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The 2006 Sierra Fire and the Tecate Cypress

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There is often controversy surrounding the relative role of individual variables affecting wildfire spread and extinguishment. For example, the traditional "fuel-driven" model suggests wildfires are spread almost exclusively by vegetation and are limited by contact with previously burned areas. This model suggests the use of prescribed burning and other methods designed to reduce the amount of vegetation on a landscape level are the best way to deal with wildfire risk.

The alternative "weather-driven" model focuses on extreme weather conditions and hypothesizes large wildfires are primarily powered by wind and low fuel moisture levels, stopping when the wind stops. This model sees wildfires as inevitable and focuses on improving community and structural design along with the strategic placement of vegetation treatments to reduce wildfire risk. Extreme weather conditions are altered by landforms so topography plays an important role in this model as well. Both models imply that firefighters are not particularly effective unless favorable environmental conditions are in place.

There are difficulties in determining what role each variable does play in wildfire spread because detailed records are generally not kept about where and how fire management resources are deployed and what weather and fuel conditions were along the final fire perimeter. This is especially true during large events such as the 2003 firestorm in southern California. Expecting such records under the stress of a major event is not realistic. However, it is possible to collect information after the fact from firefighters who were on the scene. This has

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Sierra fire as seen looking northeast from Newport Beach. Source: Stephen Francis Photography/The Nature Conservancy

been done on a limited basis with the Wildland Fire Lessons Learned Center, but a lot of information typically stays within the fire management community and is forgotten with the passing of each generation. This is unfortunate because both scientists and policy makers could benefit from the wealth of knowledge firefighters have collected by being directly on the fire line. The value of this information can not be over-emphasized. This was pointed out to me during a

"There is not enough communication between those who actually fight fires and those who conduct fire research…"

conference in San Diego, California after I had presented some conclusions about the 2003 Cedar fire that illustrated my own lack of awareness of how fire really behaves when you're facing it with a Pulaski in your hand.

A battalion chief with the US Forest Service, leaned over to me afterwards and said, "I find it interesting that someone who studies fire ecology has never fought a fire."

The chief's comment highlighted a significant problem in much of the wildland fire research conducted today; there is not enough communication between those who actually fight fires and those who conduct fire research, develop fire behavior models, or promote public policy relating to wildfire management.

This short analysis of the Sierra fire in the current issue of *The Chaparralian* is part of a larger research effort by the California Chaparral Field Institute to investigate why fires stop where they do and how certain assumptions about fire behavior can have significant influence on fire suppression activities and land management decisions. In this study, numerous firefighters who were involved in fighting the 2006 Sierra fire were interviewed and on-site field investigations were conducted to examine the fire's extent and impact. A color Landstat aerial photo of the burn zone has been included on page 3 to help you follow along with the text.

The Fire

The Sierra fire originated southeast of Sierra Peak in the Santa Ana Mountain range at the northern most tip of the Cleveland National Forest in Orange County, California. It started on Monday, February 6, 2006 at 4:28 AM as a result of an escaped prescribed burn. The burn was thought to have been extinguished Sunday night, but hidden embers were fanned by strong Santa Ana winds from the northeast in the early morning hours and began rapidly pushing flames west and southwest from the peak.

The trajectory of the Sierra fire pointed straight toward Irvine Lake and the foothill communities of Tustin. Strategic back firing operations (marked FO on the Landstat photo) along the 241 toll road and the Santiago Creek drainage north of the lake were conducted to hold the head of the fire there. In the canyons above a portion of the southeastern perimeter, fuel loads were lower due to the 1997 Baker fire, but the fire continued to back down-slope toward a Southern California Edison access road.

Tecate cypress trees burned in the Sierra fire.

Landsat (satellite) Aerial Photo of the Sierra Fire Scar. Dark areas indicate most intense burning. "FO" indicates firing out operations (back fires). Source: USGS

Moderating weather conditions caused the fire to pause within upper drainages allowing firefighters time to attack the fire directly by hand cutting fire lines and bulldozing fire breaks.

Things were different at the northern edge of the fire. Pushed by strong, prevailing NE winds, the fire had originally by-passed the 2002 Green fire scar. However, by Wednesday the flames began dropping down into the previously burned area through Gypsum Canyon and toward Highway 91. As the fire moved into the 2002 scar it burned downhill against prevailing winds. Firefighters aggressively lit back fires from both Highway 91 and the toll road in order to hold the fire within these boundaries. The objective was to prevent embers from crossing over and endangering communities such as Anaheim Hills.

Unlike typical Santa Ana condition days in the autumn when the drought season is coming to a close there was just enough moisture in the environment to prevent long-range spotting across both the toll road and Highway 91. However, some embers did ignite sections of the toll road median. A couple of small fires occurred about a mile west, but it is unclear if they were related to the main fire or sympathy fires lit by arsonists.

All totaled it was the aggressive back firing performed to protect the surrounding communities that ultimately led to the majority of the area burned. Out of 10,584 acres consumed, approximately 8,000 were the result of back firing operations.

Analysis

In support of the fuel-driven model, it has been suggested that the Sierra fire moved quickly until it burned into the 2002 Green fire scar, going out when it entered that previously burned area. This perspective does not agree with the actual events as described by on-scene firefighters.

The main trajectory of the Sierra fire was unaffected by the Green fire scar due to the strong winds pushing the flames forward. This may have been similar to what happened during the 2001 Viejas fire in eastern San Diego County. In that situation, extremely strong NE winds 50 to 60 miles per hour powered the flames down a narrow corridor, leaving dense, 30-year-old chaparral on either side unburned.

When the fire did begin burning into the Green fire scar after its initial run, it did so as a downhill, backing fire (moving against the wind), burning through fine, grassy fuels late Wednesday afternoon at approximately 4PM. By about 4AM the following morning, flames within this scar had been extinguished. Around noon, a moist, western marine layer moved over the mountains assisting in fire mop-up operations.

What role did the 2002 Green fire scar play in halting the Sierra fire spread?

Very little vegetation had regenerated in the scar since 2002. This was one of the possible reasons

The 2002 Green fire scar. Fine fuels growing under burned Tecate cypress trees. Dark green plants are Tecate cypress seedlings.

Unburned chaparral patches east of the 241 toll road.

suggested as to why the area didn't carry back fires well from either the toll road or Highway 91. Perhaps more revealing was what happened to back fired areas that had survived the 2002 fire along the northern end of the toll road; large patches of dense chaparral failed to burn (see photo above). Yet despite opposing winds and downhill topographic features, the finer fuels were dry enough to allow the main fire front to keep moving in a northeastern direction through the scar. The flames continued burning until two additional variables came into play, cooler evening weather and effective firefighting action.

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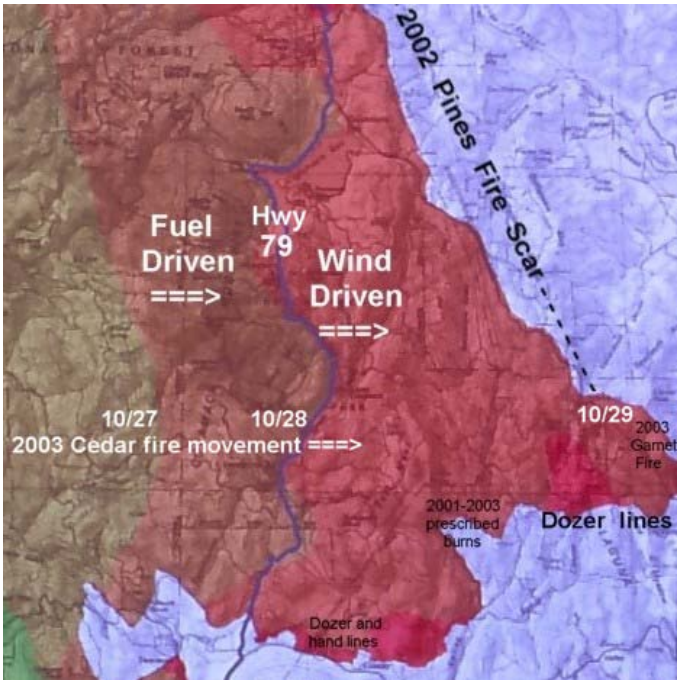
Conclusions

Neither the fuel nor weather-driven models alone can account for how the Sierra fire spread. The Baker and Green fire scars did allow for flanking actions in lighter fuels, but as the recent grass wildfires in Texas and Oklahoma have demonstrated, even light fuels can carry uncontrollable fire. Assuming fires will stop naturally at previous fire scars can lead to potentially dangerous decisions. A large majority of firefighter fatalities have occurred during fires in light fuels.

The fact that the fire continued to spread into the Green fire scar despite cooler afternoon and evening weather conditions, light fuels, and against prevailing winds downhill strongly suggests that if firefighters had not been present, the fire would have crossed over into surrounding communities.

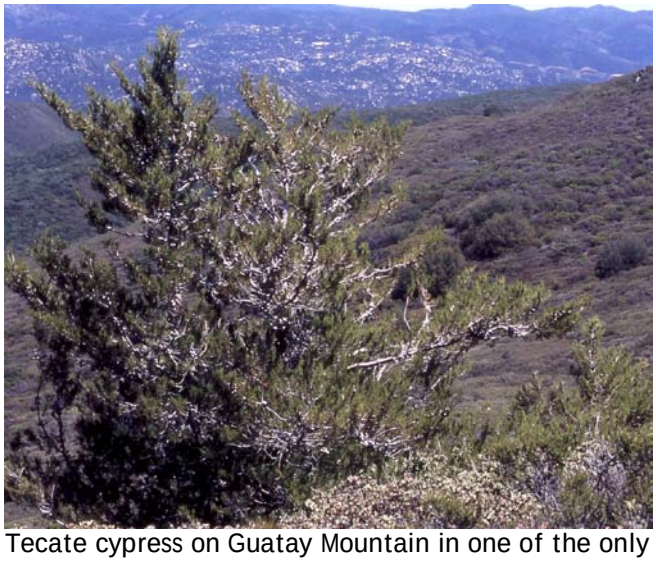
Which variable is the most important in fire spread? As every firefighter knows, it depends. However, extreme weather events do have a tendency to trump all other variables when they occur, burning fuels that one would not expect. Based on firefighter observations, the re-burn of the 2002 Green fire scar was primarily a fuel-driven event. The main fire movement from Sierra Peak was a weather-driven event. It is quite likely most fires demonstrate similar combinations. The 2003 Cedar fire provides another example. From Saturday evening (October 25th) through early Sunday afternoon, the western front was exclusively a weather-driven event burning through both light and heavy fuels with abandon. The eastern flame front was a fuel-driven backing fire (against the wind) burning through Cuyamaca State Park on October 28th. Then the wind shifted to blowing eastward in the late afternoon/evening, leading to a weather-driven event pushing the flames across Highway 79 toward Mt. Laguna. The fire ultimately stopped at different locations for different reasons; hitting the still blackened ground of the 2002 Pines fire scar, excellent firefighting, and rain (**see map below**).



Successful firefighting is a combination of strategic leadership, firefighter skill, and taking advantage of variables that may affect fire behavior. Rarely does a single variable dictate how a fire will spread or where it will stop. Fires move according to a complex set of factors that can often surprise even the most experienced.

It appears one of the most crucial variables in the Sierra fire turns out to be topography. This fire burned within an historical fire corridor where many fires in the past have run: the 1948 Green river fire (47,000 acres), the 1967 Paseo Grande fire (49,000 acres), and the 1982 Gypsum fire (16,800 acres). The normal trajectory of these fires has been in a southwestern/western direction powered by Santa Ana winds, not to the north/northeast as was the case for the slop-over of the Sierra fire into the Green fire scar.

Studies of fire corridors (where fires repeatedly occur and often follow similar pathways) may be useful in providing accurate predictions where and how the next fire might burn. Interestingly, knowledge of past fire history within the fire corridor where the Sierra fire ran allowed Battalion Chief Michael Rohde of the Orange County Fire Authority to accurately predict how long it would take for the flames to reach particular points along its southwestward



Tecate cypress on Guatay Mountain in one of the only remaining stands of old-growth chaparral in San Diego County.

Tecate cypress seedling after the 2002 Green fire.

trajectory. Such information should be given more attention in our efforts to protect both community and natural resource values in the future.
It is likely the frequency of fires, weather-driven or not, will continue to increase within the Orange County fire corridor as surrounding population pressures continue to grow. There is also an increased probability of unusual fires spreading south/southeast as the result of ignitions from the toll road, Highway 91 and a new development at the base of Gypsum Canyon.

Resource Values

The likelihood of increased fire frequency in southern California highlights a fire management concern that has been growing over the past few years; the protection of natural resource values.

East of Gypsum Canyon, scattered on a gently sloping plain, grows an extremely important population of Tecate cypress (*Cupressus forbesii*). This species is one of the few trees that grows within the chaparral and is listed as seriously endangered by the California Native Plant Society (CNPS List 1B.1). There are four locations where this species exists in the state: Tecate Peak, Otay mountain near the U.S./Mexican border, Guatay Mountain near Descanso, and around Sierra Peak. The oldest tree was over 200 years old and was part of the Sierra Peak population. It burned during the 2002 Green fire. The Tecate Peak population once covered approximately 260 acres, but has been reduced to less than 90 acres because of repeated fires. The only population that remains in a relatively pristine, unburned state is the small one on Guatay.

These trees are truly remarkable with their thin, reddish bark, multiple trunks, and fine, scale-like leaves. They can reach up to thirty feet and form an airy canopy decorated with quarter-sized cones that remain closed until stimulated by the heat. Although they have been labeled as a fire-dependent species, such a classification implies they "need" fire to survive. This is not the case as longevity studies have never been conducted. It is best to view this species, as well as all other plant species that have some type of fire-adaptive reproductive trait, as "fire regime sensitive." This means their reproductive cycle is stimulated by some fire cue established under a particular fire regime. But if the fire regime is altered in some way, such as an increase in fire frequency or season of burn, then the species can become compromised and eventually extirpated from a site. There is a distinct possibility the Tecate cypress will suffer continued reduction in population this century and will likely become extinct due to increased fire frequency unless significant action is taken to protect existing populations now.

The Sierra Peak population provides a case in point. The 1982 Gypsum fire burned most of the Tecate cypress groves between Gypsum Canyon and Sierra Peak. The 2002 Green fire hit the area again and killed nearly all the 20-year-old saplings in addition to the oldest individual known. The saplings had barely reached maturity, but there were enough cones to supply sufficient seed stock for regeneration. The Sierra fire killed most of the trees that had survived the Green fire. If the Sierra fire had spread into the Green fire scar earlier on Wednesday, the fine fuels surrounding the four year old trees would have created enough heat to kill most of the individuals (photo pg. 4). If another fire hits this area within the next 15 years, there is little doubt that the majority of this Tecate cypress population will be eliminated. The surrounding chaparral ecosystem will be seriously compromised as well since it needs at least 20 years create a viable seed bank of obligate-seeding species.

Such resource risks need to have a higher priority than they currently do during the cost/benefit analysis of any wildland prescribed burning program. Although the Sierra fire generally left the recovering, four-year-old Tecate cypress population alone, it did end up taking out most of the remaining 20-year-olds. The entire area should have been classified as a kind *critical alert zone* that would have prevented using fire for fuel modification in the first place. Such a designation and an appropriate management plan is really our only hope if we want to sustain Sierra Peak's unique Tecate cypress-chaparral ecosystem.

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