



NATIONAL PARK SERVICE

KLAMATH FIRE ECOLOGY PROGRAM ANNUAL REPORT

CALENDAR YEAR 2010



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On the cover: Image from Redwood's 2010 Coyote Creek prescribed burn in the Bald Hills.

A. INTRODUCTION

2010 was a successful, yet challenging year for the Klamath Network Fire Ecology program. The highlights include Fire Ecologist Jen Beck having her second child, Lead Becky Smith surviving Technical Fire Management thus far, hosting the PWR Fire Ecology and Fire GIS Meeting, and the fire effects crew installing 10 plots in the immensely steep, wildly dense Wildcat second growth burn unit within Redwood National Park.

The Klamath Fire Ecology program hosted the 2010 PWR Fire Ecology and Fire GIS Meeting in Orick, CA. It was a great opportunity for like-minded fire and GIS geeks to convene and share ideas about research, data, budget issues, and creative solutions. The meeting ended with a field trip to the Bald Hills to discuss some of the challenges to Redwood National Park's prescribed burn program.

Unfortunately, 2010 was also the year in which the amount of plots scheduled to be sampled exceeded an amount ever thought humanly possible. This fact was known going into the field season, and even with plots being rescheduled to the following year there proved to be too many. An added complication arose two weeks before the field season started, with a Redwood fire management directive stating no one could travel before receiving a government issued credit card. This threw the first two weeks of the crew's field season into limbo as they were scheduled to travel to Whiskeytown NRA for the first six weeks of the season.

Once credit cards were attained, the crew spent four weeks in Whiskeytown. A total of 17 FMH forest plots and 10 brush plots were scheduled to be read; only 13 forest plots were sampled. After a snowy trip to the Queen Mary unit at the end of June, it was decided that it would not be feasible to sample the remaining four plots within the Queen Mary unit due to the cold and snowy spring conditions. The crew then focused their energy on trying to complete all scheduled plots within Redwood. With the help of many resource management interns, the Chief of Vegetation Management, and the Plant Ecologist, 17 FMH forest plots and 15 grass plots were read. This was a large task considering that every plot was read during the correct phenological stage for the first time in many years.

The crew spent one week at the beginning of August in Oregon Caves NM installing and re-sampling plots. The remainder of the season was spent in Redwood installing rapid assessment plots within the Wildcat burn unit, reading and installing fir plots within multiple burn units, and working on data entry. The crew was able to help with four prescribed burns in Redwood, acting as RXB2(t), FEMO(t), and FFT2.

B. PROGRAM SUMMARY

This is the 18th annual report for the fire ecology program based out of Redwood National Park. The program has experienced several transformations in its almost 21 years of existence, and it is about to undergo another as both the Fire Ecologist and Lead Fire Effects Monitor vacate their positions by the end of March 2011. The Fire Ecology program tends 200 plots of mostly long-term vegetation and fuels monitoring data to help assess fire management treatments, refine fire management target conditions and objectives, and manage in an adaptive and proactive manner. Fire Effects Monitors Becky Smith, Miles Boiko, and Mindy Bumgarner sampled 100 plots, while Botanists

Extraordinaire Leonel Arguello and Stassia Samuels (REDW) sampled ten plots... making a grand total of 110 plots sampled during the 2010 field season. Lead Monitor Becky Smith also greatly assisted with prescribed burn season by finalizing plans, gaining signatures, making essential contacts, and implementing the burns as a Burn Boss trainee. It is not surprising that Becky Smith also received a Quality Step Increase award in 2010 to acknowledge her outstanding accomplishments.

TABLE 1. FIRE EFFECTS PLOT WORKLOAD (2010) AND TOTAL PLOTS INSTALLED.

Park	Monitoring Unit	Type of Plot	Pre-burn 2010	Immed. Post 2010	Postburn (1-20 yrs) 2010	Total Plots
Redwood National Park	Mixed Prairie (GMIPR1D03)	FMH Grass plot	0	8	15	38
Redwood National Park	Oregon Oak Woodland (FQUGA1D09)	FMH Forest plot	0	4	17	26
Redwood National Park	Old Growth Redwood (FSESE1D08)	FMH Forest plot	0	0	0	4
Redwood National Park	Fir Plots	Rapid Assessment**	14	13	10	50
Redwood National Park	Wildcat Second Growth	Rapid Assessment	10*	0	0	10
Whiskeytown National Recreation Area	Whiteleaf Manzanita (BARVIG04)	FMH Brush Plot	0	0	0	10
Whiskeytown National Recreation Area	Whiteleaf Manzanita (FARVI1D04)	FMH Forest Plot	0	0	0	4
Whiskeytown National Recreation Area	Oak Woodland (FQUKE1D09)	FMH Forest Plot	0	0	8	11
Whiskeytown National Recreation Area	Oak Woodland (FQUCH1D09)	FMH Forest Plot	0	0	1	2
Whiskeytown National Recreation Area	Ponderosa Pine Forest (FPIPO1D09)	FMH Forest Plot	0	0	3	6
Whiskeytown National Recreation Area	Mixed Conifer Forest (FMICO1D08)	FMH Forest Plot	0	0	1	18
Whiskeytown National Recreation Area	Knobcone Pine Woodland (FPIAT1D10)	FMH Forest Plot	0	0	0	5
Oregon Caves National Monument	Douglas-fir Forest (FPSME1D08)	FMH Forest Plot	0	0	2	8
Oregon Caves National Monument	CC-9 Thinning	Rapid Assessment	0	0	0	4
Oregon Caves National Monument	Horseshoe Shaded Fuel Break	Rapid Assessment	4*	0	0	4
Total			28	25	57	200

* denotes pilot sampling plots

**denotes short-term monitoring plots (preburn through two years postburn only)



FIGURE 1. MINDY, MILES, AND BECKY IN THE BALD HILLS.

TABLE 2. FIRE ECOLOGY STAFFING 2010

Ecologist and Monitors	Starting Date	Ending Date	# of Pay Periods	READ Qualified (Yes or No)	Training and Development
Jen Beck	1/01/10	12/31/10	26	Yes	S-490, S-495, B-3, Fire Refresher, attended NPS FAM conference
Becky Smith	1/01/10	12/31/03	26	No	Technical Fire Management, RX-341, RXB2 task book completed
Mindy Bumgarner	5/16/10	9/30/10	10	No	S-130, S-190, S-290
Miles Boiko	5/16/10	9/30/10	10	No	S-290

C. REDWOOD NATIONAL PARK

The Fire Effects Monitoring program at Redwood contains six monitoring types: Oak Woodland, Mixed Prairie, Old-Growth (inactive), Little Bald Hills (inactive), Fir Plots (short-term monitoring), and Wildcat second growth. Results are available for Mixed Prairie, Oak Woodland, Fir Plots, and Wildcat (unburned – not in Table 3).

All results shown in Table 3 include 80% confidence intervals of the mean. Minimum sample size has been attained for only the Oak Woodland (FQUGA1D09) monitoring type. Sampling event codes consist of a two-number prefix for how many times a plot has burned (01 for once, 02 for twice, etc.) followed by the abbreviation “YR” for “year” and followed by how many years have elapsed post-burn (02 for two, 05 for five, etc.). 04YR02 is two years after the fourth burn; 06YR02 is two years after the sixth burn.

TABLE 3. MANAGEMENT OBJECTIVES AND MONITORING RESULTS FOR REDWOOD NATIONAL PARK.

Monitoring Unit	Management Objective	Monitoring Results (80% confidence interval)	Objective Achieved?	Year Last Analysis Completed
Mixed Prairie (GMIPR1D03)	1 st Burn: Do not reduce native plant relative cover by >10% from preburn levels within two years of the burn.	Change in native plant relative cover = +8.6% PRE: 24.2 (21.0—27.3) % cover 01YR02: 26.3 (23.2—29.4) % cover (<i>n</i> = 27 plots, 12 burn units)	Yes	2010
	2 nd Burn: Do not reduce native plant relative cover by >10% from preburn levels within two years of the burn.	Change in native plant relative cover = -1.3% PRE: 26.7 (22.7—30.7) % cover 02YR02: 26.4 (20.9—31.8) % cover (<i>n</i> = 16 plots, 10 burn units)	Yes	2010
	3 rd Burn: Do not reduce native plant relative cover by >10% from preburn levels within two years of the burn.	Change in native plant relative cover = +18.3% PRE: 27.5 (22.7—32.3) % cover 03YR02: 32.5 (27.7—37.4) % cover (<i>n</i> = 13 plots, 6 burn units)	Yes	2010
	4 th Burn: Do not reduce native plant relative cover by >10% from preburn levels within two years of the burn.	Change in native plant relative cover = -10.1% PRE: 34.4 (27.2—41.7) % cover 04YR02: 31.0 (27.0—34.9) % cover (<i>n</i> = 6 plots, 5 burn units)	No	2010
	5 th Burn: Do not reduce native plant relative cover by >10% from preburn levels within two years of the burn.	Change in native plant relative cover = -6.9% PRE: 26.4 (21.0—31.8) % cover 05YR02: 24.6 (19.9—29.2) % cover (<i>n</i> = 7 plots, 4 burn units)	Yes	2010
	6 th Burn: Do not reduce native plant relative cover by >10% from preburn levels within two years of the burn.	Change in native plant relative cover = -29.3% PRE: 31.4 (17.2—45.7) % cover 06YR02: 22.2 (21.5—22.9) % cover (<i>n</i> = 3 plots, 2 burn units)	No	2010
Oregon Oak	1 st Burn: Do not reduce native plant relative cover by	Change in native plant relative cover = -7.8%	Yes	2010

Monitoring Unit	Management Objective	Monitoring Results (80% confidence interval)	Objective Achieved?	Year Last Analysis Completed
Woodland (FQUGA1D09)	>10% from preburn levels within two years of the burn.	PRE: 49.8 (45.3—54.2) % cover 01YR02: 45.9 (40.8—51.0) % cover (<i>n</i> = 22 plots, 8 burn units)		
	2 nd Burn: Do not reduce native plant relative cover by >10% from preburn levels within two years of the burn.	Change in native plant relative cover = -7.1% PRE: 48.2 (40.0—56.3) % cover 02YR02: 44.8 (38.8—50.7) % cover (<i>n</i> = 9 plots, 5 burn units)	Yes	2010
	3 rd Burn: Do not reduce native plant relative cover by >10% from preburn levels within two years of the burn.	Change in native plant relative cover = -13.2% PRE: 52.5 (45.8—59.2) % cover 03YR02: 45.6 (40.5—50.6) % cover (<i>n</i> = 13 plots, 5 burn units)	No	2010
	4 th Burn: Do not reduce native plant relative cover by >10% from preburn levels within two years of the burn.	Change in native plant relative cover = -23.4% PRE: 49.6 (40.0—59.1) % cover 04YR02: 38.0 (33.8—42.2) % cover (<i>n</i> = 4 plots, 2 burn units)	No	2010
	5 th Burn: Do not reduce native plant relative cover by >10% from preburn levels within two years of the burn.	Change in native plant relative cover = -32.9% PRE: 40.8 (15.9—65.7) % cover 05YR02: 27.4 (22.5—32.2) % cover (<i>n</i> = 3 plots, 2 burn units)	No	2010
	6 th Burn: Do not reduce native plant relative cover by >10% from preburn levels within two years of the burn.	Change in native plant relative cover = -30.9% PRE: 47.4 (40.2—54.6) 06YR02: 32.7 (26.2—39.3) (<i>n</i> = 6 plots, 1 burn unit)	No	2010
Encroaching Fir (Fir Plots)	In open grassland, reduce density of live Douglas-fir, <3' tall, by ≥80% within two years of the burn	Change in density = -90.3% PRE: 1042 (285—1799) trees/acre YR02: 101 (44—159) trees/acre (<i>n</i> = 4 plots, 4 burn units)	Yes	2010
	Early-Season Burns: In oak woodlands with conifer encroachment, reduce density of live Douglas-fir, <3' tall, by ≥50% within two years of the burn	Change in density = -26.0% PRE: 996 (660—1332) trees/acre YR02: 737 (303—1171) trees/acre (<i>n</i> = 5 plots, 3 burn units)	No	2010
	Late-Season Burns: In oak woodlands with conifer encroachment, reduce density of live Douglas-fir, <3' tall, by ≥50% within two years of the burn	Change in density = -100% PRE: 121 trees/acre YR02: 0 trees/acre (<i>n</i> = 1 plot, 1 burn unit)	Yes	2010

Redwood – Mixed Prairie and Oregon Oak Woodland

While sample sizes are small, fire effects data are starting to show a trend in declining relative cover of native plants in units that have been burned more frequently. A meeting of fire and vegetation managers will be held in February 2011 to examine this issue with greater scrutiny. For those avid readers of the fire ecology annual report who have noticed a change in numbers reported this year vs. the 2009 annual report, this is due to changes made to the database as a result of quality control and error checking efforts. Past quality checking efforts have generally focused on ensuring the correct data are entered, and this is usually the case. The database errors we are currently encountering involve errors made between or among sampling events. The oak woodland and mixed prairie fire effects plots have been plagued with errors in species identification for *Agrostis* and *Vicia* species. This is problematic because the most commonly encountered species of both *Agrostis* and *Vicia* differ in “native” status; so relative native plant cover was changing among sample events for a single plot based on observer error. After consultations with the Chief of Vegetation Management, it was decided that *Agrostis hallii* (native) had probably been misidentified and was really *A. capillaris* or *A. stolonifera* (both exotic). *Vicia* species were excluded from analysis in 2010, and rectifications will be made on a plot-by-plot basis when and if possible.

Due to the reductions in relative native plant cover expressed in Table 3, plot data were further examined by lifeform, lifecycle and nativity for the mixed prairie and oak woodland plots that have experienced six burn entries. Three mixed prairie plots, two within the Schoolhouse burn unit and one within the Woodengate burn unit were included in this analysis. Annual exotic forbs increased 124% from preburn to two years after the sixth burn (06YR02), and annual exotic grasses increased 101%. Annual native forbs increased 486% from preburn to 06YR02, and perennial native grasses decreased 71%. Table 4 displays relative plant cover preburn, one year after the first burn (01YR01), one year after the second burn (02YR01), two years after the third burn (03YR02), and two years after the six burn (06YR02). Figure 3 shows mean percent relative cover of species for PRE and 06YR02 sampling events.

A total of six oak woodland plots, all within the Schoolhouse burn unit, have experienced six burn entries. Annual exotic grasses increased 98% from preburn to 06YR02; annual native forbs decreased 73% from preburn to 06YR02; and perennial native grasses decreased by 27%. Table 5 shows relative plant cover for preburn, 01YR02, and 06YR02 sampling events. Figure 4 displays mean percent relative cover of species for PRE and 06YR02 sampling events.



FIGURE 2. LUPINE BLOOM IN THE BALD HILLS.

TABLE 4. MIXED PRAIRIE (N = 3) MEAN RELATIVE COVER OF PLANT SPECIES BY LIFECYCLE AND LIFEFORM THROUGH TIME.

	Annual Exotic Forb	Perennial Exotic Forb	Annual Exotic Grass	Perennial Exotic Grass	Annual Native Forb	Perennial Native Forb	Perennial Native Grass
PRE	4.2	15.1	21.5	32.0	2.2	1.8	21.8
01YR01	2.6	16.5	13.4	35.6	9.5	1.0	20.4
02YR01	5.2	10.4	21.1	23.4	20.4	2.5	15.8
03YR02	3.2	12.2	33.4	19.6	9.2	1.2	20.0
06YR02	9.4	13.3	43.2	11.8	12.9	1.8	6.3

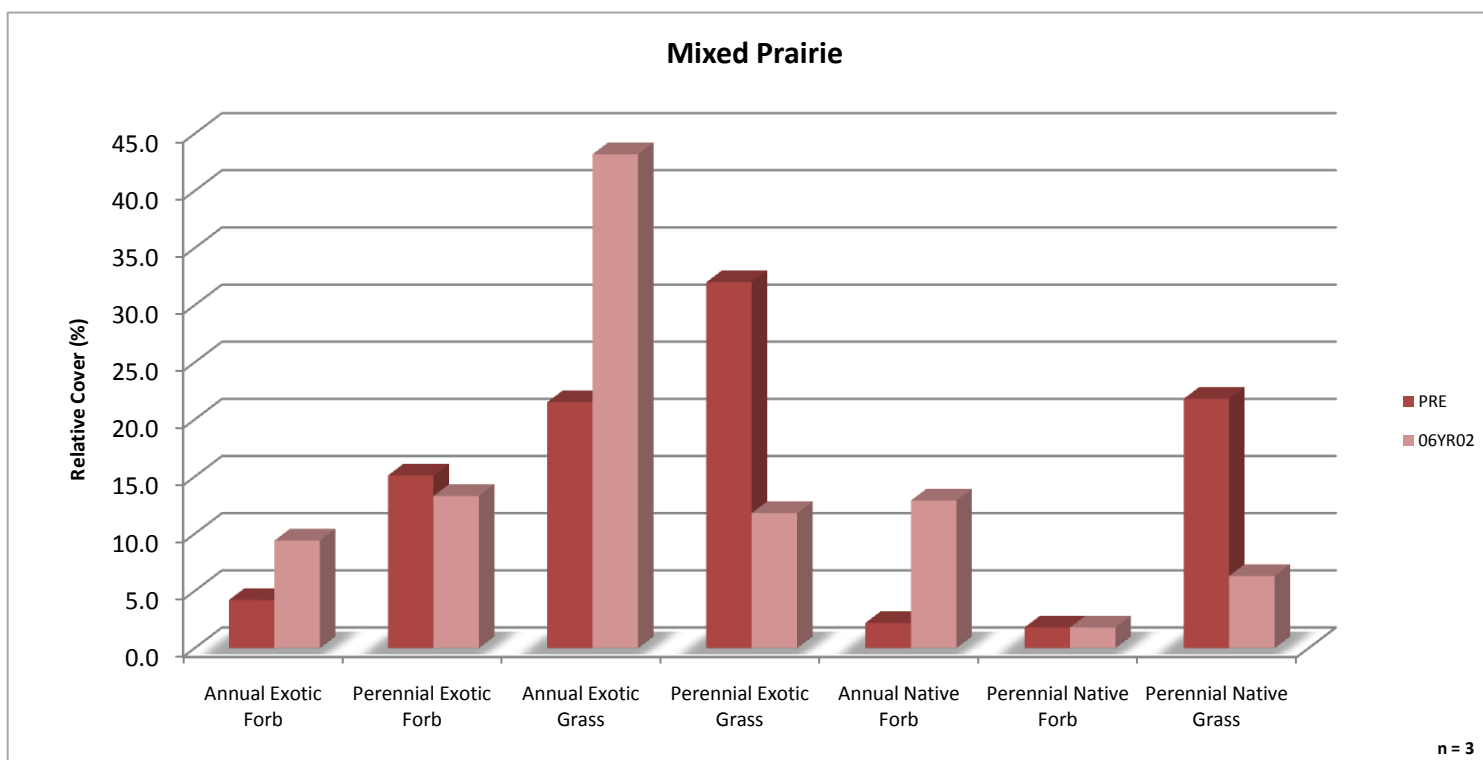


FIGURE 3. MEAN RELATIVE COVER THROUGH TIME IN MIXED PRAIRIE PLOTS.

TABLE 5. OAK WOODLAND (N = 6) MEAN RELATIVE COVER OF PLANT SPECIES BY LIFECYCLE AND LIFEFORM THROUGH TIME.

	Annual Exotic Forb	Perennial Exotic Forb	Annual Exotic Grass	Perennial Exotic Grass	Annual Native Forb	Perennial Native Forb	Perennial Native Grass
PRE	5.8	6.6	16.8	23.3	8.8	5.5	28.1
01YR02	2.6	10.0	18.0	30.3	1.8	8.9	22.2
06YR02	6.2	4.4	33.4	23.3	2.4	5.2	20.4

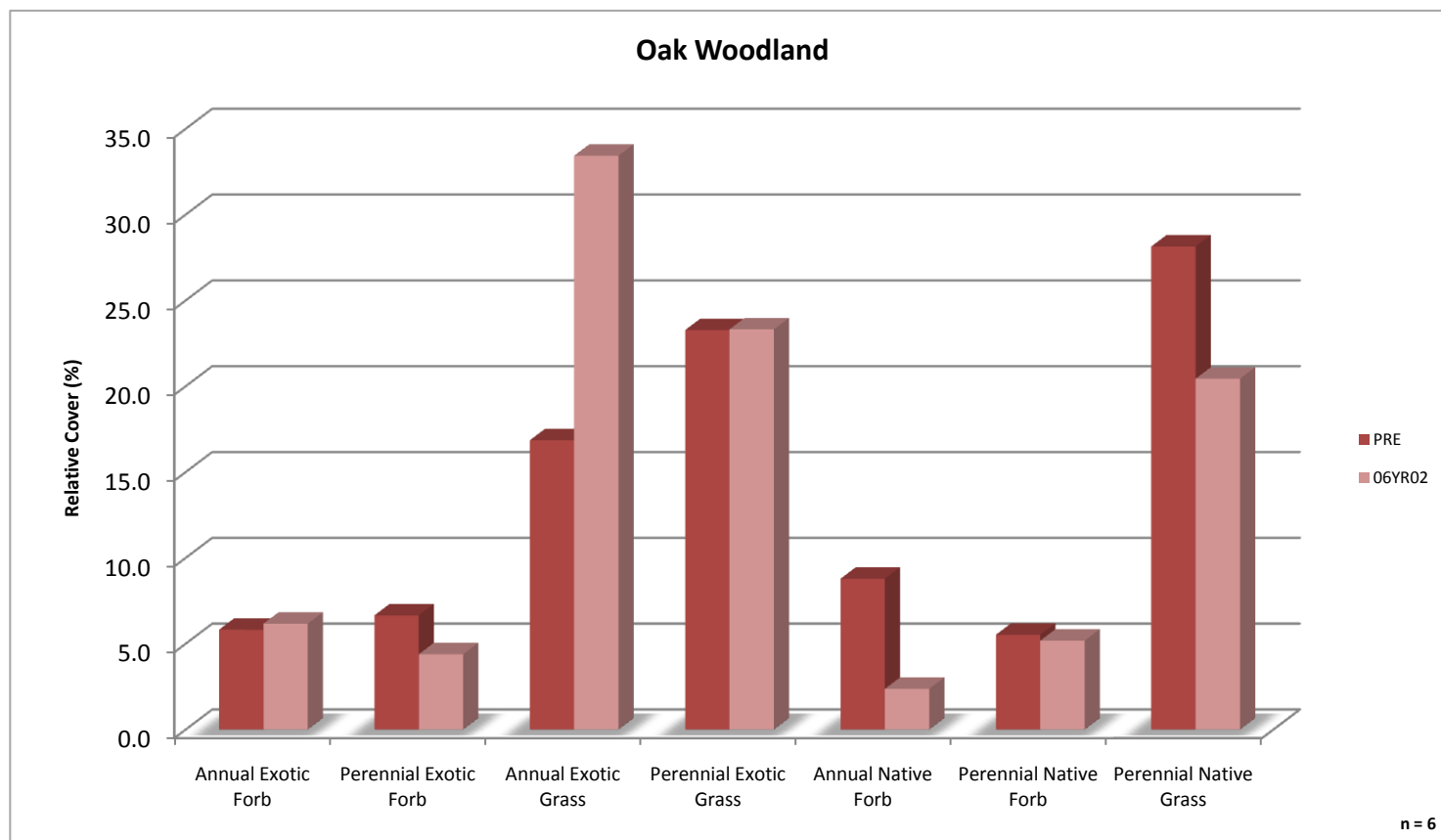


FIGURE 4. MEAN RELATIVE COVER THROUGH TIME IN OAK WOODLAND PLOTS.

A total of 27 oak woodland FMH plots exist within Redwood NP. All of these oak woodland plots are dominated by Oregon white oak (*Quercus garryana* var. *garryana*), and have been sampled sporadically over time. Some of these plots were placed into inactive status over the years due to the crew's overburdened workload, but all have been unearthed and made active within the last three years. Because of this and the crew's workload, many sampling events are missing from the long term data set. Over time there were also discrepancies on how to classify a clump of oaks: as a single large tagged tree with multiple untagged stems, or each stem as an individual tagged tree. Tree tags have been added and removed multiple times over the years, so therefore oak woodland tree data has been deemed so messy that they are unusable. During the 2010 field season the crew desperately tried to take notes, and determine what methodology had been used for preburn sampling events in an attempt to fix this issue. While every effort possible was made in the field, most of the work to untangle the oak clump mess has to be done in the office through multiple FFI queries to track each individual tree through time. Over the course of the past six months, a total of seven oak woodland plots have had tree data uber-cleaned, and data for six of these plots are presented below (Fig. 5 and 6).

The Schoolhouse burn unit has had six burn entries. Six FMH plots were installed between 1991 and 1993 (PRE) within the unit. The unit was first burned in 1993, and plots were sampled two years after the burn (01YR02). Schoolhouse was burned for the sixth time in 2008, and plots were sampled two years after the burn (06YR02 - 2010). Trees within the unit have decreased from an average of 168 trees per acre preburn (PRE), to 141 trees per acre two years after the first burn (01YR02), a 16% reduction. Tree density continued to decrease to 101 trees per acre two years after the sixth burn (06YR02), a 40% decrease from preburn (Fig. 5) Tree basal area was reduced from an average of 104 ft² per acre preburn (PRE), to 100 ft² per acre two years after the first burn (01YR02) which was a decrease of 4%. Tree basal area again decreased to 93 ft² per acre two years after the sixth burn (06YR02), a decrease of 11% (Fig. 6).

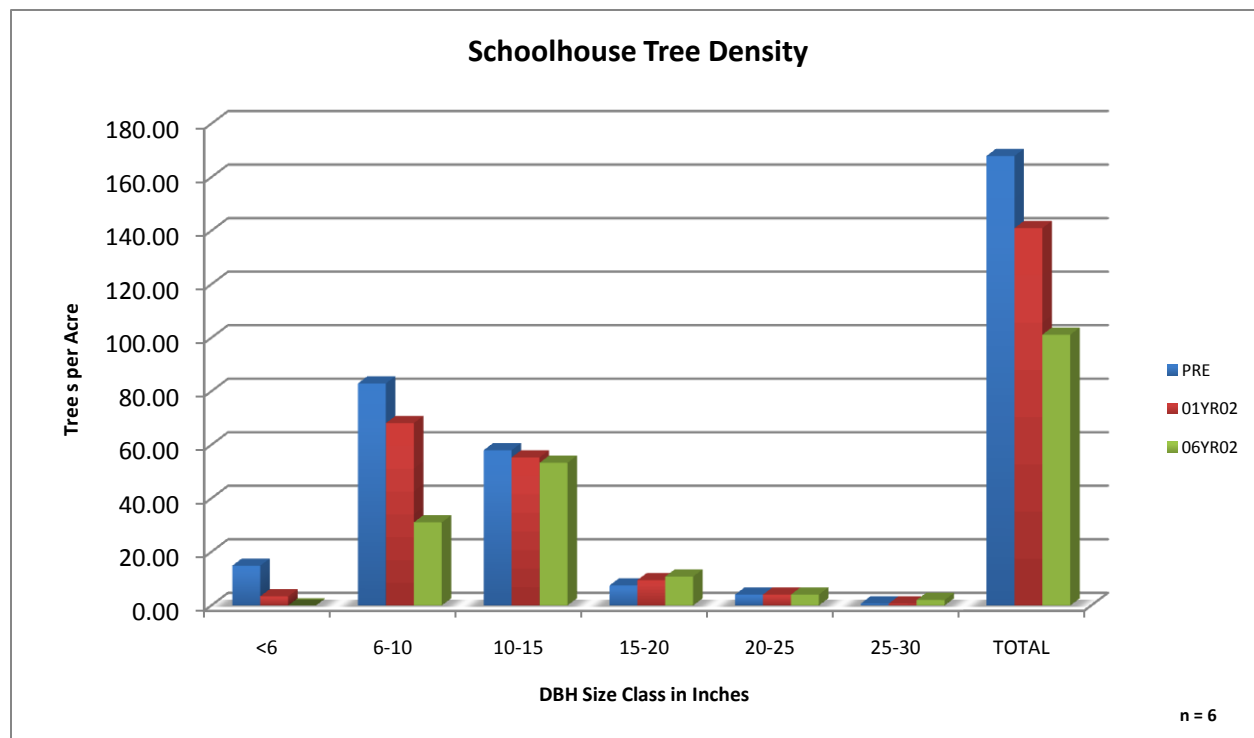


FIGURE 5. TREE DENSITY IN OAK WOODLAND PLOTS BY SAMPLING EVENT IN THE SCHOOLHOUSE BURN UNIT.

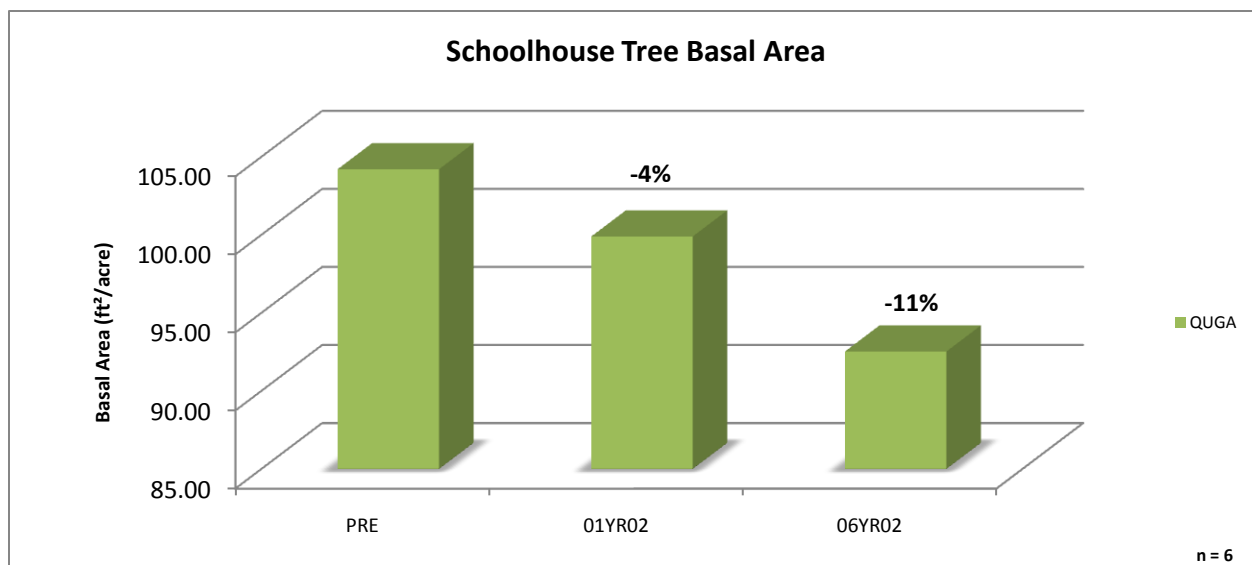


FIGURE 6. SCHOOLHOUSE BURN UNIT TREE BASAL AREA DECLINING THROUGH TIME. NUMBERS ABOVE EACH BAR INDICATE CHANGE FROM “PRE” SAMPLING EVENT.



PHOTO 1. SCHOOLHOUSE FQUGA1D09-22, PRE 1992



PHOTO 2. SCHOOLHOUSE FQUGA1D09-22, 01YR01 1994



PHOTO 3. SCHOOLHOUSE FQUGA1D09-22, 03YR02 2000



PHOTO 4. SCHOOLHOUSE FQUGA1D09-22, 04POST 2001



PHOTO 5. SCHOOLHOUSE FQUGA1D09-22, 04YR02 2003

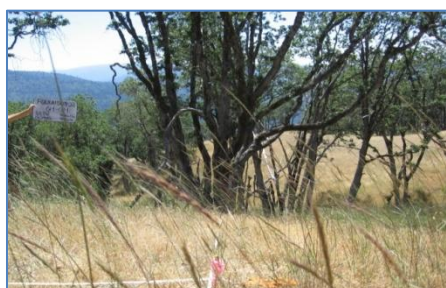


PHOTO 6. SCHOOLHOUSE FQUGA1D09-22, 06YR02 2010

Redwood – Fir Plots

Fir plots were designed to quickly assess fire management objectives targeting conifer encroachment in prairies and oak woodlands. Individual fir seedlings and saplings were not tagged or mapped to expedite data collection and maximize the number of plots installed per treatment unit. However, it was realized this field season that in the time between sampling visits from immediate postburn (POST) to two years postburn (YR02), a new crop of fir seedlings can emerge within the plot boundary, confounding efforts to assess delayed mortality from the previous prescribed burn. In future assessments, living firs will be mapped at the immediate postburn sampling event so that “old” seedlings can be distinguished from “new” ones. This also illustrates the challenge that conifer encroachment presents for managing the Bald Hills, as new seedlings may rapidly infill behind recently killed ones.

TABLE 6. AVERAGE FIR DENSITY PREBURN, IMMEDIATELY POSTBURN, AND TWO YEARS POSTBURN.

Plot Type	PRE	POST	YR02	Change PRE to POST	Change POST to YR02
Fir Plots: Open Grassland (n = 4)	1042 trees/acre	263 trees/acre	101 trees/acre	-75%	-62%
Fir Plots: Oak Woodland - Early Season Burn (n = 5)	996 trees/acre	340 trees/acre	735 trees/acre	-66%	+116%
Fir Plots: Oak Woodland - Late Season Burn (n = 1)	121 trees/acre	0 trees/acre	0 trees/acre	-100%	0%

Redwood – Wildcat Unit

The Wildcat prescribed burn unit is scheduled for treatment in the fall of 2012. This project is significant for Redwood NP in that it is the park’s first attempt to burn a large expanse of second growth forest (the unit encompasses approximately 1300 acres). Additionally, the unit contains the Copper Creek watershed, which has steelhead trout (federally threatened species) in its lowest reach. Copper Creek drains into Redwood Creek, which is habitat for coho and chinook salmon (also federally threatened species).

Ten rapid assessment fire effects monitoring plots were installed in the southern half of the unit during the 2010 field season. These plots provide some baseline information on conditions within this second growth forest. Plot methodology can be found in the Redwood NP Fire Monitoring Plan. Additional plots will be installed in the north section of the unit prior to burning.

Wildcat Unit – Tree Density & Basal Area

The unit is dominated by small-diameter trees (Fig. 7). Average live pole-sized (trees <6” DBH) tree density is 398 trees/acre and primarily composed of tan oak (*Notholithocarpus densiflorus*). Redwood (*Sequoia sempervirens*) dominates the larger (> 20”) diameter classes.

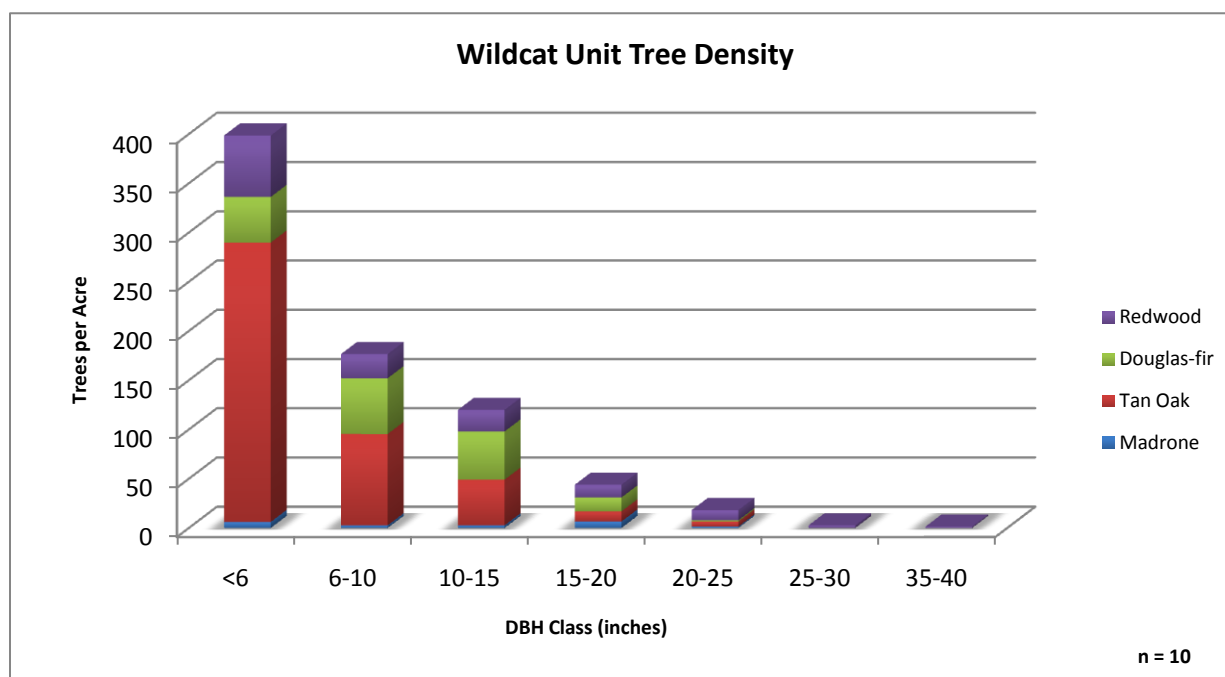


FIGURE 7. PREBURN (2010) LIVE TREE DENSITY WITHIN THE WILDCAT UNIT BY DBH CLASS AND SPECIES.

Table 7 summarizes preburn stand conditions within the Wildcat unit based on rapid assessment plot data. Dead pole size tree density is high (288 trees/acre) and dominated by Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*).

TABLE 7. SUMMARY OF PREBURN (2010) FOREST STRUCTURE IN THE WILDCAT UNIT BASED ON RAPID ASSESSMENT PLOT DATA. OVERSTORY TREES ARE >6" DBH; POLE-SIZED TREES ARE <6" DBH.

Variable	Mean	SE	80% CI
Live Overstory Tree Density (trees/acre)	361.9	29.1	321.7—402.1
Dead Overstory Tree Density (trees/acre)	24.5	8.0	13.4—35.6
Live Pole Tree Density (trees/acre)	398.4	51.7	326.9—469.9
Dead Pole Tree Density (trees/acre)	287.8	65.8	196.8—378.8
Total Live Tree Density (trees/acre)	760.4	71.7	661.2—859.6
Total Dead Tree Density (trees/acre)	312.2	65.2	222.0—402.4
Live Overstory Basal Area (ft ² /acre)	299.9	22.1	269.3—330.5
Dead Overstory Basal Area (ft ² /acre)	9.3	3.2	4.8—13.7
Live Pole Tree Basal Area (ft ² /acre)	26.0	2.7	22.3—29.7
Dead Pole Tree Basal Area (ft ² /acre)	13.0	3.0	8.8—17.1
Total Live Tree Basal Area (ft ² /acre)	325.9	21.8	295.8—356.0
Total Dead Tree Basal Area (ft ² /acre)	22.2	4.5	16.0—28.4

Live tree basal area is dominated by tan oak (Fig. 8), followed by redwood and Douglas-fir. Total live basal area is high at 326 ft²/acre.

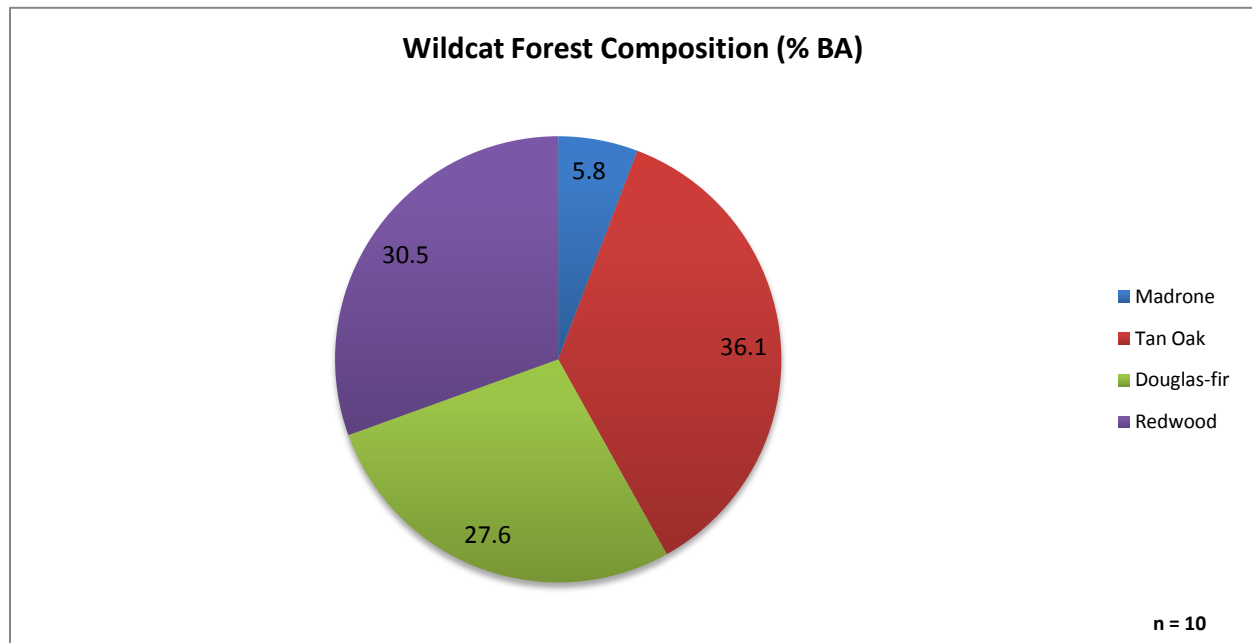


FIGURE 8. PREBURN (2010) PERCENT LIVE BASAL AREA (TOTAL IS 100%) BY SPECIES FOR THE WILDCAT UNIT.

Wildcat Unit - Fuel Load

Dead & down surface fuel loading is dominated by 1000-hour fuels (woody materials >3" diameter), primarily rotten ones (25.1 tons/acre). Average total fuel load is 54.8 (80% CI is 36.1—73.4) tons/acre. Fuel load by size class is summarized in Table 8. Figure 9 illustrates how fuel load is distributed by size class.

TABLE 8. PREBURN (2010) DEAD AND DOWN SURFACE FUEL LOAD (TONS/ACRE) BY SIZE CLASS FOR THE WILDCAT UNIT, INCLUDING DUFF AND LITTER DEPTH (INCHES).

Variable	Mean (tons/acre)	SE	80% CI
1 hour	0.6	0.22	0.3—0.9
10 hour	1.4	0.28	1.0—1.8
100 hour	3.0	0.92	1.7—4.2
1000 hour Sound	13.5	6.48	4.6—22.5
1000 hour Rotten	25.1	13.85	5.9—44.3
Duff	6.3	1.01	4.9—7.7
Litter	4.9	0.79	3.8—5.9
Total	54.8	13.50	36.1—73.4
<i>Depth (inches)</i>			
<i>Duff Depth (in)</i>	<i>0.6"</i>	<i>0.09</i>	<i>0.5—0.8</i>
<i>Litter Depth (in)</i>	<i>1.0"</i>	<i>0.16</i>	<i>0.8—1.2</i>

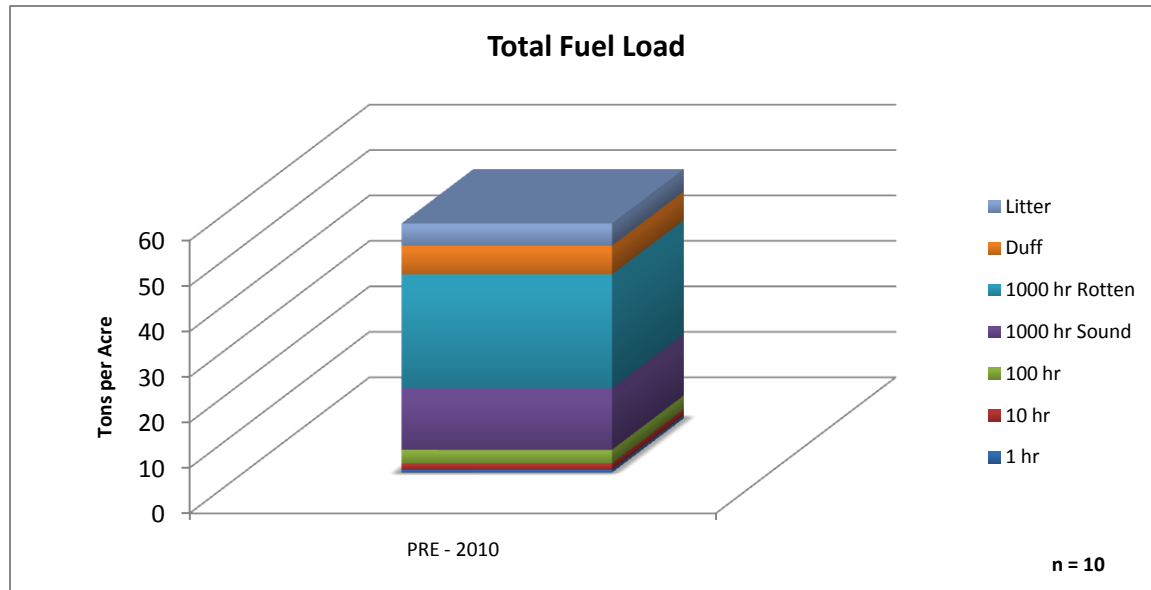


FIGURE 9. PREBURN (2010) DEAD & DOWN SURFACE FUEL LOADING BY SIZE CLASS IN THE WILDCAT UNIT.



FIGURE 10. CONDITIONS WITHIN THE WILDCAT UNIT.

D. WHISKEYTOWN NATIONAL RECREATION AREA

Whiskeytown contains 6 monitoring types: Black Oak Woodland, Live Oak Woodland, Mixed Conifer, Ponderosa Pine, Chaparral, and Knobcone Pine.

All results shown in Table 9 include 80% confidence intervals of the mean. Minimum sample size has not been attained for any monitoring type at Whiskeytown. Sampling event codes consist of a two-number prefix for how many times a plot has burned (01 for once, 02 for twice, etc.) followed by the abbreviation "YR" for "year" and followed by how many years have elapsed post-burn (02 for two, 05 for five, etc.). 01YR15 is fifteen years after the first burn; 03YR02 is two years after the third burn.

TABLE 9. MANAGEMENT OBJECTIVES AND MONITORING RESULTS FOR WHISKEYTOWN NRA.

Monitoring Unit	Management Objective	Monitoring Results (80% confidence interval)	Objective Achieved?	Year Last Analysis Completed
Chaparral	Maintain dead surface fuel loading between 2-10 tons/acre	00PRE: 16.2 (11.2—21.3) tons/acre 01POST: 6.2 (0.2—12.1) tons/acre 01YR01: 7.5 (1.1—13.8) tons/acre (<i>n</i> = 4 plots, 2 fires)	Yes	2009
Oak Woodland	Maintain average overstory* tree densities of 5-50 trees/acre <i>*live trees >10" DBH</i>	00PRE: 55 (47—63) trees/acre 01YR01: 42 (33—51) trees/acre 01YR02: 33 (23—42) trees/acre (<i>n</i> = 9 plots, 4 fires)	Yes	2010
	Maintain average overstory* tree densities of 5-50 trees/acre <i>*live trees >10" DBH</i>	00PRE: 59 (46—72) trees/acre 01YR01: 45 (29—62) trees/acre 01YR02: 38 (23—53) trees/acre 01YR05: 41 (31—52) trees/acre 01YR15: 49 (33—65) trees/acre (<i>n</i> = 5 plots, 1 fire)	Yes	2010
	Maintain average pole-sized* tree densities between 20-100 trees/acre <i>*live trees <10" DBH</i>	00PRE: 318 (240—396) trees/acre 01YR01: 168 (87—249) trees/acre 01YR02: 148 (73—223) trees/acre (<i>n</i> = 9 plots, 4 fires)	No	2010
	Maintain average pole-sized* tree densities between 20-100 trees/acre <i>*live trees <10" DBH</i>	00PRE: 350 (199—501) trees/acre 01YR01: 272 (107—437) trees/acre 01YR02: 239 (85—392) trees/acre 01YR05: 216 (78—353) trees/acre 01YR15: 183 (97—269) trees/acre (<i>n</i> = 4 plots, 1 fire)	No	2010
	Maintain average total dead surface fuel loads between 5-15 tons/acre	00PRE: 20.6 (19.3—21.9) tons/acre 01POST: 3.8 (2.9—4.7) tons/acre 01YR01: 7.6 (4.0—11.2) tons/acre 01YR02: 8.7 (5.6—11.8) tons/acre (<i>n</i> = 9 plots, 4 fires)	Yes	2010
	Maintain average total dead surface fuel loads between 5-15 tons/acre	00PRE: 20.2 (18.0—22.4) tons/acre 01POST: 3.4 (2.3—4.5) tons/acre 01YR01: 10.1 (3.1—16.9) tons/acre 01YR02: 10.3 (5.0—15.6) tons/acre 01YR05: 23.7 (13.9—33.5) tons/acre 01YR15: 19.2 (15.8—22.6) tons/acre (<i>n</i> = 5 plots, 1 fire)	Yes, then no	2010
Knobcone Pine Woodland	Maintain total dead surface fuel loads between 8-35 tons/acre	00PRE: 13.7 (10.8—16.6) tons/acre 02POST: 27.3 (15.5—39.0) tons/acre 02YR02: 42.4 (33.2—51.6) tons/acre 02YR05: 44.4 (31.9—56.9) tons/acre (<i>n</i> = 5 plots, 2 fires)	Not really	2009
Mixed Conifer Forest	Maintain 10-65 overstory* trees/acre <i>*live trees >10" DBH</i>	00PRE: 49 (39—59) trees/acre 01YR01: 49 (41—58) trees/acre 01YR02: 49 (40—57) trees/acre 01YR05: 49 (39—59) trees/acre (<i>n</i> = 9 plots, 2 fires)	Yes	2009

Monitoring Unit	Management Objective	Monitoring Results (80% confidence interval)	Objective Achieved?	Year Last Analysis Completed
	Maintain 10-65 overstory* trees/acre <i>*live trees >10" DBH</i>	00PRE: 44 (34—54) trees/acre 01YR01: 47 (38—56) trees/acre 01YR02: 49 (41—57) trees/acre 01YR05: 52 (43—60) trees/acre 01YR15: 66 (50—83) trees/acre (<i>n</i> = 5 plots, 1 fire)	Yes, then no	2009
	Maintain average pole-sized* tree density between 10-80 trees/acre <i>*live trees <10" DBH</i>	00PRE: 234 (125—342) trees/acre 01YR01: 124 (48—200) trees/acre 01YR02: 104 (45—163) trees/acre 01YR05: 100 (47—152) trees/acre (<i>n</i> = 9 plots, 2 fires)	No	2009
	Maintain average pole-sized* tree density between 10-80 trees/acre <i>*live trees <10" DBH</i>	00PRE: 312 (131—493) trees/acre 01YR01: 170 (39—301) trees/acre 01YR02: 130 (39—222) trees/acre 01YR05: 131 (49—214) trees/acre 01YR15: 142 (41—242) trees/acre (<i>n</i> = 5 plots, 1 fire)	No	2009
	Maintain basal area of 75-200 ft ² /acre	00PRE: 160.4 (105.9—214.9) ft ² /acre 01YR01: 160.0 (107.2—212.8) ft ² /acre 01YR02: 143.2 (95.0—191.4) ft ² /acre 01YR05: 133.2 (83.7—182.7) ft ² /acre (<i>n</i> = 9 plots, 2 fires)	Yes	2009
	Maintain basal area of 75-200 ft ² /acre	00PRE: 75.1 (43.1—107.1) ft ² /acre 01YR01: 81.2 (49.6—112.8) ft ² /acre 01YR02: 83.2 (51.8—114.6) ft ² /acre 01YR05: 80.5 (56.7—104.3) ft ² /acre 01YR15: 109.9 (79.4—140.4) ft ² /acre (<i>n</i> = 5 plots, 1 fire)	Yes	2009
	Maintain dead surface fuel load between 10-35 tons/acre	00PRE: 35.9 (24.1—47.4) tons/acre 01YR01: 16.7 (10.7—22.7) tons/acre 01YR02: 18.3 (12.4—24.2) tons/acre 01YR05: 35.3 (21.2—49.4) tons/acre (<i>n</i> = 9 plots, 2 fires)	Yes, then no	2009
	Maintain dead surface fuel load between 10-35 tons/acre	00PRE: 19.7 (15.5—23.9) tons/acre 01YR01: 8.5 (4.9—12.2) tons/acre 01YR02: 13.1 (4.9—21.2) tons/acre 01YR05: 17.9 (15.1—20.7) tons/acre 01YR15: 15.4 (13.8—17.0) tons/acre (<i>n</i> = 5 plots, 1 fire)	Yes	2009
Ponderosa Pine Forest	Maintain average overstory* tree densities between 15-45 trees/acre <i>*live trees >10" DBH</i>	00PRE: 92 (69—115) trees/acre 01YR01: 87 (67—106) trees/acre (<i>n</i> = 5 plots, 3 fires)	No	2009
	Maintain average overstory* tree densities between 15-45 trees/acre	00PRE: 105 (71—140) trees/acre 01YR01: 94 (64—124) trees/acre 01YR02: 85 (67—103) trees/acre	No	2010

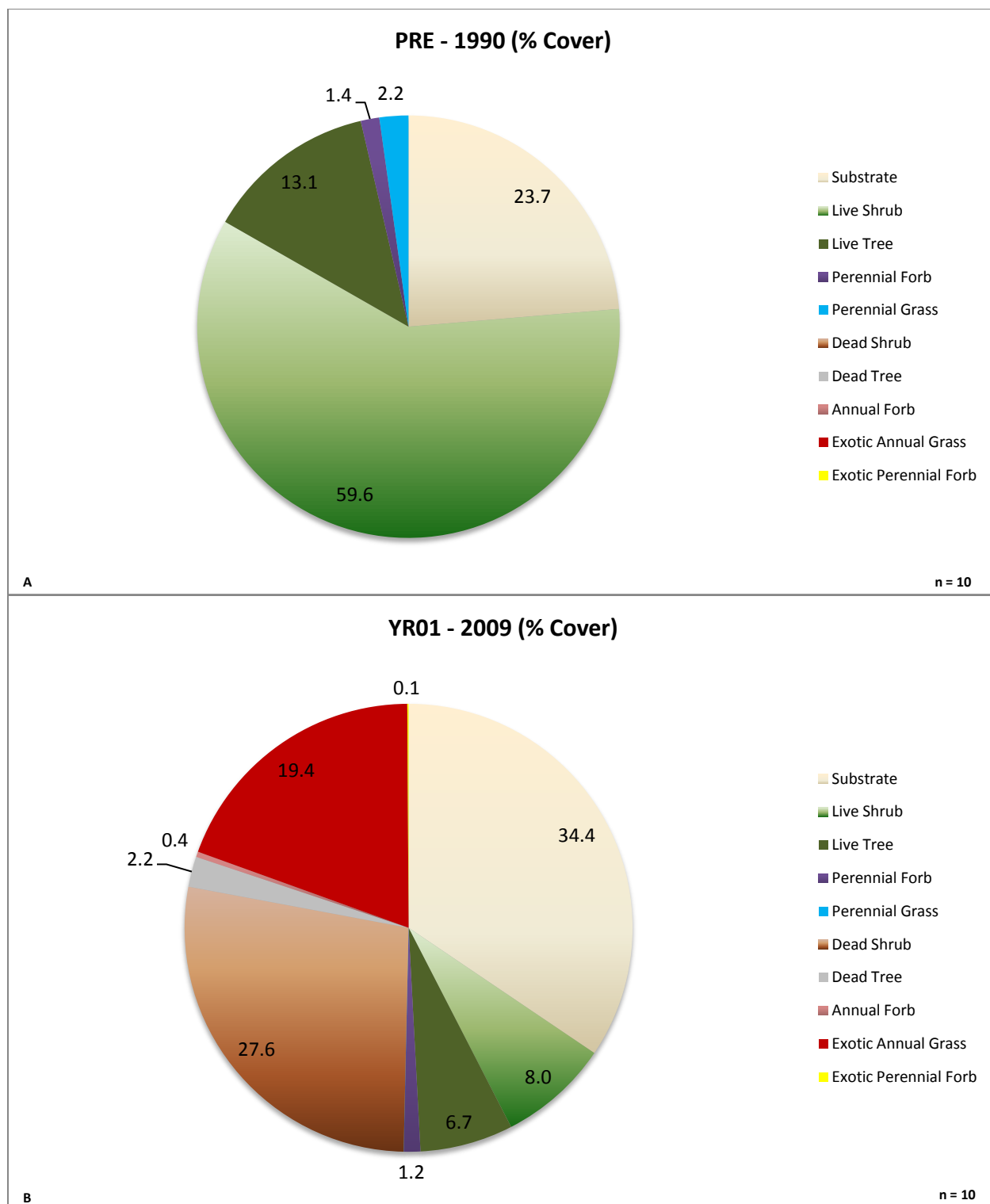
Monitoring Unit	Management Objective	Monitoring Results (80% confidence interval)	Objective Achieved?	Year Last Analysis Completed
	<i>*live trees >10" DBH</i>	02YR02: 81 (69—93) trees/acre 02YR05: 74 (61—88) trees/acre 02YR10: 77 (59—95) trees/acre 03YR01: 76 (53—98) trees/acre 03YR02: 63 (34—93) trees/acre (<i>n</i> = 3 plots, 4 fires)		
	Maintain 10-75 pole-sized* trees/acre <i>*live trees <10" DBH</i>	00PRE: 424 (299—549) trees/acre 01YR01: 262 (88—436) trees/acre (<i>n</i> = 5 plots, 3 fires)	No	2009
	Maintain 10-75 pole-sized* trees/acre <i>*live trees <10" DBH</i>	00PRE: 301 (197—404) trees/acre 01YR01: 80 (11—148) trees/acre 01YR02: 63 (0—146) trees/acre 02YR02: 45 (0—94) trees/acre 02YR05: 32 (0—73) trees/acre 02YR10: 36 (5—68) trees/acre 03YR01: 14 (1—26) trees/acre 03YR02: 12 (1—24) trees/acre (<i>n</i> = 3 plots, 4 fires)	Yes	2010
	Maintain average dead surface fuel load of 5-28 tons/acre	00PRE: 32.3 (26.3—38.3) tons/acre 01YR01: 23.7 (0.0—47.4) tons/acre (<i>n</i> = 5 plots, 3 fires)	Yes	2009
	Maintain average dead surface fuel load of 5-28 tons/acre	00PRE: 29.7 (24.7—34.6) tons/acre 01POST: 5.3 (2.1—8.5) tons/acre 01YR01: 10.1 (6.2—14.0) tons/acre 02POST: 5.6 (4.9—6.2) tons/acre 02YR02: 16.4 (5.2—27.5) tons/acre 02YR05: 29.3 (14.0—44.5) tons/acre 02YR10: 30.8 (23.5—38.1) tons/acre 03POST: 12.2 (10.3—14.0) tons/acre 03YR01: 12.9 (11.4—14.5) tons/acre 03YR02: 15.8 (9.0—22.6) tons/acre (<i>n</i> = 3 plots, 4 fires)	Generally yes	2010

Whiskeytown – Chaparral

The Motion Complex of 2008 blazed through the northeastern portion of Whiskeytown, and in the process burned many “inactive” Fire Monitoring Handbook (FMH) Brush plots that had been installed in 1990. The plots were located outside of current burn units, and had not been sampled since the initial preburn sampling event in 1990. In 2009, the plots were sampled one year post-wildfire. While it is impossible to know what happened in terms of vegetation dynamics in these plots over the course of 19 years, the plots did not experience any large disturbance event until the Motion Complex of fires in 2008. The one year postburn (YR01) sampling event showed that exotic annual grasses (primarily *Aira caryophyllaea*, *Vulpia bromoides*, and *Gastridium ventricosum*) have invaded plot areas (Fig. 11). Preburn shrub cover was primarily whiteleaf manzanita (*Arctostaphylos viscida*) with some toyon (*Heteromeles arbutifolia*); preburn tree cover was dominated by live oak (*Quercus chrysolepis*), knobcone pine (*Pinus attenuata*), and black oak (*Quercus kelloggii*). Native perennial forbs found in these plots include iris (*Iris purdyi*) and wild hyacinth (*Dichelostemma multiflorum*).



FIGURES 11 A&B. PLOTS BARVI1D04-05 (11A) AND BARVI1D04-20 (11B) PREBURN-1990 AND YR01-2009.



FIGURES 12 A&B. PREBURN – 12A (1990) AND ONE YEAR POSTBURN – 12B (YR01 - 2009) VEGETATION IN PLOTS BURNED BY THE 2008 MOTION COMPLEX. PREBURN VEGETATION WAS COMPRISED ENTIRELY OF NATIVE SPECIES. “SUBSTRATE” INDICATES COVER BY LITTER, BARE GROUND, ROCK, OR WOOD ONLY (NO VEGETATION PRESENT).

Whiskeytown – Oak Woodland: Brandy Creek

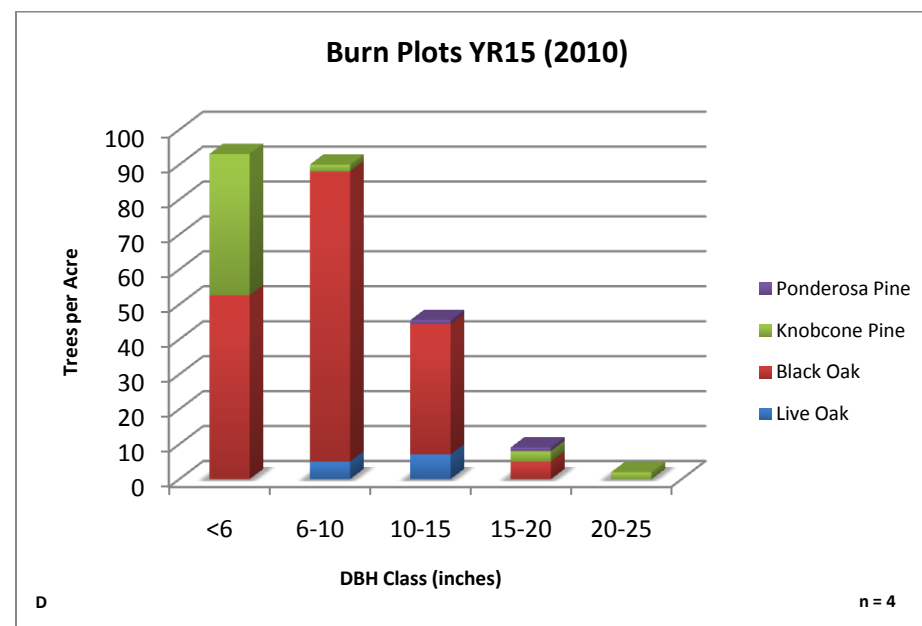
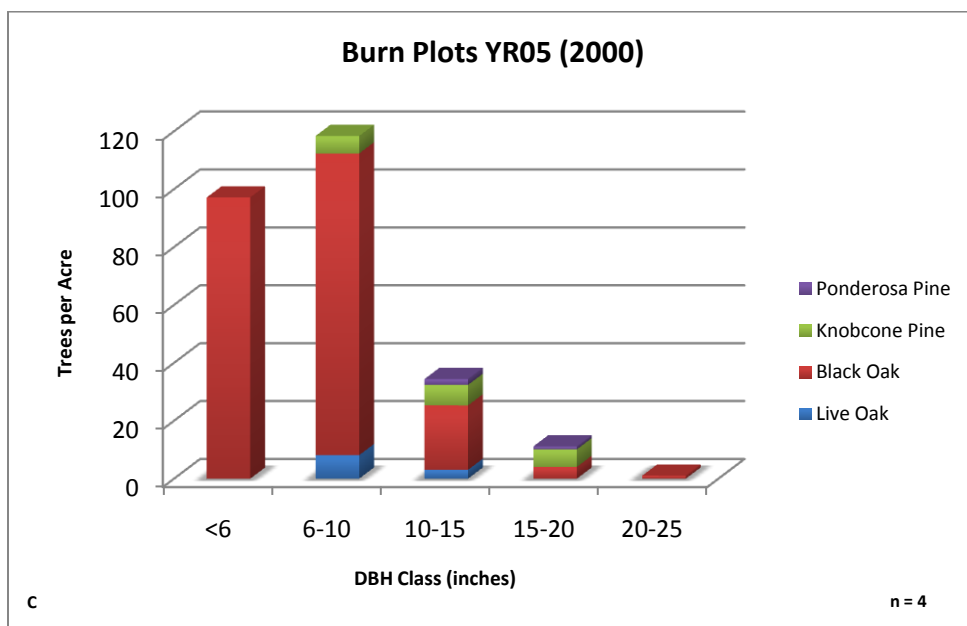
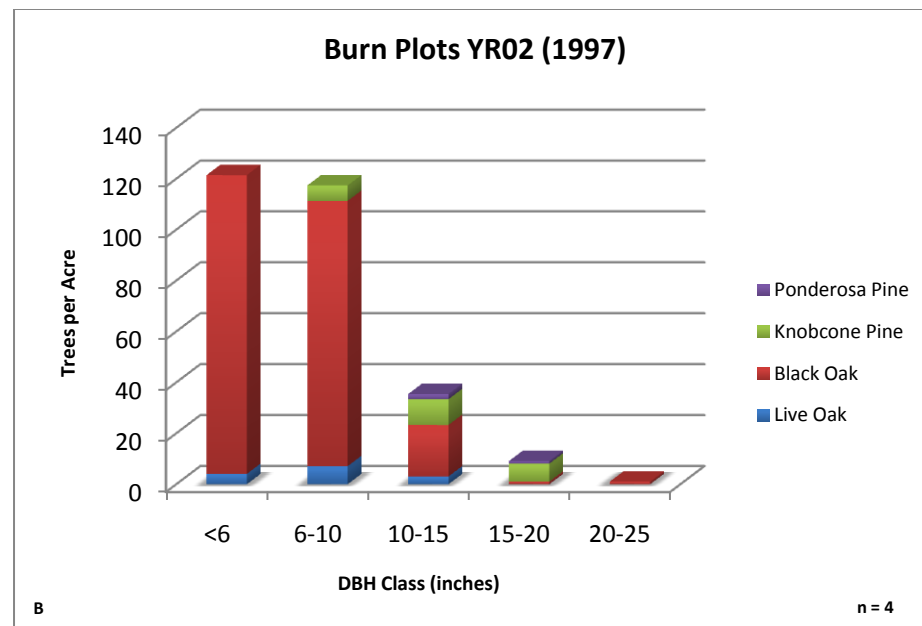
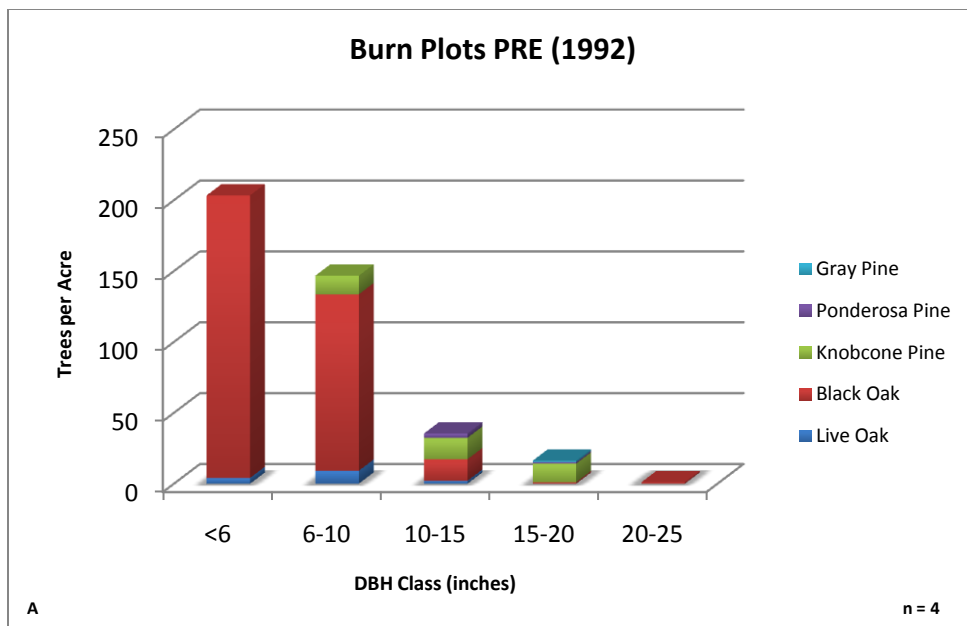
The Brandy Creek unit was treated with prescribed fire in September of 1995. Five FMH forest plots were burned; one plot fell outside the control lines and is, by default, a “control” plot that has not been treated with fire. The plots have been sampled preburn (PRE – 1992), one year after the burn (YR01 – 1996), two years after the burn (YR02 – 1997), five years after the burn (YR05 – 2000), and fifteen years after the burn (YR15 – 2010). The “control” plot was sampled on the same schedule as the burn plots. Results are presented for tree density, tree basal area, and total fuel loading.

Brandy Creek - Tree Density

While the preburn Brandy Creek burn plots were dominated by black oak, there were also components of live oak, knobcone pine, ponderosa pine (*Pinus ponderosa*), gray pine (*Pinus sabiana*), and Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*). Preburn total tree density was high in the burn plots at 403 trees/acre; by YR01 this was reduced to 326 trees/acre (-19% change from PRE), by YR02 total tree density was 284 trees/acre (-29% change from PRE), by YR05 total tree density was 262 trees/acre (-35% change from PRE), and at YR15 total tree density was 240 trees/acre (-41% change from PRE). One plot (plot 7) was excluded from data analysis due to dense knobcone pine recruitment within the plot; density of knobcone pines between 2.5–6” DBH was 2007 trees/acre. Data from the four remaining burn plots also show an increase in small diameter knobcone pines by the YR15 sampling event (Fig. 14).

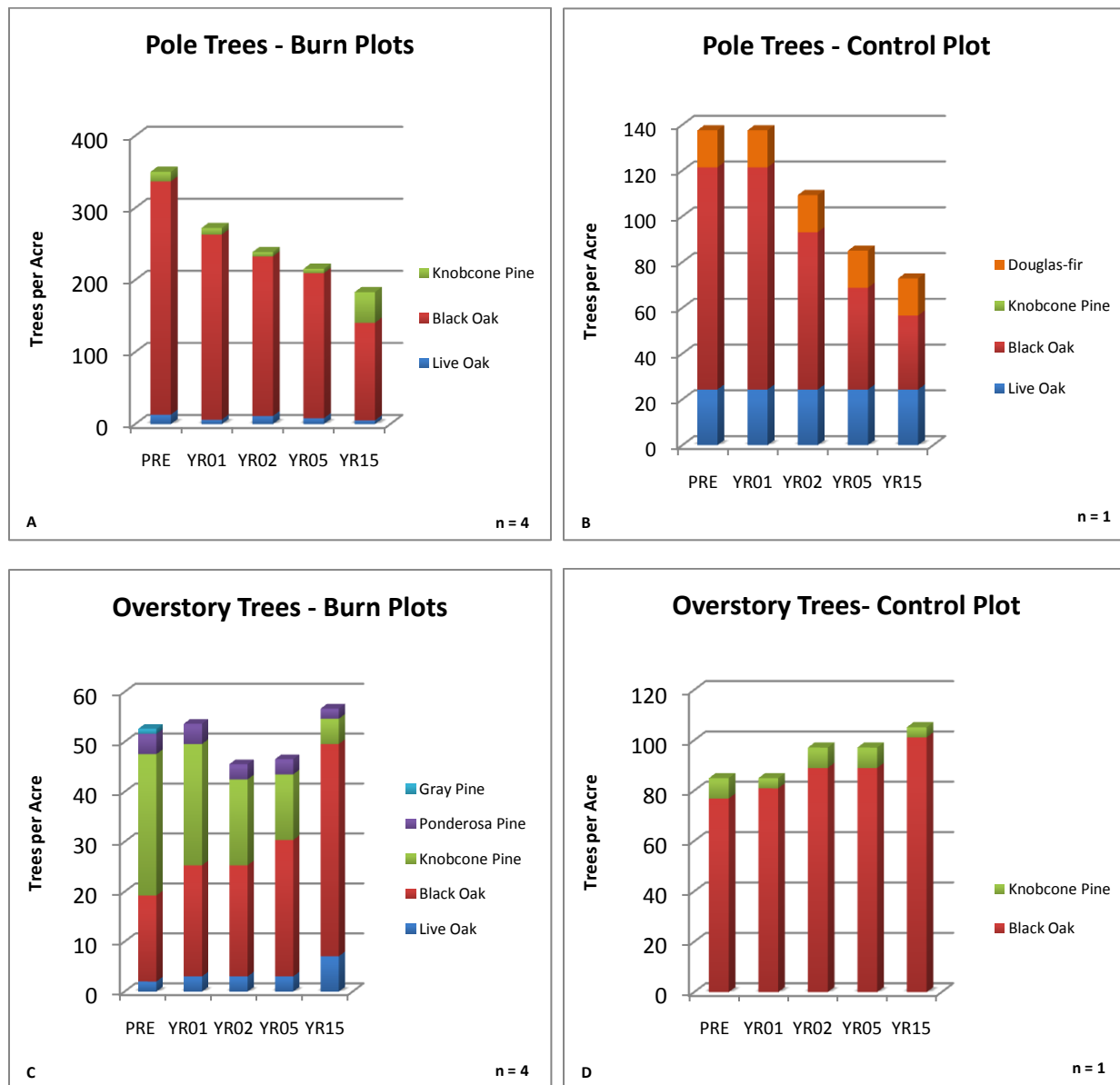


FIGURE 13. PLOT FQUKE1D09-07, YR15 (2010) BEING OVER TAKEN BY KNOBCONE PINES.



FIGURES 14 A-D. TREE DENSITY BY SPECIES AND DBH CLASS THROUGH TIME IN THE BRANDY CREEK BURN PLOTS.

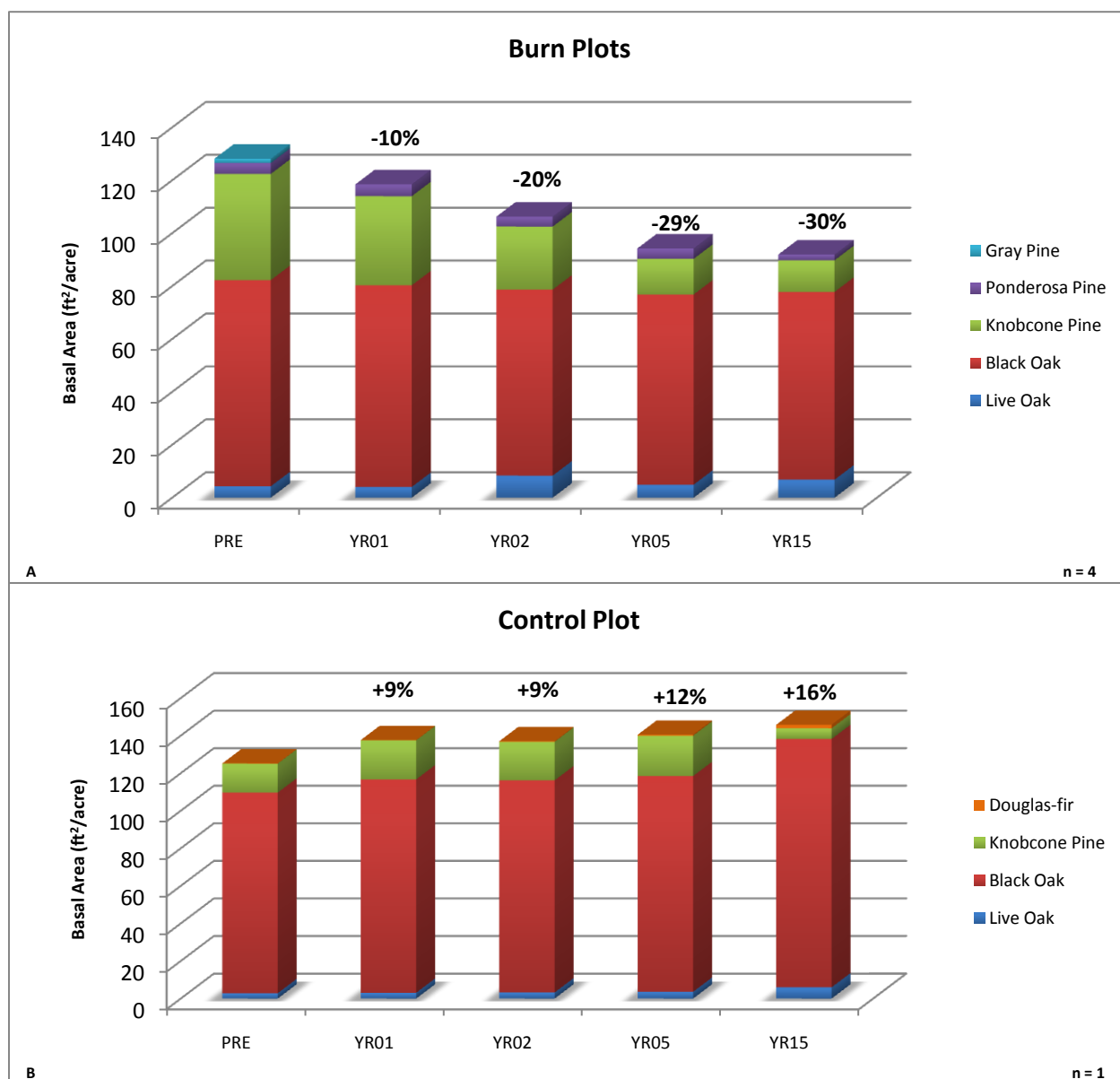
Tree density in the Brandy Creek control plot looks a bit different. The control plot had 223 total trees/acre at the PRE (1992) sampling event; this increased to 226 trees/acre at the YR01 (1996) sampling event (+2% from PRE), was reduced to 206 trees/acre at the YR02 (1997) sampling event (-7% change from PRE), declined farther to 182 trees/acre at the YR05 (2000) sampling event (-18% change from PRE), and was 178 trees/acre at the YR15 (2010) sampling event (-20% change from PRE). The reduction in density is primarily due to mortality of pole-sized (<10" DBH) black oak trees. The same trend is evident in the burn plots. Some of the pole-sized black oaks grow out of this size class and fill into the forest overstory, but many more simply die (Fig. 15).



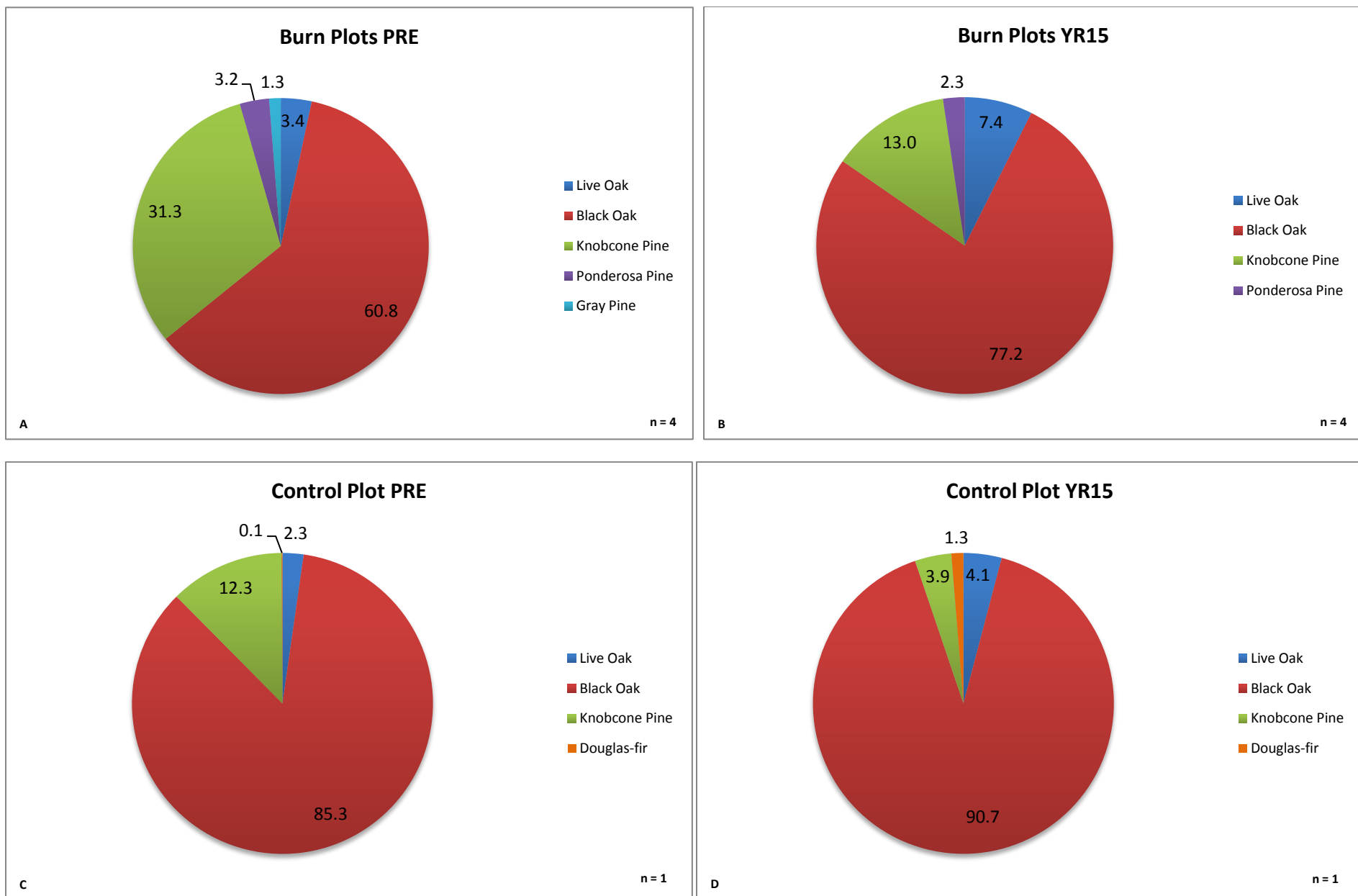
FIGURES 15 A-D. POLE-SIZED (<10" DBH) AND OVERSTORY (>10" DBH) TREE DENSITY BY SPECIES FOR BRANDY CREEK BURN (15A&C) AND CONTROL (15B&D) PLOTS OVER TIME.

Brandy Creek - Tree Basal Area

The burn plots undergo a steady reduction (-30.4%) in total tree basal area over time from 128 ft²/acre at the PRE sampling event to 92 ft²/acre at YR15 (Fig. 16). The opposite is true in the control plot; it experiences a 16.4% increase in total basal area from 125 ft²/acre at the PRE sampling event to 146 ft²/acre at YR15. In the burn plots, black oak increases its dominance within the stand from the PRE to YR15 sampling events by going from 61% to 77% of the total basal area. Knobcone pine is reduced after burning from being 31% of the total basal area PRE to 13% at the YR15 sampling event (Fig. 17). In the control plots, black oak also increases its dominance within the stand; its total basal area increases from 85% in the PRE (1992) sampling event to 91% in the YR15 (2010) sampling event.



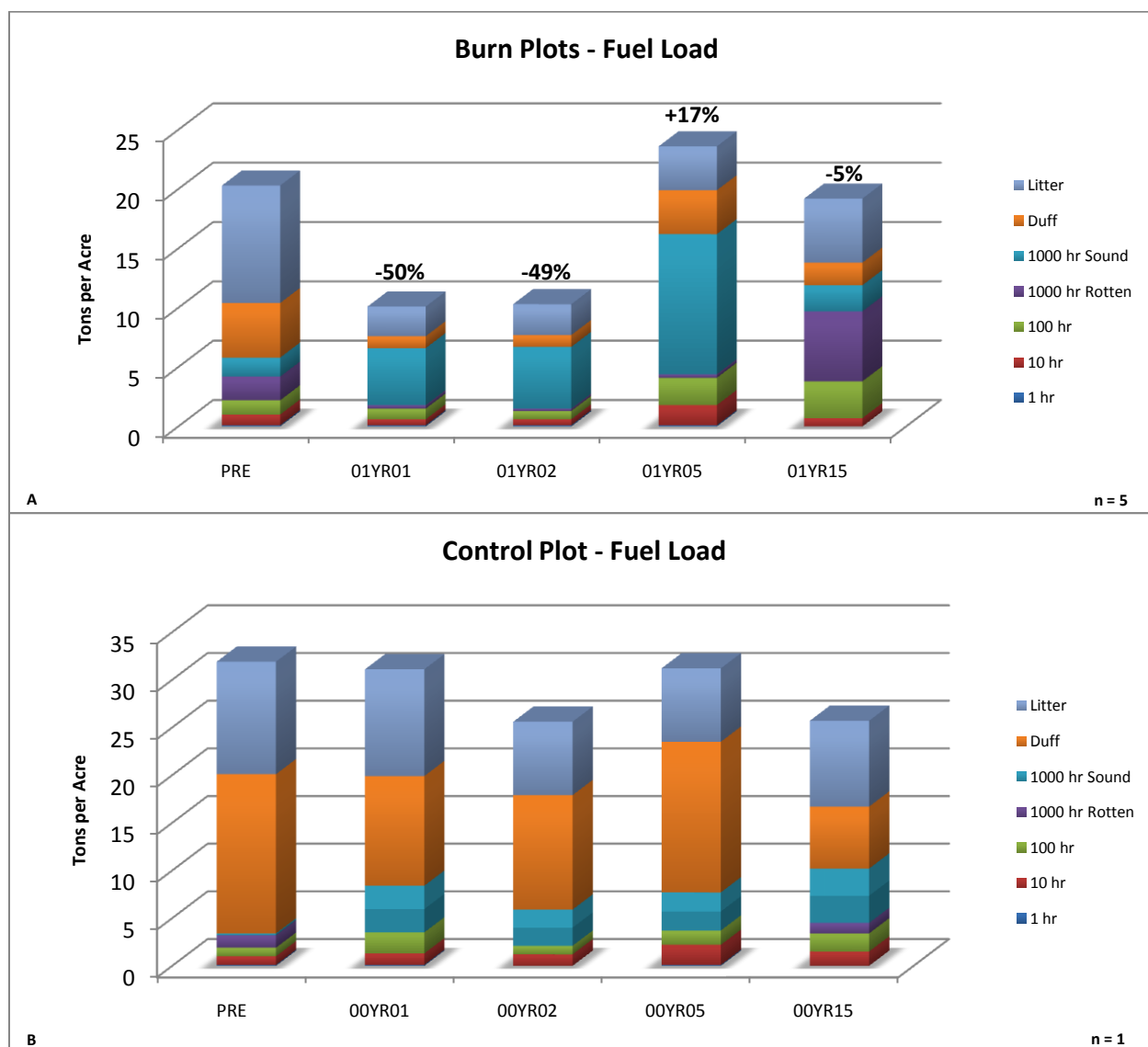
FIGURES 16 A&B. TOTAL BASAL AREA BY SPECIES OVER TIME IN THE BRANDY CREEK BURN (16A) AND CONTROL (16B) PLOTS. CHANGE FROM "PRE" SAMPLING EVENT IS NOTED ABOVE EACH BAR.



FIGURES 17 A-D. TOTAL BASAL AREA (TOTAL IS 100%) BY SPECIES OVER TIME IN THE BRANDY CREEK BURN (17A&B) AND CONTROL (17C&D) PLOTS.

Brandy Creek - Fuel Load

Total dead and down surface fuel load in the burn plots was reduced by 50% at YR01; by YR05 total fuel load exceeds preburn levels due to a pulse of fire-killed trees contributing to the '1000-hr Sound' fuel size class. At the YR15 sampling event, many of these sound logs are decomposing. Total fuel load in the burn plots varies over time between 10-24 tons/acre, and the nature of the forest floor changes from being dominated by litter and duff to having more woody materials (Fig. 18). In the control plot, the total fuel load remains between 26—32 tons/acre and is composed mostly of litter and duff through time with some 1000 hour sound materials (from pole-sized black oak tree mortality). Variations in total fuel load may change over time due to such factors as observer error (e.g., difficulty in relocating transect through dense vegetation) and trampling/disturbance from humans and/or wildlife.



FIGURES 18 A&B. TOTAL DEAD & DOWN SURFACE FUEL LOAD BY SIZE CLASS OVER TIME IN THE BRANDY CREEK BURN (18A) AND CONTROL (18B) PLOTS. NUMBERS ABOVE EACH BAR INDICATE PERCENT CHANGE FROM PRE (1992) SAMPLING EVENT.



PHOTO 1. BRANDY CREEK FQUKE1D09-03, PRE 1992



PHOTO 2. BRANDY CREEK FQUKE1D09-03, 01POST 1995



PHOTO 3. BRANDY CREEK FQUKE1D09-03, 01YR02 1997



PHOTO 4. BRANDY CREEK FQUKE1D09-03, 01YR05 2000



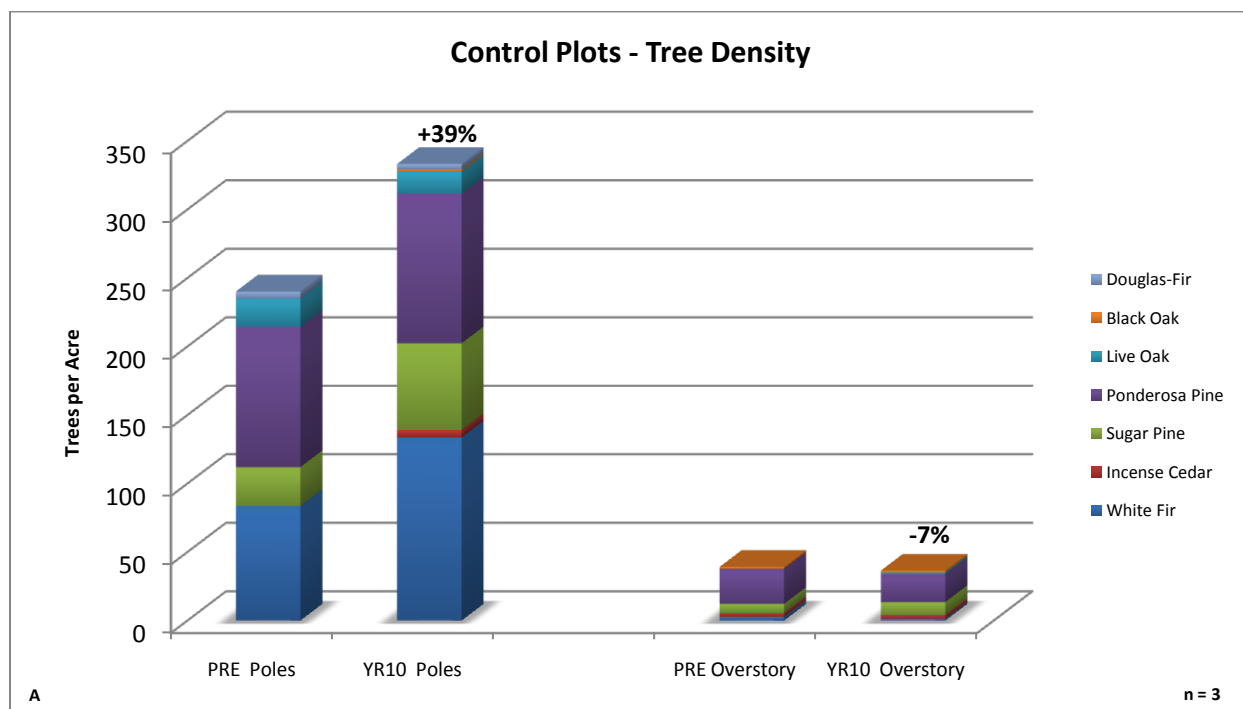
PHOTO 5. BRANDY CREEK FQUKE1D09-03, 01YR15 2010

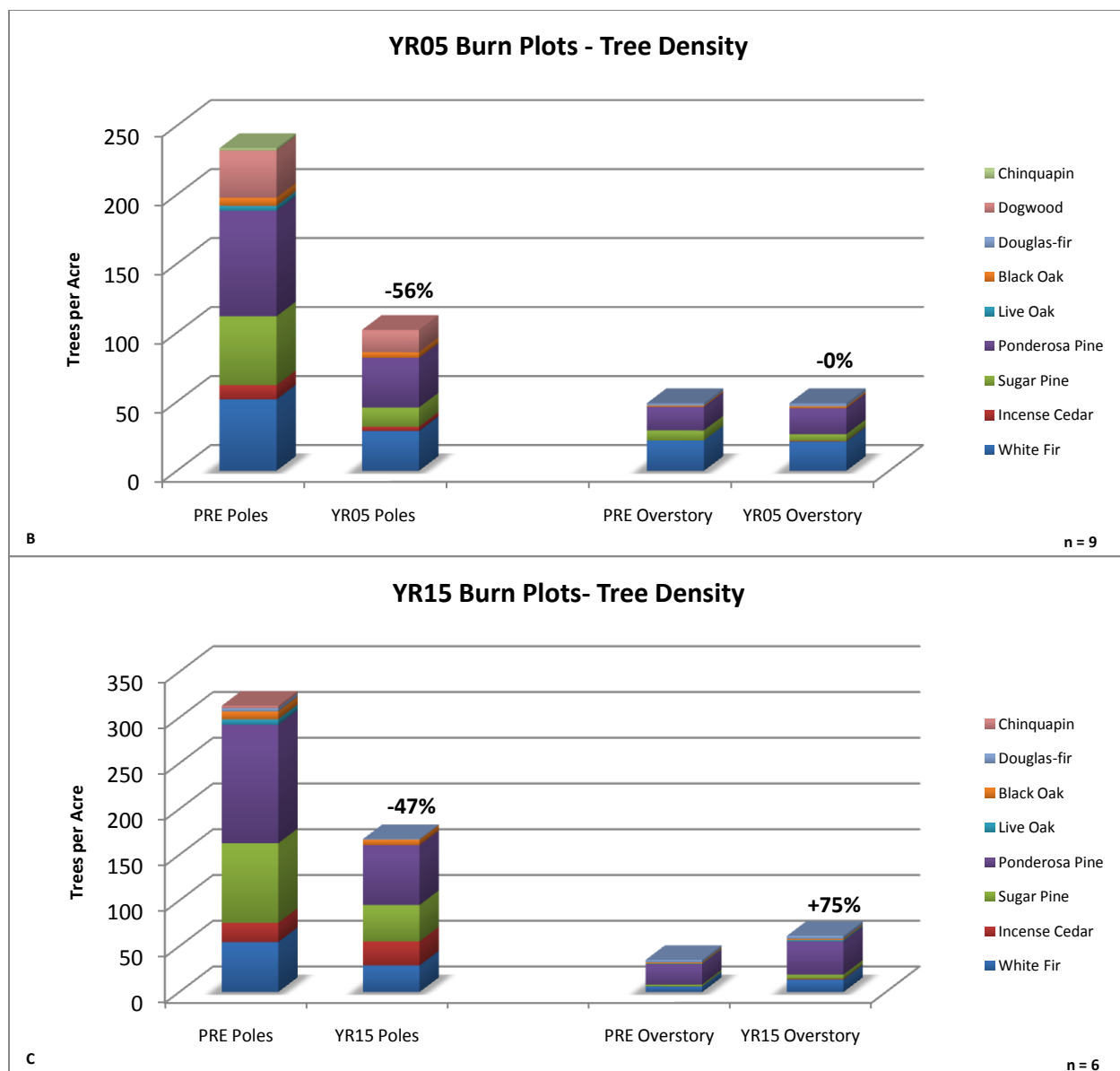
Whiskeytown – Mixed Conifer Plots

The Mixed Conifer monitoring type is found within Whiskeytown’s higher elevations and is characterized by a diverse forest canopy composed of white fir (*Abies concolor*), incense cedar (*Calocedrus decurrens*), sugar pine (*Pinus lambertiana*), ponderosa pine, live oak, black oak, and/or Douglas-fir, with occasional mountain dogwood (*Cornus nuttallii*) and, infrequently, giant chinquapin (*Chrysolepis chrysophylla* var. *chrysophylla*). Fire effects monitoring data presented here includes information from three control plots that were sampled “preburn” (PRE) in 1990 (1 plot – Coggins Park area) and 1999 (2 plots – Countyline burn unit) and ten years later (YR10) in 2000 (1 Coggins Park plot) and 2009 (2 Countyline plots). All three plots were installed with the intent to have them treated with prescribed fire, but they either ended up outside the unit boundaries or the unit did not burn. Information will also be presented from nine plots that were sampled preburn “PRE” in 1990 (4 plots – Queen Mary burn unit) and 1993 (5 plots – Coggins Park unit), and sampled again five years postburn (YR05) in 2001 (4 Queen Mary plots) and 1999 (5 Coggins Park plots). The Queen Mary unit was burned in the fall of 1996; the Coggins Park unit was treated in the fall of 1994. Information will also be presented from six Coggins Park plots that were sampled preburn (PRE) in 1993 and fifteen years postburn (YR15) in 2009 (data from the YR05 sampling event will not be presented for these six plots along with YR15 data due to missing YR05 data).

Mixed Conifer Plots - Tree Density

The control plots show a 38.8% increase in pole-sized (<10” DBH) tree density from 240 trees/acre at the PRE sampling event to 333 trees/acre at the YR10 sampling event. There is also a 7% reduction in overstory (>10” DBH) tree density during that same time period, from 39 trees/acre PRE to 36 trees/acre YR10. The burn plots show the opposite trend, at least with respect to pole-size trees. The YR05 burn plots have a 56% reduction in pole-sized tree density from PRE to YR05 sampling events with no increase in overstory tree density. The YR15 burn plots have a 47% reduction in pole-sized tree density from PRE to YR15 sampling events, with a 75% increase in overstory tree density from 35 trees/acre PRE to 61 trees/acre YR15.



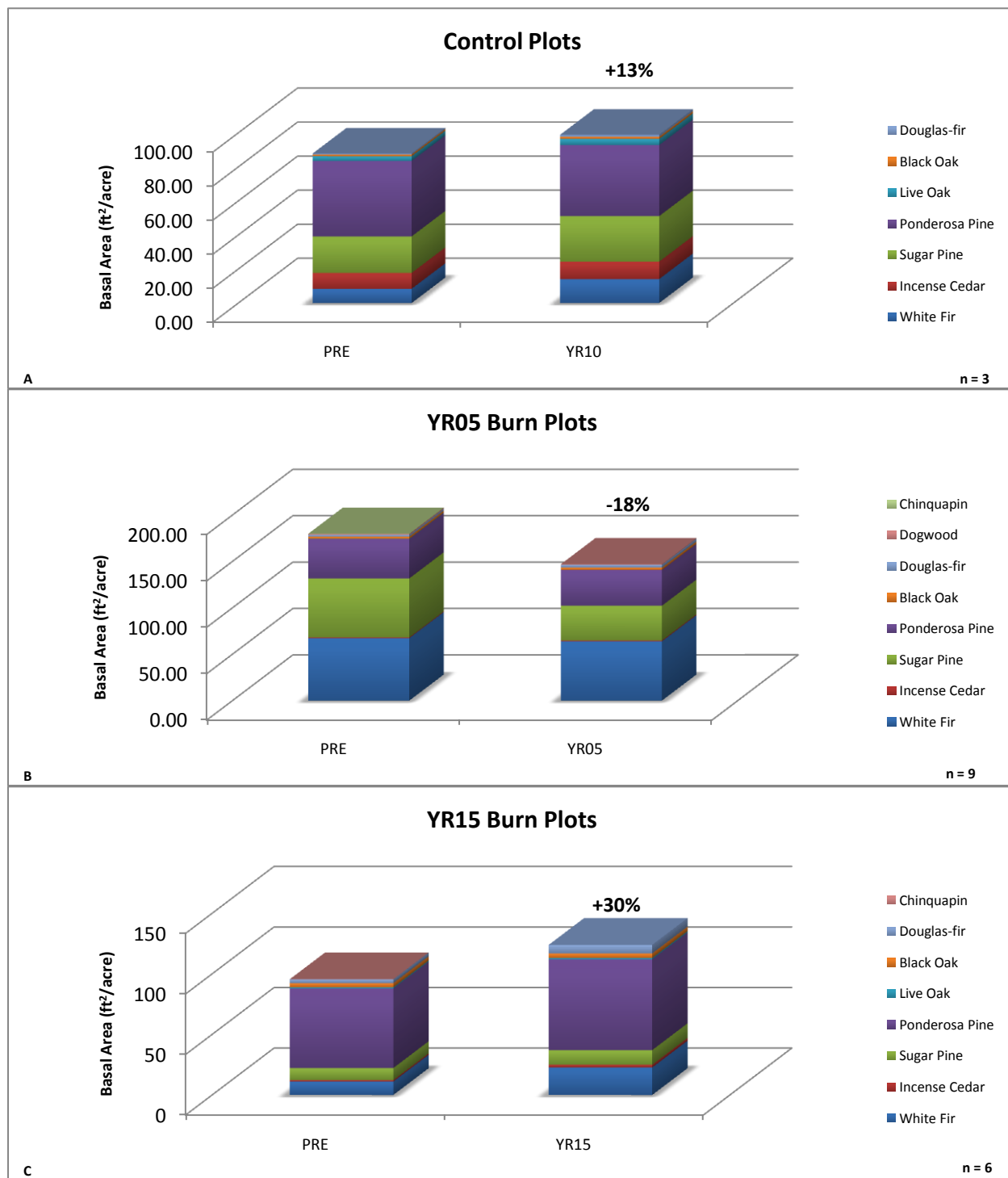


FIGURES 19 A-C. TREE DENSITY BY SPECIES AND SIZE CLASS OVER TIME IN THE MIXED CONIFER CONTROL (19A) AND BURN (19B&C) PLOTS FOR POLE (<10" DBH) AND OVERSTORY (>10" DBH) TREES. NUMBERS ABOVE EACH BAR INDICATE CHANGE FROM "PRE" SAMPLING EVENT.

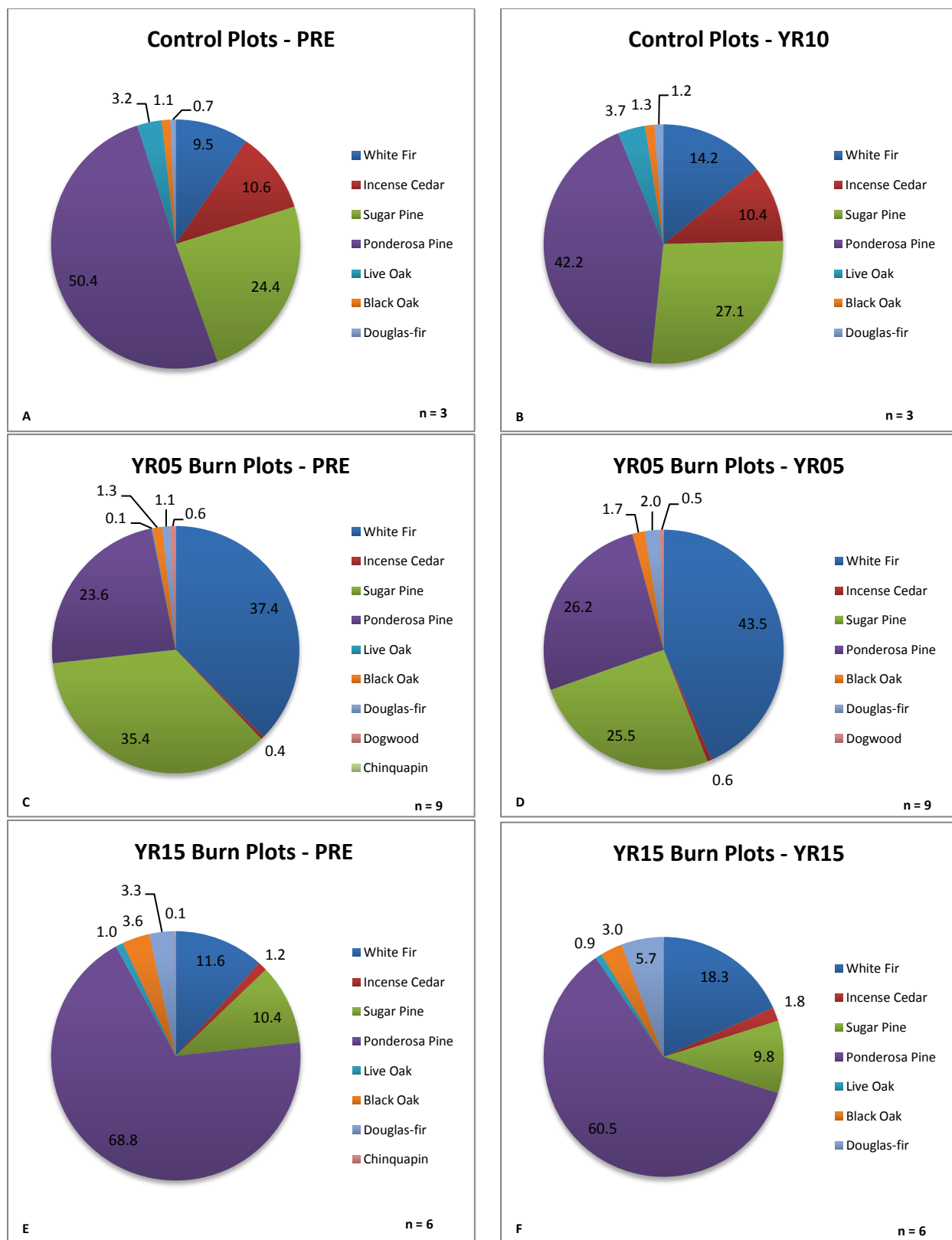
Mixed Conifer Plots - Tree Basal Area

Total basal area in the control plots increases 12.6% from PRE to YR10 sampling events from 88 to 99 ft²/acre. Total basal area in the YR05 burn plots is reduced by 18.2% between PRE and YR05 sampling events from 180 to 147 ft²/acre. Total basal area increases by 30% in the YR15 burn plots from 96 ft²/acre in the PRE sampling event to 124 ft²/acre in the YR15 sampling event (Fig. 20). How this relates to forest composition within these plots is evident when comparing Figs. 19—21. Control plots see an increase in the proportion of white fir (mostly pole-sized) and sugar pine basal area and a decrease in overstory ponderosa pine basal area. YR05 burn plots have an increase in the proportion of white fir and ponderosa pine basal area due to a reduction in pole-sized sugar pine

trees. YR15 burn plots have an increase in the proportion of white fir basal area (Fig. 21) at the expense of ponderosa pine, even though ponderosa pine basal area increases from 66—75 ft²/acre from PRE to YR15 (white fir basal area increases from 11—23 ft²/acre from PRE to YR15).



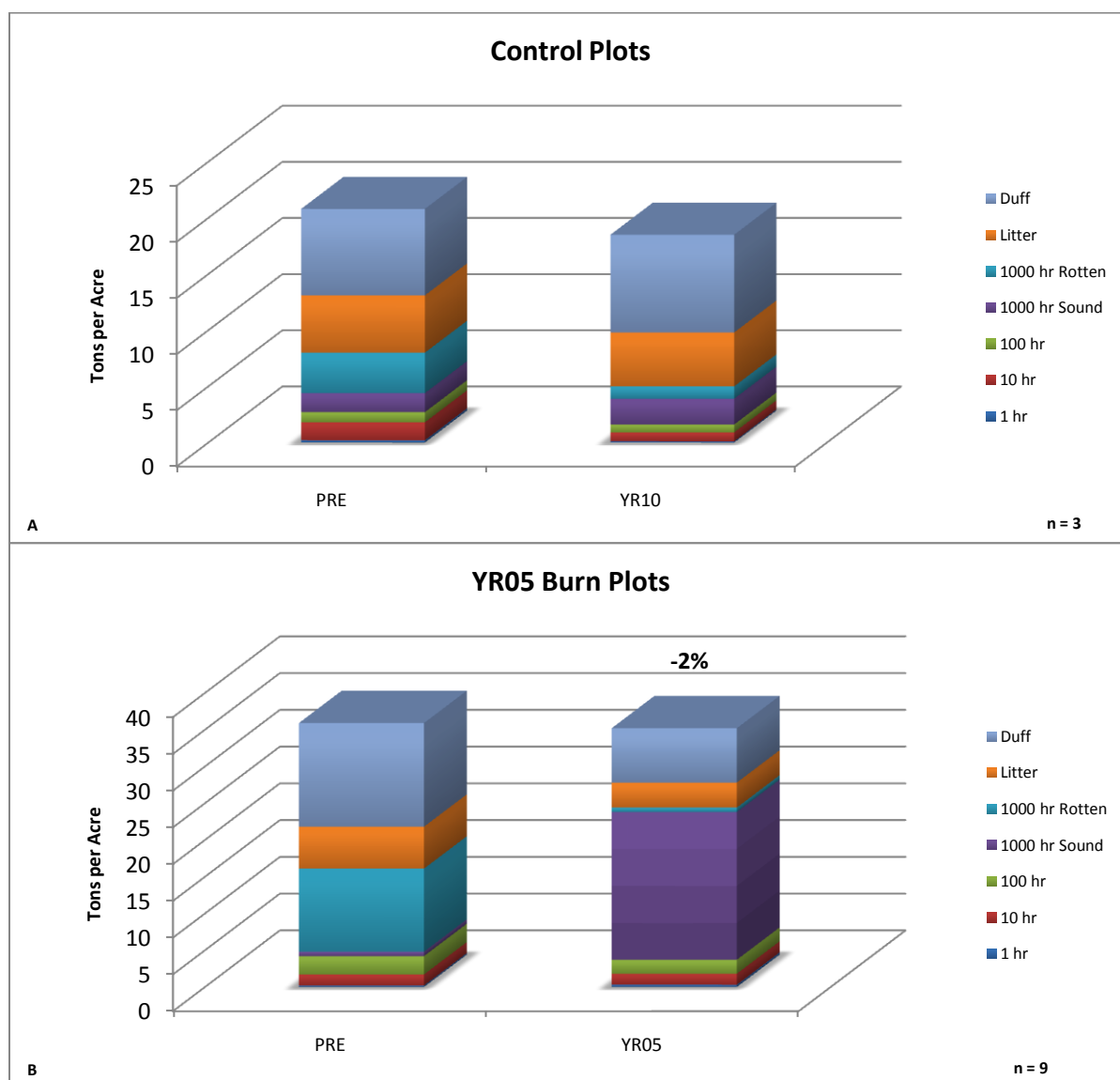
FIGURES 20 A-C. CHANGES IN TOTAL BASAL AREA BY SPECIES OVER TIME IN CONTROL (20A) AND BURN (20B&C) MIXED CONIFER PLOTS. NUMBERS ABOVE EACH BAR INDICATE CHANGE FROM THE "PRE" SAMPLING EVENT.

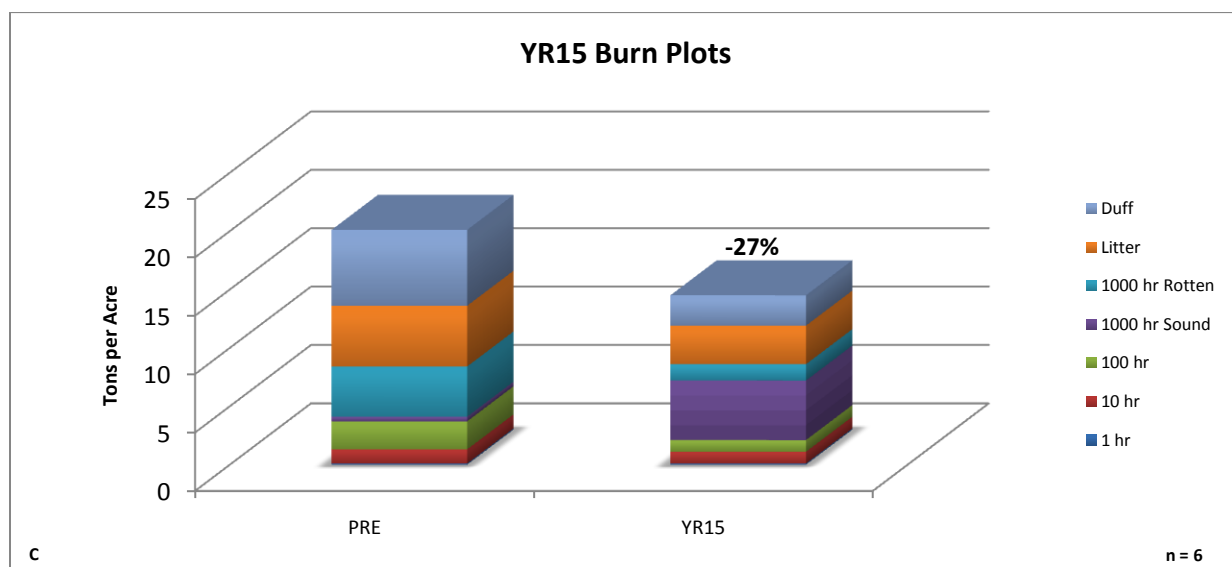


FIGURES 21 A-F. PERCENT BASAL AREA BY SPECIES (TOTAL IS 100%) OVER TIME FOR THE CONTROL (21A&B) AND BURN (21C-F) MIXED CONIFER PLOTS.

Mixed Conifer Plots – Fuel Load

The dead and down surface fuel load in the control plots does not change very much from PRE (21.3 tons/acre) to YR10 (18.5 tons/acre) sampling events. The bulk of the fuel load is comprised of litter and duff; average litter and duff depth remains 1.8" from PRE to YR10. In the YR05 burn plots, fuel load starts at 35.9 PRE, is reduced 54% one year postburn to 16.7 tons/acre; at two years postburn fuel load is 18.3 tons/acre, and by the YR05 sampling event total fuel load is almost back to preburn levels at 35.3 tons/acre. The YR05 total fuel load is dominated by rotting 1000-hour fuels (size class >3" in diameter), which are the remnants of fire-killed pole-sized trees. The average litter and duff depths in the YR05 plots is reduced by the burn from 2.6" in the PRE sampling event to 1.4" by the YR05 sampling event. For the YR15 burn plots, total fuel load remains 15% below preburn levels (which were 20.0 tons/acre) fifteen years postburn at 14.6 tons/acre. Similar to the YR05 burn plots, the YR15 burn plots are dominated by rotting 1000-hour fuels at the YR15 sampling event. Average preburn litter and duff depth preburn was 1.7" and 0.9" at the YR15 sampling event.





FIGURES 22 A-C. TOTAL DEAD & DOWN SURFACE FUEL LOAD OVER TIME FOR THE MIXED CONIFER CONTROL (22A) AND BURN (22B-C) PLOTS. THE NUMBER ABOVE EACH BAR INDICATES CHANGE FROM "PRE" SAMPLING EVENT.



FIGURE 23. COGGINS PARK CONTROL PLOT FMICO1D08-10, PRE (1993), AND 00YR10 (2003).



PHOTO 1. COGGINS PARK FMICO1D08-12, PRE 1993



PHOTO 2. COGGINS PARK FMICO1D08-12, 01POST 1994



PHOTO 3. COGGINS PARK FMICO1D08-12, 01YR01 1995



PHOTO 4. COGGINS PARK FMICO1D08-12, 01YR02 1996



PHOTO 5. COGGINS PARK FMICO1D08-12, 01YR05 1999

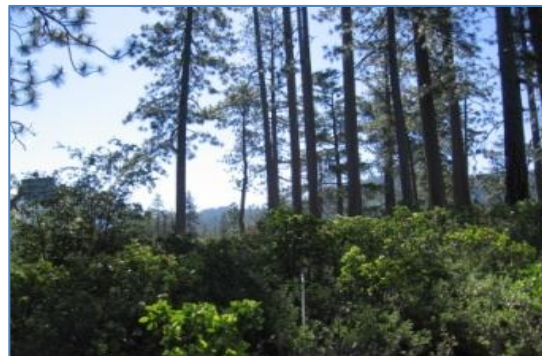


PHOTO 6. COGGINS PARK FMICO1D08-12, 01YR15 2009

Whiskeytown – Monarch/Dog Ponderosa Pine Plots

Three plots within the Ponderosa Pine monitoring type were installed in the Monarch Mountain burn unit that was treated with prescribed fire in the spring of 1995. The plots were burned for a second time in the fall of 1998. The plots were treated for the third time with prescribed fire in the fall of 2008 as part of the larger Dog Unit prescribed burn. While three plots do not constitute a large sample size, the fact that they have been sampled consistently through time allows for the observation of some interesting trends after repeated prescribed fire treatments. Plot data will be presented for tree density, tree basal area, and fuel load.

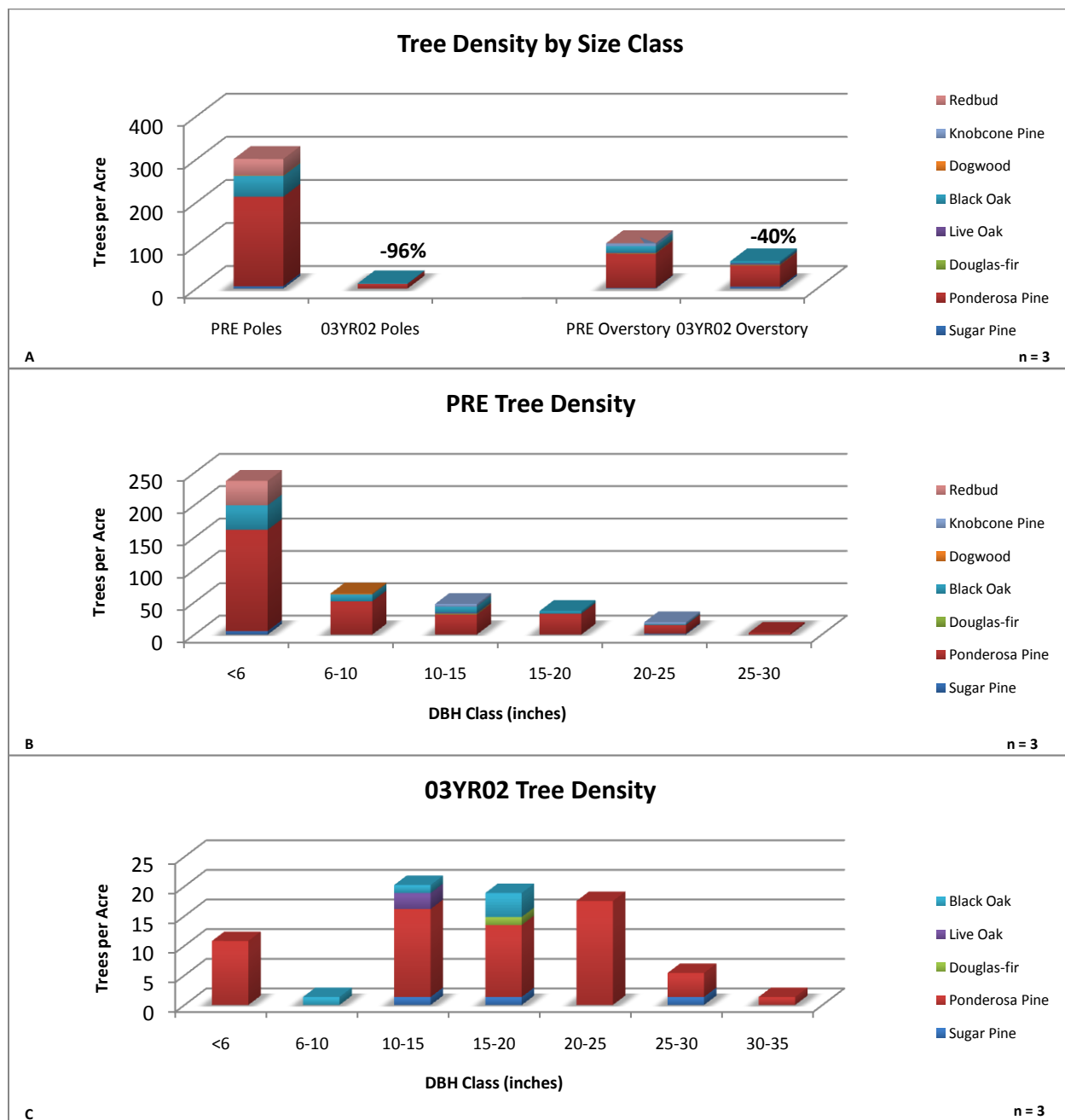
While not elaborated upon here, repeated prescribed fire has the potential to change the nature of the forest understory. Between PRE and 03YR02 sampling events, total cover of forbs increased from 2% to 11%; total graminoid cover increased from 9% to 43%.



FIGURE 24. WHISKEYTOWN PRESCRIBED BURN.

Monarch/Dog Plots – Tree Density

Tree density was reduced after three prescribed fire treatments. Pole-sized (<10" DBH) trees were reduced 96% between preburn (PRE – 1995) and two years after the third burn (03YR02 – 2010) sampling events from 301 to 12 trees/acre. Overstory (>10" DBH) trees were reduced 40% from PRE to 03YR02 sampling events from 105 to 63 trees/acre. After three prescribed burns, the more fire-sensitive tree species (western redbud – *Cercis occidentalis*, knobcone pine, and mountain dogwood) have been eliminated from plot areas, while the more fire-resistant ponderosa pine has grown to occupy larger size classes in the canopy.



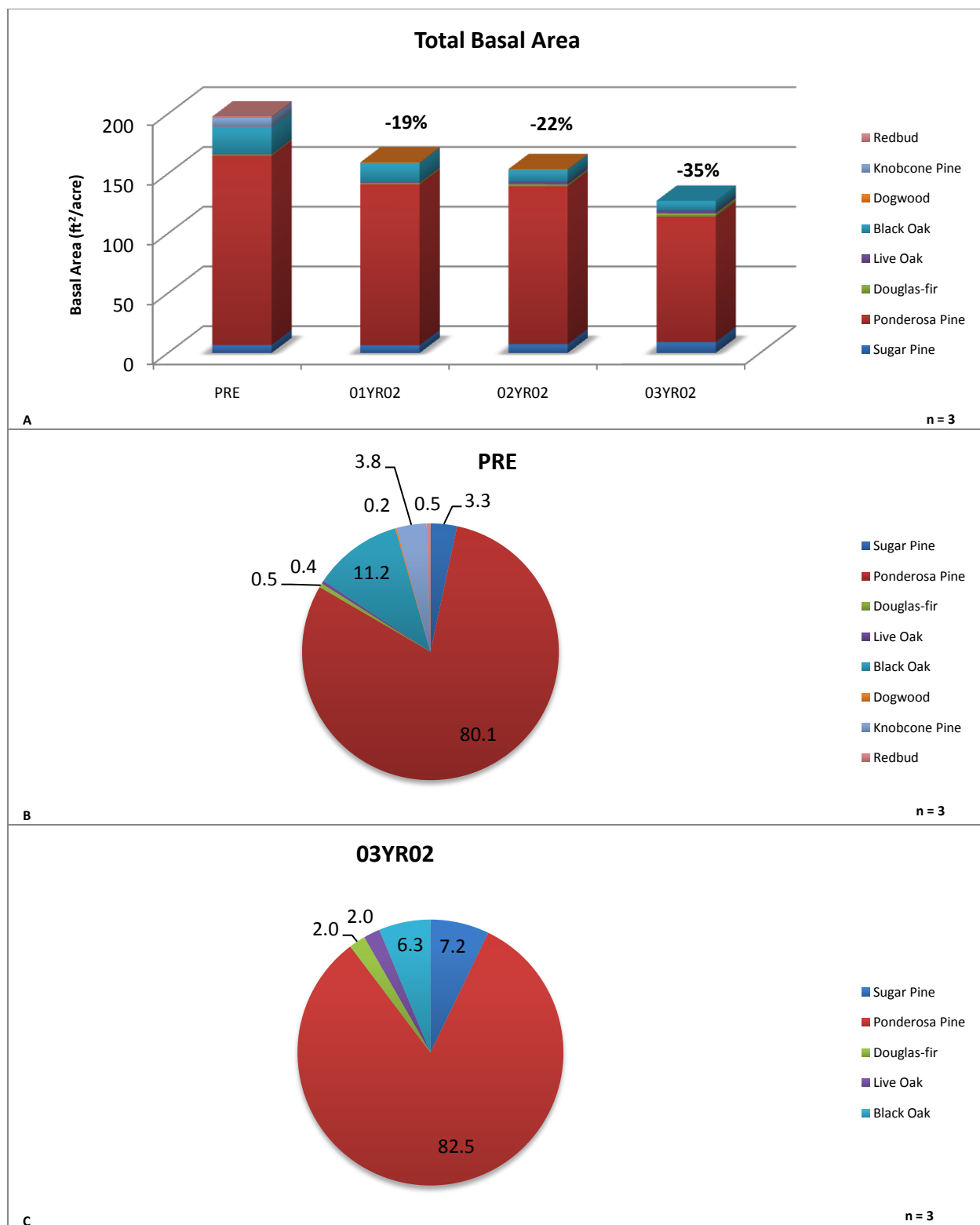
FIGURES 25 A-C. TREE DENSITY DYNAMICS BY SPECIES AND DBH CLASS OVER TIME IN THE MONARCH/DOG PONDEROSA PINE PLOTS. NUMBERS ABOVE EACH BAR INDICATE PERCENT CHANGE FROM "PRE" SAMPLING EVENT.



FIGURE 26. PRE (1995) AND 03YR02 (2010) Q4-Q1 PHOTOPOINT IN PLOT FPIPO1D09-04 IN THE MONARCH/DOG UNITS.

Monarch/Dog Plots – Tree Basal Area

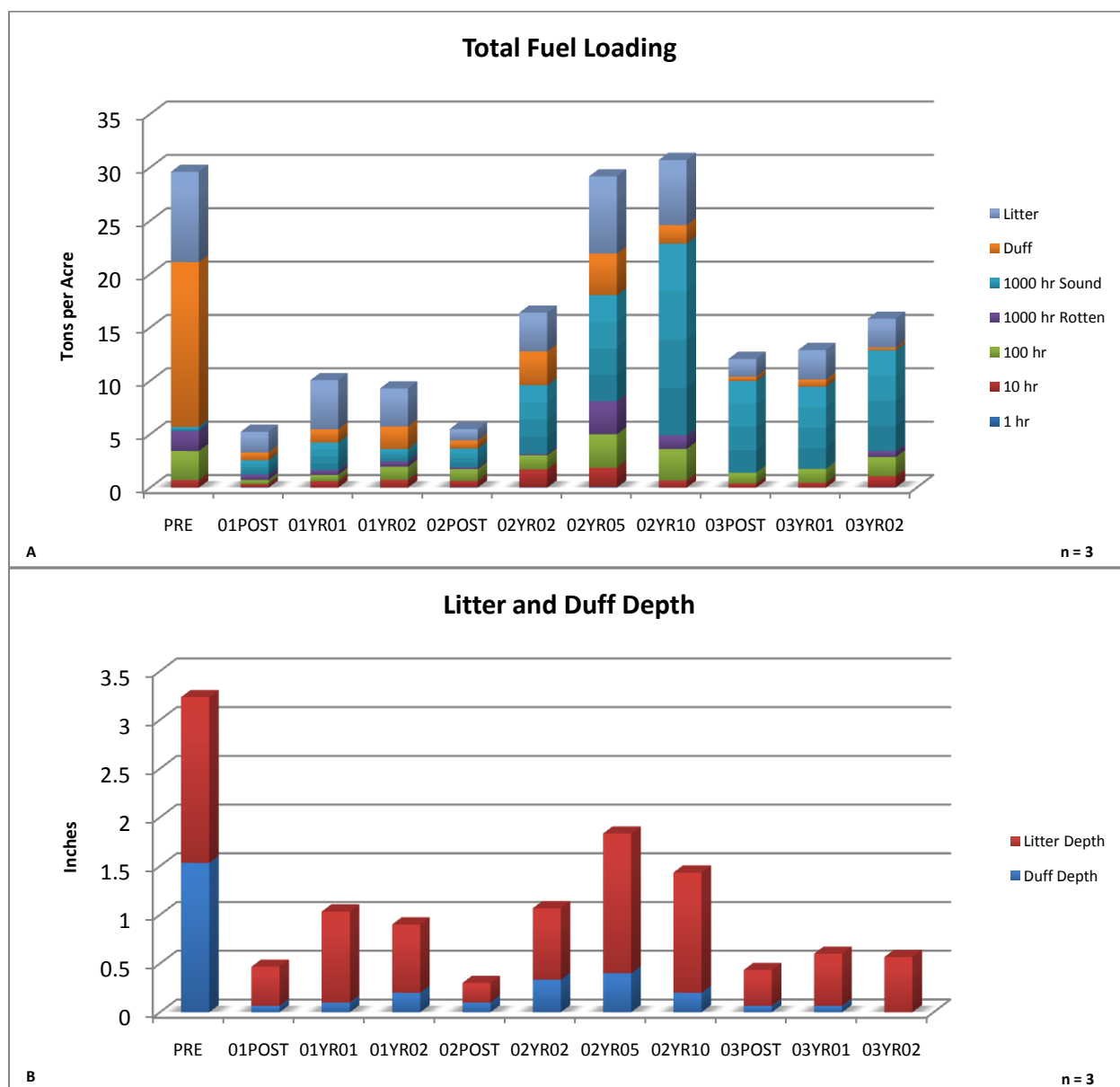
Total basal area is reduced after three prescribed fire treatments from 198 ft²/acre at the PRE sampling event to 160 ft²/acre at the 01YR02 (two years after the first burn - 1997) sampling event, to 154 ft²/acre at the 02YR02 (two years after the second burn - 2000) sampling event, to 127 ft²/acre at the 03YR02 sampling event. After three prescribed burns, total basal area has been reduced in plot areas by 35%. The proportion of basal area occupied by ponderosa pine does not change much from the PRE to 03YR02 sampling events. Live oak, sugar pine, and Douglas-fir increase their contributions to total basal area from PRE to 03YR02 sampling events, while the proportion of black oak and the more fire-sensitive species decreases over time.



FIGURES 27 A-C. CHANGES IN TREE BASAL AREA OVER TIME IN THE MONARCH/DOG PLOTS. 27A ILLUSTRATES CHANGE IN TOTAL BASAL AREA BY SPECIES OVER TIME; NUMBERS ABOVE EACH BAR DENOTE CHANGE FROM "PRE" SAMPLING EVENT. 27B&C ILLUSTRATE CHANGES IN PERCENT BASAL AREA (TOTAL IS 100%) BY SPECIES BETWEEN PRE AND 03YR02 SAMPLING EVENTS.

Monarch/Dog Plots – Fuel Load

Total dead and down surface fuel load in the Monarch/Dog plots is reduced by three prescribed fire treatments. The preburn (1995) total dead surface fuel load of 29.7 tons/acre is reduced to 5.3 tons/acre after the first prescribed fire (01POST – 1995/6); after the second prescribed fire, total dead surface fuel load is 5.6 tons/acre (02POST – 1998); and after the third prescribed fire, total dead surface fuel load is 12.2 tons/acre (03POST – 2008). The nature of the dead surface fuel load changes with repeated prescribed fire treatments. The forest floor is transformed from being composed mostly of litter and duff preburn and after the first prescribed burn to consisting of predominantly recently fallen woody materials (1000 hour “sound” fuels) after the second and third prescribed fires (Figure 28A). Average litter and duff depth is reduced from 3.2” preburn to 0.5” 01POST (1995/6). Litter and duff depth is maintained at low levels after prescribed fire treatments (0.3” at 02POST; 0.4” at 03POST).



FIGURES 28 A&B. DEAD & DOWN SURFACE FUEL LOAD OVER TIME IN THE MONARCH/DOG PLOTS. 28A SHOWS TOTAL FUEL LOAD BY FUEL SIZE CLASS. 28B SHOWS AVERAGE LITTER AND DUFF DEPTH (INCHES) OVER TIME.



PHOTO 1. MONARCH FPIPO1D09-02, PRE 1995



PHOTO 2. MONARCH FPIPO1D09-02, 01YR01 1996



PHOTO 3. MONARCH FPIPO1D09-02, 01YR02 1997



PHOTO 4. MONARCH FPIPO1D08-09, 02YR02 2000



PHOTO 5. MONARCH FPIPO1D08-09, 02YR10 2008



PHOTO 6. MONARCH FPIPO1D08-09, 03YR02 2010

E. OREGON CAVES NATIONAL MONUMENT

Oregon Caves contains three monitoring types: Douglas-Fir (FMH) – 8 plots, CC9 (Rapid Assessment) – 4 plots, and Horseshoe Shaded Fuelbreak - HSFB (Rapid Assessment) – 4 plots. The HSFB plots have not been sampled post-thinning, so results will not be presented in this report (pre-treatment summaries are available upon request). Minimum sample size has not been achieved for any monitoring type at Oregon Caves. Sampling event codes consist of a two-number prefix for how many times a plot has been treated (01 for once, 02 for twice, etc.) followed by the abbreviation “YR” for “year” and followed by how many years have elapsed post-treatment (02 for two, 05 for five, etc.). 01YR11 is eleven years after the first burn; 02YR03 is three years after the second treatment.

TABLE 10. MANAGEMENT OBJECTIVES AND MONITORING RESULTS FOR OREGON CAVES.

Monitoring Unit	Management Objective	Monitoring Results (80% confidence interval)	Objective Achieved?	Year Last Analysis Completed
Douglas-fir (FPSME1D08)	At immediate postburn: Reduce total fuel load by 20-50% from preburn levels	Reduction in total dead surface fuel load: -71.5% PRE: 115.5 (0 – 235) tons/acre YR01: 32.9 (11.3—54.5) tons/acre (<i>n</i> = 3 plots, 2 fires)	No	2008
	At three years postburn: Limit mortality of large overstory trees, >60 cm DBH, to <10% of preburn levels	0% change from preburn (<i>n</i> = 3 plots, 2 fires)	Yes	2008

Oregon Caves – Douglas-Fir Plots

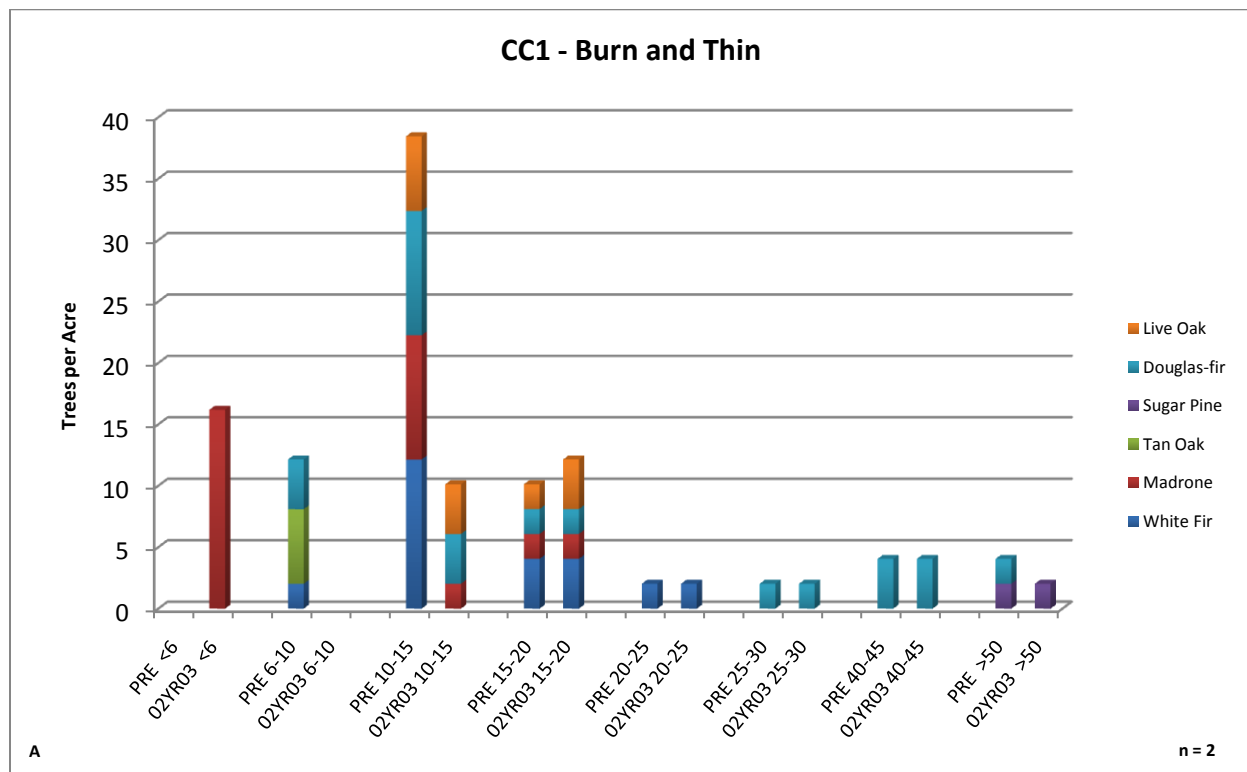
The Douglas-fir monitoring type wins the Klamath Fire Ecology program’s “Most Diverse Monitoring Type” award. It contains a mix of conifer and hardwood species, including, of course, Douglas-fir, white fir, Pacific madrone (*Arbutus menziesii*), tan oak, sugar pine, live oak, Port Orford cedar (*Chamaecyparis lawsoniana*), big-leaf maple (*Acer macrophyllum*), mountain dogwood, hazelnut (*Corylus cornuta*), mountain hemlock (*Tsuga mertensiana*), giant chinquapin, and Jeffrey pine (*Pinus jeffreyi*). Phew. The Douglas-fir monitoring type contains eight FMH Forest plots within four burn units. One of the units (CC1 – 2 plots) has been treated with prescribed fire once and hand-thinned twice. One of the units (CC3 – 1 plot) has been treated with prescribed fire only. Another unit (CC4 – 3 plots) has been hand-thinned twice (but plots have not been sampled since the second thinning). And the last unit (CC5 – 2 plots) has been hand-thinned once. Hand-thinning treatments included pile burning. The plots were sampled preburn (PRE) and then at various stages post-treatment; results will be presented for the PRE and most recent sampling events, which are as follows:

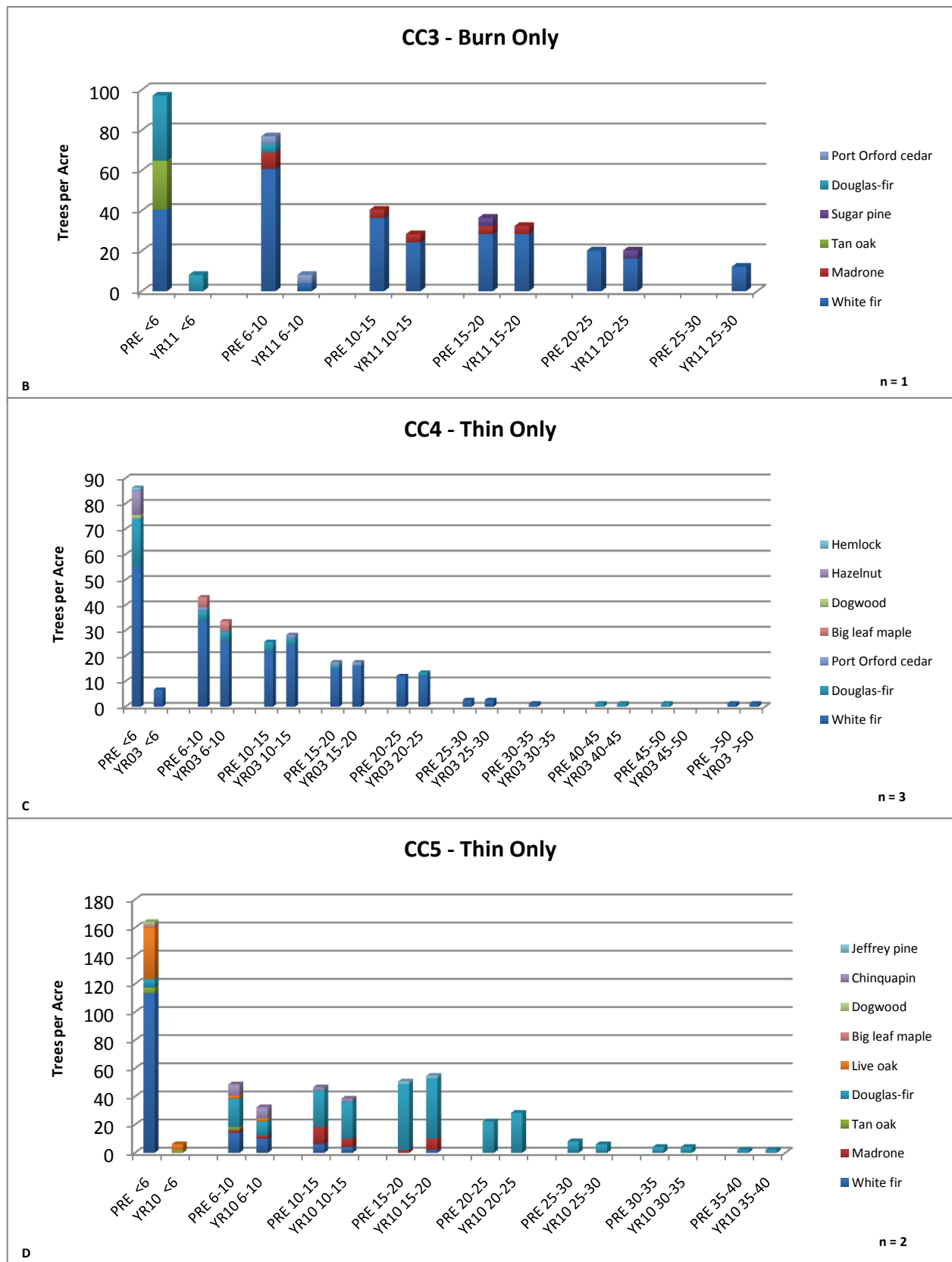
- CC1: PRE (1996/7) and 02YR03 (2010) – the plots were treated with prescribed fire (broadcast-burned) and hand-thinned in 1997, and then hand-thinned again in 2007. *Note: The plot was installed post-thinning, so no “true” pre-treatment data exist.*

- CC3: PRE (1997) and 01YR11 (2008) – the plots were treated with prescribed fire (broadcast-burned) only in 1997.
- CC4: PRE (1997/8) and 01YR03 (2001) – the plots were hand-thinned in 1998; they were hand-thinned again in 2006, but they have not been sampled since that treatment.
- CC5: PRE (1999) and 01YR10 (2009) – the plots were hand-thinned in 1999.

Douglas-fir Plots – Tree Density

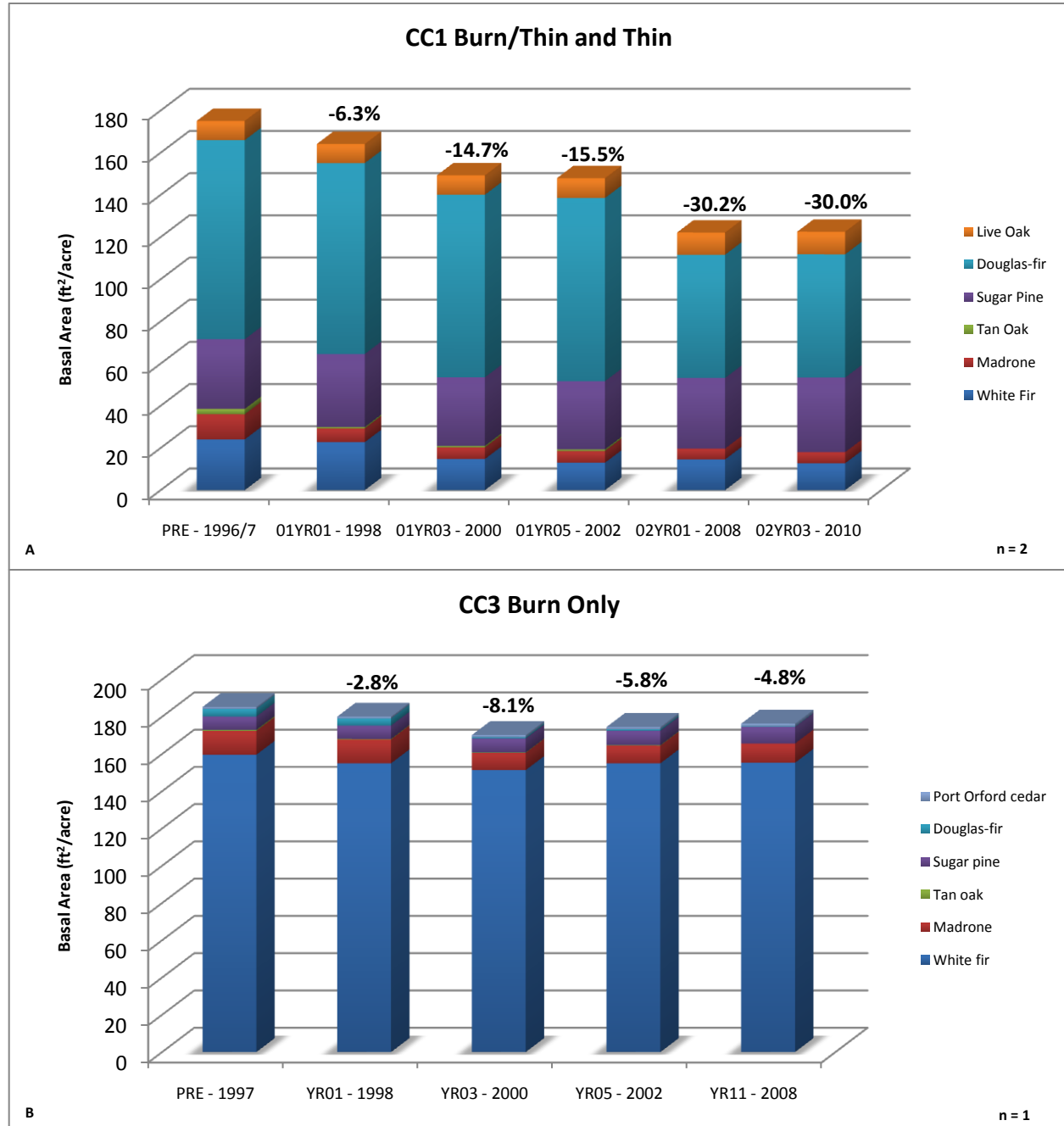
Tree densities across all treatment units show the most change in the smaller (<10”) DBH classes. Since the CC1 plots were thinned before the plot was sampled at the PRE sampling event, it is impossible to know how much tree density changed after the first thinning. After the second thinning (02YR03), “pole” tree (<10” DBH) size class is completely dominated by madrone since it was spared during the thinning treatment. Overstory (>10” DBH) tree density was reduced by 46% between PRE and 02YR03 sampling events (primarily in the 10-15” DBH class). For the CC3 plot, pole-sized tree density was reduced by 91% between PRE and YR11 sampling events, while overstory tree density was reduced by 4% during the same time period. Since only live tree density is presented here, it appears that there are no overstory Douglas-fir trees in the CC3 plot. However, the PRE sampling event captured several large dead Douglas-fir (this info will be elaborated upon in the tree basal area section – see Fig. 31). In the CC4 plots, pole tree density was reduced by 69% between PRE and YR03; overstory tree density increased by 2% during that time period. Only white fir are represented in the smallest DBH class (<6”) after thinning. And in the CC5 plots, pole-sized tree density was reduced 82% between PRE and YR10; overstory tree density remained unchanged during this time period. After thinning treatment, the smallest DBH size class (<6”) is comprised of live oak and tan oak.

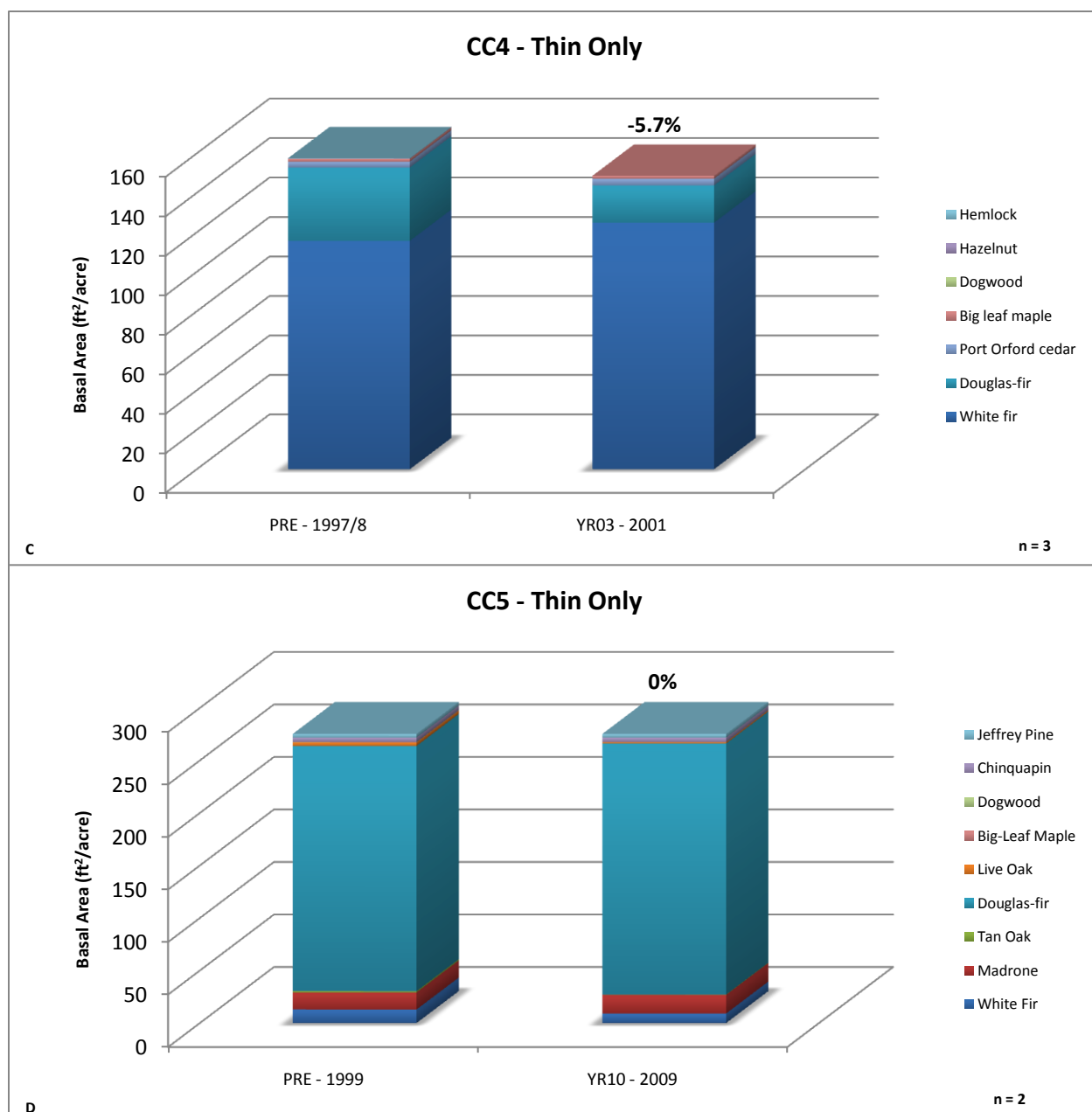




Douglas-fir Plots – Tree Basal Area

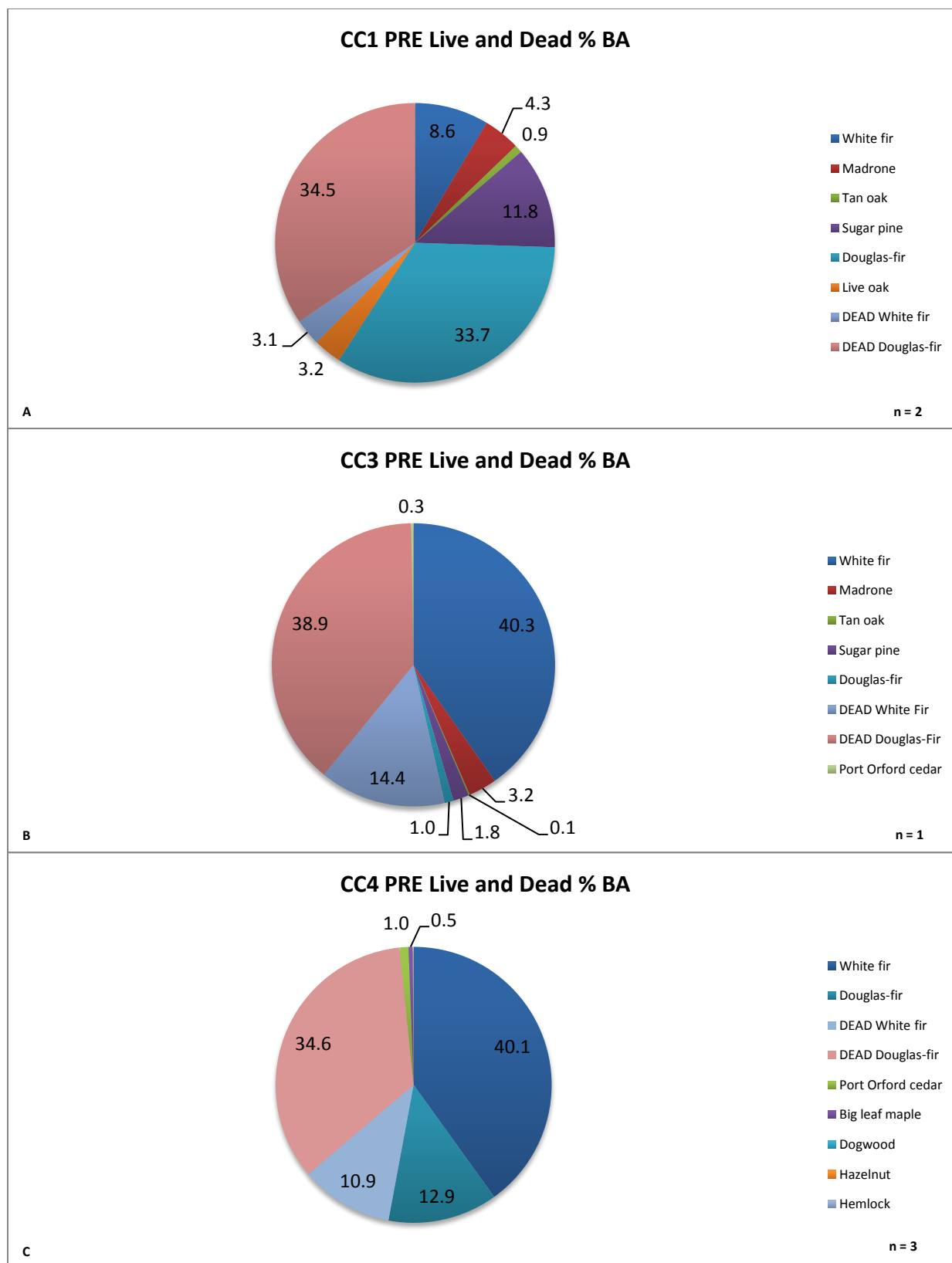
Changes in total tree basal area differ among treatment units over time. In the CC1 plots, total basal area is reduced by 30% from PRE to 02YR03 sampling events; it creeps back up a bit between the 02YR01 and 02YR03 sampling events. Douglas-fir experiences the greatest reduction in basal area; it changes from 94.4 ft²/acre at the PRE sampling event to 58.4 ft²/acre at the 02YR03 sampling event. In the CC3 plot, total basal area is reduced 4.8% between PRE and YR11; basal area starts increasing after the YR03 sampling event. In the CC4 plots, total basal area is reduced by 5.7% between PRE and YR03 sampling events. And in CC5, total basal area is unchanged between PRE and YR10 sampling events.





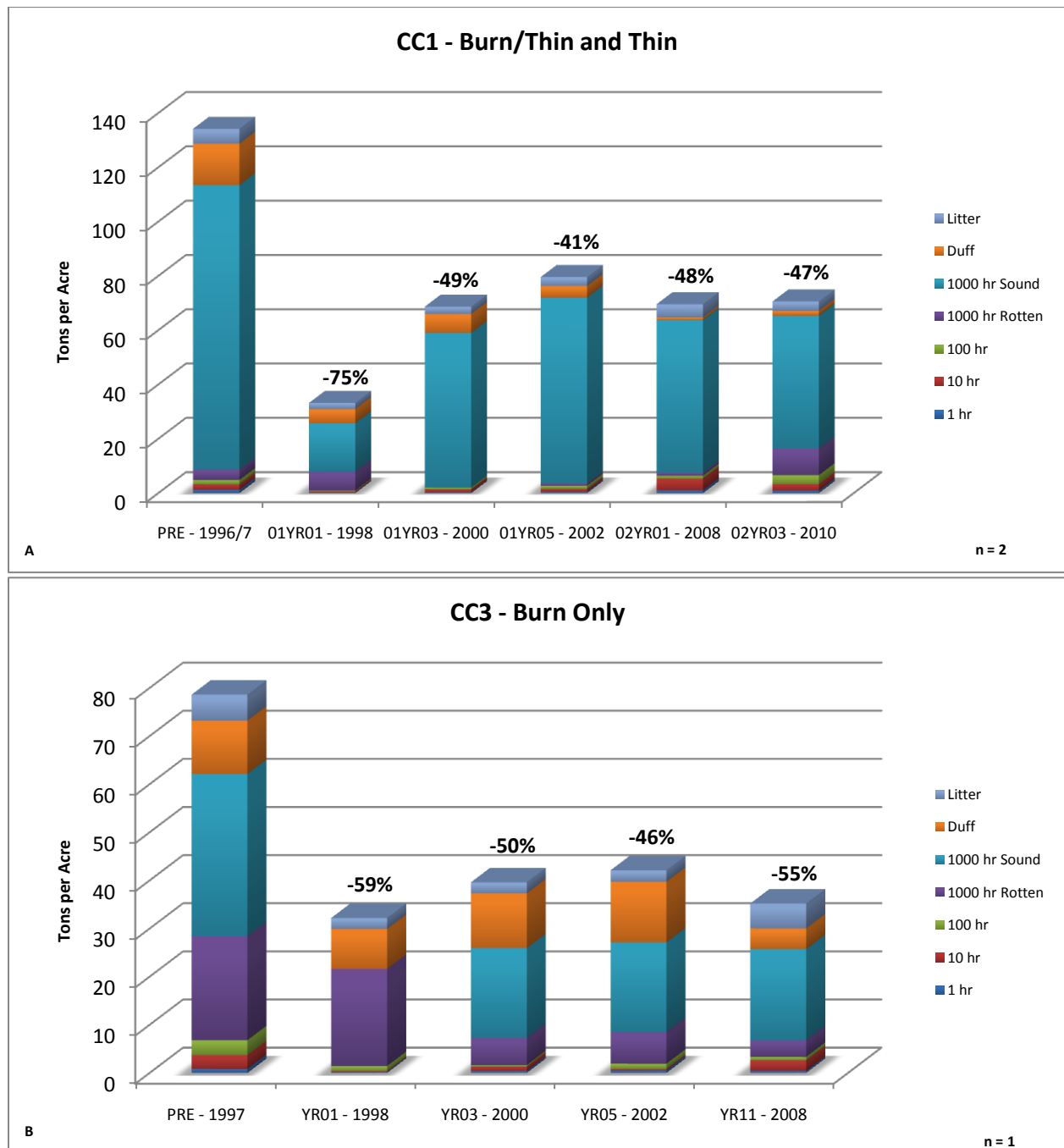
FIGURES 30 A-D. CHANGES IN TOTAL LIVE TREE BASAL AREA OVER TIME BY SPECIES IN THE DOUGLAS-FIR PLOTS. NUMBERS ABOVE EACH BAR INDICATE CHANGE FROM "PRE" SAMPLING EVENT.

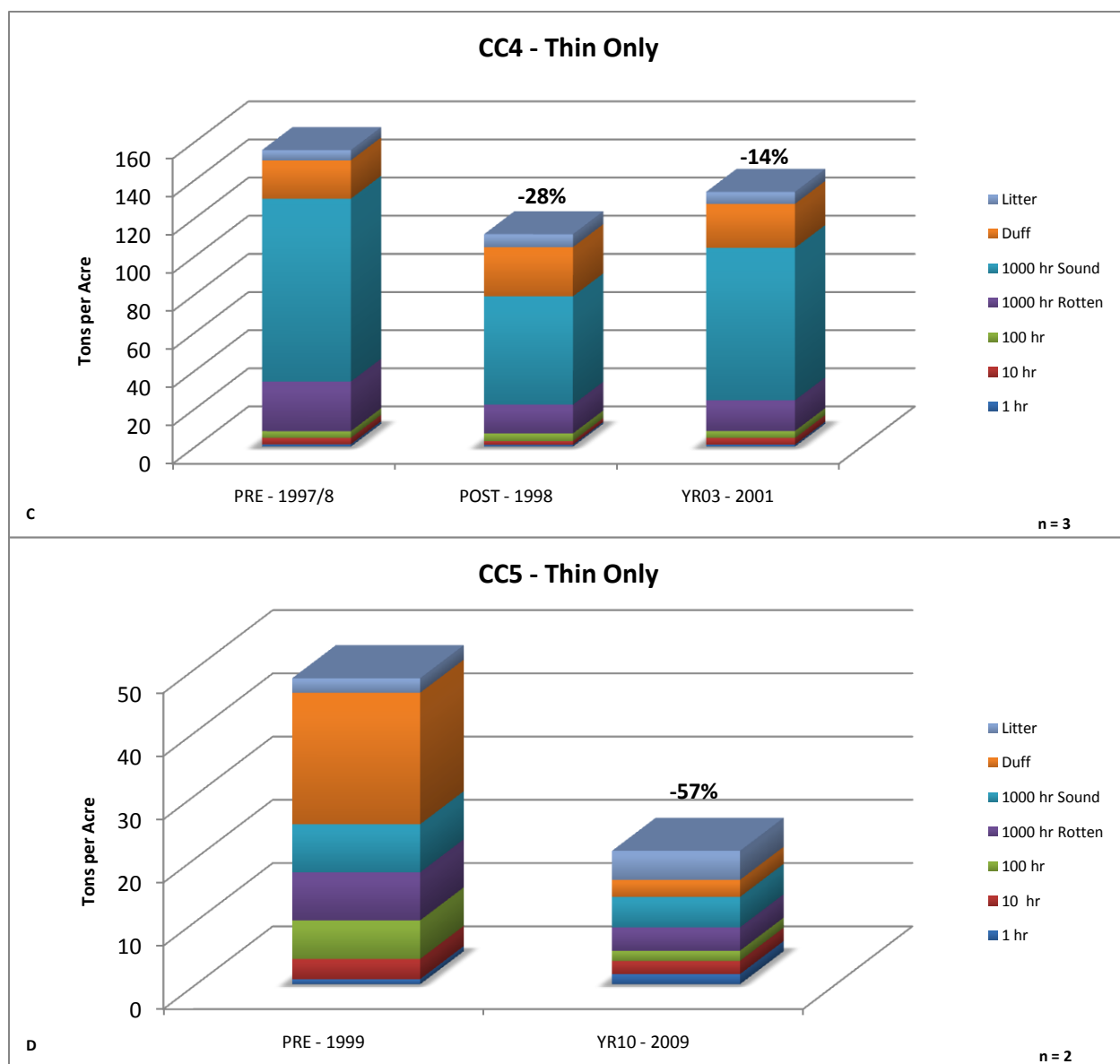
In results presented thus far, only live tree basal area has been included in data analysis. Dead tree basal area is presented here because the CC1, CC3, and CC4 units contained large-diameter dead Douglas-fir when the plots were installed and sampled at the "PRE" event. When looking at dead and live basal area for these units, dead Douglas-fir comprises a large proportion of total basal area (Fig. 31).



Douglas-fir Plots – Fuel Load

Total dead & down surface fuel load is generally reduced after treatments. The CC1 plots experience a 47% reduction in total fuel load between PRE and 02YR03. The CC3 plot's total fuel load is reduced by 55% between the PRE and YR11 sampling events. The CC4 plots contain an immediate post-treatment sampling event (POST), which was sampled between 2 weeks – 2 months of the actual treatment. Total fuel load is reduced by 14% in these plots between PRE and YR03 sampling events. And the CC5 plots experienced a 57% reduction in total fuel load between PRE and YR10 sampling events, including a substantial reduction in duff loading.





FIGURES 32 A-D. TOTAL DEAD & DOWN SURFACE FUEL LOADING BY SIZE CLASS IN THE DOUGLAS-FIR PLOTS.



PHOTO 1. FPSME1D10-07, PRE 1996



PHOTO 2. FPSME1D10-07, 01YR01 1998



PHOTO 3. FPSME1D10-07, 01YR03 2000



PHOTO 4. FPSME1D10-07, 01YR05 2002



PHOTO 5. FPSME1D10-07, 02YR01 2008



PHOTO 6. FPSME1D10-07, 02YR03 2010

Oregon Caves: CC9 Rapid Assessment Plots

A Rapid Assessment plot protocol has been utilized at Oregon Caves to monitor thinning effects on forest composition and structure, understory vegetation, and dead and down surface fuel load. Pilot sampling is still underway and methodology being adjusted as needed, but some results are available from monitoring plots within the CC9 unit. Four plots were installed and sampled preburn (PRE – 2008) and one year post-treatment (YR01 – 2009). Pole-sized (<10" DBH) trees were reduced 43% between PRE and YR01 sampling events, targeting small white fir. Overstory trees (>10" DBH) were reduced by 4% between PRE and YR01 sampling events, again with a slight reduction in white fir. Total basal area was reduced in plot areas by 4%. The dead and down surface fuel load was reduced 21% from PRE to YR01 sampling events, with the primary reduction occurring in the "1000-hour Sound" (sound woody materials >3" in diameter) fuel size class.



FIGURE 33. CC9 PLOT 2 PRE (2008) AND YR01 (2009).

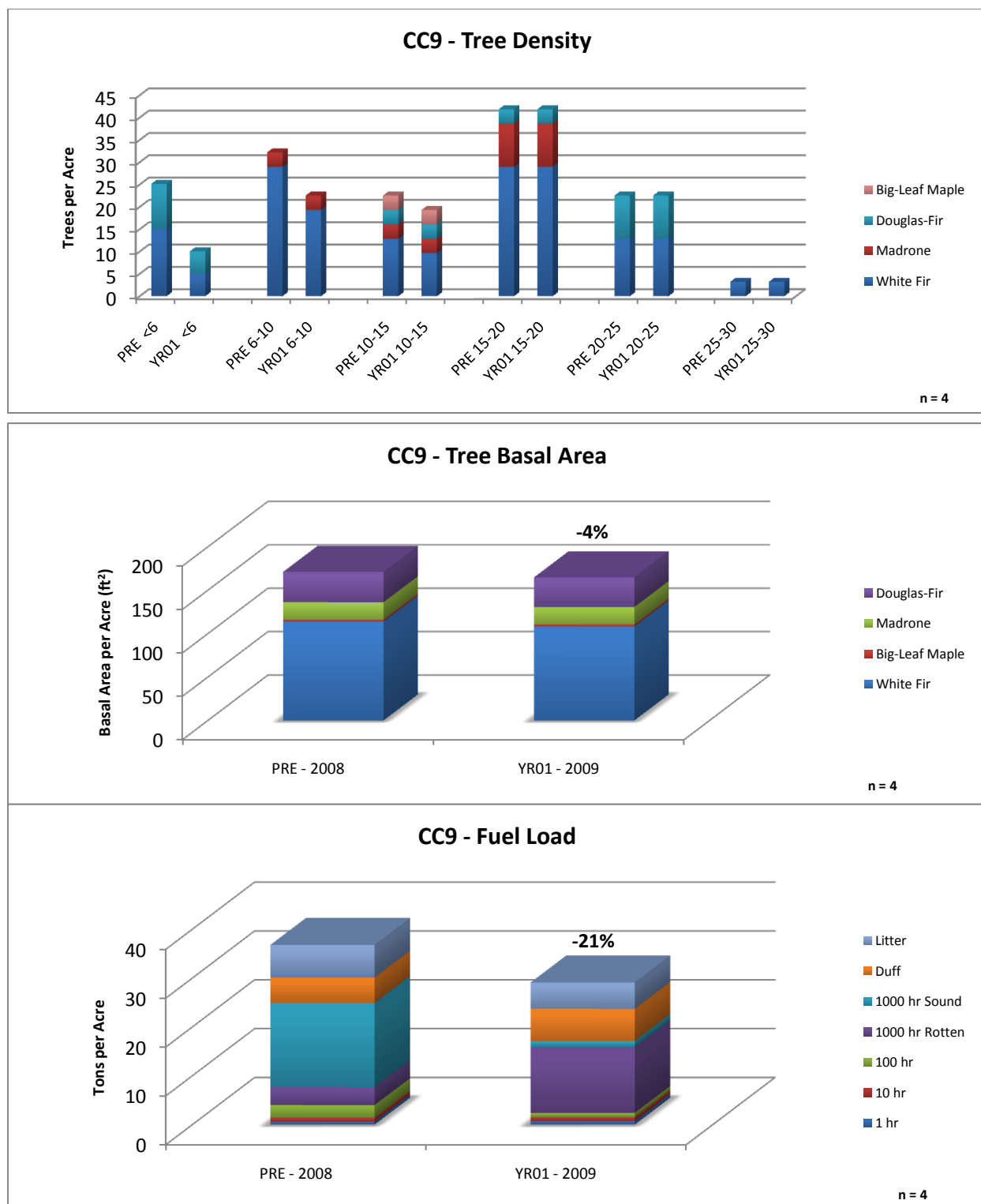


FIGURE 34. POST-TREATMENT CHANGES IN TREE DENSITY, TREE BASAL AREA, AND FUEL LOAD IN THE CC9 PLOTS.

Managers at Oregon Caves are concerned about how fire suppression and an altered fire regime may be impacting cave resources, especially with respect to cave water (water yield and water chemistry). An excessively dense forest with high dead & down surface fuel loading affects the water that reaches the cave, with unknown impacts to cave ecosystems and habitat for rare cave endemics. Another concern is how effective past and current fire management thinning prescriptions have been at reducing total stand basal area and total dead and down surface fuel load within the monument. Table 11 displays plot data from treatment units over time for basal area (ft²/acre) and total fuel load (tons/acre).

TABLE 11. CHANGES IN TOTAL LIVE TREE BASAL AREA AND TOTAL FUEL LOAD BY TREATMENT UNIT OVER TIME. CHANGE FROM “PRE” SAMPLING EVENT IS INDICATED IN RED BOLD FONT.

TOTAL BASAL AREA	Treatment	PRE	01YR01	01YR03	01YR05	01YR10	01YR11	02YR01	02YR03
CC1 (n = 2)	1. Rx Burn/Thin (1997) 2. Thin (2007)	175	164 (-6%)	149 (-15%)	148 (-16%)			122 (-30%)	123 (-30%)
CC3 (n = 1)	1. Rx Burn (1997)	185	180 (-3%)	170 (-8%)	175 (-6%)		176 (-5%)		
CC4 (n = 3)	1. Thin (1998)	158		149 (-6%)					
CC5 (n = 2)	1. Thin (1999)	275				275 (0%)			
CC9 (n = 4)	1. Thin (2009)	171	165 (-4%)						
TOTAL FUEL LOAD	Treatment	PRE	01YR01	01YR03	01YR05	01YR10	01YR11	02YR01	02YR03
CC1 (n = 2)	1. Rx Burn/Thin (1997) 2. Thin (2007)	134	33 (-75%)	69 (-49%)	80 (-41%)			70 (-48%)	71 (-47%)
CC3 (n = 1)	1. Rx Burn (1997)	79	32 (-59%)	40 (-50%)	42 (-46%)		35 (-55%)		
CC4 (n = 3)	1. Thin (1998)	156		134 (-14%)					
CC5 (n = 2)	1. Thin (1999)	48				21 (-57%)			
CC9 (n = 4)	1. Thin (2009)	37	29 (-21%)						



FIGURE 35. IMAGE FROM HORSESHOE FUEL BREAK PLOT 2, PRE SAMPLING EVENT (2010).

F. FIRE ECOLOGIST ACCOMPLISHMENTS AND AREAS OF FOCUS

The Fire Ecologist's most impressive accomplishment of 2010 was bringing Will Adams Beck into the world. Aside from that, the year was filled with new and ongoing work items to support all three parks served.



FIGURE 36. WILL ADAMS BECK.

TABLE 12. FIRE ECOLOGIST ACCOMPLISHMENTS/FOCUS AREAS

Category	Percent Time	Accomplishments and/or areas of activities
Planning	5%	Assisted with FMP revisions for REDW and ORCA
NPS Meetings/ task groups	5%	Various meetings at REDW, WHIS, ORCA
Prescribed fire projects	10%	Assisted with prescribed fire projects
Non-fire fuels projects	5%	Assisted with Brandy Creek forest restoration project
Research	5%	NPS Reserve Fund Research Requests
Data analysis and management	30%	Data analysis, cleanup, management
Supervision/Admin	5%	Supervision, payroll, travel authorization/vouchers, etc.
Training	10%	Completed S-490 and S-495
Miscellaneous	25%	Maternity leave – 7 PP

G. FIRE EFFECTS CREW ACCOMPLISHMENTS AND AREAS OF FOCUS

TABLE 13. FIRE EFFECTS CREW ACCOMPLISHMENTS/FOCUS AREAS

Category	Percent Time	Notes
FMH plots	30%	This includes organizing data for season and actual sampling of plots.
WUI plots	0%	
CBI plots	0%	
Other plot work	10%	Fir plots in REDW, and rapid assessment plots in REDW
Wildfire assignments	1%	Two crewmembers worked on one fire, for two days in REDW.
Prescribed fire projects	10%	The Lead assisted in writing and reviewing burn plans, and all three crewmembers helped with four prescribed burns as RXB2(t), FEMO(t), and FFT2.
Non-fire fuels projects	5%	Rapid assessment plots within thinning units in ORCA
Data entry	25%	Ugh.
Data analysis	1%	Lead assisted with annual report calculations.
Supervision/Admin	10%	Double ugh.
Training	8%	This is only a fraction of the amount of time the Lead spent in TFM, and is closer to the crewmember's time in training.



FIGURE 37. LEAD BECKY SMITH'S FAVORITE PLANT THAT MAKES HER OOZE WITH EXCITEMENT.

H. ADDITIONAL INFORMATION

TABLE 14. DATA ENTRY AND PROJECTS MONITORED

Park	% 2010 Data Entered	% 2010 Data Quality Checked	# Prescribed Fires Monitored	# Non-fire Fuels Treatments Monitored	# Wildfires Monitored*	# BAER Treatments Monitored
Redwood National Park	100%	100%	4	0	0	0
Whiskeytown National Recreation Area	100%	100%	0	0	0	0
Oregon Caves National Monument	100%	100%	0	0	0	0

The credit card issue that faced the crew during the first part of the 2010 field season halted fieldwork because of timing and plant phenology. It was too early to read plots in Redwood NP, and the crew was not allowed to travel until every crewmember had a government credit card in their possession. After losing two weeks of the field season, it was decided that the Redwood Employee Association would loan money to seasonal employees for travel, should they not want to use their own money. This creative solution allowed the crew to begin traveling to Whiskeytown immediately to start sampling low elevation plots. Trying to obtain government credit cards for seasonal crewmembers before traveling will continue to be a challenge in upcoming years, since sampling in Whiskeytown will always need to occur at the very beginning of the field season.

We at the Klamath Fire Ecology program would also like to shout out that WE HEART HEART HEART FFI v. 1.04!!! Super great features that we adore include:

1. Query Builder “Apply Selections” button. WHAT A TIME SAVER FOR FOLKS WITH GIGANTIC DATABASES!!
2. Reports & Analysis: ability to export the report in pdf, excel, and word. Very cool.
3. The addition of a Burn/Treatment Area line to the Project Management and Sample Event page.

FFI components that could use improvement include the Protocol Manager User Guide and using Protocol Manager-created protocols in Query Builder. If the User Guide included a section titled “How to Design Protocols for Use with Query Builder” that included tips and tricks for getting your protocols to actually work within QB, then many hours would be saved in the process of import protocols/enter data/try to use QB/fail miserably/pound head against desk in frustration/delete data entered/delete bad protocol/return to Protocol Manager/redesign protocol/repeat process. We are still unclear about whether user-designed protocols can actually contain species lists that function within QB... after having John Caratti “fix” our FFI and PM databases so that the Protocol Manager-created protocols’ species lists actually appear within QB (instead of that funky code), they still don’t really work. Sigh. A sample “tip” for the User Guide would be: if you plan on using QB to calculate basal area, make sure your ‘area sampled’ field is in one of the units available in the drop-down menu (e.g., go with hectares, not square meters).