

Fire Management in the West

Research and teaching fire ecology in Arizona

By Susan McGinley



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Once a fire starts, whether by lightning or by human ignition, the way it will burn depends on the amount, condition and distribution of the fuel load. Fire ecologists measure this in tons per acre for oak woodland and timber, and in pounds per square foot in grassland. They can look at what's out there and factor in the amount of brush or wood on the ground, the moisture level, the slope of a hillside, the speed and direction of the wind, and make some educated guesses about how intensely the fire will burn and where it might go. By figuring out each fire's characteristic burn pattern and intensity from the start, natural resource managers and fire fighters have a better idea how to monitor and control it. After the devastating fires that swept Arizona in 2002, this still-evolving strategy has become even more critical.

"Fire is so variable," says Malcolm Zwolinski, a professor of watershed management at the University of Arizona who has studied the effects of fire

for 30 years. "If you had seen the Bullock fire near Mt. Lemmon last year, you'd have noticed that some areas were untouched by fire; others were lightly singed, moderately singed, or severely burned. It could be just the way the heat column was established, and other factors. That's what makes fire such a challenge."

Zwolinski and his colleagues from the School of Renewable Natural Resources in the UA College of Agriculture and Life Sciences are working on fire behavior models based on GIS maps, plus climate and ground information to assist local, state and federal agencies. Scientists from the Laboratory of Tree Ring Research and the Department of Geography and Regional Development are also investigating fire histories, climate changes and fuels' availability.

"When fire managers look at potential fire danger, trying to anticipate the worst case scenario, they look at the fuel conditions," Zwolinski says. The type of fuel makes a difference. "Last

year's Roper fire burned and spread very quickly in grassland because it had fine fuels such as grasses and herbaceous materials that burn and move rapidly, but don't generate as much heat as you would get in timber areas with tons of fuel," he says. "When those ignite there is a lot of heat released."

Low-elevation grassland fires generally burn and expand very rapidly, don't produce a lot of energy, and don't cause as much resource damage. These fires can be quite beneficial, burning off dead material and releasing nutrients, such as nitrogen, magnesium, potassium and phosphorus to make them more available to plants. The fire burns the tops of grasses, leaving them to regenerate from their growth points at the base.

"Very often you'll see a quick green-up after a grassland fire," Zwolinski says. "The new growth provides improved grazing for domestic animals and wildlife." Periodic grassland fires also control some of the woody shrubs that have invaded grasslands in the Southwest over the past few decades.

Timber fires, on the other hand, with their increased fuel load, have the potential to burn more intensely, and can often destroy the growth points of the trees, located at the apexes of the lateral and terminal branches.

"The impacts of fire to a large extent are related to how well a plant species is adapted to resist fire," Zwolinski says. "Grasslands do better in general, yet Ponderosa pines can resist fire because they have thick bark and a higher foliar moisture content than other types of trees, such as eucalyptus that burn quickly." Surprisingly, Zwolinski says most cacti species are not tolerant to fire, including saguaros, prickly pear and barrel cactus. Tumbleweeds are very flammable and can spread fires.

Take years of increasingly flammable plant populations and decades of fire suppression in Arizona, add low humidities, high temperatures, drought

and wind, and you get ideal conditions for fire, according to Zwolinski. That's where fuel and fire behavior models come in.

"We still don't know everything about controlling fire," he says. "Computer outputs show us how long and how far a fire might burn. We try to use the fire behavior models when we want to suppress a fire, to see where it will go and how hot it will get, based on fuel load. This technique can also be used for a prescribed burn." In either case the researchers look at spatial and seasonal distribution of fuels, moisture level, slopes, wind direction and speed, air temperature and humidity. They project environmental conditions into the model and run it to find out what might happen.

Zwolinski believes the 2002 fire season may promote more public acceptance and tolerance of prescribed burns in Arizona, if there could be more certainty about where they might go. "Even a prescribed burn can get out of control," he notes. "Although the nature of fire is that it's unpredictable, a modeling system can help us figure out how a fire might act, so we can ignite test areas. Then based on these results, we can start to increase our use of fires as a treatment."

Not only does Zwolinski investigate these models as part of his research, he also shares his knowledge with college students and as a representative to the

Southwest Fire Council, which includes federal, state and local land management agencies in Arizona, New Mexico and west Texas. He teaches courses in fire ecology and wildland fire management that draw students from across the university who are interested in the impacts of fire on the environment. He also participates in a national training course on the role of fire in ecosystem management for professional fire fighters.

Fire is such a natural part of the environment that it fits into many of the courses offered to students in the School of Renewable Natural Resources. His students have served as seasonal firefighters and in permanent capacities in federal, state and local natural resources agencies, Zwolinski says. They serve as wildlife biologists, range conservationists, foresters, fuels experts, fire management officers and others.

"In a classroom setting we try to be quite neutral about fire," he says. "You have wildfires that happen at the wrong place and wrong time, that need to be put out. At other times you may want to deliberately apply fire to an ecosystem. Yet the chemistry and physics of fire don't change in either case. We look at desirable impacts. A wildfire may be allowed to continue if it's not doing much damage, but loss of life, property or resources such as timber or watershed value must be taken into account."

When a fire goes out, that's when a lot of the work starts, according to Zwolinski. A group of federal scientists form a BAER (Burned Area Emergency Rehabilitation) team to go into a burned area and come up with projections and recommendations to minimize the damage.

"Education doesn't stop with how to put a fire out, it also involves what you do after a fire with the rehabilitation changes that take place," he says. The forest ecosystem is still there, and fire doesn't always damage it. Fire can open an area up, allowing smaller forage shrubs and berries to grow. This in turn increases wildlife habitats and recreational opportunities such as hiking.

Above all, Zwolinski says Western conifer forests are different from hardwood forests in the eastern United States, and thus require a different management approach.

"Western forests have a lot more needle-bearing trees that are susceptible to fire," he says. Hardwood forests in the East are difficult to burn because the trees have an elevated crown and large surface leaves, so you don't get the conflagrations that occur in the West. The increased moisture, mainly from snow, causes a more rapid decomposition of debris. Out in the drier West, decomposition is slower.

All of this makes a difference in the fundamental approach agencies take to managing fire in the West. Controversial approaches abound, from complete suppression of fire that led to the problem in the first place, to the clearcutting or logging of old growth forests that won't solve the problem either, according to Zwolinski.

"Mt. Lemmon was reported to be one of the most dangerous areas for fire in the country, and so was Mt. Graham," Zwolinski says. "The solution to preventing this buildup is *thinning* the younger trees, not clearcutting, and burning underneath them to reduce fuel load and the danger of fire."*



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