National Park Service
Fire Ecology Annual Report
Sequoia and Kings Canyon National Parks
and Devils Postpile National Monument
Calendar Year 2005

Anthony C. Caprio and Karen Webster
Division of Natural Resources
January 2006

Summary

During 2005 39 FMH plot visits were made within nine monitoring units in Sequoia and Kings Canyon N.P. (SEKI) and Devils Postpile N.M. (DEPO). These included six new plot installations and reads of nine preburn and seven postburn. Two plots were burned for the third time since 1980 by the Comb WFU Fire. All FMH data were converted to FEAT 2.4 (Fire Ecology Assessment Tool) format and a significant effort was made in testing and providing feedback to the developers for FEAT software updates. The conversion required considerable effort in error checking and data correction. Additional fieldwork continued for several projects that have or will provide supplemental information to the fire management program at both the local and national levels. The most involved of these was the CBI (composite burn index) field sampling of areas burned in 2004 for the National Landscape Assessment Project (burn severity mapping). The fire ecology staff also participated in four prescribed burns or wildland fire use (WFU) fires in SEKI although opportunities for involvement declined relative to previous years. The Pacific West Region regional fire ecology meeting was hosted by SEKI in May.

In 2004 the Fire Ecologist received funding for a fire history reconstruction at Devils Postpile N.M. (DEPO). Crossdating of fire history samples and analysis of age-structure plots continued in 2005. Preliminary results have reshaped our understanding of fire's role in the DEPO area and were important input into the recently completed DEPO Fire and Fuels Management Plan (FFMP) and Environmental Assessment (EA). The Ecologist also attended and presented a paper at the Fire and Climate Workshop held at NAU, Flagstaff. During August the Ecologist was SEKI Resource Advisor working with the Fire Use Teams managing the Comb Complex WFU. Additionally, the Fire Ecologist collaborated with and was actively involved in a number of fire related research projects underway in the parks by USGS, USDA, NASA, or university researchers (several funded through JFSP) and assisted in developing new project proposals. Inputs (data and meetings) were also provided to the national LANDFIRE modeling effort with fire/vegetation models developed for high elevation vegetation types of the Sierra Nevada.

Considerable efforts in public outreach were also made through venues such as publications, the *Fire Information Cache* website, field trips, and lectures to university classes or other groups. These reach a large audience and provide important support for fire management and fire related natural resources activities. Additionally, interviews were provided to several newspapers (LA Times, Fresno Bee, San Francisco Chronicle) and National Public Radio on topics relating to fire management and fire ecology.

Of interest for SEKI fire management was that more acres burned in the parks in 2005 than in any year since 1920. Also significant was that, of the total 14,087 ac burned, only 2.2 ac were fires that were suppressed with 9,042 ac of wildland fire use and 5,042 ac of prescribed burning.

Funding issues continued to impact some positions in the SEKI Fire Ecology Program, although temporary solutions were found with the assistance of the Fire Management Office.

I - Program Results

An updated summary of results is presented through 2005 for the four primary monitoring units (***Table 1-1***). Monitoring over the last two decades has primarily emphasized been giant sequoia, white fir, and low-elevation mixed-conifer vegetation. Recent sampling has been directed at mechanical treatments. Although sample size for mechanical treatment plots remains limited additional plots will be added as treatments continue. Currently these plots are providing the only quantitative documentation of treatment effects and effectiveness (fuel reduction or changes in stand density). Data suggest density reduction objectives are being met while we are not successfully meeting our fuel reduction objectives. Increases in fine fuel from the thinning

Table 1-1. **Management objectives and monitoring results for 2005.** Monitoring results are 80% confidence intervals around the mean. Fuel reduction objectives/results are mean percent reduction from preburn to immediate postburn. Stand density objectives/results are stand density five-years postburn. 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 (80% confidence interval)	Objective Achieved?
Giant sequoia-mixed conifer forest	60-95% total fuel reduction	Total fuel reduction = 71-81% *(n=28 plots, 18 fires)*	**YES**
	5-yr postburn stand density: 50-250 trees/ha <80 cm DBH 10-75 trees/ha ≥ 80 cm DBH	Stand density = 190-256 trees/ha <80 cm DBH 34-46 trees/ha ≥ 80 cm DBH *(n=29 plots, 18 fires)*	**YES**
	5-yr postburn stand composition: 40-80% fir, 10-40 sequoia, 5-20% pine	Fir = 77.8% Sequoia = 10% Pine = 10% *(n=30 plots, 18 fires)*	**YES**
White fir-mixed conifer forest	60-95% total fuel reduction	total fuel reduction = 62-85% *(n=11 plots, 7 fires)*	**YES*** *but minimum sample size not achieved
	5-yr postburn stand density: 50-250 trees/ha <80 cm DBH 10-75 trees/ha ≥ 80 cm DBH	stand density = 272-356 trees/ha <80 cm DBH 28-44 trees/ha ≥ 80 cm DBH *(n=10 plots, 6 fires)*	**NO** for trees <80 cm DBH; **YES** for trees >80 cm DBH
Low elevation-mixed conifer forest	60-95% total fuel reduction	total fuel reduction = 75-93% *(n=5 plots, 3 fires)*	**YES**
	5-yr postburn stand density: 50-250 trees/ha <80 cm DBH 10-75 trees/ha ≥ 80 cm DBH	stand density = 310-562 trees/ha <80 cm DBH 9-35 trees/ha ≥ 80 cm DBH *(n=5 plots, 3 fires)*	Uncertain – sample size too small
Mechanical Thinning + Pile Burning	Reduce fuels to < 12 tons/acre immediate post treatment	Fuel load = 36 tons/acre (total fuel reduction 57%) *(n=7, 5 treatments)*	**NO*** * but sample size too small
	Immediate post treatment stand structure: maximum of 25 trees/acre < 22.9 cm DBH	Stand density = 9.7 trees/acre < 22.9 cm DBH *(n=7, 5 treatments)*	**YES*** * but sample size too small

operations might be responsible for the latter. Two plots added in 2005 are not shown in ***Table 1-1*** since pile burning has not been completed. The analyses of mechanical treatment data also indicate plots may need to be looked at by vegetation type to better understand treatment effects. Mechanical treatment objectives will be reviewed in 2006 by fire management and natural resources staff based on treatment results, plot data, and new research results.

II - Workload and Staffing

Workload - In 2005 39 FMH plot visits were made in nine monitoring types (***Table 2-1***). Six of the visits were new installs with a new xeric conifer/Jeffrey pine type being developed. Full transition to the Fire Ecology Assessment Tool (FEAT) was made during 2005. All fire effect's plot data and most CBI data were converted to FEAT version 2.4 prior to the 2005 field season (pre-2004 CBI data are in the process of being transferred from paper data sheets). All 2005 field data have been entered into FEAT. There was continued assessment of FEAT in a field environment and beta testing of the FEAT Summary Builder Module. Additionally, CBI data for the National Landscape Assessment Project was collected on one fire from 2004 fire (Hot Springs Fire in the upper Kern River drainage). This provided feedback on unusual high elevation vegetation types: xeric conifer, western juniper, montane chaparral, and foxtail pine. Lastly, one seasonal spent approximately one payperiod in November assisting Santa Monica Mountains National Monument with postfire severity sampling after large wildfires burned through portions of the monument.

Table 2-1. Fire ecology plot workload 2005.

Park	Type of Plot (FMH, photo point, other)	Monitoring Unit	Installs 2005	Postburn 2005	Postburn (1-30 yrs)	Total Plots
SEKI	FMH forest	Giant sequoia-mixed conifer		3	8	**48**
		White fir-mixed conifer			2	**17**
		Low elevation-mixed conifer		1	3	**8**
		Red Fir Forest			3	**7**
		Ponderosa Forest		2	5	**25**
		Xeric Conifer PIJE	1	1		**1**
		Buckeye Wildfire				**3**
		Blue Oak Woodland				**2**
	FMH brush	Chamise Chaparral				**3**
		Montane Chaparral/sagebrush	1			**7**
		Mixed Chaparral				**6**
	FMH Mechanical	Thinning + Pile Burning	2		5	**9**
	CBI*	Hot Springs Fire	29			**174**
	Fire Regime*	East Fork Kaweah R.	23			**187**
	Cheatgrass Monitoring*	Roads End Rx Burn	119			**119**
DEPO	FMH Forest	Rainbow Wildfire	1			**9**
	FMH Mechanical	Thinning + Pile Burning	1			**1**
	Fire Regime*	DEPO fire history				**52**
Total FMH			**6**	**7**	**26**	**146**
Total Other			**171**			**532**

*Not permanent plots

Over the past few years discussions have occurred about fire effects in xeric conifer vegetation. These are primarily open-to-moderately-closed stands of Jeffrey pine with a manzanita understory. These frequently 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".

Several long-term "special study" projects were continued in 2005. 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. Work continued on the analysis of fire history samples and age structure data collected in DEPO during 2004.

Fire ecology staff continued to assist on burn projects when duties allowed, although actual participation was down from previous years. The Fire Ecologist was SEKI's resource advisor contact for teams and modules in park for the Comb Complex WFU fire. This was an approximately three week assignment during August.

As emphasized by park management, considerable effort in public outreach was made during the year though avenues such as publications, the *Fire Information Cache* website, field trips, and lectures to university classes or other groups. Programs were done in coordination with the SEKI Fire Information Officer (Jody Lyle) or other park staff. These reached a large audience and provided important support for fire management and fire related natural resources activities. One interesting query was received during the Comb Fire from a New York architectural firm designing the National AIDS Memorial. They where looking for a better understanding on how fire affects forests because one design element of the memorial was going have a burned forest theme. Additionally, interviews were provided to several newspapers (LA Times, Fresno

Figure 2-1. Preburn plot sampling of an open ponderosa pine/mountain misery vegetation before the plot was burned by the Comb WFU Fire. This plot has burned three times: 1980, 1998, 2005.

Bee, and San Francisco Chronicle) and National Public Radio on topics relating to fire management and fire ecology. The *Fire Information Cache* web page continues to be very popular with tens-of-thousands of hits annually. Unfortunately there is neither time nor funding available for the site to be converted to the new NPS CMS web page format mandated to be completed in 2006.

Staffing - Fire funded staffing during 2005 consisted of Fire Ecologist, Lead Fire Effects Monitor, and four Fire Effects Seasonals (***Table 2-2***). One additional position, an SCA Associate, was funded via NRPP funding for a fire history study in DEPO. Overall, Fire Effects continues to be under funded with supplemental funding required to maintain staffing. For example, the Lead Fire Effects Monitor is only supported at 15 payperiods versus 20 that are needed. Additionally, the program lacks an Assistant Lead Fire Effects Monitor position. Lack of an assistant position hurts crew retention year-to-year. This also results in a reduction of productive summer field time as new crews need to be retrained annually. Additionally, as for the past several years, the Fire Ecologist position has only been funded at a Step 1 rather than a Step 4 level with support dollars required to make-up the difference. This continues to hamper position development as opportunities for training and travel to valuable management/scientific meeting/conferences is limited.

Table 2-2. Fire Ecology Staffing 2005. 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	Training and Development
Amanda Young*	5/20/05	11/3/05	12#	S-130, S-190
Akasha Faist*	5/20/05	10/14/05	10.5#	S-290, initiated FEMO taskbook
Elizabeth Urbanski*	5/20/05	10/14/05	10.5#	S-130, S-190
Gina Radieve*	5/20/05	10/14/05	10.5†	S-130, S-190
Karen Webster	2/14/05	11/26/05	15#+5†	FEAT/Stats training, fire refresher,
Tony Caprio	Full Time^			FEAT/Stats training, fire refresher, Flagstaff Fire/Climate Workshop
Other Positions				
David Turner (SCA)	9/12/05	12/23/05	15 weeks	

* seasonal/temporary employee, # Account no. 8557-0401-H14, ^ Account no. 8557-0021-W11

Figure 2-2. 2005 Fire effects crew (from left: Amanda Young, Elizabeth Urbanski, Karen Webster, Akasha Faist, Gina Radieve, and David Turner (SCA volunteer who worked with crew on CBI sampling) (photo by fire effects).

Table 2-3. Fire Ecologist accomplishments and focus areas.

Category	Time (%)	Accomplishments/Focus Areas
General Planning	15%	• Assisted in the development of the Fire and Fuels Management Plan for DEPO • Implemented annual updates to SEKI FFMP • Provided guidance and procedures for public review of FMP EAs for DEPO • SEKI fire management work plan development • SEKI Fire Management Committee – Trees of Special Interest (sequoias) • Rx burn plans • Updated Res. Adv/MIST guidelines for SEKI
Fx Monitoring Plans	<5%	Fire effects monitoring and fire research plans for DEPO FFMP
Presentations, Field Trips (see Public Outreach below)	5%	• Joint Redwood Mtn. field trip with USDA Seq. NF, UC Berkeley Whittaker Forest, Sierra Club, and SEKI • PowerPoint programs and field trips (2) to Fresno State forest ecology class (spring and fall) • Classroom lecture to Fresno State upper-level plant ecology class (fire ecology, fire effects, tree-rings and fire history) • Day-long field trip for Carhart Wilderness Training class (fire ecology/wilderness topics) • Introduction and discussion on fire management and research to visiting Chinese (Taiwan) scientists (with SEKI USGS). • Discussion and field trip for forest and fire managers from Mexico (group hosted by USDA Seq. NF)
NPS Meetings/ Task Groups	10%	• Hosted PWR Annual Fire Ecology Meeting at SEKI • SIEN I&M Vital Signs Monitoring Workshop • SIEN I&M monitoring plan review • SIEN I&M Sequoia Tree Inventory
Interagency Work	5%	• Assisted in the development of FMUs and values at risk for FPA • Region 5 Sierra Nevada LANDFIRE modeling workshop – high elevation forests • LANDFIRE data request for georeferenced vegetation plot data from SEKI
Fire Assignments and Fuels Projects	10%	Resource Advisor on Comb WFU (20 shifts), Grant West Rx FEMO observer (one shift), Highbridge East Rx FEMO observer (one shift)
Research	5%	• Fire regime sampling – completed high elevation sampling for East Fork Fire History Project • Assisted with JFSP proposals (3 – UA chaparral fire history, USGS grey pine dynamics & fire, URI sediment/soil fire history) • SEKI fire ecology liaison to NASA/NPS project on fire and exotics • Continued input into JFSP Wilderness Inst. "Retrospective Fire Analysis Study" for SEKI
Management or Research Document Reviews	5%	• Reviewed A. Heard's thesis on fire and water quality • Fire plan reviews (AM, Highbridge) • Provided review on Ecological Society of America/USGS fire policy statement • NPS fire history book – all chapters w/ spec. ref to SEKI • Review of JFSP USGS SEKI Fire and Fire Surrogate (FFS) publications • Arno/Fiedler's book, ***Mimicking Nature's Fire***, was published in 2005 with a chapter on fire in SEKI
Fx Field Work	5%	• Assisted fire effects crew with FMH plots (nine plot visits) • Special projects • Cedar Grove cheatgrass – baseline sampling Roads End Rx Burn.
Data Entry	<1%	• Fire effects monitors completed all 2005 FMH data entry • DEPO fire history • Roads End cheatgrass
Data Management and Conversion	<5%	• Lead monitor completed data conversion to FEAT 2.4 • Data checks • All data sets in SEKI/DEPO were migrated from NAD27 to NAD83

Category	Time (%)	Accomplishments/Focus Areas
Data Analysis	5%	• FMH data • DEPO fire history/age structure analysis • Fire climate analysis of East Fork Kaweah R. watershed fire regimes • Fx DEPO 10 yr post-Rainbow Fire
Reports	15%	• SEKI 2004 Div. Nat. Res. Fire Ecology Annual Report • 2004 PWR Fire Ecology Annual Report • DEPO fire history progress report • DEPO 10 year postfire Fire Effects Report
Supervision/Admin	5%	• Supervised lead monitor, completed evaluations • Travel and time paperwork • Supervised SCA (Sept. to Dec.) • Served as thesis committee member for A. Heard (CSU Ft. Collins)
Training & Professional Development	<5%	• FEAT/Stats Training Ft. Collins • Firefighter refresher • Fire/Climate Workshop Flagstaff, AZ • Contributed to USGS/NPS FFS paper now in review *"Tree mortality from fire and bark beetles following early and late season prescribed fires in a Sierra Nevada mixed-conifer forest"* • PT – all PT was/is carried out on personal time
Miscellaneous	5%	miscellaneous other things, SEKI Resources & USGS input/coordination
Public Outreach	<5%	• Fire Information Cache, SEKI Fire Portal\ • Provided interviews *to Fresno Bee, LA Times, San Francisco Chronicle*, and National Public Radio • Washington Tree (several interviews on fire and sequoia ecology after the top of worlds second largest tree collapsed in a windstorm after being damaged by a WFU fire in 2003 – the story made international news)

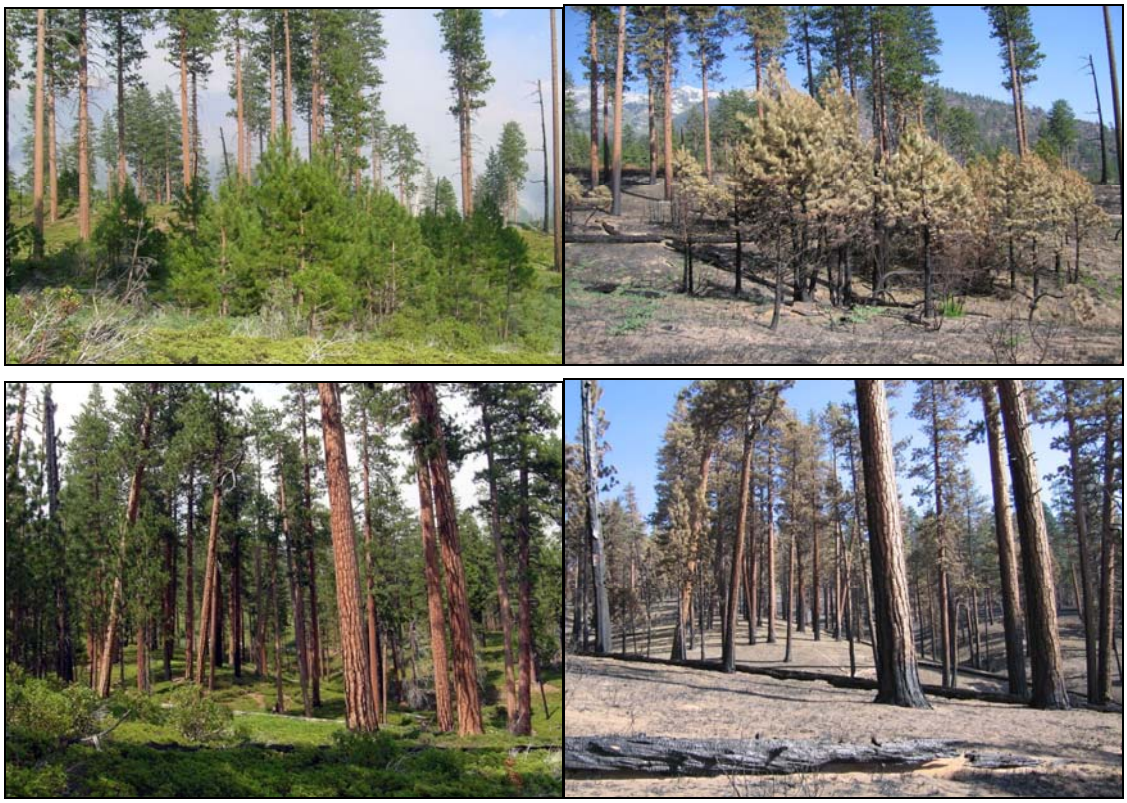

Figure 2-3. Prefire and immediate postfire images of two paired photo points (right to left) in the Comb WFU Fire showing fire effects on overstory (ponderosa pine) and understory (primarily mountain misery). The plots are shown being burned by a headfire in Fig. 4.4-1 that resulted in patches of crown scorch**.**

Table 2-4. Fire Effects Crew Accomplishments. The following time estimates are based out of the total number of weeks the fire effects crew worked (roughly 11 pay periods).

Category	Time (%)	Notes
FMH plots	60%	Completed 39 reads, all but one were forest plots.
Mechanical Treatment plots	15%	Installed two new thinning plots and read five previously installed plots.
CBI plots	10%	Installed 29 plots for Hot Springs Fire Use Fire
Other plot work	10%	• Increasing giant sequoia sample size • Sugar pine mortality study • Giant sequoia seedlings in re-burns • Giant sequoia trees of special interest
Fire Assignments and Fuels Projects	5%	Crew assisted on two prescribed burns (total of nine shifts)
Data Entry	10%	• Completed data entry for 2005 data • Entered missing data from FMH into FEAT
Data Management and Conversion	<5%	Error checked converted data
Data Analysis	0%	
Training and Professional Development	15%	• 3 Crewmembers attended 130/190 • 1 crewmember completed 290 and initiated FEMO taskbook • 1 crewmember attended fire refresher training • All crewmembers participated in PT • All crewmembers attended mandatory park trainings (defensive driver, hazmat etc).
Miscellaneous	5%	Crew helped with black bear management, meadow invertebrate sampling, and search and rescue.

Figure 2-4. Hot Springs WFU Fire composite burn index (CBI) sampling. Image on left shows montane chaparral and xeric conifer (with scattered Jeffrey pine) that had a fairly continuous shrub understory preburn (Kern Canyon, Chagoopa Plateau, and Great Western Divide are visible in near, middle, and far distance). Image on right shows higher elevation dry foxtail/lodgepole pine stand with isolated patches of fuel under trees where fire spread occurred as embers were carried by the wind between patches.

Table 2-5. 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	35%	Completed 39 reads, all but one was a forest plot.
Mechanical Treatment plots	5%	Installed two new FMH thinning plots and read five previously installed FMH thinning plots.
CBI plots	5%	Installed 29 plots for Hot Springs Fire Use Fire
Other plot work	0%	
Fire Assignments and Fuels Projects	<1%	Worked on two prescribed fires (2 shifts total).
Data Entry	<1%	
Data Management and Conversion	30%	• Prepared species lists for FMH conversion • Converted SEKI and DEPO databases from FMH to FEAT • Error checked converted data • Error checked data entered from 2005 • Miscellaneous database upkeep – merging subsamples, renaming subsamples etc.
Data Analysis	<5%	• Provided analyses to Fire Ecologist and Prescribed Fire Specialist • Provided other data as requested
Supervision/Admin	25%	• Hired and supervised four fire effects monitors; evaluations, time, travel and other administrative paperwork
Training & Professional Development	<5%	• Attended one week FEAT/stats training • Completed fire refresher training • Participated in PT
Miscellaneous	<5%	Provided feedback on FEAT program in general and summary builder in particular.

III Outlook for FY2006

The outlook for Fire Ecology in 2006 includes regularly scheduled rereads of about 30 fire effects plots, plus five rereads of plots that are off schedule, and four potential preburn rereads of established plots located in areas with burns planned. Additionally, several new plots may be installed in mechanical or in a new fire monitoring vegetation type (xeric conifer - Jeffrey pine) depending on burn or thinning project implementation. CBI sampling will be conducted on the Comb WFU (8,675 ac) and Lewis Creek, Quarry, Grant West, Grant E+G, Highbridge, and Highbridge East prescribed burns (4,822 ac). Because of the large area burned in 2005 (13,557 ac) this will be a very challenging task for the coming year with only the fire effects crew. Additional field support will probably be required to complete the CBI sampling on these burns. The 10-Year Devils Postpile Fire Effects Report will be completed and the data from the DEPO fire history study will be analyzed and written-up. Special projects will be continued (see ***Section 4.1*** for project list). Rapid assessment of cheatgrass occurrence and severity in Cedar Grove burn units (pre and postfire) will also be conducted. This will involve postfire sampling of the Roads End Rx and prefire sampling of a second prescribed fire unit. Lastly, depending on whether funding is available, the annual Association of Fire Ecology Conference may be attended. There will also be continued involvement in a number of collaborative field or research projects underway in the parks USGS, NASA, and USDA.

IV - Other Fire Ecology Accomplishments or Projects

The fire effects crew used the updated FEAT 2.4 software/database in both the field and office during 2005 with continued feedback given to the developers. The conversion to a new system of data collection had its ups and downs during the field season. Staff also provided input into the DEPO Fire and Fuels Management Plan and EA. Additionally, they were involved with a number of local or national NPS studies that supplemented plot monitoring duties (see ***Section 4.1***). This work complements SEKI's network of fire effects monitoring plots or provides additional fire ecology information important to the fire management program. Staff also provided feedback to the SEKI fire management program (see ***Section 4.2***). Lastly, fire ecology staff were/are involved with a number of collaborative research studies with other agencies, universities, or parks (see ***Section 4.3***). A list of recently completed, currently underway, or proposed projects are given below with an abstract. Lastly the '*Fire Information Cache*" provides a valuable and much used source of information on fire and natural resources including an extensive bibliography on fire in the southern Sierra Nevada (see ***Section 4.4***).

4.1 - Fire Ecology Projects 2005

The Fire Ecology Program in SEKI/DEPO was directly involved in a variety fire-related projects during 2005. Some were the continuation of longer-term projects requiring annual or periodic monitoring (***Projects 4.1.1*** *through* ***4.1.5***) while others have specific data needs that will be completed in a season or two (***Projects 4.1.6*** *through* ***4.1.7***). These projects are providing valuable input into the SEKI and DEPO fire management programs.

(4.1.1) *Increased Giant Sequoia Sample Size*

Because of their great size, mature giant sequoia tree density is very low in the standard 20 m x 50 m forest plots. To increase the sample size of giant sequoia, we sample all, or a subset of, giant sequoia trees in prescribed burn units in the Giant Forest. Pre- and postburn methods followed the FMH protocol for overstory tree sampling combined with the FMH database for the Giant sequoia-mixed conifer forest monitoring type. A total of 983 giant sequoias were sampled in seven separate units burned between 1993 and 1999. This information will provide sufficient sample depth to assess the long-term effects of prescribed fire on mature giant sequoia trees over a long period of time. While monitoring continues for trees currently in the study no additional giant sequoias were added in 2005.

(4.1.2) *Giant Sequoia Seedlings in Reburns*

There is increasing interest in the fate of giant sequoia reproduction following second entry burns (following the initial restoration burn) has become timelier. Some areas of the parks where early-prescribed burning efforts were concentrated have surpassed the historic fire return interval without subsequent burning. In some of these areas, giant sequoia regeneration of varying density resulted from the initial burn. Knowledge about fire effects on these young trees following subsequent prescribed burns is critical, especially given the importance of giant sequoias and their fire-dependent regeneration. As a result of the parks' interest in this issue, plots were installed in reburn areas beginning in 1988 (expanded in 1997) to specifically assess the reburn mortality/survival of groups of giant sequoia seedlings established after the initial

burn. This information is expected to be helpful in making decisions related to reburn scheduling in other areas in the parks. In addition to continued monitoring of established sites new sampling sites (additional replicates) were established in the Redwood Mountain area during 2005.

(4.1.3) *Sugar Pine Preburn Litter/Duff Removal*

Questions about sugar pine mortality, fire and blister rust have been raised in SEKI and become controversial. Large tree mortality following prescribed fire is a concern for land managers attempting to reduce fuels and restore the process of fire in fire-dependent ecosystems. Information is especially critical in areas where fuels have accumulated following an unnaturally long fire free period due to past fire exclusion. Pines, including sugar pine, seem to be especially susceptible to mortality following fire. Whether this mortality is directly related to returning fire after a long absence in short-return interval regimes, or a combination of fire and other previously existing stressors, is unknown at this time. Research scientists from the USDA Forest Service Riverside Fire Lab found that removing some of the deep organic layer around trees prior to burning reduces large tree mortality in some forest types in Arizona. This type of preburn fuel removal may be an option in areas where large tree mortality is an important sociological or ecological issue.

To examine whether a difference in mortality occurs between trees with fuels removed and trees without fuels removed and also to test the practicality of fuel removal methods, fuel was removed around large sugar pines in several prescribed burn units between 1996 and 2003. A total of 62 pairs of trees (trees were paired mitigated and unmitigated with 124 trees total) have been monitored (***Table 4.3.1-1***). Of these, 22 pairs were rejected postburn because of burns outside planned prescription. Overall mortality (mitigated and unmitigated) by 2005 was 14% of the remaining 80 trees (72 PILA and 8 PIPO) in four burn units. All trees dying were PILA (13.5% across the four burn units) and mortality occurred up to seven-years postfire. However, interestingly, mortality of mitigated and unmitigated trees was similar (14% and 13% respectively, mitigated and unmitigated, each with N=40) across all burn units. This suggests little correlation between either mitigation practice and mortality. Protocols were slightly modified during 2004 so that annual censuses will be reduced. A Joints Fire Sciences Program proposal submitted in 2004 by USGS and SEKI to address the issue in more detail was not funded but funding for a large scale study was received by the USGS SEKI Field Station from USGS funds earmarked to support NPS research needs.

Table 4.3.1-1. Burn treatments utilized in PILA fuels mitigation project.

Burn	Year Burned	# Paired Trees	Status
Sunset	1996	12	Rejected because burn was spotty and most trees not treated
Pinewood	1997	10	Rejected because severe crown scorch confounded mortality effects
Broken Arrow	1998	15	
Lower Deadwood	2000	2	
Bear Hill	2001	19	Subset of trees with temperature sensors installed prior to burn
Upper Deadwood	2003	2	

(4.1.4) *Composite Burn Index (CBI)*

The composite burn index sampling is part of the National Landscape Assessment Project (burn severity mapping). The assessment primarily addresses the need to identify and quantify fire effects over large areas, emphasizing comparability of results, along with the capacity to aggregate information across geographic regions and time. Although the scale of the results are coarse they provide information on spatial heterogeneity of burns and how fire interacts with vegetation and topography. The quantitative measure that is mapped is "burn severity", defined here as a scaled index gauging the magnitude of ecological change caused by fire. CBI field sampling methods are used to derive severity index values that summarize general fire effects within an area or the average burn condition on a plot. The question CBI attempts to answer is how ecologically important are consequences of a given fire or how much has fire altered the biophysical conditions of a site? CBI ratings incorporate such factors as condition and color of the soil, amount of vegetation or fuel consumed, resprouting from burned plants, establishment of new colonizing species, and blackening or scorching of trees. The primary goal of field sampling is to capture the range of variation found within burns, covering as many fire effects and biophysical settings as possible.

All field sampling in SEKI was undertaken as *extended assessment* (about one year postburn) , which is the primary reference point for change from prefire conditions, as it has a chance to reveal survivorship potential and delayed mortality. Only one burn in 2004 met the minimum size requirements for sampling. This was the Hot Springs Burn located in the Kern Canyon area of Sequoia National Park.

Preburn vegetation in the area of Hot Springs Fire was primarily xeric conifer (Jeffrey pine and western juniper), montane chaparral, red fir, and subalpine conifer types (lodgepole pine, western white pine, and foxtail pine) (see ***Figure 2-4***). Some problems were encountered while using the CBI field rating criteria. In some situations fire severity scores from the remote sensing match what actually occurs on the ground but the final CBI score does not. For example, in the montane chaparral vegetation type with a supposed severity rating of "severe" the final CBI scores came out "moderate". On site it was clear that these plots had burned with high severity. The manzanita (*Arctostaphylos patula* [ARPA]**)** was burned completely to the ground with only small nubs left and was not resprouting. The substrate ranking pulled the CBI scores towards moderate but litter and duff don't contribute to severity in these plant communities. Fire behavior (and thus burn severity) was driven by slope/wind. Above ground shrub parts were almost completely consumed but litter and duff were barely scorched. Essentially, what occurred was a crown fire in the shrubs. The field crews felt eliminating substrates from consideration in the overall score would put the final score into the "high" severity category and provide a better CBI estimate.

A dNBR fire severity atlas using LANDSAT images back to the 1980s is also being developed.

Table 4.1.4-1. Three composite levels (A-C) encompass the five strata level (1-5). CBI scoring is done for each strata and averaged to the desired composite level.

A. Total Plot	B. Understory	1. Substrates
		2. Herbs, Low shrubs and Small Trees
		3. Tall Shrubs and Sapling Trees
	C. Overstory	4. Intermediate Trees (pole-sized trees, subcanopy)
		5. Big Trees (mature, dominant/co-dominant, upper canopy)

Figure 4.1.4-1. Fire effects crew crossing Boreal Plateau in route to the Hot Springs Burn where CBI sampling was carried out in dry high elevation vegetation types (photo by Amanda Young).

(4.1.5) *Kings Canyon Cheatgrass Monitoring*

Over the last decade cheatgrass (*Bromus tectorum*) has invaded many mid-elevation sites on the west slope of the Sierra Nevada including areas of Sequoia and Kings Canyon National Parks. One area where the increase in this winter/spring annual has been very pronounced is the valley floor of Kings Canyon. Invasion of plant communities in the Great Basin by this species has often resulted in dramatic and undesirable changes in fire regimes (increased frequency) and community composition (decreased diversity). Concern about the rapid increase in the dominance of this species in Kings Canyon led to the suspension of the burn program in the fall of 1998. Surveys to detect spatial patterns in its occurrence suggested a relationship between stock use and fire severity, with a possible interaction affect. A JFSP funded USGS research study examined a variety of factors that were thought to influence cheatgrass dynamics. Results suggested little could be done to control the infestation once established. The 2005 Roads End Rx Burn was the first prescribed burn back on the valley floor since 1998. Monitoring of cheatgrass within the burn unit was begun to help ascertain how the fire will affect cheatgrass. A rapid assessment protocol used for the monitoring was adapted from protocols developed by SEKI invasive plant survey teams. It uses a georeferenced 50x50 m grid search pattern with cheatgrass cover and burn severity observations recorded in each grid cell. A crew of six (without experience) was able to collect data on ~119 cells in one work day. Distinct preburn patterns of cheatgrass occurrence were observed (***Fig. 4.1.5-1***) with presence generally corresponding to locations that had experienced past fire and were adjacent to trails used by stock. Cells will be resampled in the spring of 2006, one year after the preburn sample.

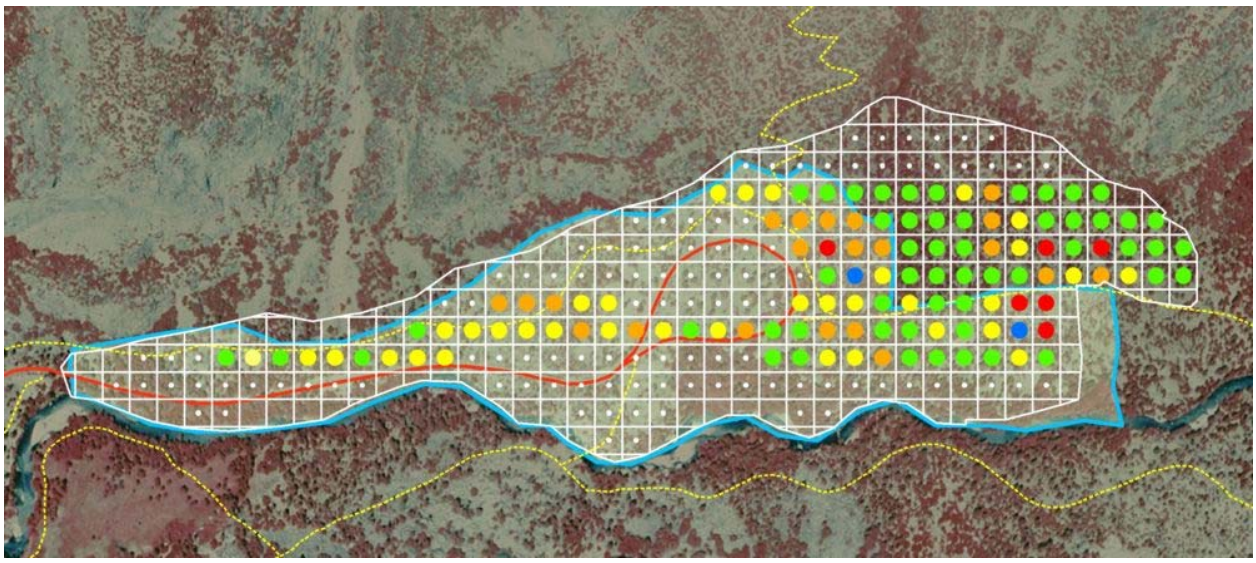

Figure 3.1.5-1. Results of preburn cheatgrass monitoring for the Roads End Rx Burn, Kings Canyon. Colored dots represent cheatgrass cover (%) detected within 50x50 m cells (green=not detected, yellow=present <1% cover, orange= 1 to <10%, red= 10 to <20%, blue=≥20%). Original burn unit is outlined in white over ortho quad (north is to top). Area actually burned in 2005 is shown as lightly shaded polygon enclosed by blue line. Portions of the unit had been burned previously. Dotted yellow lines are trails and solid red line the Kings Canyon Road.

(4.1.6) *Named Trees Inventory*

In response to the accidental ignition of the Washington tree in 2003 and follow-up by the SEKI Fire Management Committee, a fire susceptibility inventory for all named sequoia trees in the park was begun. The purpose of the inventory is to identify named trees, document their location and condition, and describe site characteristics around each tree that might influence fire. A number of conditions or site factors were identified and are being surveyed in the field. Digital photos of each tree are also being taken. This information can be used during burn plan development and implementation to assist in; 1) determining if a tree is susceptible to adverse fire impacts, and 2) developing potential mitigation actions appropriate to minimize these impacts. The information gathered will be made available as a database, spreadsheet, and as GIS layer(s).

In early 2005 a workgroup in SEKI established criteria that trees need to meet to be considered a "named tree". The current list contains 98 trees located in seven park groves. As of November 2005 all known named trees in Giant Forest have been visited with the exception of the area from McKinley south to Circle Meadow and from Washington and Welton east to the House Group and President tree. All data has been entered into a database and can be joined to the GIS layers of named trees in the sequoia tree inventory map and viewed in ArcView/ArcGIS. This should provide a valuable easy to access source of information during burn plan development or during wildland fires.

Table 4.1.6-1. Listing of tree characteristics and conditions surveyed.

live/dead	fuel jackpots (#)	Slope (%)
FMH CPC code	mean litter and duff depth (inches)	presence of nearby snags (#)
hollow (y/n)	tree lean (degrees)	crown condition (%)
catface present (y/n, #, width)	presence of facing trees (y/n)	photos: tree, crown, fuel
fuel continuity (y/n)		

(4.1.7) ***Reconstructing Pre-EuroAmerican Fire History of Devils Postpile National Monument***, PMIS #: 92344, Anthony Caprio, SEKI and Deanna Dulen, DEPO

This study is reconstructing attributes of fire prior to EuroAmerican settlement using fire scarred trees and stand structure data to provide baseline information for developing and implementing natural resource and fire management plans and activities. Little is known about fire's past role in this ecosystem although elsewhere in the Sierra Nevada significant alterations occurred with settlement resulting in dramatic vegetation changes and unnaturally high fuel loadings. Using dendrochronological analysis, properties of pre-1900 fire regimes can be determined that characterize temporal and spatial attributes and the variability of past fires, providing insight about how fire helped shape the landscape. Results will be valuable in fire management planning in DEPO (preliminary results have already reshaped our view of fire regimes in the monument).

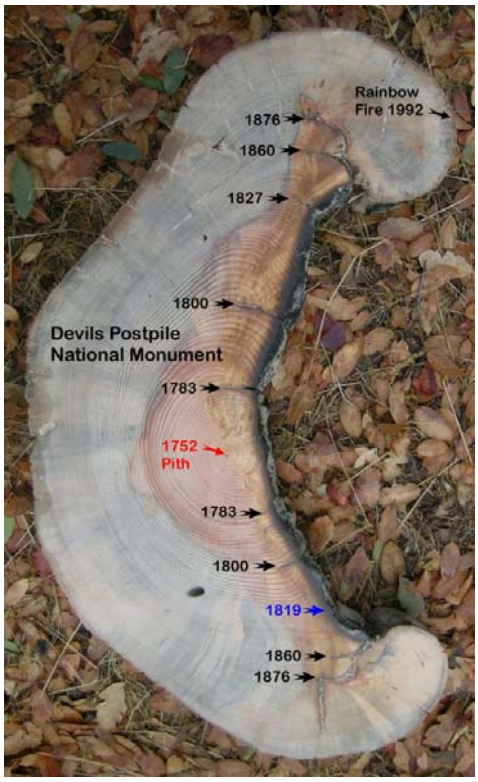

Figure 4.1.7-1. Fire history sample (cross-section from a PIJE log) collected near the southeast corner of Devils Postpile NM showing fire scars and dates of seven fires: 1783, 1800, 1819 (no scar visible on this section but found on other sections from the same tree), 1827, 1860, 1876, and 1992 (Rainbow Fire).

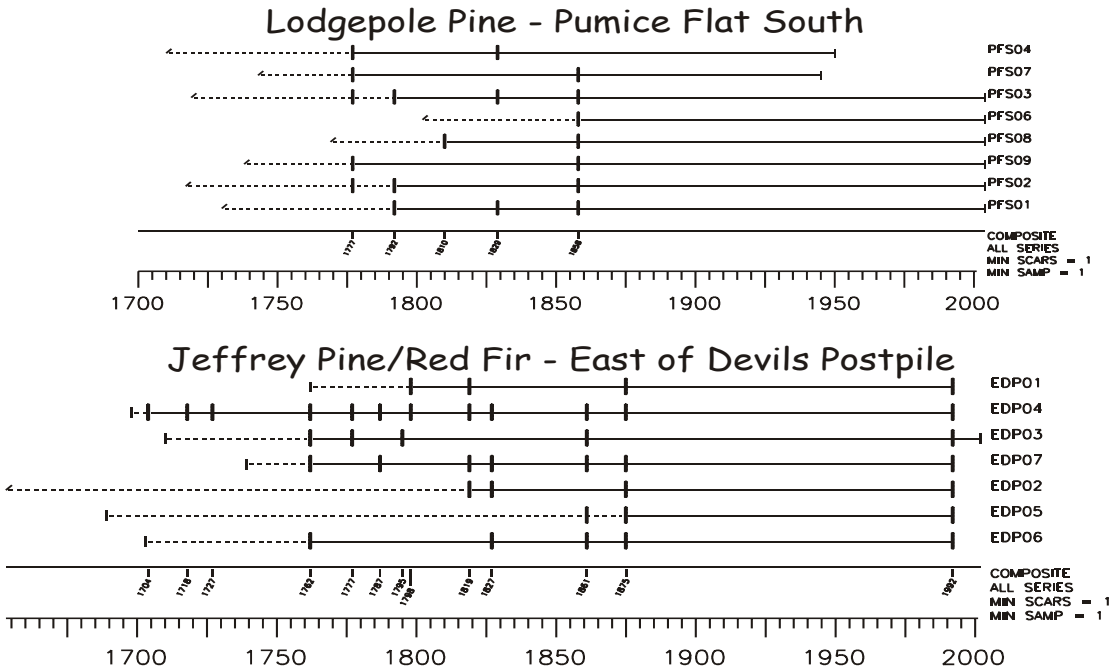

Figure 4.1.7-2. Fire history chronologies from two sites in DEPO. Greater frequency is being observed in Jeffrey pine/red fir and in lodgepole pine communities. Each horizontal line represents a single tree and the span of its record. Each vertical dash along each of these lines indicates a fire event record. A composite at the bottom of each graph lists all fire dates for the site. The 1992 scar or death date at EDP was a result of the Rainbow Fire.

A total of 74 samples (partial cross-sections from old trees or logs – see ***Figure 4.1.7-1***) were collected at 12 sites in or adjacent to the monument in the most common forest types. Detailed data describing each site's vegetation, topography, and fuels were also collected. Samples are being processed (stabilized and sanded) and are being crossdating to obtain fire event dates. Preliminary results suggest moderate fire frequency over much but not all the monument (see ***Figure 4.1.7-2***). Age structure data was also collected at two one hectare unburned sites. Additionally, 33 random "regeneration" plots were established in burned areas to collect data on preburn forest structure, composition, and postfire forest regeneration (nine similar plots were also established in unburned areas for comparison). These circular plots are permanently marked and could be resampled at some point in the future to determine how forest vegetation is responding long term.

4.2 - Feedback to Fire Management Program

The Fire and Fuels Management Plan (FFMP) and Environmental Assessment (EA) for Devils Postpile N. M. were completed in 2005 (http://www.nps.gov/depo/pphtml/documents.html). The fire ecology program had significant input into the development of the preferred alternative in the Devils Postpile National Monument Fire Management Plan. Results from the fire effects plots and fire history sampling during 2004 provided important information for plan development. The preliminary results from fire history sampling (see ***Section 4.1.7***) indicated that much, but not all (the northwest appears to have had much longer intervals between fires), of the monument had a moderate frequency (~10 – 25 years) surface fire regime indicating that the 1992 Rainbow Fire, which resulted in large patches of complete overstory mortality, was an abnormal event. Prior to this study fire was generally thought to be rare in the area (SEKI 1982[1]) with stand replacing fires the rule. Plot data also indicated very limited tree regeneration in the high severity patches located away from seed sources with most regeneration present establishing within one or two years of the 1992 burn. As a result it was felt care should be exercised in fire planning that would consider impacts since fire in these areas could potentially result in long-term type conversion to shrub dominated vegetation. However, it was also felt that initiating a burn program in areas where the 1992 fire had been less severe (occurring primarily as an understory or of mixed severity burn) would be beneficial.

The second annual update has been made to the Fire and Fuels Management Plan for Sequoia and Kings Canyon. Full copies of the plan and EA for SEKI can be found at: http://www.nps.gov/seki/fire/ffmp/ffmp.htm. Both the SEKI and DEPO plan contain copies of the Fire Monitoring Plan (Appendix C).

Direct feedback was also provided for a number of burn plans being developed in SEKI. This included development of five year burn plans and comments about portions of burn units that incorporated areas of vegetation that had limited fire occurrence in the past (for example, foxtail pine, western juniper, and piñon pine vegetation types) and where care needs to be used in planning so that these vegetation types are not negatively impacted. This was also useful resource input during the plan development for the Comb WFU fire because unusual stands of piñon pine exist on the west slope of the Sierra Nevada in this location. Close coordination also occurred between fire management, fire ecologist, and SEKI USGS researchers on restarting the

[1] USDI. 1982. Natural Resources Management Statement for Devils Postpile National Monument. Sequoia and Kings Canyon National Parks and Devils Postpile National Monument. 20 pp.

Cedar Grove burn program (burn scheduled for 2005) after it was shut down in 1998 due to the exotic cheatgrass invasion of the area. Results from the USGS cheatgrass study, funded by JFSP, will be utilized in making burn plan decisions. The extent and severity of cheatgrass occurrence was documented in the area of the Roads End Burn prior to the fire (see ***Figure 4.1.5-1***) using rapid assessment sampling methods. The same area will be resampled in 2006 to document postfire changes. This will continue in 2006 as burn plans are developed and implemented in Cedar Grove.

4.3 – SEKI/DEPO Fire Research Projects and Collaboration

This section on research projects and collaboration has been broken into three subsections; completed, current, and proposed projects.

4.3.1 - *Projects Completed 2005*

(4.3.1.1) ***Fire and Fire Surrogates: Sequoia and Kings Canyon Study Area*****.** JFSP funded 2000. SEKI PI, Jon Keeley; Project Manager, Eric Knapp

Abstract: Compared to historic conditions, many forests in the U.S. are now denser and have more surface fuels. For years, managers have recognized this problem and have acted to reduce stem density and fuels by thinning, burning, and/or fuel treatments. The Fire and Fire Surrogate study is a network of 13 long-term sites established nationwide to evaluate the ecosystem impacts of different fire hazard reduction treatment in forests that historically experienced short-interval, low- to moderate-severity fire regimes. Results at each site and meaningful comparisons across sites will be enabled by a common or a core research design, one key aspect of which is a large set of core response variables and measurement protocols. Core variables encompass several broad disciplinary areas, including fire and fuels, vegetation, wildlife, entomology, pathology, soils/hydrology, utilization/economics, and social science. The fuel reduction treatments being investigated by USGS researchers at Sequoia National Park are early season and late season prescribed fire. USGS is cooperating with the National Park Service in this effort. Late season burns were carried out in the fall of 2001 and early season burns in the spring of 2002.

(4.3.1.2) ***Fire and Invasive Annual Grasses in Western Ecosystems*****.** JFSP funded 2001; PI USGS, Matt Brooks, Jayne Belnap, Jon E. Keeley, and Robert Sanford.

Abstract: Annual grasses have invaded shrub and forest ecosystems in western North America and are linked to changes in both ecosystem structure and function and in some cases have altered fire regimes. This has occurred over vast expanses of public lands in the Great Basin and the Mojave Desert, and is a threat to lower elevation yellow pine forests. We hypothesize that fire has the potential for contributing the most to annual grass invasion in low nutrient soils, where postfire increases in their availability are more effectively exploited by invasive grasses than by the native flora. Soil nutrient changes can vary widely depending on soil properties and the amount and duration of soil heating. In forested ecosystems such impacts of fire on soil nutrients and light solar radiation are potentially more profound now than under historic conditions because of unnaturally high fuel loads.
We propose to investigate the interactions between fire and soil nutrients over three ecosystems currently dominated or threatened by invasive annual grasses in western North America -- Great Basin shrubland, Mojave Desert scrub and Sierra Nevada yellow pine forest. Common factors driving the fire/annual grass cycle in these ecosystems will lead to generalizations widely applicable beyond the ecosystems under study. In addition, each of these systems has unique features that contribute to the dominance of invasive annual grasses, and elucidation of these will contribute to a broader understanding of the problem.

We will use intensive field manipulations at representative sites in these three regions that will couple burning, nutrients, fuels and light treatments. In addition, extensive surveys will be conducted across these regions to assess the soil nutrient status associated with invaded and non-invaded sites. These field studies will be coupled with laboratory studies to examine in detail the relationship between soil heating and nutrient availability for invasive grasses. With this information, managers could determine in advance if habitats are naturally vulnerable or resistant to invasions, enabling limited resources to be more effectively deployed both during and after fires. Fire prescriptions could be designed to avoid creating conditions susceptible to invasion, plus, restoration techniques could be better targeted, saving both time and money.

(4.3.1.3) ***The Effects of Prescribed Burning on Stream Water Chemistry at Different Spatial and Temporal Scales.*** Colorado State University M.S. graduate project for Andi Heard; Advisor John Stednick; SEKI collaboration, Anthony Caprio.

Abstract: Federal agencies are using prescribed burning as a tool to reduce fuel loads and to restore ecological integrity in forests. A better understanding of the effects of prescribed fire and fire exclusion on forested watersheds is needed in order to better establish objectives for prescribed fire programs and methods to monitor if these objectives are met. The Mineral King Risk Reduction Project in Sequoia National Park is a landscape scale prescribed fire project, in which a 20,000 ha watershed is being treated with prescribed fire over several years. Prescribed burning has the potential to alter chemical and physical water quality parameters. The extent to which water quality is affected by prescribed fire at different scales requires further investigation. An earlier study in Sequoia National Park demonstrated that the reintroduction of fire had a significant effect on the hydrology and water quality in a 13 ha catchment. Our research will expand on this study and investigate the changes on specific water quality parameters associated with the large scale prescribed fire project in Sequoia National Park. The water quality parameters that have the potential to be affected by fire are pH, specific conductivity, alkalinity, stream temperature and concentrations of sulfate, nitrate, orthophosphate, chloride, calcium, magnesium, potassium, and sodium.

Our study will test the hypothesis that changes in stream water chemistry as a result of prescribed burning will be the same at different spatial and temporal scales. The project will investigate the effects of prescribed burning on stream water chemistry at different spatial and temporal scales in the East Fork of the Kaweah River in Sequoia National Park, California. Pre- and post fire, water quality parameters will be monitored. To investigate the potential effects of prescribed fire at different scales these parameters will be measured in small (i.e. 100 ha) and large (i.e. 20,000 ha) catchments treated with prescribed fire over the past several years.

This study will provide a further understanding of how prescribed burning is affecting stream water chemistry in Sequoia National Park. The results of this study will aid land managers in determining the effect of prescribed fire on water quality and what water quality parameters should be included in a monitoring program and the most effective scale at which these parameters should be monitored.

4.3.2 - *Current Projects*

(4.3.2.1) ***Reconstructing Pre-EuroAmerican Fire History of Devils Postpile National Monument.*** NPS funded; SEKI PI, Anthony Caprio and DEPO, Deana Dulan.

Abstract: Understanding historic fire regimes and how they have changed is critical in developing and implementing appropriate natural resource and fire management planning (the fire management plan for Devils Postpile will be started in 2004). Important attributes of these regimes can be reconstructed by dendroecological analyses of fire history samples (fire scars found on old trees or logs). These provide a powerful tool to characterize temporal and spatial attributes of past fires, to examine their variability, and to understand how they have shaped landscapes over time. Understanding past variation across a landscape may also be key in understanding potential future variation in fire under a changing climate regime. This fire history study in Devils Postpile National Monument will provide important baseline information on these attributes and help in the selection of appropriate fire related management actions and restoration goals. Such information has become a key component of fire planning at Sequoia and Kings Canyon N.P. using "ecological needs" models and fire return interval departure (FRID) analysis in GIS. Study objectives are to reconstruct fire history in major vegetation types of the monument over the last 300-400 years and to ascertain patterns of fire frequency, spatial extent and patchiness of past fires (limited to immediate area of DEPO, actual area of fires might be larger), temporal and spatial fire occurrence variability, and approximate seasonal occurrence.

(4.3.2.2) ***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

Abstract: 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.

(4.3.2.3) ***Setting Forest Structural Goals for Fire Management.*** NPS funded; PI USGS Nate Stevenson and Scott Martens; and SEKI, Anthony Caprio

Abstract: We aim to create a general approach to aid in setting quantitative and defensible forest structural goals for fire management, and apply the approach across all forest types in Sequoia and Kings Canyon National Parks (SEKI). To reach this end, this project is organized to accomplish four tasks. First, for a variety of species and forest types, we will use available age-size data (from tree cores that have already been collected) from at least ten separate studies within SEKI to determine diameter thresholds for trees likely to have established pre-1875, post-1875, and mixed pre- and post-1875 (1875 is the median date of last fire at more than 60 sites in a variety of forest types in SEKI). Second, across a range of spatial scales and by species for each of SEKI's eight forest types, we will determine the contemporary (unburned, at the time the plots were established) mean and range of densities of trees in the three key size classes determined in Objective 1. Third, we will use the combined age and density data to aid in setting forest structural restoration goals for fire management.

(4.3.2.4) ***Historical Wildland Fire Use: Lessons to be Learned from Twenty-five Years of Wilderness Fire Management.*** JFSP funded 2002; RMRS PI, Matthew Rollins with work in SEKI by Co-PI, Scott Stephens.

Abstract: We propose three research tasks that take advantage of a 25-year legacy of wildland fire use in the Sugarloaf-Roaring River (SRR) region of the Sequoia and Kings Canyon National Parks, California; the Illilouette Creek Basin (ICB) in Yosemite National Park, California; the Rincon Mountain Wilderness (RMW) in Saguaro National Park, Arizona; and the Gila/Aldo Leopold Wilderness Complex (GALWC) in the Gila National Forest, New Mexico using landscape-scale experimentation and simulation modeling. Individually, these tasks will address the following main research questions: 1) Are there thresholds in pre-fire stand structure in ponderosa pine/Douglas-fir forests that lead to undesired levels of canopy mortality in wildland fire use operations? 2) How has the introduction of wildland fire use programs in Sequoia and Kings Canyon, Yosemite, and the Gila National Forest affected the nature of fire spread in these areas over time? And, 3) How do landscape composition, structure, and function vary under different fire management strategies? Together, the three proposed research tasks will quantify the effects of specific types of fires on landscape structure, composition, and function based on extensive field inventories, broad-scale ecological simulation modeling, and 25 years of well-documented wildland fire use in these four wilderness areas.

(4.3.2.5) ***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: Tony Caprio).

Abstract: 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.

(4.3.2.6) ***The Sugar Pine Dilemma: Prescription Burning and the Management of a Declining Species***. USGS PI: Phillip van Mantgem. Park-Orientated Biological Studies BRD Cyclical Funds.
Prescribed fire is a primary tool for forest restoration, but changing forest conditions may create circumstances where the simple reintroduction of fire may not be sufficient to achieve some restoration goals. This may be true for sugar pine (*Pinus lambertiana*) in the Sierra Nevada of California, where high post-fire mortality coupled with the ongoing effects of an introduced pathogen (white pine blister rust, *Cronartium ribicola*) could contribute to local extinctions. The objective of this study is to determine if fuels removal, a simple and cost effective strategy, may help to reduce sugar pine mortality following prescribed fire. We propose removing fuels in a 0.5 m radius around the base of individual trees and compare post-fire survivorship between treated and untreated trees. We will test the effectiveness of the fuels removal treatment at multiple fires to help managers decide under which conditions the added expense of this treatment might be most worthwhile. This study addresses significant local knowledge gaps in at least three areas of importance to parks management: (1) setting of desired future conditions for the composition and structure of mixed conifer forests through fire management, (2) direct management of sugar pine populations, and (3) interpretation of the fire management program to the general public, in particular the relations among fire, pathogens, and climate. The results of this study will provide fire managers a much improved knowledge base when burning stands containing sugar pine.

4.3.3 - *Proposals Submitted in 2005 for Fire Related Projects*

(4.3.3.1) ***Records of the Presence and Intensity of Past Fires in Sediments and Soils: Detecting Black Carbon and Organic Molecular Tracers.*** PI Rainer Lohmann, URI and Co-PI Tony Caprio, NPS.
This study will investigate whether a molecular fingerprint of past fires can be obtained from sediments or soils utilizing pyrogenic black carbon (BC), polycyclic aromatic hydrocarbons (PAHs) and lower chlorinated dibenzofurans (PCDFs). Sediment samples taken from Oriole Lake will be compared to an independent fire record preserved in the scars of nearby conifer trees. Additionally, soil samples will be collected along a transect in the East Fork and will be compared to the fire history from the watershed reconstructed from tree rings to determine whether this type of sample can yield information about pre-EuroAmerican settlement fire regimes at a wider landscape scale. If the "ground-truthing" indicates these sampling methods looking at geochemical markers prove useful they could: 1) provide a long record of fire occurrence (1000+ years) valuable for understanding fire-climate relationships, and 2) potentially provide a means of acquiring past fire regime information from vegetation types where a tree-ring fire scar record does not exist (chaparral, oak woodland, evergreen hardwood forest).

4.4 – "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. However, the pages are in need of a facelift to bring them up-to-date with current web standards.

Figure 4.4-1. Headfire that burned through the Comb Fire pine/bear clover fire effects plots. (photo by Todd Erdody)