Thinning and Logging on Banco Bonito and in the Jemez Mountains

Recent postings and commentary in the local Facebook group "Jemez Chat" about logging on National Forests and the ongoing project at Banco Bonito reminded me of the history of timber harvesting on this "pretty bench" of the Jemez Mountains. This history recounts how large-scale railroad logging along the Rio Guadalupe and its tributaries on the San Diego Grant (which was privately owned at that time) shifted to truck logging on the Baca Location and other private and federal lands.

By the late 1920s, most of the easily accessible timber in the Guadalupe watersheds had been harvested. In the 1930s, gasoline-powered logging trucks became available, prompting the New Mexico Timber & Lumber Company (later shortened to New Mexico Timber, Inc., or NMT) to extend roads from the Rio Guadalupe to the Baca Location/ Ranch, where vast uncut stands of virgin timber awaited. NMT acquired the timber rights on the Baca Ranch in the 1930s (access for cutting in 1935 and purchase of the rights in 1939).[1]

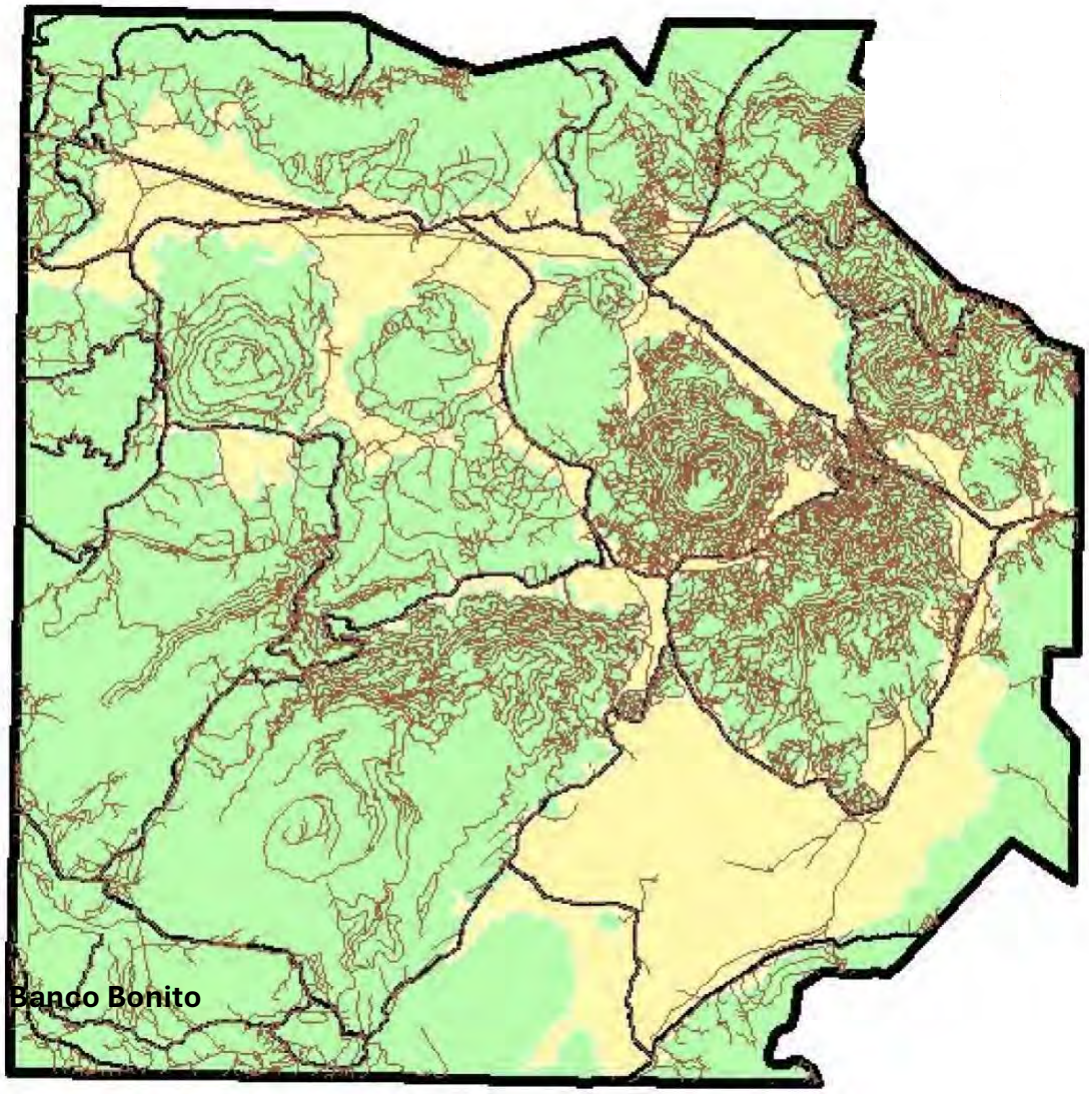
For several years during the 1930s, logs were transported from the Baca to the railway on the Guadalupe and then by train to the mill in Bernalillo. However, a locomotive boiler explosion, a labor strike at the mill, the burning of the large trestle at Guadalupe Box, and floods that washed away rails and bridges – all contributed to the end of railway operations in 1941.[2]

In the early 1930s, the Civilian Conservation Corps (CCC) established multiple camps in the Jemez, and they improved and created what they called the "Trans-Jemez" roadway. This included the network of State Roads (SR) 4 and 126 and Forest Roads (FR) 376 and 10. These improved roads enabled more extensive logging on the Baca Ranch, the east side of the San Diego Grant on Cat and San Juan Mesas, and some Forest Service lands. After the railway closed most of the logs were hauled down FR 376 to a new mill built at Gilman, just below the Guadalupe Box. Some logs went down FR 10 to a mill in Ponderosa or to Bernalillo. After SR 4 was improved and paved in the 1960s, it became a major haul route for logging trucks through Jemez Springs.[3]

The late 20s and 30s were boom times for the community of Vallecitos de los Indios (called Sierra de los Pinos today, or SLP). In addition to the Caldwell and Abousleman sawmills, a small church, schoolhouse, and multiple family cabins were built around the "vallecito" during that era. The population living in the Jemez Mountains north of Jemez Pueblo more than tripled after 1920 due to the influx of railroad men, loggers, and their families.[4] The population also increased from about 1934 to 1940 with the presence of more than 100 CCC men working and living in camps around the Jemez.

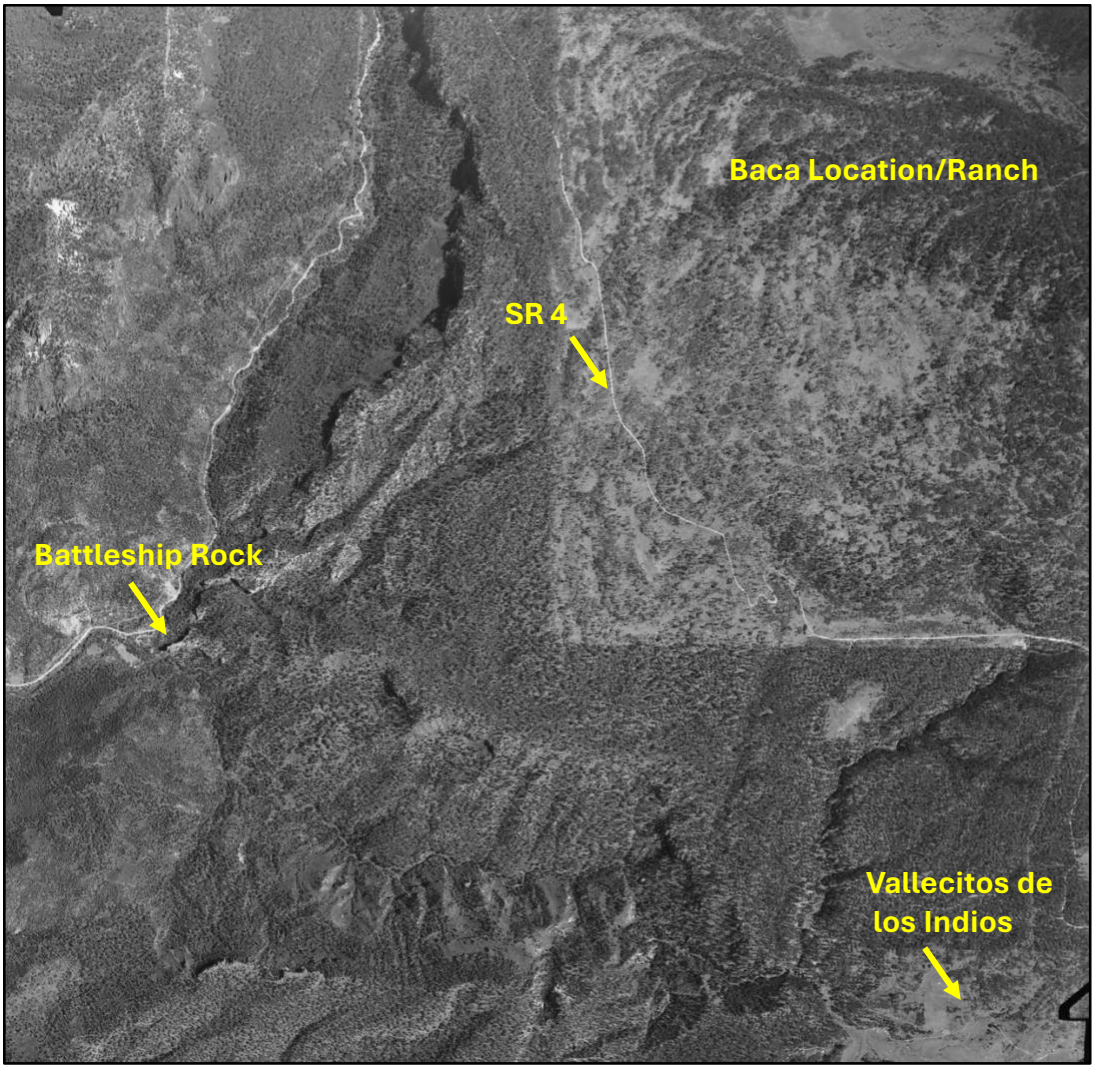
The logging on the Baca was intense during the 1930s-60s, especially in the easily accessible ponderosa pine stands on Banco Bonito. This landscape is an old lava flow (about 60,000 to 70,000 years old) that emerged from a vent just northwest of the El Cajete crater. It is a relatively level but rolling landscape with low ridges, swales, and shallow explosion craters. It was fairly easy to access and haul logs from SR 4 and various roads extending from it.

The history of this logging and subsequent forest fuels management for fire hazard reduction through the 2000s are evident in maps and repeat views using aerial photos, satellite images, and Lidar (light and ranging) maps. The extensive clearcut logging and incredible networks of roads bulldozed on the domes after 1960 within the Baca Location are also evident in photos and maps.



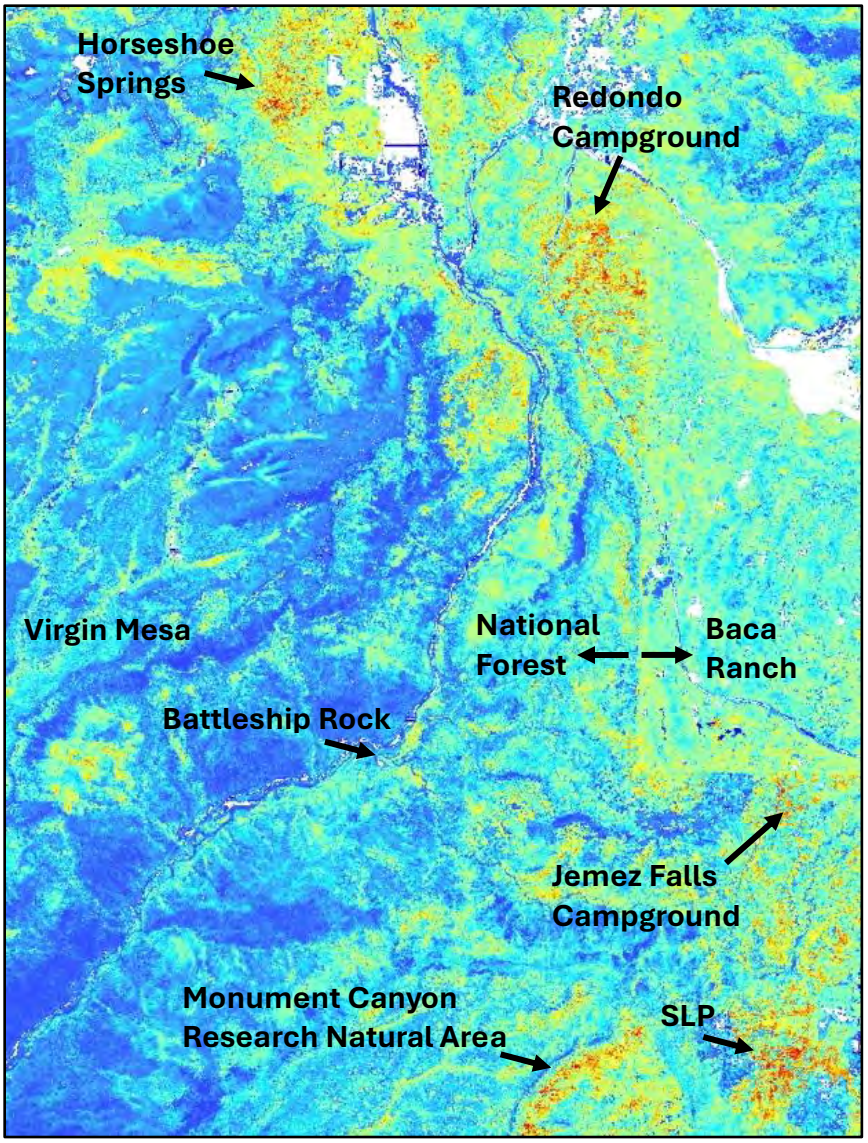
This map (previous page) of roads within the Baca Location was created by Craig Allen for his 1989 PhD thesis, using extensive analysis of aerial photography. Most of the logging roads on the volcanic domes in the central and northeastern part of the Baca were built during the NMT clearcut logging from the 1960s to 1971. (I will describe some of this history later.)[5]

The NMT logging on Banco Bonito after 1935 is obvious in a 1954 aerial photograph. The contrast is striking between the surrounding Forest Service lands to the west and south and the Baca Location (Baca Ranch). It appears from this photo, and from age structures of forests today in this part of the old Baca (now Valles Caldera National Preserve) that the pre-1954 timber operations were not clear-cut logging, per se. However, almost all of the largest diameter (greater than 12 inches), tallest, straightest stem, and oldest trees were cut on the Baca side of the fence. This is sometimes termed "high-grade logging," and in its worst form, the loggers followed the maxim "cut the best and leave the rest."



The May 1954 aerial photo of the southwest corner of the Baca (previous page) shows extensive logging on Banco Bonito, but most trees less than 12 inches in diameter were left, and these effectively reseeded the cut-over areas. During subsequent decades the forest filled in with "dog hair thickets" of small diameter trees.

On the National Forest side of the fence, west and south of the Baca, relatively small timber contracts were executed during the post-1950s era. These primarily involved selective harvests following Southwestern ponderosa pine silvicultural protocols developed by Forest Service scientists Gus Pearson and Gilbert Schubert. In these harvests, the remaining forest retains a range of tree age classes, including some large mature trees that provide a seed source. The mature "leave" trees were chosen for their "good form," based on stem and crown characteristics, as a silvicultural strategy to regenerate improved timber quality.[6]



At left is a colorized version of the canopy-layer of the lidar map from the Jemez. It was obtained by the Forest Service and National Park Service in 2012. The airborne laser-based scan results in a 3-dimensional map of both the ground surface and all of the vegetation above it (the canopy-layer). The colors here represent tree heights; the red pixels are trees greater than 36 meters (>118 feet), and the orange pixels are trees 26 to 35 meters (85 to 114 feet) tall.

A few relatively small harvests on the Forest Service side are visible in aerial photos and the lidar map (light and dark blue

areas west and south of the boundary). The blue areas on Virgin Mesa are a combination of areas that were high-grade logged on the San Diego Grant before 1965, and areas burned by wildfires since 1971. The dark blue areas south of Battleship Rock in San Diego Canyon are mostly cliff faces and short-stature piñon-juniper woodlands.

Some areas on Banco Bonito were purposely left uncut, with virgin stands of large ponderosa left along the SR 4 and around campgrounds for the benefit of scenic vistas. The largest patch of remaining uncut old-growth forest on Banco Bonito became the location of Redondo Campground in about 1969. To this day, this is one of the largest developed Forest Service campgrounds in the Southwest Region.

In addition to the old-growth timber remaining around Redondo Campground, note the tall stands of trees around the Horseshoe Springs community near La Cueva, the west end of Vallecitos de los Indios (SLP), and in the Monument Canyon Research Natural Area at the northern end of Cat Mesa. The tallest trees visible in this view, which rank among the tallest in the Jemez Mountains, grow along a drainage bottom in the Monument Canyon RNA, reaching a maximum height of 162 feet.[7] From our tree-ring studies we know that many of largest diameter, tallest trees in the Jemez are over 400 years old. The oldest living tree sampled in Monument Canyon germinated before 1498 CE (527 years ago).[8]

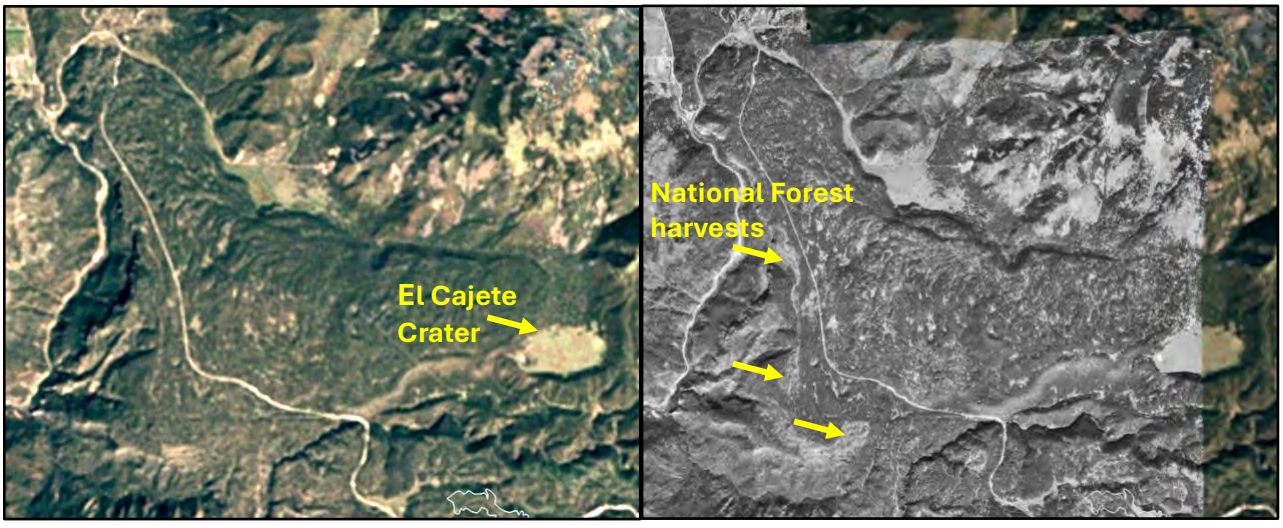
Also note that none of the tallest trees (red or orange pixels) remain on the Baca side of the fence. The yellow pixels there are trees 21 to 25 meters in height (69 to 85 feet). Before the logging era of the 1920s—1960s, there were undoubtedly many very big and tall ponderosas extending across Banco Bonito and the mesas of the San Diego Grant.

The “reject” large diameter trees from the 1920s-60s high-grade logging, such as the tree at left on Virgin Mesa, San Diego Grant, were typically bent, leaning, forked, or fire scarred (this one is all of the above).

After more than 140 years of big-tree logging, the only remaining uncut (virgin) timber stands in the Jemez with many large diameter and very tall trees are located near special places preserved by the Forest Service or others. For example, around big campgrounds and old summer home developments, in Monument Canyon RNA, and on inaccessible benches below cliffs. If you want to see what old-growth ponderosa pine forests used to look like across vast swaths of the Jemez before logging you can visit a remnant example in the History Grove near the Valles Caldera ranch headquarters area.

The photo on the left above is from the 1904 report on the "Jemez Forest Reserve," showcasing an old-growth ponderosa pine stand, possibly located on Banco Bonito. Some of these trees appear to be 3 to 4 feet in diameter. The photo on the right depicts the old-growth stand in the History Grove. This beautiful stand, situated near the Baca Ranch headquarters, was preserved by the ranch owners, first the Bond family and then the Dunigan family. Almost all the other old-growth ponderosa stands around the perimeter of the Valles were heavily logged between the 1930s and the 1960s.

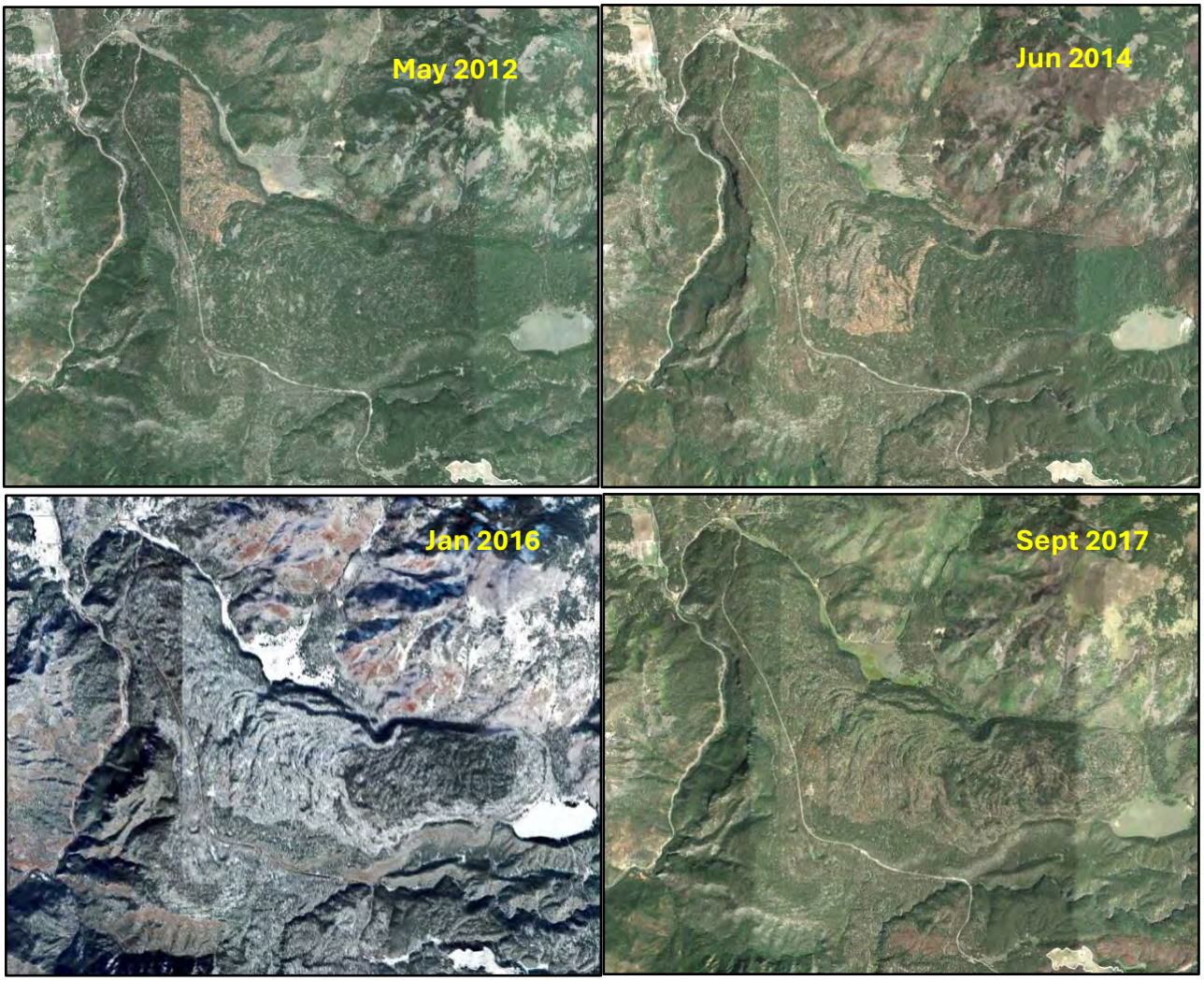
Most of the forest stands on the San Diego Grant and Baca Location that were heavily harvested in the 1920s to 1950s were regenerated prolifically with young trees. It was generally wetter from the late 1950s through the early 1980s in the Jemez than today, and during that era millions of trees were established in the understories of leave trees. By the 1980s, the striking difference in appearance between the Baca and National Forest lands was reduced. This is evident in set of satellite images from Google Earth, below:



In these photos from 1995 (above, at left) and 1996 (above, at right) the Baca/Forest Service boundary is almost completely obscured because small trees have infilled the

understories on both sides. Relatively small timber sales on the National Forest side are apparent in 1996, outside the southwest boundaries of the Baca (also visible in the lidar map, page 4).

The Jemez Ranger District, Forest Service and the Valles Caldera National Preserve, National Park Service began thinning large areas on these public lands after 2009 using federal grant funding for the Southwest Jemez Mountains Collaborative Landscape Restoration Program (SWJM CFLRP). Local contractors carried out the work and processed the wood products obtained. Extensive thinning and logging of trees with diameters less than 16 inches (at breast height) were carried out on the Baca/Valles Caldera side of the boundary, as progressively evident in these photos (below) from 2012, 2014, 2016, and 2017. The Forest Service also contracted extensive thinning/logging on the mesas south of Vallecitos de los Indios (SLP, Sierra de los Pinos), and elsewhere around the Jemez Ranger District with funding from the SWJM CFLRP.[9]



The thinning and fuels treatments carried out south of SLP on San Juan Mesa probably saved more than one hundred homes during the 2022 Cerro Pelado Fire. The fire ignited south of the thinned areas and burned intensely and fast toward SLP. The running crown fire encountered the thinned areas, decreased in intensity, and mostly dropped to the ground. Then the wind shifted slightly towards the east pushing the fire around the neighborhood. People were safely evacuated and only a few structures were lost.[10]

Recent Harvest on Forest Service Lands on Banco Bonito

The Forest Service recently contracted a project to thin and log areas immediately west of the Baca/Valles Caldera Boundary. The Forest Service marked all the trees to be left as residual trees, so the Forest Service specified the degree of thinning/harvesting. That project is now underway as I write this.

Along with three colleagues and friends, I visited the area on March 5, 2025, to see what we thought about the thinning and tree harvesting for wood products. Among the four of us, three have PhDs in ecological sciences, and two have advanced degrees that included coursework in forestry. My graduate degrees are in "Watershed Management," and I took coursework that would qualify me as a certified forester by the Society of American Foresters. Also, among the four of us, three have experience in land and forest management, including one of us who led the planning and implementation of extensive forest thinning projects in the Jemez.

The following is my opinion – and not necessarily the opinions of my colleagues – about the recent thinning/logging on Banco Bonito.

Panoramic photo of the thinned-logged area south of Redondo Campground (above), showing FR 4A, log deck, and opened stand.

Overall, I would grade this project with a provisional letter of B (for good), considering the goals of reducing crown fire risk in this area, and restoring healthy forest conditions for resilience to continuing warming and drying climate. The reason I don't

consider this to be an excellent project (grade A) is that, in my opinion, some of the openings left between trees are too large, and too many large diameter and relatively tall trees were harvested. Also, the slash generated by the cutting has not yet been dealt with completely, so it remains to be seen how well that is done (hence, the "provisional" letter grade).

You can get a sense of the scale of the large openings that were created in places by viewing the photos (previous page and above) and from this brief video clip of a drone flyover of the far northern end of the project, linked here.

I agree overall with the strategy of reducing tree density (i.e., reducing number of trees per acre, tree basal area, and interlocking canopies, etc.), and the project has certainly achieved that. However, there is a risk of creating too large openings in this area during the current and future climate. The soils are shallow on Banco Bonito, and so trees are shallow-rooted. Windthrow and stem breakage losses are increased as the forest stand is opened as much as it has been in places. Also, the dry/hot conditions of recent decades (and likely future years) results in low survival of seedlings in large openings.[11] Residual leave trees may also be subject to drier conditions and stress in large openings because the snow cover melts out (or sublimates) faster in these openings rather than in stands with more canopy cover.

In comparison, I would give the work done on the National Park Service side of the fence an A grade. There, the general strategy was to retain about 30% canopy cover, and only trees smaller in diameter (at breast height) than 16 inches were cut. Slash fuels have been well treated, including with prescribed fire.

Apparently no diameter cap was used in the recent cut on the National Forest side, as some 16 to 20+ inch diameter logs were present in the log decks, and likewise, some of these large stumps were visible. It will be interesting to compare the Google Earth images of this recent thin/harvest compared to the Baca/Valles Caldera work in coming months when the images are available.

The ratio of large-diameter trees (16+ inches DBH, e.g., photo at left) that were felled to smaller-diameter saw-log trees (10 to 16 inch), as evident in log decks and stumps, was about 1 in 50+ trees. That is, relatively few large (and probably tall) trees were cut. However, given the small overall proportion of such large trees that are remaining on Banco Bonito (see the lidar map on page 4), I think almost all these trees should be retained. If these large trees were clearly dying, then harvesting them was justified. This appears to have been the case for a few of the large trees in the log decks, and evident on some large stumps, which had the presence of “blue stain” in the sapwood. This indicates that these trees were already probably already dead or dying from bark beetle attack.

This is an uncut area just south of the current thinning-logging (above), and it appears to be in the planned cutting area. Leave trees are marked with orange paint.

The photo above shows a “dog-hair” thicket of small-diameter trees on the left that has not been thinned yet. This was the general condition of Banco Bonito before the recent thinning-logging on both sides of the Baca-Valles Caldera/National Forest boundary. A thinned area in the recent project and SR 4 is visible on the right.

In summary, I would have recommended a somewhat lighter thinning/harvesting in the current project, maintaining more canopy cover, and retaining all of the healthy, largest-diameter trees greater than 16 inches DBH. However, I recognize this is a Monday-morning-quarterback opinion, and it may be that some of the larger openings were already partly open, and some of the largest trees that were cut were clearly dying or recently dead. Assuming the remaining slash fuels will be removed safely, this type of thinning/logging greatly reduces the risk of losing the entire stand in a future high-severity crown fire.

Clear-Cut, “Jammer Logging” on the old Baca Ranch

In reading the comments posted in the Jemez Chat Facebook group about the Banco Bonito operation I noticed some confusion and conflation of the terms “thinning” and “logging,” and selective harvesting versus “clearcut” logging. The Banco Bonito Forest treatments by the National Park Service and U.S. Forest Service since the 2000s have been both thinnings (reducing tree numbers and canopy cover) and timber harvests, i.e., logging. They were logging operations because saw logs were obtained and hauled away for producing lumber or other wood products. But these operations were also selective thinnings, with many healthy leave trees, and a few snags retained for wildlife.

Clearcut logging is a different beast, involving the cutting of all or almost all trees within different-sized patches of forests. In the past, this was sometimes done with the idea that these areas would naturally regenerate or would be planted back to forest, or there was little or no concern about what would happen in these places after the cutting.

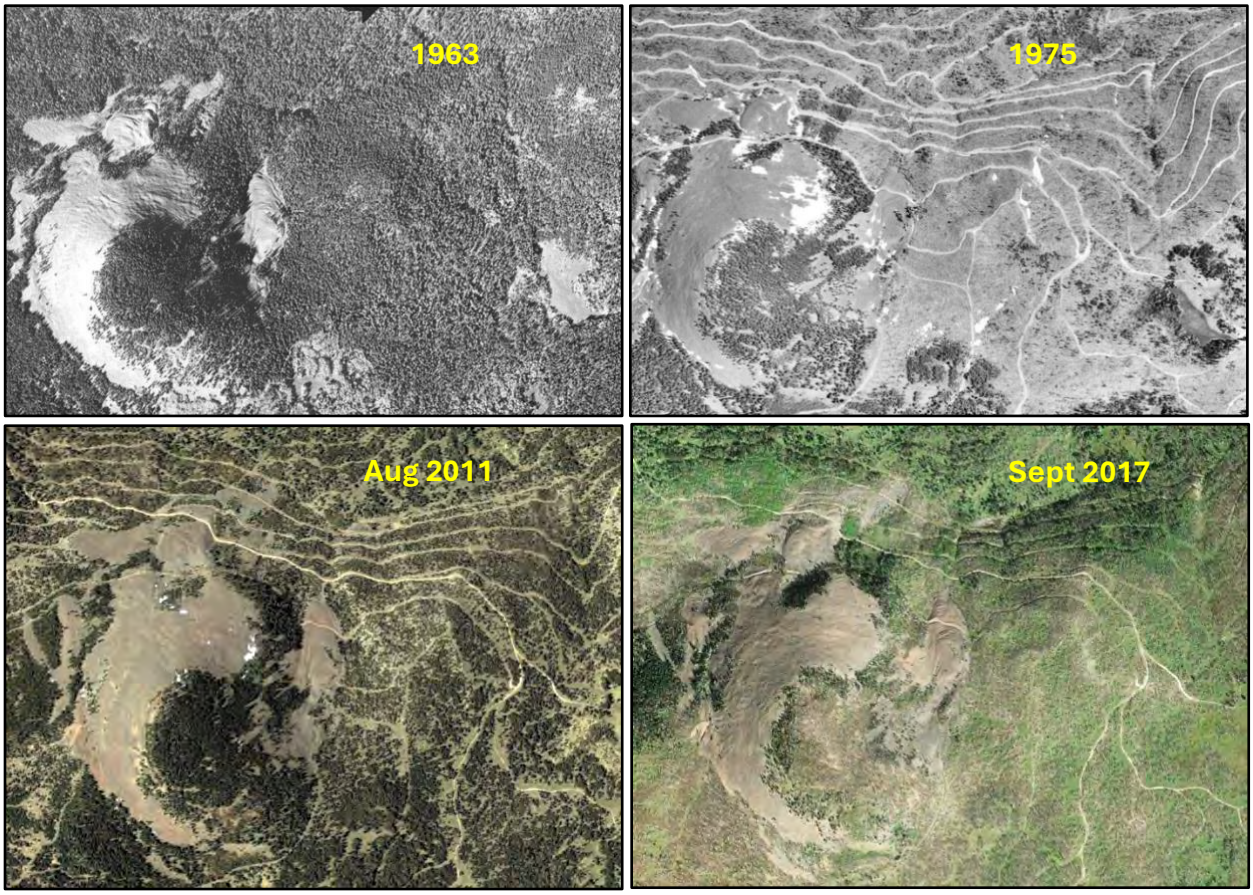
Historically, there are no examples of extensive clearcut logging on the southern plateau of the Jemez on National Forest lands, to my knowledge.[12] There are, unfortunately, examples of extensive clearcut logging on the Valles Caldera, from the 1960s to 1971 when NMT owned the timber rights on the old Baca Ranch. This history is recounted thoroughly by Craig Martin and by Kurt Anschuetz and Tom Merlan in their books on the Baca and Valles Caldera land-use history.[13] So, I will only summarize some key points.

After the easily accessible ponderosa pine was cut over on the Baca Ranch by the 1960s, including some clearcutting along the edges of the Valles, NMT went after the higher elevation pine, Douglas-fir, and white fir that grew on the slopes and tops of the volcanic domes within the Caldera. This type of logging is called "jammer logging," where many roads are built across steep slopes, almost all the trees are felled over large areas, and the logs are dragged by chains and cables up or down the slopes to "landings" on the roads. To say the least, this form of clearcut logging, including the very extensive road building (see the map on page 2), is quite destructive of the forest and soils.

James Patrick Dunigan, the Texas oilman who owned the Baca Ranch but not the timber rights (beginning in 1963), saw the bad effects of the jammer logging on soil erosion and water quality. He sued the NMT to stop the abusive logging and to acquire a "successor interest" in the timber rights. The court case went on for years, until 1971, when Dunigan purchased the timber rights and the clearcut logging ended. In the interim, a large part of the high-elevation forests of the Baca was clearcut.[14]

Remarkably, many of those cut-over areas recovered to aspen and conifer forests, but some did not. The generally wetter climate from the 1970s to early 1980s may have enabled this regeneration. Although there was considerable forest recovery after the 1960s to 1971 clearcutting, there was no follow-up thinning of these forests, and in most places, they grew back as very dense stands of aspen and mixed conifer trees (i.e., mixtures of ponderosa pine, Douglas-fir, and white fir). Considerable amounts of slash also remained in these stands from the clearcut logging.

Tree-ring fire scar studies within the Valles Caldera and surrounding high-elevation mixed conifer forests in the Jemez clearly show that before the heavy sheep grazing era (circa the 1870s to 1920s), low-intensity surface fires burned these high-elevation slopes every 15 to 40 years, maintaining relatively open stands. More frequent fires burned in the lower elevation, pure ponderosa pine stands (about 5 to 10-year intervals), maintaining very open stands (see the 1904 photo on page 5). The lack of fire after the sheep grazing began, and the continued lack of fire after the jammer logging, allowed these stands to become overly fuel-dense with trees and old slash; they were then primed for a high-severity crown fire. [15]



The photo sequence above shows Redondito Peak (just north of Redondo Peak) and surrounding areas before (1963) and after the jammer logging (1975), and partially recovered forest in 2011, and in 2017 following the 2013 Thompson Ridge Fire. The bare areas on the west and north slope of Redondito are broken, angular, volcanic rock surfaces (also known as "felsenmeers") The dark green areas in the 2011 photo are conifer and aspen trees that came back after the logging, while the light green areas in the post-fire 2017 photo are shrubs and grasses.[16]

Both the 2011 Las Conchas Fire and the 2013 Thompson Ridge Fire burned very severely across the former clearcut areas on the Valles Caldera National Preserve. Almost all trees were killed in very large patches. Gambel oak, New Mexican locust and various grass species have recovered on these burned patches (see 2017 photo), but very few trees have regenerated there. Recent studies of large high-severity burn patches in the Jemez and elsewhere in the Southwest show that these areas have undergone a "type conversion" from forest to shrublands/grasslands, and they are unlikely to recover to forest under current and near-future climate conditions.[17]

The 2011 and 2013 wildfires also burned very severely in many of the selectively cut ponderosa pine-dominant forests, as well as in uncut areas, such as on the Pajarito Plateau on National Forest and National Park lands around and within Bandelier National Monument. The common factors causing uncharacteristic high severity wildfire[18], in both the regrown clearcut areas within the Baca, and ponderosa pine forests that were selectively cut or uncut, was (1) the accumulated living and dead fuels in the understory since fire suppression and the heavy logging era, and (2) extreme, hot droughts since the late 1990s drying the living and dead forest fuels.

To summarize the main points of this report:

- There has been extensive logging on the southern Jemez Plateau over the past century, and very few virgin, old-growth stands or large, tall trees remain. These small patches of old-growth forest are around campgrounds, older housing communities, a research natural area, and on isolated benches below the mesas.
- Logging on the National Forest after about 1905 was selective and generally based on forestry-silvicultural guidelines intended to improve the stand (i.e., grow better-quality timber trees) and for other purposes, such as wildlife and watershed protection.
- Logging during the 1920s to 60s on the San Diego Grant and Baca Ranch was also selective, but this was a selection of the largest, tallest, and straightest trees. This was typically high-grade-type logging.
- Both the selectively cut areas (high-grade and silvicultural-based) and the clearcut areas in the Jemez regenerated extensively after the harvests of the 1920s-1971 with very dense stands of small-diameter trees in the understory. A few “pre-commercial” thinning treatments (not producing saw logs) were carried out on the National Forest as early as the 1960s, but it wasn’t until the 2000s, with a major federal investment (SWJM CFLRP), that extensive areas were thinned (e.g., the Valles Caldera side on Banco Bonito, and on San Juan and Cat Mesa on National Forest), combined with logging of some of the remaining large trees.

Finally, in my opinion, given all of this history, future thinning and logging in this part of the Jemez should focus on forest stands with dense thickets of small-diameter trees, and saw log harvesting should generally be limited to trees less than 16 inches dbh unless they are dying or recently dead. Canopy cover of around 30% may be appropriate in ponderosa pine stands. These treatments will probably cost more money than they generate, but after more than a century of wealth extraction from our forests, this investment is long overdue. Remaining old-growth patches with large and tall trees should especially be preserved. Careful and safe treatment of slash fuels, including both pile burning and broadcast burning, will be essential. It has been shown repeatedly that the

thinning of high fuel density ponderosa pine and mixed conifer stands, followed by the use of fire as a tool to treat slash fuels and maintain open stands, is the most practical and effective combination of treatments to reduce risks of future high-severity wildfires.[19]

Endnotes:

[1] Histories of the Baca Location and Valles Caldera describe the sheep herding, logging, and lawsuit by James Dunigan against New Mexico Timber to halt the clearcut logging on the Baca Ranch: Martin, Craig. 2003. Valle Grande: A history of the Baca Location No. 1. Los Alamos, NM: All Seasons Publishing.; Anschuetz, Kurt F., and Thomas Merlan. 2007. More Than a Scenic Mountain Landscape: Valles Caldera National Preserve Land Use History, USDA Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-GTR-196. 277 pgs

[2] The history of the Santa Fe Northwestern railroad logging in the Rio Guadalupe watershed is described in detail by Glover, Vernon J. 1990. Jemez Mountains Railroads: Santa Fe National Forest, New Mexico. No. 9. USDA Forest Service, Southwestern Region. 77 pgs.; I summarize this history with additional information about the struggle of Jemez Pueblo to retain their farmlands taken by the railroad in Chapter 12, Swetnam, Thomas W. 2025. The Jemez Mountains, A Cultural and Natural History, University of New Mexico Press.

[3] Scurlock, Dan. 1981. pgs. 131-160, Chapter 11, Euro-American History of the Study Area, In: Craig Baker and Joseph C. Winter, editors, High Altitude Adaptations Along Redondo Creek, Office of Contract Archeology, University of New Mexico.

[4] Scurlock, 1981; Census data for Precinct 10, Sandoval County, 1920 and 1930 census records.

[5] The road map for the Baca Location is from: Allen, C.D. 1989. Changes in the landscape of the Jemez Mountains, New Mexico. PhD Dissertation. University of California at Berkeley, Berkeley, CA; A detailed history of timber harvesting on the Baca Location is by Balmat, Jeff and John Kupfer. 2004. Assessment of Timber Resources and Logging History of the Valles Caldera National Preserve. Unpublished Report, Department of Geography and Regional Development University of Arizona, Tucson; and Balmat, Jeff. 2004. Assessment of Timber Resources and Logging History of the Valles Caldera National Preserve, Master of Arts Thesis, Department of Geography and Regional Development University of Arizona, Tucson.

[6] Pearson, Gustaf A. 1950. Management of ponderosa pine in the Southwest, as developed by research and experimental practice. No. 6. US Department of Agriculture, Forest Service; Schubert, Gilbert H. 1974. Silviculture of southwestern ponderosa pine: the status of our knowledge. Vol. 123. Rocky Mountain Forest and Range Experiment Station, Forest Service, US Department of Agriculture.

[7] Swetnam, Tyson L., Ann M. Lynch, Donald A. Falk, Steve R. Yool, and D. Philip Guertin. 2015. Discriminating Disturbance from Natural Variation with LiDAR in Semi-arid Forests in the Southwestern USA. Ecosphere 6(6):97.

[8] Falk, Donald A. 2004. Scaling rules for fire regimes. PhD Dissertation, University of Arizona. This detailed study tree-ring sampled more than 200 trees in Monument Canyon Research Natural Area for fire history and age structure analysis.

[9] Parmenter, Robert R. (Compiler). 2024. Final Monitoring Report, 2010-2020. Southwest Jemez Mountains Collaborative Forest Landscape Restoration Project (SWJM CFLRP). Valles Caldera National Preserve, Jemez Springs, New Mexico, USA. (SWJM CFLRP).

[10] I recount some of the forest management and fire history changes in the Jemez leading to the 2022 Cerro Pelado Fire, including Google Earth images and the fire severity map showing the effects of thinning in reducing fire severity: in Chapters 29 to 32, Swetnam, Thomas W. 2025. The Jemez Mountains, A Cultural and Natural History, University of New Mexico Press.

[11] Christopher Marsh, Joseph L. Crockett, Daniel Krofcheck, Alisa Keyser, Craig D. Allen, Marcy Litvak, Matthew D. Hurteau. 2022. Planted seedling survival in a post-wildfire landscape: From experimental planting to predictive probabilistic surfaces. Forest Ecology and Management 525,120524, ISSN 0378-1127; Joseph L Crockett, Matthew D Hurteau. 2024. Ability of seedlings to survive heat and drought portends future demographic challenges for five southwestern US conifers, Tree Physiology 44: 1

[12] There was some patch clear-cutting of spruce-fir forests northwest of Chicoma Peak during the late 1970s to 1980s. There are also a couple of places that might qualify as relatively small patch clearcuts on the Southern Plateau: 1) An approximate 33-acre forest area was clearcut for the Copar open-pit pumice mine in the late 1980s. This 1872 Mining Act claim, located about 2 miles east of Sierra los Pinos and about 200 yards north of SR 4, was closed down in 1993 after the Jemez National Recreation Area was established. The “reclamation” wasn’t completed until about 2017, and presumably the surface soils were restored. It appears that perhaps 40 to 50% of the former open-pit has planted tree seedlings/saplings that are slowly reforesting part of the area. And 2) a “mistletoe sanitation” cut on the north end of Cat Mesa in about 2016 appears to include small clearcuts in places. This approximately 130-acre treatment, intended to control a mistletoe infection, might technically be considered a “seed-tree cut,” as almost all trees were removed except for very widely spaced and scattered mature trees. In subsequent years there was some stem breakage and windthrow of these leave trees, and extensive growth of weeds on the surface. Few trees have regenerated so far in this area. Other thinning/harvest treatments under the SWJM CFLRP in this area of Cat and San Juan Mesas from about 2009 to 2020 were generally less intensively cut, with more leave trees. The intensity of thinning and large tree harvesting in most of these areas is probably similar to the work recently done on Banco Bonito.

[13] Anschuetz and Merlan, 2007

[14] Anschuetz and Merlan, 2007; Between 1980 and 2000 Dunigan continued some logging operations on the Baca Ranch, but these were primarily selective harvests carried out under sustainable forestry guidelines established by the New Mexico State Forestry department (see Balmat and Kupfer 2004, and Balmat 2004, endnote 5).

[15] Morino, Kiyomi A., Christopher H. Baisan, and Thomas W. Swetnam. Spring 1998. Expanded Fire Regime Studies in the Jemez Mountains. Unpublished Report, to Craig Allen, National Biological Service/USGS; Swetnam, Thomas W., Joshua Farella, Christopher I. Roos, Matthew J. Liebmann, Donald A. Falk, and Craig D. Allen. 2016. Multiscale perspectives of fire, climate and humans in western North America and the Jemez Mountains, USA. Philosophical Transactions of the Royal Society B: Biological Sciences 371(1696):20150168; Dewar, Jacqueline J., Donald A. Falk, Thomas W. Swetnam, Christopher H. Baisan, Craig D. Allen, Robert R. Parmenter, Ellis Q. Margolis, and Erana J. Taylor. 2021. Valleys of Fire: Historical Fire Regimes of Forest-Grassland Ecotones Across the Montane Landscape of the Valles Caldera National Preserve, New Mexico, USA. Landscape Ecology 36:331–352.

[16] The 1963 and 1975 photos are from Balmat and Kupfer, 2004 (see endnote 5), and the 2011 and 2017 images are from Google Earth.

[17] Guiterman, Christopher H., Ellis Q. Margolis, and Thomas W. Swetnam. 2015. Dendroecological Methods for Reconstructing High-Severity Fire in Pine-Oak Forests. Tree-Ring Research 71(2):67-77; Guiterman, Christopher H., Ellis Q. Margolis, Craig D. Allen, Donald A. Falk and Thomas W. Swetnam. 2018. Long-term Persistence and Fire Resilience of Oak Shrubfields in Dry Conifer Forests of Northern New Mexico. Ecosystems 21:943-959; Coop, Jonathan D., Sean A. Parks, Camille S. Stevens-Rumann, Shelley D. Crausbay, Philip E. Higuera, Matthew D. Hurteau, Alan Tepley, et al. 2020. Wildfire-driven forest conversion in western North American landscapes. BioScience 70, no. 8:659-673; Guiterman, Christopher H., Rachel M. Gregg, Laura A.E. Marshall, Jill J. Beckmann, Phillip J. van Mantgem, Donald A. Falk, et. al. 2022. Vegetation Type Conversion in the US Southwest: Frontline Observations and Management Responses. Fire Ecology 18(1):1-16.

[18] By “uncharacteristic high severity wildfire” I mean fire that burns with impacts on vegetation and soils across larger patches than was characteristic or typical of fire behavior and effects over very long time periods in the past, including over evolutionary time scales with regard to the dominant species of trees. The term “uncharacteristic wildfire” is widely used in fire ecology and forest management literature and by land management agencies in recent decades (see for example Hardy, Colin C. 2005. Wildland fire hazard and risk: Problems, definitions, and context. Forest Ecology and Management 211, no. 1-2: 73-82).

[19] Hunter, M.E.; Shepperd, W.D.; Lentile, J.E.; Lundquist, J.E.; Andreu, M.G.; Butler, J.L.; Smith, F.W. 2007. A comprehensive guide to fuels treatment practices for ponderosa pine in the Black Hills, Colorado Front Range, and Southwest. Gen. Tech. Rep. RMRS-GTR-198. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 93 p.; Fulé, P.Z., J.E. Crouse, J.P. Roccaforte, and E.L. Kalies. 2012. Do thinning and/or burning treatments in western USA ponderosa or Jeffrey pine-dominated forests help restore natural fire behavior? Forest Ecology and Management 269: 68–81; Prichard, Susan J., Paul F. Hessburg, R. Keala Hagmann, Nicholas A. Povak, Solomon Z. Dobrowski, Matthew D. Hurteau, Van R. Kane et al. 2021. Adapting western North American forests to climate change and wildfires: 10 common questions. Ecological Applications 31(8): e02433.; And see this website for general information on thinning and prescribed fire as management strategies: https://fixtheforest.org/