National Park Service
Fire Ecology Annual Report 2008
Sequoia & Kings Canyon National Parks and Devils Postpile National Monument

Anthony C. Caprio
Division of Resource Management and Science

Executive Summary

There was significant fire activity in Sequoia and Kings Canyon N.P. (SEKI) during 2008, which contrasted markedly with 2007. A Type II team was in the Parks, for the first time since 1996, managing suppression activities on the 3,685 ac *Hidden Wildland Fire*. Other significant fire activity included eight prescribed burns (2,098 ac) and the interagency *Tehipite Wildland Fire* (11,596 ac with 4,140 ac within Kings Canyon). SEKI was also a prototype park for the new NPS Wildland Fire Management Policy. The Fire Ecology program was involved in all these activities to a greater or lesser extent. During the year thirty-two FMH plot visits were made within eight fire monitoring types. These included two new plot installations and preburn and postburn reads of two plots. Additionally, 14 fire research plots established at Redwood Mtn. in 1969 by Bruce Kilgore were resampled. This is the fourth read of these plots which are showing interesting long-term forest changes following burns in the 1970s, particularly the abundance of sugar pine reproduction. An analysis, using FMH data in FFI, of the effects of repeat burns on fuels and overstory species in giant sequoia-mixed conifer forest plots was completed and presented at the *Southern Sierra Science Symposium* in Visalia and at the *2008 CAFE Conference* in San Diego. The analysis evaluated long-term fire effects (up to 25 yrs) and whether management objectives were being met. Additionally, FMH data sets were readied and rechecked after conversion from FEAT to the new FFI fire ecology database and analysis software prior to the start of the 2008 field season. All FMH data collected in 2008 was entered into FFI, along with data from several pre-FMH legacy data sets. Fieldwork also continued on several special projects that have or will provide supplemental information to the fire management program at both the local and national levels. This included CBI (composite burn index) field sampling for the National Landscape Assessment Project (burn severity mapping) with data collected on two prescribed burns and a "rare" wildland fire of moderate size in high elevation foxtail pine. Other projects included cheatgrass monitoring in prescribed burn units and an expanded data set evaluating fire and giant sequoia mortality (seedlings through monarchs). Special projects data has also been input into FFI. Fire ecology staff also participated as crewmembers on three prescribed burns, as READs during suppression and rehab activities on both the Hidden and Tehipite Fires, the *40th Anniversary of Operational Prescribed Fire in* the parks, and in an interagency cross-boundary fire planning exercise with Sequoia NF.

Additionally, the Fire Ecologist collaborated on a number of fire related research projects underway in the parks by USGS, USFS, NASA, or university researchers. Two summer seasonals were hired with NASA/NIFC funding in 2008 who collected data at random plot locations throughout the parks in support of data needs for an invasive species modeling study. Two studies funded by NIFC Reserve Funds were also underway. Field sampling for the WFU versus Rx fire study was carried out by USGS staff in the summer 2008 and preliminary analysis completed. Funds for the southern Sierra lodgepole fire regime study were obligated with a cooperative research agreement with Rocky Mountain Tree-Ring Research for field and sample analysis in 2009. The SEKI Fire Effects Lead, Karen Webster, continued her graduate studies (NPS funded M.S. program) at the University of Washington (Sept. to June) that will focus on the analysis of fire effects on understory plant species using data collected in the park's FMH fire effects plots over the last 25 years. Inputs or feedback (data and meetings) were also provided to the SIEN *Inventory and Monitoring Program* (Fire Ecologist joined the Science Committee in 2008) and as a member of the SEKI *Fire Management Committee.*

Considerable efforts in public outreach were also made through venues such as publications, the *Fire Information Cache* website (undergoing revision to meet the NPS CMS standards), field trips, and lectures to university classes or other groups. The Fire Information Cache was converted to the NPS mandated CMS formatted, although is in need content updates and additions.

Workload and Staffing

During 2008, 32 FMH plot visits were made in seven monitoring types (***Table 1***). Two of these visits were new installs. Full transition to the FFI (*FEAT-FIREMON Integrated*) was completed during the spring with initial data validation completed. Additionally, CBI data was collected on three 2007 fires (Wall Spring R_x, Valley View-B R_x, Willow WFU). Multiple sample points (60 total) were collected within major vegetation types in each of five severity classes (unburned, low, low-moderate, moderate, moderate-high, and high) based on ΔNBR values. SEKI has been using a slightly modified CBI protocol over the last three years, with additional data on both pre and postfire tree species cover estimated during field sampling, which is providing additional detail for analyzing fire severity responses. All CBI data through 2008 has been entered into FFI.

Table 1. Fire ecology plot workload 2008**.**

Park	Type of Plot (FMH, photo point, other)	Monitoring Unit	Installs/Pre-Burn Reads	Postburn Reads	Postburn (1-40 yrs)	Not Treated^	Total Plots#
SEKI	FMH forest	Giant sequoia-mixed conifer	1		7	3	**50 / 9**
		White fir-mixed conifer			3		**17 / 2**
		Low elevation-mixed conifer		1			**7 / 2**
		Red Fir Forest				1	**7 / 4**
		Ponderosa Forest	1	2	3		**24 / 7**
		Xeric Jeffrey Pine			1		**2 / 0**
		Buckeye Wildfire					**3 / 0**
		Blue Oak Woodland					**2 / 0**
	FMH brush	Chamise Chaparral			3		**3 / 0**
		Montane Chaparral/Sagebrush					**7 / 5**
		Mixed Chaparral					**9 / 0**
	FMH Mechanical	Thinning + Pile Burning					**10 / 0**
	CBI*†	Three 07 Burns (WFU or R_x)			60		**551**
	Cheatgrass Monitoring*†	Horse Trail/Roads End R_x			77	56	**377 / 56**
	Forest Structure	Forest Structure					**8**
	Kilgore Plots (pre-FMH)	1968 Rattlesnake R_x					**14 / 3**
		1969 Redwood Mtn. R_x			13	1	**14 / 1**
	Cedar Grove (pre-FMH)	1970 Cedar R_x	1	1			**2 / 0**
	NASA Exotics	Random Pts. Park Wide				200 (14)	**200**
	Oak Mortality	Zumwalt R_x		497 trees			**1 / 0**
		Sheep Cr. Mech.+R_x		163 trees			**1 / 0**
	Sequoia Seedlings	10 Rx Burns		8			**21 / 0**
	Expanded Sequoia Mort.	7 R_x Burns		1			**7 / 0**
DEPO	FMH Forest	Rainbow Wildfire (postfire)					**9 / 3**
	FMH Mechanical	Thinning + Pile Burning			6		**1**
	Fire Regime*	DEPO fire history					**52**
	Tree Regeneration†	Rainbow Fire Tree Regen.					**42 / 9**
Total FMH or pre-FMH			**3**	**4**	**30**	**5**	**152 / 29**
Total Other			**301**	**139**	**11**	**56**	**1058**

*Not permanent plots; †Sampled using specific rapid assessment protocols; ^Not treated = unburned "controls", #Total plots/number unburned,

Staffing during 2008 consisted of the Fire Ecologist, Lead Fire Effects Monitor, seasonal Assistant Lead Fire Effects Monitor, and three Fire Effects Seasonals (**Table 2-1 to 2-4**). The GS-6 Assistant Lead was again hired in order to recruit and retain quality fire effects monitors as well as provide an assistant to the Fire Effects Lead. A two month emergency hire during the winter back-filled for the lead monitor (out of park at graduate school) and worked on the data transition from FEAT to FFI. Additionally, two summer seasonals were hired with NASA/NIFC funding in 2008 to collected data at random plot locations throughout the parks to supply data for an invasive species modeling effort. They were co-supervised by the Fire Ecologist and SEKI's Restoration Ecologist. The SEKI Fire Effects Lead, Karen Webster, continued her graduate studies (NPS funded M.S. program) at the University of Washington (Sept. to June) that is focusing on the analysis of prescribed fire effects on understory plant species using data collected in the park's FMH fire effects plots over the last 25 years.

Table 2-1. Fire Ecology Staffing 2007. Table gives staff names, start/end dates, number payperiods worked, account information, and training for the year. All positions were arduous duty red carded.

Staff	Start Date	End Date	# of Pay Periods	READ Qualified	Training and Development
Heather McCarthy*	2/19/08 5/16/08	4/11/08 8/1/08	4# 5.5#	No	fire refresher, IT Info Security, FFI Workshop, DRMS, SEKI Safety
Chelsea Morgan*	5/27/08	11/14/08	12.5#	Yes (LQ)	S130, S190, L180, IT Info Security, SEKI Safety
Dallas Anderson *	5/27/08	11/21/08	13#	Yes (LQ)	S130, S190, L180, IT Info Security, SEKI Safety
Monica Delmartini *	5/27/08	11/21/08	13†	Yes (LQ)	fire refresher, IT Info Sec.. DRMS, SEKI Safety
Todd Erdody*	8/15/08	8/26/08	1#	NA	(backfill for FMH/NASA project)
Christi Sorrell*	6/2/08	11/21/08	12.5α	NA	IT Info Security, DRMS, SEKI Safety
Mike Stefancic*	6/2/08	8/16/08	5.5α	NA	IT Info Security, DRMS, SEKI Safety
Karen Webster	1//2/08	12/19/08	20#	Yes (LQ)	fire refresher, began MS graduate studies Univ. Washington, IT Info Security
Tony Caprio		Full Time^		Yes (LQ, O)	fire refresher, NPS, IT Info Security, DRMS, SEKI Safety

*Seasonal/temporary employee, #Account no. 8557-0801-H14, ^Account no. 8557-0021-H11, †funded by projects, αNASA/NIFC funded, LQ = READ line qualified, O = READ overhead experience

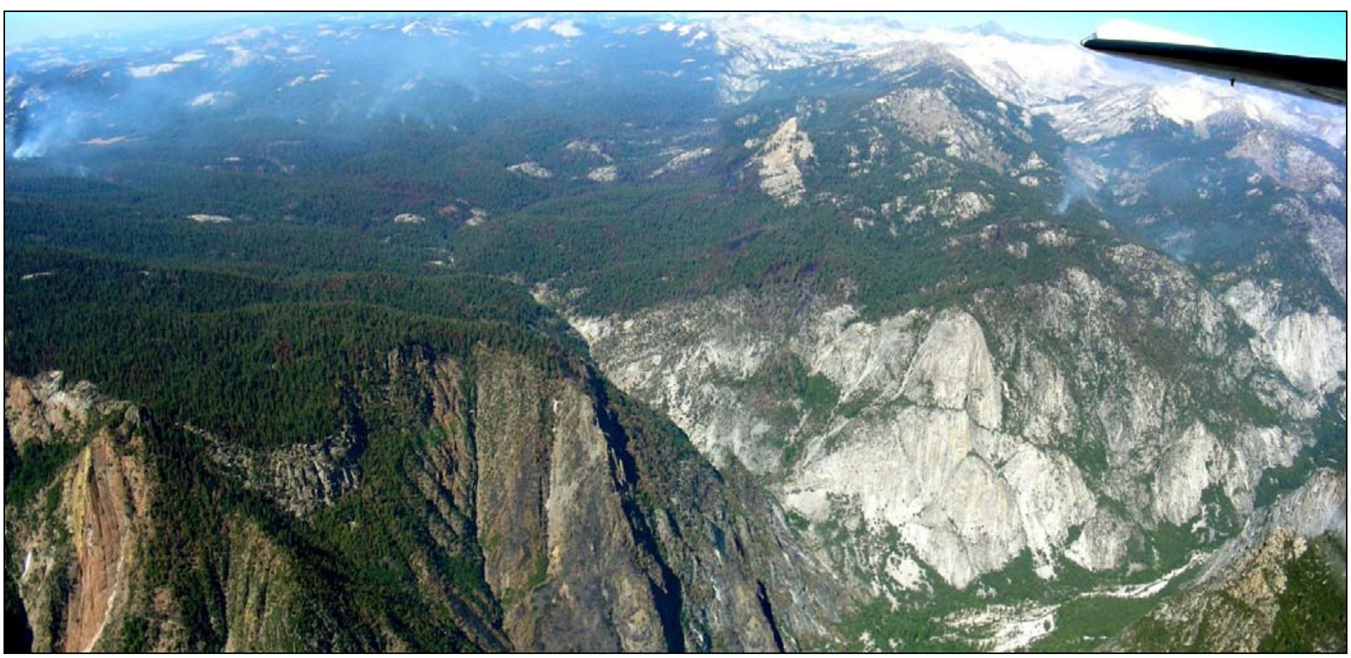

Figure 2. Aerial view of the 2008 Tehipite Wildland Fire that burned on Kings Canyon NP and Sierra NF (view is to northwest with Middle Fork of Kings River in forground). Fire was ignited by lightning on forested cliffs at lower left center of image.

Table 2-2. Fire Ecologist accomplishments and focus areas.

Category	Time (%)	Accomplishments/Focus Areas
General Planning	20%	• Annual review of SEKI Five-year Plan of Proposed Fire and Fuels Treatments • Detailed five year update to SEKI FFMP • SEKI annual fire management work plan development/implementation • SEKI Fire Management Committee member • SEKI I&M Science Committee member • Review R_x burn plans • Planning - 40th Anniversary of Operational R_x Fire in SEKI
Presentations and Field Trips (also see Public Outreach below)	7%	• Presentation and field trip for Fresno State "ecology" class • SEKI 40th Anniv. Oper. Fire Mgmt. – "*Returning Fire to the Mountains: the Good, the Bad, the Ugly"* + field trip • Southern Sierra Science Symposium – Poster on "*Integrating Fire History and Fire Management"* • Southern Sierra Science Symposium – Poster on "E*ffects of repeat fires on giant sequoia-mixed conifer forest"* • 2008 YOSE Fire Science Review – *fire & lodgepole in the southern Sierra* • DEPO GMP science scoping meeting (*fire effects and fire history/regimes*) • 2008 CAFÉ San Diego – *East Fork landscape fire history/fire regimes* • 2008 CAFÉ San Diego – e*ffects of repeat fires on giant sequoia-mixed conifer* • Camp Nelson – Fire ecology and management discussion/panel for community education meeting explaining SEKI/NPS fire management
Intrapark Support / Task Groups	7%	• Primary liaison between FMO and natural resources division • SIEN I&M landscape/forest protocol development • Wilderness Operations Annual Review • SEKI digital photography data management workgroup • SEKI campfire elevational limits and foxtail pine analysis • Sequoia tree digital GIS inventory workgroup • Edit/feedback to SEKI FIO on "Success Stories" • Div. of Resource Mgmt. & Sci. "core operations and strategic planning"
Interpark / Interagency Support	5%	• Southern Sierra Science Symposium-Interagency workgroup developing science and management needs for southern Sierra Nevada • SEKI fire info to USDA FS PSW Research Station researchers • Dillonwood Interagency Fire Exercise preparing Sequoia & Kings Canyon NP and Sequoia NF for interagency fire management in the area of the Dillonwood giant sequoia grove • SIEN I&M Science Committee •.DEPO GMP science review in YOSE • Southern Sierra Nevada PICO fire study • Joint Sequoia N.F./SEKI *Workshop on Scientific Values for the Southern Sierra* • Attended YOSE Fire Science Review and made a presentation on fire and lodgepole pine in the southern Sierra Nevada
Fire Assignments and Fuels Projects	8%	• Supervisory READ on Hidden Fire (~21 shifts) • READ for Tehipite Wildland Fire suppression activities (2 shifts)
Research	5%	• Resampled 1969 Kilgore Rattlesnake plots at Redwood Mtn. • Worked with USGS cooperators on WFU vs Rx Fire comparison (NIFC reserve funding) • SEKI fire ecology liaison to NASA/NPS/CSU project on fire and exotics. Co-supervised field crew collecting data for project. • Continued input into JFSP Wilderness Inst. "Retrospective Fire Analysis Study" for SEKI • Oriole Lake sediment study – Coop. research between Rainer Lohman at Univ. Rhode Island Graduate School of Oceanography and SEKI on fire regimes in lake sediments based on 2007 lake sampling. • Wrote funding proposal and cooperative study agreement with Rocky Mtn. Tree-Ring Research on lodgepole fire regime study (NIFC reserve funding)

Category	Time (%)	Accomplishments/Focus Areas
		• Feedback to CSU STARFIRE modeling • Summarized fire effects and CBI data to Dylan Schwilk (USGS Sequoia-Kings Canyon Research Station/Texas Tech. Univ.) for detailed analysis "*Leaf size, litter flammability, and restoration fire: Changes in stand composition influence pattern of burning*"
Management or Research Document Reviews	8%	• Fire plan reviews (Hart, Wuksachi, Zumwalt, Cedar Buffs) • Data reviews and responses to issues related to 1) fire and oaks/piñon, 2) fire and foxtail pines. • Peer reviews of research papers (*Fire Ecology, CJFS*)
F_x Field Work	7%	• Assisted & trained fire effects crew with FMH plots and CBI sampling • Field sampling methods development for NASA/NIFC invasives sampling • Cedar Grove cheatgrass – baseline sampling Roads End R_x Burn/Horse Trail R_x • Relocate plots and train crew for resampling of 1969 Kilgore Redwood Mtn. plots • PICO age structure (Chagoopa Plat.) methods development/initial sampling • Cedar Grove oak mortality survey
Data Entry	<1%	• Fire effects monitors completed all 2008 FMH data entry into FFI • Roads End/Horse Trail cheatgrass – 3 yr postfire sampling • Error checking 2008 CBI data
Data Management and Conversion	2%	• FFI implementation • Assist with post conversion checks of FMH after conversion from FEAT to FFI • Reviewed data collected for NASA/NIFC invasives project • GIS support for Fire Ecology (CBI & FMH plots, info for READs)
Data Analysis	5%	• FMH data, specifically effects of repeat fires on giant sequoia-mixed conifer • Fire and oak mortality – Zumwalt R_x • Fire climate analysis of East Fork Kaweah R. watershed fire regimes • Fire and Cheatgrass – Cedar Grove R_x units
Reports/Publications /Proposals	8%	• SEKI 2007 Div. Nat. Res. Fire Ecology Annual Report • 2007 PWR/NIFC Fire Ecology Annual Report • *Black Carbon and Sorption of PAHs in Natural Fire-Impacted Sediments from Oriole Lake (CA*). Lohman et al., Fall 2008 AGU presentation • SEKI contact for Oriole Lake JFSP • Two research/resource mgmt. funding proposals submitted in 2008 (one funded)
Supervision/Admin	8%	• Supervised lead monitor, completed evaluations • Directly supervised fire effects crew for about three months during 2008 because both crew lead and assistant were out of park at graduate school. • Hired and co-supervised GS-7 assistant for two months for FFI conversion & data verification • Co-supervised two seasonals working on NASA/NIFC invasives project • Travel, credit card, and payroll paperwork • Budget; fire ecology/effects and NASA/NIFC study • Develop PICO study cooperative research agreement with Rocky Mtn. Tree-Ring Research
Training & Professional Development	5%	• Firefighter refresher + Aviation training/refresher • AFÉ Conference – Tucson, AZ (Jan.) • CAFÉ Conference-San Diego, CA (Dec.) • Attended Sametime/conference call training sessions • Physical Training (PT)
Miscellaneous	5%	• SEKI Div. Nat. Resources (strategic planning) & SEKI USGS input/coordination related to fire operations and research needs.
Public Outreach	<1%	• Fire Information Cache, SEKI Fire Portal • Fresno State - ecology class • Interviewed by several newspapers (LA Times) • Panel and discussion on NPS fire management to Camp Nelson community meeting (local community south of park)

Table 2-3. Fire Effects Crew Accomplishments. The following time estimates are based out of the total number of weeks the fire effects crew worked (roughly 12 pay periods).

Category	Time (%)	Notes
FMH plots	40%	• Completed 32 reads. Installed two plots (One unburned PIPO & one SEGI) • Plant identification
WUI plots	<5%	• four plot reads
CBI plots	5%	• Installed 60 plots for Wall Spr. R_x, Valley View R_x, and Willow WFU.
Other plot work	10%	• Increasing giant sequoia sample size • PICO field sampling • NASA plots (sampled 9 plots) • Giant sequoia seedlings in reburns • Giant sequoia trees of special interest • Cheatgrass monitoring • 1969 Kilgore Redwood Mtn. plot sampling (14 plots reread) • 1970 Cedar Grove burn plot pre- and post Cedar Bluffs R_x Burn rereads
Fire Assignments and Fuels Projects	15%	• Crew members assisted on three prescribed burns. Three crewmembers worked as READs and assisted/monitored postfire rehab on the Hidden Wildland Fire (~28 shifts).
Data Entry	10%	• Completed data entry for 2008 data (FMH, CBI, Kilgore, Spec. Projects)
Database Maintenance	5%	• Error checking converted FEAT to FFI data and other database cleanup tasks.
Data Analysis	<2%	• Independent crew projects
Training and Professional Development	10%	• Two crewmember attended S130 and S190 • Three crewmembers attended fire refresher training • All crewmembers participated in PT • All crewmembers attended mandatory park trainings (defensive driver, hazmat etc) • Three crew members READ trained on Hidden Wildland Fire
Miscellaneous	0%	

Figure 3. READ (Resource Advisor) on 2008 Hidden Wildland Fire evaluating effects of the burn and suppression activities on the few giant sequoias in the Skagway Grove that were within the fire perimeter. All control lines were rehabed in the fall of 2008.

Table 2-4. Lead Fire Effects Monitor Accomplishments. The following time estimates are based out of the total number of weeks the lead fire effects monitor worked (20 pay periods).

Category	Time (%)	Notes
FMH plots	20%	• Completed 30 reads, installed three plots.
WUI plots	5%	• Completed four plot reads.
CBI	0%	
Other Plot Work	<1%	• Crew projects
Fire Assignments and Fuels Projects	0%	
Data Entry	<1%	
Data Management	15%	• Some error checking of data converted to FFI from FEAT • Error checked data entered from 2008
Data Analysis	35%	• Data analysis for thesis (fire & understory vegetation in FMH plots)
Supervision/Admin	20%	• Hired and supervised four fire effects monitors; • Seasonal evaluations, • Time, travel and other administrative paperwork
Training & Professional Development	5%	• Attended graduate level courses at University of Washington • Completed fire refresher training • Participated in PT
Miscellaneous	0%	

Management Objectives and Monitoring Results 2008

An updated summary of results is presented through 2008 for the four primary monitoring units (***Table 1-1***). Monitoring over the last three decades has primarily emphasized giant sequoia, white fir, and low-elevation mixed-conifer vegetation. Recent sampling has been directed at mechanical treatments, red fir, and xeric conifer (Jeffrey pine/greenleaf manzanita), although sample sizes remain limited for the latter protocols. Plots will be added as implementation of prescribed burn treatments continues within the types. Currently the mechanical treatment plots are providing the only quantitative documentation of effects and effectiveness (fuel reduction or changes in stand density) of the treatments. Data suggest density and fuel reduction objectives are not being met. Increases in fine fuel from the thinning operations might be responsible for the increase in fuel loading post treatment. The analyses of mechanical treatment data also indicate plots may need to be analyzed at by vegetation type to better understand treatment effects. Mechanical treatment objectives are being reviewed by fire management and natural resources staff based on treatment results, plot data, and new research results.

Over the past several years discussions have occurred about fire effects in xeric conifer vegetation (now classed as *Jeffrey pine/greenleaf manzanita woodland* in SEKI’s new vegetation map). These are primarily open-to-moderately-closed stands of Jeffrey pine with a manzanita understory. These often burn with a high intensity headfire through the shrub understory with considerable impacts to overstory trees. Many of these trees are old-growth—many centuries old—indicating they survived repeated past fires (also documented by fire history data). The question raised is whether vegetation and/or fuels in this community have changed so dramatically since the 1860s that fire restoration under current prescriptions is having negative impacts. Since additional burns are planned in this type a monitoring unit is being developed and plots installed as burn plans are written and burns occur. Similar concerns are being raised for other xeric forest communities, i.e. western juniper and single-leaf piñon pine. These two communities have limited distributions in SEKI and are thus susceptible to long-term negative impacts. Both species have very limited resistance to fire other than survival in “safe sites” where ignition or fire spread is unlikely. This information was used to modify aerial ignition patterns during the 2008 Cedar Bluffs R_x Burn so old growth piñon pine was not forced to burn.

Several long-term “special study” projects were continued in 2008. These include data collection on giant sequoia mortality (seedlings and large mature trees), fire and sugar pine mortality, and named tree inventory (named giant sequoias). Each project is assigned to a seasonal crew member as an individual summer project.

Table 3. **Management objectives and monitoring results for 2008.** Fuel reduction objectives/results are mean percent reduction from preburn to immediate postburn. Stand density objectives/results are for live stand density five years postburn with 10 year results also provided if available. Stand composition at five years post-burn is also given for giant sequoia-mixed conifer. Results from “initial” and “second” entry restoration burns in giant sequoia-mixed conifer are shown. When the “n” value for number of plots is underlined the minimum sample size has been attained for that variable.

Monitoring Unit	Management Objective (Restoration)	Monitoring Results	N	Objective Achieved?
Giant sequoia-mixed conifer forest	**Initial Entry Restoration Burn**			
	60-95% total fuel reduction:	Total fuel reduction = 72.4%	*31*	**YES**
	5-yr postburn stand density: 50-250 trees/ha <80 cm DBH 10-75 trees/ha ≥ 80 cm DBH	5-yr stand density = 575 trees/ha <80 cm DBH 46 trees/ha ≥ 80 cm DBH	*29*	**NO** (<80 cm) **YES** (>80 cm)
		10-yr stand density = 324 trees/ha <80 cm DBH 42 trees/ha ≥ 80 cm DBH	*28*	**N/A**
	5-yr postburn stand composition: 40-80% fir, 10-40% sequoia, 5-20% pine	Fir = 73.5% Sequoia = 8.4% Pine = 12.0% Other = 6.2%	*31*	**YES** (except sequoia low)
	Second Entry Restoration Burn			
	Total fuel reduction:	Total fuel reduction = 38.5% Change from 1st to 2nd Prefire = -17.3 %	*21*	**N/A**
	5-yr postburn stand density:	5-yr stand density = 166 trees/ha <80 cm DBH 39 trees/ha ≥ 80 cm DBH	*14*	**YES**
		10-yr stand density = 97 trees/ha <80 cm DBH 43 trees/ha ≥ 80 cm DBH	*6*	**N/A**
	5-yr postburn stand composition:	Fir = 70.3% Sequoia = 17.4% Pine = 12.3% Other = 0%	*14*	**YES**
White fir-mixed conifer forest	60-95% total fuel reduction	total fuel reduction = 62-85%	*11*	**YES****but minimum sample size too small
	5-yr postburn stand density: 50-250 trees/ha <80 cm DBH 10-75 trees/ha ≥ 80 cm DBH	5 yr stand density = 652 trees/ha <80 cm DBH 37 trees/ha ≥ 80 cm DBH	*10*	**NO** (<80 cm) **YES** (>80 cm)
		10 yr stand density = 401 trees/ha <80 cm DBH 33 trees/ha ≥ 80 cm DBH	*10*	**N/A**
Low elevation-mixed conifer forest	60-95% total fuel reduction	total fuel reduction = 75-93%	*5*	**YES*** but sample size too small
	5-yr postburn stand density: 50-250 trees/ha <80 cm DBH 10-75 trees/ha ≥ 80 cm DBH	5 yr stand density = 542 trees/ha <80 cm DBH 22 trees/ha ≥ 80 cm DBH	*5*	**NO** (<80 cm) **YES** (>80 cm)* but sample size too small
		10 yr stand density = 316 trees/ha <80 cm DBH 17 trees/ha ≥ 80 cm DBH	*5*	**N/A**
Mechanical Thinning + Pile Burning	Reduce fuels to < 12 tons/acre immediate post treatment*	Fuel load = 52 tons/acre post (total fuel reduction 22%)	*9*	**NO**** but sample size too small
	Immediate post treatment stand structure: maximum of 25 trees/acre < 22.9 cm DBH*	Stand density = 17 trees/acre < 20 cm DBH (range 8-61)	*9*	**YES*** * but sample size too small

* Excluding DEPO plot.

Other Fire Ecology Accomplishments or Projects

SEKI 40th Fire Anniversary Workshop

Both the Fire Ecologist and Fire Effects Seasonals participated in the workshop and/or field trip. A presentation on "*Returning Fire to the Mountains: the Good, the Bad, the Ugly*" was given.

Studying the Past to Plan for the Future: Reflecting on 40 Years of Fire Management

Excerpts from Success Story about the workshop written by Deb Schweizer, SEKI FIO.

The parks held a meeting in June that invited many of the orginal research scientists and fire managers, along with contemporary park, regional, and national.leaders within the National Park Service, and USGS and Forest Service partners. The intent was to honor and to learn from those who implemented these changes as well as those who developed the fire program in the succeeding years. Discussion centered on what they did and did not accomplish and why. The parks' current fire managers sought their advice for the current and future fire program. A few of the noted names in attendance were Howard Shellhammer and Bruce Kilgore. Both were integral to the first sequoia fire studies.

Figure 4. Fire effects crewmember, Monica Delmartini, explaining use of a laser rangefinder, used to measure tree height, to Bruce Kilgore and Dan Taylor at one of their 1969 Redwood Mtn. plots while on the workshop field trip. The fire effects crew was doing a 40-year resample of the plot.

Park managers recognize that the foundation to a good science-based program is to constantly re-evaluate assumptions and test their soundness. This meeting also challenged these invitees as well as today's scientists and managers to discuss issues including global climate change, the results of fire exclusion on fire behavior, increasing wildland –urban interface, and air quality to consider what it means for the future of fire management.

Among the lessons taken from this meeting are:

- Sequoia & Kings Canyon National Parks truly hold a historic role in federal fire management history. This history should not be lost.
- The long tradition of a science-based fire management program in the parks has improved the program and should be continued
- Many of the decisions of the last 40 years were controversial, politically opposed, and contrary to years of conventional wisdom. Leaders of today must also back innovative programs that can advance the health of park ecosystems even in the face of resistance.
- Public perceptions of fire management have a direct effect on the activity of a prescribed fire and wildland fire use program. Continued education and outreach for the fire management program must continue.
- Managing fire into the future brings a great deal of uncertainty, especially related to global climate change. However, it is clear that the parks must continue with their fire management program which will encourage ecosystem resiliency. Science holds the key to knowing how to adapt to these changes.

Perhaps, most importantly, this meeting brought together some of the most experienced professionals in fire management, both past and present, and challenged them all to consider how fire management proceeds for the next 40 years.

Effects of Repeat Fires on Giant Sequoia-Mixed Conifer Forest

Analysis presented at *Southern Sierra Science Symposium* and *California Association for Fire Ecology Conference*.

Effects and Response of Giant Sequoia-Mixed Conifer Forest to Repeat Restoration Burns, Sequoia and Kings Canyon National Parks. Anthony C. Caprio: SEKI Division of Resources Management & Science and MaryBeth Keifer: N.P.S., National Interagency Fire Center

Abstract

Prescribed fire has been used to reduce fuels and restore natural processes in the parks since 1968. A fire effects monitoring program was initiated in 1982 and specific fuel and vegetation target conditions for restoration (structural) and maintenance (process) goals were developed to assess progress towards achieving program objectives. Now that some areas of giant sequoia-mixed conifer forest have undergone two restoration burns, 6-18 years apart (pre-EuroAmerican fire return intervals were 5-25 years), long-term results and objectives are being reevaluated. Data has been collected at 33 burned and nine unburned plots located in eight sequoia groves that received no mechanical thinning prior to treatment with prescribed fire. Pre-fire tree diameter class distribution was weighted toward small shade tolerant tree species, with limited regeneration of giant sequoia or other shade intolerant species. Fuel loads averaged 14.2 kg·m^{-2} (63.4 t·ac^{-1}) (range 4.4 to 37.6 kg·m^{-2}), a result of up to 150 years of fire exclusion. Initial burns reduced stand density, of trees greater than 1.4 m height, 59% by 10-years postfire, achieving management objectives. Five years after the second burn, stand density was 72% of the original pre-fire density. Total basal area remained relatively constant after the two burns but quadratic mean tree diameter increased as densities declined. Mortality was greatest in smaller diameter size classes (<40 cm) and was proportionally greater in white fir than sugar pine or red fir with little giant sequoia morality. Both fir and giant sequoia seedling densities increased following the restoration of fire. Shrubs were the primary understory component that responded to the burns with substantial cover increases 10 years following the initial burns with this shrub response persisting through the second burn. A similar but less pronounced response was observed in forbs but not graminoids. Total fuel loads were reduced 74% by the initial burn and 40% by the second. Fuels returned to pre-fire levels in about 10 years, although composition shifted, with the duff fraction declining and the fraction of woody fuels increasing. Heavy 1000 hour sound fuels were the primary component of postfire fuel accumulations, exceeding original pre-fire loads by 44% and 165% 10 years following the first and second burns respectively. These findings suggest that at least two, and potentially more, restoration burns are needed to restore fuel and vegetation conditions in giant sequoia forests and that 150 years of fire exclusion cannot be undone quickly.

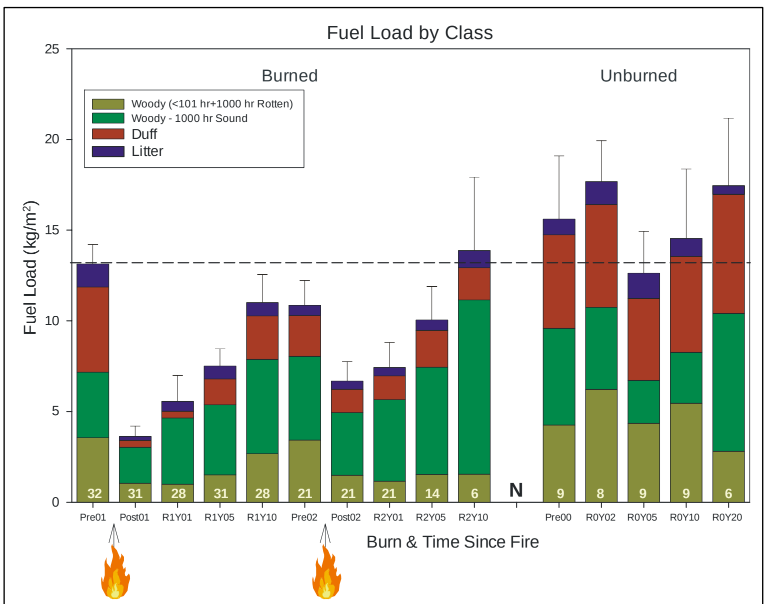

Figure 5. Fuel load changes by fuel type for 10 years following one and two fires in giant sequoia-mixed conifer forest. Variation in unburned plots is shown at right. Error bars are ±1SE and N is sample size.

Data Overview

Data from 42 FMH plots (Fire Monitoring Handbook 2003) collected in giant sequoia-mixed conifer forest over the last 26 years were analyzed. Repeated pre- and post-burn measurements were made in 33 plots burned at least once with 22 of these burned two times. Nine additional plots remained unburned and provided a measure of non-fire related variation over the 20+ years of sampling. Fuel loads ("litter", "duff", "1000 hr sound", and "fine woody+1000 hr rotten") returned to pre-fire levels by 10 years post-burn after both the first and second burns. Pre-burn fuel loads, which averaged 14.2 kg·m^{-2} (63.4 t·ac^{-1}) (range 4.4 to 37.6 kg·m^{-2}), were reduced 74% and 40% after the first and second burns respectively.

However, following the second burn fuel composition changed from being primarily composed of litter/duff preburn to being primarily composed of large diameter woody material (>3 inch diameter 1000 hr sound) (**Fig. 5**). Heavy 1000 hour sound fuels exceeded original pre-fire loads by 44% and 165% 10 years following the first and second burns respectively Lower consumption during the second burn was probably a result of fuels being more patchy with less litter/duff to carry fire and often composed of larger diameter sound woody material that frequently was not completely consumed. Similar changes were observed following repeat fires in Bruce Kilgore's 1968 red fir-mixed conifer plots burned in 1968 and 2001 and resampled in 2007 (see 2007 Annual Report) where trees killed by the 1968 prescribed fire remained standing as snags but fell during or after the 2001 Burnt WFU (**Fig. 6**). This may suggest a general long-term pattern in post-fire fuel accumulation in these forest types. Overall basal area in giant sequoia-mixed conifer forest declined little following the two burns indicating tree mortality primarily occurred in smaller size classes, although basal area was dominated by large giant sequoia trees. Quadratic mean diameter increased over time at burned but not in unburned plots, again, apparently the result of proportionally greater mortality of smaller diameter trees than large trees. Changes in the size class distribution of major tree species following burning also indicated fire caused tree mortality was principally occurring in smaller size classes (<40 cm) of white fir. Prior to the burns there was limited seedling establishment of any species, but particularly of giant sequoias, which were essentially absent due to 100+ years of fire exclusion. Post-fire establishment of both fir species and giant sequoias increased substantially. Coincidently, over all tree density decreased during both burns, compared to little change at unburned plots. Five years following the initial burn density of trees greater than DBH height had decreased 59% and by five years following the second burn had decreased to 72% of pre-fire levels. This has resulted in a very apparent opening of the forest when pre- and post-fire photo-point images are compared. Density decreases primarily occurred in white fir and incense cedar. There was little overall change in giant sequoias density, although some mortality of sequoia reproduction, which established after the first fire, was observed following the reburn (53% overall but highly variable among burns). Additionally, immediately post-fire, total understory cover by life-form declined slightly, but exceeded preburn levels by one year post-fire. By 10 years following each burn total understory cover exceeded preburn cover. Shrubs and ferns were the primary increasers with cover increases persisting through the second burn. Much of the post-fire shrub response appeared to be a result of the germination of species found in a soil seed banks (species such as deer brush [and white thorn [).

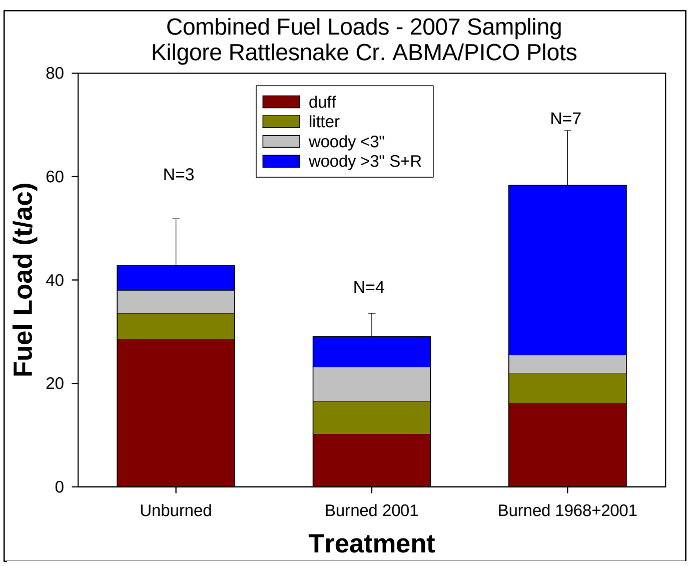

Figure 6. Averaged fuel loads (tons/acres) by type (duff, litter, woody <3 in. dia., and sound+rotten woody >3 in. dia.) for the Rattlesnake plots that have been burned twice (1968 + 2001), burned once (2001), and are unburned. Duff fuel has been reduced by fire (even though sampling occurred 6 years postfire) while larger sized fuels (>3 in. dia.) increased following the second burn. Long-term reduction of litter and small woody fuels is not apparent

Summary

We analyzed data from 42 FMH plots collected in giant sequoia-mixed conifer forest over the last 26 yrs. Our objectives were to document and quantity broad changes occurring in sequoia groves that have experienced repeat burns. This information will be used to assess whether burns are meeting overall management objectives and if new objectives should be developed following multiple burns. Repeated pre- and post-burn measurements were made in 33 burned (22 burned two times) and nine unburned plots. Results showed total fuel loads neared preburn levels by 10 years post-fire after each burn but fuel composition shifted from being primarily litter, duff, and rotten logs to being largely composed of 1000 hr sound fuels (logs >3 in. dia.). This accumulation was the result of fire caused of tree mortality with accumulation accelerating following reburns. Several measures highlighted changes in forest structure with decreased stand density and the persistence of larger diameter trees. Mortality of overstory giant sequoias was negligible with significant reductions of white fir and incense cedar. Seedling numbers of both firs and giant sequoias were substantially greater following reintroduction of fire. This is particularly important for giant sequoias because the species has experienced little regeneration prior to fire's reintroduction. Understory cover, particularly shrubs and ferns, increased as the canopy opened and fire apparently stimulated seed bank germination. Following 100+ years of fire exclusion our findings suggest that two or more restoration burns are needed to restore fuel and vegetation conditions in giant sequoia-mixed conifer forests but that the original objectives of the burn program are largely being achieved.

Figure 7. Photo-point series from giant sequoia plot 75 in Grant Grove from 1990 through 2007 with burns in 1992 and 2005 showing decrease in understory trees and the opening of the stand.

Cedar Bluff Prescribed Burn and Piñon Pine – Integrating Ecological Information and Burn Planning

While single-leaf piñon pine *(P. monophylla)* is common in the Great Basin, populations of this species, often found mixed with large old canyon live oaks (*Q. Chrysolepis),* are rare on the west slope of the Sierra Nevada. In Kings Canyon moderately extensive stands exist on the steep rocky slopes often surrounded by ponderosa or Jeffrey pines found on somewhat less extreme sites. However, unlike ponderosa pine and many other Sierran tree species, piñon possesses little resistance to fire and is subject high levels of mortality by even light burning. Fire history sampling in Kings Canyon documented that the stands sampled were all three to five hundred years old without evidence of spreading fire (**Fig. 8**). In contrast, nearby ponderosa/Jeffrey pine forest had a record of repeated frequent fire (3-7 years). Additionally, both the 2005 Comb and 2006 Roaring WFU fires provided examples of this process after burning into the margins of piñon stands, but generally not spreading into the stands because of the broken terrain and light fuels. Because of this information, recommendations were made to adjust burn plans and operations to exclude piñon stands during ignition, although not from subsequent fire spread. Review of the postfire effects of the burn indicated the operations were successful with burning of the long-needle pine forest but little fire spread into piñon, most likely because of rocky terrain and barriers to fire spread. The successful operation was detailed in a "Success Story" by Deb Schweizer (attached below) that "*demonstrated the successful integration of ecological information with burn implementation.*"

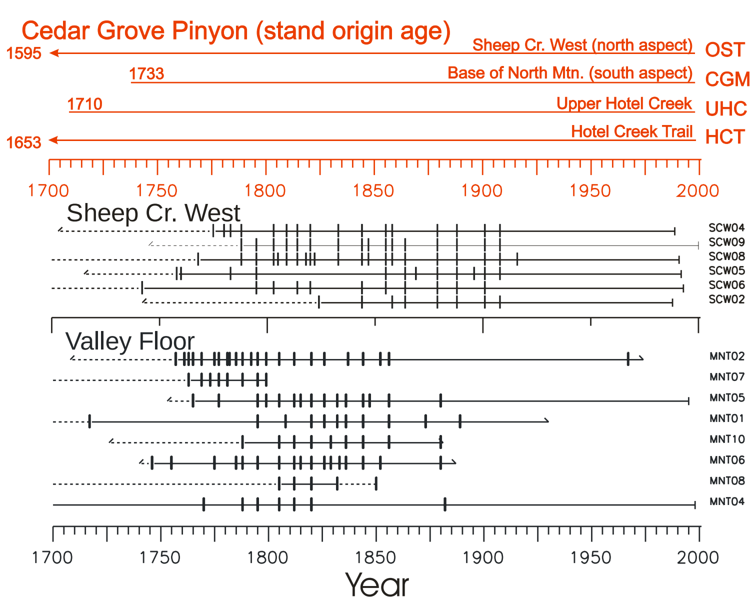

Figure 8. Piñon stand age (in red at top with stand age at left) and fire scar chronologies from adjacent long-needle pine sites in Kings Canyon. Each piñon stand sampled is represented by a single horizontal, while horizontal lines at the two long-needle pine sites represent individual trees with vertical tics indicating specific fire dates.

Advantage in Timing: Cedar Bluffs Prescribed Fire,
Success Story, *Deb Schweizer, Fire Education Specialist*

Fire managers in Sequoia & Kings Canyon National Parks seized an opportunity to complete a prescribed fire in Cedar Grove that provided safer control measures while also achieving key ecological goals.

Timing was everything for this project. This prescribed fire unit, located along the Kings River drainage in Kings Canyon National Park, adjoined to the area burned by the Roaring Fire of 2006. The 2006 lightning fire grew to over 1,700 acres and cleaned the forest floor of accumulated woody debris. When completing the 1006 acre Cedar Bluffs Prescribed Fire, fire managers knew that the south flank of the unit would be controlled when the fire spread upslope into the Roaring Fire area and extinguished in the absence of available forest fuels.

Additionally, there was a lesson provided by the Roaring Fire that the parks' fire ecologist listened to. The vegetation in the Cedar Grove area is composed of the mixed conifer vegetation type as well as areas of live oak and single leaf piñon pine. Historically, fire naturally occurs approximately every fifteen years in the mixed conifer forest of the Sierra Nevada. However, live oak and piñon pine forests experience natural fire infrequently. The 2006 Roaring Fire backed into these areas and went out on its own.

The mixed conifer forest species have adapted to fire over thousands of years and thrive in a natural cycle of low severity fires. Fire helps thin this forest, opening the canopy and allowing sunlight through. It recycles nutrients to the soil while reducing the amount of dead, woody debris. This aids the sprouting and re-growth of plants, shrubs, and trees. Fire also helps to create a mosaic of diverse habitats for plants and animals.

Mature piñon pine and live oak forests are rare to the western slopes of the southern Sierra Nevada and are not fire tolerant. Fires often burn around the piñon/oak areas because the vegetation is sparsely spaced. Piñon nuts are and important food source for birds and animals in the parks.

By observing the fire behavior of the Roaring Fire, and under the direction of the fire ecologist, fire managers attempted to simulate the natural pattern of fire in this area. Ignitions were completed in the mixed conifer forest while the live oak and piñon pine areas were deliberately avoided. The fire behavior was similar to a natural fire event. The forest floor was cleansed of accumulated forest fuels in the mixed conifer forest and the fire naturally did not carry into the oak/piñon areas.

"The Cedar Bluffs project provided an excellent opportunity to verify our prescribed fire methods," said Tony Caprio, the parks fire ecologist. "Prescribed fires are set under pre-determined conditions that consider safety, control, and simulating natural fire events for ecological goals. This project demonstrated the successful integration of ecological information with burn implementation.

SEKI/DEPO Fire Research Projects and Collaboration

Projects Completed 2008

Learning from the Past: Retrospective Analyses of Fire Behavior in Yosemite and Sequoia-Kings Canyon National Parks. JFSP funded 2004; PI Wilderness Institute, Carol Miller and Anne Black; YOSE, Mike Beasley; SEKI, Anthony Caprio

Yosemite and Sequoia-Kings Canyon National Parks have identified a critical need to be able to understand and track the consequences of their fire suppression decisions. To address this local research need, we will use retrospective fire behavior modeling and risk-benefit assessments for suppressed lightning ignitions that have occurred since 1991 in the two Parks. For the first time, the Parks will be able to quantify the consequences of their suppression decisions. We will determine where lightning ignitions would have spread had they not been suppressed and we will assess the effects that would have resulted from these fires. The proposed project combines fire behavior modeling technology with the information contained in the Parks' fire records and the local experience of the current fire management staff to better understand and quantify the consequences of suppression decisions. Results from our analyses will be compiled and presented in a GIS data library that will allow easy reference for managers during the fire season when making the decision whether or not to suppress, when preparing Stage III Wildland Fire Implementation Plan (WFIP) analyses, and when developing appropriate management response on suppression incidents. Furthermore, the project will develop methodology and step-by-step procedures for conducting these retrospective analyses so that Park fire management staff can update and add to this information resource annually. The information and understanding generated by this research will improve the prioritization and planning of fuels management activities by supplementing the Fire Return Interval Departure analysis that is routinely done by both Parks. The results of our analyses will allow park managers to frame future decisions and cost-benefit analyses in the context of past experiences, to track the cumulative effects of suppression, and to communicate tradeoffs to the public and other governmental entities. As all land managers need to understand and track the consequences of their fire management decisions, the methods we develop will have broad national applicability and will provide a template for conducting similar analyses.

Current Projects

Effects of Prescribed Fire versus Wildland Fire Use in Sequoia and Kings Canyon and Yosemite National Parks Jon E. Keeley, Anthony C. Caprio, and Jen Hooke. *(Funded)*

Since the late 1960s and early 1970s Sequoia, Kings Canyon and Yosemite national parks have had a formal program for managing natural lightning-ignited wildland fire use fires (WFU) and applying prescribed fire (R_x). The long history and widespread application of both practices to a range of forest types provides a natural laboratory to compare resulting effects and burn patterns. There will be close collaboration with fire managers in order to fully understand the prescriptions and protocols associated with each of these fire types. Results will be valuable to managers because large areas within the parks are being managed with R_x burning due to various constraints.

Burn patterns will be determined from fires occurring within the last 5 years and severity patterns from fires within the past 10 years. For both we will determine percentage area burned by fire severity class based on measures of tree crown scorch height. We will also map patterns of tree demography in both burned and unburned patches and evaluate understory recovery among severities. We will focus on paired comparisons between recent R_x and similar aged WFU fires in areas of similar forest types, elevation, slope, and aspect. Data collection will center on field sampling, since Landsat fire severity maps are available for all fires over 300 acres in the last 10 years and EROS data center can provide digital maps of smaller prescribed burns. We will use these data to evaluate the ability of remote sensing data for capturing differences in fire type.

We will test hypotheses related to patterns of burn heterogeneity such as: 1) do WFU fires exhibit a significantly different proportion of area within the fire perimeter in unburned patches than R_x fires, 2) do WFU fires exhibit a significantly different proportion of high severity burning, 3) do WFU fires exhibit significantly greater or lesser variance in the size of high severity patches than R_x fires, and 4) is fuel consumption more or less heterogeneous in WFU fires than in R_x?

A second component of this study is to better understand patterns of forest regeneration and biodiversity. We will examine several response variables within each patch type and test hypotheses such as: 1) within high severity patches is regeneration (trees < 1.37 m tall) significantly different from either unburned patches or the low severity matrix in which both patch types are embedded, 2) within unburned patches is regeneration (trees < 1.37 m tall) survivorship significantly different than in either high severity patches or the low severity matrix in which both patch types are embedded, 3) in burned areas not classified as high severity, is the variance in fire severity (measured by crown scorch height and bole char height) significantly different than in WFU fires than in R_x fires, 4) in both high severity patches as well as the surrounding matrix of low severity surface fire, is proportional mortality significantly different in smaller DBH classes, 5) in both high severity patches as well as the surrounding matrix of low severity surface fire, is proportional mortality significantly different in white fir (*Abies concolor*) than associated species, and 6) as the heterogeneity in burning patterns increases does plant biodiversity increase?

Using NASA's Invasive Species Forecasting System to Support National Park Service Decisions on Fire Management Activities and Invasive Plant Species Control. NPS PI: Nate Benson, NASA PI: Jeff Morisette, CSU PI: Brad Welch (SEKI fire ecology liaison: Anthony Caprio).

Two major sources of ecological disturbance are fire and invasive species. They are not independent. Both are major issues affecting land management decisions throughout the National Park System. The proposed work will allow the National Park Service to enhance management decisions related to invasive species and fire management. The approach is to utilize existing Earth Science resources to better understand the interaction between fire, burnt area, and invasive species, and then to utilize this understanding to better manage National Park lands in such as way as to respect the natural ecological significance of fire while guarding against alien plant invasion. The Earth Science tools to be used are satellite-based active fire and burn scar mapping available through NASA Earth Observing System (EOS) resources and invasive species habitat modeling available through the existing, joint NASA/USGS "Invasive Species Forecasting System" (ISFS). Study areas include Sequoia and Kings Canyon National Parks, Alaska Region, and Yellowstone & Grand Teton National Parks with local support from invasive species managers, fire ecologists, and GIS specialists.

Figure 9. *(left)* 2007 Willow WFU fire (during fire at left) in high elevation foxtail (*Pinus balfouriana*) and lodgepole pine (*P. contorta*) in Big Arroyo (Sequoia N.P.). Such fires are relatively uncommon and usually involve single trees. Without continuous surface fuels this fire primarily spread by spotting among scattered patches of fuel. Highly resinous foxtail pine logs burn readily once ignited (Photos by SEKI Fire Monitors). *(right)* Postfire effects on the same hillside observed during CBI sampling one year after burn.

***Effects of Prescribed Fire on Understory Vegetation in Mixed-Conifer Forests of the Southern Sierra Nevada, California*.** NPS Karen Webster.

Background - National Park Service (NPS) policy requires fire managers to define and evaluate restoration objectives and results (NPS RM-18). Evaluation is assessed via a national standardized fire effects monitoring program (NPS FMH 2003). For more than 20 years Sequoia and Kings Canyon National Parks (SEKI) and most other land managers have primarily used overstory tree and fuels data to determine success of reintroducing fire to mixed-conifer forests. It is assumed that by restoring overstory tree structure and fuel loading, other aspects of the community will automatically follow. Although extensive, long-term data on understory vegetation have been collected as part of the national NPS fire effects program, they have not been examined quantitatively, limiting our ability to assess the effectiveness of prescribed fire for restoring other important components of these forests (e.g., understory structure and biological diversity). The majority of biodiversity in the mixed-conifer forests occurs in the understory. In particular, the southern Sierra Nevada mixed-conifer is home to the greatest vascular plant species richness as well as endemic and rare plants (Shevock 1996).

NPS policy requires fire managers to define and evaluate restoration objectives and results. Objective 3 in the SEKI Fire and Fuels Management Plan (FFMP) specifies that we will “Understand the consequences of fire management actions”. This research will address the following major tasks under Objective 3: (1) The project will provide information on plant community responses to fire. This information is lacking and identified as an important research need in SEKI’s FFMP, Appendix D, Fire and Fuels Research Plan. (2) The results will help managers to refine both the planning and execution of management activities. For example, understanding the differences in understory vegetation between untreated and fire treated forests will assist managers in making decisions regarding fire treatment and suppression actions. Also, knowledge of how fire frequency affects understory vegetation can help managers to schedule future treatments, which is a critical part of the fire program’s success. (3) Measurable understory vegetation objectives and structural goals are currently non-existent. The results will begin the process of adding an understory vegetation component to restoration and maintenance target conditions, which are used to gauge overall program success. The research will support development of desired future conditions and quantifiable understory vegetation objectives.

This research project will also contribute to our continuing understanding of non-native plant responses to fire and thus assist the parks in adjusting management actions as necessary. Finally, this research will provide the opportunity to analyze existing long term fire effects monitoring data sets, which is encouraged at the regional and national NPS Fire Ecology program levels. Understanding the broader range of ecosystem responses and incorporating that knowledge into the fire management program is particularly important as managers face ever increasing constraints (air quality regulations, fiscal limitations, non-native species) and are directed to use more creative methods in applying fire (e.g., changes in the season or frequency of burning).

The project will provide information on plant community responses to fire that is lacking. Most studies on understory vegetation in the Sierra mixed-conifer forest involve thinning and burning and are of short duration (Wayman and North 2007; Knapp et al. 2007) or are only interested in silviculture practices and ignore fire altogether (Battles et al.

2001). By improving our understanding of post-fire understory vegetation dynamics, land managers can more effectively apply management activities. The research will aid in refinement of desired future conditions for these parks and support development of quantifiable understory vegetation objectives and target conditions. Overall, the research will provide a strong foundation for understanding understory vegetation responses to prescribed fire, and for refining strategies that seek to maintain native plant diversity and structure, vital components of ecosystem health and resiliency.

Research Questions - My project will investigate the responses of understory vegetation to prescribed fire in mixed-conifer forests of the Sierra Nevada using existing long-term, fire effects monitoring data from Sequoia & Kings Canyon National Parks (SEKI). Four questions will be addressed:

(1) How do areas which have burned differ from areas that have not?
(2) How does understory vegetation respond to fire over time (e.g. one year post fire vs. ten years post fire)?
(3) How does fire severity and heterogeneity of the burn affect understory vegetation?
(4) How does fire frequency affect understory vegetation? Does timing of the second burn (i.e. years since the first fire) make a difference in understory vegetation?

I will evaluate these questions by specifically focusing on the following for each question:

a) Are there differences in species composition and diversity?
b) Are there differences in functional groups (e.g. herb, shrub, tree, and fern)?
c) Are there differences in relative abundance of species and functional groups?

Methods - I will be using existing data from the fire effects monitoring program at SEKI. I am proposing to use the following statistical analyses: 1) repeated measures PERMANOVA and 2) NMDS ordination to plot successional trajectories of communities.

Proposed Projects

***Fire and Lodgepole Pine in Southern Sierra Parks*.** Anthony C. Caprio[1] and Kent van Wagtendonk[2] (Funded)

Lodgepole pine (*Pinus contorta*) is a widely distributed species occurring throughout much of western North America across a diverse set of habitats. It is also one of the most widespread forest types in the Sierra Nevada, particularly important at higher elevations. Fire has generally been described as having a minor role in Sierran lodgepole (var. *murrayana*) in contrast to Rocky Mountain lodgepole (var. *latifolia*) (Keeley 1981; Parker 1986, 1988). Persistence of Sierran lodgepole has been mainly attributed to gap phase dynamics characterized by continuous or intermittent regeneration with fires depicted as being small and infrequent. In contrast, several recent studies in Sequoia and Kings Canyon N.P. (SEKI) suggest fire may play a more active role in community dynamics (Keifer 1991; Caprio 2006, in press). This work indicates that at least some fires can be of large size and of mixed severity that result in forests with age structure patterns having both discretely aged and mixed age patches. However, fire regimes have not been well studied in Sierran lodgepole and fire's role prior to EuroAmerican settlement is poorly understood (Skinner and Chang 1996).

Figure 10. Fire scarred lodgepole pine on Chagoopa Plateau in SEKI with five fires recorded in the catface. This is an unusual tree, most scarred trees have only on or two scars.

We propose to initiate a more thorough look at fire's role in lodgepole pine communities in the southern Sierra by sampling fire history to examine fire frequency and stand structure patterns to examine past fire regime type. Fire history would be sampled in YOSE at five or more sites. We will also examine patch patterns of lodgepole in one or two areas in YOSE (in association with fire history sampling) and on Chagoopa Plateau in SEKI (an areas where extensive fire history data already exists) using recently acquired aerial photos. Patterns will be mapped using GIS and used as a basis for stand age-structure sampling. We believe this is practical because, unlike many lower elevation vegetation types, forest turnover in lodgepole is slower and structural patterns from the past (pre-1900) still exist largely intact. Lastly, we will examine patterns of fire severity from contemporary fires in lodgepole forest using ΔNBR values from the NPS/USGS Burn Severity Mapping Project that will be compared to mapped historic patterns.

[1]Fire Ecologist, Sequoia & Kings Canyon N.P. and [2]Fire GIS, Yosemite N.P.

Oral History of Fire Management and Research in Sequoia and Kings Canyon National Parks: Learning from the Pioneers. Sequoia Parks Foundation Proposal**.** Submitted by: Tom Burge, Tony Caprio, Ward Eldredge, Linda Mutch, and Debra Schweizer

An outgrowth of the 40th Anniversary Workshop. Oral histories of the fire program, captured from people who had a variety of roles in shaping the program, can provide information that is not currently available in archived records. This information is time-sensitive, as much of it will die with those who carry it in their memories. We anticipate the following benefits to Sequoia and Kings Canyon National Parks as well as to others who have an interest in understanding the challenges and history of fire management in national parks:

- A better understanding of what motivated managers to accept the risks of initiating a new, challenging, and potentially controversial program
- Information about the relationships among science, management, and interpretation that enabled the program to gain support and move forward
- Insight into how individuals made decisions and influenced the opinions of others
- Personal stories that give the program a human face, and help us understand the individual successes and challenges that were part of the program's history
- A better understanding of the relationship between the Sequoia and Kings Canyon National Parks' fire program and outside people and organizations
- Better documentation of the history of the parks' fire program

The products for this project would include:

- Filmed or digitally recorded interviews of managers, scientists, and members of the public who played important roles in SEKI's fire program
- Complete documentation of interviews for NPS archives
- Transcriptions of interviews, as funding allows
- A written report summarizing highlights of the interviews
- Recommendation of others who should be interviewed if funding does not allow interviewing all who played important roles in the program

These interviews could then be available for further research and interpretive projects and could also be a source of lessons learned and wisdom to inform future directions the fire program may take in the face of new challenges.

Public Outreach

"Fire Information Cache" Fire and Natural Resources Web Site

The *Fire Information Cache* web site, at: http://www.nps.gov/seki/fire/indxfire.htm, continues to be a popular destination providing a variety of information about fire management activities related to natural resources, information about fire research in the parks, a fire bibliography emphasizing fire in the Sierra Nevada with many downloadable papers in HTML or PDF format, and links to fire management activities and documents for SEKI. The pages have been receiving more than 30,000 visits annually and are one of the most visited pages on the SEKI web site. The bibliography is widely used or referenced on other web sites as a source for information about fire in SEKI and the southern Sierra Nevada Mountains. The pages are currently undergoing conversion to CMS format and should be posted by early 2008.