Fiery probe of environmental problems

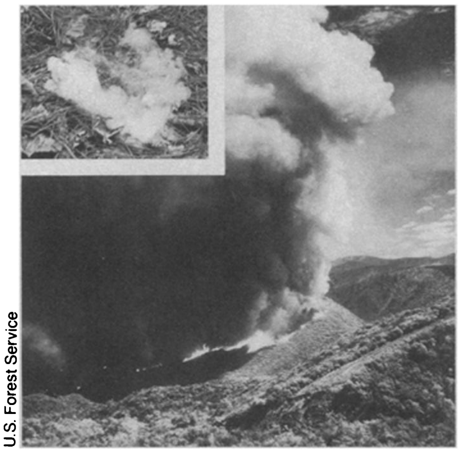
A 1,000-acre chaparral-forest fire about 30 miles east of Los Angeles is bringing researchers together from all over the United States. Weather permitting, the fire was to be ignited as early as Oct. 2, in Lodi Canyon, a region within the Angeles National Forest. The fire, scheduled as part of a fire management program, may prove a valuable research tool. It may not only provide preliminary answers to some of forest management's bigger environmental questions, but also help resolve several key uncertainties in the controversial "nuclear winter" scenario.

The older the shrubs and trees in a parcel of chaparral forest, the more combustible material it will harbor. Unless it is periodically burned, such a shrubby forest will develop into acres of natural kindling, awaiting only the first errant spark, lit match or lightning bolt to blaze out of control. Though it's not practical to burn off all of the older chaparral — there is too much — foresters have found it prudent to selectively burn several-thousand-acre patches within older tracts, essentially creating a mosaic of forest with varying combustibility.

In the western United States, this type of "prescribed" burning "is really starting to roll," says Philip J. Riggan, a U.S. Forest Service ecologist in Riverside, Calif., and the scientist in charge of the Lodi Canyon burn project. However, he adds, as useful as these burns are, they have significant environmental impacts.

The large-scale burning of biomass — trees and shrubs — can produce significant amounts of pollution. A 100,000-acre wildfire (not uncommon) might generate the equivalent of half the particulates and 10 percent of the nitrogen oxides (NO_x) emitted annually in the Los Angeles Air Basin. However, Riggan notes, it's possible that fifty 2,000-acre prescribed burns might produce almost as much pollution as a single 100,000-acre wildfire. Moreover, in addition to creating its own combustion pollutants, any fire could help transport pollutants it didn't generate. Industrial pollutants that had blown east and settled in the forest — sulfates from Los Angeles, for example — could be picked up by the fire's strong winds, thrown into the atmosphere and allowed to settle far beyond their initial forest resting spot.

Joel Levine, an atmospheric scientist at NASA Langley Research Center in Hampton, Va., worries about the air pollutants that don't settle out but instead rise and chemically interact with the atmosphere. He points out that carbon dioxide, methane and nitrous oxide (N_2O) — all products of biomass burning — are important "greenhouse gases" (SN:5/18/85, p.308). N_2O can even destroy the stratospheric ozone layer (SN:8/23/86, p.119), while other combustion gases can adversely affect the photochemistry of the lower atmosphere. However, Levine says, except for a few small-scale experiments, no one has quantified the production of these from burning biomass.


U.S. Forest Service

Earlier chaparral fire. Inset shows the golf-ball-sized fuel pellets used to ignite prescribed fires from the air.

It was to study issues such as these that Riggan began organizing the Lodi Canyon project about two years ago. Research conducted in conjunction with the fire will involve at least 20 projects and participants from three Forest Service offices, two NASA research centers, the Environmental Protection Agency (EPA), the Defense Department, Sandia National Laboratories, several state universities, the California Air Resources Board, the California Department of Forestry and the Los Angeles County Fire Department. It is expected to be the most instrumented and studied forest fire in history.

To understand the fire's effects, one needs measures not only of how much was burned but also of the temperature at which it burned. Data on the former will be provided by Forest Service ecologists, who recently catalogued the Lodi Canyon site in terms of species, biomass-fuel density and moisture content. A postfire survey will calculate what remains for a quantitative gauge of the mass burned. Researchers from NASA Ames Research Center in Mountain View, Calif., will fly a plane with infrared-monitoring equipment over the site, mapping the fire's temperature profile over time. These data will be calibrated against readings from ground-level sensors.

Levine and Wesley R. Cofer head a team from NASA Langley that will identify and quantify emissions 100 to 500 feet above the fire. The gases will be collected in balloon-like 10-gallon bags as L.A. County Fire Department helicopters fly low over the flames. To see how widely emissions vary with temperature, samples will be collected even from above smoldering embers.

An EPA plane out of Las Vegas will use a laser-radar (lidar) system to measure particulates emitted by the fire and to map a 3-dimensional outline of its smoky combustion plume. Funded by the California Air Resources Board, Roger Atkinson at the University of California at Riverside is sending filters on a plane from Sandia to collect polycyclic aromatic hydrocarbons (PAHs). Many PAHs and their by-products are known or suspected carcinogens.

Riggan is studying factors affecting soil. For example, he notes that some organic compounds in the soil will vaporize under a fire's intense heat, move down into cooler regions of the soil and there condense out into a water-repellent varnish. When it rains, water unable to penetrate the varnish will begin washing away the varnish's soil cover. Data from Riggan's initial studies suggest that the lower temperatures that may occur in a prescribed burn could lead to less varnish and therefore less erosion than occurs in intense wildfires. "We can probably cut the annual [postfire erosion] per acre in half by moderating the fire's intensity," he says.

Much attention has focused on a pair of "nuclear winter" projects, sponsored by the Defense Nuclear Agency (DNA), that will use the forest fire as a simulation of areas left burning in the aftermath of a nuclear war. Research planes from Sandia and the University of Washington in Seattle will collect particulates from the combustion plume to monitor, among other things, their size and blackness, where they are transported and the degree to which processes such as rain might remove them. Analyses of the data will take two to four months. And "quite frankly," says Peter Lunn, DNA's chief scientist at the tests, "we're not sure what we're going to get out of this."

One reason, he notes, is that forest fires aren't a very good source of the type of smoke that would best test the nuclear winter hypothesis — highly lofted, very sooty black particles (SN:9/22/84, p.182). Though Lawrence Radke, head of the Seattle research team, agrees, he adds that in terms of the combustible material per acre it holds, burning chaparral should simulate a burning suburb.

Analyses of data from all the tests are expected to be formally presented at a meeting next spring. — *J. Raloff*