning followed by burning) prior to a wildfire improved the forest's resilience to fire. Overstory trees were not killed by the wildfire.
Photo credit: John F. Marshall LLC **Further reading:** Hagmann et al. 2021; Hessburg et al. 2005; Prichard et al. 2021

Forest treatments can prepare forests to receive fire.

Fire plays an important role in dry conifer forests, but large patches of high-severity fire in these forests can have outsized or negative impacts. Forest treatments that reduce tree density and surface and ladder fuels, such as thinning coupled with prescribed burning, prepare a forest to receive fire in ways that lead to more desirable outcomes. When a wildfire moves through a previously treated area, it often burns at lower intensity, leading to more characteristic and often beneficial fire effects.

A recent intensive review of over 40 case studies where wildfire burned into areas with previous forest treatments found overwhelming evidence that thinning, coupled with prescribed burning or pile burning, can reduce future wildfire severity by more than 60 percent relative to untreated areas. Areas lacking previous treatment experienced higher fire severity compared to areas that had been treated. Thinning followed by prescribed burning was the most effective treatment combination, with a 72 percent reduction in wildfire severity compared to areas that were not treated. At sites treated by thinning alone, average fire severity was only reduced by 27 percent. In some cases, thinning treatments led to higher wildfire severity than in nearby untreated areas, likely due to increased surface fuels left from thinning activities. These findings underscore the importance of treating surface fuels through burning when reducing future wildfire severity is the goal.

By reducing the severity of future fire, forest treatments pay it forward and can help stabilize carbon over the long term, improve wildlife habitat, and protect watersheds from severe fire effects. Treatments also create more options for wildfire response, including management of unplanned natural ignitions to achieve management objectives. If we prepare landscapes to receive fire, we can improve wildfire outcomes.

Location: Bootleg Fire, Fremont-Winema National Forest, Oregon taken in 2021.
Treatments: Stands on both sides of the road were pre-commercially and commercially thinned in 2017 and 2018. The stand on the left hand side of the road was also prescribed burned.
What we learned: Thinning followed by prescribed burning substantially reduced crown fire and overstory tree mortality compared with the thin only stands, likely due to the reduction of surface fuels by burning.
Photo credit: John F. Marshall LLC
Further reading: Davis et al. 2024; Brodie et al. 2024, Prichard et al. 2021

Forest treatments can prepare forests to receive fire *(continued)*.

Thinning coupled with prescribed burning can reduce future wildfire severity. Clockwise from top left: thinning treatments on the Custer-Gallatin National Forest, Montana; a grapple skidder drags bundles of treetops and branches to clear the worksite on the Kaibab National Forest, Arizona (USDA photo); a prescribed burn on the Bitterroot National Forest in Montana consumes surface fuels including logs, branches, and pine litter; a wildland firefighter helps ignite a prescribed burn on the Manti-La Sal National Forest, Utah. All photos courtesy USDA Forest Service unless otherwise noted.

The 2021 Caldor Fire near South Lake Tahoe, California burned both sites pictured. In the top photo, note the high tree density in a forest stand that had not been recently thinned or burned. This likely contributed to intense fire behavior and severe wildfire effects resulting in high tree mortality. In the bottom photo, note how previous fuel treatments reduced overall tree density and increased space between crowns. As a result, the severity of the wildfire was reduced, leading to lower tree mortality and more desirable fire effects.

Fire and forest management, or lack thereof, change the trajectory of a forest.

Dry conifer forests in the western United States evolved with regular, low- to moderate- severity fire. These dry sites are characterized by stands of mostly ponderosa pine or a mix of conifers (depending on the location these could include ponderosa pine, white pine, Jeffrey pine, limber pine, and others). In the past, fires cleared surface fuels and killed smaller trees, creating open forests dominated by larger trees with fire-resistant traits (e.g., thick bark). More open (lower density) forests have more resources (e.g., water and nutrients) and grow more vigorously, giving them a better ability to defend against insects, disease, and other disturbances.

Tree species in dry conifer forests have high light requirements and those growing in dense forests are stressed and more susceptible to mortality from insects and disease, as they must compete for limited resources especially during periods of drought that are common in these forest types. Trees that die from high-severity fire, insects, or disease will eventually fall to the ground, becoming heavy surface fuel that can burn and smolder for days.

Without periodic fire, or forest management that mimics the effects of frequent, low-severity fire, the trajectory of a forest changes. Seedlings establish and eventually grow large enough to link flammable materials from the ground up to the mature forest canopy, often called ladder fuels. Ladder fuels increase the chances of high-severity fire, which can kill both young and mature trees. Additionally, these high-severity fires can reach the crowns of trees, making them difficult to control and threatening nearby communities.

1991 (before treatment)

1997 (4 years after thin and Rx burn)

2015 (22 years after thin and Rx burn)

Location: Lick Creek Demonstration-Research Forest, Bitterroot National Forest, Montana.
Treatments: Commercial thin followed by prescribed burn.
What we learned: By the mid 1980's, over a century of fire suppression and harvesting transformed the open, seral ponderosa pine structure at Lick Creek to one of thick, dense stands. The plots in these photos were thinned in 1992 and prescribed burned in 1993, which reduced tree density and surface/ladder fuels, effectively transitioning forest structure back to an open ponderosa pine dominated stand.
Further reading: Crotteau et al. 2018; Hood et al. 2020

1992 (untreated)

1995 (untreated)

2016 (untreated)

1992 (before treatment)

1995 (1 year after thin and Rx burn)

2016 (21 years after thin and Rx burn)

Location: Fort Valley Experimental Forest, Arizona.
Treatments: Commercial thinning followed by prescribed burning, starting in the mid-1990s.
What we learned: In the absence of fire and forest management, dry ponderosa pine forests in the Southwestern United States have become dense with unhealthy, small diameter trees and accumulated woody debris and surface fuels. Forest treatments that reduce tree densities promote tree growth and tree recovery following periods of drought.
Photo credit: Ecological Restoration Institute, Northern Arizona University
Further reading: Thomas and Waring 2015; Steckel et al. 2020; McKinney 2023.

Forest treatments that reduce fuels often have other benefits.

In certain forest types, including ponderosa pine and dry mixed conifer, forest treatments with fuels reduction objectives provide benefits beyond reducing the chance of high-severity fire. These benefits include persistent increased tree growth, even during drought, and reduced tree mortality from mountain pine beetle. Treatments can also increase understory native vegetation diversity, provide pollinator habitat, and increase carbon stability on the landscape in soil and overstory trees.

Forest treatments can be designed to promote landscape biodiversity through creating patch mosaics and restoring heterogeneous forest structure (e.g., clumps and gaps). These projects can have a role in habitat creation and maintenance for forest wildlife and plant species such as northern goshawk, whitebark pine, California spotted owl, and woodpeckers. Forest treatments can restore historical forest structure, maintain old and large trees, protect wildlife habitat from severe fire activity, and enhance forest resilience under a changing climate.

Location: Chelan Wildlife Area and the Okanogan-Wenatchee National Forest, Washington.
What we learned: Thinning reduces canopy fuels, but can also be used to restore clumps and gaps in forest structure, as shown in the foreground of this photo. The diverse forest structure can have trickle-down benefits for trees, understory plants, and wildlife species.
Photo credit: : John F. Marshall LLC
Further reading: Hurteau 2019; Steel et al. 2021; Tepley et al. 2020

Forest treatments that reduce fuels often have other benefits *(continued)*.

Location: Landscape view of the Black Hills National Forest, South Dakota
Treatment: The site in the photograph was commercially thinned in 2005. Throughout the Black Hills National Forest, over 450,000 acres have been impacted by mountain pine bark beetle. The peak of the bark beetle epidemic was between 2013 and 2014. This photo was taken in 2014.
What we learned: Previously thinned ponderosa pine sites (outlined by the yellow dashed lines) in the Black Hills had lower bark beetle-caused tree mortality than adjacent unthinned sites (outside of the yellow dashed lines and within the area outlined by red dashed lines) with higher tree densities.
Further reading: Negron et al. 2017; Graham et al. 2016

Examples of typical unthinned (top photo) and thinned (bottom photo) stands of ponderosa pine in the Black Hills Experimental Forest, located within the Black Hills National Forest. Here, researchers have studied the impacts of forest management and density reduction treatments on forest health and tree vigor over decades.

Forest treatments that reduce fuels often have other benefits *(continued)*.


2001 (before treatment)


2010 (8 years after thinning)


2019 (after follow-up thinning + mastication)

Location: Blodgett Forest Research Station, California.
Treatments: Mechanical thinning in 2001 with a followup mastication treatment in 2018.
What we learned: In addition to reducing simulated wildfire hazard, mechanical thinning accelerated individual tree growth and increased tree vigor in the remaining overstory trees (as shown by tree ring widths and tree crown expansion). Increased tree vigor can ultimately increase the stand's ability to withstand drought conditions and pest infestations. The photo series above shows how mechanical thinning restored healthy tree densities, ultimately resulting in larger and healthier trees.
Further reading: Stephens et al. 2024; Collins et al. 2019.
Photo credit: Scott Stephens.


2005 (untreated)


2015 (untreated)


2022 (untreated)


2005 (3 years after thin and Rx burn)


2015 (13 years after thin and Rx burn)


2022 (20 years after thin and Rx burn)

Location: Lubrecht Experimental Forest, Montana.
Treatments: No treatment vs. commercial thin followed by prescribed burn.
What we learned: These photos show the effects of a mountain pine beetle outbreak that occurred between 2005 and 2012. The untreated stand (upper row of photos) experienced higher levels of mortality in mature ponderosa pine compared to the adjacent treated stand (lower row of photos) that was thinned in 2002 and burned in 2003 to reduce fire hazard. Note the surface fuel accumulation in the untreated plots, caused by trees that died and fell as a result of the beetle outbreak.
Further reading: Hood et al. 2016; 2024.

Dry forests need periodic fire.

In the absence of fire or ecologically appropriate forest treatments, dry conifer forests can shift from being dominated by more fire-adapted, shade-intolerant species (e.g., western larch, ponderosa pine, Jeffrey pine) to shade-tolerant species (e.g., Douglas-fir, white fir, grand fir), which form a dense understory that grows into a closed canopy. Importantly, fire and forest treatments change or maintain a more open forest structure that supports wildlife habitat, regeneration of shade-intolerant species, and native plant understories. A more open forest structure also decreases the risk of high-severity fire and improves resilience to drought, insects, and disease.

2011 (before treatment)

2020 (after thin and Rx burn)

Location: Stanislaus-Tuolumne Experimental Forest, California.
Treatments: Variable density thinning followed by prescribed burn.
What we learned: The combination of variable density thinning (trees are thinned to form clumps and gaps) and prescribed fire not only reduced wildfire hazard but also restored the tree structure historically found in forests shaped by frequent fire, which benefits wildlife, understory vegetation, and general biodiversity. Note the understory "desert" in 2011 and the increase in native understory plant cover by 2020. Many native plants in these forests have seeds that are stimulated to germinate by fire.
Further reading: Knapp et al. 2013; 2021; Odland et al. 2021

2005 (3 years after thin)

2015 (13 years after thin)

2022 (20 years after thin)

2005 (3 years after thin and Rx burn)

2015 (13 years after thin and Rx burn)

2022 (20 years after thin and Rx burn)

Location: Lubrecht Experimental Forest, Montana.
Treatments: Commercial thin vs. commercial thin followed by prescribed burn.
What we learned: In Northern Rockies dry forests, the overstory is often dominated by ponderosa pine with Douglas-fir present in the understory. Periodic fire kills young Douglas-fir and consumes surface fuel, which helps maintain forest structure and composition and reduces future fire severity. In the thin-only treatment (upper photos), note dense Douglas-fir regeneration growing over time. In the adjacent thin + prescribed burn treatment (lower photos), note the absence of Douglas-fir seedlings.
Further reading: Hood et al. 2024.

Thinning and burning change forests in different ways.

Managers design forest treatments to meet specific objectives. In the case of fuel reduction treatments, it is important to consider multiple “layers” of fuel. Mechanical treatments (e.g., thinning, masticating) can precisely remove trees of exact sizes, species, and spacing specifications. However, mechanical treatments alone can increase surface fuel loads in the form of branches and needles left on the forest floor as a result of the treatment (also referred to as “activity fuels”). These leftover fuels can increase future fire severity if not reduced by prescribed fire or further treatment (e.g., piling and burning). By contrast, prescribed fire alone can consume surface fuels and kill small trees, but may not adequately reduce mature tree density, especially if trees have developed fire-resistant thick bark or if the fire burns with very low severity. Small trees that are killed in a prescribed burn can fall to the ground in later years, leading to a re-accumulation of surface fuel. The most effective treatments often involve multiple treatment activities (e.g., thinning followed by prescribed burning).

Location: Blodgett Forest Research Station, California.
Treatments: A) prescribed burn only (burns in 2002, 2009, and 2017); B) thin only (commercial thin + mastication in 2002 with followup mastication in 2017 and commercial thin in 2019); C) thin + prescribed burn (commercial thin + mastication in 2002 with followup mastication in 2017 and second burn in 2018); and D) no treatment.
What we learned: Although all treatments reduced simulated fire hazard in this Sierra Nevada dry mixed conifer forest, the prescribed burn treatment (photo A) and the thin + prescribed burn treatment (photo C) significantly reduced duff and surface fuels.
Further reading: Stephens et al. 2024.

Location: Stanislaus-Tuolumne Experimental Forest, California.
Treatments: thin-only, prescribed burn-only, or thin followed by prescribed burn (note top images are pretreatment and bottom images are posttreatment).
What we learned: In the thin-only unit, surface fuel load remains similar to pretreatment, making the stand vulnerable to high-severity wildfire. In the prescribed burn-only unit, prescribed fire consumed much of the original surface fuel, but canopy cover remained high and trees that were killed by the prescribed burn have fallen to the ground. The thin + prescribed burn treatment not only reduced wildfire hazard, but also restored clumps and gaps to the forest structure and increased understory plant cover and diversity.
Further reading: Knapp et al. 2013; 2021.

Thinning helps “reset” forest structure so prescribed and natural fires can do their work.

Combined thinning and burning treatments are typically most effective at changing forest structure and composition, reducing surface fuels, and improving ecological resilience. The effects of thinning and burning, when used together, are most effective in increasing forest resilience to disturbance (e.g., fire, drought, and/or beetle outbreaks). A recent review of thinning and burning studies supports this finding that thinning and prescribed burning treatments had the longest lasting effect on reducing fire severity, compared to thin and pile burn, thin-only, and prescribed fire-only treatments.

In areas that have not burned in decades, thinning coupled with prescribed fire can better meet stand density and fuel reduction objectives than prescribed fire alone. One reason this combination is effective is that thinning can target shade-tolerant species that may be resistant to surface fires as they mature and their bark develops.


1991 (before treatment)


1993 (after thin)


1994 (after Rx burn)

Location: Lick Creek Demonstration-Research Forest, Bitterroot National Forest, Montana.
Treatments: Commercial thin followed by prescribed burn.
What we learned: In this dry, ponderosa pine dominated stand, over a century of fire exclusion resulted in a dense, overgrown forest. Commercial thinning in 1992 opened up the forest canopy and reduced the chance of a crown fire but increased the amount of surface fuel on the forest floor (e.g., logs, branches, needles). The followup prescribed burn reduced surface fuel and killing smaller trees that were not removed by thinning. At this site, thinning and burning were both necessary to restore forest structure.
Further reading: Crotteau et al. 2018; Science You Can Use 2021.


2001 (before treatment)


2002 (after mechanical treatment)


2003 (after Rx burn)

Location: Blodgett Forest Research Station, California.
Treatment: These photos show the immediate impact of mechanical thinning (timber harvest and mastication) followed by prescribed fire at the Fire and Fire Surrogate Study site in a dry mixed conifer forest in the Sierra Nevada.
What we learned: The combination of mechanical thinning followed by prescribed burning reduced unintended overstory tree mortality that can sometimes happen with prescribed burning. The combination of thinning and burning also reduced surface fuel loads and was most effective at reducing simulated wildfire severity. This treatment combination also met economic goals because it included commercial timber harvesting before burning.
Further reading: Stephens et al. 2024.

There is a story in the understory too.

Forest treatments can increase richness and cover of both native and nonnative understory plant species, which generally peaks five to ten years post-treatment. As overstory tree cover returns, understory plants move towards pretreatment levels of richness and cover. A study of eight dry conifer sites along the Colorado Front Range demonstrated native plant cover and species richness increases following mechanical forest restoration treatments. Similarly, in ponderosa pine forests of the southwestern United States, native plant cover and species richness increased for more than a decade in research plots that were thinned and burned. These findings are consistent in dry conifer forests elsewhere in the West.

Culturally important species can also increase following forest treatments and fire. For example, in forests throughout the western U.S., thinleaf huckleberry generally survives low to moderate severity fire but can experience significant mortality following high severity fire. Because of its preference for high light settings such as canopy gaps, thimbleberry abundance often increases in forests following thinning or removal of the overstory canopy. Thimbleberry often resprouts vigorously following fire, except in cases of high severity fire.

2008 (3 years after mastication)

2011 (6 years after mastication)

2011 (adjacent untreated site)

Location: Manitou Experimental Forest, Colorado.
Treatment: Heavy machinery was used to masticate unwanted shrubs and small-diameter trees and the masticated biomass was broadcast on the ground. Relative to adjacent untreated ponderosa-dominated stands, the average tree basal area was reduced by 58 percent in these ponderosa-dominated stands.
What we learned: Understory plant cover and diversity was greater in the sites that were treated using mastication 6 years after treatment, especially for native grasses and forbs. Note the more open tree canopy structure and increased cover of native grasses, forbs, and shrubs in the masticated site compared to the adjacent untreated site.
Further reading: Fornwalt et al. 2017; Demarest et al. 2023; Springer et al. 2024; Jang et al. 2021

1991 (before treatment)

1993 (after thin)

1994 (after Rx burn)

1996 (3 growing seasons after thin)

1997 (3 growing seasons after Rx burn)

2015 (22 growing seasons after thin and Rx burn)

Location: Lick Creek Demonstration-Research Forest, Bitterroot National Forest, Montana.
Treatments: Commercial thin followed by prescribed burn.
What we learned: Understory plant cover declined immediately after treatments but then increased. Native cover peaked about 5 years after treatment (74 percent greater than pretreatment) and then gradually declined to levels similar to pretreatment as overstory tree cover filled back in (as shown in 2015). Nonnative grasses and forbs followed similar patterns, but their cover increased more sharply after treatment (as shown in 1996). While nonnative plant cover gradually declined over time, it remained slightly elevated throughout the period of study, suggesting that intensive forest treatments may favor nonnative species on certain sites.
Further reading: Crotteau et al. 2018; Science You Can Use 2021.

Maintenance treatments are critical after 10–25 years.

Recurring maintenance treatments are necessary in forests with historical frequent, low-severity fire regimes. While forest and fuel treatments can initially reduce fire hazard, this effect wanes over time as biomass (vegetation and fuels on the forest floor) recovers to pretreatment levels. Maintenance treatments should generally be repeated in a cycle that mimics the historical occurrence of fire on the landscape. In dry conifer forests in the western United States, this typically means repeating treatments at least every 10–25 years. While some sites may need repeated mechanical thinning treatments, other sites can be maintained with prescribed or natural fire alone. Recurring forest treatments can exacerbate the cover of nonnative plant species, so minimally invasive activities or longer maintenance intervals may be preferred at sites where these species are present.

Location: Lubrecht Experimental Forest, Montana.
Treatments: Commercial thin followed by prescribed burn.
What we learned: Forest and fuel treatments need to be maintained on a cycle similar to the fire return interval of that forest. Prescribed fire can extend the longevity of fuel treatments by killing pockets of tree seedlings that would otherwise grow into ladder fuels. In this case, sites that were thinned and burned in 2002 were ready for a maintenance treatment 20 years later. These sites were successfully reburned in spring 2024.
Further reading: Hood et al. 2020; 2024.

Location: Lick Creek Demonstration-Research Forest, Bitterroot National Forest, Montana.
Treatments: Shelterwood harvest followed by prescribed burn.
What we learned: There are several noteworthy lessons in this series of photos: (1) In 1993, residual slash from harvest activity and dense Douglas-fir seedlings are consumed by the prescribed burn, demonstrating the importance of treating surface fuels. (2) In 1997, note the flush of understory vegetation five growing seasons after the thin + prescribed burn treatment. (3) In 2005, young Douglas-fir seedlings begin to emerge. By 2016, those seedlings have grown into ladder fuels and a maintenance burn or other treatment is needed to maintain open conditions.
Further reading: Crotteau et al. 2018; Science You Can Use 2021.

Lick Creek, Bitterroot National Forest, Montana

About the Study Areas

Black Hills Experimental Forest: The Black Hills Experimental Forest is located in the Black Hills National Forest in western South Dakota. This 3,438-acre Experimental Forest administered by the USDA Forest Service Rocky Mountain Research Station is dominated by ponderosa pine and was established primarily to study timber production, harvesting, and the impact of management activities. Currently, research conducted on the Black Hills includes topics topics such as the reintroduction of prescribed fire, management of mountain pine beetle infestations, impacts of forest management on wildlife habitat, forage production, and other ecosystem services.

Blodgett Berkeley Fire Surrogate Study: As part of the national Fire and Fire Surrogate Study effort, UC Berkeley implemented a suite of fuel treatments at its Blodgett Forest Research Station in the northern Sierra Nevada beginning in 2001. The Fire and Fire Surrogate Study at Blodgett Forest Research Station is a network of 12 stands, ranging in size from 35 to 70 acres, each of which was randomly assigned one of four possible treatments, which represent the basic range of forest restoration and fire hazard reduction options.

Fire and Fire Surrogate Study (FFS): The Fire and Fire Surrogate Study is a nationwide research effort funded by the Joint Fire Science Program, commenced in 2001 to evaluate the impacts of prescribed fire and mechanical fuel reduction treatments. The nationwide FFS study encompasses 12 sites in 10 states (Montana, Washington, Oregon, California, Arizona, Ohio, North Carolina, South Carolina, Alabama, Florida).

Fort Valley Experimental Forest: The first Forest Service research facility established in the Nation, the Fort Valley Experimental Forest (formerly the Coconino Experiment Station) opened in August 1908. Researchers established the site to determine why ponderosa pine was not regenerating after logging. Fort Valley became a major field and laboratory site for forest management investigations. Fort Valley is administered by the USDA Forest Service Rocky Mountain Research Station.

Lick Creek Demonstration-Research Forest: The Lick Creek study area is located in the northern Rocky Mountains of the United States in a ponderosa pine dominated forest. Lick Creek, located on the Darby/Sula District of the Bitterroot National Forest, is the longest running fuel treatment and restoration study in the western United States. It was established in 1991 as a cooperative venture between the Bitterroot National Forest, University of Montana, and USDA Forest Service Rocky Mountain Research Station. Through repeat photography and numerous published studies, studies at this site show how fuels and vegetation have changed over the 20+ years since treatment and compare the effects of harvesting with and without prescribed burning.

Lubrecht Experimental Forest: A 28,000-acre outdoor laboratory and classroom located 30 miles northeast of Missoula, Montana, the Lubrecht Experimental Forest lies in in the Blackfoot River drainage. The University of Montana's Forest and Conservation Experiment Station and the Montana Department of State Lands jointly own and cooperatively manage the forest. Lubrecht is home to one of the Fire and Fire Surrogate Study sites used to evaluate the effects of thinning and burning treatments on vegetation, fuels, wildfire potential and behavior, and ecosystem structure and processes in frequently burned, fire-adapted forests.

Manitou Experimental Forest: Established in 1936 and administered by the USDA Forest Service Rocky Mountain Research Station, the Manitou Experimental Forest covers 16,700 acres in central Colorado. Much of Manitou is covered by ponderosa pine and dry mixed conifer forests, with grasslands, moist mixed conifer forests, and lodgepole pine forests also prevalent in places. Early research at Manitou focused on range and forest watershed management, but the scope of research has expanded significantly over time. Today, researchers are studying diverse questions related to forest meteorology, hydrology, ecology, and management at both stand and watershed scales.

Stanislaus-Tuolumne Experimental Forest: The Stanislaus-Tuolumne Experimental Forest, managed by the Pacific Southwest Research Station, covers 1,700 acres in the central Sierra Nevada, near Pinecrest, California. It was selected as typical of mixed conifer stands of the Sierra Nevada, specifically those of high site-quality on mid-elevation west slopes. The Stanislaus-Tuolumne was formally created in December of 1943, though research in the area had been ongoing since the 1920s.

Washington and Oregon photos included in this *Science You Can Use* were taken by professional photographer **John F. Marshall** in collaboration with the Fremont-Winema National Forest, the **Pacific Northwest Research Station**, The Nature Conservancy, and the Washington Department of Fish and Wildlife. Marshall's photos help document different stages of forest treatment—and the effects of wildfire in those treatments—on sites throughout central and eastern Washington and Oregon. This region is characterized by a range of forest types, including ponderosa pine, juniper woodland, and dry to mesic mixed conifer at higher elevations. Marshall's photos depict dry ponderosa and mixed conifer sites.

Manitou Experimental Forest, Colorado

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