Forest Management: Recovery of Burned Forests After Catastrophic Fire

Querencia in Action: Landowner Guide



Recovery is a Process.

Forest ecosystems develop over long periods of time, and recovery from wildfire can take decades or longer. A forest may not return to exactly what it was before a wildfire, but a recovering forest can still provide habitat, opportunities for recreation, and a place to observe change and renewal little by little, sometimes with a helping hand from you. Recovery does not happen on the same timeline or follow the same path in every place or forest. This guide introduces some of the common patterns of forest recovery and offers ideas for observing and supporting that process.

> **Recovery is the process of healing.**
>
> Recovery to the former forest stand may not always be possible. A recovering forest can still offer habitat, recreation and a place to observe how the healing process occurs a little bit at a time, sometimes with a helping hand from you.

How Forests Recover After Catastrophic Fire

After a fire burns through a forest, the recovery process is impacted by how severe and intense the fire was. In some cases, the forest might have to begin recovering from bare mineral soil. This reboot returns the forest to an early stage of succession, which is the process where different plant species replace one another over time. Each stage of succession favors specific plant traits that allow different species to thrive under the conditions available at that time and place.

A forest can simultaneously experience multiple stages of succession across its landscape, and succession can reset or redirect if another disturbance impacts the same site (e.g., a wildfire one year followed by a flood the next year). This results in a dynamic pattern of forest recovery, with plant species establishing or returning at rates driven by local conditions (e.g., elevation, slope, aspect, and temperature), as well as the availability of and proximity to seed sources, nutrients, and moisture.

What happens next?

Not every burned forest will follow the same recovery pathway. Whether a site develops into a new forest depends on the severity of the fire and the conditions that remain afterward. The timeline below describes one possible pathway: when conditions remain suitable for trees, and the forest regenerates. Other sites may develop into shrubland, meadow or grassland, or a forest dominated by different tree species. Here, we outline the general successional patterns you might expect to see as your forest recovers.





Recovery happens a little at a time. The above photo shows this site immediately after the 2022 Hermit's Peak–Calf Canyon Fire; the right shows the same area in 2026. Returning to the same place over time can reveal changes that are easy to miss from one visit to the next. *Above photos by NMFWRI Monitoring Crew*

1. **Immediately Post-Fire:** The first plants to come back are usually fast-growing and able to tolerate disturbed ground with little to no shade. Examples include grasses, wildflowers, and some shrubs. Meanwhile, fire-injured trees may die but remain standing (Table 1), and the landscape becomes more prone to erosion or flooding without living roots holding the soil in place. Deer and elk may return to graze on new plant growth, but the presence of wildlife also depends on how close the area is to unburned patches, which provide shelter for these animals.

Crown Remaining	Chance of Survival
60%	85%
50%	75%
40%	65%
30%	50%
20%	35%
10%	20%

Table 1. Estimated ponderosa pine survival percentages based on percent of remaining living crown following wildfire. *Source: Reproduced from DeGomez, T. (2011), Recovering from Wildfire: A Guide for Arizona's Forset Owners, University of Arizona Cooperative Extension.* www.az.nrcs.usda.gov https://extension.arizona.edu/publication/recovering-wildfire-guide-arizonas-forest-owners

2. **Five to Twenty-Five Years:** Over time, tree seedlings begin to establish, and shrub cover changes in both type and structure. Dead trees weaken and eventually fall. Accumulation of deadfall in high density areas can result in logs piled on each other, also known as jackstraw. This successional transition may provide good habitat for some animals (e.g., shelter for small mammals like packrats) and reduce habitat suitability for other animals (e.g., deer and elk that rely on open and unobstructed areas to move more freely, including fleeing from predators).

3. **Many Decades Later:** At this point, a young forest has developed. Some open grassy meadows are intersected with groups of trees that have re-established after the fire. This forest will continue to evolve.



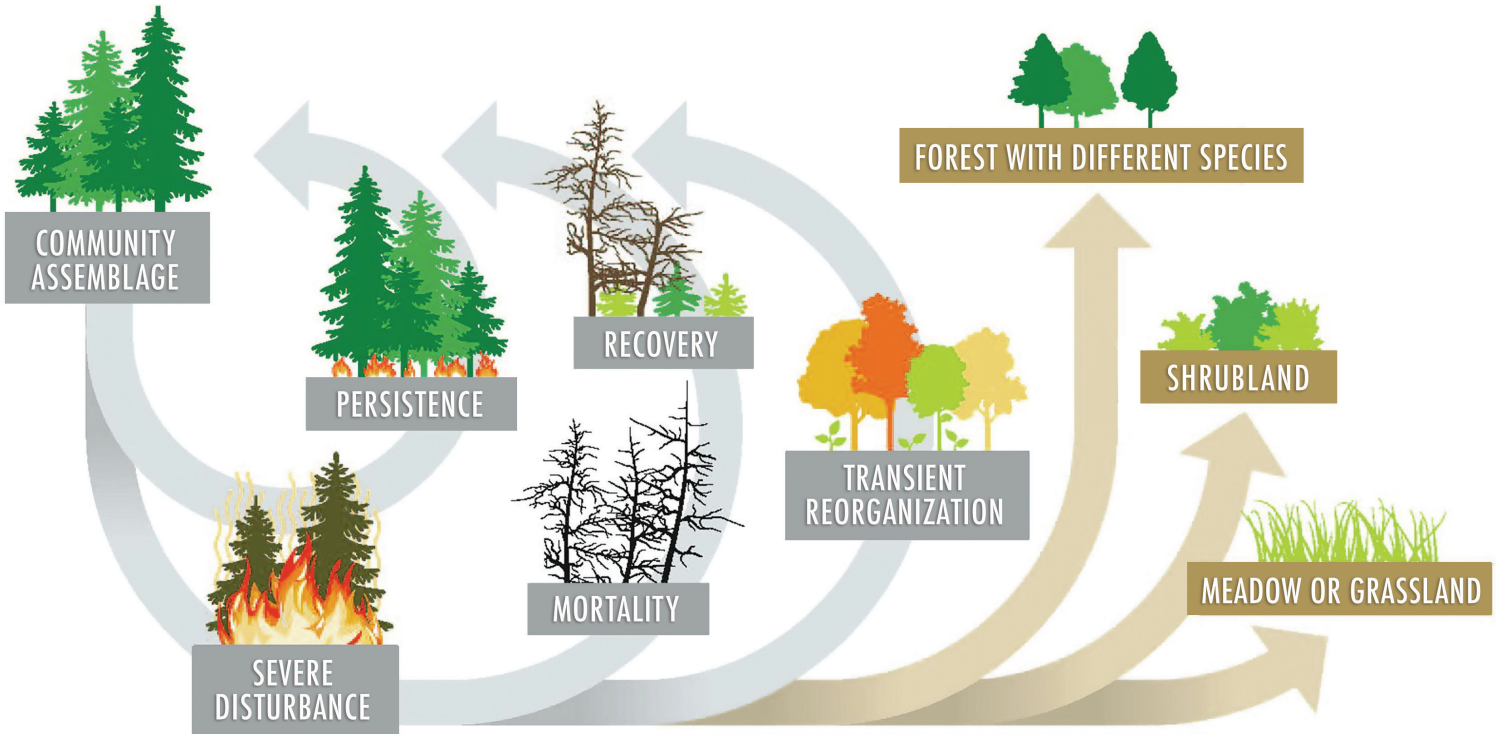
Example of jackstraw in an area with a high density of deadfall. *Photo by Jax Gaglianese-Woody*

Will The Forest Look the Same as Before the Fire?

A burned forest may become something that looks very different from what was there before the fire. In some places, the conditions that allow for a forest to thrive before the fire no longer exist. When that happens, new conditions can no longer support trees on this site, and recovery will follow a different pathway. This type of recovery involves the recovery of the soils, and as soils recover, non-tree plants become established, with root systems that help hold soils in place. As these plants become established, their leaves, flowers, stems, fruits, and seeds can provide food and habitat for wildlife. A landscape that does not return to forest (called type conversion) can still support important ecological functions and have value for people and wildlife.

- **Shrubland:** If a severe burn destroys nearby seed sources but leaves underground root systems intact, a shrub-dominated community can rapidly develop. Species like Gambel oak and New Mexico locust can resprout soon after fire. This competition, combined with occasional disturbance, can make it difficult for conifers to reestablish and allow the shrubland to persist. Shrublands provide food, cover, and nesting habitat for birds and other wildlife, and their roots can help stabilize soil and reduce erosion.

- **Meadow or grassland:** In areas without surviving trees or resprouting shrubs, a forest can convert into a long-lasting meadow or grassland. Once established, grasses and wildflowers can become the dominant vegetation. The open



Possible recovery trajectories following a wildfire. *Credit: Adapted from USGS Western Ecological Research Center (2022). Public Domain.*



A mountain-side in Pecos Wilderness recovering from the HPCC burn. Notice the mosaic of unburned patches, burned patches with standing dead trees and deadfall, aspen and oak regeneration, and open areas distributed across the valley, ridge, and elevation gradient. *Photo by Jax Gaglianese-Woody*

conditions can also support species that depend on sunny, non-forested habitats. Dense grass root systems can make it difficult for tree and shrub seedlings to become established, allowing the meadow or grassland to persist. While very different from a forested ecosystem, these open areas can serve as important habitat corridors and breaks between forested areas, increasing habitat diversity across the landscape.

- **Forest returns with different species:** In some areas, a forest returns, but with a shift in dominant species. For example, sun-loving species like aspen can become dominant after a fire. Aspens are clonal species with dense underground root networks that enable rapid resprouting and allow them to establish quickly. Although aspen forests are often seen as temporary states in succession, they can persist for decades or centuries. While different than the historical conifer-dominated ecosystem, aspen forests provide forage and cover for wildlife and create conditions that support a diverse understory of grasses, wildlife, and shrubs.

Recovery Across the Landscape:

Forests across the landscape recover at different speeds and on different trajectories. One way to think about a forested landscape is as a mosaic of tree stands and open patches with grass-wildflower-shrub communities. The tiles of the mosaic are not equally sized or perfectly bounded; instead, there are stands of living and dead trees, with individual trees in some open spaces and signs of decay and regeneration throughout. This mosaic evolved in response to differences in site conditions, disturbance levels, and tree population trends. Those same differences influence how a landscape recovers after disturbance—how a new mosaic is formed. North-facing slopes retain moisture longer, while south-facing slopes tend to be drier and sunnier, so these slopes recover differently. Drainages, ridges, and valleys will each recover in unique ways because their topography influences water availability, erosion, debris accumulation, and plant growth. Nearby unburned patches can also influence recovery, as these areas can act as refugia for wildlife and seed-producing trees.

Influencing the Recovery Trajectory

Depending on your goals, you may want to actively support how your land recovers. A good place to start is to observe what is happening in nature and ask questions that can help you understand how the forest is currently recovering. Then you can make informed decisions that support your goals *(For help determining your goals, see the Making Decisions guide)*.

Observing Change and Recovery: Trees are rarely the first plants to return after a fire. They are also not always the plants that will dominate the landscape in the future. You may need to become familiar with a whole new set of species. Here are a few questions you can ask when noticing a new plant:

- Has this plant grown on this property before?
- Is this plant spreading quickly?

- Is it forming dense patches?
- Is it native to the area?
- Is it preventing tree seedlings or other plants from establishing?
- Is it concentrated along roads, driveways, or disturbed soil?

Recognizing Invasive/Undesirable Plant Species: An unfamiliar plant does not always require immediate action, but there are some species to watch out for. Areas disturbed by wildfire can be especially vulnerable to invasive or otherwise undesirable plant species. These species can rapidly establish and spread on a site, outcompeting native plants for resources and reducing native plant diversity and wildlife habitat *(see more in the Post-Fire Plant Communities guide)*. Learning to recognize a few common invasive species can help you notice and respond to them early.

In many cases, early intervention is easier and less expensive than managing a large infestation years later. So, when might you consider managing an invasive/undesirable plant?

- It is spreading rapidly
- It is reducing plant diversity
- It is increasing wildfire risk
- It interferes with your goals for the property
- It is listed as invasive or noxious in New Mexico *(To learn more about individual species, refer to Noxious and Troublesome Weeds of New Mexico at https://pubs.nmsu.edu/_circulars/CR698/)*

The strategies you use to manage invasive/undesirable plants depend on the extent of the infestation and biology of the plant. Potential management options include:

- Hand pulling or digging
- Targeted mowing or cutting
- Herbicide treatment
- Reseeding with native species
- Monitoring

Managing infestations often requires a combination of strategies and repeated treatments over several years.

Identifying Invasive Thistles

New Mexico has 12 native and 4 introduced thistle species. Here are a few examples of invasive thistle species that commonly show up after a wildfire. But be aware that there are many native thistles too, which are critical for pollinators. Learn to tell the different here: https://www.npsnm.org/books-and-booklets/thistle-identification-booklet/





Top: Musk thistle *(Carduus nutans) Photo by Jax Gaglianese-Woody.* Below: Scotch thistle *(Onopordum acanthium) Photo by Steve Dewey, Utah State University, Bugwood.org.* Left: Bull thistle *(Cirsium vulgare) photo by Forest and Kim Starr, Starr Environmental, Bugwood.org.*



When might you consider planting trees?

Forests rely on regeneration, or the establishment of seedlings and saplings, to regrow after disturbance. Three factors strongly influence natural tree regeneration in Southwestern forests: fire severity, distance to seed sources, and time since the fire. These factors can help you determine whether planting trees could supplement natural regeneration. Here are a few questions to help you determine if planting is appropriate and aligns with your goals:

Are seedlings already present? If seedlings are already present on your site, then natural regeneration has already started to occur. The presence of seedlings indicates that your site's conditions already favor at least some natural regeneration. It may help to flag any seedlings and saplings and place exclosures around them to protect them from grazers. Even when natural regeneration is occurring, planting seedlings may still be necessary to help establish an adequate number and distribution of trees to meet your goals.

How far is the nearest seed source? Tree regeneration in Southwestern pine forests relies heavily on nearby seed sources, particularly surviving trees and forest patches. Ponderosa pine seeds typically disperse within 120 feet of the parent tree (or roughly 1-1.5 times its height). As distance from surviving



Recognizing regeneration

Young tree seedlings can be easy to overlook, especially when they are surrounded by grasses and other vegetation. They can also look very different from their mature counterparts, and some species, especially conifers, can be difficult to identify to species when they are young. Look for small plants with delicate stems and young leaves or needles. As they grow, their leaves, needles, and branching patterns become more distinctive. The photos below show examples of seedlings that you may find on your site following a wildfire.

Clockwise from top right: Aspen *(Populus tremuloides)*, White fir *(Abies concolor)* Ponderosa pine *(Pinus ponderosa)*, and Douglas-fir *(Pseudotsuga menziesii)*.
Top right photo by Jax Gaglianese-Woody, all others by Emily Yannayon.







seed sources increases, the likelihood of natural tree regeneration decreases. Douglas-fir shows a similar pattern, although its lighter seeds can disperse farther under favorable conditions and may have greater regeneration success than ponderosa pine.

Has enough time passed to evaluate natural regeneration? Natural regeneration of ponderosa pine and other conifers in Southwestern pine forests can take more than a decade following high-severity fire. The density of regeneration tends to be lower in severely burned areas that are farther from living trees, and regeneration takes longer as distance from seed sources increases. Before deciding if natural regeneration is occurring or not, consider how long it has been since the fire, along with your site's proximity to surviving seed sources.

What are your goals? Your goals will help you determine whether planting trees is appropriate. Goals could include providing wildfire habitat, reducing future wildfire risk, regaining forest cover, protecting soil and water resources, restoring scenic or cultural value, producing forest wood products, and/or creating a resilient forest for future generations *(For help determining goals, see the Making Decisions guide)*. Each of these goals can help you develop a planting strategy that considers where to plant, at what density, and even what frequency. If the goal is to reduce future wildfire risk, consider carefully how many seedlings to plant, where to plant them, and how close together. If your primary goal is to create wildlife habitat, planting may or may not be necessary if natural recovery and regeneration are already providing habitat.

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Considerations. Several factors can influence seedling success. Waiting a few years after fire can help you evaluate natural regeneration and understand how vegetation is recovering across the site. It also allows the forest floor to resettle and soil to stabilize while early-stage vegetation begins to establish. The timing of planting should be determined by local temperature and precipitation patterns, as seedlings are particularly sensitive during their first few weeks after transplantation. Preparing the planting site and selecting species suited to local conditions can further improve survival. If seedlings are likely to be browsed, you might consider using small exclosures or other forms of protection. Where you source seedlings also matters.

Near right: A forest showing signs of recovery after a fire. *Photo by Jax Gaglianese-Woody.* Far right: Ponderosa pine seedling. *Photo by Carolina May.*





Seedlings grown from seed adapted to wetter or cooler regions may be less suited to the dry, warm conditions of New Mexico. Whenever possible, select seedlings from a seed zone or source that is climatically similar to your planting site.

When might you consider seeding?

Seeding native grasses and wildflowers after a burn can help stabilize soil, outcompete undesirable plant species, and create habitat for wildlife. Before investing in seeding efforts, consider which native species your site can support and what your reseeding goals are. Like planting seedlings, spread seed during the appropriate time of the year when monsoons and cooler temperatures can increase success rates. For more guidance on reseeding, see the guides Reseeding and Revegetation Degraded Sites and Ethical and Sustainable Seed Harvesting.

Watching the Changes

The forest will continue evolving long after the fire, responding to changing seasons and weather patterns that bring water, sunlight, and nutrients in cycles of abundance and scarcity. These changes will drive successional transitions and create opportunities for wildlife, which in turn influence the forest's recovery over time. Witnessing these changes after wildfire can be both healing and painful. Grieving the loss and change of your forest while also appreciating the forest's regrowth and recovery are both valid emotions that depend on your individual experience

Resources

Plant ID tools and Native Plant Resources

- Wildflowers of New Mexico - https://www.npsnm.org/wildflowersnm/Home.html
- NM Native Plant Society - https://www.npsnm.org/
- INaturalist - https://www.inaturalist.org/
- Seedlings of PNW Plants: A photographic Guide: https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1005&context=seeds
- Visit the NMFWRI website for regularly updated plant ID tools and guides - https://nmfwri.org/resources/new-mexico-plant-guides/

Identifying NM invasive and weedy plant species

- Noxious and Troublesome Weeds of New Mexico - https://pubs.nmsu.edu/_circulars/CR698/
- New Mexico Thistle Guide - https://nmfwri.org/wp-content/uploads/2020/07/NM_Thistles_screen_or_8.5x11_292016.pdf

Contacts

- NM State Forestry (NMSF) - https://www.emnrd.nm.gov/sfd/contact-us/find-a-district-office/
- Soil and Water Conservation Districts (SWCD) - https://www.nmacd.org/directories
- NM Department of Wildlife (NMDOW) - https://wildlife.dgf.nm.gov/
- NM Natural Resources Conservation Service (NRCS) - https://www.nrcs.usda.gov/state-offices/new-mexico
- NM Department of Agriculture (NMDA) - https://nmdeptag.nmsu.edu/#gsc.tab=0

Seed and Tree Planting Programs

- Conservation Seedling Program - https://www.emnrd.nm.gov/sfd/seedlings/
- Landscape Stewardship Program - https://www.emnrd.nm.gov/sfd/stewardship/
- Carbon Stewardship Program - https://www.emnrd.nm.gov/sfd/forest-and-watershed-health-office/
- Forest Health Initiative - https://www.emnrd.nm.gov/sfd/forest-health/

Other Guides

- After Wildfire: A Guide for NM Communities - https://storymaps.arcgis.com/stories/a41fe5fc3d064faabba12b71d167161b
- NMFWRI Landowner Guides - https://nmfwri.org/stewardship/wildfire-resiliency/ r QIA guides: https://nmfwri.org/stewardship/wildfire-resiliency/

Right: Fall colors emerge beneath burned trees as the mountainside recovers after the 2022 Hermit's Peak–Calf Canyon wildfire *Photo by Jax Gaglianese-Woody.*



and connection to the landscape. One way to stay connected to the recovery of your land is to simply pay attention. You can do this by documenting your forest in ways that are meaningful to you:

- Take photos from the same location each year
- Mark patches of seedlings
- Take walks and notice the changes in grasses and shrubs
- Record wildlife sightings

Taking time to observe the landscape over the years can reveal the many small changes that contribute to its recovery.

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Contributors: Content Development: Jax Gaglianese-Woody, Kathryn Mahan, Shantini Ramakrishnan Editors: Crystal Medina, Edward Martinez, Vincent Vispo, Taryn Schlosser Design: Sarah Friedland Cover Photo: Jax Gaglianese-Woody

New Mexico Forest and Watershed Restoration Institute
New Mexico Highlands University

Wildfire Resiliency Training Center
Luna Community College

FIRE NM
Fire Informed Restoration Education for New Mexico