

BRYCE CANYON NATIONAL PARK

FIRE EFFECTS MONITORING PROGRAM

2001 ANNUAL REPORT

INTRODUCTION

The Zion Fire Effects Crew worked hard to support the great burn work at Bryce Canyon National Park this year. Prescribed fire at Bryce Canyon was instrumental in leading the National Park Service's post-moratorium return to burning, with the safe and successful treatment of a portion of the (Sheep) East Creek Ridge burn unit early in the season, and the application of aerial ignition in the treatment of interior sections of the unit in September. We developed a Black Sage monitoring type (BARNO1T05) and installed 3 plots for this type in the (Sheep) East Creek burn unit. We monitored the burns, and located and collected pre-burn and post-burn data from all the plots in the burn unit.

We also installed 2 plots in the Podunk-Yovimpa2 burn unit, in the White Fir/Mixed Conifer monitoring type (FABCO1G08). This burn unit is slated for treatment in 2002.

There are 6 previously installed transects in the Black Sage monitoring type, which we will be assessing. No installations are scheduled for 2002.

We re-measured 10 plots this year; immediate post-burn reads of Black Sagebrush (BARNO1T05) and Ponderosa Pine forest (FPIPO1T05) plots in the (Sheep) East Creek Ridge burn unit, and a 1 year post-burn read of a White Fir/Mixed Conifer plot in the Agua burn unit.

PLOT NETWORK INFORMATION

TABLE 1. Plot installation by plot type.

Number of Plots Installed Previous Years				Number of Plots Installed 2001				Total Number Plots Installed			
G	B	F	Total	G	B	F	Total	G	B	F	Total
0	(6 [^])	34 (3C)	37	0	3	2	5	0	3 (6 [^])	36 (3C)	42

C = Control Plots

([^]) Indicates that plots were installed pre Fire Pro funding and need to be evaluated if they will remain in the monitoring system. Not part of totals.

TABLE 2. Plot remeasurements by plot type for 2001 and 2002.

Total Plots to Remeasure 2002				Total Plots Remeasured 2001			
G	B	F	Total	G	B	F	Total
0	2(2P)	8(3P)	15	0	(2P)	1(7P)	10

C = Control Plots

P = Immediate Postburn Re-measurements

TABLE 3. Five-year projected number of plot re-measurements by year.

2001	2002	2003	2004	2005	2006
10	10	12	6	16	7

TABLE 4. Projected plot installation.

Plots to be Installed 2002				Projected Total			
G	B	F	Total	G	B	F	Total
0	2	2	4	0	3	36(3C)	42

C = Control Plots

TABLE 5. Table Justification

	2001 SACS Request			2001 Accomplishments		
PARK	# of Plots to Establish	Next Year Re-measure	Total Plots	# of Plots Established	# of Plots Re-measured	Total Plots
BRCA	3	14	17	5	10 [^]	15

[^]= Plot numbers are less because planned burns were not accomplished or projected burn units were no longer proposed to occur as planned. Part of the reason for this is due to the Park Service moratorium, but the major reason is due to the new policy changes, i.e. updating Burn Plans, NEPA compliance, re-writing Fire Management Plans (FMP) and Wildland Urban Interface (WUI) projects.

TABLE 6. Number of plots that have burned.*

Total Plots Burned 2001				Total Plots Burned to Date			
G	B	F	Total	G	B	F	Total
0	2	7	9	0	2	34	36

*This number does not reflect the plots that burned prior to 1996 due to plot reduction process

TABLE 7. Postburn plot summary.

	G	B	F	Total
Immediate Postburn	0	2	34	36
1 Year Postburn	0	0	18	18
2 Year Postburn	0	0	17	17
5 Year Postburn	0	0	11 (3C)	14
Total	--	2	83	85

TABLE 8. Number of plots installed by monitoring type.

Monitoring Type Code	Monitoring Type Name	Number of Plots Installed in 2001	Total Number of Plots Installed
FPIPO1T02	Ponderosa Pine	0	22
FABCO1G08	White Fir/Mixed Conifer	2	14 (3C)
BARNO1T05	Black Sagebrush	3	3

DATA ANALYSIS

MINIMUM PLOT CALCULATIONS

TABLE 9. Calculated minimum plot number by monitoring type and monitoring type variable.

Monitoring Type	Primary Monitoring Type Variable		Secondary Monitoring Type Variable		Tertiary Monitoring Type Variable	
	80%/25	80%/20	80%/25	80%/20	80%/25	80%/20
FABCO1T10	<u>8</u>	13	42	66	56	88
“ †	43 @ 20% reduction	7 @ 50% reduction				
FPIPO1T02/9	90%/25	90%/20				
	<u>18*</u>	<u>27</u>	<u>2</u>	3		
BARNO1T02	<u>26</u>	41				

*This number was calculated with all of the Ponderosa Pine plots labeled as FPIPO1G02 -PRE plots. Earlier documents and discussions said that we would maintain 22 plots in this type due to concerns from past resource managers in the park about overstory Ponderosa Pine.

Bold underlined* = Minimum Plot Numbers Achieved

† = Number Obtained Using Minimum Detectable Change (Using 80%/25)

Note: The secondary and tertiary variables are variables of interest, but minimum plot numbers will not be set at these high levels unless the trend data suggests to managers that this variable be monitored with increased sampling or at a higher level and possibly researched.

Given the high number of plots needed to detect a – 20% reduction (43 plots); we need to discuss the objective: Reduce total fuel loading by 20 to 50% immediate post burn. The fuels at Bryce Canyon in the mixed conifer monitoring type are highly variable.

The NPS National Fire Monitoring Handbook states that the minimum detectable change is the size or amount of change that you want to be able to detect between two time periods. It also states that we need to determine how much of a change is biologically meaningful for the population or variable of interest and gives this warning. If you choose a minimum detectable change amount of less than 30%, consider reevaluating this decision. Extremely variable populations may require a larger sample than you can afford in order to detect these low levels of change.

TABLE 9A. Results of minimum plot calculations by monitoring type and monitoring variable.

<u>Monitoring Type</u>	<u>Monitoring Variable</u>	<u># of Plots</u>	<u>Mean</u>	<u>S.D.</u>	<u>Minimum plot by condition min plot</u>	
					80%/25	80%/20
<u>FABCO1T10</u>	1 Total Fuel loading	14	7.85	4.16	<u>8</u>	13
		12	2.54	1.36	9	13
<u>FABCO1T10</u>	2 ABCO pole tree density	14	465.9/ha	558.6	42	66
		11	200.0/ha	388.2	113	177
<u>FABCO1T10</u>	3 ABCO Seedling tree density	14	5430.3/ha	7540.3	56	88
		12	850.3/ha	1343.3	74	116
<u>FPIPO1T02/9</u>	1 Overstory Tree Density	22	162.7	98.9	90%	90%
					18	27
<u>FPIPO1T02/9</u>	2 Total Fuel loading	7	5.16/ha	1.31	2	3
		7	3.15/ha	0.81	2	3
<u>BARNO1T02</u>	1 Black Sagebrush Density/ha	3	17833.3	12086.5	26	41
			Not available			

Mean = mean value of the primary monitoring variable

S.D. = Standard deviation

= Condition Minimum plots – {Burned plots that have reached objectives time frame}

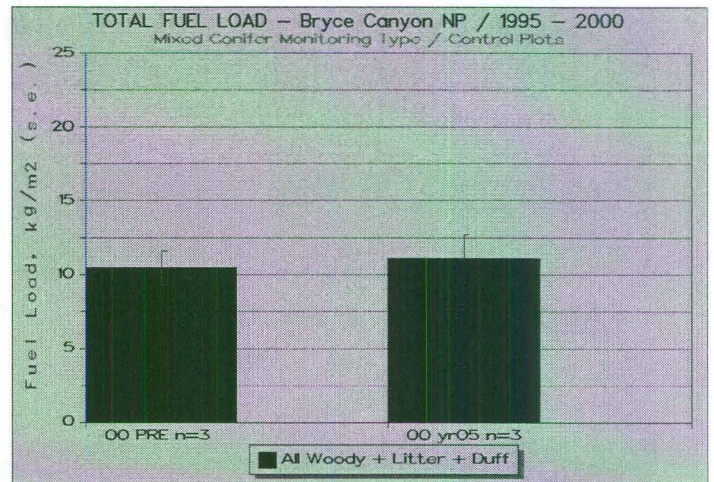
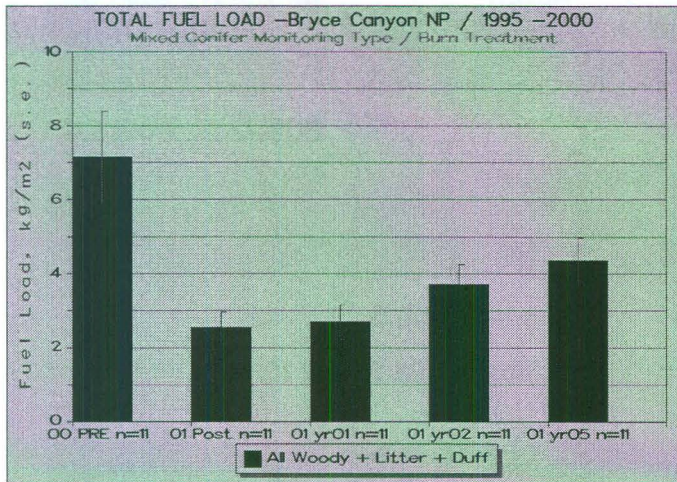
Initial Interpretation of the Data

Data Analysis

The following section lists the objectives of each monitoring type and an analysis of the primary variable of interest as listed in the objectives. Graphical presentations of the data are shown using two types namely Multi burn status and Change over time graphs. Multi burn status lumps all plots for the analysis of the variable. For example, juniper density is analyzed for pre burn plots for that type and then it is separately analyzed showing year 1 analysis. Change over time compares each plot individually over time for example pre burn fuel loading on plot 1 to post burn fuel loading on plot 1.

Fuel Loading – Graphs and Data

Fuel Loading – Multiple Burn Status - Graphs



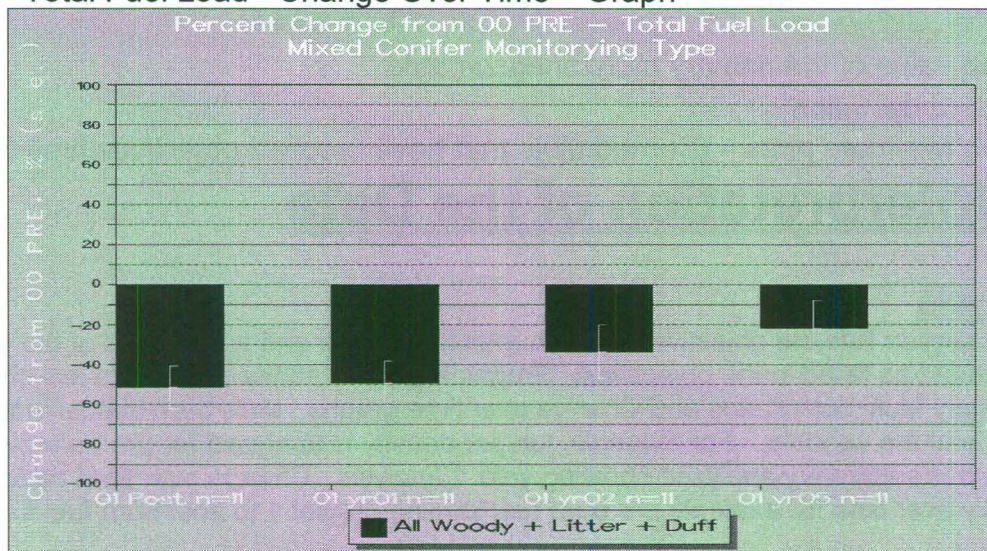
RESULTS:

Pre-burn fuel loading for 11 plots was reduced 64% from 7.16 kg/m² to 2.55 kg/m² within 1 month of the prescribed fire for the average fuel loading of all plots. Three control plots had a fuel load of 10.46 kg/m² and at the 5-year sample, fuels measured 11.10 kg/m².

OBJECTIVES:

Reduce total fuel loading by 20 to 50% immediate post burn. Total fuel loading was reduced 64% for the average fuel loading of all plots. This exceeds the 20-50% reduction objective by 14%.

Burn Plots - Total Fuel Load - Change Over Time – Graph



Burn Plots - Total Fuel Load - Change Over Time - Data

FMH 3.10

Fire Monitoring Data Analysis - BRCA
Change Over Time

02/27/02

Percent Change from 00 PRE - Total Fuel Load
Mixed Conifer Monitoring Type
Bryce Canyon NP - (1995-2000)

List of plots output:

FABCO1G08-	54-00	PRE		FABCO1G08-	55-00	PRE		FABCO1G08-	56-00	PRE
FABCO1G08-	57-00	PRE		FABCO1G08-	58-00	PRE		FABCO1G08-	59-00	PRE
FABCO1G08-	60-00	PRE		FABCO1G08-	61-00	PRE		FABCO1G08-	62-00	PRE
FABCO1G08-	63-00	PRE		FABCO1G08-	64-00	PRE		FABCO1G08-	54-01	Post
FABCO1G08-	55-01	Post		FABCO1G08-	56-01	Post		FABCO1G08-	57-01	Post
FABCO1G08-	58-01	Post		FABCO1G08-	59-01	Post		FABCO1G08-	60-01	Post
FABCO1G08-	61-01	Post		FABCO1G08-	62-01	Post		FABCO1G08-	63-01	Post
FABCO1G08-	64-01	Post		FABCO1G08-	54-01	yr01		FABCO1G08-	55-01	yr01
FABCO1G08-	56-01	yr01		FABCO1G08-	57-01	yr01		FABCO1G08-	58-01	yr01
FABCO1G08-	59-01	yr01		FABCO1G08-	60-01	yr01		FABCO1G08-	61-01	yr01
FABCO1G08-	62-01	yr01		FABCO1G08-	63-01	yr01		FABCO1G08-	64-01	yr01
FABCO1G08-	54-01	yr02		FABCO1G08-	55-01	yr02		FABCO1G08-	56-01	yr02
FABCO1G08-	57-01	yr02		FABCO1G08-	58-01	yr02		FABCO1G08-	59-01	yr02
FABCO1G08-	60-01	yr02		FABCO1G08-	61-01	yr02		FABCO1G08-	62-01	yr02
FABCO1G08-	63-01	yr02		FABCO1G08-	64-01	yr02		FABCO1G08-	54-01	yr05
FABCO1G08-	55-01	yr05		FABCO1G08-	56-01	yr05		FABCO1G08-	57-01	yr05
FABCO1G08-	58-01	yr05		FABCO1G08-	59-01	yr05		FABCO1G08-	60-01	yr05
FABCO1G08-	61-01	yr05		FABCO1G08-	62-01	yr05		FABCO1G08-	63-01	yr05
FABCO1G08-	64-01	yr05								

List of menu selections for this output:

First Visit: 00 PRE

Metric Units

Burn Status	01 Post	01 yr01	01 yr02	01 yr05
# of Plots (n) =	11	11	11	11

All Woody + Litter + Duff

Mean Change from 00 PRE, %.....	-51.58	-49.53	-33.60	-22.02
standard deviation.....	35.81	36.26	44.24	46.25
standard error.....	10.80	10.93	13.34	13.95
80% confidence interval (CI)....	14.81	15.00	18.30	19.13
CI lower limit.....	-66.40	-64.53	-51.90	-41.15
CI upper limit.....	-36.77	-34.53	-15.30	-2.88

Total fuel loading was reduced 52% looking at the fuel change over time. Change over time compares each plot individually over time for example pre burn fuel loading on plot 54 to post burn fuel loading on plot 54. Where as multiple burn status lumps all plots. Thus the difference between a 64% and 52% reduction in total fuels.

Control Plots - Total Fuel Load - Change Over Time – Graph & Data.



FMH 3.10

Fire Monitoring Data Analysis - BRCA
Change Over Time

02/27/02

Percent Change from 00 PRE - Total Fuel Load
Mixed Conifer Monitoring Type - Control plots
Bryce Canyon NP - (1995-2000)

List of plots output:

FABCO1G08-	53-00 PRE		FABCO1G08-	53-00 yr05
FABCO1G08-	65-00 PRE		FABCO1G08-	65-00 yr05
FABCO1G08-	66-00 PRE		FABCO1G08-	66-00 yr05

List of menu selections for this output:

First Visit: 00 PRE
Metric Units

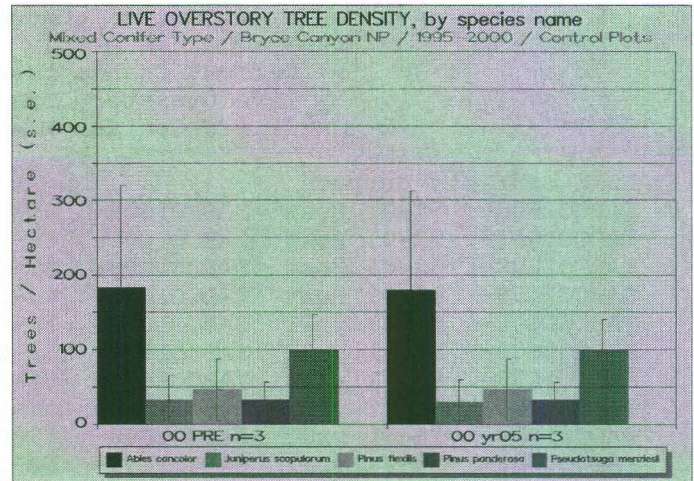
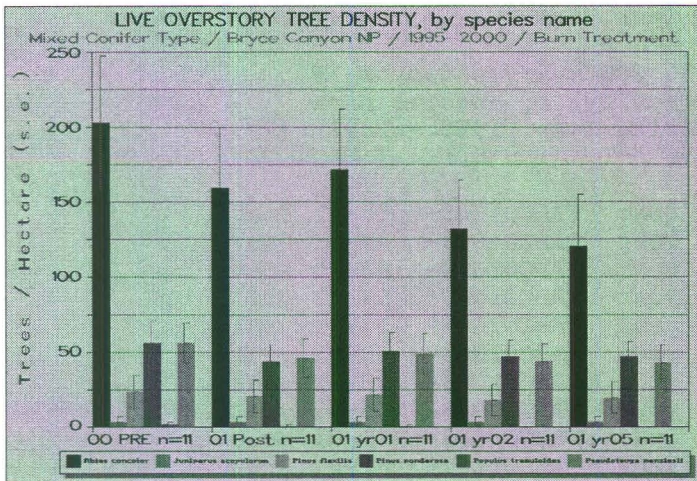
Burn Status 00 yr05
of Plots (n) = 3

All Woody + Litter + Duff

Mean Change from 00 PRE, %.....	5.28
standard deviation.....	8.73
standard error.....	5.04
80% confidence interval (CI).....	9.51
CI lower limit.....	-4.23
CI upper limit.....	14.79

Overstory Tree - Graphs and Data

Overstory Tree – Multiple Burn Status - Graphs



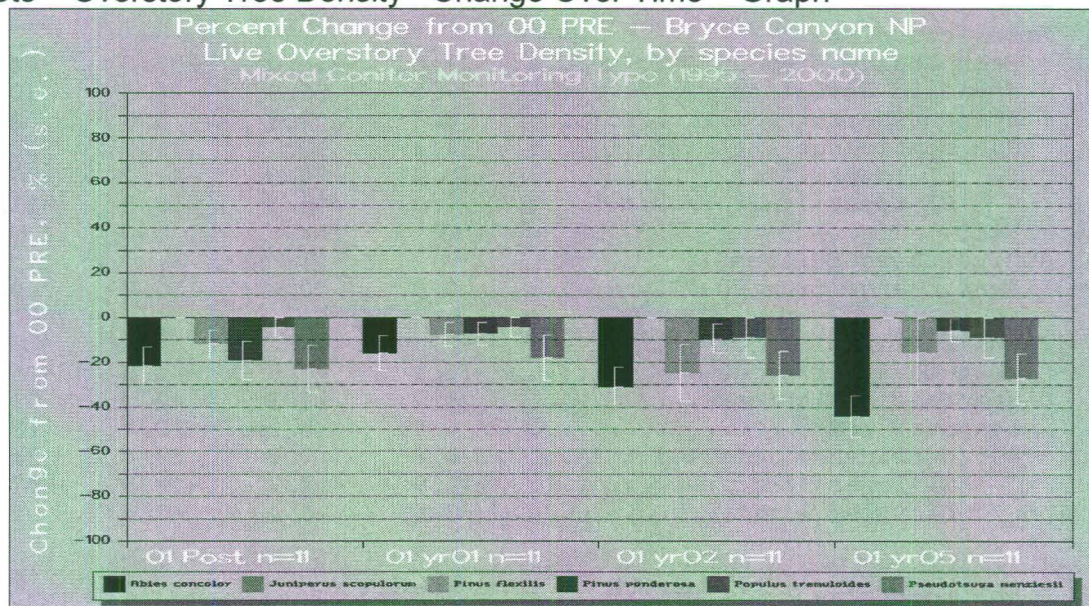
RESULTS:

White fir overstory trees had a density of 202.7 trees per hectare, which was reduced 40.4% to 120.9 trees/hectare for 11 plots 5 years after the prescribed burn using a multiple burn status analysis. The 3 control plots had a density of 183.3 trees/hectare and at the 5-year sample period had 180.0 trees/hectare. Other tree species densities remained relatively constant in the control plots. Ponderosa pine overstory trees were reduced 16.1% from 56.4 to 47.3 trees/hectare.

OBJECTIVES:

No specific objectives for overstory trees developed, however limited ponderosa tree mortality was desired.

Burn Plots – Overstory Tree Density - Change Over Time – Graph



Burn Plots – Overstory Tree Density - Change Over Time – Data

FMH 3.10

Fire Monitoring Data Analysis - BRCA
Change Over Time

03/04/02

Percent Change from 00 PRE - Bryce Canyon NP
Live Overstory Tree Density, by species name
Mixed Conifer Monitoring Type (1995 - 2000)

List of plots output:

FABCO1G08-	54-01 Post	FABCO1G08-	55-01 Post	FABCO1G08-	56-01 Post
FABCO1G08-	57-01 Post	FABCO1G08-	58-01 Post	FABCO1G08-	59-01 Post
FABCO1G08-	60-01 Post	FABCO1G08-	61-01 Post	FABCO1G08-	62-01 Post
FABCO1G08-	63-01 Post	FABCO1G08-	64-01 Post	FABCO1G08-	54-01 yr01
FABCO1G08-	55-01 yr01	FABCO1G08-	56-01 yr01	FABCO1G08-	57-01 yr01
FABCO1G08-	58-01 yr01	FABCO1G08-	59-01 yr01	FABCO1G08-	60-01 yr01
FABCO1G08-	61-01 yr01	FABCO1G08-	62-01 yr01	FABCO1G08-	63-01 yr01
FABCO1G08-	64-01 yr01	FABCO1G08-	54-01 yr02	FABCO1G08-	55-01 yr02
FABCO1G08-	56-01 yr02	FABCO1G08-	57-01 yr02	FABCO1G08-	58-01 yr02
FABCO1G08-	59-01 yr02	FABCO1G08-	60-01 yr02	FABCO1G08-	61-01 yr02
FABCO1G08-	62-01 yr02	FABCO1G08-	63-01 yr02	FABCO1G08-	64-01 yr02
FABCO1G08-	54-01 yr05	FABCO1G08-	55-01 yr05	FABCO1G08-	56-01 yr05
FABCO1G08-	57-01 yr05	FABCO1G08-	58-01 yr05	FABCO1G08-	59-01 yr05
FABCO1G08-	60-01 yr05	FABCO1G08-	61-01 yr05	FABCO1G08-	62-01 yr05
FABCO1G08-	63-01 yr05	FABCO1G08-	64-01 yr05		

List of menu selections for this output:

Natives	Non-natives	Live Only
All Classes Lumped	Full Species Name	First Visit: 00 PRE
Metric Units		

Burn Status	01 Post	01 yr01	01 yr02	01 yr05
# of Plots (n) =	11	11	11	11

Abies concolor

Mean Change from 00 PRE, %.....	-21.6	-16.0	-31.0	-44.5
standard deviation.....	27.5	25.8	28.3	30.9
standard error.....	8.3	7.8	8.5	9.3
80% confidence interval (CI).....	11.4	10.7	11.7	12.8
CI lower limit.....	-33.0	-26.6	-42.7	-57.2
CI upper limit.....	-10.2	-5.3	-19.3	-31.7

Juniperus scopulorum

Mean Change from 00 PRE, %.....	0.0	0.0	0.0	0.0
---------------------------------	-----	-----	-----	-----

Pinus flexilis

Mean Change from 00 PRE, %.....	-12.1	-7.6	-24.9	-15.9
standard deviation.....	21.2	17.3	42.0	51.7
standard error.....	6.4	5.2	12.7	15.6
80% confidence interval (CI).....	8.8	7.1	17.4	21.4
CI lower limit.....	-20.9	-14.7	-42.3	-37.2
CI upper limit.....	-3.4	-0.4	-7.6	5.5

Pinus ponderosa

Mean Change from 00 PRE, %.....	-19.3	-7.4	-9.7	-5.8
standard deviation.....	28.0	17.0	21.5	16.9

standard error.....	8.5	5.1	6.5	5.1
80% confidence interval (CI).....	11.6	7.0	8.9	7.0
CI lower limit.....	-30.9	-14.4	-18.6	-12.7
CI upper limit.....	-7.7	-0.4	-0.8	1.2
<i>Populus tremuloides</i>				
Mean Change from 00 PRE, %.....	-4.5	-4.5	-9.1	-9.1
standard deviation.....	15.1	15.1	30.2	30.2
standard error.....	4.5	4.5	9.1	9.1
80% confidence interval (CI).....	6.2	6.2	12.5	12.5
CI lower limit.....	-10.8	-10.8	-21.6	-21.6
CI upper limit.....	1.7	1.7	3.4	3.4
<i>Pseudotsuga menziesii</i>				
Mean Change from 00 PRE, %.....	-23.1	-18.2	-26.0	-27.3
standard deviation.....	35.0	33.9	35.1	36.6
standard error.....	10.5	10.2	10.6	11.0
80% confidence interval (CI).....	14.5	14.0	14.5	15.1
CI lower limit.....	-37.6	-32.2	-40.6	-42.5
CI upper limit.....	-8.7	-4.2	-11.5	-12.2

White Fir overstory tree density was reduced 44.5% five years after treatment with a change over time analysis. Change over time compares each plot individually over time for example pre burn trees on plot 54 to post burn trees on plot 54. Multiple burn status lumps all plots for its analysis. Thus the difference between a 40.4% and 44.5% reduction in overstory tree density.

Control Plots – Overstory Tree Density - Change Over Time – Graph



Control Plots - Overstory Tree Density - Change Over Time -Data

FMH 3.10

Fire Monitoring Data Analysis - BRCA
Change Over Time

03/04/02

Percent Change from 00 PRE

Live Overstory Tree Density, by species name, FABCO1G08

List of plots output:

FABCO1G08-	53-00 PRE		FABCO1G08-	53-00 yr05
FABCO1G08-	65-00 PRE		FABCO1G08-	65-00 yr05
FABCO1G08-	66-00 PRE		FABCO1G08-	66-00 yr05

List of menu selections for this output:

Natives	Non-natives
Live Only	All Classes Lumped
Full Species Name	First Visit: 00 PRE
Metric Units	

Burn Status	00 yr05
# of Plots (n) =	3

Abies concolor

Mean Change from 00 PRE, %.....	-0.7
standard deviation.....	1.3
standard error.....	0.7
80% confidence interval (CI).....	1.4
CI lower limit.....	-2.1
CI upper limit.....	0.7

Juniperus scopulorum

Mean Change from 00 PRE, %.....	-3.3
standard deviation.....	5.8
standard error.....	3.3
80% confidence interval (CI).....	6.3
CI lower limit.....	-9.6
CI upper limit.....	3.0

Pinus flexilis

Mean Change from 00 PRE, %.....	0.0
---------------------------------	-----

Pinus ponderosa

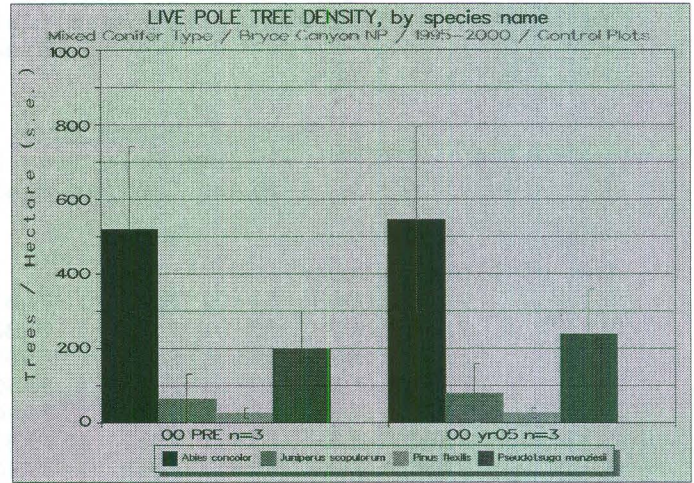
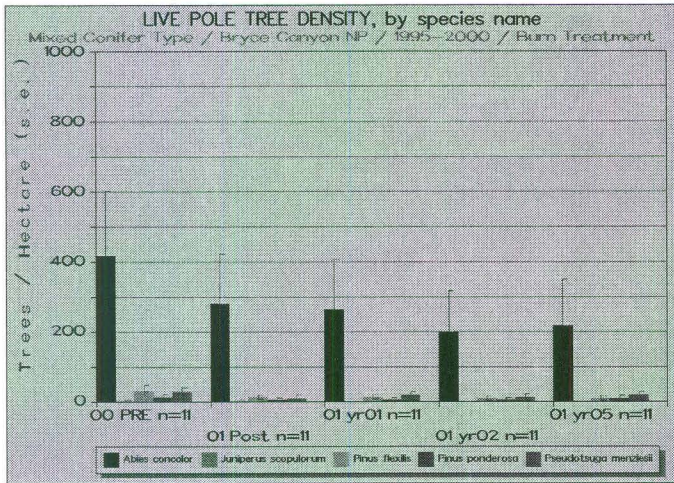
Mean Change from 00 PRE, %.....	0.0
---------------------------------	-----

Pseudotsuga menziesii

Mean Change from 00 PRE, %.....	4.8
standard deviation.....	18.2
standard error.....	10.5
80% confidence interval (CI).....	19.9
CI lower limit.....	-15.0
CI upper limit.....	24.7

Pole Tree - Graphs and Data

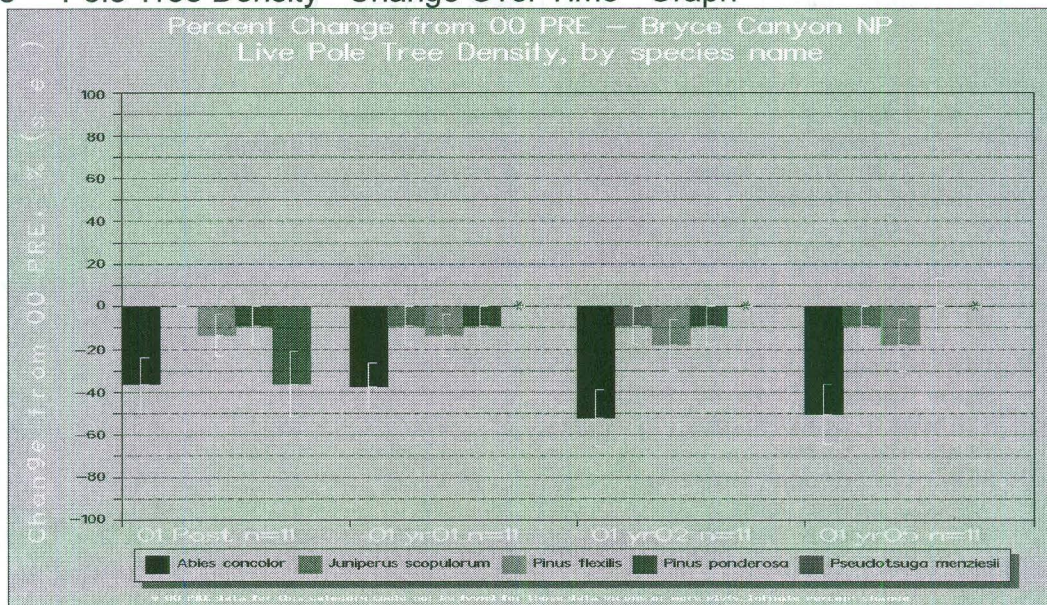
Pole Tree Density - Multiple Burn Status - Graphs



RESULTS: Treatment white fir pole sized tree densities decreased 57.1% from 465.9 to 200.0 trees per hectare 2 years after the burn. At the year 5 sample period poles showed a density of 218.2 trees/hectare which is a 53.2% reduction from pre burn levels using the multiple burn status analysis. Control white fir poles increased 5.1% from 520.0 to 546.7 trees per hectare.

OBJECTIVES: Reduce white fir pole tree (2.51 to 15.0 cm DBH) density by 20 to 40% within 2 years of the prescribed burn. Pole sized trees were reduced within two years of the treatment 12% above the 20-40% objective. At the year five sample period poles showed a density of 218.2 trees/hectare which is a 47.8% reduction from pre burn levels. Control white fir poles increased 5.1% from 520.0 to 546.7 trees per hectare.

Burn Plots - Pole Tree Density - Change Over Time - Graph



Burn Plots - Pole Tree Density - Change Over Time - Data

FMH 3.10

Fire Monitoring Data Analysis - BRCA
Change Over Time

03/04/02

Percent Change from 00 PRE - Bryce Canyon NP
Live Pole Tree Density, by species name
Mixed Conifer Monitoring Type (1995 - 2000)

List of plots output:

FABCO1G08-	54-01	Post	:	FABCO1G08-	54-01	yr02
FABCO1G08-	55-01	Post	:	FABCO1G08-	55-01	yr02
FABCO1G08-	56-01	Post	:	FABCO1G08-	56-01	yr02
FABCO1G08-	57-01	Post	:	FABCO1G08-	57-01	yr02
FABCO1G08-	58-01	Post	:	FABCO1G08-	58-01	yr02
FABCO1G08-	59-01	Post	:	FABCO1G08-	59-01	yr02
FABCO1G08-	60-01	Post	:	FABCO1G08-	60-01	yr02
FABCO1G08-	61-01	Post	:	FABCO1G08-	61-01	yr02
FABCO1G08-	62-01	Post	:	FABCO1G08-	62-01	yr02
FABCO1G08-	63-01	Post	:	FABCO1G08-	63-01	yr02
FABCO1G08-	64-01	Post	:	FABCO1G08-	64-01	yr02
FABCO1G08-	54-01	yr01	:	FABCO1G08-	54-01	yr05
FABCO1G08-	55-01	yr01	:	FABCO1G08-	55-01	yr05
FABCO1G08-	56-01	yr01	:	FABCO1G08-	56-01	yr05
FABCO1G08-	57-01	yr01	:	FABCO1G08-	57-01	yr05
FABCO1G08-	58-01	yr01	:	FABCO1G08-	58-01	yr05
FABCO1G08-	59-01	yr01	:	FABCO1G08-	59-01	yr05
FABCO1G08-	60-01	yr01	:	FABCO1G08-	60-01	yr05
FABCO1G08-	61-01	yr01	:	FABCO1G08-	61-01	yr05
FABCO1G08-	62-01	yr01	:	FABCO1G08-	62-01	yr05
FABCO1G08-	63-01	yr01	:	FABCO1G08-	63-01	yr05
FABCO1G08-	64-01	yr01	:	FABCO1G08-	64-01	yr05

List of menu selections for this output:

Natives	Non-natives
Live Only	All Classes Lumped
Full Species Name	First Visit: 00 PRE
Metric Units	

Burn Status	01 Post	01 yr01	01 yr02	01 yr05
# of Plots (n) =	11	11	11	11

Abies concolor

Mean Change from 00 PRE, %.....	-36.5	-37.7	-52.2	-50.4
standard deviation.....	42.5	36.5	43.4	46.0
standard error.....	12.8	11.0	13.1	13.9
80% confidence interval (CI).....	17.6	15.1	18.0	19.0
CI lower limit.....	-54.1	-52.9	-70.2	-69.4
CI upper limit.....	-18.9	-22.6	-34.2	-31.4

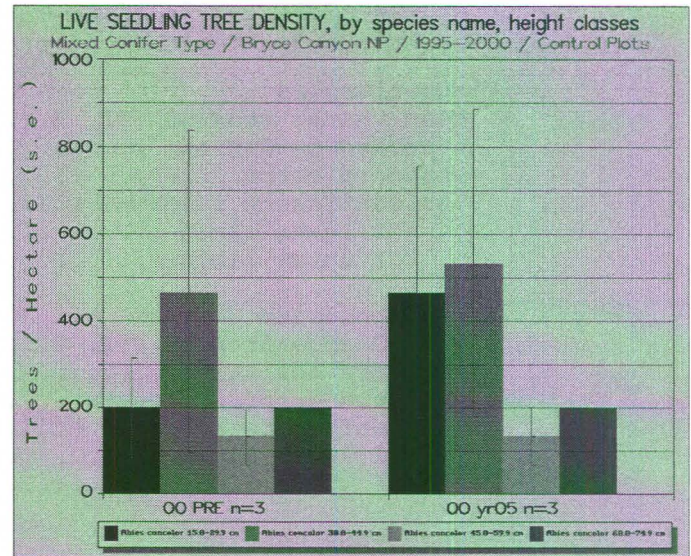
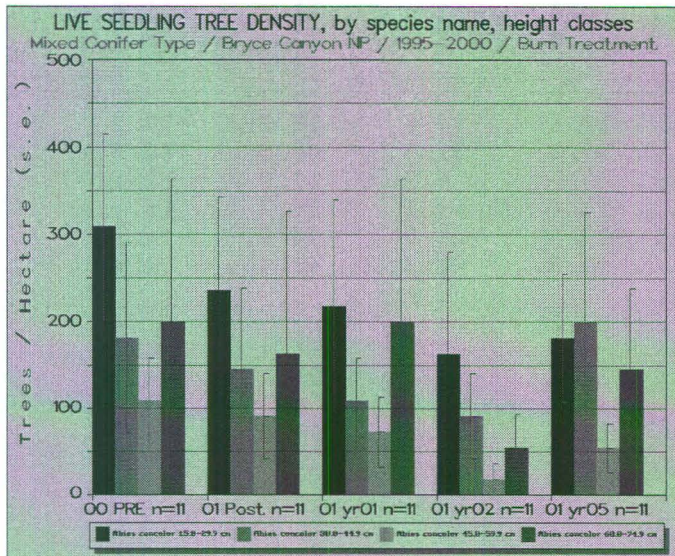
Juniperus scopulorum				
Mean Change from 00 PRE, %.....	0.0	-9.1	-9.1	-9.1
standard deviation.....	0.0	30.2	30.2	30.2
standard error.....	0.0	9.1	9.1	9.1
80% confidence interval (CI).....	0.0	12.5	12.5	12.5
CI lower limit.....	0.0	-21.6	-21.6	-21.6
CI upper limit.....	0.0	3.4	3.4	3.4
Pinus flexilis				
Mean Change from 00 PRE, %.....	-13.6	-13.6	-18.2	-18.2
standard deviation.....	32.3	32.3	40.5	40.5
standard error.....	9.7	9.7	12.2	12.2
80% confidence interval (CI).....	13.4	13.4	16.7	16.7
CI lower limit.....	-27.0	-27.0	-34.9	-34.9
CI upper limit.....	-0.3	-0.3	-1.4	-1.4
Pinus ponderosa				
Mean Change from 00 PRE, %.....	-9.1	-9.1	-9.1	0.0
standard deviation.....	30.2	30.2	30.2	44.7
standard error.....	9.1	9.1	9.1	13.5
80% confidence interval (CI).....	12.5	12.5	12.5	18.5
CI lower limit.....	-21.6	-21.6	-21.6	-18.5
CI upper limit.....	3.4	3.4	3.4	18.5
Pseudotsuga menziesii				
Mean Change from 00 PRE, %.....	-36.4	*	*	*
standard deviation.....	50.5	*	*	*
standard error.....	15.2	*	*	*
80% confidence interval (CI).....	20.9	*	*	*
CI lower limit.....	-57.2	*	*	*
CI upper limit.....	-15.5	*	*	*

* Indicates that the 00 PRE visit could not be found for those data. Percent change would be meaningless.

White Fir pole tree density was reduced 52.2% two years after treatment with a change over time analysis. Change over time compares each plot individually over time for example pre burn trees on plot 54 to post burn trees on plot 54. Multiple burn status lumps all plots for its analysis. Thus the difference between a 57.1% and 52.2% reduction in pole tree density.

Seedling Tree - Graphs and Data

Seedling Tree Density - Multiple Burn Status - Graphs



RESULTS:

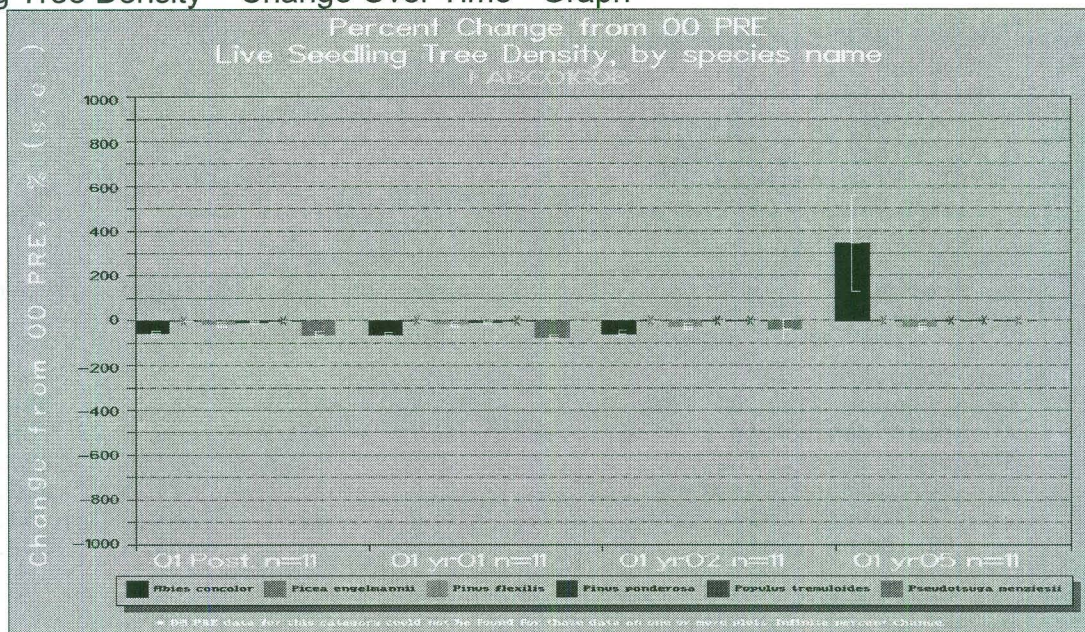
Seedling tree densities in the 15.0 to 29.9cm height class were reduced 29.4% from 309.1 to 218.2 trees/hectare 2 years after treatment with a multiple burn status analysis lumping all plots. The 3 control plots showed a 133.3% increase at the year 5 sample period. Seedling tree densities in the 30.0 to 44.9cm height class decreased 40.0% at the 2 year read from 181.8 to 109.1 trees/hectare. Control seedlings in this height class increased 14.3%. Seedlings measuring 45.0 to 59.9cm in height decreased 33.3% 2 years after the prescribed burn while control density remained the same. Seedlings in the 60.0 to 74.9cm height class remained the same for both treatment and control plots at the 2 and 5 year sample periods respectively.

OBJECTIVES:

Reduce seedling tree (0 to 2.5cm DBH) density by 20 to 40% within 1 year of the burn. Seedling trees were reduced by 78% within one year of the treatment.

Comparing year five data with treatment vs. control there were 3963.6 trees per hectare pre burn and 12090.9 seedlings by year five for a 205% increase. This is due to a sprouting of seedlings in the 0 to 14.9cm height class. Omitting this height class there were 836.4 seedlings per hectare pre burn with a 22% reduction to 654.5 per hectare five years after treatment.

Seedling Tree Density - Change Over Time - Graph



Seedling Tree Density - Change Over Time - Data

FMH 3.10

Fire Monitoring Data Analysis - BRCA
Change Over Time

03/04/02

Percent Change from 00 PRE
Live Seedling Tree Density, by species name
FABCO1G08

List of plots output:

FABCO1G08-	54-01	Post	FABCO1G08-	54-01	yr02
FABCO1G08-	55-01	Post	FABCO1G08-	55-01	yr02
FABCO1G08-	56-01	Post	FABCO1G08-	56-01	yr02
FABCO1G08-	57-01	Post	FABCO1G08-	57-01	yr02
FABCO1G08-	58-01	Post	FABCO1G08-	58-01	yr02
FABCO1G08-	59-01	Post	FABCO1G08-	59-01	yr02
FABCO1G08-	60-01	Post	FABCO1G08-	60-01	yr02
FABCO1G08-	61-01	Post	FABCO1G08-	61-01	yr02
FABCO1G08-	62-01	Post	FABCO1G08-	62-01	yr02
FABCO1G08-	63-01	Post	FABCO1G08-	63-01	yr02
FABCO1G08-	64-01	Post	FABCO1G08-	64-01	yr02
FABCO1G08-	54-01	yr01	FABCO1G08-	54-01	yr05
FABCO1G08-	55-01	yr01	FABCO1G08-	55-01	yr05
FABCO1G08-	56-01	yr01	FABCO1G08-	56-01	yr05
FABCO1G08-	57-01	yr01	FABCO1G08-	57-01	yr05
FABCO1G08-	58-01	yr01	FABCO1G08-	58-01	yr05
FABCO1G08-	59-01	yr01	FABCO1G08-	59-01	yr05
FABCO1G08-	60-01	yr01	FABCO1G08-	60-01	yr05
FABCO1G08-	61-01	yr01	FABCO1G08-	61-01	yr05
FABCO1G08-	62-01	yr01	FABCO1G08-	62-01	yr05
FABCO1G08-	63-01	yr01	FABCO1G08-	63-01	yr05
FABCO1G08-	64-01	yr01	FABCO1G08-	64-01	yr05

List of menu selections for this output:

Natives
Non-natives
Live Only
All Classes Lumped
Full Species Name
First Visit: 00 PRE
Metric Units

Burn Status	01 Post	01 yr01	01 yr02	01 yr05
# of Plots (n) =	11	11	11	11
<i>Abies concolor</i>				
Mean Change from 00 PRE, %.....	-58.7	-65.3	-60.3	346.8
standard deviation.....	44.7	41.3	52.0	706.3
standard error.....	13.5	12.5	15.7	213.0
80% confidence interval (CI).....	18.5	17.1	21.5	292.2
CI lower limit.....	-77.2	-82.4	-81.8	54.7
CI upper limit.....	-40.2	-48.2	-38.7	639.0
<i>Picea engelmannii</i>				
Mean Change from 00 PRE, %.....	*	*	*	*
<i>Pinus flexilis</i>				
Mean Change from 00 PRE, %.....	-18.2	-18.2	-27.3	-27.3
standard deviation.....	40.5	40.5	46.7	46.7
standard error.....	12.2	12.2	14.1	14.1
80% confidence interval (CI).....	16.7	16.7	19.3	19.3
CI lower limit.....	-34.9	-34.9	-46.6	-46.6
CI upper limit.....	-1.4	-1.4	-8.0	-8.0
<i>Pinus ponderosa</i>				
Mean Change from 00 PRE, %.....	-10.6	-10.6	*	*
standard deviation.....	23.9	23.9	*	*
standard error.....	7.2	7.2	*	*
80% confidence interval (CI).....	9.9	9.9	*	*
CI lower limit.....	-20.5	-20.5	*	*
CI upper limit.....	-0.7	-0.7	*	*
<i>Populus tremuloides</i>				
Mean Change from 00 PRE, %.....	*	*	*	*
<i>Pseudotsuga menziesii</i>				
Mean Change from 00 PRE, %.....	-62.1	-73.9	-37.6	*
standard deviation.....	45.5	40.0	148.5	*
standard error.....	13.7	12.1	44.8	*
80% confidence interval (CI).....	18.8	16.6	61.4	*
CI lower limit.....	-81.0	-90.5	-99.0	*
CI upper limit.....	-43.3	-57.4	23.9	*

* Indicates that the 00 PRE visit could not be found for those data. Percent change would be meaningless.

Exotics Monitoring/Alert:

This year's sampling and analysis revealed the presence of *Bromus carinatus* within one plot, and near another, in the (Sheep) East Creek Ridge burn unit. This species was intercepted on the herbaceous transect of brush plot 3 in the Black Sage monitoring type (BARNO1T05). It was also found within 5 meters of the perimeter of plot 52 in the White Fir/Mixed Conifer monitoring type (FABCO1G08). This non-native species has not been previously recorded on or near any plots. See 2000 report for previous exotics data.

Actions to be Taken Based on this Data Analysis

A review together with Bryce Canyon Resource/Fire Management staff is necessary in order to determine if burn plan and fire monitoring type description objectives are meeting desired goals. Actions to be taken regarding exotic plant species will also be determined in this review. Presenting the data has been discussed with an informal resource/fire presentation occurring first followed up by a presentation at one of Bryce Canyons all employee meetings.

Vegetation monitoring type description sheets need to be reviewed. The objectives need to be evaluated given the analysis in this document. At this time no specific question needs to be addressed with research. Continued burning and monitoring is recommended until we have more data.

Additional Analyses Needed

Additional analyses need to be performed on the ponderosa pine plots particularly with the plots that were installed in the late 80's. Overstory tree data can be explored and analyzed with current sampling techniques and protocols, however the collected data may not. Table 9 footnote stated that the minimum plot number was calculated with all of the Ponderosa Pine plots labeled as FPIPO1G02 -PRE plots. Further work needs to be done with this type in organizing and cleaning up the database.

PROGRAM INFORMATION

Staff Participants

Henry Bastian, Fire Ecologist
Sarah Cooper, Bio Tech
Brian Raper, Bio Tech

Claire Crow, Lead Bio Tech
Ed Hentzelt, Bio Tech
Virginia McDaniel, Rare Plants – assistance thanked.

Additional help in plant identification on the Black Sagebrush plots was cheerfully provided by Fletcher Linton, Park Botanist, Bryce Canyon NP. We gratefully acknowledge his assistance.

Changes in Protocol

No changes in protocol were instituted in 2001. However, pilot monitoring was started with the black sagebrush monitoring type. This data will need to be analyzed to find the coefficient of variation between sampling sizes to see which size will provide statistically sound data with minimum effort.

Recommended Changes in Protocol

The completed handbook was received and new protocols outlined in the handbook along with new data forms will be implemented during the 2002 field season.

Changes in Protocol following a Program Review

No changes in protocol were instituted in 2001 and the program received a partial review in 1998 from Paul Reeberg. Most of the recommend changes were implemented. For example those that were not were the color of stakes and the review stated that this was a minor change. Table 9 footnote stated that the minimum plot number was calculated with all of the Ponderosa Pine plots labeled as FPIPO1G02 -PRE plots. Further work needs to be done with this type in organizing and cleaning up the database. Because of the difference in the ways the data was collected it is difficult to analyze certain portions of the ponderosa pine monitoring type. Extensive time will be required to update and correlate that information.

The database has been searched for errors using the edit menu and the check this data form all plots. Errors were corrected with the exception of some updates that need to occur with the species either not being entered or updated on forms FMH-6 and FMH-15. Quality control is performed by an error checker once the data is entered and also at a lesser degree by the lead crewmember and ecologist.

Data Management

Fire effects data collected at Bryce Canyon National Park is stored at Zion National Park. Once this year's data has been entered and analyzed, a copy of the zipped digital file will be forwarded to Bryce Canyon. A printed hard copy of the report and the poster presentation of the mixed conifer data will be sent. All digital information will be in the forwarded package. Original slides and voucher specimens are stored at Zion, but are available to Bryce Canyon staff upon request.

EQUIPMENT INFORMATION

Fire effects equipment is stored in the Zion Fire Operations office, in the old safe, in the light brown storage cabinet. Fire effects purchases are completed on a DI-1, Requisition form. Since 2001 all DI-1's have been completed digitally and are stored in the following location. Zion Net work F:/ drive (Ranger Divisions drive), F:/Fire Mgmt Office/Fire Effects/DI-1s/2002.... folders. All suppliers can be reference there or in previous reports. Fire effects digital data is stored on the fire ecologist laptop computer, the fire effects desktop computer, and the fire effects crew laptop along with zipped database files being stored on the Zion network. This network is routinely backed up. Slide and prints are located on the crew leads desk shelf and plot data folders are maintained in a light brown filing cabinet next to the fire effects crew leads desk. Some other fire effects equipment is located around the corner by the Zion Fire Management Officers office with voucher specimens, miscellaneous files, and identification books located in a fire safe filing cabinet. Next to that is the drying oven and a desk with the fire effects microscope and plant identification materials and presses. In the drawer of the desk are the field forms and some other fire effects plot folders.

INNOVATIONS

The only innovation is the addition of taking plot images (prints) out into the field to allow replication of the image. Sending in our slides in for print development has done this. Zion NP has some new slide scanners that may allow us to print scanned images for this purpose in the future.

Monitoring Type Information

The BARNO1T05 monitoring type was developed this season. See attached. Table 9 footnote stated that the minimum plot number was calculated with all of the Ponderosa Pine plots labeled as FPIPO1G02 -PRE plots. Further work needs to be done with this type in organizing and cleaning up the database. Because of the difference in the ways the data was collected it is difficult to analyze certain portions of the ponderosa pine monitoring type. Extensive time will be required to update and correlate that information.

Status of Five-Year Plan

Although the moratorium on prescribed burning has been lifted, the new directives require additional resources on each burn and burn plan revisions. As a result, the schedule for implementation of projects on the five-year burn plan is uncertain.

TABLE 10. Transects/plots classified by burn unit and monitoring type.

Burn Unit	Monitoring Type		
	FPIPO1T02	FABCO1G08	BARTR1T05
Residential	2,3,4,9,22,26	--	--
Paria	36,37,44,45,47,50	--	--
Sunset	13,18,20	--	--
(Sheep) East Creek Ridge	67,68,69,70,71,72,75	--	--
East Creek Meadows		--	1,2,3
County Line	--	54,55	--
Agua I	--	52	--
Yovimpa	--	56,57,58,59,60, 61,62,63,64	--
Podunk-Yovimpa2	--	66,77,78	--

TABLE 11. Completed Prescribed Burns, -2001.

Year	Project Name	Completion Date	Acres	# FMH Plots	Project Type
1982	Meadow (East Creek Meadow)	6/1982	18	?^	Black Sagebrush
1991	Residential	10/1991	438	(*8)27	Ponderosa Pine
1992	Sunset	10/1992	348	(*3)9	Ponderosa Pine
1993	Paria Burn Units (All)		839		
1993	Paria North	09/22/93	360	(*4)17	Ponderosa Pine
1993	Paria South	09/23/93	195	(*2)6	Ponderosa Pine
1993	Paria Burn#2	11/9/93	115	0	Ponderosa Pine
??	??	??	??	?^	?^
1994	Fairyland	9/1994	885	0	Ponderosa Pine
1995	County Line	07/28/95	130	2(1C)	Mixed Conifer
1995	Yovimpa	08/30/95	530	9(2C)	Mixed Conifer
1998	Residential (Second Entry)	06/02/98	438	8	Ponderosa Pine
1999	Agua II	10/1999	24	0	Mixed Conifer
1999	Agua III	11/1999	42	0	Mixed Conifer
2000	Agua I	05/05/00	124	1	Mixed Conifer
2000	East Creek Meadow	4/2000	428	0	PIPO & Black Sage
2001	East (Sheep) Creek Ridge ECR / Meadows (All)		1303 Total		
2001	ECR I Meadows	09/??/01	71	3	Black Sagebrush?
2001	ECR II	6/??/01	184	1	Ponderosa Pine
2001	ECR III	09/29/01	1048	6	Ponderosa Pine

?^ = Question to be determined by Bastian

?? = Questions for Bryce Canyon staff.

(*#) = Number of plots being maintained out of total listed in the unit.

TABLE 12. Proposed prescribed burns, 2002-.

Proposed Year	Project Name	Spring/ Fall	Acres	# FMH Plots	Project Type
2002	Loop I, II, III				
2002	Fairyland			0	Ponderosa Pine
?	Podunk-Yovimpa2			3	White Fir/Mixed Conifer
2003					
2004					
2005					
2006					
2007					

TABLE 13. Plots to be re-measured in 2002.

Plot name and number	Burn unit	Most recent read date	Burn status in 2002	Comments
FABCO1G08 #52	Agua I	09/25/01	01-YR2	
BARNO1T05 #2	(Sheep) East Creek Ridge	09/23/01	01-YR1	
BARNO1T05 #3	(Sheep) East Creek Ridge	09/23/01	01-YR1	
FPIPO1T02 #67	(Sheep) East Creek Ridge	10/22/01	01-YR1	
FPIPO1T02 #68	(Sheep) East Creek Ridge	10/22/01	01-YR1	
FPIPO1T02 #69	(Sheep) East Creek Ridge	10/22/01	01-YR1	
FPIPO1T02 #70	(Sheep) East Creek Ridge	08/07/01	01-YR1	
FPIPO1T02 #71	(Sheep) East Creek Ridge	10/23/01	01-YR1	
FPIPO1T02 #72	(Sheep) East Creek Ridge	10/23/01	01-YR1	
FPIPO1T02 #75	(Sheep) East Creek Ridge	10/22/01	01-YR1	
PLOTS WHICH MAY REQUIRE IMMEDIATE POSTBURN MONITORING IF ALL SCHEDULED BURNS ARE COMPLETED				
FABCO1G08 #66	Yovimpa2-Podunk-	07/14/01	01-POST	Plot will be changed from a control plot to a burn plot.
FABCO1G08 #77	Yovimpa2-Podunk-	08/08/01	01-POST	
FABCO1G08 #78	Yovimpa2-Podunk-	08/09/00	01-POST	

TABLE 14. Plots to install in 2002.

Proposed project area	# of plots	Project type	Comments
Meadow units	2	ARNO	
Mixed conifer units	2	ABCO	
	20 ?	CBI – Composite Burn Index	
	10 ?	Mechanical	

Prepared by: Henry Bastian and Claire Crow

APPENDIX A.

FMH4

MONITORING TYPE DESCRIPTION SHEET

PARK: BRCA

Monitoring

Type Code* B A R N O 1 T 0 2/5

Date Described: 4/2001

Monitoring Type Name: Black sagebrush

Preparer\s: Ross Wilmore, Rick Wallen, Fletcher Linton, Art Latterell, Henry Bastian

Burn Prescription: To be filled in later with Ross Wilmore.

Fire Management Objective(s): 1) Reduce brush density by 40-70% within 2 years post burn. 2) Increase native grasses and forbes in 5-10 years by >10% cover.

Fire

Monitoring Objective(s): 1) We want to be 80% sure of detecting a reduction of 40% change in the average brush density. We also want to detect a 10% change in the relative cover of native grasses and forbes. For all of these objectives we are willing to accept a 20% chance of saying a change took place, when in fact it did not.

Fire Monitoring Variable(s): Average Brush density [*Artemisia nova* (black sagebrush); increase cover of native grasses [*Stipa comata* (needle and thread grass), *Poa fendleriana* (muttongrass), *Koeleria macrantha* (junegrass), *Elymus elymoides* (squirrel tail)] and forbes [*Senecio multilobatus* (Untia groundsel), *Calyophus lavandulifolius* (lavender evening primrose)]

Physical Description: This monitoring type occurs along alluvial hollows or stringers on top of the Paunsaugunt plateau between 7,600 and 8,300 feet in the central eastern portion of Bryce Canyon NP. The slope varies from 1 to 15 percent and includes all aspects. Steep slopes >50% are excluded. Soils are derived from alluvial calcareous parent materials (primarily limestone, and calcareous mudstone). Typically, the topsoil layer is a brown mildly alkaline fine sandy loam 4 to 10 inches thick and the subsoil is a light-brown mildly alkaline sandy clay loam about 25 inches thick. Substratum varies from well-drained coarse limestone alluvium along the margins to less well-drained yellowish-brown clay loams in the bottom portions of the hollows.

Biological Description: The transect should contain black sagebrush as the primary component in all size classes (must be >75% of species diversity). Other shrub species such as *Chrysothamnus viscidiflorus* (mountain rabbitbrush), *Tetradymia canescens* (gray horsebrush), *Artemisia frigida* (fringed sagebrush), and *Purshia tridentata* (bitterbrush) could compose a small portion of the transect (<25% of species diversity). Common grass species include *Stipa comata* (needle and thread grass), *Poa fendleriana* (muttongrass), *Koeleria macrantha* (junegrass), and *Elymus elymoides* (squirrel tail). Common herbs include *Senecio multilobatus* (Untia groundsel) and *Calyophus lavandulifolius* (lavender evening primrose). Trees surrounding the hollows or stringers consist primarily of ponderosa pine with Rocky Mountain juniper, white fir, and maple present in varying degrees.

Rejection Criteria: Exclude perennial streams, anomalous vegetation patches, ecotone type boundaries, large rock outcroppings or barren areas (>20% of the plot), or areas within 20 meters of physical barriers such as roads, or trails. Exclude archeological/cultural sites

Notes: The brush density is done 1 meters on each side of the 0 meter to 30 meter transect. Photos will be taken 1.5-2 meters from re-bar and approximately 4 feet from the ground. General reference photos should be taken from 0p or 30p with significant identifiable features in the background (Landscape scale). Pilot sampling for brush will be done 2 meters on each side of the transect with each side counted separately.

FMH4 PLOT PROTOCOLS Park: BRCA Code:BARNO1T04

GENERAL PROTOCOLS		YES ()	NO ()			YES ()	NO ()
Preburn	Alt. Treatment Plots (opt)			Herb Height (opt)			
	Herbaceous Density (opt)			Abbreviated Tags (opt)			
	OP/Origin Buried (opt)			Crown Intercept (opt)			
	Voucher Specimens (opt)			Herb. Fuel Load (opt)			
Belt Transect Width: 2 meters				Stakes Installed at: ALL			
Herbaceous frame dimensions: None				Herbaceous density data collected at: N/A			
Herbaceous Data Collected at: Q4-Q1 Q3-Q2 0P-50P <u>0-30P</u>							
Burn	Duff Moisture/ Sug			Flame Zone Depth/ Sug			
Postburn	Herbaceous Data (opt)			Herb. Fuel Load (opt)			
	100 Pt. Burn Severity (opt)			FMH-24 7pt. Burn Severity			
FOREST PLOT PROTOCOLS Not Applicable		YES ()	NO ()			YES ()	NO ()

Sug = Suggested

Opt =