



**National Park Service
Klamath Fire Ecology Annual Report
Calendar Year 2014**



Copper Creek Rx Burn - Redwood National Park - 2014

A. Summary

The 2014 calendar year was similar to the past two years for the Klamath Fire Ecology program, in that collaboration and creativity were essential in accomplishing monitoring and research needs throughout the Network. Efforts at REDW were again focused on advancing the understanding of fire effects in 2nd growth redwood forests. The Fire Ecologist assisted the REDW Forester and USGS crews to re-sample the Lower Airstrip Addition burn unit at 01YR01 (year 1 report attached). Monitoring efforts at WHIS were focused on upper elevation mixed-conifer forest, with the re-measurement of six plots treated with Rx fire the previous year. Lastly, in an effort to monitor treatment effects in ORCA's shaded fuelbreak units, the ORCA Chief of Resource Management assisted the Fire Ecologist with the installation of three pre-treatment RA plots in the Horseshoe Shaded Fuelbreak.

The Klamath Fire Ecologist also maintained involvement with the larger fire ecology and management community by co-hosting a Fire Science Consortium field tour at WHIS, hosting a Humboldt State University class fieldtrip at REDW, presenting at the Klamath Fire Ecology Symposium in Orleans, CA, and attending the Norcal Rx Fire Council meeting in Sacramento, CA.

The 2014 calendar year marked year one for the Service First agreement between Redwood National Park and Six Rivers National Forest interagency fire management organization. The Fire Ecologist allocated 10% time to SRNF in 2014, but will increase to 25% in 2015. While the new agreement may add workload, it provides an opportunity for increased resource sharing and budget solvency. The agreement will be re-visited annually to ensure the needs of both organizations are being addressed.

Table 1. Fire Effects Plot Workload (2014) and Total Plots Installed

Park	Monitoring Unit	Type of Plot	Pre-burn 2013	Immed. Post 2013	Postburn (1-20 yrs) 2013	Annual total (2013)	Total Plots
Redwood National Park	Mixed Prairie (GMIPR1D03)	FMH Grass plot	0	0	0	0	38
Redwood National Park	Oregon Oak Woodland (FQUGA1D09)	FMH Forest plot	0	7	0	7	26
Redwood National Park	Old Growth Redwood (FSESE1D08)	FMH Forest plot	0	0	0	0	4
Redwood National Park	Fir Plots	RA**	0	0	0	0	60**
Redwood National Park	Second Growth Forest	RA	0	0	9	9	19
Redwood National Park	Second Growth Forest	1-Ha Large Plot Sampling	0	0	0	0	2
Redwood National Park	Shaded-Fuelbreak	Photo-Points	4	0	0	4	12
Whiskeytown National Recreation Area	Whiteleaf Manzanita (BARVIG04)	FMH Brush Plot	0	0	0	0	10
Whiskeytown National Recreation Area	Whiteleaf Manzanita (FARVI1D04)	FMH Forest Plot	0	0	0	0	4
Whiskeytown National Recreation Area	Oak Woodland (FQUKE1D09)	FMH Forest Plot	0	0	0	0	11
Whiskeytown National Recreation Area	Oak Woodland (FQUCH1D09)	FMH Forest Plot	0	0	0	0	2
Whiskeytown National Recreation Area	Ponderosa Pine Forest (FPIPO1D09)	FMH Forest Plot	0	0	0	0	6
Whiskeytown National Recreation Area	Mixed Conifer Forest (FMICO1D08)	FMH Forest Plot (post-thin)	0	0	6	6	18
Whiskeytown National Recreation Area	Knobcone Pine Woodland (FPIAT1D10)	FMH Forest Plot	0	0	0	0	5
Whiskeytown National Recreation Area	East Boundary Mixed oak & conifer	Photo-Point	0	0	0	0	20
Whiskeytown National Recreation Area	Encroached Black Oak Woodland	Boulder Mechanical RA	0	0	0	0	9
Oregon Caves National Monument	Douglas-fir Forest (FPSME1D10)	FMH Forest Plot	0	0	0	0	8
Oregon Caves	CC-9 Thinning	RA	0	0	0	0	4

Park	Monitoring Unit	Type of Plot	Pre-burn 2013	Immed. Post 2013	Postburn (1-20 yrs) 2013	Annual total (2013)	Total Plots
National Monument							
Oregon Caves National Monument	Horseshoe Shaded Fuel Break	Rapid Assessment	3	0	0	3	7
Total			7	7	15	29	258

* Pilot sampling plots

Complete the staffing and personnel development table for fire ecologist and monitors (Table 2). Include fire training (e.g. S-290, RX-310), NPS training, distance learning or on-campus college credit, technology training, NWCG taskbooks initiated or completed, conferences attended, etc.

Table 2. Fire Ecology Staffing 2014

Ecologist and Monitors	Starting Date	Ending Date	# of Pay Periods	READ Qualified (Yes or No)	Training and Development
Fire Ecologist	1/1/14	12/31/14	26	Yes	Fire Refresher; Norcal Rx Fire Council Meeting; Klamath Fire Ecology Conference (presenter)
HSU Intern*	1/15/2014	5/15/14	90 hours	n/a	n/a
HSU Intern*	1/15/2014	5/15/14	90 hours	n/a	n/a

*REDW hosted an internship program with Humboldt State University during the spring semester, 2014. The Fire Ecologist utilized two interns for 90 hours each, and both assisted with fire effects plot work at REDW.

Table 3. 2014 Management Objectives and Monitoring Results

All results shown are 80% confidence intervals of the mean. Previously analyzed results for other monitoring types are available in past annual reports.

Whiskeytown

Monitoring Unit	Management Objective	Monitoring Results (80% confidence interval)	Objective Achieved?	Year Last Analysis Completed
Mixed Conifer Forest	Maintain 10-65 overstory* trees/acre *live trees >10" DBH	00PRE: 39 (30—49) trees/acre 01YR15: 61 (46—76) trees/acre 02YR01: 67 (50—83) trees/acre (n = 6 plots, 2 fires)	No, but close	2014 (1993-2014)
	Maintain average pole-sized* tree density between 10-80 trees/acre *live trees <10" DBH	00PRE: 313 (170—455) trees/acre 01YR15: 166 (76—257) trees/acre 02YR01: 143 (64—223) trees/acre (n = 6 plots, 2 fires)	No	2014 (1993-2014)
	Maintain dead surface fuel load between 10-35	00PRE: 21.0 (17.1—24.8) tons/acre 01POST: 10.3 (4.8—15.8) tons/acre	No, but close	2014 (1993-

	tons/acre	01YR15: 14.2 (12.1—16.4) tons/acre 02YR01: 9.5 (4.8—15.8) tons/acre (<i>n</i> = 5 plots, 2 fires)		2014)
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B. Program Information

Please complete the tables below which contain additional information that we feel is valuable to compile on an annual basis to help assess the fire ecology program workload. Everglades National Park is used as a fictitious example in the tables.

Table 4. Planning - 2014

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 2014)	Assisted with how many BAER plans in 2014?
Redwood National Park	YES	2010	3 (FMH program; Fir plots; second growth RA)	0
Whiskeytown National Recreation Area	YES	2012	4 (FMH program;. Mechanical RA; shaded fuelbreak; photo-point)	0
Oregon Caves National Monument	NO	2013	2 (FMH; Fuelbreak RA)	0

Table 5. Monitoring - 2014

Park	% 2014 Data Entered	% 2014 Data Quality Checked	# Prescribed Fires Monitored*	# Non-fire Fuels Treatments Monitored*	# Wildfires Monitored*	# BAER Treatments Monitored*
Redwood National Park	90%	90%	3	1	0	0
Whiskeytown National Recreation Area	95%	95%	1	0	0	0
Oregon Caves National Monument	100%	100%	0	1	0	0

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

Table 6. Communicating Results - 2014

Park	# of Project Monitoring Reports completed in 2014	# of Annual meeting(s) with Park staff	# of Formal presentations of results	Do you use Minitab?*
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Redwood National Park	1	3	1	n
Whiskeytown National Recreation Area	1	3	1 (Fire Science Consortium Field Tour)	n
Oregon Caves National Monument	0	1	0	n

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

Table 7. Research - 2014

Park	Are research needs identified in FMP or Monitoring Plan? (yes or no)	# of Proposals Submitted in 2014	# of Proposals Funded in 2014	# of Research Projects Supported in 2014*	Additional Comments
Redwood National Park	Not really	1	0	2	
Whiskeytown National Recreation Area	Yes (but needs to be updated)	0	0	1	
Oregon Caves National Monument	No	0	0	0	

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

C. Fire ecologist accomplishments and areas of focus

Table 8. Fire Ecologist 2014 Accomplishments/Focus Areas

Category	Percent Time	Accomplishments and/or areas of activities
Planning	30 %	Rx plan development, FMP updates, meetings about ongoing projects at parks
Presentations	2%	Presenter at 2014 Klamath Fire Ecology Symposium in Orleans, CA; Co-lead for Fire Science Consortium field tour at WHIS
NPS Meetings/ task groups	10%	READ, Climate Issues in parks, Lower Prairie Creek project at REDW
Interagency work	10%	Work with Six Rivers NF; Fire history of low elevation oak woodlands pilot study (WHIS) collaboration with UC Cooperative Extension
Wildfire assignments	4%	READ on one fire assignment (Happy Camp Complex)
Prescribed fire projects	2%	FEMO for 2 Rx fires at REDW
Non-fire fuels projects	2%	Conifer removal projects at REDW
Research	10%	Fire Effects in 2 nd Growth Redwood (Save the Redwoods League funds), collaboration with USGS, WHIS low elevation fire history.
Data collection	10%	Assisted with all fieldwork at REDW, WHIS, ORCA, in collaboration with vegetation management staff and USGS staff
Data entry	5%	Data management for REDW, WHIS, and ORCA

Data analysis	5%	Estimated amount of time spent performing analyses, including data summaries and statistical tests.
Supervision/Admin	2%	Volunteers and Interns at REDW
Training	2%	Fire refresher, PT
Travel out-of-park for plot or project work	5%	WHIS and ORCA site visits
Miscellaneous	1%	FEMO reports, Email...

D. Fire effects crew accomplishments and areas of focus

N/A

E. 2015 Direction

As part of the Service First agreement between Redwood National Park and Six Rivers National Forest, the Klamath Network Fire Ecologist will continue to serve at the Fire Ecologist for the Forest in addition to the network Parks (25% Forest, 75% Parks). The Fire Ecologist will continue to seek research and monitoring funds from alternative sources in 2015.

F. Optional Information

**REDW Lower Airstrip Addition Rx Burn: 1-YR Post-Burn
Data Summary to Save the Redwoods League**



Prepared by Eamon Engber (NPS) and Phil van Mantgem (USGS)

December 2014

Background

A primary mission for managers of coastal redwood ecosystems is restoring degraded forests. At Redwood National Park (RNP) approximately 59% (32,000 hectares) of the landbase is comprised of highly degraded second-growth forests. The typical vegetation in second-growth forests at RNP is dense, even-aged Douglas-fir (*Pseudotsuga menziesii*) stands with simple canopy structure and little understory cover or diversity. These areas have been the target for intensive restoration projects to repair degraded watersheds and promote a rapid return to old-growth conditions. RNP vegetation management staff currently use mechanical thinning as their primary restoration tool. While mechanical thinning is suitable for many areas in RNP, there are large portions of the park where these treatments cannot be used because of the removal of old logging roads and inaccessible terrain; in these areas, prescribed fire may be a feasible alternative.

We attempted to maximize our ability to learn from the 2013 Lower Airstrip Addition prescribed fire via (1) large-scale intensive monitoring to better understand forest successional trajectories, (2) a characterization of small trees, fuels, and understory vegetation on a network of small plots. We installed two large (1-ha) plots in the burn unit to assess fire effects on overstory trees (≥ 20 cm DBH), and an additional 9 small plots (0.07 ha) randomly located to assess overstory trees, pole trees (< 20 cm), fuels, and understory vegetation (Figure 1) (See Appendix 1 for monitoring protocol).

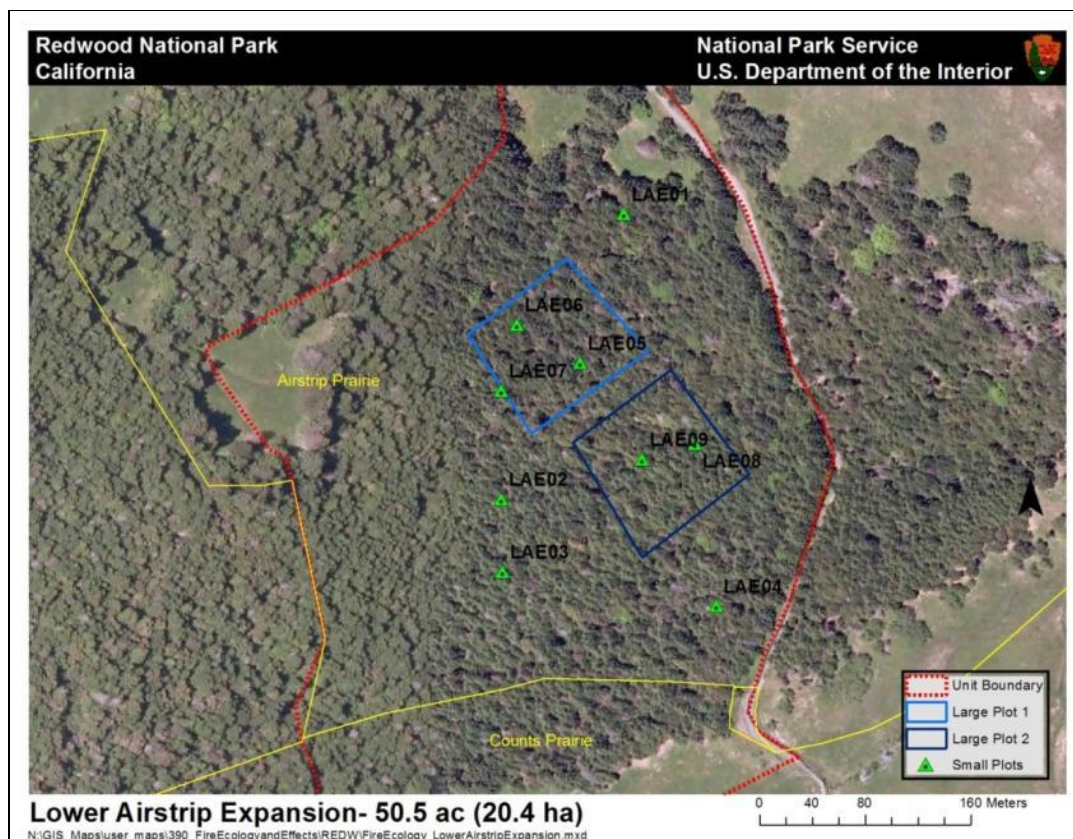


Figure 1. Unit map with installed monitoring plots.

In addition to research objectives for the Lower Airstrip Addition burn, Redwood National Park Fire Management has a number of management objectives, including:

- Assess utility of Rx Fire to meet 2nd growth forest restoration objectives
- Increase mean stem diameter of residual mixed conifer by at least 15% 2yr post burn
- Reduce mean stand density by at least 15% 2yr post burn
- Initiate regeneration of Redwood by any amount 2yr post burn
- Increase the understory shrub and herbaceous cover by any amount 2yr post burn
- Reduce surface and ground fuel loading by at least 30% immediately post burn

To date, NPS and USGS staff have completed the PRE-burn, immediate POST-burn (fire severity assessment), and ONE-year post-burn plot reads. Here we report on 1 yr post-burn results for tree mortality, tree resprouting, and fuels. A 2 yr post-burn plot read is scheduled for the 2015 season, as well as a 5 yr post-burn read in 2018. Understory vegetation will be re-assessed at the 2 yr read, and results will be reported in winter 2015/16.

Conditions of Burn - Weather

The Lower Airstrip Addition Rx burn was completed on October 31, 2013, following over eight inches of rainfall between September 19, 2013 and October 12, 2013. Therefore, prior to the burn, duff and heavy fuels (1000-hr) began to recover from summer low levels, with duff moisture at ca. 65% and 1000-hr fuel moisture at 35% (Figure 2). Fog impacted the unit on the morning of burn, resulting in relatively high 10 hr fuel moisture until 1000 (27%, measured at nearby Schoolhouse RAWS), followed by a decline to the low teens by mid-afternoon as the fog cleared. Relative humidity hovered around 40-50 %, resulting in dampened fine fuels (leaf litter) at the start of the burn. Winds were very light within the unit throughout the burn (0-2 mph), and maximum temperature was around 60°F.

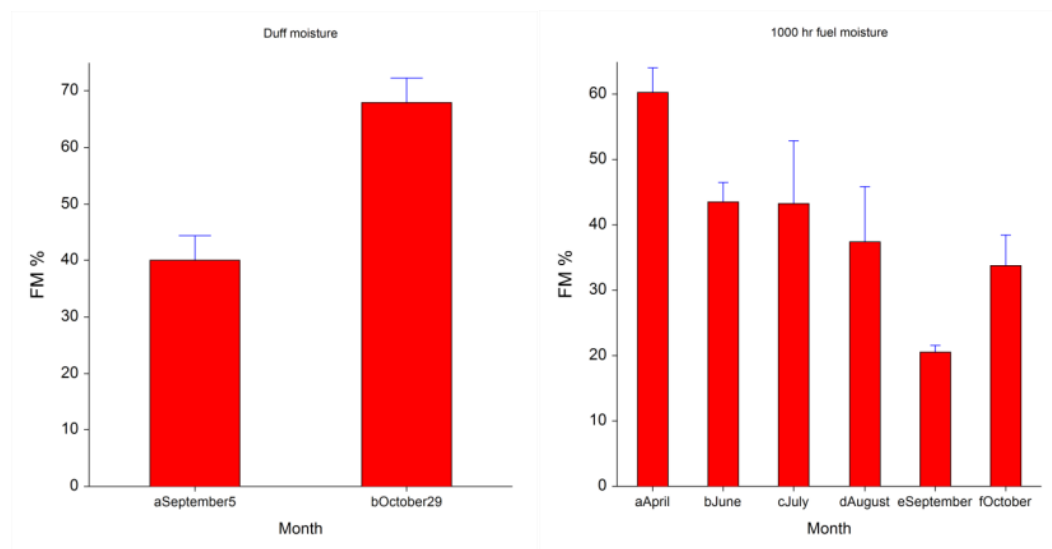


Figure 2. Duff (left) and 1000-hr (right) fuel moisture in the Lower Airstrip Expansion unit leading up to the 10/31/2013 burn day.

Conditions of Burn - Fire Behavior

Fire spread was intermittent throughout the burn and mostly low intensity, with flame lengths typically less than 1 foot (30.5 cm) (Figure 3.), though there were small pockets ($\sim 1/10^{\text{th}}$ ha) of high-severity fire where fuels, topography, and ignition patterns aligned. Many areas with green vegetation (ferns) or short-needle litter (Douglas-fir fuelbeds) carried fire poorly and resulted in a patchy burn pattern. An important observation was that areas with a higher proportion of redwood in the overstory burned quite well despite the low/moderate weather conditions, likely responding to the long-needle redwood leaf litter and resultant low bulk density fuelbeds (Figure 4).



Figure 3. Typical low intensity fire behavior in an area dominated by tanoak, Douglas-fir, and redwood.



Figure 4. Fire behavior and fuel consumption picked up in areas with more redwood in the overstory, likely resulting from increased flammability of redwood litter beds.

Preliminary Findings – Tree mortality

Over 1200 living and dead overstory trees were sampled within the two large 1-ha plots. Overall tree mortality was low in the unit, as expected given the low-intensity fire behavior observed during the burn. For overstory trees ≥ 20 cm DBH, the one year post-fire mortality rate for redwood was 1.39%, 2.13% for Douglas-fir, and 2.15% for other species (hardwoods), i.e. there was little change in the overstory diameter distribution following the burn (Figure 6). The two-year post-burn assessment in 2015 may pick up some delayed mortality and will be a better assessment of overall tree mortality, though rates are likely to remain low.

A total of 171 pole trees (<20 cm DBH) were sampled on the 9 small plots ($n= 12$ redwood, 39 Douglas-fir, 96 tanoak, 24 bay laurel), with an overall mortality rate of 58% for redwood, 25% for Douglas-fir, 36% for tanoak, and 21% for bay laurel (Figure 7). Mortality of redwood was mostly concentrated in poles smaller than 10 cm DBH. Increased fire spread in areas dominated by redwood is a contributing factor to redwood mortality in the pole size class, i.e. areas with redwood were more likely to burn. Under a drier weather scenario, more fire spread would occur throughout the unit, potentially elevating mortality in areas not dominated by redwood.



Figure 5. Heterogeneous burn pattern in the Lower Airstrip Addition unit.

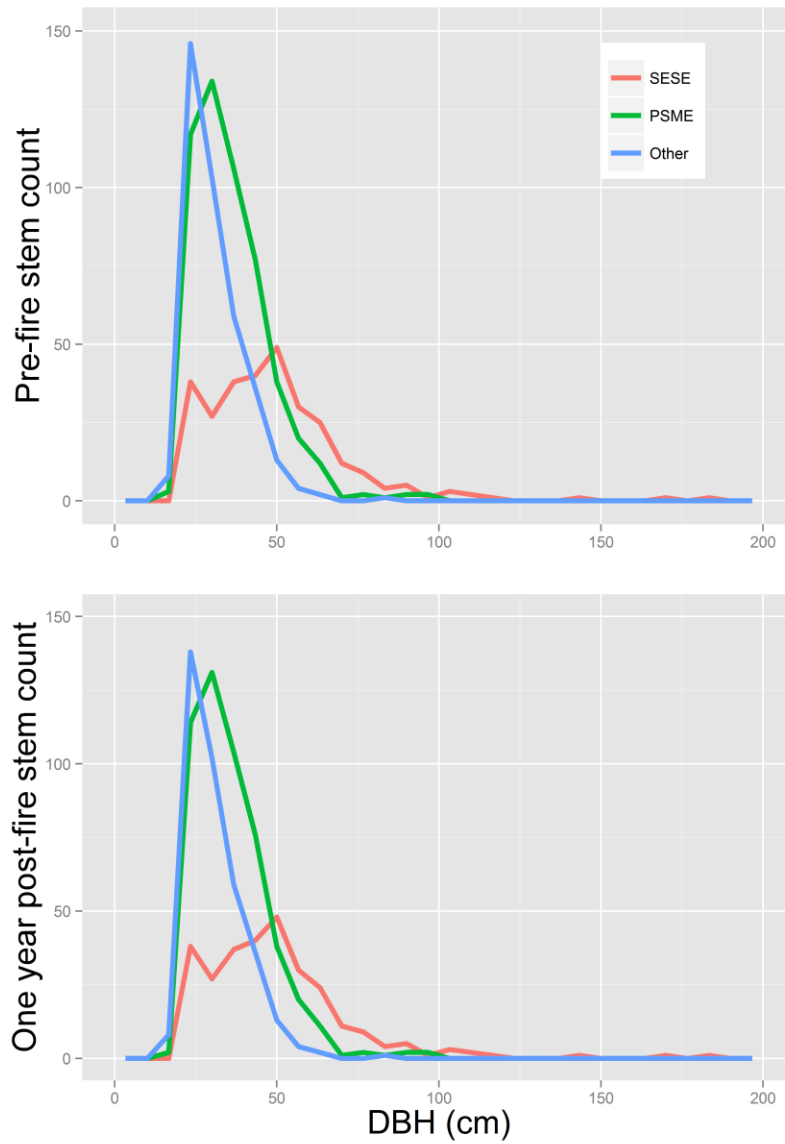


Figure 6. Overstory (≥ 20 cm DBH) stem count pre and post-burn for SESE (redwood), PSME (Douglas-fir), and other species (mostly hardwoods), sampled on two, 1-ha plots. Mortality rates for all species were low at one year post-burn.

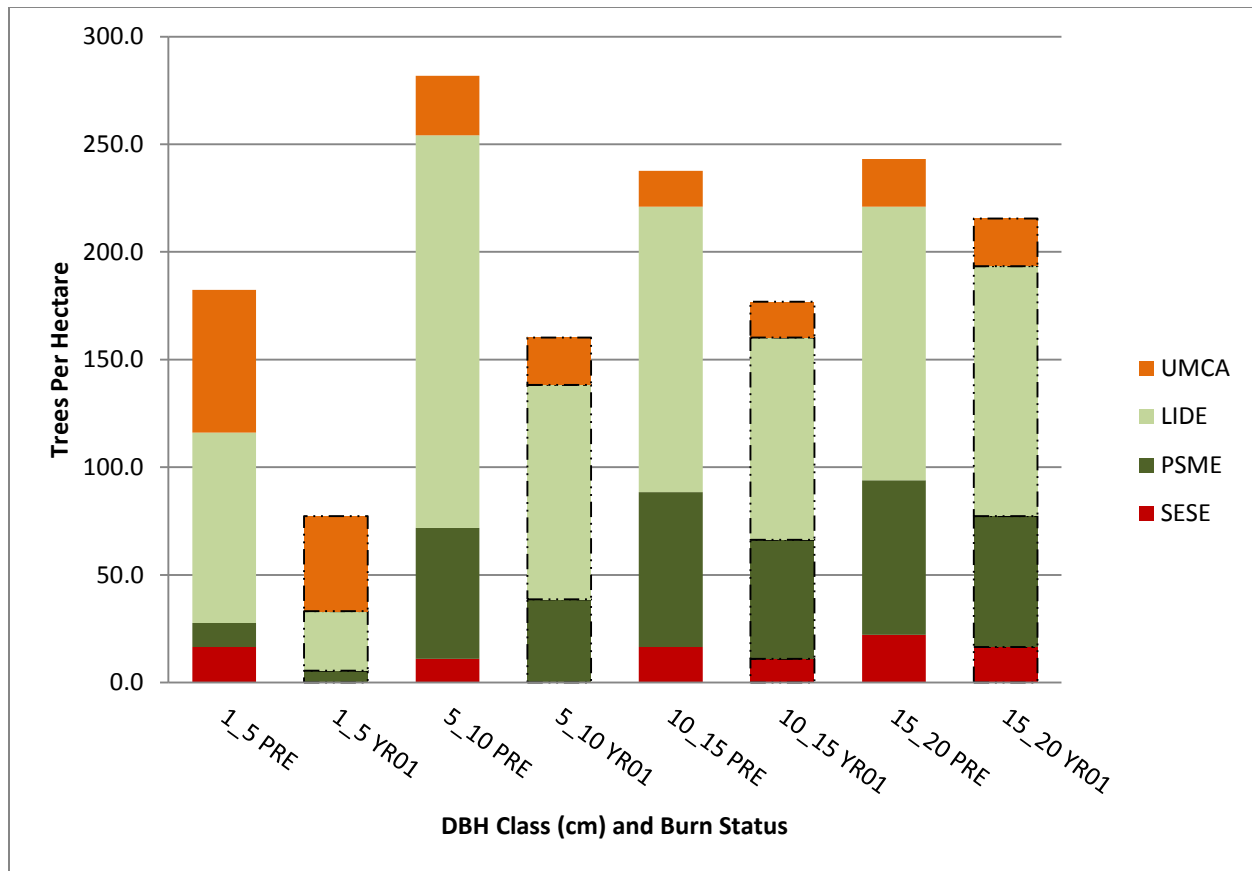


Figure 7. Pre and post-fire (YR01) pole (<20 cm DBH) density by diameter class and species.

Preliminary Findings – Sprouting Response

For overstory redwoods, 29% of the stems had new basal sprouts at 1 year post-burn, with a mean sprout height of 39 cm. About 7.5% of overstory redwoods had new epicormic sprouts on the bole. Redwood pole-sized trees had a more vigorous sprouting response than overstory trees, with 73% resprouting from the base (mean sprout height of 36 cm) and 27% from the bole (epicormic), generally outcompeting tanoak and bay laurel (Figure 8). Generally, areas with higher fire intensity had a more vigorous sprouting response.

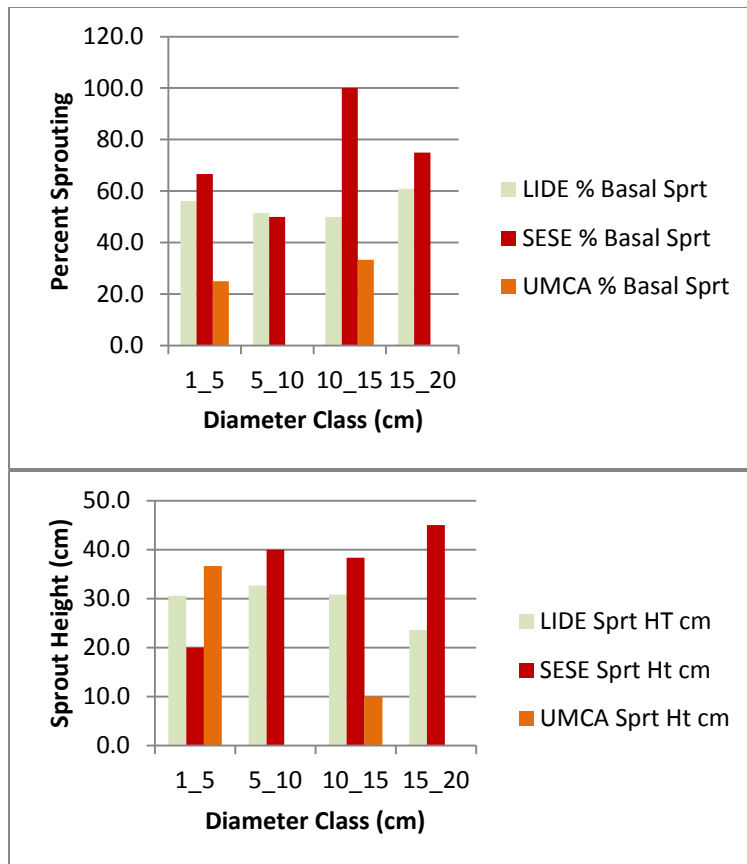


Figure 8. Top: Percent of pole trees sprouting post-burn, by diameter class. Bottom: Sprout height by diameter class for poles.



Figure 9. Basal and epicormic sprouting on redwood in the Lower Airstrip Addition Burn Unit.

Preliminary Findings – Fuels

Fuels were assessed on nine small plots in the burn unit; four of these plots had no fire spread occur during the burn. Total fine fuel (<3 inch diameter woody particles) load was reduced by 33 % (Figure 10). For 1000-hr woody fuels (>3 inch diameter), fuel consumption was quite variable, with some plots recruiting fuel and others consuming fuel (Figure 10). Overall change was an increase in 1000-hr fuels by 48 % (Figure 10). Fuel recruitment occurred through snag and branch fall as well as exposure of buried logs that were not measured pre-burn. Litter and duff depths were reduced by 40 % and 43 %, respectively (Figure 11).

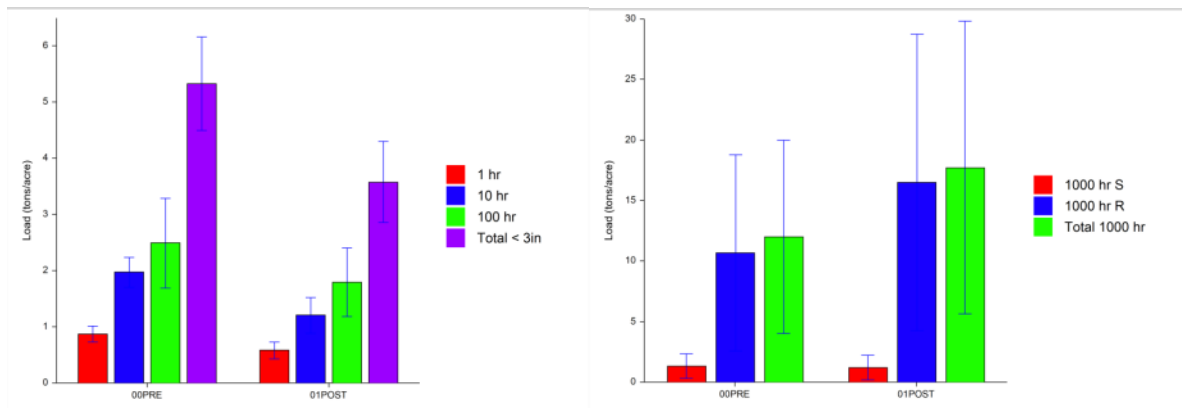


Figure 10. Fine fuel (Left) and 1000-hr woody fuels (Right) PRE and POST burn in the Lower Airstrip Addition Unit.

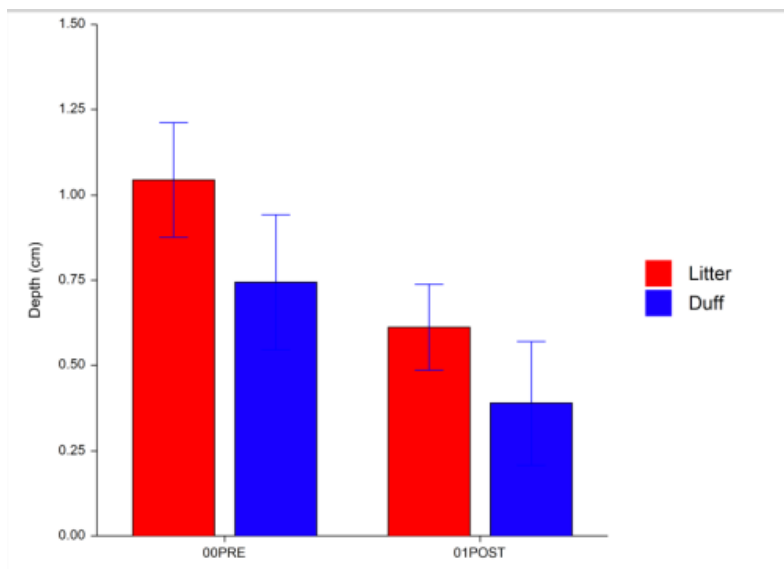


Figure 11. Litter and Duff depth PRE and POST burn in the Lower Airstrip Addition Unit.

PRE BURN

POST-BURN



Figure 12. TOP (LEFT to RIGHT): Photo-point depicting heavy fuel consumption. BOTTOM (LEFT to RIGHT): Photo-point depicting plot where no fire spread occurred during the burn.

Preliminary Conclusions and Work to Come

- The low-intensity fire resulted in small changes to overstory forest structure at one-yr post-burn, but substantial thinning of pole-sized trees. Pole-sized redwood sustained greatest mortality rate, though sample size was small (12 trees). Fire treatments hold promise as a thinning tool in second growth forests, but additional burns would be helpful to further examine fire effects.
- The burn initiated a vigorous sprouting response (basal and epicormic) on pole and overstory redwoods.
- A drier burn window may have increased fire spread throughout the unit and elevated mortality rates in areas not dominated by redwood.
- Redwood leaf litter is quite flammable and areas dominated by redwood were observed to burn at a higher intensity and with greater fuel consumption than areas dominated by Douglas-fir. While small redwoods may be susceptible to increased mortality, competitors are likely to suffer greater injury, and the ability of redwood to resprout may give the species an advantage.
- Further assessment of plots at two and five years post-burn will shed light on the role of delayed mortality and growth response, as well as understory and fuels response to a single, low-intensity burn.
- All overstory trees in the large plots were mapped, and future work may include a spatial analysis of fire severity (ground and bole char, crown injury), as it relates to species composition.

INSTRUCTIONS FOR UPLOADING 2014 ANNUAL REPORT TO DATA STORE

1. Save your report as a PDF file using the following file naming convention "2014 *Park/Network Name* Annual Report.pdf".
2. **NEW THIS YEAR!!!** We will now be uploading our annual reports to the IRMA Data Store instead of the Fire Ecology Sharepoint site. This change will allow us to have all of our Fire Ecology Program information stored in one reliable, accessible location. We are working with the I&M program to transfer all of our past annual reports from Sharepoint to the Data Store. Once this is done, you will be able to use the versioning feature of Data Store to clone the last annual report reference and update it with the current year's report (just as we are doing with the FFI databases). I will be sending out separate, detailed instructions for uploading the annual reports to the Data Store as soon as they are finalized.
3. Please e-mail your regional ecologist, MaryBeth Keifer, and Nate Benson to let us know when you get your report uploaded.

Call MaryBeth Keifer (603-795-2333) if you have any questions or problems.