Sequoia & Kings Canyon
National Parks

National Park Service
U.S. Department of the Interior

Fire & Fuels Management

Bringing Fire Back

Fires have been part of the environment in Sequoia and Kings Canyon for thousands of years. Lightning started many fires before people lived here. Occurring regularly, these natural fires usually had low flames and cleared the forest floor without killing the whole forest.

During much of the last century, however, land managers and the public believed fire was a destructive force and suppressed all burns. As a result, our forests have changed in structure, diversity, and density. Trees are now found in areas that naturally contained other types of vegetation like shrubs and grasses. In many areas where trees have historically grown, there is an abnormal and dangerous accumulation of fuel: dead trees, limbs, leaves, needles, dense thickets of small live trees, and undergrowth. Now when a fire starts, it can become extremely hot, fed by these concentrated fuels. These fires are difficult to control, threaten people, and can cause long-term damage to the ecosystem.

Lightning continues to start fires. We want these natural fires to do their ecological work, but this is much easier if we reduce the heavy fuel load that has built up in the forest. How can we restore ecological conditions so that fire can safely return to the landscape?

*Continues in **Fire** (page 4)*

Under the Sequoias

One Firefighter's Season

The following journal entries are based on actual events at Sequoia and Kings Canyon National Parks during the summer of 2002.

May 28 *– Today I started my first job as a firefighter at Sequoia and Kings Canyon National Parks (SEKI). I'm working on a 20-person handcrew stationed at park headquarters. After a short orientation, they issued our gear. There is so much to learn, it feels overwhelming. Just knowing the functions of all the fire management employees seems daunting. I hope that I will get a chance to work with all of them this summer. I can't wait to fight fire!*

June 7 *– I just completed my introductory training called "Fire School." Along with the other new firefighters, I spent five days learning how and why fires move across the landscape depending on weather and topography. Our teachers also talked a lot about safety on the fireline. I guess I'd never thought about all the dangers associated with this job. Let me tell you, it's hard not to think about it when you're practicing jumping inside your fire shelter in less than 25 seconds (it looks like a small tin-foil tent that you carry folded on your belt). Today, we took the physical fitness exam called the "pack test." We carried 45 lbs. on our backs and walked 3 miles in less than 45 minutes. It's hard, but I passed. Let's go fight fire!*

June 18 *– I'm tired! My crew spent the last four days doing prep work in Giant Forest for a prescribed burn called Sherman Creek. We dug a mile of fireline on steep hills with lots of vegetation. They were long days but it's amazing what we can accomplish as a crew. It's strange to me that I've been here for three weeks and I haven't even seen a flame.*

*Continues in **Journal** (page 2)*

Inside

Journal *(Continued from page 1)*

June 30 – *We fought our first fire today! Someone tossed a cigarette on the ground near Cedar Grove. Visitors reported the blaze at noon. Since we were in the area, we responded along with one fire engine, the helicopter, and another hand crew from the neighboring national forest. We knocked it down in just 4 hours and it was less than two acres. Now the action is starting…*

July 14 – *Fire management is more complicated than I thought. Today we discovered a lightning-caused fire in Mineral King. When I heard the call come over the radio, I jumped – another fire to fight! But I was wrong. After studying it, the bosses back at headquarters decided to manage the Atwell Fire as a fire use project. This means we allow the fire to spread naturally and improve conditions in the forest. It turns out that the lightning strike hit a tree in an area that had a prescribed burn in 1995. Since this earlier burn already reduced fuels on the ground, there was no need for expensive suppression. So, rather than sending my large crew, two monitors hiked to the fire to observe its behavior and spread.*

July 20 – *Two days ago, conditions were finally right to light. Approximately fifty people, including my crew, met for an early morning briefing before the Sherman Creek Prescribed Fire. The burn boss explained where each crew would work and how to talk to each other on the radio. We hiked out to our locations and the burn began around 11:00 a.m. For experience, the burn boss wanted everyone to use a drip-torch, the hand-held canister used to ignite the fire. I ignited for about two hours as we slowly moved the fire from one edge of the unit to the other. It took three days to finish 125 acres. When I was working as a "holder" on the perimeter of the fire, I had a chance to talk a bit with the researchers who were studying how fire affects different species of plants and animals. Much work has already been done on how giant sequoias need fire since it creates the necessary conditions for their reproduction.*

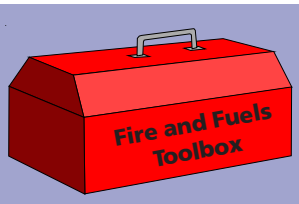
August 19 – *My first helicopter ride! How cool! Our crew was flown out to the Kern Ranger Station in the southern part of Sequoia three days ago. Our job was to clear excess fuels around the station and outbuildings to protect them from the McNally Fire, a large human-caused fire just six miles below the park boundary. Becaused of its intensity and location, McNally could easily burn into the park. The Kern backcountry ranger is ready to implement the evacuation plan. Our work will hopefully save the buildings when all the people leave. This week while working in the Kern, I realized that I wasn't really "fighting" fire, but rather preparing for it. So long as we can protect people and structures, it's good to let fire back in the forest.*

October 7 – *I'm going to be on TV! Today, a film crew from Japan followed our crew as we scouted a new fireline for a prescribed fire next year. I guess our fire program here at SEKI is well known and generates interest internationally. The director interviewed my crew boss and then asked me a few questions on camera. My co-worker, Sharon, talked about her experiences being a woman firefighter.*

October 25 – *As the season draws to a close, it is interesting to see projects come full circle. Today our crew did rehabilitation work on the Sherman Creek fireline that we built in June. When the fire is completely out, it is important to make the old fireline invisible. It prevents erosion and it looks more natural for visitors. I can tell that my fitness level has improved because I can hike up these hills more easily now.*

November 13 – *After nearly 10 inches of rain last week, the time was right to head to Mineral King and burn debris piles. Earlier in the summer, a contractor was hired to create a protective buffer, called defensible space, around the private community of Silver City inside the park. They used chainsaws to thin out shrubs and small trees. Then they piled the dead and down material for us to burn in the fall or winter. We ignited approximately 75 piles today. It's like having numerous bonfires burning at once.*

November 16 – *My season at SEKI is over. I can't believe all the things I've done over the last five months. I thought that I was going to come here and fight fires all summer, but what I ended up doing was even more rewarding. I helped bring fire back to these mountains in a way that is safe for people and park resources. I can't wait to come back next year.* ■



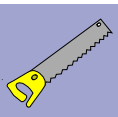
Sequoia and Kings Canyon have eight different tools that help meet fire and fuels management objectives. The tools are used at different times and in different places but they are equally important.

Preparedness Activities - Preplanning (like training) to enhance firefighter and public safety.

Wildland Fire Use - Managing unplanned fires to benefit natural resources.

Wildland Fire Suppression - Suppressing unwanted fires.

Prescribed Fire - Igniting fires for restoration or hazard fuel reduction.



Mechanical Fuel Reduction - Using chainsaws or other eqiupment to remove woody fuels around communities and facilities.

Information / Education - Communicating with the public.

Monitoring - Assessing the effects of the program over time.

Research - Gathering new scientific information.

Research and Monitoring:
Staying Ahead of the Curve

With a dynamic fire management program, how do Sequoia and Kings Canyon National Parks "stay ahead of the curve?" The parks are committed to research and monitoring which constantly feed new information to the fire management decision-makers. Some of this work is completed by park personnel, while other work happens through interagency cooperation or public/private partnerships.

For over two decades, the parks have collected data on fire effects. Since 1986, there has been a crew dedicated to this effort. This crew maintains study plots in prescribed fire areas.

Firefighters from the National Park Service and the U.S. Geological Survey cooperate on a research burn to study fire effects on cheat grass, an invasive species.

They visit these plots before the burns and then return in a regular cycle after (one, two, five and ten years after). The crew compares the remaining tree species, understory plants, and duff layer (decomposing organic material) to what was there before the burn. They look for the percentage of tree mortality, scorch height on trees, new growth, and the amount of fuel still on the ground. Recently, this crew has started collecting data before and after mechanical fuel reduction projects as well.

This crew's work shows that the parks' prescribed fires consistently achieve their objective of reducing fuels and the burns make significant progress towards restoring forest structure (sizes and types of trees). Plots in giant sequoia groves also show successful germination of young sequoias where prescribed burns have occurred. This regeneration is almost completely absent in unburned areas.

Beyond this routine monitoring, the parks regularly host researchers studying fire-related topics such as the effects of burning in different seasons, invasive plants, root mortality, cambium heating, soil nutrients, water chemistry, small mammals, and fire history. In SEKI, these studies are conducted by the U.S. Geological Survey, the U.S. Forest Service Riverside Fire Lab, and various universities from around the country. ■

How do Sequoias Survive Fire?

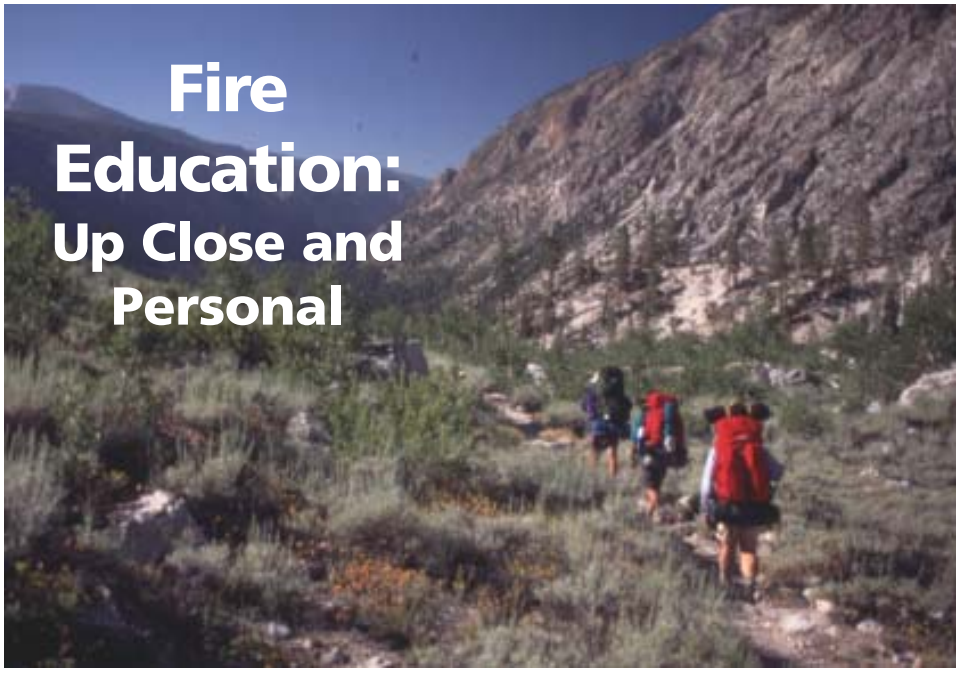
During their more than 2,000-year lifetimes, giant sequoia trees have seen it all: weather, changes in climate, and fire.

Research shows that fire has been a regular companion to these trees for millennia. The natural fire cycle in sequoia groves was every 5 to 20 years for the last 3,000 years. How did they survive so many fires?

The trees protect themselves from internal damage during a fire with their thick layer of bark. Blackened areas, or scars, deep within the trees not only confirm the past fires, but also prove the ability of these trees to survive.

The tiny seeds of the sequoia stay inside closed cones for 10-20 years. Fire opens the cones and releases these seeds, recycles nutrients into the soil, thins out competing species of trees, and leaves behind nutrient-rich ash and mineral soil for germinating sequoias.

Sequoias are sun-loving trees. Where high-intensity fires open holes in the forest canopy, sunlight is able to shine through. Giant sequoias take advantage of these bright spots. Years later, this results in a group of large trees that are the same age, like the Senate Group in Giant Forest. These groups mark the locations of high intensity fires of long ago that created excellent growing conditions.



Fire Education: Up Close and Personal

In early September 2002, backcountry hikers in Kings Canyon National Park had the experience of a lifetime. While walking the high-elevation trails south of Dusy Basin, they observed a lightning-caused fire burning naturally in the wilderness, eventually spreading over 1,500 acres.

It all began a few days before the Labor Day weekend when a park trail crew discovered the Palisade Fire burning on both sides of the popular John Muir/Pacific Crest Trail. Committed to improving forest health and maintaining natural processes, park managers chose not to suppress the fire. But a question remained about how to manage the busy trail over the holiday weekend.

In the past, fire managers always closed trails near fire operations, often for extended periods of time. In these cases, hikers would be rerouted or denied access into certain areas. But the Palisade Fire was different. Park staff and volunteers were stationed at both sides of the fire to control trail access. When firefighters on scene felt it was safe, hikers were escorted daily through the 4-mile fire area.

Some backpackers were worried about the "destruction" they would witness, but their hike through the fire turned into a chance to observe nature in action. They listened to the crackling of burning logs beside the trail. They watched orange embers glow under piles of down wood. Overhead, birds moved from tree to tree avoiding the smoke, while squirrels crawled in holes underground. At times, they heard the sound of a tree falling in the distance – a simple reminder of fire's ability to clean up the forest.

The Palisade Fire was an ideal example of how to balance visitor needs and safety with ecosystem restoration. This "ranger-led hike" not only prevented a lengthy detour for the hikers but it also gave them first-hand experience with a natural process. ■

Fire *(Continued from page 1)*

These parks use three different tools to reduce heavy fuel loads: prescribed fire, wildland fire use, and mechanical fuel reduction (see page 2 for a description of these tools). The goal of the fire and fuels program is to reintroduce the process of fire, restore forest structure, reduce hazardous fuels, and protect people, ecosystems, and facilities from catastrophic fire.

After decades of work, the parks have made progress, but there is more to be done. By continuing the fire and fuels management program, we hope to restore forest conditions and set the stage for natural lightning fires to again safely benefit the ecosystem.

Protecting Communities

Protecting communities and ecosystems from destructive wildland fire is a high priority for the National Park Service. Managers at Sequoia and Kings Canyon think about this work every day as they choose the right "tools" to get the job done. The most newsworthy tool, fire suppression, should only be a last resort. What can be done before a dangerous fire starts?

Mechanical fuel reduction projects are utilized near communities either adjacent to or inside park boundaries. These projects use chainsaws or other equipment to cut, pile, and then burn or chip excess woody debris. For example, the parks hired a private local contractor to thin and pile debris on 20 acres around the community of Silver City. Park fire crews burned the excess material during the winter.

Education projects are another crucial tool for community protection. With help from the local FireSafe Council, the California Department of Forestry, and the U.S. Forest Service, the parks hosted a "Demonstration Project" for the community of Wilsonia. Crews cut and piled debris on a 2-acre lot so residents could learn how to apply fuel reduction techniques on their own property.

The parks also use prescribed fire and wildland fire use projects to protect communities. By restoring ecosystems and reintroducing fire in wilderness areas, we reduce the risk of large fires moving into communities later.

Getting a Handle on Smoke

In a helicopter, high above the 1999 Halstead prescribed fire, fire managers watch flames move through the forest. From their aerial perspective, the vast peaks of the Sierra Nevada dwarf the smoke rising up from the 880-acre burn. The radio crackles as a crew boss from the fireline announces that they are halting ignitions for the day in order to control the amount of smoke. This is a common practice during burn operations at Sequoia and Kings Canyon National Parks.

Like all prescribed burns, Halstead was planned months in advance with an emphasis on how to manage smoke levels in neighboring Wuksachi Village. In preparation, the burn boss studied past weather patterns to determine the time of year with the best smoke dispersal. Then he made predictions for smoke emissions based on the type of vegetation, its quantity, and moisture levels. In a high-elevation red-fir forest like Halstead, smoke from heavy fuels can be generated for several weeks until a fire is completely out. How does this affect visitors?

Back on the ground at Wuksachi Village, visitors gather in the hotel bar to watch the smoke on the ridge above them. Later that evening, people join a ranger for a program about prescribed fire. While most visitors are intrigued by the event unfolding before them, some people find they are sensitive to smoke at levels much lower than established health standards. To help these people, rangers try to advise potential visitors about fire conditions on the park website before they come. Rangers also provide information in the lobby and offer suggestions, such as simply remembering to close windows at night when wind currents reverse the daytime direction of smoke and carry it down canyon.

To protect visitors and residents, the Air District and park managers work together to choose days for ignitions.

Each morning during the burn, a fire technician checks data from the "Smoke and Weather Module." Parked in Wuksachi Village, this mobile unit measures particulate levels in the air near active prescribed fires. Particulates are solid or liquid airborne particles produced by things like vehicle emissions, agricultural activities, and fires. The module records levels every hour and then computes a 24-hour average which correlates to the National Ambient Air Quality Standards (NAAQS) established by the Environmental Protection Agency (EPA). As on previous days, the technician reports back to Fire Dispatch a 24-hour average in the "good" range (only one day of this 21-day burn dropped into the "moderate" range).

Another major component of prescribed burning is the cooperation between fire managers and the local San Joaquin Valley Unified Air Pollution Control District. The parks provide the Air District with written plans for upcoming burns. These plans give information about location, timing, weather patterns, estimated smoke emissions, predicted plume path, and methods to minimize smoke by controlling the number of acres burned per day. To protect visitors and residents, the Air District and park managers work together to choose days for ignition. It is common for both parties to postpone burns due to regional air quality conditions.

While crisp, clean air is part of the Sierra environment, so too is smoke from wildland fires. The National Park Service works hard to balance these conditions for the benefit of people and park resources. ■

Is that Dirty Air from a Park Fire?

Not necessarily. The scenic vistas in the parks, especially in the summer, are highly obscured by regional haze. Haze is caused when sunlight encounters tiny particles in the air. These particles may be the result of either natural events or human activities. According to the local Air District, over 95% of the particulate pollution in our area originates from valley sources (i.e. motor vehicles, industrial fuel burning, manufacturing, and agriculture). Less than 5% comes from wildland fires in the Sierra Nevada.

Looking to the west from the edge of Giant Forest on two different days.

Making Maps Out of Tree Rings

What were fires like 100 years ago in these parks? What about 2,000 years ago? Who was keeping records back then? The trees!

The science of *dendrochronology* studies the annual growth rings of trees. Each year, trees in temperate climates add a new ring of growth to their cambium layer, just underneath the bark. In addition to showing a tree's age, the rings serve as a history book of past events. Scientists are trained to see the visual clues in tree rings that give information about past fires and precipitation trends. What are these clues?

Clue #1: Fire Scars Mark Past Fires

Fire scars are blackened areas on annual growth rings where the tree's cambium layer was killed by fire. The tree no longer grows in the scarred area. In later years, the tree often slowly covers over this scar as new rings grow over it from the living portions of the tree.

Clue #2: Ring Size Indicates Past Precipitation

Annual rings vary in width from year to year depending on weather and other growing conditions. For example, drought results in very little growth, so rings are thin. During wet years, trees grow thicker rings.

Living Trees as Calendars

Living trees are good sources of information because they allow us to pinpoint the exact dates of past events. If a cross-section of a living tree is taken in 1999 and it shows a fire scar fifteen growth rings from the outer edge of the wood, we know that the fire burned in 1984. If many trees in the same area show similar scars, we know the fire was large. For example, samples taken in the Middle Fork of the Kaweah drainage show widespread fires in 1707 and 1873 as well as other years in between.

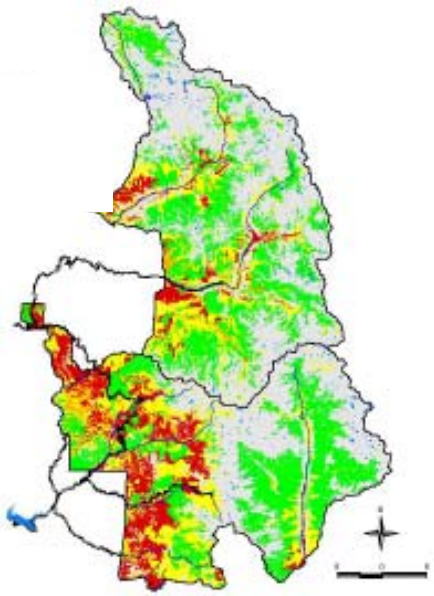
While some fire history samples are removed as wedges from living trees, the bulk of the samples comes from dead trees or old logs. How can information be extracted from dead trees when we do not know when they died?

Using Clues to Crossdate

Scientists put all of the visual clues to work in a technique called crossdating. This technique compares growth rings from live trees with those of much older dead trees in the same area. Since growth rings vary in width from year to year, it is possible to correlate live and dead trees by matching up the ring-width patterns.

Imagine that there was a documented drought in the 1860s that caused 8 very small annual growth rings in most trees. Because the date of this ring pattern is known, scientists use it as a reference point to date older dead trees in the

Departure from Fire Return Intervals



Areas that have missed 5 to 17 fire return intervals

Missed 3 to 4 intervals

Missed 1 to 2 intervals

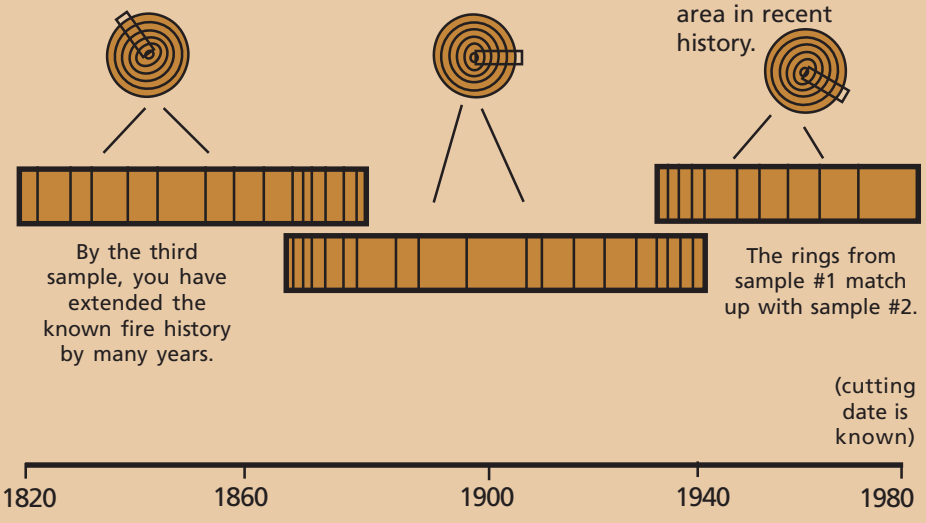
Rock, Ice, and Water

How Crossdating Works (Read figure from right to left)

3. This process can be repeated as many times as possible. Standing dead trees or logs are good sources of more information.

2. Next, you can match those patterns with other pieces of wood from the area. Perhaps logs from old cabins. This will show more ring patterns farther back in history.

1. First, you need a sample from a living tree or one with a known death date. This will show ring patterns for that area in recent history.



area. Trees that were young at the time of the drought have those small rings near their center. If scientists find a dead tree with that pattern near its outer edge, they know that it was older during that drought. They are able to work backwards from those known rings and provide dates for other scars and patterns on that previously "dateless" piece of wood. If they find other distinctive patterns, they repeat the process again, dating progressively older trees (see brown box below left).

With crossdating, the 2-3,000 year old giant sequoias become the richest history books around! Crossdating is frequently used in the parks because it does not harm living trees. For example, the samples taken in the Kaweah study (mentioned earlier) came from 91 trees, only 15 of which were living.

Fire Cycles

Fire scars not only highlight specific large fires in the past, they help us understand *fire return intervals*. This is the amount of time between fires. Fire return intervals vary depending on vegetation type. For example, a Ponderosa pine forest (4,000-5,000 feet in elevation) has a short interval of three to nine years, whereas a subalpine conifer forest (9,500-11,000 feet) has a large interval of 187 to 508 years. Fires became much less frequent at all elevations after 1900 due to European settlement in the area, livestock grazing (which removed grassy fuels), and fire suppression.

Planning for the Future

So how does all this fire history information help us plan for the future? One way is for fire managers to take the information and computerize it using Geographic Information Systems (GIS). GIS can hold and analyze data, which can be used to create maps. See the simple GIS map on the previous page depicting the areas in the park that have missed five to seventeen of their natural fire return intervals due to human intervention. The map is made by layering different kinds of data: vegetation type, historic fire return intervals, and actual fires that have burned in this century. It combines what we know about past fire cycles with what has actually burned. By using this information to plan prescribed burns, managers can reintroduce fire into the areas with the greatest need for its beneficial effects. ■

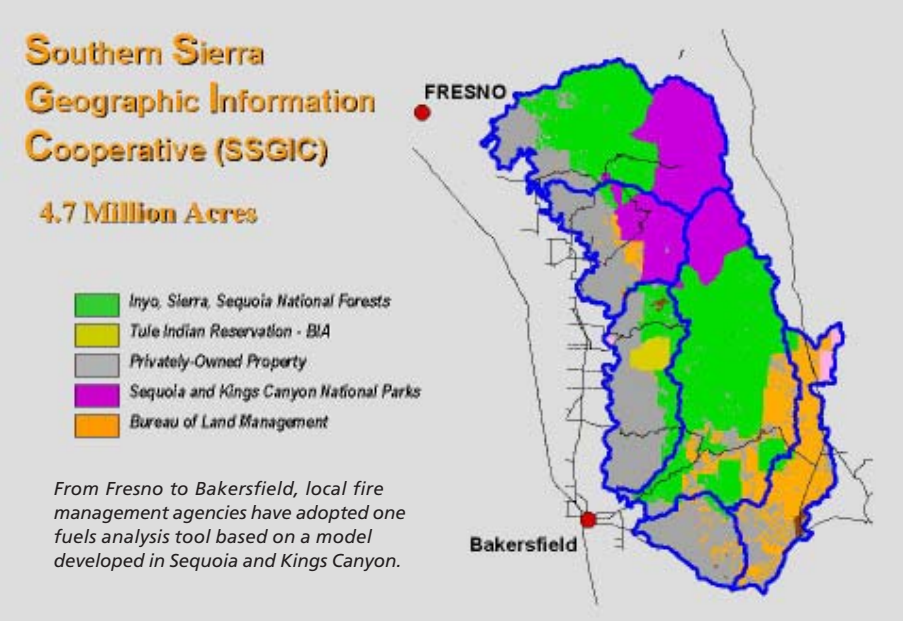
Planning with our Partners

For over three decades Sequoia and Kings Canyon National Parks (SEKI) have reduced hazardous fuels through the use of prescribed fire and now, more recently, with mechanical fuel reduction projects. In the past, locations for projects were chosen based on local knowledge and experience. While this was adequate for many years, the complexity of today's work calls for a more sophisticated method of picking project locations.

Beginning in 1996, the parks began using computerized Geographic Information Systems (GIS) to analyze fire information such as historic fires, vegetation, fuels, topography, location of infrastructure, and more. Using GIS data, SEKI fire managers developed models for analyzing complex questions. For instance, managers might ask: what area has an ecological need for restoration, is in close proximity to a community, and is not too steep to endanger firefighters or crews? Based on these chosen parameters, GIS specialists display information graphically for managers to make better decisions that will safeguard park resources and people.

Beginning in 1999, SEKI and other federal, state, and local partner agencies began adopting a landscape approach for identifying and prioritizing hazardous fuels projects. With increasing emphasis on interagency partnerships, these agencies needed a common planning method, especially in areas that were close to shared agency boundaries.

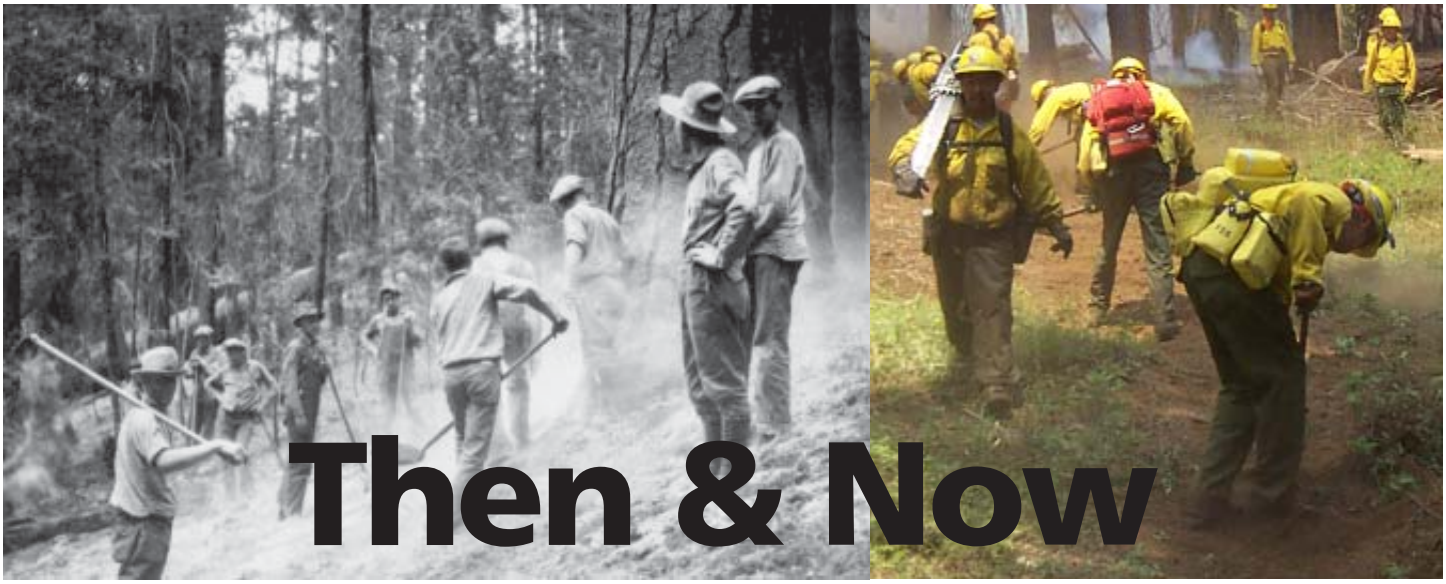
The interagency partners established the Southern Sierra Geographic Information Cooperative (SSGIC). As a result, land managers for over 4.7 million acres in the southern Sierra are using common data, analysis models, and mapping systems. Using this unified planning approach, SEKI and the other fire agencies recently identified 91,000 acres of hazardous fuels that will be collaboratively treated by local agencies over multiple years.



From Fresno to Bakersfield, local fire management agencies have adopted one fuels analysis tool based on a model developed in Sequoia and Kings Canyon.

This new interagency approach to hazardous fuels planning will benefit everyone: agencies who need to cooperate across boundaries, taxpayers who want to fund high priority projects, and residents in hazardous areas who need fuel reduction work.

For more information about this project, visit ssgic.cr.usgs.gov.



Then & Now

(Left) A crew fights a 1926 fire at Muir Grove in Sequoia National Park. *(Right)* Firefighters dig line in preparation for the Highway Prescribed Fire in 2002.

There's an old saying, "What a difference a day makes." What about years, decades, or even a century? The profession of firefighting has changed greatly since the federal government nationalized the effort in the late 1800's. Looking back on the early strategies and equipment, present-day firefighters feel lucky to have so many modern inventions at their disposal. While fire remains a powerful force, we approach it differently today than we did in the past. Take a look at a few changes between then and now.

National Park Service
U.S. Department of the Interior

Writer / Editor / Designer
Jody Lyle - Fire Education Specialist

Technical Advisors
Tony Caprio - Fire Ecologist
MaryBeth Keifer - Ecologist
Annie Esperanza - Air Quality Specialist
Ben Jacobs - Fuels Specialist
Dave Brothwell - Engine Captain
The Division of Interpretation

Map Graphics
Karen Folger - Fire GIS Specialist
Pat Lineback - GIS Specialist

Comments or Questions?
Jody Lyle
Fire Education Specialist
Sequoia and Kings Canyon National Parks
47050 Generals Highway
Three Rivers, CA 93271-9651
559 565-3703

Published in March 2003

THEN: *Mountain-top lookouts were the main detection system for finding fires. Sequoia and Kings Canyon National Parks built six fire lookouts in the 1920's.*
NOW: Fire managers detect new fires through the use of computers and aircraft. Computerized "lightning detection systems" track thousands of strikes each year. The system tells managers where every lightning strike hit in the last 24 hours. Planes and helicopters are dispatched to these specific locations to look for smoke. Sequoia and Kings Canyon no longer staff any fire lookouts.

THEN: *Early firefighters used a compass and hand-drawn maps to show where fires were located.*
NOW: Computer mapping specialists digitize fire perimeters using Global Positioning Systems (GPS). This information is used to quickly create detailed, current maps that increase firefighter effectiveness and safety.

THEN: *All firefighters were men.*
NOW: Men and women work alongside each other on the fireline. In addition to breaking this gender barrier, many minority groups have taken their place in the firefighting ranks. This diversity strengthens the collective effort and these people serve as role models for children in many communities.

THEN: *Early firefighters had simple hand tools and no protective clothing.*
NOW: Firefighters on the line are required to wear fire-retardant clothing, heavy leather boots, and helmets; carry an assortment of hand tools; and be trained in the use of fire shelters for personal protection.

THEN: *Fire was considered an enemy that needed to be eliminated from forests. All fires that were detected were aggressively fought.*
NOW: Land managers understand that fire is an important part of natural ecosystems. Fire maintains many of the landscapes that we have come to love. Each fire is evaluated individually to determine the right response. Sometimes this means full suppression and other times it means allowing a fire to spread naturally to benefit the forest. Both strategies protect natural resources and communities.

Wildland firefighters of today are proud of their profession's long tradition. The actions of early firefighters, including their successes and mistakes, continue to teach us everyday. We are able to do our jobs safely because of their hard work and experience. ■

For more fire and fuels information, visit these websites:

Sequoia & Kings Canyon National Parks
www.nps.gov/seki/fire/indxfire.htm
National Park Service
www.nps.gov/fire
National Interagency Fire Center
www.nifc.gov
Firewise
www.firewise.org