National Park Service
Fire Ecology Annual Report Calendar Year 2011
Sequoia & Kings Canyon National Parks
and Devils Postpile National Monument

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2011 Program Overview

One of the most significant changes to the Fire Ecology Program in the last 15 years occurred in 2011. In response to expected budget reductions SEKI's fire effects program (Resources Management) and fire monitoring program (Fire Management) were merged with reduced crew size and a single Lead and Assistant Lead. Major activities for the year involved "fire effects" (FMH) and "rapid assessment" (RAP) plot sampling, data analysis, and operational fire support. The late snowmelt in May/June delayed the start of field work by 4-5 weeks at mid-to-upper elevation sites. Burns that fire ecology staff were involved with included the *Hole-in-the-Wall, Redwood Mtn., Huckleberry, Round Meadow, Nature Trail,* and *Swale East "prescribed burns" (Rx)* and the *Lion Wildfire*. Considerable effort went in to the successful implementation of the Redwood Mt. Rx where there were special resource concerns related to thickets of giant sequoia regeneration. A major update to all SEKI fuels data was completed using custom fuel constants based on proportional species basal area within each plot. This update was part of an overall update to fuels for burn planning and reporting. Additionally, staff collaborated on several manuscripts that address fire and natural resource issues, with some utilizing long-term fire ecology data sets. During the year significant time was invested by the fire ecologist on SEKI's Resources Management Division ***Natural Resources Condition Assessment*** (NRCA) and ***Fire Management Scenario Planning Project***, as a member of the SEKI *Fire Management Committee,* which included a review of the Round Meadow Rx Plan, and on input to park compliance. Time was also committed as the federal representative for a Joint Fire Science (JFS) project and to SIEN *Inventory and Monitoring Program*. Also, of note for 2011 was the adoption by the USDA Forest Service of a modified "fire return interval departure" (FRID) analysis, developed within the SEKI fire ecology program, statewide across California.

Fire effects of the 2011 Redwood prescribed Fire on a thicket of giant sequoia regeneration (Partin Grove) created by a 1977 Rx fire that killed all trees except monarch sequoias. Because of the doghair thicket there was concern by the park and the public that all the sequoias would be killed. Our objective was to thin and leave at least 10% of the regeneration alive.

Workload and Staffing

To plan for projected budget reductions in fire funding SEKI fire management staff decided to merge the existing Fire Monitoring Crew and Fire Effects Crew in 2011. Overall crew size was reduced from 13 (8 and 5 respectively for the two crews) down to 7 with a single PSTF Fire Effects Lead position. This allowed the park to refill the lead position which was announced but not filled until the fall of 2011. Overall fire effects had a very busy season just to meet basic objectives. However, 41 FMH plot visits were made within seven monitoring types with an additional 38 RAP and 16 Kilgore plots sampled (***Tables 1*** and ***2***).

Additionally, postburn black oak mortality/survival was sampled in the 2010 Viewpoint prescribed burn. A few planned reads were missed because access to the areas where plots were located was not approved by law enforcement due to potential marijuana growing activities (brush plots). Approximately 41 reads are projected for 2012. Other monitoring or work highlights included:

- "Rapid assessment plots" (RAP) sampling was initiated in 2010 to collect greater detail on fuel loads within burn units with this data used in burn planning and postfire fuel consumption reporting. Data will provide higher quality fuel estimates to be made spatially across a unit and among the predominant Scott & Burgan fuel types in a unit, as well as providing a postfire measure of surface area burned. These data will provide more reliable pre and postfire smoke production estimates. All RAP plots are removed at the time of the postburn read. Mean fuel reduction on four prescribed burns in 2011was about 40 t/a or about 45% of the total prefire fuel load. 18 preburn RAP plots were installed and 20 postburn RAP plots were read (a set of RAP plots had been installed in 2010 by SEKI's fire monitoring crew).
- No "composite burn index" (CBI) plots (burn severity assessment) were sampled (other than Horse Rx in the fall of 2010) due to late season prescribed fire activities and associated workload. CBI plot sample points were selected and sampling could occur in early summer 2012 for the Sheep, Moro, and Viewpoint burns but the added workload on the merged fire ecology crew may preclude this.
- Postfire fuels and severity data were also collected on 16 Kilgore legacy plots (originally installed in 1969) following the 2011 Redwood Mtn. Rx, a second entry burn (a third burn in a subset of plots). These are some of the oldest fire effects plots in the NPS.
- Fuel moisture samples were collected biweekly from May to October at Elk Cr., part of a long-term fuel moisture monitoring designed to give information to fire staff on vegetation conditions year-to-year and seasonal changes in live chamise moisture content. Because there is 10-15 years data at this site the *National Phenology Network*—interested in the timing of life cycle events of plants—has expressed interest in the dataset.
- The ecologist worked with the SEKI smoke tech (Ariane Sarzotti) updating and summarizing much of the parks fuels data (FMH, fuels plots, RAP) by fuel/vegetation type and by time since fire into tables that can be used for burn planning and projecting current and future smoke production (see ***Table 4***). Nearly all FMH data has been updated with the custom constants.

All data entry for the southern Sierra lodgepole pine fire regime study was completed (seven addition plots were sampled in SEKI in 2010) and preliminary analyses are being done. Field data (fuels and forest structure data) have been input into a custom FFI database and crossdating of age structure cores (~2,500 trees) and fire history samples (partial tree bole sections with fire scars) is being completed by the research cooperator (Peter Brown, Rocky Mountain Tree-Ring Research) and SEKI fire ecologist. Difficulties in crossdating have been encountered at two sites that are somewhat mesic (Bridleveil and Hockett) with annual rings series that are complacent (little year-to-year variation).

Without a lead position during 2011 the assistant lead, as well as all crew members, had to assume added responsibility for meeting summer goals. Overall work load increased for the assistant lead in 2011 because crew size increased from three to five. Duties for the crew also expanded with the merging of the two crews with RAP, fuel moisture monitoring, and some operational fireline "fire monitoring" (FEMO) activities now part of the crew's function. This also meant more planning and greater day-to-day interaction and direction of the crew by the fire ecologist and coordination with fire management. Additionally, further sampling on several special projects designed to provide supplemental information to the fire management program continued to be on hold. This included an expanded data set evaluating fire and its effects on giant sequoia mortality and regeneration (seedlings through monarchs) and continued field evaluations and additions of named giant sequoia trees to the Named Tree Inventory

database that can be used for fire planning and long-term monitoring. There was also considerable added workload for the ecologist, particular personnel management, hiring, and summer preplanning, which reduced time available for data analysis or addressing other management needs.

Table 1. Fire ecology plot workload in 2011 and total plots installed (red numbers highlight updated values for 2011).
RAP plots are a new sampling protocol added in 2011.

Park	Type of Plot (FMH, photo point, other)	Monitoring Unit	Installs/Pre-Burn Reads	Immed. Postburn	Postburn (1-40 yrs)	Not Treated^	Total Plots#
SEKI	FMH forest	Giant sequoia-mixed conifer		8	6		**50 / 9**
		White fir-mixed conifer		1	4		**18 / 2**
		Low elevation-mixed conifer			1		**6 / 1**
		Red fir forest	1				**7 / 4**
		Ponderosa forest	3		7		**22 / 6**
		Xeric Jeffrey pine			3		**6 / 0**
		Buckeye Wildfire					**3 / 0**
		Blue oak woodland			1		**2 / 0**
	FMH brush	Chamise chaparral					**4 / 0**
		Montane chaparral/sagebrush			2		**7 / 2**
		Mixed chaparral					**9 / 0**
	FMH Mechanical	Thinning+pile burning+Rx burn			3		**10 / 0**
	Rapid Assessment (RAP)	Rx burns	18	20			**22 / 0**
	CBI*†						**868**
	Cheatgrass Monitoring*†	Horse Trail/Roads End Rx					**377 / 56**
	Forest Structure*	S. Sierra PICO fire regimes					**91**
	Kilgore Plots (pre-FMH)	1968 Rattlesnake Rx					**14 / 3**
		1969 Redwood Mtn. Rx		14		2	**18 / 3**
	Legacy Plots	1970 Cedar Rx			1		**2 / 0**
		1978 Mineral King Red Fir					**3 / 1**
	Black Oak Fire Effects*†	Cedar Rx burns	1				**5 / 0**
	Sequoia Seedlings	10 Rx burns					**21 / 0**
	Expanded Sequoia Mort.	7 Rx burns					**7 / 3**
	Tree Regeneration*†	Redwood Mtn. PILA regen.					**12 / 12**
DEPO	FMH Forest	Rainbow Wildfire (postfire)					**9 / 3**
	FMH Mechanical	Thinning + pile burning					**1 / 0**
	Tree Regeneration†	Rainbow Fire tree regen.					**42 / 9**
Total FMH or pre-FMH			**4**	**9**	**27**		**175 / 36**
Total Other (permanent and non-permanent)			**19**	**34**	**1**	**2**	**1435**

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

Figure 2. Repeat photos (left to right) taken in 1969 (preburn), 1988 (after one burn), and 2011 (after second burn) from a "Kilgore" plot at Redwood Mountain. This plot was burned in 1977 and 2011 (others were also burned in 1969). The plots, established in 1969 in giant sequoia-mixed conifer forest, were some of the first fire research/fire effects plots in a national park.

Staffing details 2011 - Staffing for the merged fire effects and fire monitoring crews consisted of PFT GS-11 fire ecologist, a seasonal assistant lead GS-6, four GS-5 seasonal biological technicians, and a GS-3 student hire biological technician. The student hire was unfortunately only able to work two payperiods in June for medical reasons and was replaced by a GS-5 seasonal rehire for the last two months of the season.

Our original PSTF GS-7 lead fire effects position remained unfilled, as per the direction of PWR fire management office, however because the lead fire monitor position was vacant at the time the crews were merged it was decided by SEKI fire management to hire a lead who would oversee the combined programs with an emphasis on maintaining fire effects monitoring at its current level. Overall crew size of the two crews was reduced from 13 to seven with a single PSTF Lead and Assistant Lead (reduced from two each). Some functions of the fire monitors were shifted to Fire Management's Crew 91 or eliminated with others retained by the merged crew (Crew 9). SEKI's fire effects and fire monitoring programs were separated in the early 1990s so emphasis could be placed on hiring crews with more specialized skill sets but the two crews have always worked closely, frequently sharing crew members. The new PSTF GS-7 fire effects lead position was announced in the summer of 2011 and filled in September by Tyler Schmitt with a start date of December 18, 2011 (EOD date in January – moving costs covered by PWR). Besides function, crew offices and equipment were merged and reorganized early in the summer.

Table 2. Fire Ecology Staffing 2011

Ecologist and Monitors	Starting Date	Ending Date	# of Pay Periods	READ Qualified (Yes or No)	Training and Development
Tony Caprio	1/1/11	12/31/11	26	Yes	Fire Refresher, B3/Aviation Safety Refresher, Operational Leadership, George Wright Society meeting and READ workshop, Forest Insect and Pathogens, FISSA, Injury Prevention for Field Biologists, Retirement Training, Performance Plan Writing for Supervisors, Credit Card (CC), Basic Supervisory Training, Supervisory Reasonable Suspicion/Post Accident Drug/Alcohol Testing Program, Federal Resume Writing Training, Discrimination and Whistleblowing in the Workplace
Christy Frenzen	5/9/11	10/22/11	12	Trainee	Fire Refresher, IT, CC, Forest Insect and Pathogens
Mike Turner	5/23/11	11/5/11	12	No	Fire Refresher, S-133, IT, CC, FEMO Trainee
Daniel Leach	6/13/11	10/22/11	9.5	No	Fire Refresher, S-133, IT, CC
Miles Boiko	5/23/11	11/5/11	12	No	Fire Refresher, S-133, IT, CC, FEMO Trainee
Dario Bravo	5/9/11	10/22/11	11	No	Fire Refresher, IT, CC, Interim representative on the fire management safety committee, Forest Insect and Pathogens, (Fire Management 1, Prevention 1)†.
Roxanne Kessler*	8/1/11	11/5/11	7	Trainee	Fire Refresher, S-133, B3, IT, CC, FEMO Trainee
Danielle Knapp[#] {student hire (GS-3)}	5/31/11	6/17/11	2	No	S-130/S-190, IT, CC

[#] Danielle worked only two payperiods (June) due to illness.
* Roxanne worked a short season beginning August 1 filling in behind Danielle.
† Dario took time off to take these two classes in pursuit of a structural fire career.

Hot Springs Wildfire 2004 - Kern Canyon and Chagoopa Plateau (left side of image)

Management Objectives and Monitoring Results

Table 3. Summary of management objectives and monitoring results. 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?	Anal. Yr
Giant sequoia-mixed conifer forest	**Initial Entry Restoration Burn**				
	60-95% total fuel reduction:	Total fuel reduction = 72.4%	*31*	**YES**	2008
	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)	2008
	10-yr postburn stand density:	10-yr stand density = 324 trees/ha <80 cm DBH 42 trees/ha ≥ 80 cm DBH	*28*	**N/A**	2008
	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)	2008
	Second Entry Restoration Burn				
	Total fuel reduction:	total fuel reduction = 38.5% change from 1st to 2nd prefire = -17.3 %	*21*	**N/A**	2008
	5-yr postburn stand density:	5-yr stand density = 166 trees/ha <80 cm DBH 39 trees/ha ≥ 80 cm DBH	*14*	**YES**	2008
	10-yr postburn stand density:	10-yr stand density = 97 trees/ha <80 cm DBH 43 trees/ha ≥ 80 cm DBH	*6*	**N/A**	2008
	5-yr postburn stand composition:	Fir = 70.3% Sequoia = 17.4% Pine = 12.3% Other = 0%	*14*	**YES**	2008
Ponderosa pine-mixed conifer forest	**Initial Entry Restoration Burn**				
	60-95% total fuel reduction:	total fuel reduction = 90.5%	*8*	**YES**	2010
	5-yr postburn stand density: 50-250 trees/ha <80 cm 10-75 trees/ha >80 cm	5-yr stand density = 284 trees/ha <80 cm DBH 20 trees/ha ≥ 80 cm DBH	*7*	**NO** (<80cm) **YES** (>80 cm)	2010
	10-yr postburn stand density:	10-yr stand density = 421 trees/ha <80 cm DBH 20 trees/ha ≥ 80 cm DBH	*12*	**N/A**	2010

		5-yr postburn stand composition: (50-80% pine, 5-20% fir, 10-20% cedar, 1-10% oak)	Fir = 11.5% Cedar = 16.9% Pine = 43.4% Black Oak = 7.9% Live Oak = 20.4%	*8*	**Partially**	2010
	Second Entry Restoration Burn					
		Total fuel reduction:	total fuel reduction = 65.4% change from 1st to 2nd prefire = -30.1%	*5*	**N/A**	2010
	Third Entry Burn					
		Total fuel reduction:	total fuel reduction = 47.4%	*6*	**N/A**	2010
White fir-mixed conifer forest	**Initial Entry Restoration Burn**					
		60-95% total fuel reduction	total fuel reduction = 77.6%	*13*	**YES**** but minimum sample size too small	2009
		5-yr postburn stand density: 50-250 trees/ha <80 cm 10-75 trees/ha ≥ 80 cm	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 postburn stand density:	10 yr stand density = 401 trees/ha <80 cm DBH 33 trees/ha ≥ 80 cm DBH	*10*	**N/A**	**?**
	Second Entry Restoration Burn					
		Total fuel reduction:	total fuel reduction = 42.5%	*4*	**N/A**	2009
Low elevation-mixed conifer forest	**Initial Entry Restoration Burn**					
		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 postburn stand density:	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	2008
		Immediate post treatment stand structure: maximum of 25 tree/acre <22.9 cm DBH*	stand density = 17 trees/acres <20 cm DBH (range 8-61)	*9*	**YES*** but sample size too small	2008

* Excluding DEPO plot.

Ignition around giant sequoia trees on the Huckleberry Prescribed Burn, a third entry burn, in Giant Forest, fall 2011.

Table 4. Example of change in fuel loads (median values) over time (20 years) by fuel model (FAR40) following first, second, and third entry burns. Data are shown for three of the nine FAR40 fuel types for which SEKI has data. Source of data are FMH, RAP, and fire monitor plots. Number of burns varies from fuel type to fuel type.

FM_Far 40	*Fuel Model*	Burn Code*	N	1 hr	10 hr	100 hr	*Total 1-100 hr*	1000 hr Sound	1000 hr Rotten	*Total 1-1000 hr*	Duff	Litter	***Total***
165	***Very high load, dry climate timber-shrub***												
		-1	7	0.33	1.48	2.16	*3.97*	0.79	1.04	*5.79*	23.75	9.03	***38.58***
		1x0	5	0.10	0.44	1.53	*2.07*	0.00	0.19	*2.25*	0.21	0.49	***2.95***
		1x10	3	0.48	1.52	4.11	*6.11*	15.45	43.78	*65.35*	18.72	4.90	***88.97***
		1x20	no data										
		2x0	no data										
		2x10	no data										
		2x20	no data										
		3x0	no data										
184	***Small downed logs***												
		-1	89	0.38	1.31	2.12	*3.81*	7.74	2.30	*13.84*	38.12	8.48	***60.45***
		1x0	20	0.10	0.56	0.80	*1.46*	6.03	1.34	*8.82*	2.04	1.91	***12.77***
		1x10	21	0.36	1.13	1.62	*3.10*	14.48	4.28	*21.87*	21.74	7.03	***50.64***
		1x20	6	0.05	0.92	1.55	*2.53*	19.12	0.00	*21.64*	11.52	12.05	***45.22***
		2x0	7	0.23	0.24	0.58	*1.06*	0.00	0.00	*1.06*	2.48	2.79	***6.33***
		2x10	6	0.26	0.81	1.39	*2.46*	6.99	11.01	*20.45*	17.02	3.76	***41.23***
		2x20	no data										
		3x0	no data										
96	***Recently burned***												
		-1	29	0.33	1.23	1.98	*3.54*	5.49	3.76	*12.79*	35.43	8.47	***56.69***
		1x0	16	0.05	0.22	0.28	*0.55*	1.28	0.00	*1.83*	2.40	1.14	***5.37***
		1x10	14	0.69	1.26	1.11	*3.06*	10.48	0.75	*14.29*	20.00	7.27	***41.55***
		1x20	no data										
		2x0	11	0.05	0.22	0.28	*0.55*	1.28	0.00	*1.83*	2.40	1.14	***5.37***
		2x10	no data										
		2x20	no data										
		3x0	3	0.30	0.45	2.00	*2.75*	0.00	1.27	*4.02*	7.18	4.07	***15.28***

* Burn Codes; "-1" = preburn - never burned, "0" = post – same year, "10" = post – 8-13 years, "20" = post – 20 years; and "1x" = first entry burn, "2x" = second entry burn, "3x" = third entry burn.

Redwood Prescribed Burn, a second entry burn in July 2011, in the Redwood Mountain Grove of giant sequoias. The burn is in an area where some of the first prescribed burning in the park service occurred in the 1960s.

B. Fire ecologist accomplishments and areas of focus

Table 5. Fire Ecologist Accomplishments/Focus Areas

Category	Percent Time	Accomplishments and/or areas of activities
Planning	35	• Assisted in the development and review of the five-year burn plan for SEKI • Annual FFMP update • Assisted in review of the annual burn plan for SEKI • Burn plan scoping and data needs (some on site visits were required to address or remedy issues such as the Round Meadow Rx Unit and Redwood Mtn. Partin Grove ignition), • Developed summer's overview of seasonal crew activities • Support for SEKI's Division of Resources Management and Science: 1) **Natural Resource Condition Assessment** - Altered Fire Regimes - Giant Sequoias - Five-Needle Pines - Intact Forests - Foothills Vegetation 2) **Alternative Fire Management Futures** (Fire Scenario Planning) – climate change/fire and future vulnerabilty assessments for southern Sierra Nevada 3) Very detailed SEKI Resource Management Division workplans, accomplishment reports (took at least two payperiods of time) • Provided input on DEPO's Natural Resource Condition Assessment (data and fire regime information)
Presentations	5	• A presentation by fire ecologist was made at the *2011 MEDECOS XII Conference at UCLA* – ***Fire Science, Fire Management, and Restoring Fire in Sequoia and Kings Canyon National Parks***. • Fire ecologist presented a lecture on fire management, ecology, and field sampling methods to a forest ecology class from Fresno State Univ., Dr. Ruth Kern. • Fire Scenario Planning – ***Climate and Fire in Sequoia & Kings Canyon*** • Humboldt State For 422 Capstone class (presentation on ***Sequoia and Kings Canyon Fire Ecology Program*** and associated field trip) with Phil Omi and Tom Nichols • Sequoia Speaks (local community outreach) – ***Fire in a Changing World: Past, Present, and Future***. • SEKI Interpreter Training Workshop – ***Fire and Giant Sequoias*** • Responded to media and other individual inquiries on fire were made via consultation with the parks' fire and public information officers.
NPS Meetings/ task groups	15	• Member of SEKI Fire Management Committee • SEKI Spring and Fall Ops Meetings • **SEKI Natural Resource Condition Assessment** (NRCA) – (attended NRCA Focal Resource Leads Meeting and Roll-Up Workshop):and reviewed sections on *Foothills Vegetation*, *Five-Needle Pines*, *Altered Fire Regimes*, *Intact Forests*, and co-authored *Giant Sequoia* section. • **Alternative Fire Management Futures** (Fire Scenario Planning) four workshops in 2011 • Primary liaison between FMO and Natural Resources Division

		• Wilderness Operations Annual Review
Interagency work	<5	• Hosted Cathy Mardell, NSW Park Range, Australia on a Churchill Fellowship study to examine fuel management methods in the US and see what of these could be used for managing fuels in Australia.
Wildfire assignments	<5	• No specific assignments but provided fire regime information to Sierra National Forest during the Lion Wildfire that could have been used for management operations of the fire outside the parks. This information was used for management of the fire when it burned on to park lands resulting in more acceptable fire effects, particularly in relation to the fire sensitive foxtail pine ecosystem.
Prescribed fire projects	5	• Prefire input and postfire AAR reviews of all prescribed burns. • Ecological effects observer on several Rx burns in a sensitive areas; Round Meadow Rx, Redwood Rx and Partin Grove, Hole-in-the Wall, Nature Trail, Huckleberry • Visited all other Rx units postfire to review effects
Non-fire fuels projects		None in 2011
Research	10	• NPS Reserve Funded Studies 1) PICO fire regimes (RMTRR, SEKI, YOSE) 2) Wildfire vs Prescribed Fire (UC Berkeley, USGS, SEKI) – manuscript preparation and publication. Co-author on published manuscript: *A Comparison of Effects from Prescribed Fires and Wildfires Managed for Resource Objectives in Sequoia and Kings Canyon National Parks.* • Federal cooperator on JFSP study: ***Reconstructing natural fire events, their strength and causes: A Case Study in Oriole Lake.*** Co-author on published manuscript: *Enhanced Sorption of PAHs in Natural-Fire-Impacted Sediments from Oriole Lake, California*. • Study Carbon Sequestration and Fire (USGS, YOSE and SEKI) 1) Below ground carbon and fire (proposal – not funded) 2) Above ground carbon and fire (funded) ***Impacts of Fire Management on Carbon Stocks in Yosemite and Sequoia & Kings Canyon National Parks.*** • Collaborated with Dylan Schwilk (Texas Tech) on flammability research using FMH and CBI data from SEKI – co-author on published manuscript: *Scaling from Leaf Traits to Fire Behaviour: Community Composition Predicts Fire Severity in a Temperate Forest.*
Data collection	<5	Time spent in the field collecting data was primarily related to crew training, development of sampling protocols, addressing protocol issues, or maintaining currency in sampling methods.
Data entry	<5	Primarily related to crew training or making corrections to FFI database. Discovered two major data issues; 1) trees were duplicated within a read in the DEPO FFI database similar to the problem found in the SEKI FEAT database, indicating this was probably an import issue from FMH to FEAT carried over to FFI, and 2) an issue with dead tree data entry beginning in 2003 was encountered.
Data analysis	5	• Analyzed and summarized all pre- and postfire RAP/FMH plot data for the year. • Oversaw calculation of updated fuel constant values by smoke tech (Ari Sarzoti) for all fuels data in FFI that will be used to provide more realistic fuel load values for burns to improve both projected and actual smoke production values.
Supervision/Admin	20	• Hiring (seasonal crew of four and lead fire effects position), supervision, evaluations, crew training, payroll, budget, travel

		authorization/vouchers, purchasing, etc. • Administered agreement between NPS, CESU and URI for Oriole L. JFSP funded study
Training	<5	• Firefighter refresher • PT • Supervisor training • Required hiring training • Attended mandatory park trainings (defensive driver, hazmat etc)
Miscellaneous	5	• Assisted and reviewed success stories for FIO • Parkwide compliance (subject matter expert on fire and giant sequoias) • Provide reviews of research permit applications in areas of expertise; fire ecology, forest ecology, and dendrochronology • Fire Ecology section in 2010 ***SEKI Superintendants Annual Report***

The SEKI fire ecologist collaborated on a number of fire projects underway in the parks by SEKI staff, USGS staff, and university researchers. Over the past year a number of these projects were or are in the final stages of completion with manuscripts prepared by the PIs.

- Work continued of the study investigating fire regimes and fire related forest dynamics in southern Sierra Nevada lodgepole pine (*Pinus contorta*), A study investigating fire regimes and fire related forest dynamics in southern Sierra Nevada lodgepole pine (*Pinus contorta*) is a joint project between SEKI, YOSE and research cooperator, Dr. Peter Brown at Rocky Mountain Tree-Ring Research (funded by NIFC NPS reserve funds). Two study areas were sampled in both YOSE (Dana/Tuolumne and Bridalveil) and SEKI (Hockett Lakes and Chagoopa Plateau). Fire ecology crews from the two parks worked together to facilitate collection of several thousand tree-ring samples for determining tree age structure and fire history. *See additional detail on the study below in Section D.*

- Ecologist collaborated on the fire and carbon sequestration project that will involve sampling and data from FMH plots - USGS, YOSE, and SEKI: "**Impacts of Fire Management on Carbon Stocks in Yosemite and Sequoia & Kings Canyon National Parks**". Sampling protocols were developed and SEKI FMH data provided for analysis. Site selection for additional collections in SEKI were made and reviewed based on local knowledge of fire occurrence and terrain characteristics. Nearly all sites were successfully collected in 2011.

- The fire ecologist was the federal cooperator on a JFS project by University of Rhode Island researcher Dr. Rainer Lohmann to reconstruct a record of past fires and their magnitude by detecting the occurrence of pyrogenic black carbon (BC) and other molecular compounds as fingerprints of past fires in lake sediments and soils. The relevance of the historical record this study may provide is highlighted by recent research indicating black carbon is an important climate forcing agent, estimated to be second only to CO_2 as an anthropogenic contributor to global change. Early results were published, ***Enhanced Sorption of PAHs in Natural-Fire-Impacted Sediments from Oriole Lake, California***. (J. Sullivan, K. Bollinger, A. Caprio, M. Cantwell, P. Appleby, J. King, B. Ligouis, and R. Lohmann. Environ. Sci. Technol. 2011, 45: 2626–2633). *See additional detail below in Section D.*

- Fire ecologist worked with SEKI prescribed fire specialist (Ben Jacobs) and smoke tech (Ari Sarzoti) in developing, calculating, and inputting custom fuel constant values to SEKI fuels data in FFI (see ***Table 4***). Additionally assistance was given to the fire monitoring crew in developing a RAP (short-term rapid assessment plots for pre and post-fire fuels and severity assessments). This information will improve our fuel load estimates for proscribed burns and will be used for reporting both projected and actual smoke production values from the burns.

- The fire ecologist collaborated on a manuscript with Dr. Dylan Schwilk, Texas Tech University looking at changes in flammability of park plant communities: ***Scaling from Leaf Traits to Fire Behaviour: Community Composition Predicts Fire Severity in a Temperate Forest***. (D.W. Schwilk and A.C. Caprio. Journal of Ecology 2011, 99 (4): 970–980). The results suggest that the restoration of fire can result in changes to the flammability of the resulting vegetation. This has a number of implications for fire and natural resource managers. For example, shifts in forest composition from short to long-needle conifers can affects fuel flammability with flammability increasing although total fuel loads may decrease. Understanding flammability characteristics of leaf traits is also important because projected changes in climate may result in unique and no-analog plant communities. The analysis utilized both FMH plot data and a modified set CBI data (additional variable were collected) in the analysis. The work is being further expanded upon by graduate students at Texas Tech., with a JFS proposal submitted in 2011 with support from SEKI.

- Contributions were made to the USGS/NPS/UC Berkeley study looking at effects of wildland fire versus prescribed fire, funded by National Interagency Fire Center (NIFC) reserve funds with the results published, ***A Comparison of Effects from Prescribed Fires and Wildfires Managed for Resource Objectives in Sequoia and Kings Canyon National Parks***, (J.C.B. Nesmith, A.C. Caprio, A.H. Pfaff, T.W. McGinnis, J.E. Keeley. Forest Ecology and Management 2011, 261:1275–1282). The results indicate differences between wildfire and prescribed fires were generally not detectable and both fire types resulted in highly variable effects.

- SEKI hosted a visit by Cathy Mardell and Eric Claussen who were on a two month Churchill Fellowship Study Tour of the US and Canada to review methods of fuel assessment and the tools used to predict the accumulation of fuels in natural landscapes. Cathy is a ranger and natural resource land manager in the NSW National Parks and Wildlife Service and the goal of the fellowship was to learn about fuel measurement methods that can be used in Australia where measurement methods are currently lacking. While at SEKI Cathy and Eric visited with fire staff and spent a day in the field with the Fx crew during a read of a FMH plot.

2009 Horse Wildfire viewed from Hockett Meadow at dusk, Sequoia National Park. The fire primarily burned in lodgepole pine (*Pinus contorta*) and red fir (*Abies magnifica*), with the upper margins fingering into lower elevation foxtail pine (*P. balfouriana*). Foxtail pine has thin bark and little resistance to fire but fuels are sparse and dispersed so fires rare carry very far in this forest type. Dead wood on the ground in these stands can be two to four thousand years old indicating the rare occurrence of fire. Fire may limit the survival and expansion of foxtail into elevations below which it is usually found (about 2,900 m) where it is replaced by western white pine (*P. monticola*) and red fir.

C. Fire effects crew accomplishments and areas of focus

Table 6. Fire Effects Crew Accomplishments/Focus Areas.

Category	Percent Time	Notes
FMH Rx plots	40	Completed 38 FMH Rx reads
WUI plots	5	Three mechanically thinned plots (one read after broadcast burn of plot)
RAP plots	12	18 preburn and 20 postburn RAP plots were sampled in 6 burns
Other plot work	5	• Postfire sampling of 16 Kilgore Redwood Mtn. plots • Fire effects on black oaks in Cedar Grove (one burn)
Wildfire assignments	<5	Three crew members had one assignments as either FEMO (one person) or FEMO trainee (two crew members) on Lion Wildfire
Prescribed fire projects	10	Crew members assisted with the implementation of six prescribed burn projects as FFT2, FEMO, or FEMO trainee
Non-fire fuels projects	0	
Data entry	13	
Data analysis	<5	Custom fuels constants calc. by plot and read
Supervision/Admin	<5	Assistant lead monitor oversaw five staff; misc travel vouchers, time paperwork (Quicktime), and evaluations
Training	15	• Refresher training if previously redcarded. • One new crew member completed S130/S190 • All regular crew members were B3 certified • Three crew members opened FEMO task books and all had 1-2 assignments on Rx fires • PT • Required administrative training (credit card, IT, etc.)
Miscellaneous	<5	

2010 Sheep Wildfire showing paired pre and postfire images at two FMH plots within the burn. Preburn image (left) was taken in 2008 (plots established in 2006) and postfire image (right) was taken in October 2010 during postfire reads of the two plots. Plots were located in relatively open PIPO with a predominantly mountain misery understory. The last fire in the area was 1908.

D. Additional Program Information

Table 7. Planning - 2011

Park	Does Park have written DFCs? (yes or no)	Date Park-level Monitoring Plan completed (or revised)	Total # of Project- or Community-level Monitoring Plans (not just 2011)	Assisted with how many BAER plans in 2011?
Sequoia & Kings Canyon NP (SEKI)	yes	2011	0	1
Devils Postpile NM (DEPO)	no		0	0

Table 8. Monitoring - 2011

Park	% 2011 Data Entered	% 2011 Data Quality Checked	# 2011 Prescribed Fires Monitored*	Pre-2011 Prescribed Fires Monitored[#]	# Non-fire Fuels Treatments Monitored*	# Wildfires Monitored*	# BAER Treatments Monitored*
SEKI	80%	75%	6	~75 burns[#] by 28 plots	4	1	0
DEPO**	N/A	100%	0	0	0	0	0

***** Number of treatment units with treatment effects monitoring conducted. Include pre-burn and both short and long-term post-burn monitoring but not burn-day monitoring.

** No treatments or data collected in Devils Postpile in 2011.

[#] Given the burn history, the amount of area burned, and age of FMH sampling (30 years) this is a somewhat complicated value to derive since nearly all plots monitor prescribed burns from previous years with many of these monitoring multiple prescribed fires (up to three).

Duplicate tree records were discovered in the DEPO FFI database with anywhere from 1 to 4 duplicate records for a particular tree with a read with data scattered across a different set of field among these records requiring each record to be checked and data merged into one new record. A similar and much larger issue was discovered in the SEKI database after the FMH data was imported into FEAT. There has been no data collected at DEPO since 2005 so this problem probably carried over from FEAT. It was only discovered because a potential problem (turned out not to be a problem at DEPO but was in SEKI) with snag data that was being checked in the database.

Table 9. Communicating Results - 2011

Park	# of Project Monitoring Reports completed in 2011	# of Annual meeting(s) with Park staff	# of Formal presentations of results	Do you use Minitab?*
Sequoia & Kings Canyon NP	3	Met biweekly with both FMO & RMS	3	Yes
Devils Postpile NM	0	0	0	Yes

***** This information will help to assess Minitab multi-user license needs.

- An invited presentation by the fire ecologist, "***Fire Science, Fire Management, and Restoring Fire in Sequoia and Kings Canyon National Parks***", was made at the ***2011 MEDECOS XII Conference*** at UCLA in a session on the *Restoration in Mediterranean Climate Ecosystems: Linking Science and Management in an Era of Global Change*. This Mediterranean ecosystem conference is an international gathering attended by scientists and managers from the five Mediterranean regions of the world.
- The fire ecologist developed and gave a presentation on SEKI's "***Fire Ecology Program***" to a Capstone class (Forestry 422) out of Humboldt State University. This included a field trip and training session in Giant Forest on common equipment use and sampling methods used by NPS fire ecology crews.
- The fire ecologist developed and made a presentation on ***Fire in a Changing World: Past, Present, and Future***, to the local community as part of the Sequoia Speaks Series coordinated by SEKI Interpretive Division to introduce local communities to park management and climate change issues.
- Hosted "brown bag" talks by 1) Cathy Mardell on Australian national parks and fire management and 2) Rita Margarida Magalhães, PhD graduate student of Dylan Schwilk at Texas Tech, on fire and fuel flammability research that is ongoing in the parks.
- Led fire ecology field trips for UC Fresno forest ecology class and students of all ages from the Colburn Music School of Performing Arts-Center Stage Strings Summer Music Camp (gifted young musicians and staff from around the world on a day off from class).
- Other presentations to park staff: 1) to SEKI Interpretation staff during training on ***Fire and Giant Sequoias***, 2) ***Climate and Fire in Sequoia & Kings Canyon NP: A Review of Our Current Knowledge*** to a meeting for the Alternative Fire Futures Project.

Newly germinated giant sequoia seedlings in June 2011 in an area burned by the 2010 Bobcat Prescribed Burn. These seedlings are about one and a half centimeters tall and just a few days old. One still has the seed coat attached, which is about the size of a flake of oatmeal.

Table 10. Research - 2011

Park	Are research needs identified in FMP or Monitoring Plan? (yes or no)	# of Proposals Submitted in 2011	# of Proposals Funded in 2011	# of Research Projects Supported in 2011*	Additional Comments
Sequoia & Kings Canyon NP	yes	1	0	7	Supported JFS projects submitted by 1) UC Berkeley and 2) Texas Tech
Devils Postpile NM	yes	0	0	0	

*****Number of funded research projects, new or ongoing, supported by the fire ecology program including logistical info or support, staffing, etc.

E. 2012 Direction

A new fire effects lead was hired in the fall of 2011 with an EOD date in January 2012. Training and an introduction to the SEKI fire program, including our monitoring program and protocols, as well as business practices in the parks will occupy considerable time in 2012. 2011 was a learning year for a combined effects and monitoring crew. Things we've learned will be further refined and implemented in 2012. One immediate change in sampling protocols will be to drop year (yr02) reads given workloads and reduced crew sizes. Sampling post, yr01, yr05… will continue for the near future. Planning for budget reductions, including what protocols can be dropped or continued and what monitoring units could be discontinued, have been discussed. The giant sequoia and ponderosa pine monitoring types would have the greatest priority (in the order given) for continued monitoring. Continued monitoring of existing plots would have priority over establishing new plots (although few new plots are even now being added due to workloads). Monitoring plots with long-term data sets would also have priority for continued monitoring over recently installed plots.

F. Other Information

FFI version 1.04.01 was installed in the fall of 2011 and all SEKI FFI databases upgraded. Unlike all previous FFI versions the databases did not double in size during the conversion process and actually decreased in size slightly. The current database (FFI version 1.03) with associated backup file was approaching 2 GB and an attempt to upgrade to the original FFI version 1.04.00 was rejected because of the increase in database size. Access of the main SEKI database is still slow, which might be associated with database size and use across a network. Issues related to saving records seems to have improved but won't really be tested until several crew members are entering data simultaneously. The copy and paste of "Projects" and "Macroplots" now appears to be functioning correctly. This has now allowed us to move all CBI data into a separate database from a combined FMH + CBI database that originated in FEAT. This will simplify the databases somewhat and may help the functioning of FFI.

The one suggestion for improving FFI would involve fuel constants and improving our ability to easily modify and update constants after fuels data has been entered. Currently, values for constants only roll down through all individual data points as they're entered for the first time. If future modifications of the constants are made these have to be added individually for each data point (for example, 40 times for litter & duff). Being able select a particular constant for FWD, CWD, LD that would then automatically roll down through each data point would allow for greater flexibility in updating and modifying data.

Details SEKI/DEPO Fire Research Projects and Collaboration

1) *Fire and Lodgepole Pine in Southern Sierra Parks*. Anthony Caprio (SEKI), Peter Brown (RMTRR), Gus Smith (YOSE) – Funded by NPS Reserve Funds

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 and is 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). 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 7. 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 one or two scars. Unfortunately the tree was not in an area sampled.

We have initiated 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. We have completed field sampling in four areas; two areas in YOSE (Upper Tuolumne/Dana Meadows - 23 subplots in 2009 and Bridalveil Creek - 22 subplots in 2009) and in SEKI (Chagoopa Plateau - 25 subplots in 2008/2010 and Hockett Plateaus - 25 subplots 2009/2010). Fire ecology crews from the two parks worked together to facilitate collection of several thousand tree-ring samples for determining tree age structure and fire history.

***Reconstructing natural fire events, their strength and causes: A Case Study in Oriole Lake*.** Rainer Lohmann (URI) and Anthony Caprio (SEKI) – Funded by JFS Program.

The study is comparing data from sediment cores collected in 2007 at the lowest elevation lake in SEKI to the historic fire regime. The fire regime data is based on both contemporary fire records of mapped fire within the East Fork Drainage of the Kaweah River and reconstructed fire history from fire scarred trees collected from the surrounding landscape. It will reconstruct a record of past fires and their magnitude by detecting the occurrence of pyrogenic black carbon (BC) and other molecular compounds as fingerprints of past fires in lake sediments and soils. The study has the potential to reconstruct fire occurrence many hundreds to thousands of years into the past. These data will be compared to local and regional climate data. The relevance of the record this study provides is highlighted by recent research indicating black carbon is an important climate forcing agent, estimated to be second only to CO_2 as an anthropogenic contributor to global change. A paper summarizing the initial stages of the analysis was published in 2011 in **Environ. Sci. Technol**. (see Section B above). This study will be completed in 2012.