A Giant Outdoor Hydrologic Lab

A visitor to the San Dimas Experimental Forest might be forgiven for wondering where the trees are. It's not that San Dimas doesn't have trees; the native chaparral that furs the canyonsides has a lot of scrub oak—technically a tree—amid chamise, ceanothus, and toyon. Moister riparian grottos support laurel, sycamore, and alder. And clinging to the edges of roads are a few specimens of incense-cedar and Coulter pine, exotics brought in by early foresters.

Unlike most other experimental forests, San Dimas was not established to support the commercial management of timber. Instead, it is a giant outdoor hydrologic laboratory where scientists study how water circulates through the arid, shrubby landscape, how extreme rainfall and runoff events shape the land from ridgetop to valley floor, and how wildfires affect the system's hydrology and hasten erosion.

When San Dimas was established in 1933, the pressing research question was how to squeeze more water out of the mountain ecosystem. Leaders in the rapidly developing Los Angeles basin below wanted more water for drinking and irrigating crops.

One important early study at San Dimas yielded a rough baseline of how much water was being consumed by the various plant communities. With the help of inmate laborers, researchers sank 26 large concrete containers into the hillside at the research station at Tanbark Flats. They planted each of these lysimeters, as they are called, with different grasses, shrubs, and trees. Special plumbing made it possible to measure the water coming in and going out.

Although a flawed design made precise measurements impossible, scientists found that, in general, trees and shrubs used water "extravagantly" (in the words of a later report), while grass "saved water if kept clear of weeds."

In the decades that followed, researchers experimented with a variety of methods for getting rid of the woody vegetation and increasing the grass. These trials involved herbicides, defoliant gases, bulldozers, and other tools that today's researchers might regard as heavy-handed. Results were mostly unsuccessful—it turned out that extracting more water from these mountains proved impractical, costly, environmentally damaging, or all three.

Nevertheless, these studies and others have yielded a wealth of long-term data that are helping to answer today's important questions, such as what

In the foreground are unburned chaparral and converted grass watersheds in the San Dimas Experimental Forest. In the background is 3,050-meter (10,000-foot) Mt. Baldy, highest peak in the San Gabriel Mountains.

people can and cannot do about landslides, floods, and wildfires that characterize the restless ecosystem of the San Gabriel Mountains.

"We have upland areas that burn frequently and with great enthusiasm," says Pete Wohlgemuth, research hydrologist and program manager at San Dimas. "We have lowland areas filled with people and property and infrastructure. Every time it burns, big erosion events happen. Part of my job is to try to understand these events for planning and risk assessment. And the other part is to determine whether we can do anything to offset some of the negative consequences in a cost-effective, environmentally sensitive way."

The geologically active San Gabriel Mountains (along with neighboring mountains), are being upthrust as two of the Earth's crustal plates grind against each other. The mountains are rising faster than erosion is wearing them down, and over the past few million years, gravity and running water have been sloughing soil and rocks down into the valleys below.

The Los Angeles coastal plain owes its existence to fires and debris slides, says Wohlgemuth: "If we didn't have these processes, we would have a lot more ocean." A pulse of erosion is typically triggered by a wildfire, especially if the fire season is followed by a wet winter.

Wildfire has struck the San Dimas on an average of every 40 years since its establishment in 1933 (there is evidence that the presettlement fire interval was longer). The largest and most intense of these fires occurred in 1960, when "the whole forest burned to the ground," says Wohlgemuth.

The bare hills left by the 1960 fire seemed to reinforce the wisdom of converting the landscape into something tamer and more tractable. Between 1958 and the mid-1960s, researchers used herbicides and bulldozers on the chaparral in an attempt to "type-convert" the thirsty shrub community to grass. The theory was that the quick-growing grass would stabilize the hillside better

than chaparral. As it turned out, it doesn’t—steepness of slope and intensity of rainfall make more of a difference in whether a slide will occur than the type of vegetation growing on the ground.

Other erosion-control experiments from that era included building concrete check dams along tributary streams, digging wide contour terraces across the slope with a bulldozer, and planting barley in horizontal strips.

Results of these trials were inconclusive, says Wohlgemuth. The 1960s produced several dry years in a row followed by wetter years and culminating in the storm of the century in 1969. So it was hard to tell if the weather or the treatments made more of a difference.

In the 1970s, many of the water-flow monitoring stations at the San Dimas were mothballed (“under the illusion that we’d learned all we could from that study,” Wohlgemuth says), and ultimately the ideal of large-scale manipulation of the landscape fell out of favor for both environmental and practical reasons. “Most people would not use those treatments today. But that’s why we have experimental forests—so you can try this outlandish stuff and see if it works.”

Another fire in 2002 offered an opportunity to try other ways of slowing erosion. One test concerned a chemical called polyacrylamide, which is used in agriculture as a flocculant—it binds soil particles together. The manufacturing company offered to aerially spray its product on the San Dimas as a field test. Aggregating the soil into larger particles, it was thought, would encourage water to infiltrate rather than sweep downhill and carry the soil with it.

A few years before the fire, Wohlgemuth and his colleagues had reactivated the mothballed monitoring stations. They had been keeping track of water flow for eight years by the time the 2002 fire occurred, so they were prepared to evaluate any change that occurred as a result of the chemical. A few years of measurements revealed that the spray didn’t work well enough in the shallow, coarse San Gabriel soils to warrant the expense of applying it.

A more promising treatment is stream-channel barriers made of prefabricated log sections placed every 9–15 meters (30–50 feet) along a channel. “We found they worked great,” says Wohlgemuth. “They reduced erosion down at the debris basin tremendously, and eventually they’ll biodegrade.”

Whether or not it has paid off in practical tools, all the research at San Dimas has yielded useful information. “Experiments like these are the only way we can learn how the natural system works,” says Wohlgemuth. “If we don’t know how to understand and quantify products like water, or sediment that is poised to come down into somebody’s living room, there’s no way we can develop cost-effective mitigation that will still be environmentally benign.”

The 2002 Williams Fire produced floods and massive erosion on the San Dimas Experimental Forest.

United States
Department of
Agriculture

Forest Service

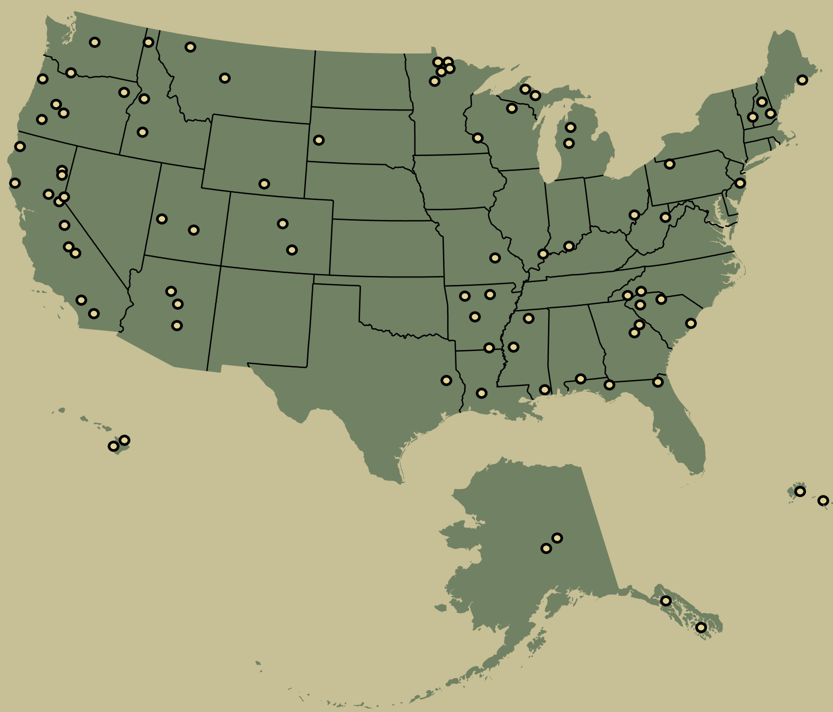
General Technical Report
FPL–GTR–182

Experimental Forests and Ranges





100 Years of Research Success Stories



Experimental forests and ranges across the nation

Experimental Forests and Ranges

100 Years of Research Success Stories

Gail Wells

Gail Wells Communication

Contributors

Washington Office
Deborah Hayes, Katrina Krause, Ann Bartuska

Forest Products Laboratory
Susan LeVan-Green (Editor-in-Chief), Jim Anderson, Tivoli Gough

Northern Research Station
Mary Beth Adams, Thomas M. Schuler, Randy Kolka, Steve Sebestyen, Laura S. Kenefic, John C. Brissette, Susan Stout, Keith Kanoti (Maine Forest Service)

Pacific Northwest Research Station
Fred Swanson, Sarah Greene, Margaret Herring (Oregon State University)

Pacific Southwest Research Station
Martin Ritchie, Carl Skinner, Tom Lisle, Elizabeth Keppeler, Leslie Reid, Peter M. Wohlegemuth

Rocky Mountain Research Station
Stanley G. Kitchen, Ward McCaughey

Southern Research Station
Jim Guldin, Don C. Bragg, Michael G. Shelton, David Loftis, Cathryn Greenberg, Julia Murphy

"….and all those selfless souls who kept conducting excellent research on Experimental Forests and Ranges throughout the years."

The land cannot speak, but it can communicate. A change in the flow of a stream, the timing of bud break on a sycamore tree, the rate at which shrubs come in after a wildfire—all these are messages people can read if they know the language. That language is science.

Contents