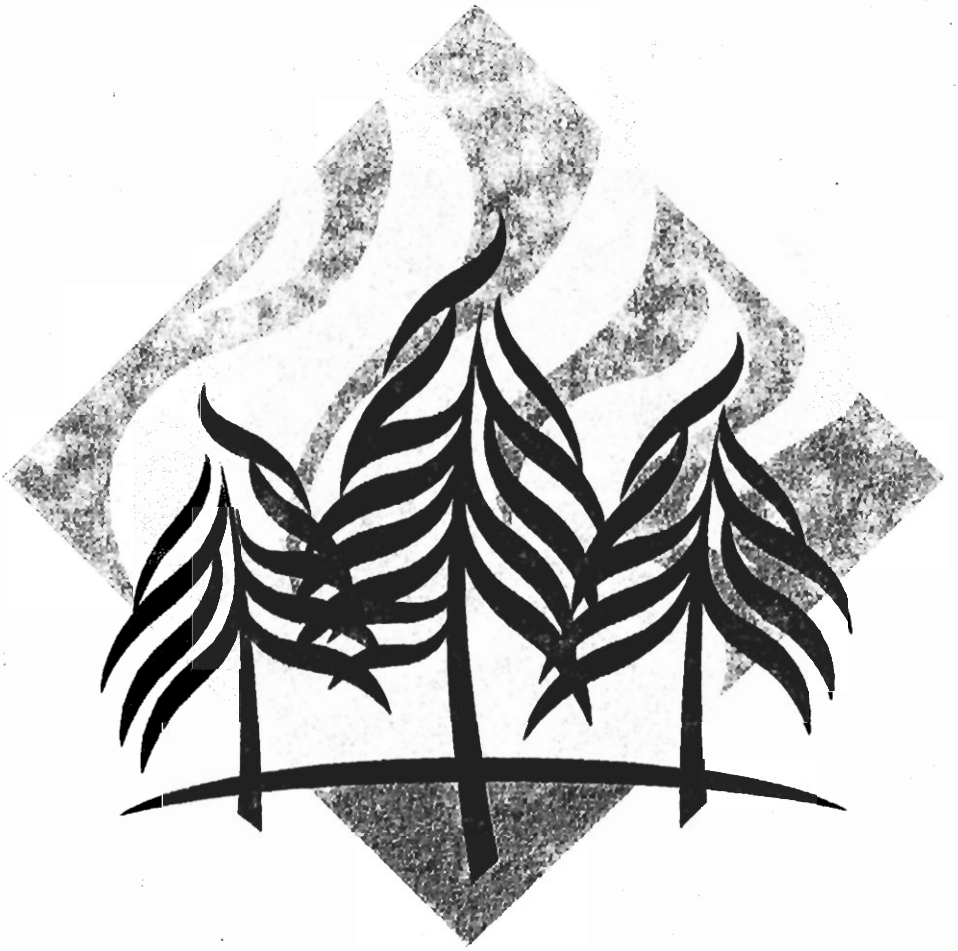

Prescribed Fire Annual Summary
1999

National Park Service
Grand Canyon National Park
Branch of Fire and Aviation
P.O. BOX 129
Grand Canyon, AZ 86023

Prescribed Fire Annual Summary
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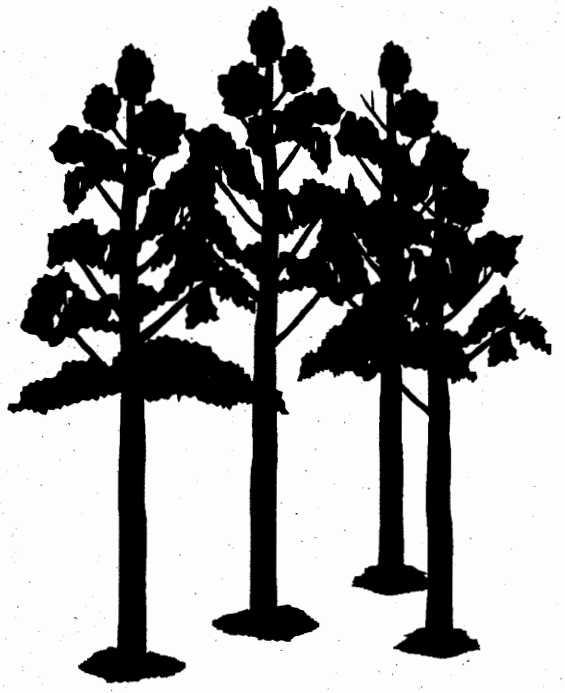
Acknowledgements

The Prescribed Fire staff would like to recognize the numerous people who helped our program have a successful year. Grand Canyon had a record-breaking year and accomplished all activities in a safe and cost effective manner. Thank you to Arrowhead Interagency Hotshot Crew, BLM Boise Smokejumpers, Kaibab National Forest, Coconino National Forest, Bandelier Prescribed Fire Module, Grand Teton National Park, Zion Prescribed Fire Module, Zion National Park, Dave Lentz, Dave Hamrick, Grand Canyon Science Center Staff, Grand Canyon Law Enforcement, Interpretation, Public Affairs Office, and all Fire and Aviation Staff.



Prescribed Fire Operations 1999

Introduction

This report will serve as a summary of Prescribed Fire Operations 1999 calendar year accomplishments. The purpose of this report is to provide documentation of accomplishment and other activities to aid Fire Program Managers in future decisions and program development at Grand Canyon National Park.

Goals

The goals of the Prescribed Fire Program at Grand Canyon National Park are:

1. Provide a safe working environment for all employees while working on prescribed fire projects.
2. To meet or exceed prescribed fire targets for the fiscal year. This goal is tied to the Resource Management Plan, Fire Management Plan and Grand Canyon's General Management Plan.
3. Adhere to all guidelines and policies concerning natural and cultural resources for all prescribed fire projects.
4. Provide adequate training opportunities for all fire management staff to further their career development and improve the prescribed fire program at Grand Canyon National Park.

Staffing

The staff for Prescribed Fire Operations in 1999 consisted of a Prescribed Fire Specialist (GS-0462-7/8/9), and two Forestry Technicians (GS-0462-05). The Prescribed Fire Operations Staff participated in prescribed fire activities (this includes planning, burn prep, burn operations), fuel sampling, meetings (usually outside of staff – i.e. with other park personnel and other agencies), fire-use activities and as fire monitors. Please reference the following table for a breakdown of crew activities. Crewmembers kept a daily log of activities. The day activity was categorized by the activity that took most of the day. The days in Table one include both GS-0462-05 Forestry Technicians. Both of these tables do not include overtime days spent doing the various activities.

Table 1: Two GS-0462-05

Category	Prescribed Fire	Fire Use	Fuel Sampling	Training	Meetings	Suppression Fire	Suppression Aid	SAR Assist	Paid Medical*
Days	**64**	**23**	**20**	**30**	**3**	**47**	**13**	**4**	**8**
Percent	**31%**	**11%**	**9%**	**14%**	**1%**	**22%**	**6%**	**2%**	**4%**

*Paid Medical was for an employee that had an on-the-job injury. The employee was on light duty for this time. This time includes travel back and forth to medical specialist (North Rim to Flagstaff).

Table 2: One GS-0462-7/8/9

Category	Prescribed Fire	Fire Use	Training include instruct	Meetings	A/L, S/L, & FSL	Suppression Fire
Days	**85**	**36**	**28**	**28**	**30**	**43**
Percent	**35%**	**14%**	**11%**	**11%**	**12%**	**17%**

The Prescribed Fire program has funded other positions in fire and resource management to complete compliance and other work to ensure the success and progress of the prescribed fire program at Grand Canyon National Park.

Prescribed fire funded four suppression personnel (one GS-09, one GS-06, and two GS-05's) for 250 days in 1999. These personnel assisted in dispatch functions, mechanical treatments, prescribed burning planning, prep and execution of prescribed fire projects. Prescribed fire also funded one GS-6 to attend RX-300 (Prescribed Fire Burn Boss).

Prescribed fire has funded one GS-07 TERM GIS technician, one GS-05 SEASONAL wildlife technician, one GS-09 TERM archeologist and three GS-05 TERM archeology technicians.

Fuel Moisture Monitoring Summary

The fuels moisture-monitoring program is based on protocols and guidelines found in the Fire Monitoring Handbook for Grand Canyon National Park. Appendix A summarizes where fuel data was collected and what was sampled at each location. Appendix B contains year-end graphs of live and dead fuel moistures. This information was used for prescribed burning, fire-use fires and for monitoring historical trends at Grand Canyon National Park.

The current protocols and guidelines are currently under review and will be changed for the 2000 fire season. The reason for these changes include representative sampling sites, ideas and suggestions for more personnel to be involved, and a more standardized system for both South Rim and North Rim. This effort will be done jointly between the Fire Effects Specialist, South Rim Suppression Specialist, North Rim Suppression Specialist, and the Prescribed Fire Specialist. Along with changes in protocol, the prescribed fire specialist will attempt to establish a system that tracks trends in data such as 1000-hour fuel moisture departures from long term averages, ERC (energy release component) and 1000-hour minimums and maximums. These will be done in graph form and available for Grand Canyon personnel.

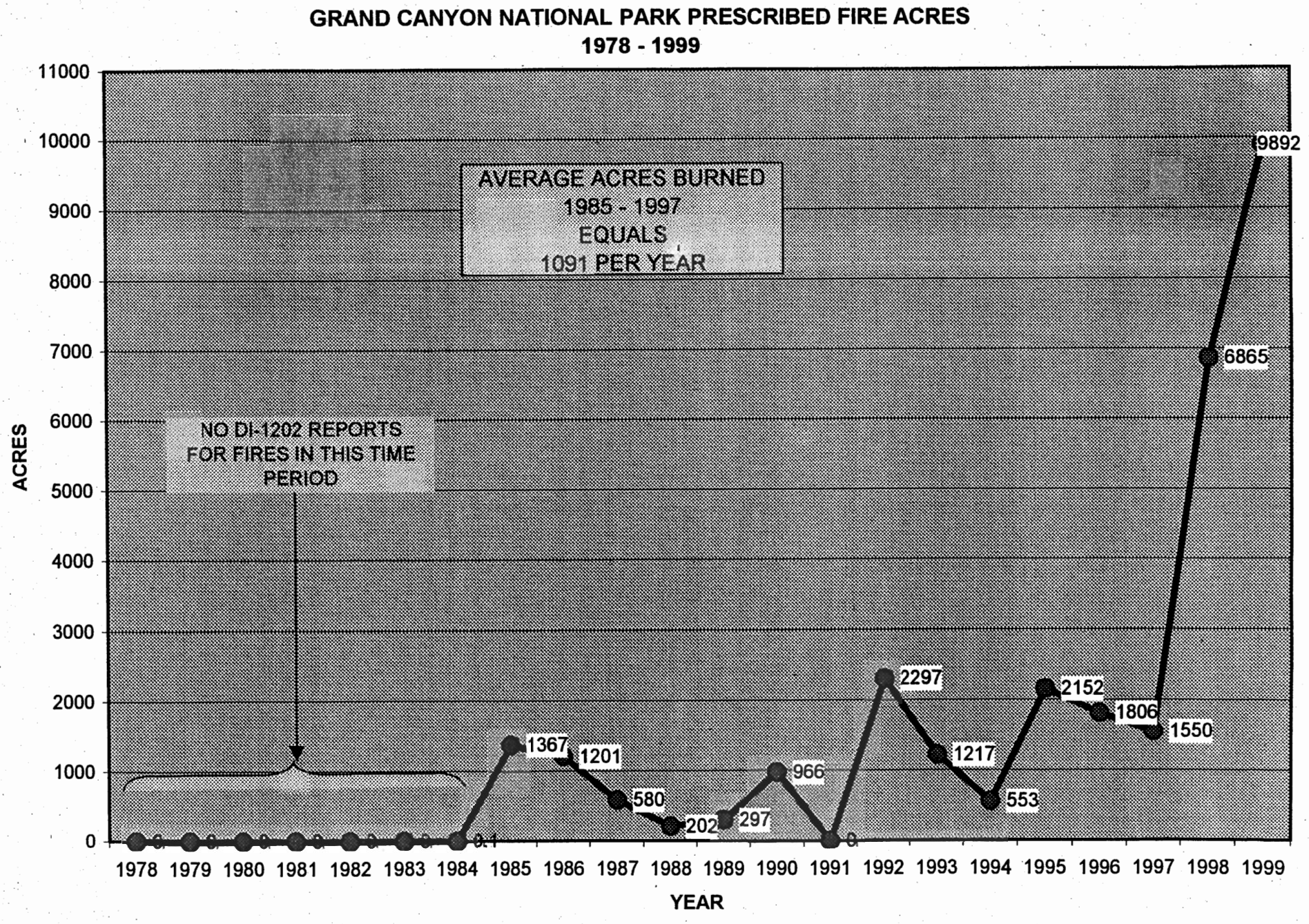
Long-Range Burn Plan and Other Burn Rotations

The current long-range burn plan worked well for resource management and fire management in the 1999 calendar year. Appendix C contains the current long-range burn plan. The Prescribed Fire Manager and Prescribed Fire Specialist, in conjunction with the Fire Effects Monitoring Program, have developed a burn rotation for the South Rim (appendix C). This burn rotation is for the South Rim ponderosa pine fuel types and is designed to help Managers determine burn priorities for the next several years. The next step for development of a long-range burn rotation is the rotation for ponderosa pine areas among the North Rim. The development of these rotations will help with FMH Plot Schedule, compliance work and budget development.

Several long term and landscape burn plans were written in 1999. These plans are designed to last for several years over thousands of acres. Plans written in 1999 include Long Jim I, II, III, Picnic (5,300 acres, South Rim), Horsethief (5,341 acres, South Rim), Shoshone (1,308 acres, South Rim), 2nd Entry South Rim Ponderosa Pine for the Entrance/Quarry/Moqui/Tusayan/Lonetree/Grapevine /Shoshone/Long Jim units (10,605 acres). Other burn plans started in 1999/2000 for a landscape scale objective include Walla Valley (6,000 acres, North Rim), Boundary (8,500 acres, North Rim), Nankoweap, Imperial, Hayden, Vista I and IV, Greenland and Kibbey (3,200 acres, North Rim), 2nd Entry South Rim Ponderosa Pine for the Watson I, II, III and IV, and Hance units (3,133 acres), and Blackberry (N/A acres, Inner Canyon). A map of the all the current burn units for Grand Canyon National Park is located in Appendix E.

Prescribed Fire Summaries

The following pages cover summaries of all completed prescribed fire projects for 1999. Please note when looking at cost, some units contain only FY99 cost and other figures contain Calendar 99, FY99 and FY00 costs. A true calendar-year cost of projects was done with the best-cost figures available. Appendix D contains a spreadsheet showing all prescribed fire projects and total costs. Again, this chart in appendix D is only for FY99 and portions of FY00 and contains information from calendar year 1998. Appendix F contains all prescribed fire project maps. These project maps will show treatment and/or burned areas for projects that are several thousand acres in size or multi-year projects. Grand Canyon National Park completed 9,846 acres of prescribed fire, 81 acres of mechanical treatment, and 46.5 acres of pile burning. *(See attached graph)*


GRAND CANYON NATIONAL PARK PRESCRIBED FIRE ACRES
1978 - 1999
ACRES
YEAR
AVERAGE ACRES BURNED
1985 - 1997
EQUALS
1091 PER YEAR
NO DI-1202 REPORTS
FOR FIRES IN THIS TIME
PERIOD
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999
0 0 0 0 0 0 0 0.1 1367 1201 580 202 297 966 0 2297 1217 553 2152 1806 1550 6865 9892

Prescribed Fire Project Summaries

Shoshone Prescribed Fire Project

Unit Information:

Size: 1297 acres
Location: South Rim
Fuel Type: Ponderosa Pine
Number of entry: First Entry
Operational Periods: One burning period
Unit Cost: $79,084.00
Cost per Acre: $60.97

OPERATIONS: This unit was a first entry burn that occurred in one day during the spring of 1999 (March 30, 1999). 2 Type 3 NPS engines, 2 Type 6 FS engines, 1 AMFAC structure engine with 5 personnel, 1 5,000 gallon water tender, Rx monitors from GRCA and other misc. personnel from GRCA NP were involved in the burn operations of this unit. Several other people from GRCA NP were involved including public information, interpreters, logistical support, dispatch and other functions to support the personnel.

SAFETY: There were no significant incidents or accidents concerning this burn. Public Safety was the greatest safety concern due to the location of the burn and Highway 64. A Public Safety Specialist was assigned to this project and was responsible for all public safety operations. Several law enforcement rangers were involved with this effort, and several citations were issued to the public for entering a closed area.

HELICOPTER: The GRCA NP helicopter was used during burn operations for this unit. The helicopter was used for dispensing Ping-Pong balls (6,500 ball were dropped during firing operations), reconnaissance, and smoke management concerns. The helicopter flew for 5.8 hours and cost $12,543.24. All operations were safe and accident free.

SMOKE MANAGEMENT: GRCA NP worked with ADEQ and Carl Bowman, GRCA Air Quality Specialist, to manage the smoke for this prescribed fire unit. No emission standards were broken during any operational periods. DataRams were used to measure particulate matter in key locations surrounding the prescribed fire activities. GRCA personnel took photos of smoke at different times throughout a 24 hour period to show smoke flows and impacts to the Grand Canyon and Village area. Mop-up did occur along the unit boundaries to help minimize smoke impacts to the highway and residence in the area. A major snowstorm occurred two days after ignition assisting in the mop-up operation and smoke management concerns.

Public Information: There were several public contacts made for this project. Public Service announcements, press releases, and site bulletins were done for this project. A general fire phamplet/handout was given to all visitors via the gate on days when smoke was visible (usually firing operation days). This handout explained the role and benefits of fire. All residents and local hotels were given (delivered by GRCA personnel or posted on door) a general statement and map about the project. Interpreters roamed all overlooks and areas where general publics were, to talk about the prescribed fire project.

See appendix F for map.

Horsethief Prescribed Fire Project

Unit Information:

Size: 400 acres (Unit is 5341 acres)
Location: South Rim
Fuel Type: Ponderosa Pine and Pinyon Juniper
Number of entry: First Entry
Operational Periods: One burning period
Unit Cost: $ 46,729.00
Cost per Acre: $ 116.82

OPERATIONS: This unit was a first entry burn that occurred in one day (as well as four days of blacklining efforts) during the fall of 1999 (September 8, 1999). 1 Type 5 NPS engine, 1 Type 6 BIA engine, Rx monitors from GRCA and other misc. personnel from GRCA NP were involved in the burn operations of this unit. Several other people from GRCA NP were involved including public information, interpreters, logistical support, dispatch and other functions to support the personnel.

SAFETY: There were no significant incidents or accidents concerning this burn. Public Safety was the greatest safety concern due to the location of the burn and West Rim Drive. There were no incidents.

HELICOPTER: The GRCA NP helicopter was used during burn operations for this unit. The helicopter was used for dispensing Ping-Pong balls (firing operations), reconnaissance, and smoke management concerns. The helicopter flew for 1.4 hours and cost $3,627.40. All operations were safe and accident free.

SMOKE MANAGEMENT: GRCA NP worked with ADEQ and Carl Bowman, GRCA Air Quality Specialist, to manage the smoke for this prescribed fire unit. No emission standards were broken during any operational periods. DataRams were used to measure particulate matter in key locations surrounding the prescribed fire activities. GRCA personnel took photos of smoke at different times throughout a 24 hour period to show smoke flows and impacts to the Grand Canyon, the Village area, and the town of Tusayan. No impacts were experienced at any of these areas due to burning with winds from the north-northeast. Signs were posted in the event that a wind shift would occur; however this did not happen.

Public Information: There were several public contacts made for this project. Public Service announcements, press releases, and site bulletins were done for this project. Interpreters roamed all overlooks and areas where general publics were, to talk about the prescribed fire project. Due to the wind conditions and smoke location, a lot of the general publics were not aware of the prescribed fire activity, therefore not creating as much interest as expected. All contacts were positive and supportive of the prescribed fire program.

See appendix F for map.

Lonetree Prescribed Fire Project

Unit Information:

Size: 318 acres (Unit is 860 acres)
Location: South Rim
Fuel Type: Ponderosa Pine
Number of entry: First Entry
Operational Periods: One burning period
Unit Cost: $38,260.00
Cost per Acre: $100.16

OPERATIONS: This unit was a first entry burn that occurred in the spring of 1999 (5/15/99). 1 Type 3 NPS engine, 1 Type 6 NPS engine, 2 Type 6 FS engines, Misc. FS OH, Rx monitors from GRCA and other misc. personnel from GRCA NP were involved in the burn operations of this unit. Several other people from GRCA NP were involved including public information, interpreters, logistical support, dispatch and other functions to support the personnel.

SAFETY: There were no significant incidents or accidents concerning this burn. There was some health issues concerning public safety and smoke. DataRams and photo documentation were in place before, during and after burning operations to ensure that particulate matter regulations were not exceeded. One resident with severe asthma was moved to a location that would ensure no impacts from this prescribed fire.

HELICOPTER: The GRCA NP helicopter was not used during burn operations for this unit. This was due to close proximity of air tour flight route. Hand ignition was the method used for this unit.

SMOKE MANAGEMENT: GRCA NP worked with ADEQ and Carl Bowman, GRCA Air Quality Specialist, to manage the smoke for this prescribed fire unit. No emission standards were broken during any operational periods. DataRams were used to measure particulate matter in key locations surrounding the prescribed fire activities. An ADEQ Dicod was also monitored for smoke emissions. GRCA personnel took photos of smoke at different times throughout a 24-hour period to show smoke flows and impacts to the town of Tusayan. A few smoke complaints were communicated and responded to by the Burn Boss and Prescribed Fire Management Staff.

Public Information: There were several public contacts made for this project. Public Service announcements, press releases, and site bulletins were done for this project. A general fire phamplet/handout was given to all visitors via the gate on days when smoke was visible (usually firing operation days). This handout explained the role and benefits of fire. All residents and local hotels were given (delivered by GRCA personnel or posted on door) a general statement and map about the project. Interpreters roamed all overlooks and areas where general publics were, to talk about the prescribed fire project.

See appendix F for map.

Walhalla Prescribed Fire Project

Unit Information:

Size: 764 acres (1999 calendar year of FY 99); 3,225 acres (1999 calendar year of FY00); 3954 acres total; (Unit is 14,000 acres)
Location: North Rim
Fuel Type: Ponderosa Pine
Number of entry: First
Operational Periods: Five burning periods
Unit Cost: $ 191,007.04
Cost per Acre: $ 27.56

OPERATIONS: This unit was a first entry burn that occurred over five burning periods in the spring and fall of 1999 (3/2, 3/3, 11/15, 11/20, and 12/7). Rx monitors from GRCA, a detailer from the regional office, and other misc. personnel from Branch of Fire and Aviation, GRCA NP were involved in the burn operations of this unit. Several other people from GRCA NP were involved including public information, interpreters, logistical support, dispatch and other functions to support the personnel.

SAFETY: There were no significant incidents or accidents concerning this burn.

Helicopter: The GRCA NP helicopter was used during burn operations for this unit. The helicopter was used for dispensing Ping-Pong balls (firing operations), reconnaissance, and smoke management concerns. The helicopter flew for 27.6 hours (FY99 and FY00 of 1999) and cost $51,830.24 (FY99 and FY00 of 1999). All operations were safe and accident free.

SMOKE MANAGEMENT: GRCA NP worked with ADEQ and Carl Bowman, GRCA Air Quality Specialist, to manage the smoke for this prescribed fire unit. No emission standards were broken during any operational periods. DataRams were used to measure particulate matter in key locations surrounding the prescribed fire activities. GRCA personnel took photos of smoke at different times throughout a 24-hour period and on scheduled intervals up to three weeks after ignition to show smoke flows and impacts to the canyon.

Public Information: There were several public contacts made for this project. Public Service announcements, press releases, and site bulletins were done for this project. A general fire phamplet/handout was given to all visitors via the gate on days when smoke was visible (usually firing operation days). This handout explained the role and benefits of fire. Interpreters roamed South Rim overlooks and areas where general publics were, to talk about the prescribed fire project and the benefits gained for the ecosystem.

See appendix F for map.

Outlet Prescribed Fire Project

Unit Information:

Size: 3,842 acres (Unit is 10,034 acres)
Location: North Rim
Fuel Type: Ponderosa Pine and Mixed Conifer
Number of entry: First Entry
Operational Periods: 3 burning periods
Unit Cost: $ 51,348.23
Cost per Acre: $ 13.36

OPERATIONS: This unit was a first entry burn that occurred over three burning periods in the fall of 1999 (10/2, 10/5, 10/6). 1 NPS Type 6 engine, 1 4,500-gallon water tender, the Zion Fire Use Module, Rx monitors from GRCA and other misc. personnel from GRCA NP were involved in the burn operations of this unit. Several other people from GRCA NP were involved including public information, interpreters, logistical support, dispatch and other functions to support the personnel.

SAFETY: There were no significant incidents or accidents concerning this burn.

Helicopter: The GRCA NP helicopter was used during burn operations for this unit. The helicopter was used for dispensing Ping-Pong balls (firing operations), reconnaissance, and smoke management concerns. The helicopter flew for 30.1 hours and cost $43,607.59. All operations were safe and accident free.

SMOKE MANAGEMENT: GRCA NP worked with ADEQ and Carl Bowman, GRCA Air Quality Specialist, to manage the smoke for this prescribed fire unit. No emission standards were broken during any operational periods. GRCA personnel took photos of smoke at different times throughout a 24-hour period to show smoke flows and impacts to the canyon. There was some smoke complaints from Page, Arizona concerning this burn. Complaints were minor in nature and actions have been taken to avoid these types of concerns for future burning.

Public Information: There were several public contacts made for this project. Public Service announcements, press releases, and site bulletins were done for this project. A general fire phamplet and/or handout was given to all visitors via the gate on days when smoke was visible (usually firing operation days). This handout explained the role and benefits of fire. Interpreters roamed South Rim overlooks and areas where general publics were, to talk about the prescribed fire project. Old two-tracks (now used for trails) was closed for about seven days during this operation. The interpretation and fire information staff made a lot of public contacts during burning. This burn was visible from the South Rim and created a lot of interest in Grand Canyon's Prescribed Burning Program.

See appendix F for map.

Village Fuel Break – Mechanical Treatment and Prescribed Fire Project

Unit Information:

Size: 7.5 acres burned by thinning done in FY97. (Unit is 2000 acres)
Location: South Rim
Fuel Type: Ponderosa Pine and Pinyon Juniper
Number of entry: First Entry
Operational Periods: Several days of hand ignition, burning a few at a time
Unit Cost: $ 976.00
Cost per Acre: $ 130.13

OPERATIONS: This unit was a first entry mechanical treatment that occurred over the summer and winter of FY97 and FY98. Operations in 1999 included burning of these piles only. South Rim Suppression personnel from GRCA NP were involved in the burn operations of this unit. Several other people from GRCA NP were involved including public information, dispatch and other functions to support the personnel.

SAFETY: There were no significant incidents or accidents concerning this project.

Helicopter: The GRCA NP helicopter was not used during any operations for this unit.

SMOKE MANAGEMENT: GRCA NP worked with ADEQ and Carl Bowman, GRCA Air Quality Specialist, to manage the smoke for the piles from this unit. No emission standards were broken during any operational periods. Most of the larger wood debris (>4" dbh) was transferred to the BIA. The BIA sold wood permits to tribal members who then removed this wood from the site.

Public Information: There was not a lot of public interest concerning the burning of the hand piles. Information concerning the burn and smoke was posted in key locations throughout the park and on information boards. A message was posted daily for all park employees concerning the burning of the hand piles. Smoke signs were posted along road areas that might be affected. There were no smoke complaints.

See appendix F for map.

Bright Angel Mechanical Treatment and Prescribed Fire Project

Unit Information:

Size: 81 acres mechanical treatment, 39 acres burned (piles made in FY98) (Unit is 460 acres)
Location: North Rim
Fuel Type: Ponderosa Pine and Mixed Conifer
Number of entry: First Entry
Operational Periods: Numerous Operational Periods May – November
Unit Cost: $64,266.00
Cost per Acre: $558.83

OPERATIONS: This unit was a first entry treatment that occurred over the summer and fall of 1999. Arrowhead Interagency Hotshot Crew and personnel from GRCA NP were involved in the mechanical treatment and pile burning operations of this unit. Several other people from GRCA NP were involved including public information, logistical support, dispatch and other functions to support the personnel. The interpreters and public information done for this unit was imperative to the success of this project. This project is highly visible to the public and there was a lot of concern over project necessity and overall goals of the project.

SAFETY: There were no significant incidents or accidents concerning this project.

Helicopter: The GRCA NP helicopter was not used during any operations for this unit.

SMOKE MANAGEMENT: GRCA NP worked with ADEQ and Carl Bowman, GRCA Air Quality Specialist, to manage the smoke for the piles from this unit. No emission standards were broken during any operational periods.

Public Information: There was a lot of public interest concerning the purpose and goals of this project. Information concerning the thinning for defensible space was posted in key locations throughout the North Rim. Once the project was explained to the general public, there was on the site support. Fire Management Staff is still working on internal concerns and is working closely with North Rim Staff to ensure success of this project.

See appendix F for map.

Grand Canyon National Park
Fire Effects Monitoring Program Annual Report
1999 Calendar Year

Tonja Opperman, Fire Effects Specialist
Kara Leonard, Fire Effects Crew Leader

March 1, 2000

Executive Summary

The Fire Effects Monitoring Program at Grand Canyon National Park works to meet the park's annual Government Performance and Results Act (1993) goal to restore disturbed park lands, as identified on page 14 of the Grand Canyon National Park FY99 Annual Performance Plan. This Fire Effects Monitoring Program Annual Report summarizes the Fire Effects Monitoring Program activities from January 1, 1999 to December 31, 1999. The following report justifies the existing plot network, details annual accomplishments, outlines plans for expansion, and provides data analysis for all information collected to this point.

During 1999, the Fire Effects Monitoring Crew visited more plot locations than in any other year, and updated 74 plot files for a season of unparalleled success. Increased seasonal staffing, and an improved office environment contributed greatly to these efforts. A review from the Intermountain Region Fire Ecologist suggests the Grand Canyon National Park Fire Effects Monitoring Program is well on the way to meeting future fire monitoring goals.

INTRODUCTION

During the 1999 calendar year, the Grand Canyon Fire Effects Crew monitored numerous prescribed and wildland fires in addition to visiting and establishing plots in the Fire Effects Monitoring plot network. The crew of six made 53 plot visits, attended formal training classes, went on several out-of-park fire monitoring assignments, and worked a combined total of 2090 hours of overtime on various assignments and projects. Efforts made during the last two seasons to clean up plot files, organize data processing, and purchase quality equipment paid off with a highly successful 1999 field season.

GOALS

The primary aim of the Fire Effects Monitoring Program is to provide information to fire and resource managers, which allows them to affirm that prescribed fire objectives are being met or to identify and correct deficiencies. Through the Fire Effects Monitoring Program at Grand Canyon National Park, data have been collected on pinyon-juniper woodlands and ponderosa pine associations. Other ecosystems such as meadows and subalpine conifer forests will soon be part of the Fire Effects Monitoring Program.

Specific goals regarding the Fire Effects Monitoring Program can be found in the Fire Monitoring Plan, an appendix to the Fire Management Plan. This document is reviewed annually and updated as needed.

STAFFING

One GS-7 subject-to-furlough (Table 1) and one GS-6 term position managed the crew during 1999 field operations. We had a crew of six during the middle of the 1999 field season, but otherwise a crew of five. The crew visited 53 plots between April 12 and mid-September 1999.

Overtime and hazard pay hours are included to indicate that the fire effects crew members do not just function as plot monitors at Grand Canyon, but play an important part in helping with engine coverage, helibase operations, wildfires, Level 1 fire monitoring, fire reconnaissance, and other activities in the park. Several fire effects employees also had opportunities to serve on details and fire assignments out-of-park. See Table 2 for a summary of how crew time was spent during the 1999 calendar year.

TABLE 1. Fire Effects Crew Members for 1999 calendar year.

Monitor	Starting Date	Ending Date	Pay Periods Worked	Overtime Hrs	Hazard Hrs
Tonja Opperman, GS-7 (permanent)	1/1/99	12/17/99	25	325.75	272.5
Kara Leonard, GS-6 (term)	1/1/99	1/1/00	26*	102.5	65
Li Brannfors, GS-5 (seasonal)	4/12/99	12/17/99	19	364.5	345.5
Chris Moore, GS-5 (seasonal)	4/12/99	10/8/99	14	598.5	450.75
Michelle Farnham, GS-5 (seasonal)	4/12/99	10/8/99	14	389.75	169.5
Jonnathon Kline, GS-3 (STEP student hire)	6/21/99	9/17/99	7.5	308.5	188.75

*K. Leonard's furlough will be in March 2000.

TABLE 2. Base-hour crew activities by percent and category. Shaded areas are where crewmembers spent majority of base-hour time.

Monitor	FMH-Office	FMH-Field	Wildfire and Hellbase Ops.	Rx Fire Ops.	FMH Training	Other Training	Fuel Sampling	Air Quality	Teaching and Supervision	Meetings and Conferences
Tonja Opperman, GS-7	41%	9	11	5	5	1	0	0	13	15
Kara Leonard, GS-6	41	40	4	4	3	2	0	3	0	3
Li Brannfors, GS-5	26	34	18	11	8	1	1	0	0	1
Chris Moore, GS-5	14	30	42	5	3	5	0	1	0	0
Michelle Farnham, GS-5	24	50	6	7	7	5	0	1	0	0
Jonnathon Kline, GS-3	19	21	55	5	0	0	0	0	0	0

MONITORING TYPES AT GRAND CANYON

Every vegetation type at Grand Canyon National Park where prescribed fire is used, requires the Fire Effects Specialist to develop a document called the FMH-4 Monitoring Type Description sheet. This document provides a physical and biological description, desired future condition, burn prescription, and burn objectives. Grand Canyon's prescribed fire program places great importance on these documents, as they guide every burn plan.

FMH-4 Monitoring Type Description Sheets are completed for PIED, PIPO, PIPN, and PIAB (Appendix G). The PIEN FMH-4 was written in 1993 but needs revision. A draft will be ready by May 2000. The MEAD FMH-4s have not been written but will be in place before the 2000 plot installation begins in these monitoring types. The **JUOS** monitoring type is on hold for this year and will likely not be written until December 2000 or later.

SOUTH RIM PONDEROSA PINE (PIPO)

After the 1998 field season, we determined that only one more plot installation was needed in this monitoring type. A plot was installed in the Horsethief burn unit that was scheduled for ignition in the fall of 1999. However, the Horsethief subunit where the plot was located was not ignited, so this plot has not burned. One other plot was visited to gather preburn information for a second time (PRE(2)) since the plot has not burned since it was read in 1992 on the Picnic unit.

Because Grand Canyon National Park's prescribed fire program relies on opportunistic burning to take advantage of all burning opportunities, not all plots are burned in *either* spring or fall as suggested under the standard fire effects monitoring protocols. In order to tease out effects of seasonal burning, we decided, in conjunction with the Regional Fire Ecologist, to install more plots in the South Rim Ponderosa Pine. After the plots are burned there may be enough plots in spring to analyze them separately from the plots burned in fall. Before new installs take place, we must determine which season the burned plots were ignited. Once that is known, we can try to install the new plots in burn units most likely to burn in the season where data are needed. However, there are no guarantees to which season a particular burn unit will be burned. If a unit scheduled to be burned in spring of 2000 cannot be burned due to weather or staffing difficulties, then that unit is likely to be the first to be ignited in the fall season.

The target for this monitoring type is now 32 plots (see Table 3). Twenty-two exist as of December 1999, which means 10 need to be installed as soon as possible. Six plots will be installed in the Long Jim III unit during the RX-80 Preburn Inventory Techniques class taught at Grand Canyon National Park in May, 2000. The additional four plots can be installed in Grandview or Long Jim I burn units over the 2000 and 2001 field seasons.

The Fire Effects Crew will need to remain up-to-date on plans to burn South Rim units so as not to miss an opportunity to collect data.

GREAT BASIN CONIFER WOODLAND (PIED)

As stated in the 1998 report, this monitoring type may soon be discontinued. Five-year data were collected on the final two plots. No installations are scheduled. The analysis in this report is likely the final analysis that will be performed on the PIED data unless there are future informational needs. If 10-year post-reads are desired on the PIED plots, the first 10-year post-read would be scheduled for 2002 and continue through 2004. Many plots installed in the PIED monitoring type were installed when the program was still very new in the National Park Service. Written protocols did not exist, there was little crew training, and there was not a year-round staff to maintain data records. Consequently, there are many errors in the data. For example, fuel transects were read at different lengths on different plots, diameters of multiple-stemmed junipers were read in a variety of ways. Caution should be used when interpreting any of the PIED data now or after a 10-year post-burn visit.

NORTH RIM PONDEROSA PINE (PIPN)

Six more plots were installed in North Rim Ponderosa Pine for a total of 12 plots in the network. Plots are located in the Walhalla, Outlet, Walla Valley, Northwest III, and Northwest I burn units. It is estimated that nine plots have burned to date, with the plots on Walla Valley and Northwest I remaining unburned, however, PIPN11 on Walhalla may not have been burned during the December 1999 aerial ignition. Maps of the ignition indicate the ignition line is just south of the plot location. The Immediate Post for PIPN11 will have to be completed in spring 2000 if it did, indeed, burn. For now, it is assumed to be burned but not post-read.

Minimum plot calculations suggest a network of 20 plots will allow desired monitoring for both spring and fall burning (see South Rim Ponderosa Pine, above). The eight plots that need to be installed will need to be randomized over Walhalla and Walla Valley. Walhalla plot locations will be in the northern half of the unit since the southern half has already burned. Walla Valley plot locations should be randomized over the entire unit. During the 2000 field season all of these new installs are scheduled to take place.

PONDEROSA PINE/WHITE FIR ENCROACHMENT (PIAB)

Thirteen plots were re-read this year since the preburn data was over three years old and these plots are scheduled to burn in the next two years. Most of the plots that had to be re-read were installed during a research project conducted by Northern Arizona University in 1993. We have incorporated them into our existing plot network to take advantage of the installation work already completed. No installs were made in this monitoring type in 1999 because there were already enough plots according to the minimum plot calculations

from last year. However, after considering the possibility of spring and fall burning in this monitoring type, we decided to add two plots to the network to achieve minimum plots needed to evaluate overstory ponderosa pine after both spring and fall burns. The two installs will be randomized over Walhalla and Outlet/Widforss burn units. If the Fire Effects Specialist determines that the crew will be unable to complete all required plot reads and installs during the 2000 field season, the PIAB installs will be the first ones dropped from the schedule.

ROCKY MOUNTAIN SUBALPINE CONIFER (PIEN)

The three plots installed in this monitoring type during 1993 and 1994 in the Boundary and Nankoweap units remain unburned. Nine plots will be randomized and installed during the 2000 field season in the Nankoweap/Kibbey units. Although the forest description is known, the specific objectives for the area remain loosely defined with the exception of fuel load reduction. Consultation with the Science Center staff is desired before finalizing the FMH-4 Monitoring Type Description objectives over the coming years.

NORTH RIM MEADOWS (interior and edge) (MEAD)

Portions of The Basin may be burned in the future. Twenty plots will be installed in the 2000 field season—ten will be brush transects in the interior, and ten will be "edge" plots to monitor the tree line. Methods for the "edge" monitoring have not yet been determined and the FMH-4 Monitoring Type Description is still under development. All of these plots will be installed and read in August so data are as consistent as possible.

MISCELLANEOUS (XXXX)

This is not a monitoring type at all, but is the folder label given to all plots that no longer have a place in Grand Canyon National Park's Fire Effects Monitoring network. They have been removed because they are located on ecotone boundaries that do not fit easily into any of the monitoring types established. This isn't to say that the data are not important, but to include them in the network significantly increases the necessary sample size needed to evaluate primary monitoring variables. Plot stakes remain in the ground, and the plot data remains in the fire effects office to be used if it is ever needed.

Minimum Plot Calculations and Plot Install Priorities

Minimum plot calculations are shown in Table 3 for each monitoring variable. For PIED, all plots needed are installed and there are no plans to continue with this monitoring type. The JUOS monitoring type is on hold for the moment as we wait on information from planned research in this monitoring type. Both MEAD monitoring types do not have minimum plot calculations at this time since there are no plots installed. Minimum plot calculations for PIEN will be performed after five or ten plots have been installed, but there are only three installed to date. The XXXX monitoring type does not need to have

minimum plot calculations, as it is a repository for plots that currently do not fit in any monitoring type. It is included only for consistency.

For PIPO, because we will burn in all seasons without differentiating them, we will install twice as many as the minimum plot calculations, plus four extra plots. It is necessary to monitor overstory ponderosa pine with the most confidence we can reasonably achieve. Monitoring at 90% confidence with R=20 is not achievable at this time. For the time being, we will install enough plots to monitor ponderosa overstory at 80% confidence with R=20. We may find, with just a few more installations, that we can monitor this variable at 90%/R20. Although we want to monitor poles, there is so much variability that we cannot monitor them with any significance at this time. As we add plots to the network, we will continue to calculate minimum plot size for monitoring ponderosa poles. To capture fire effects for spring burns, plots must be installed the previous year.

In the PIPN monitoring type, overstory ponderosa is, again, the most important monitoring variable. It is reasonable to monitor at 90%/R20 in this type. We need 22 plots to account for possible spring and fall burning but there are currently only 12 plots. More installs are planned on Walhalla and Walla Valley in 2000. It will be important to finish installs on Walhalla in 2000 since that will likely burn first. As on the South Rim, there are not many opportunities for unburned install areas on the North Rim in this monitoring type. Although we would like to monitor ponderosa poles with statistical significance, it is not possible when 65 plots are needed. We will monitor ponderosa poles at the highest level possible with 22 plots. To capture fire effects for spring burns, plots must be installed the previous year.

The PIAB monitoring type already has 22 installed plots, but we will install six more in 2000 to try capturing some spring burn information. Some spring burns have taken place, but no plots were in these sub-units. We can reasonably monitor overstory ponderosa trees at 80%/R20 with 10 plots per burn season. More plots would be needed to monitor total fuel load and poles, but we will re-evaluate the minimum plots needed for these variables after the six are installed in 2000. Because there are enough plots already installed in this type for monitoring the primary variable, installing more PIAB plots is the lowest priority for 2000.

TABLE 3. Results of minimum plot calculations by monitoring type and monitoring type variable.

	Primary Monitoring Type Variable	Secondary Monitoring Type Variable	Tertiary Monitoring Type Variable
FPIED1D09	Fuels 80%/25 =8 (based on 6 PRE plots w/100' transects)	Overstory 80%/20= 15* JUOS, 7* PIED	n/a
FPIPO1D09	Large Ponderosa Overstory 80%/20=14* Small Ponderosa Overstory 80%/25=22* 80%/20=34 (14*2) +4=32 target	Total Fuel Load 80%/20=5* 90%/25=6* (based on 7 PRE plots w/100' transects)	PIPO Poles 80%/25=54
FJUOS1D06	n/a	n/a	n/a
FPIPN1D09	Large Ponderosa Overstory 90%/20=8* Small Ponderosa Overstory 80%/25=11* 80%/20=17 (8*2) +4=20 target	Total Fuel Load 80%/20=11, 90%/20=19	PIPO Poles 80%/25=65
FPIAB1D09	PIPO Overstory 80%/20=10, 90%/20=17 (10*2) +4=24 target	Total Fuel Load 90%/20=10	ABCO Poles 80%/25=15
BMEAD1D01	n/a	n/a	n/a
FMEAD1D01	n/a	n/a	n/a
FPIEN1D10	Total Fuel Load n/a (n=3)	Overstory n/a (n=3)	n/a
FXXXX	n/a	n/a	n/a

*= Minimum Plot Numbers Achieved

GRAND CANYON'S PLOT NETWORK

EXISTING PLOTS AND 1999 ACCOMPLISHMENTS

There are 84 plots currently installed in the network (Table 4), ten of which are in the FXXXX category and will no longer be monitored on the standard FMH schedule. One plot was installed on the South Rim this year and six were installed on the North Rim. Twenty-four visits were made to read post-burn information (Year 1, Year 2, and Year 5 post-burn) and eight visits were made to Immediate Post-burn plots. Fourteen PRE(2) visits were made to re-read preburn data since it has been over three years since data were collected and these plots are scheduled to burn in the next two years. This makes for a total of 54 plot visits in 1999—the greatest plot workload the fire effects crew has ever encountered.

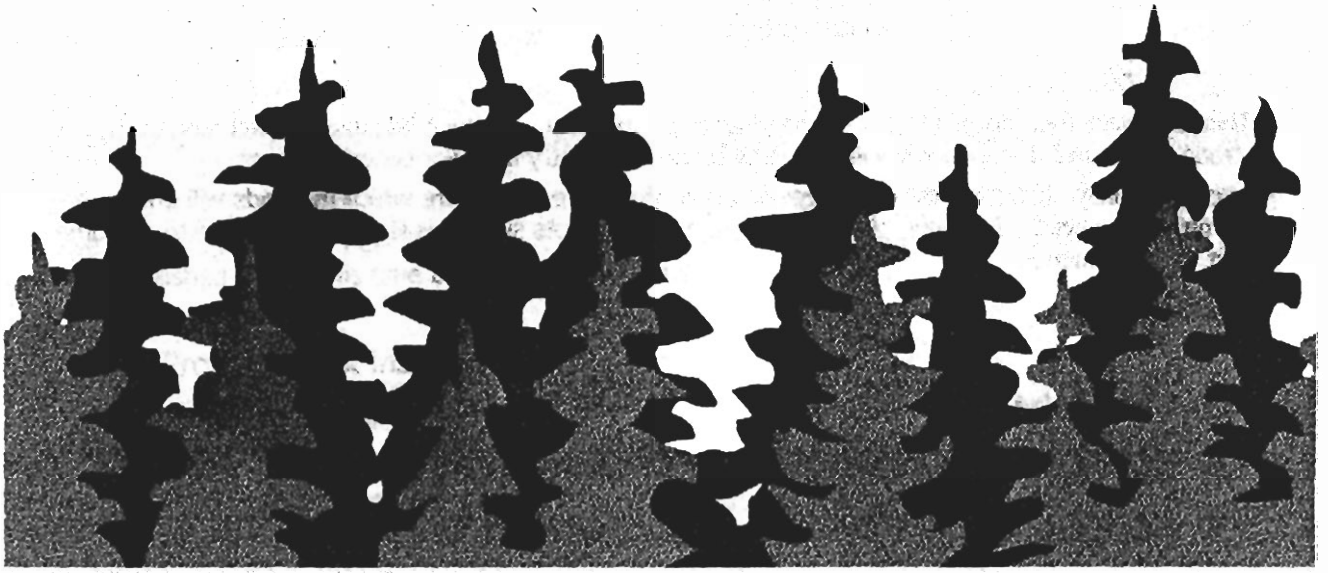


TABLE 4. Number of plots installed by monitoring type in 1999 and previously.

Monitoring Type Code	Monitoring Type Name	Rim	Number of Plots Installed in 1999	Total Number of Plots Installed
FPIED1D09	Great Basin Conifer Woodland	S	0	15
FPIPO1D09	South Rim Ponderosa Pine Forest	S	1	22
FJUOS1D06	South Rim Pinyon-Juniper Woodland	S	0	0
FPIPN1D09	North Rim Ponderosa Pine Forest	N	6	12
FPIAB1D09	North Rim Ponderosa Pine/White Fir Encroachment	N	0	22
BMEAD1D01*	North Rim Meadows--Interior	N	0	0
FMEAD1D01**	North Rim Meadows--edge	N	0	0
FPIEN1D10	Rocky Mountain Subalpine Conifer Forest	N	0	3
FXXXX	North Rim plots that do not fit in any current monitoring type	N/A	n/a	10
TOTAL			7	84

*This is a *grass* fuel model (1) but is coded as a *brush* monitoring type because we will monitor brush encroachment and the software will not allow brush data entry in a plot coded as grass.

**We will monitor the meadow edge pre- and post-fire but are not sure which methods will give us the information we need. For now, plots are coded as forest plots since it is likely we will have to do some forest measurements.

PLOT REMEASUREMENTS FOR 1999 AND BEYOND

Forty-six plots were re-measured in 1999 and 41such visits are planned for 2000 (Table 5). The GRCA Fire Effects Crew visited more plots in 1999 than in any previous year, and the workload is expected to grow through 2002 (Table 6). In 2000, 41 plot visits are planned, along with 56 installs for a total of 97 plot visits (Table 7). These installs will take place on the South Rim when Grand Canyon National Park hosts RX80, but the remaining installs will take place on the North Rim. *It is expected that the crew will spike out on the North Rim for 14 weeks in 2000.*

TABLE 5. Plot re-measurements by plot type for 1999 and 2000.

Total Plots to Remeasure 2000				Total Plots Remeasurement 1999			
G	B	F	Total	G	B	F	Total
0	0	16 (25 P)	16 (25 P)	0	0	24 (8 P)	24 (8 P) 14 (R)
TOTAL VISITS			41	TOTAL VISITS			46

P = Immediate Postburn Remeasurements
R = Remeasured plots to gather Preburn data

TABLE 6. Five-year projected number of plot re-measurements by year

Number of Plots					
1999	2000	2001	2002	2003**	2004**
24 (8 P)	16 (25 P)	24 (46 P)	76 (16 P)	75 (0 P)	23 (0 P)
32 visits	41 visits	70 visits	92 visits	75 visits**	23 visits**

**These projections assume new plots are not established after 2002. Pinyon-juniper forest and brush plots may be established during this time but plans are not finalized.

TABLE 7. Projected plot installation.

Plots to be Installed 2000				Projected Total by 12/00**			
G	B	F	Total	G	B	F	Total
0	10	46	56	0	10	130	140

**The ability to reach this goal is dependent largely on the nature of the GRCA fire season and resource availability.

POSTBURN PLOT VISIT SUMMARY

Three plots burned this year on the Outlet burn unit—plot PIPN05 was ignited by lightning and allowed to burn in the Redtail Wildland Fire Use fire, and PIPN09 and PIPN12 were ignited with plastic spheres in October 1999 (Table 8). An aerial ignition on Walhalla in December 1999 may have burned plot PIPN11, but we will not know until the plot is visited in spring of 2000. If the plot burned, it will need to be read at that time for immediate post-burn effects. We are assuming it *did* burn for the purpose of Table 8.

Table 9 shows how many of the total plots in the network have been visited at post-read intervals. Of the 84 total plots in the network, 47 have immediate post-burn data, and 4 have had immediate post-burn data gathered again, after a second burn. Although 49 plots have actually burned, two immediate post-burn visits were missed in the past, making the total number of visited plots only 47. Under a perfect fire effects monitoring schedule, the total columns in Tables 8 and 9 would show the same number.

TABLE 8. Number of burned plots.

Total Plots Burned 1999				Total Plots Burned to Date			
G	B	F	Total	G	B	F	Total
0	0	4	4 (0R)	0	0	49 (4R)	49 (4R)

R = Reburns

TABLE 9. Postburn plot summary (visits to date).

	G	B	F	Total
Immediate Postburn*	0	0	47 (4)	47 (4)**
1 Year Postburn*	0	0	47 (4)	47 (4)
2 Year Postburn	0	0	38	38
5 Year Postburn	0	0	28	28
10 Year Postburn	0	0	0	0

*Numbers in parentheses indicate number of second post-burn reads, or POST 02.

**Why are Immediate Post reads and 1 Year Post reads the same if 3 plots burned and post-read in 1999? Because PIPO19 Postread was missed in 1996 and PIPN11 probably burned December 99 but no POST has been read yet. It is NOT included as "visited" in this table.

WHERE THE PLOTS ARE LOCATED

The plots in the network are randomized across 21 different burn units (Table 10). Maps showing where plots are located in burn units are in Appendix H.

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

	Boundary	Entrance	Hance	Horsethief	Lone Tree	Nankoweep	NW I	NW III	NW V	Outlet	Picnic	Quarry	Shoshone	Tiyo I	Topeka	Village	Vista IV	Walhalla	Walla Valley	Watson IV	Widforss
PIAB								07	06	08				12			03	13			02
								25		10				22			04	14			11
										23							05	15			
																	09	16			
																		17			
																		18			
																		19			
																		20			
PIED		01									02	09			06						
		03									07	10			08						
		04										11			13						
		05													14						
		12													15						
PIEN	02					01															
	04																				
PIPN							01			05								03	06		
							02			09								04	08		
										12								07			
																		10			
																		11			
PIPO		01	15	18	19						04	06			02	08				17	
		07									05	10			03					20	
											11				09					21	
											12				13					22	
															14					24	

THE LONG-RANGE PROJECT PLAN

The Long-Range Project Plan (LRPP) is in Appendix C. The first fiscal year projected by the LRPP is very reliable, as burn plans and clearances are usually already completed for this year. As the table projects burns into the future, the table is less reliable and will be revised each year as needed. The fire effects crew must keep this information in mind when planning out long-term plot monitoring schedules.

The shift to landscape-level burning continues, and names for previously delineated small burn units are absorbed into larger units. This can make it difficult to track which plots are in which burn units. It is especially difficult when new burn boundaries are created and combined with poor plot location mapping! Now that we have many plots located by GPS, we will be more confident about exactly where plots are located. However, we will come across plots that have not had their coordinates located with GPS, and there may still be confusion.

PROGRAM INFORMATION

1999 Changes in Protocol

At Grand Canyon National Park units are burned in spring, summer, and fall for a single monitoring type. This is especially true in ponderosa pine associations. Research from northern Arizona supports burning ponderosa pine in multiple seasons. It is not possible to install plots and label them "spring", "summer", or "fall". Rather, we need to install plots, burn them, and then tease out the information to see differences between season of burn with regard to burn objectives. In order to have enough plots to analyze, we must calculate minimum sample size and then at least double it. We will then add four "extra" plots to this number. This will only be done in monitoring types where we do multiple season burning—South Rim Ponderosa Pine (PIPO), North Rim Ponderosa Pine (PIPN), and North Rim Ponderosa Pine with White Fir Encroachment (PIAB). Using this strategy, we will be more likely to have the data needed to tease out the effects of seasonal burning. In order to ensure plot information filters back to the Prescribed Fire Manager, we will randomize these new plots in areas that are scheduled to burn in the next three years rather than the next five years as the FMH protocols suggest.

See FMH-4s for details on protocols for each monitoring type (Appendix G).

Future Changes in Protocol

Although not really a change in protocol, but a change in crew management, the GRCA Fire Effects Crew must consider splitting into two smaller crews for portions of the field season in 2000. With many acres planned for ignition in the next few years, and with some of those ignitions taking place in new monitoring types, there is a need for a lot more plot installations. Also, future plot reads on the North Rim need to be completed by

September 1 before senescence of herbaceous plants, otherwise they are impossible to identify.

CONTROL PLOTS

Because burning in ponderosa pine at Grand Canyon National Park is being scrutinized by outside entities, we may opt to use control plots in the near future for monitoring types with ponderosa pine. It will be difficult to install them so that they are not at risk of being burned during a prescribed fire. We are entertaining the idea of re-reading some of the Covington plots that have already been installed on the North and South Rims in ponderosa pine. The park has agreed to protect these plots from fire. Fire Management, Resource Management, and others need to discuss the need for control plots, options for installing them and the advantages/disadvantages of "control" plots vs. "no treatment" plots.

EQUIPMENT INFORMATION

Most day-to-day fire effects equipment is in the fire effects office at #1 Shuttle Bus Road. There is a drafting table with items stored underneath, an herbarium desk and storage unit with herbarium supplies, and a large black cabinet with other supplies. Two large green and gray bins are used to haul items in the vehicles during the field season. Items like flagging, clipboards, cruising vests, camping supplies and other miscellaneous field items for the fire effects crew are stored in the fire cache, upstairs, in a gray cabinet. Rebar is stored outside the fire effects office in a wooden box painted to match the exterior of the building.

INNOVATIONS

We have a new office that provides a much better working environment than the trailer we had last year. There is space for each crewmember to have his or her own work space. There are separate computer workstations, an herbarium cabinet and desk with supplies, a drafting table, and storage areas. We have extra storage room up in the fire cache for less frequently used items.

This year we had our "plot board" in full working order. It proved essential to guiding daily crew activities while providing one place to track plot data for the season. We will photograph it with the digital camera at the end of each season, wipe it clean, and enter each planned plot visit for the following field season.

All of our plots are now in individual 3-ring binders filed on a large shelving unit in the office for easy access. The field copy is in the front of each binder and, if that plot needs to be visited, it is taken out each spring and put in a field folder. The field folder is then placed in a designated place in the office with all other field folders for that season. Once a plot is read, the folder is put in a place for "data to be entered" and, once entered, it is

again moved to a place for "data to be checked". Data sheets are put back into the 3-ring binder by the Lead Biological Technician.

As we visit older plots, we notice that there is not always adequate information in each binder in regards to plot directions and maps. We have a checklist for each binder and all these checklists are kept in one, separate binder. We have identified all deficiencies in each plot folder, or marked if data are missing. We are now working on remedies for those things that can be fixed.

At the end of 1999 we received our crew vehicle—a six-pack truck. We are in the process of purchasing a camper shell for the back. This vehicle will suit our needs as it allows all crewmembers to travel together with all gear needed for North Rim field work. We will likely request one additional seasonal truck for use in July-September when it may be necessary for the crew to split up due to different assignments.

We are considering purchasing a plot pack for each person on the crew if funds are available. The current plot pack set-up does not work well for most crewmembers that need to bring their own personal gear and lunch into the field for the whole day. It would work better for crewmembers to be assigned a day-pack for the season and a list of plot items they need to have packed in their pack. They could add their own lunch and rain gear to the pack and bring it to the plots. If someone on the crew is not available to do plot work, the crew will have to either divide up the pack contents, or carry that pack in addition to their own packs.

We obtained workspace in a temporary trailer on the North Rim for the field season. The fire archaeologist made arrangements for us to share trailer space with the archaeology crew. Having office space to store equipment, to identify plants in the late afternoons, to go through paperwork before going home, and to work when weather was not conducive to plot monitoring made working on the North Rim considerably more efficient and more comfortable.

We also created a Plot Status worksheet in Excel97 to aid in "seeing" our plot network as a whole. We use this tool to track plot activities and plan for future installations and workloads.

1999 REGIONAL PROGRAM REVIEW

The Regional Fire Ecologist, who oversees fire effects monitoring for the Intermountain Region, visited Grand Canyon National Park's Fire Effects Program twice during 1999. The first visit was in January 1999 to assess the office environment, plot folders, and data quality, as well as talk to the Grand Canyon prescribed fire staff about how well the

monitoring was meeting the needs of the program. The review was favorable, and a copy of the trip report is in Appendix I.

Recommendations were made to make sure the crew tracks how much time is used to staff fire-use fires and monitor smoke for fire-use and prescribed fires, to allow the fire effects year-round staff more time dedicated to analysis and literature review, to strengthen interaction with Science Center staff, and document the rationale for multiple-season burning. All of these matters were considered during the 1999 calendar year. Crews tracked their time (Table 2) to ensure base hours were mostly spent on fire effects activities. Our relationship with the Science Center continues to strengthen. This year, the Botanist gave an introduction to plants to the seasonal crew, we worked with the GIS specialists to make new plot location maps, and attended the annual Fire/Science Center meeting. There is definitely more room for improvement in our relationship with the Wildlife Biologist, the Revegetation Crew, and the Botanist. The rationale for multiple-season burning is documented in this report. As for lending more time for literature review, it is impossible, at this point to do so. With the current workload, there is simply not the staff available to free the Fire Effects Specialist position for keeping up with numerous ecology issues.

Another visit was made in July to assess the field skills of the crew—especially the ability for them to collect quality data. Again, the review was favorable. A copy of the trip report is in Appendix I.

DATA ANALYSIS AND DISCUSSION

Introduction

This section provides feedback to the prescribed fire staff on how well objectives are met. Some analyses that were desired last year could not be completed due to the amount of time needed to error-check the database. Last year, only the most simple analyses were performed. This year, some of those analyses have been modified to show differences between tree species or between size classes. Herbaceous data were analyzed to provide some preliminary results, which are compiled in Appendix J.

The graphical information presented in this report allows resource managers to more accurately determine whether prescribed fire is meeting objectives. Keep in mind that the objectives set in the FMH-4 Monitoring Type Descriptions are based on the best available science, and they can be revised as new information becomes available. All resource managers are invited and encouraged to contribute information that will aid in this process.

Statistical Review—What you need to Know

What is the mean?

First, we should distinguish between the sample mean and the true population mean. The sample mean is just the average value of the data we have collected for a particular variable. An example would be 187 overstory trees/hectare in preburn PIPO plots. We can get an exact, absolutely correct value of the sample mean, because we measure everything in our sample. In contrast, the true population mean is the average value of all possible data for a given variable, such as the average overstory trees/hectare in all preburn areas of the PIPO monitoring type. Usually, we don't know the true population mean because it would take too long to measure every tree – so we take a sample instead.

Reporting Variability with CI's

It is appropriate to report sample means with a measure of variability to explain how confident we are in our estimates. Otherwise, people tend to interpret the sample means as if they were the true population means. Unfortunately, we can't assume that our sample mean will be the same as the true population mean – that depends on how many samples we take, and how much variability there is in whatever we're measuring. So, we need a way to measure how well our sample mean estimates what's really out there (the true population mean). For this report, we chose to do this with 80% confidence intervals (C.I.'s). Confidence intervals are one way to report variability of results, and are calculated with different formulas depending on data variability and what we want to convey.

Interpreting CI's

Understanding how to interpret a confidence interval is best explained by example. Say, for example, that we reported a mean ponderosa pole density in YR01 plots of 375 trees per hectare, with an 80% confidence interval ranging from 200 to 550 (or 175 on either side of the mean). This says we are 80% confident that the true population mean lies somewhere between 193 and 287. It could fall anywhere in there, but we're 80% sure it's in there somewhere. Another way to look at this is that if we took 10 averages and put an 80% confidence interval on each of them, 8 of those intervals would really contain the true mean, but two would not. In other words, with 80% confidence intervals, there is a 20% chance that the true population mean falls outside of the interval. To be really sure (99%) of where the true mean lies, we would have to take a lot of samples. This, of course, is not practical.

Why CI's come in Different Sizes

The size of a confidence interval is determined by two factors. One of these is the sample standard deviation, which is a measure of the variability of the sample, and which is used as an estimate of the variability in the entire population. The more variation you have in your sample, the more difficult it is to get an estimate of the true mean, and the wider your confidence intervals will be. The other factor is sample size. The more samples you take, the closer you get to measuring the entire population, and the better your estimate of the true mean will be. As you take more samples, the size of your confidence intervals will decrease. We avoid comparing different sample sizes over time due to the confusion in interpreting the results when variation is introduced through changing sample sizes.

CI's Don't Tell the Whole Story

The current analysis consists only of confidence intervals placed on mean values. It would be incorrect to draw any conclusions about change over time from these confidence intervals alone. While these intervals can suggest trends, a more complex statistical test will be necessary before we can confidently draw defensible conclusions.

In 1998 we consulted with a statistician from Northern Arizona University to determine the most appropriate type of analysis to perform. He suggested several tests, and recommended the Random Measures ANOVA in particular. We cannot perform this analysis with any of our current software, and it would be overly time-consuming to do by hand. We would like to purchase the appropriate software in the future.

Performing this analysis would allow us to make better and more complete use of our data. For example, the confidence intervals we produced for this report treat the data from each plot visit as a totally independent, random sample. This does not allow us to

take advantage of the fact that we are actually visiting the same plot at different times. The analysis that we propose to do would take this into account. It would produce tighter confidence intervals, and would allow us to determine whether significant changes have occurred, and in which time periods they occurred.

Interpreting Bar Charts

All bar charts in this analysis compare data from the same plots only through time. The preburn reads for which there were no later reads were not included in the analysis. This ensures that sample size (n) is the same for both means (columns), but may be small. The size of the error bars may change over time as the measured data becomes more or less variable. Fuels charts show a break down of fuel size classes with an error bar for the *total* fuel load only. Statistically significant changes cannot be evaluated without more powerful statistical software—remember, averages represent only what was measured in the confines of individual plots.

Interpreting Scatter plots

The scatter plots show the actual values for each plot read. They show the amount of data that has been collected to date, and show what has happened in each plot. A diamond shape that is "moving down" represents a decrease in values over time, a diamond shape "moving up" represents an increase, and a "bull's eye" indicates no change. If there is only one diamond, it indicates that plot has not been burned.

The Fine Print

We created our C.I.'s using the following formula:

$$X \pm t_{\alpha(2),\nu} S_X$$

In which:

X = sample mean

$t_{\alpha(2),\nu}$ = the value of the t distribution for $_{\alpha(2),\nu}$

$\nu = n-1$

S_X = the sample standard error of the mean

We used the two-tailed value for $\alpha = 0.2$ for our analysis.
We used the t distribution because of our small sample size.

PIED Results and Discussion

Fuels

Objective 1: Reduce total average fuel load (including all woody material, litter, and duff) so as not to exceed 20 tons/acre (49 tons/ha) immediately post-burn.

Results: No additional plots burned since these data were analyzed last year, so the results are the same as last year. Fuel load was decreased on five measured plots by 21% from 15 tons/acre to 12 tons/acre (Figure 1). All the confidence intervals overlap, so it is impossible to determine what kind of real change occurred. The scatter plot (Figure 2) helps us understand why Figure 1 shows the increase after Post Year 2—some large dead and down material fell down on Plot 7, increasing the fuel load on that plot to about 37 tons/acre.

Was objective met? Yes, the fuel load remains under 20 tons/acre, on average.

Overstory

Objective 2: Limit overstory mortality of all species (including *Juniperus osteosperma*, *Pinus edulis*, and *Pinus ponderosa*) to 20% within 5 years post-burn.

Results: Figure 3 shows the change in density for overstory species in this monitoring type. The change, for all species combined, is 3% at Post Year 5.

Was objective met? Yes, the change in overstory density was less than 3% after 5 years.

Figure 1. Total Fuel Reduction for South Rim Pinyon-Juniper (PIED)

December 1999

n=5

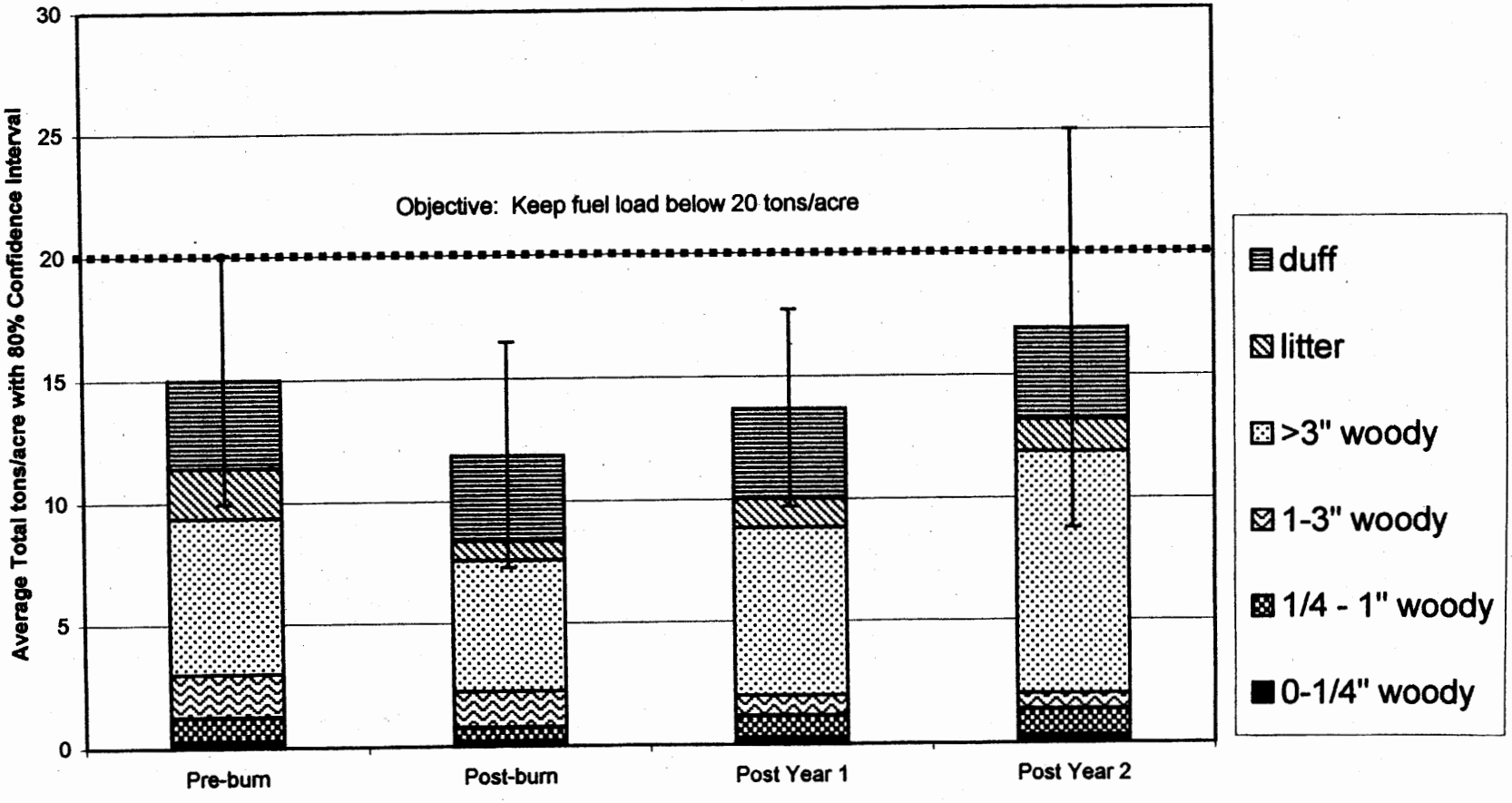


Figure 2. Change in PIED Total Fuel Load by Plot

December 1999

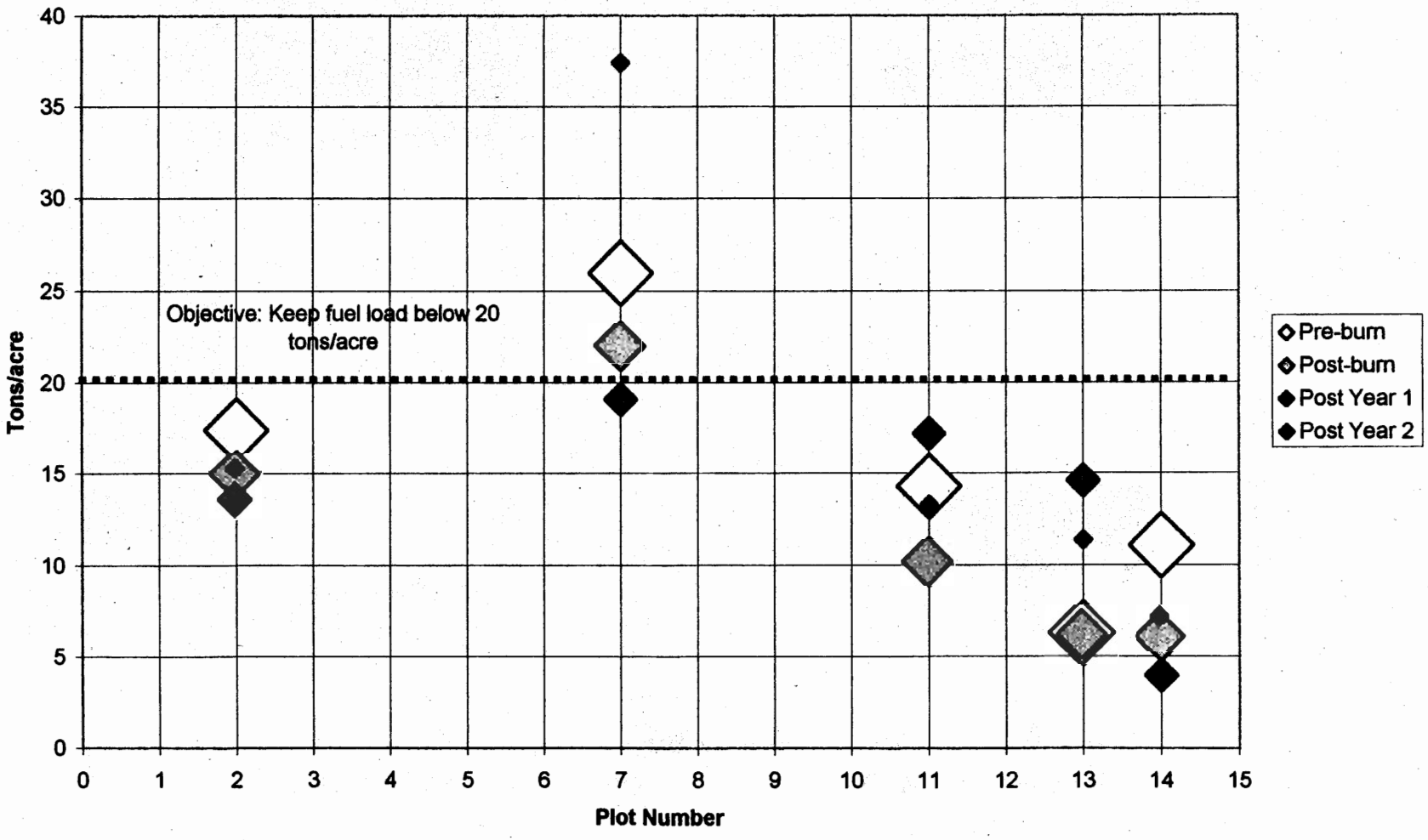
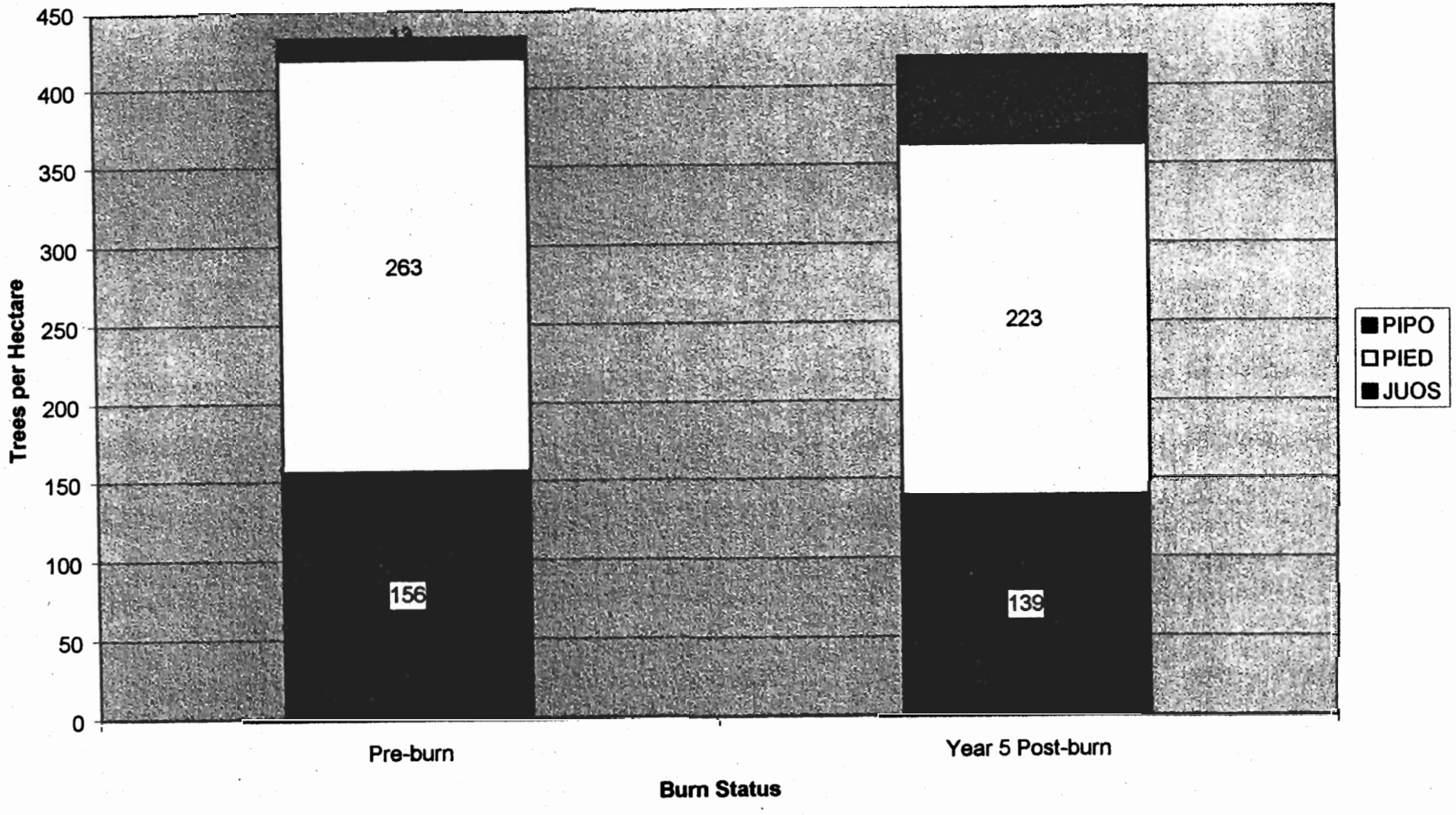


Figure 3. Overstory Density in Pinyon-Juniper Monitoring Type
December 1999
n = 12



PIPO Results and Discussion

Overstory

Objective 1: Achieve and maintain an overstory ponderosa pine density (greater than or equal to 16" dbh) of 19-25 trees per acre (47-62 trees/ha) as stated in the Desired Future Condition, and measured at five years post-burn.

Results: Figure 4 shows that there is very little change in large ponderosa pine overstory trees after five years of monitoring. The Desired Future Condition for this variable is 47-63 trees per hectare. Pre-burn densities were only 43 trees/ha, and after 5 years we have gained one tree. Figure 5 demonstrates that little change in large tree densities has occurred on most of the plots. Plot 15 shows a decrease, while others show either an increase or no change after five years.

Was objective met? Yes and no. Although the levels of large trees are not at a density previously believed to have existed on this landscape, prescribed fires have not induced significant mortality in this size class of ponderosa pine.

Objective 2: Limit average crown scorch on overstory ponderosa pine (greater than or equal to 16" dbh) to 30%, measured immediately post-burn.

Results: At this time we cannot complete analysis for this variable. The database program (fmh.exe) does not have reliable functions for accurately extracting these data. They can be compiled by hand at a future date.

Was objective met? Unknown.

Fuels

Objective 3: Reduce the total average fuel load by at least 30%, and maintain an average total fuel load of 0.2 to 9.3 tons/acre (0.5 to 23 tons/ha) as stated in the Desired Future Condition, measured immediately post-burn.

Results: The total fuel load was reduced by 40% immediately post-burn (Figure 6) and has remained near this level through Post Year 1 plot re-reads.

Was objective met? Yes, fuels were reduced by over 30% and are now within the levels defined by the Desired Future Condition.

Pole trees

Objective 4: Reduce *Pinus ponderosa* poles with dbh of 1-6 inches (2.5-15cm) to average 0-200 trees/acre (0-494 trees/ha), measured 2 years post-burn.

Results: Ponderosa pine pole densities monitored through Post Year 2 show a decrease from 420 to 336 trees per hectare, but the confidence intervals are large (Figure 7). This is due to high variation in pole densities throughout the plot network. Figure 8 shows that some plots have almost 1800 poles per hectare, while others have zero.

Was objective met? Probably not, but it's difficult to know for certain. It is impossible to install all of the plots necessary to monitor this variable well. Figure 8 shows that many of the plots are within the Desired Future Condition, but a few are extremely dense. These dense thickets represent the areas that will continue to need treatment during second-entry prescribed fires.

Other

Objective: Track snag densities over time.

Results: Figure 9 shows that snag densities have increased from Pre-burn through Post Year 5 monitoring. Relatively little change has occurred in the larger trees, but snags have doubled in the 6-15.9" size class.

Was objective met? There is no objective for a certain number of snags at this time. Consultation with the Grand Canyon National Park wildlife biologist is in progress to define an objective.

Other

Objective: Track seedling densities over time.

Results: Figure 10 shows that seedling densities have increased from Pre-burn through Post Year 5 monitoring. Juniper and pinyon seedlings have decreased, ponderosa seedlings have remained the same, and Gambel's oak seedlings have increased.

Was objective met? There is no objective for seedling densities at this time. This information is provided for general knowledge, so that other resource management staff at Grand Canyon understands the trends that are occurring.

Figure 4. Mean density of live 16" DBH or larger *Pinus ponderosa* in PIPO
December 1999
n = 12 plots

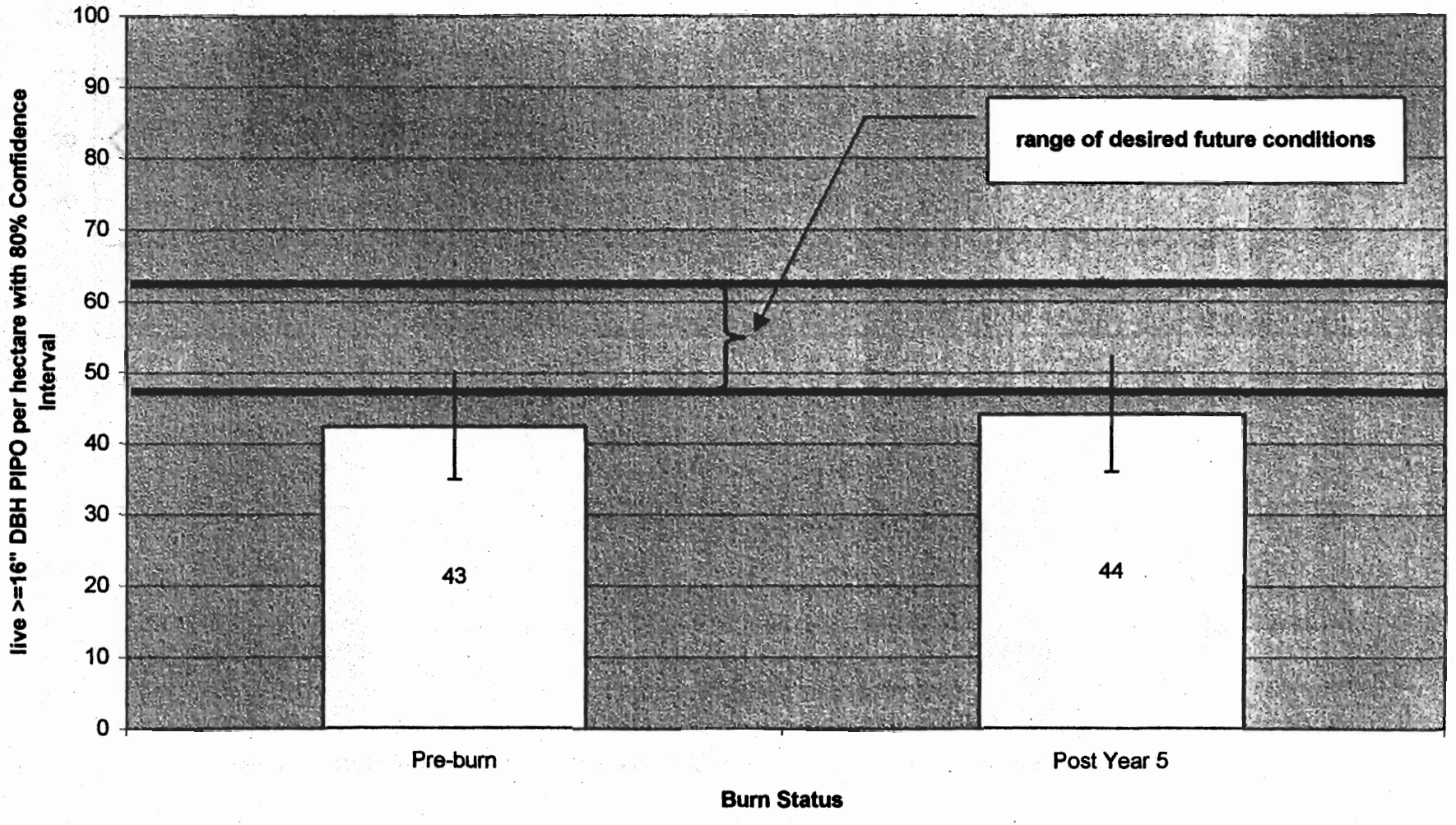


Figure 5. Change in live 16" DBH and larger *Pinus ponderosa* density in PIPO plots, by plot
December 1999

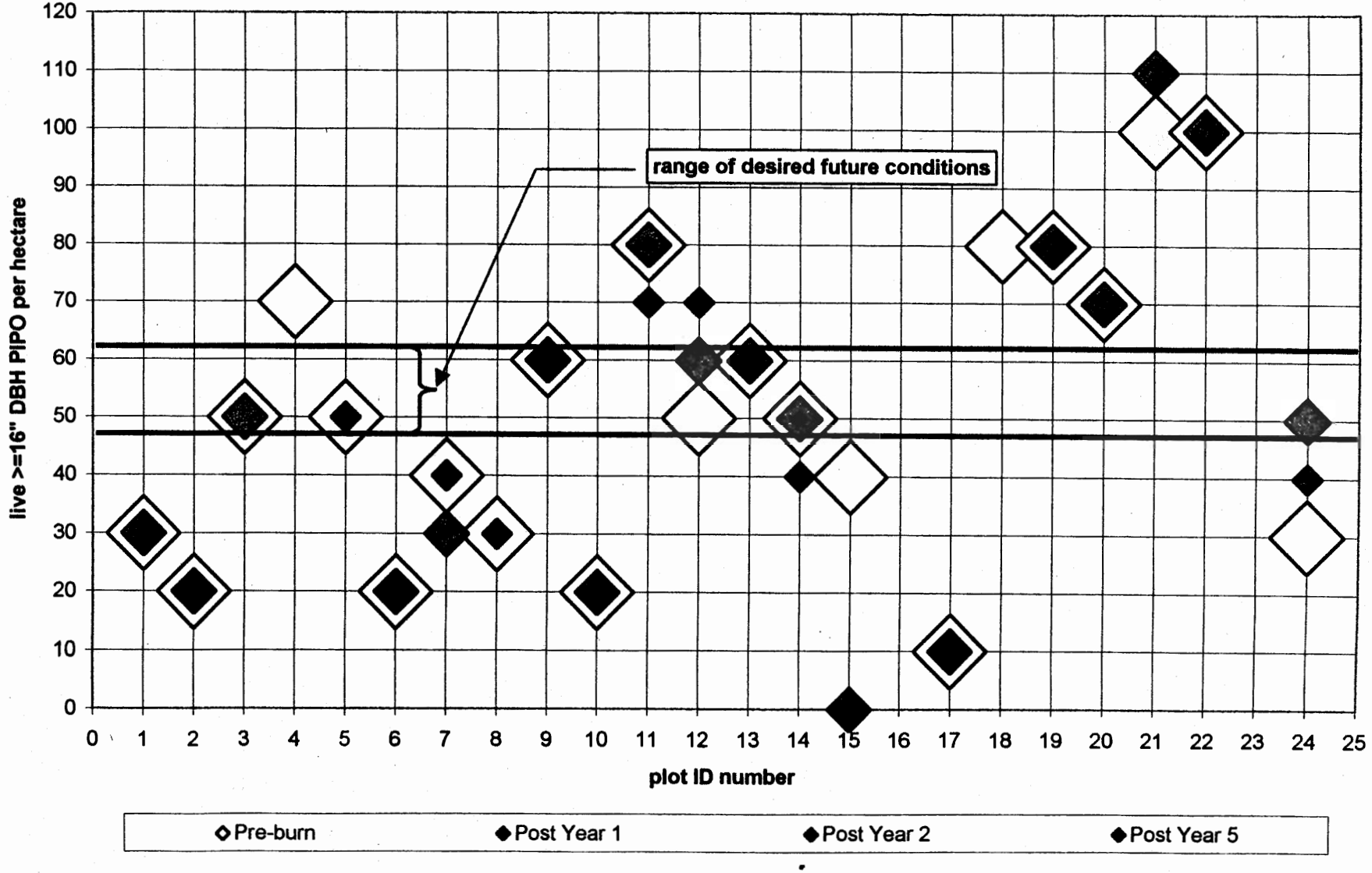


Figure 6. Total Fuel Reduction for South Rim Ponderosa Pine (PIPO)
December 1999
n=7

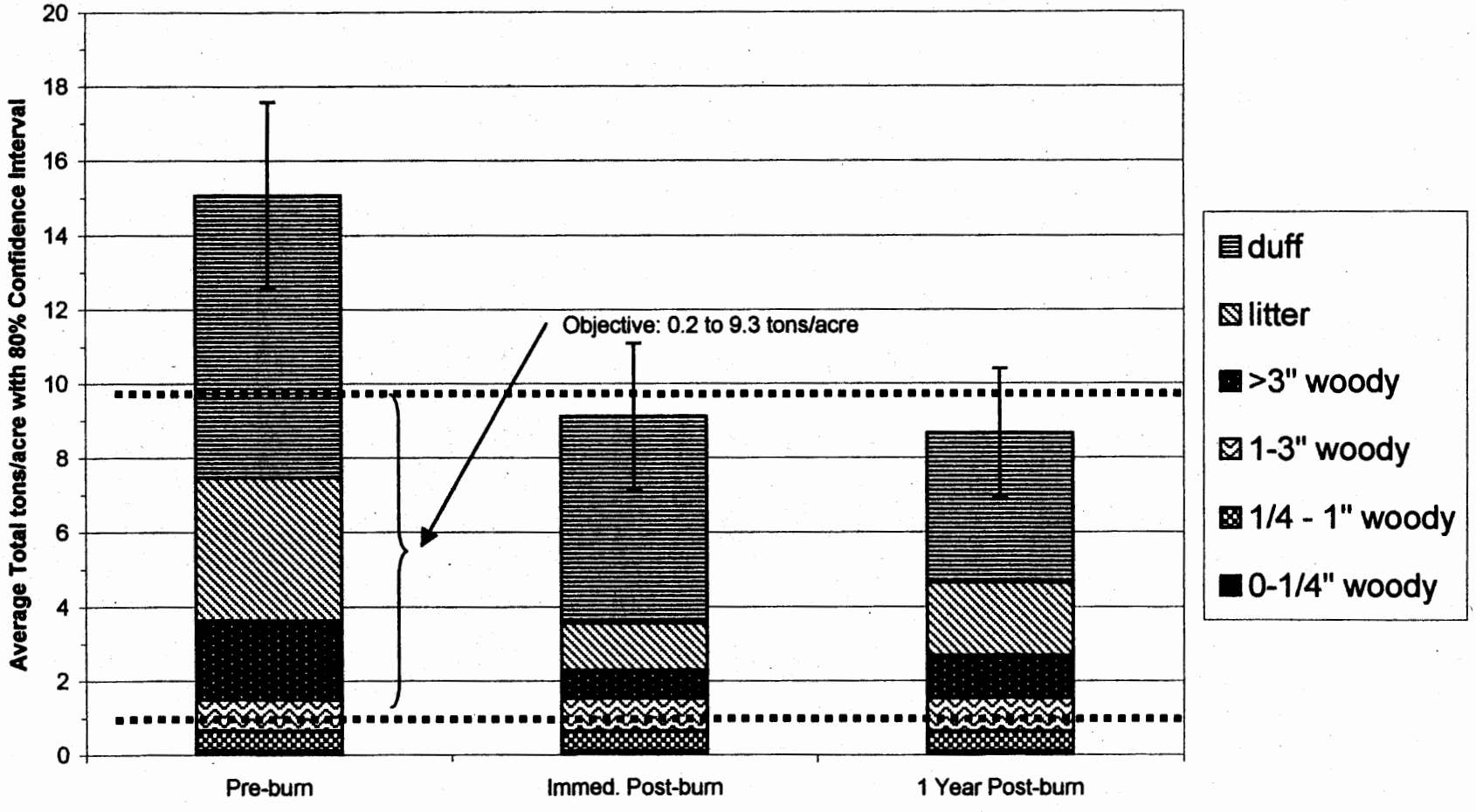


Figure 7. Change in *Pinus ponderosa* pole density, PIPO Analysis
December 1999
n = 17 plots

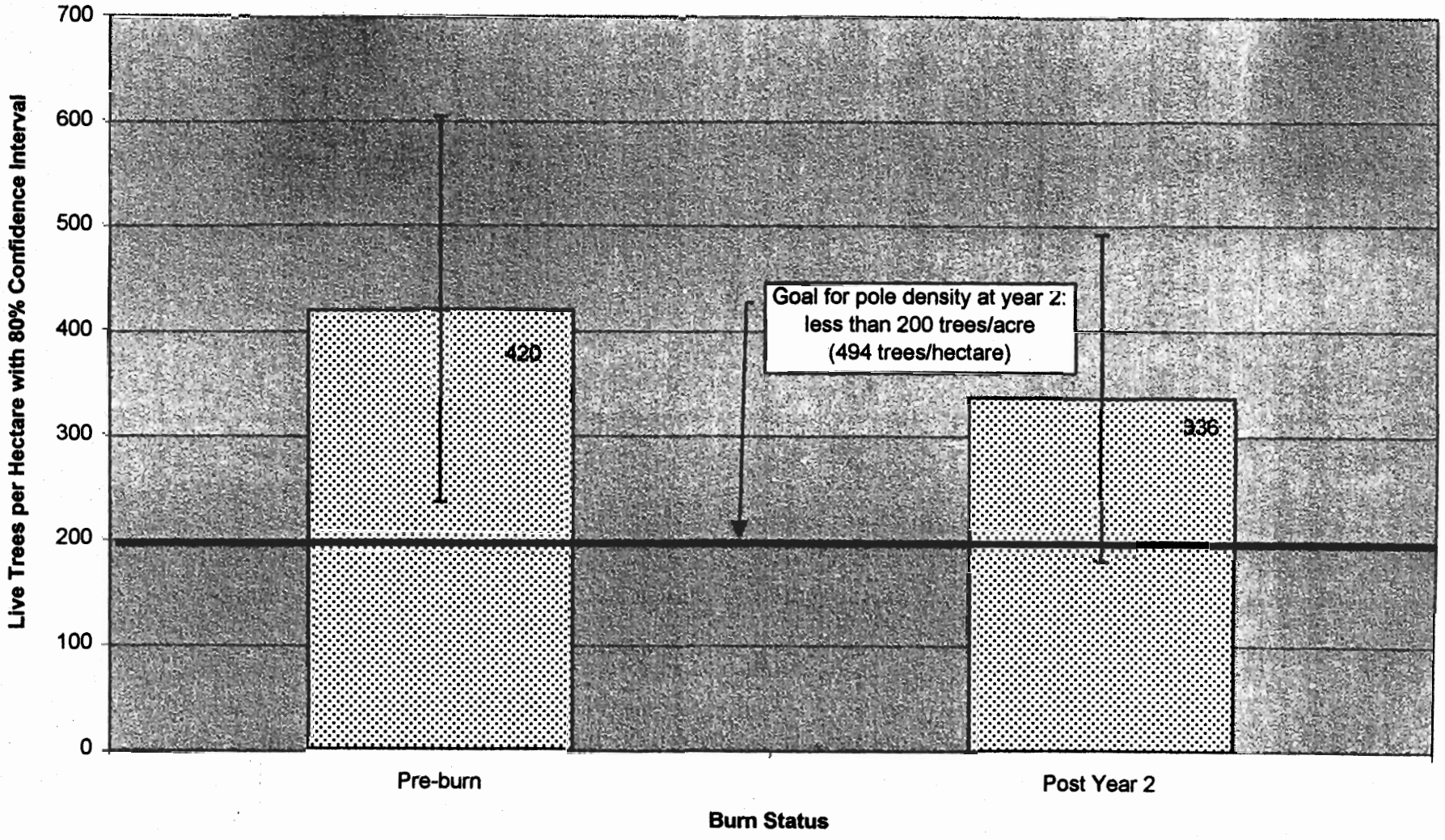


Figure 8. Change in *Pinus ponderosa* pole density in PIPO plots, by plot
December 1999

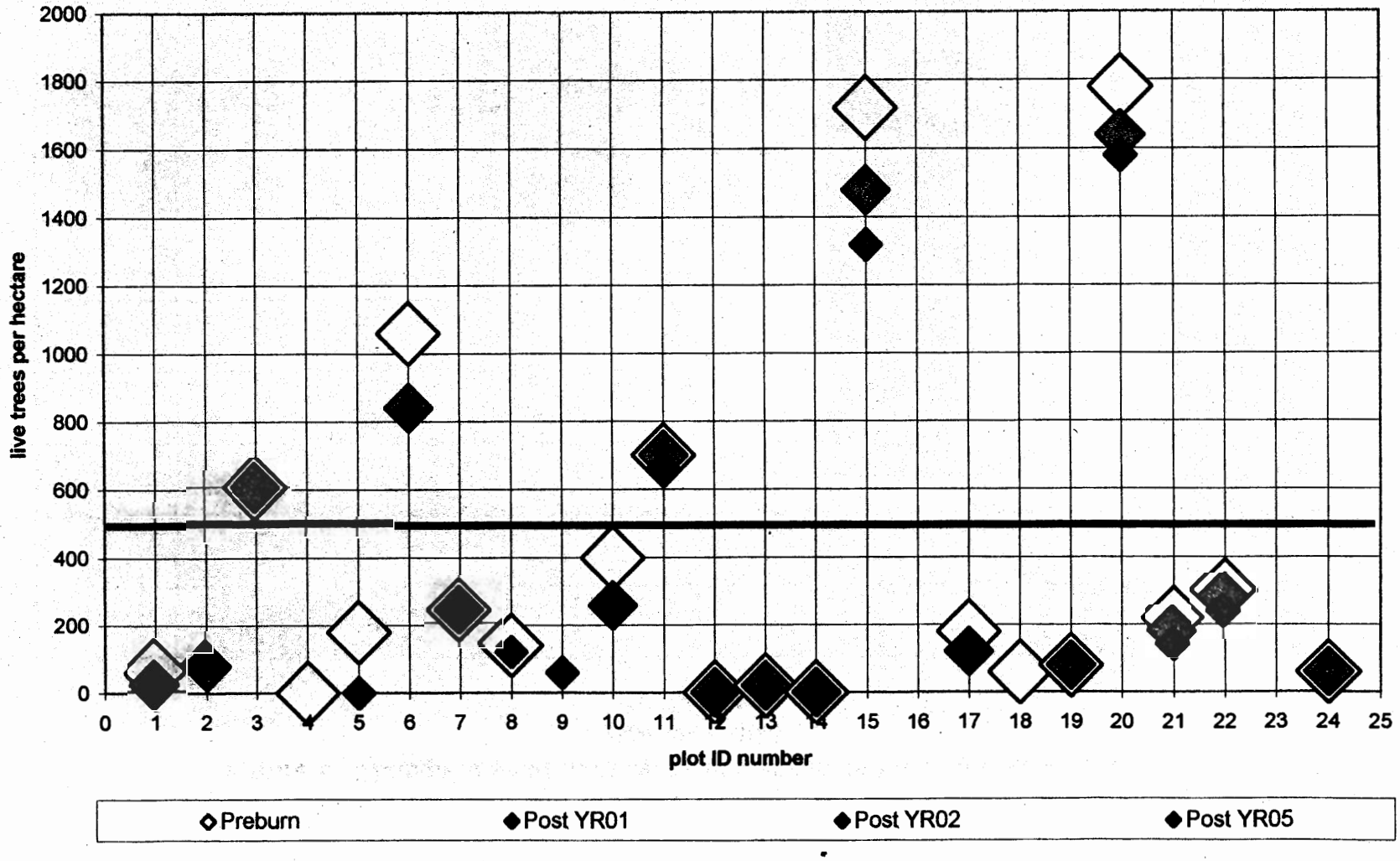


Figure 9. Change in snag density, by size class, in PIPO monitoring type
December 1999
n = 12 plots

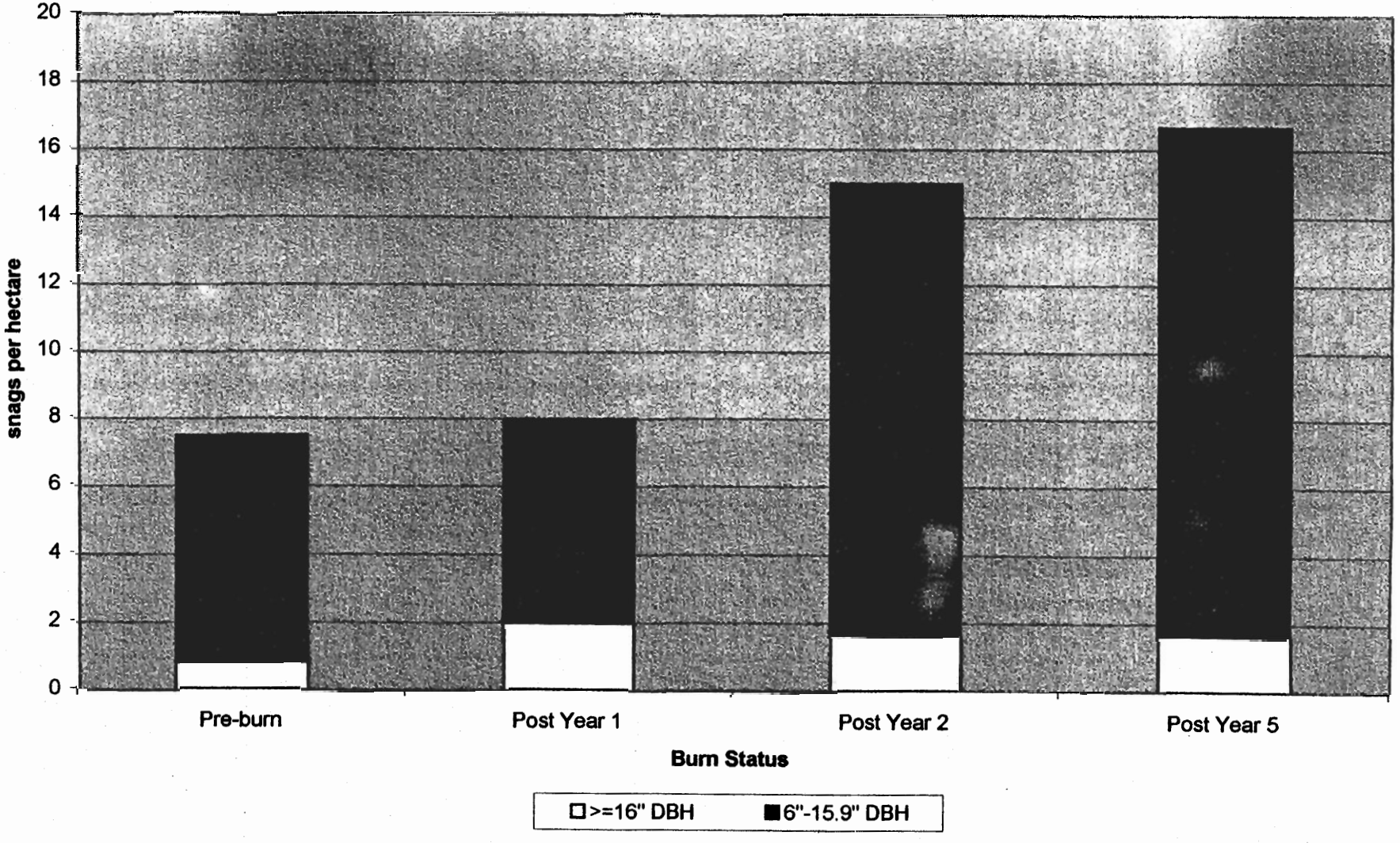
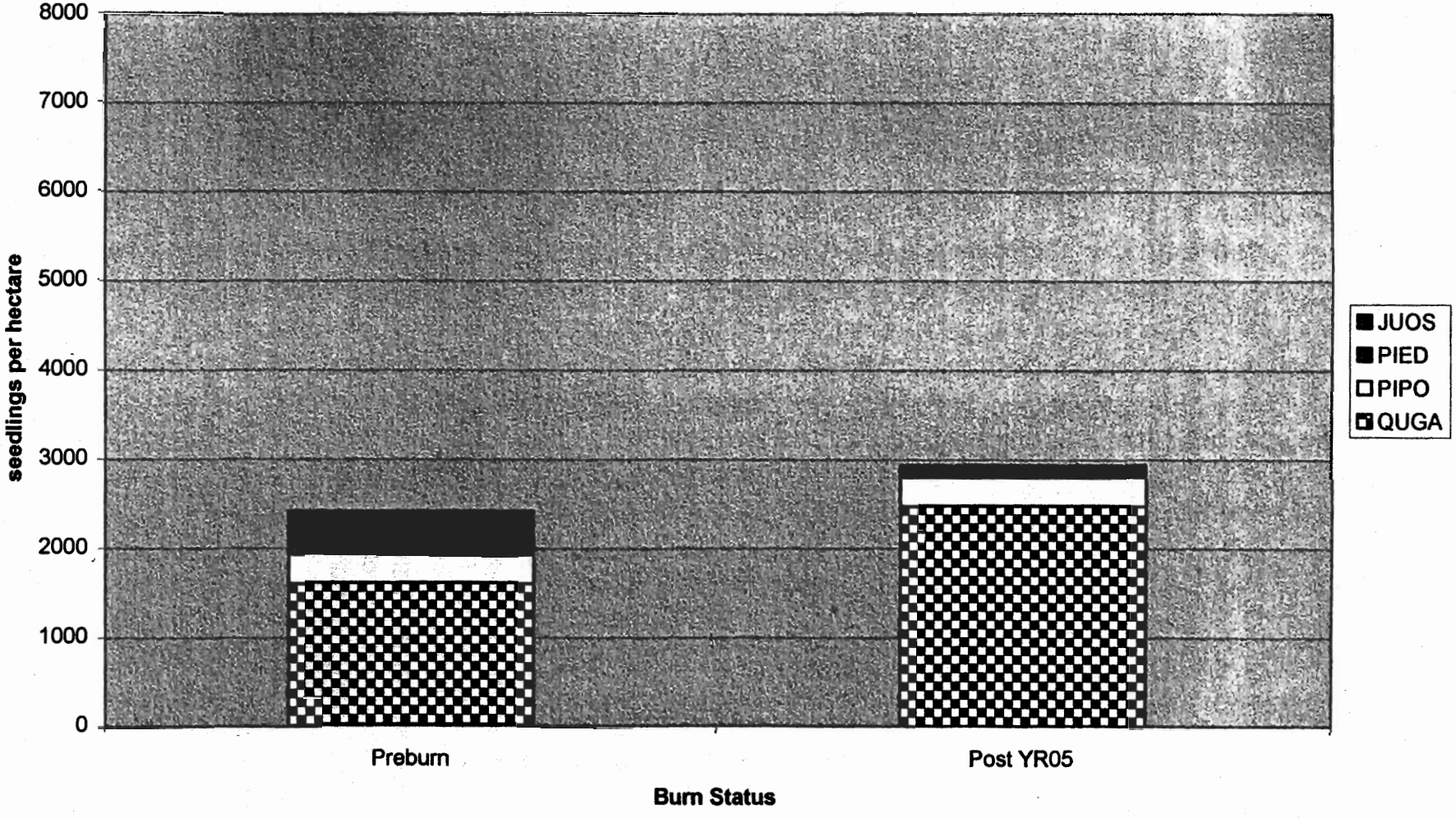


Figure 10. Change in Mean Seedling Density, PIPO Analysis
December 1999
n = 12



PIPN Results and Discussion

Overstory

Objective 1: Achieve and maintain an overstory ponderosa pine density (greater than or equal to 16" dbh) of 40-56 trees per acre (99-136 trees/ha) as stated in the Desired Future Condition, and measured at five years post-burn.

Results: Figure 11 illustrates little change in large ponderosa pine after one year of post-fire monitoring, however, the densities are still about 40 trees/hectare above the Desired Future Condition. Additional mortality is expected to show up between Post Year 1 and Post Year 5. Figure 12 demonstrates the change on individual plots. Plot 2 shows a decrease after five years—this plot is located in the Northwest III prescribed burn unit.

Was objective met? It is unknown at this time, since there are not enough five-year data.

Objective 2: Limit average crown scorch on overstory ponderosa pine (greater than or equal to 16" dbh) to 30%, measured immediately post-burn.

Results: At this time we cannot complete analysis for this variable. The database program (fmh.exe) does not have reliable functions for accurately extracting these data. They can be compiled by hand at a future date.

Was objective met? Unknown.

Fuels

Objective 3: Reduce total average fuel loading by at least 30% immediately post-burn and maintain an average total fuel load of 0.2 to 9.3 tons/acre (0.5 to 23 tons/ha) as stated in the Desired Future Condition.

Results: Figure 13 shows a total average fuel reduction of 41% immediately post-burn. The fuel load is not yet within the range of desired future conditions. Figure 14 illustrates a lot of change on individual plots.

Was objective met? Not yet, but only one treatment has occurred. It is understood that it will likely take more than one treatment to reduce fuel loads adequately. A burn prescription that would reduce fuel load to desirable levels the first time would be too hot for overstory ponderosa pine. The fuel loads in this monitoring type show the trend that was expected.

Pole trees

Objective 4: Reduce Pinus ponderosa poles with dbh of 1-6 inches (2.5-15cm) to average 0-200 trees/acre (0-494 trees/ha), measured 2 years post-burn.

Results: Figure 15 shows that ponderosa pine pole trees were reduced from 250 to 197 trees per hectare after only one year of post-fire monitoring. Figure 16 illustrates that most of the plots are already within the range of desired future conditions, except for Plot 5.

Was objective achieved? Yes, although the pole densities were already within the range of desired future conditions, they remain within these levels after one treatment.

Other

Objective: Track snag densities over time.

Results: Figure 17 shows that snag densities have increased from Pre-burn through Post Year 5 monitoring. As opposed to results from the PIPO monitoring type, larger snags show a decline here in the years following the fire. Small snags increase to about 115 trees/hectare by Post Year 5. Keep in mind that this is for only TWO plots, both burned in the Northwest III prescribed burn in 1993.

Was objective met? There is no objective for a certain number of snags at this time. Consultation with the Grand Canyon National Park wildlife biologist is in progress to define an objective.

Other

Objective: Track seedling densities over time.

Results: Figure 18 shows that aspen, white fir, and ponderosa seedling densities have decreased significantly from Pre-burn through Post Year 1 monitoring on six plots.

Was objective met? There is no objective for seedling densities at this time. This information is provided for general knowledge, so that other resource management staff at Grand Canyon understands the trends that are occurring.

Figure 11. Change in mean density of live 16" DBH or larger *Pinus ponderosa* in PIPN plots
December 1999
n = 6 plots

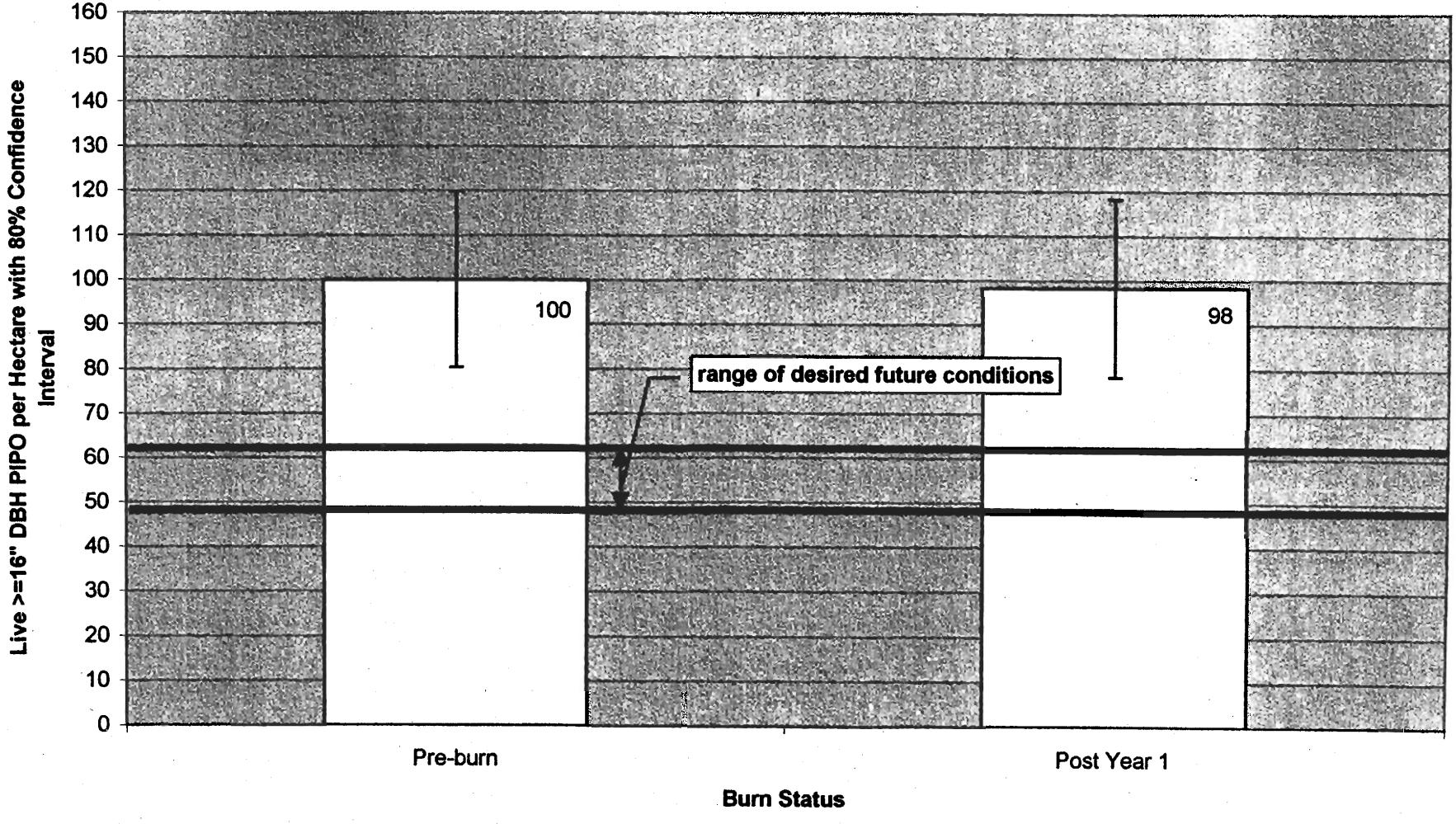


Figure 12. Change in 16" DBH and larger *Pinus ponderosa* density in PIPN plots, by plot
December 1999

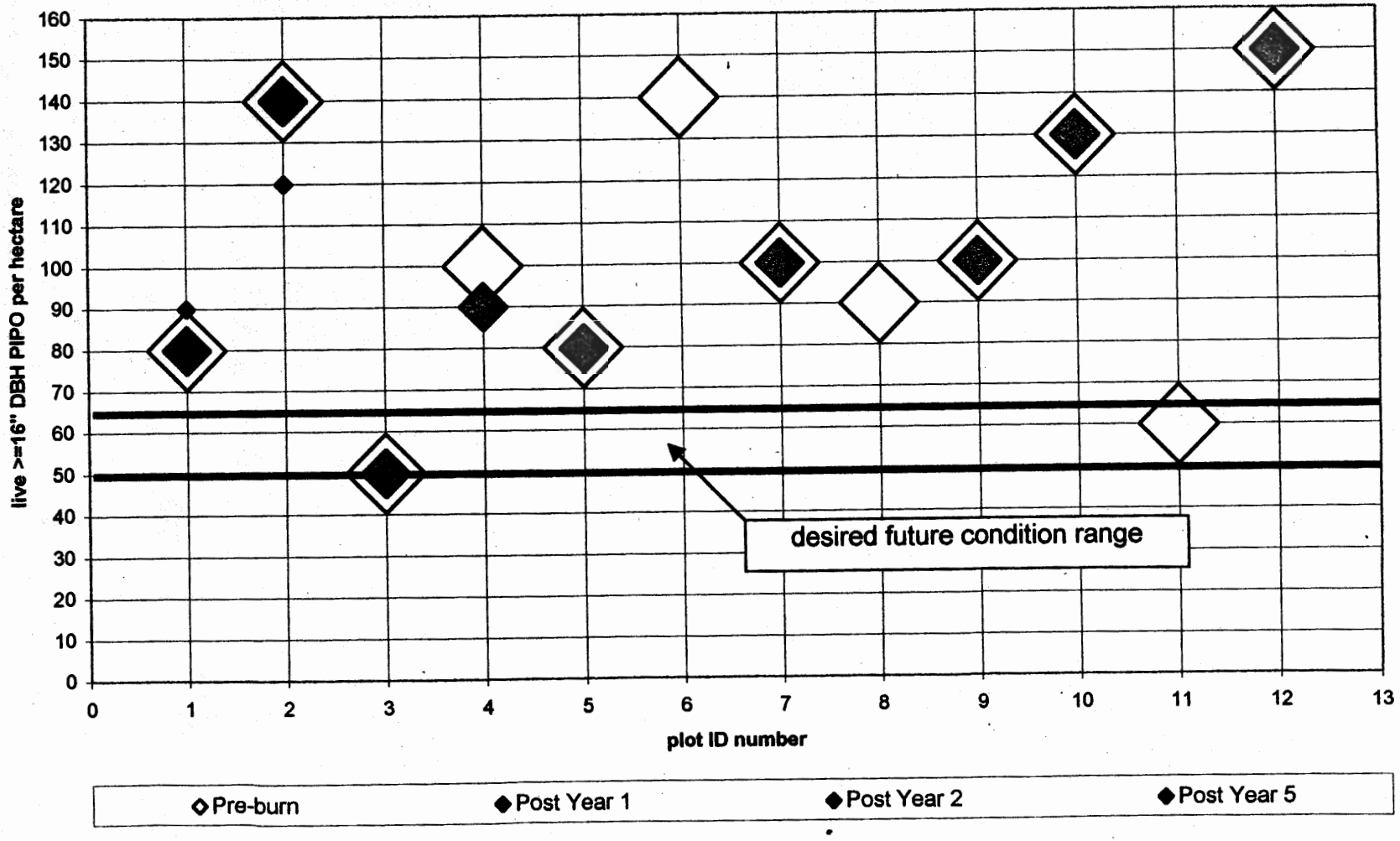


Figure 13. Total Fuel Reduction for North Rim Ponderosa Pine (PIPN)
December 1999
100-foot fuels transects, n=9

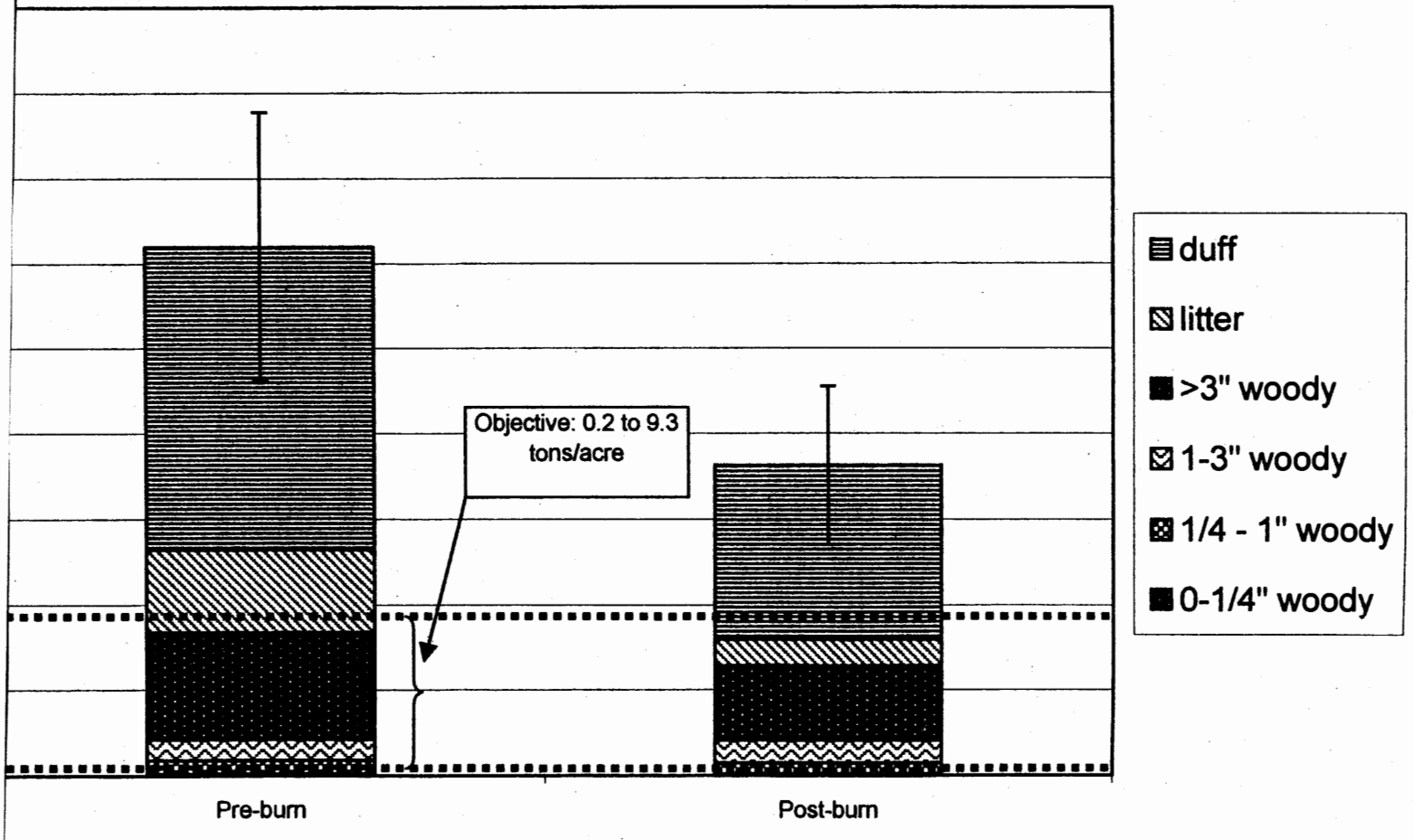


Figure 14. Change in Total PIPN Fuel Load by Plot
December 1999
100-foot fuel transects

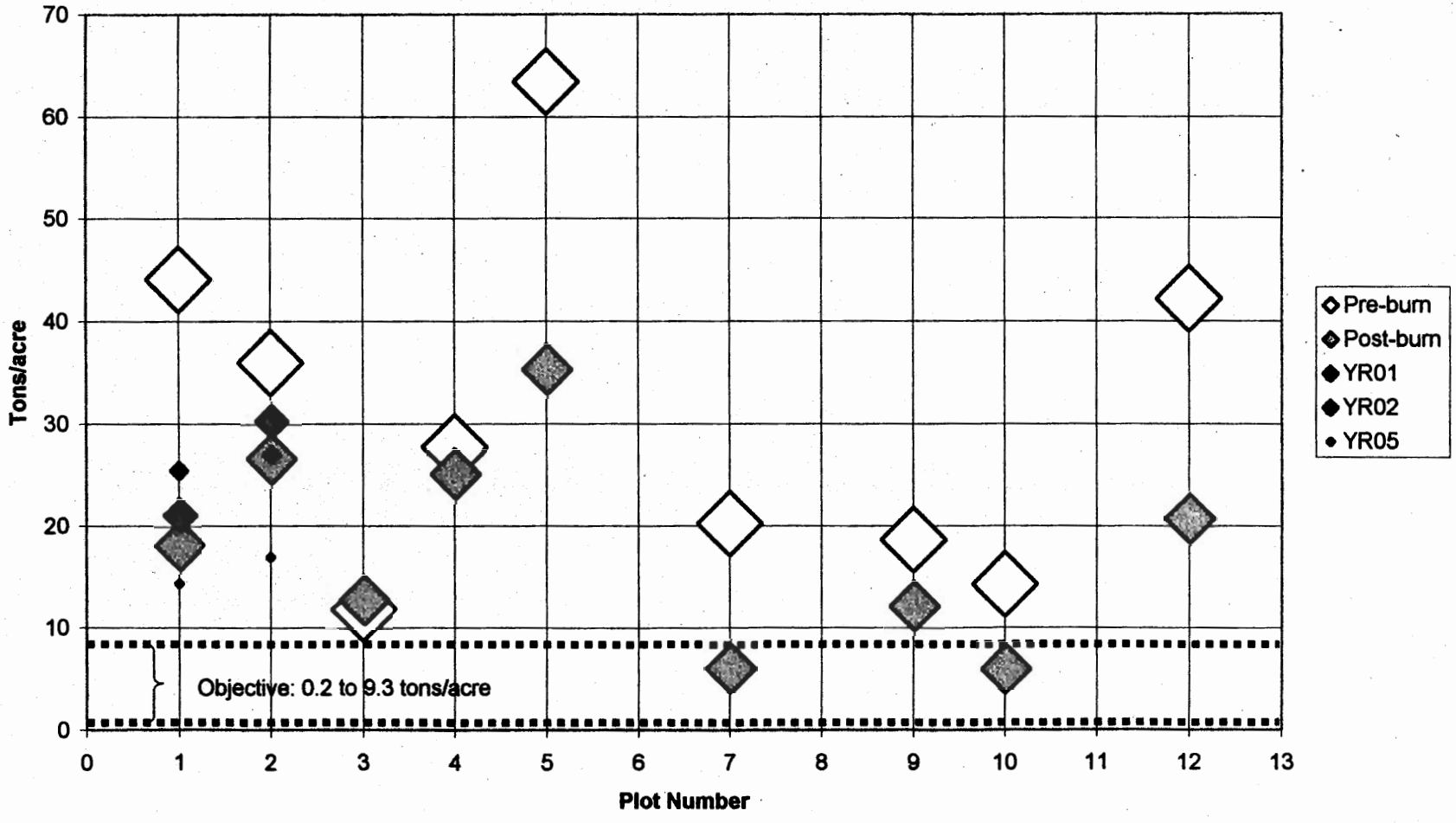
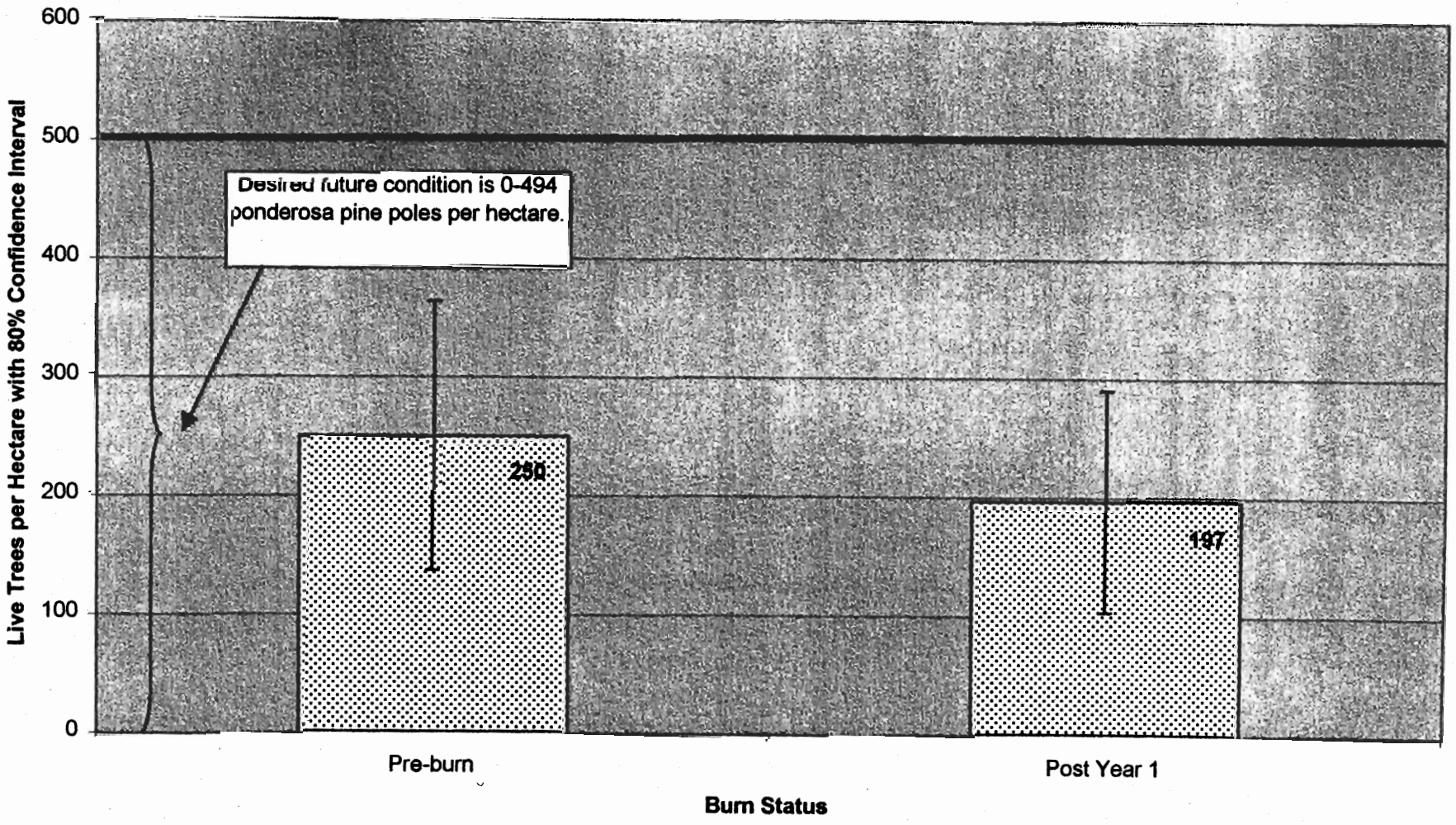


Figure15. Change in *Pinus ponderosa* pole density, PIPN pole analysis
December 1999
n = 6 plots



1-6 " 2654

Figure 16. Change in *Pinus ponderosa* pole density in PIPN plots, by plot
December 1999

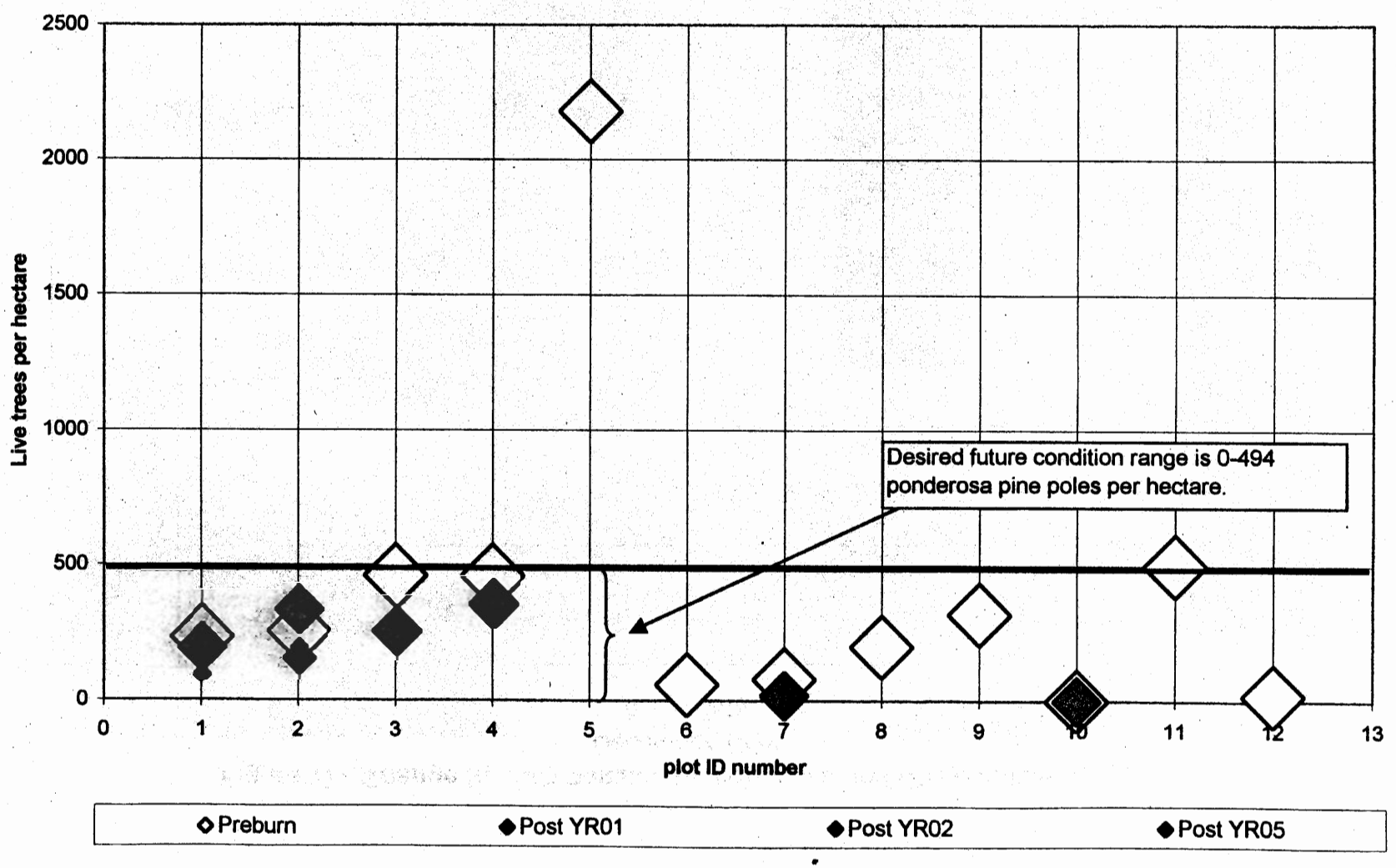


Figure 17. Change in snag density, by size class, in PIPN monitoring type
December 1999
n = 2 plots

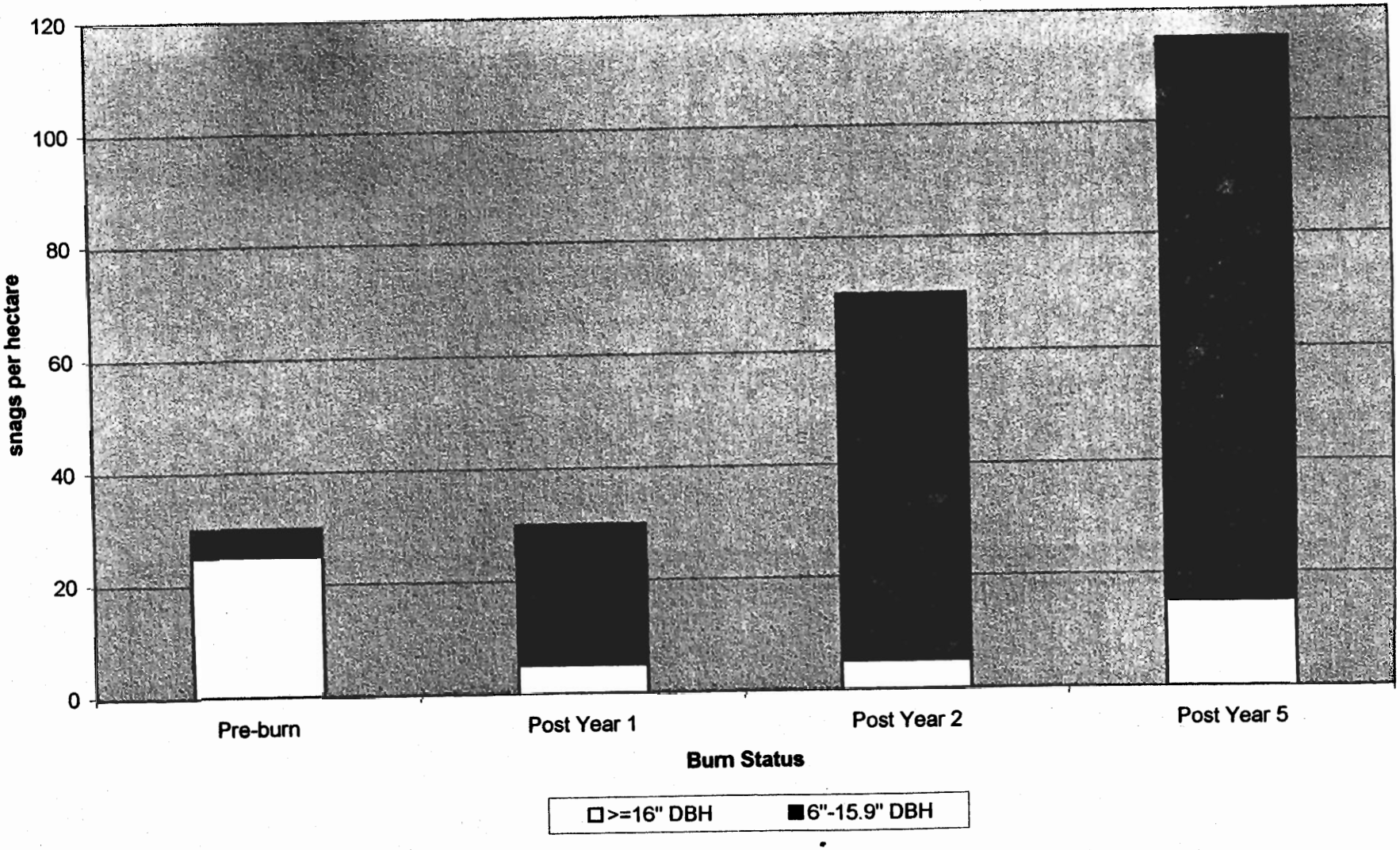
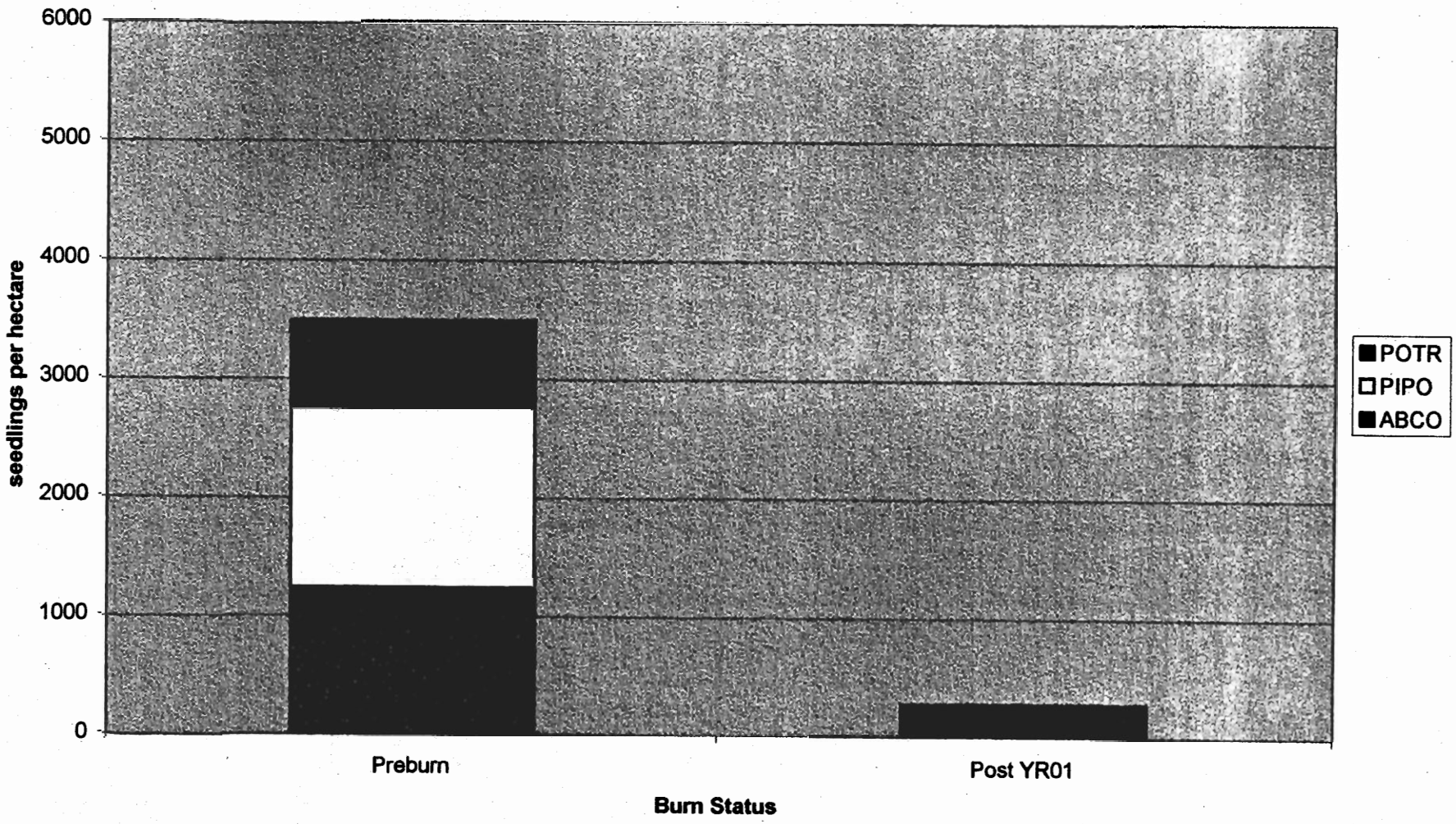


Figure 18. Change in Mean Seedling Density, PIPN Analysis
December 1999
n = 6



PIAB Results and Discussion

Overstory

Objective 1: Achieve and maintain an overstory ponderosa pine density (greater than or equal to 16" dbh) of 47-62 trees/hectare as stated in the Desired Future Condition, measured at five years post-burn. Note: *Pinus ponderosa* comprises less than 50% of overstory with remaining 50% occupied by mostly *Abies concolor* and *Populus tremuloides*.

Results: Figure 19 shows a decrease in large ponderosa pine from 71 to 59 trees per hectare. Smaller ponderosa pine overstory trees show little change. Figure 20 shows changes plot by plot, where it is noted that Plot 7 shows the most decrease. This plot is located in the Northwest III prescribed burn treated in 1993.

Was objective met? It is unknown whether or not this objective was met since there are not enough Post Year 5 data. The literature suggests additional mortality will be seen in ponderosa from Post Year 1 to Post Year 5.

Objective 2: Limit average crown scorch on overstory ponderosa pine (greater than or equal to 16" dbh) to 30%, measured immediately post-burn.

Results: At this time we cannot complete analysis for this variable. The database program (fmh.exe) does not have reliable functions for accurately extracting these data. They can be compiled by hand at a future date.

Was objective met? Unknown.

Fuels

Objective 3: Reduce total average fuel load by at least 30%, measured immediately post-burn and maintain an average total fuel load of 0.2 to 20 tons/acre as defined in the Desired Future Condition.

Results: Figure 21 shows a decrease of 42% in total fuel load, measured immediately post-burn on six plots. Figure 22 shows the range of pre-burn fuel loads that exist in this monitoring type. Plot 7, in the Northwest III prescribed burn treated in 1993 and converted to a wildfire, shows a decrease in fuel load from 75 tons/hectare to 30 tons/hectare.

Was objective met? Yes, the 30% reduction was achieved, but more treatments are needed to continue reducing the total fuel load.

Pole trees

Objective 4: Reduce pole densities to 0-247 trees/hectare by Post Year 2.

Results: Figure 23 shows that white fir pole densities were just barely within the range of desired conditions Pre-burn, but are well within the range after two years of post-fire monitoring. However, the confidence intervals are very large at the two-year mark. Figure 24 illustrates the range of white fir pole densities—approaching 1700 per acre on one plot.

Was objective met? Yes and no—white fir pole densities are within the range of desired future conditions after one prescribed fire treatment as measured on 4 plots. When additional data are added, the Post Year 2 results will be different.

Other

Objective: Track snag densities over time.

Results: Figure 25 shows that snag densities have not changed much through Post Year 1 monitoring. Larger snags show a slight increase, while smaller snags remain the same.

Was objective met? There is no objective for a certain number of snags at this time. Consultation with the Grand Canyon National Park wildlife biologist is in progress to define an objective.

Other

Objective: Track seedling densities over time.

Results: Figure 26 shows that aspen seedling densities have increased significantly from Pre-burn through Post Year 2 monitoring on four plots. There is relatively little change in ponderosa and white fir seedling densities.

Was objective met? There is no objective for seedling densities at this time. This information is provided for general knowledge, so that other resource management staff at Grand Canyon understands the trends that are occurring.

Figure 19. Change in mean density of live overstory *Pinus ponderosa* in PIAB plots
December 1999
n = 7

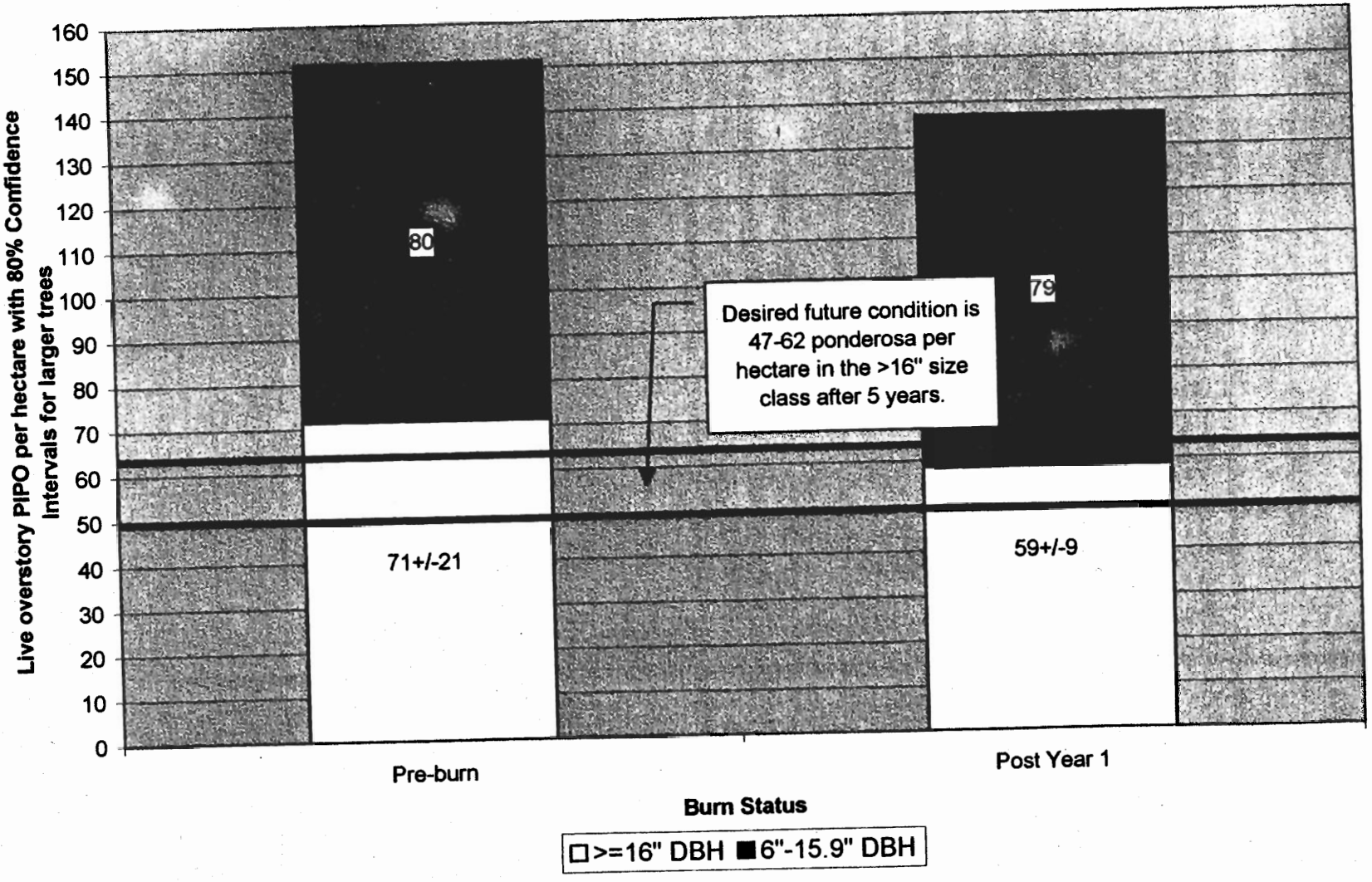


Figure 20. Change in 16" DBH or larger *Pinus ponderosa* density in PIAB plots, by plot
December 1999

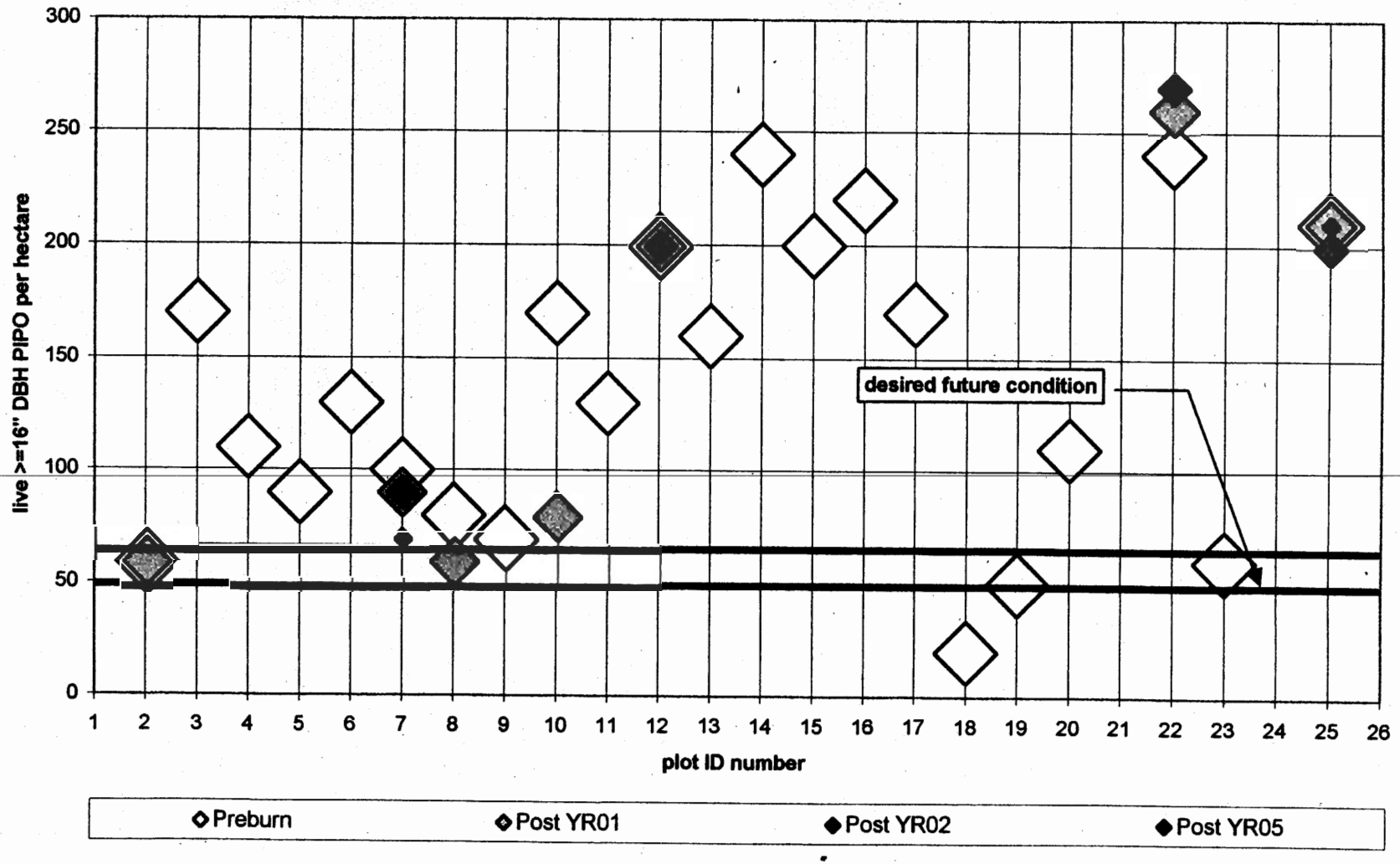


Figure 21. Total Fuel Reduction for Ponderosa with White Fir (PIAB)
December 1999
100-foot fuels transects, n=6

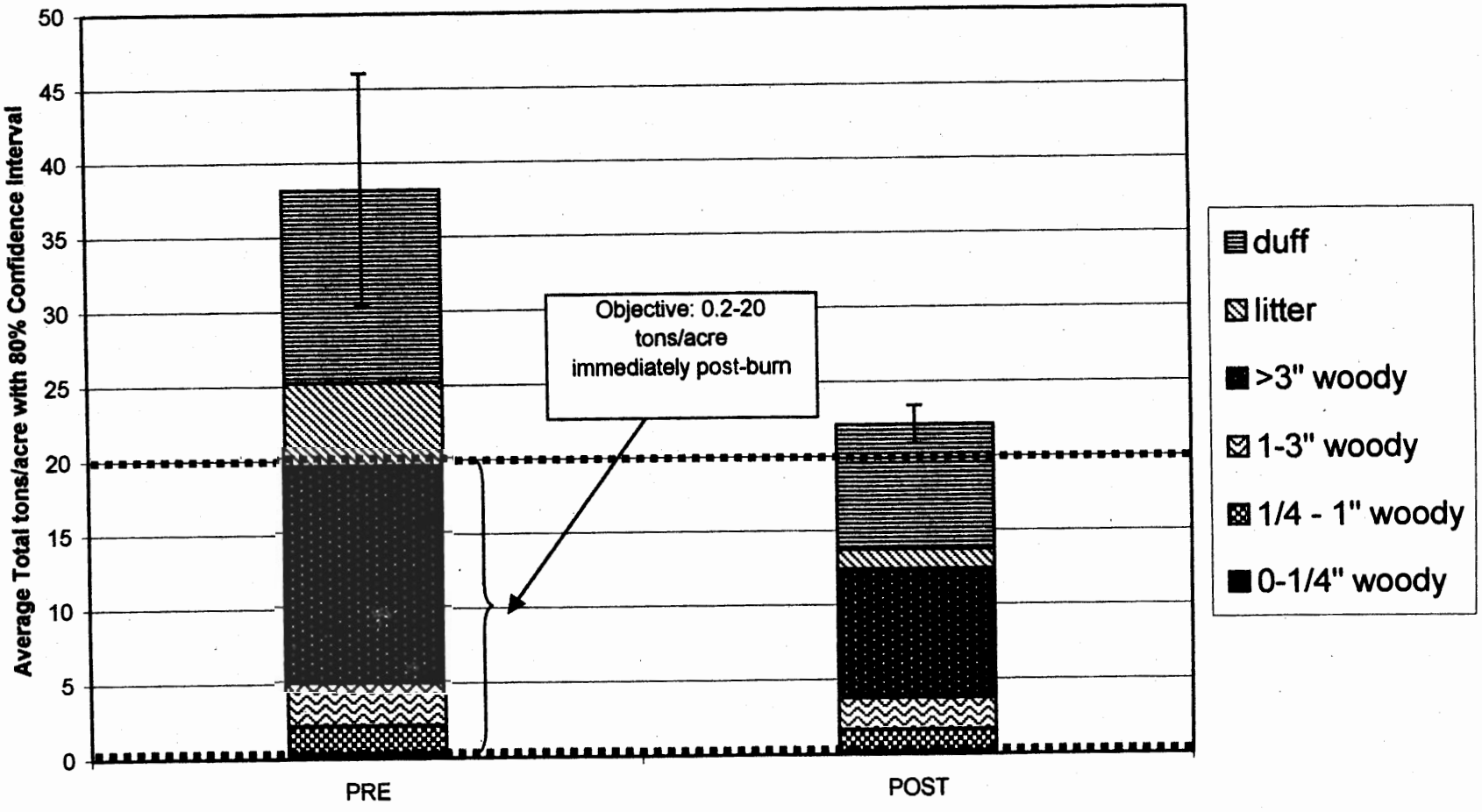


Figure 22. Change in Total PIAB Fuel Load by Plot
December 1999
100-foot fuel transects

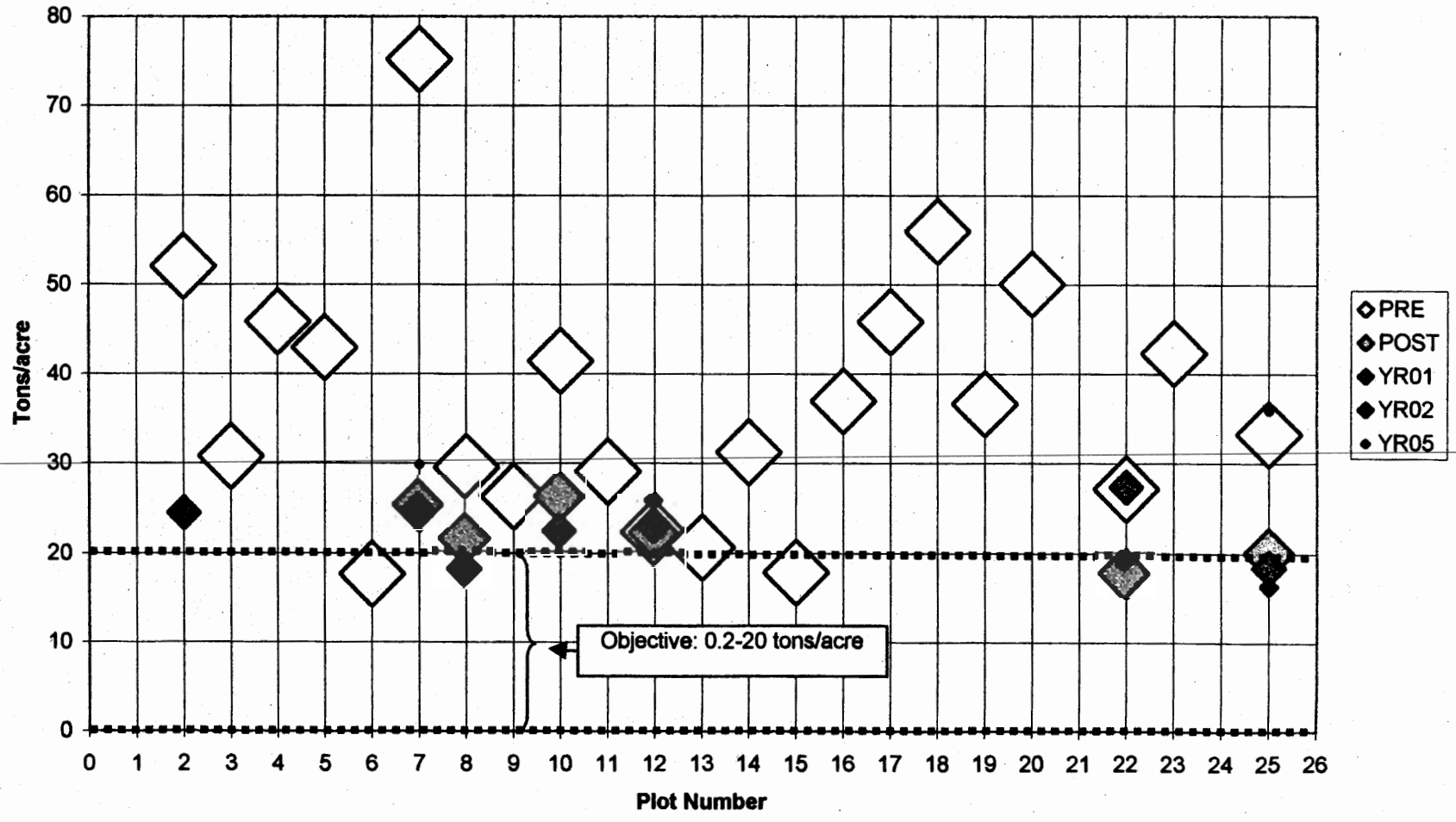


Figure 23. *Abies concolor* pole density in PIAB plots
December 1999
n = 4

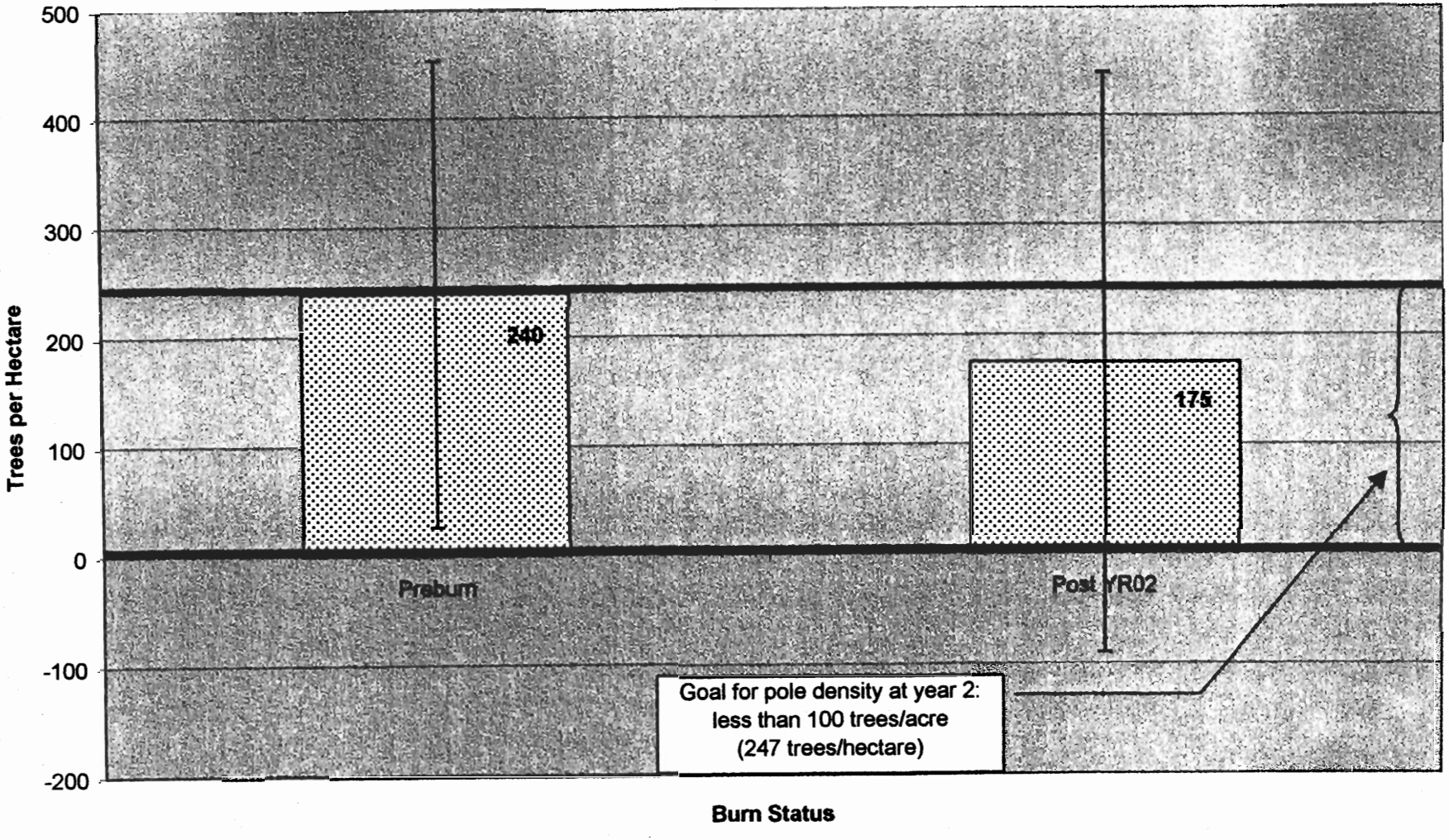


Figure 24. *Abies concolor* pole density in PIAB plots, by plot
December 1999

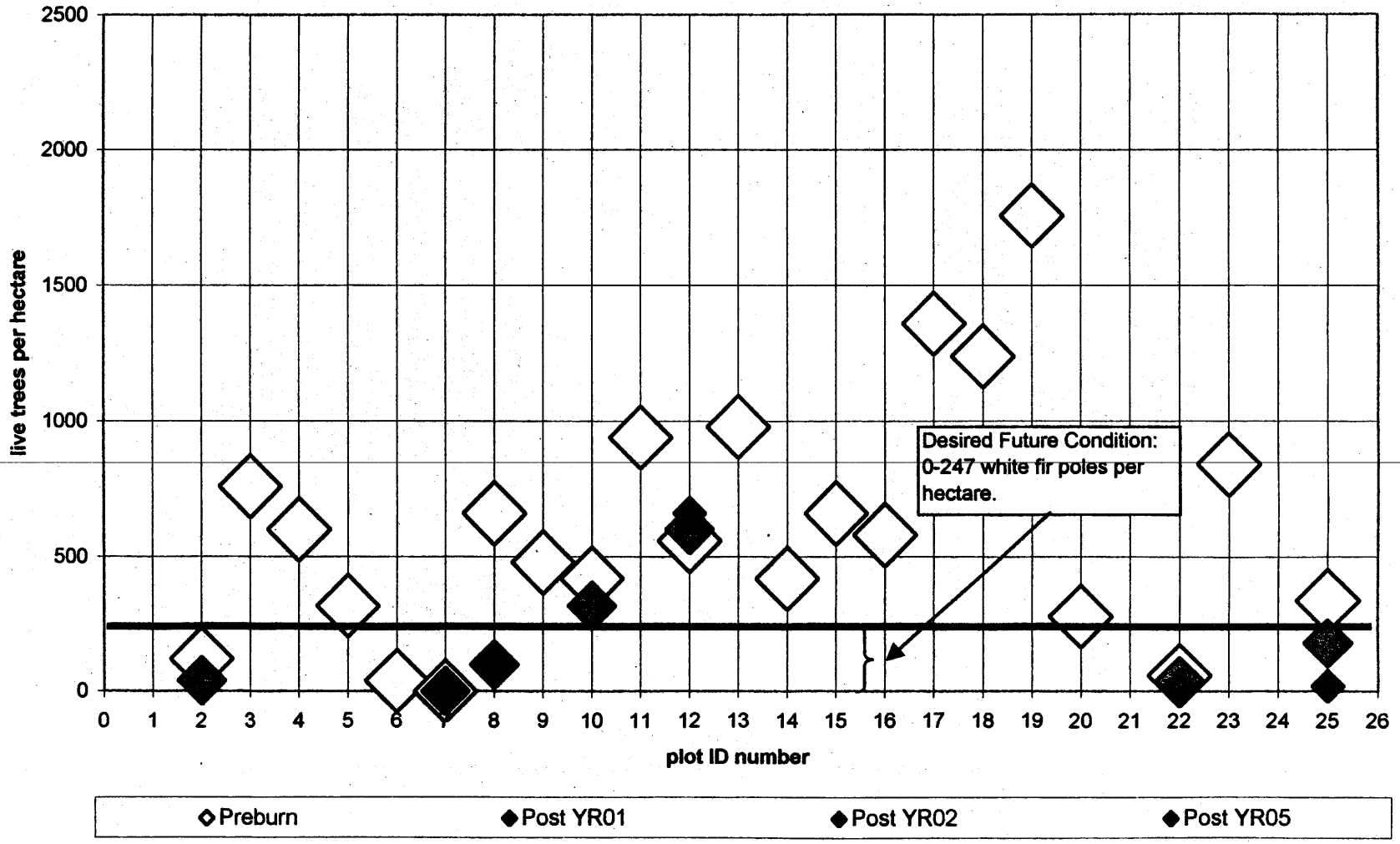


Figure 25. Change in snag density, by size class, PIAB monitoring type
December 1999
n = 7 plots

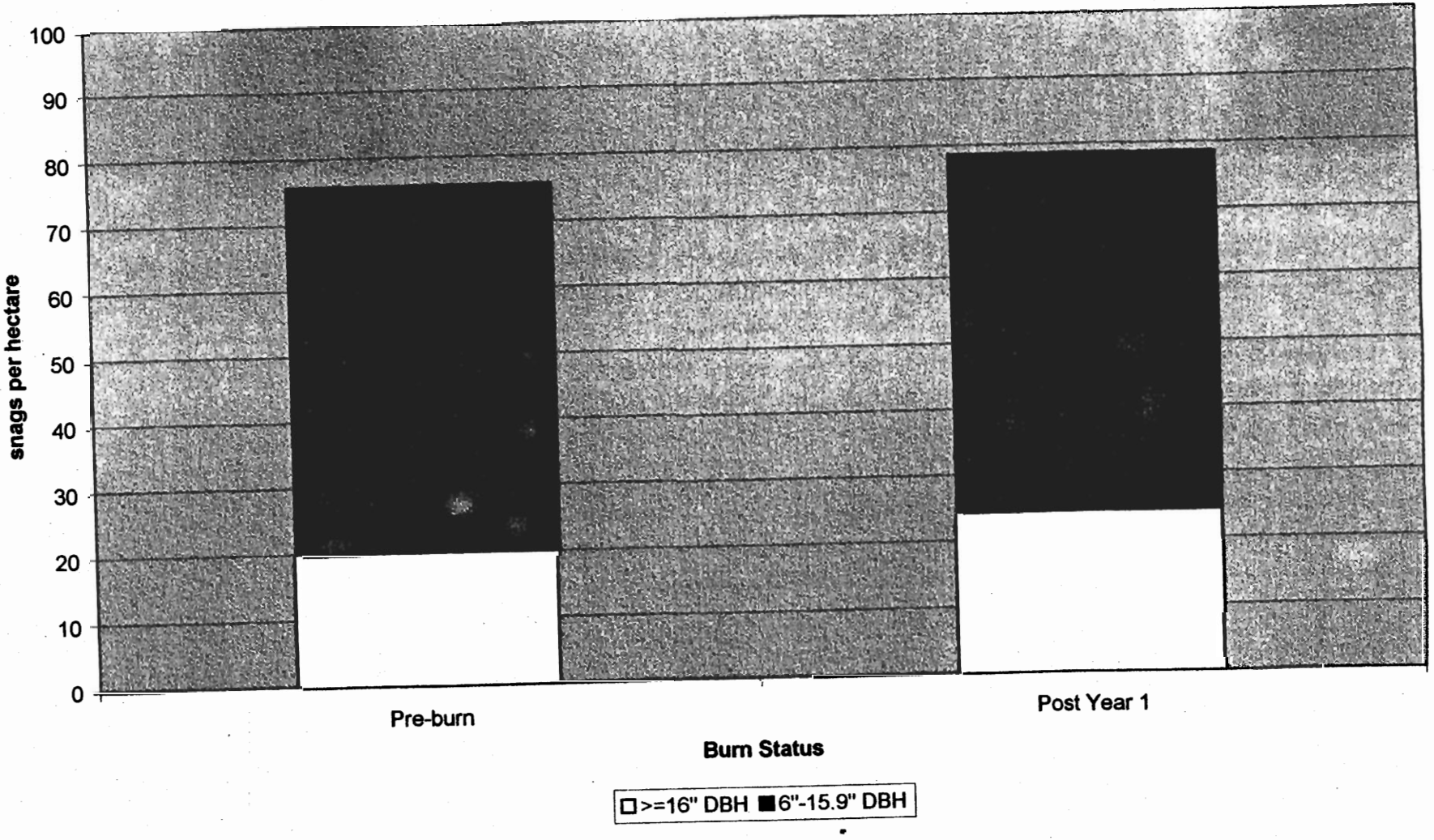
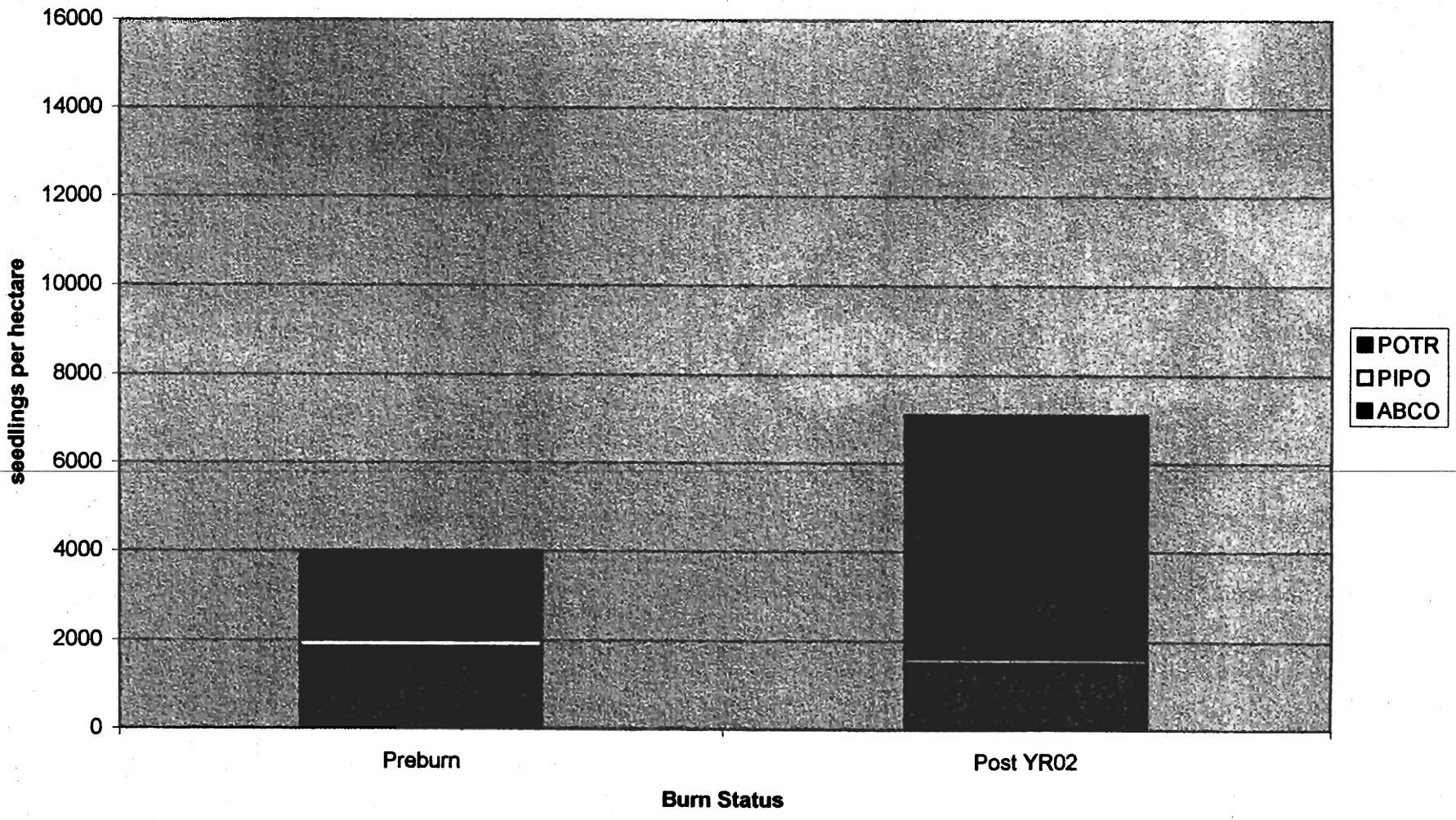


Figure 26. Chage in Mean Seedling Density, PIAB Analysis
December 1999
n = 4



FISCAL YEAR-END ACCOMPLISHMENT REPORT
Prescribed Fire Program (FARSITE)
FY 1999
Don Bertolette
(GS-7 Term Appointee)

Pre-calendar year 1999 Performance

The FARSITE (Fire Area Growth Simulation) Program effectively began five months prior to CalendarYear 1999, on August 3, 1998. In those five months, field maps were prepared, field work began and finished, and data entry started for the Walhalla Plateau Pilot Project (approximately 15,000 acres). All 453 polygons of the Walhalla Plateau were either field verified or viewed from nearest vantage point (where physically inaccessible).

FY 1999 Performance

I. Accomplishments

A) Walhalla Plateau Pilot Project completed (**15,000acres**), including:
Entry of field verified mapping polygons into Arc/Info GIS
Entry of pre-requisite FARSITE field attributes into Arc/Info GIS
Successful conversion of Arc/Info GIS data into FARSITE compatible format
Successful FARSITE runs completed on Walhalla Plateau

B) North Rim-East (approximately **135,000 acres**) modeled successfully from Walhalla Plateau Pilot Project
Field verification and refinement of North Rim-East model assignments completed
Entry of field verified mapping polygons into Arc/Info GIS
Entry of pre-requisite FARSITE field attributes into Arc/Info GIS
Successful conversion of Arc/Info GIS data into FARSITE compatible format
Successful FARSITE runs completed on North Rim (demonstrated at Quarterly summer Fire/GIS meeting)

C) North Rim-West (**approximately 70,000 acres, Mt. Emma-Toroweep Valley**) modeled successfully from Walhalla Plateau Pilot Project.
Field verification and refinement of North Rim-West model assignments completed (December 10, 1999)
Entry of field verified mapping polygons into ArcView GIS (December 23, 1999).
Entry of pre-requisite FARSITE field attributes into ArcView GIS (December 23,1999).

D) **Successful implementation of FARSITE Program** over the North Rim of forested Grand Canyon National Park, Fiscal Year 1999

E) Successfully completed S-493 (FARSITE) Training – December, 1998

F) Paper accepted – ESRI Annual Conference (withdrawn, for lack of available funding), to be resubmitted for July, 2000)

G) Successful FARSITE simulation/calibration of Camelot Fire (October 1999)

II. Deliverable Products-National

A) Joint Fire Science Conference Paper Presentation (JFSC) – June 15th, 1999.
B) Joint Fire Science Conference Poster Presentation- June 14th, 1999.
C) Submission of JFSC Paper ("Fuel Model and Forest Type Mapping for FARSITE Input") for publication in Proceedings, JFSC – August 2, 1999.
D) Presentation of "**Computer Mapping and Forest Restoration**", Eastern Old-growth Symposium, Harvard Forest, Massachusetts – November 2, 1998
E) Presentation of **"Fire Area Growth Simulation in Support of Forest Restoration in Grand Canyon National Park's North Rim"** and poster for 5th Biennial Colorado Plateau Research Conference, October 26, 1999.
F) Submitted JFSC Paper in Item II.C, to JFSC for JFSC Web Page.

III. Deliverable Products-Regional

A) Fire Perimeter Maps – Mt.Emma Fire, Regional Type II Fire Use Team
B) Burn Severity Map - Mt.Emma Fire, Regional Type II Fire Use Team
C) Redtail MMA - Redtail Fire, Regional Type II Fire Use Team
D) Redtail WFURB - Redtail Fire, Regional Type II Fire Use Team
E) Outlet MMA - Camelot Fire, Regional Type II Fire Use Team
F) Outlet WFURB - Camelot Fire, Regional Type II Fire Use Team

IV. Deliverable Products – GRCA Prescribed Fire Program

A). Maps – Prescribed Fire Management
1) Prescribed Fire boundary Unit Maps
a)36" x 44" (4)
b)17" x 22" (20)
c)11"x 17" (30)
d)8.5" x 11" (40)
2) Pinyon-Juniper Syposium (April 20, 21, 1999)
a)Expanded Pinyon-Juniper Series – 36"x 44", 8.5" x 11"
b)Expanded Ponderosa Pine Series - " " , " "
c)Vegetation Classification – All series - " , " "
3) Perimeter and Snowline, Shinumo Fire
4) Individual Project Area Maps - Prescribed Fire Burn Plan "A" – 8.5"x 11"
a)Entrance

b)Quarry
c)Moqui
d)Tusayan
e)Lone Tree
f)Grapevine
g)Shoshone
h)Long Jim's I, II, III

5) Individual Project Area Maps - Prescribed Fire Burn Plan "B" – 8.5"x 11"
a)Watson I, II, and III
b)Hance
c)Grandview I and II
d)Uncle Jim
e)Thompson
f)Nankoweap
g)Imperial
h)Hayden
i)Vista IV
j)Greenland
k)Kibbey

6) Perimeter Map – Camelot Fire (GPS)

B). Maps - FARSITE

1)Field Maps – Walhalla Plateau (36" x 44" – 1:6000 Scale)
a)North
b)South
c)East
d)West
e)All Walhalla (36"x 44" 1:12000 Scale)

2)Field Maps – North Rim (36"x 44" – 1:12,000 Scale)
a)Bright Angel
b)Shiva Temple
c)Kanabownits North
d)Kanabownits South
e)Little Lake Park North
f)Little Lake Park South

3)Field Maps – North Rim Edges (36" x 44" – 1:12,000 Scale
a)Shiva Temple North
b)King Arthur's Castle - South
c)King Arthur's Castle - East
d)Point Imperial
e)Bright Angel Point – North

4)Ponderosa Pine Transition Zone Prediction – 2520 Meter (36" x 44")
5)North Rim – East Half All
6)North Rim – East Half – Road Network
7)North Rim – East Half – Veg. Classification

8)Resource/Sensitive Areas Maps (DOQQ/DRG with Sensitive Resource Areas (Archeological sites, Threatened/Endangered/Sensitive Species Locations (Flora/Fauna), Township/Range/Sections, UTMs, Fire Roads, Helispots, Tree Towers) delineated in support of Fire Suppression/Prescription/Use Management
9)Successful calibration of FARSITE simulation for Camelot Fire, using current, during-fire data.
10)Delivery of Downstrike Likelihood Map for South Rim locations
11)Delivery of Fire Suppression – South Rim Project Planning Maps
12)Delivery of Fire Exclusion Area Maps to Fire Dispatch.

C). Presentation – First Quarterly Fire/GIS Meeting – FARSITE Mapping Program

V. Partnership/Cost Sharing Successes

1)My Joint Fire Science Conference Registration cost shared between GRCA Natural Resources Branch and Prescribed Fire Management Program
2)FARSITE capable laptop, digital camera purchased with matching grant funds from Avifaunal Project

Summary – With the support of Prescribed Fire Management (Ken Kerr/Kim Van Hemelryk) and others (my supervisor, Dan Spotskey, and others, as noted above), I have taken the FARSITE program from its inception (August 3, 1998 – my starting date at GRCA) through its implementation. In little more than a year, we've accomplished during-fire calibration of FARSITE simulation (Camelot Fire), using the BEST available data.

Utilizing a cartographic base (created by Dan Spotskey and myself) that combined the best of: 1)USGS topographic quads (from digital version, known as Digital Raster Graphics or DRGs) and 2)USGS aerial photography (from digital version, known as Digital Orthophotograph Quad Quarters, or DOQQs), we produced fieldmaps, that we have named Topo/Photos, that greatly expedited field work and ground-truthing.
This product, the Topo/Photo, now figures prominently as a cartographic base for our Natural Resource Management Map Series (distributed to Natural Resource Branch divisions, including Fire Management – which for example displays such features as 1)helispots, 2)resources requiring special protection, 3)'tree towers', 3)emergency fire road network, etc.).

FY 2000 – Future Expectations

Programmatic implementation of Prescribed Fire Management in Grand Canyon National Park's Forest Restoration Program, utilizing FARSITE as one of the management tools in the strategy of reintroducing fire into GRCA's forested ecosystems.

Further refinement field data and calibration of FARSITE simulation.

Participation in Northern Arizona University/GRCA grant partnership, where FARSITE simulations will be used for comparison with dendrochronology (historical recording of fire area, through growth-ring analysis) records for North Rim.

FY 2000 – Future Training Needs

Arc/Info – Arizona State Land Resource Information System – Phoenix, 1 week

Fire Behavior Analysis (S-490) – 1 week

Infrared Image Interpretation (S-543?)

FY 2000 – Future Conference demonstrations of Prescribed Fire Management's FARSITE program accomplishments

Requested to present GRCA Forest Restoration paper to "Managing to Create the Ancient Forest", A conference sponsored by The 500 Year Forest Foundation, Sweet Briar College, Lynchburg College, and Randolph-Macon Woman's College, May 18, 19, and 20 of the year 2000

Grand Canyon National Park
RX Fire Archaeology
FY99 Accomplishments

Planning Documents (completed by Oct 1, 1999)

- Annual Work Plan for FY99
  - Outlines projects and timelines for entire fiscal year, based on 5-year burn plan.
- Cultural Resources Compliance Framework and Methods (now in final draft stage)
  - Describes legal framework for cultural compliance and describes compliance methods to be used in Grand Canyon.
- Survey Plans – Unique survey plan developed for each burn unit, based on Cultural Resources Compliance Framework and Methods document.
  - Horsethief 3
  - Shoshone
  - Outlet
  - Uncle Jim
  - Nankoweap-Kibbey

Project Fieldwork (completed by Oct 1, 1999)

- Cultural Resources Inventory of each project contributes to GPRA goal Ib2A.
- Shoshone
- Horsethief 3
- Outlet
- Uncle Jim
- Nankoweap-Kibbey

Section 106 Clearance Documents (completed by Oct 1, 1999)

- Shoshone
- N Rim Mechanical
- Horsethief 3
- Outlet

Other Accomplishments

- Northwest IV Fence Assessment
  - Formal Determination of National Register Eligibility (non-eligible), concurrence from SHPO received in Oct, 1999
- George Wright Society Paper (topic was fire use, but I wouldn't have had time or been funded to travel if not in this position)
- Protection of Historic Properties that could be adversely impacted by fire in each burn implemented in FY99. In each instance, this protection was completed in cooperation with RX Fire personnel.
  - 23 Historic Properties in the Shoshone Burn Unit
    - Including 8 Historic Native American historic properties containing a total of 22 combustible, historic Native American structures.

        - Only one site received any adverse impacts from the implementation of the burn.
    - 7 Historic Properties in the Horsethief Burn Unit.
        - Post-fire evaluations will be completed in FY00.
    - 9 Historic Properties in the Widforss and Outlet Burn Units.
        - Post-fire evaluations will be completed in FY00.
    - On-site monitoring during implementation of Walhalla and Shoshone burns.
- Contribution to GPRA Goals
    - Initial Condition Assessment completed for each Historic Property recorded during FY99, contributing to GRPRA Goal Ia8.
    - Data collected for each historic property entered into ASMIS (Archeological Sites Management Information System), contributing to GPRA Goals Ib2A and Ia8.
    - Protection of Historic Properties that could be adversely impacted by fire meets GPRA Goal Ia8.

Personnel

- GS-9 term
    - Amy Horn-Wilson - 24 pay periods
- GS-5 terms
    - Paul Leatherbury – 23 pay periods
    - Jeremy Haines – 22 pay periods
    - Mike Schifferli – 5 pay periods
    - Eric Albright - 8 pay periods
- GS-5 STEP
    - Jennifer Cerny – 5 pay periods
    - Jay Keasling - 1 pay period
    - Kim Lanko - 1 pay period
    - Frank Wallender - 1 pay period

Prepared by Amy Horn-Wilson
August 31, 1999
Updated Nov 1, 1999

Project	*Project Acres*	*Survey Acres*	*# of H.P. in Project*	*# of H.P. Protected in FY99*	*Cost to Date*	*Final Cost**	*Cost/project acre*
Horsethief 3	301	474	49	7	$38,904.11	$38,904.11	**$82.07
Shoshone	1,308	405	68	23	$33,986.45	$33,986.45	$25.98
N Rim Mech	460		5	5		~ $1,800	~ $3.91
Outlet	10,034	1,819	52	9	$26,648.07	~ $34,000	~ $3.38
Nanko-Kibbey	3,164	~ 826	12			~ $15,000	~ $4.74
Uncle Jim	3,358	~ 665	7			~ $15,000	~ $4.47
TOTAL	*18,625*	*~ 4,189*	*193*	*44*		*~ 138,690*	*~ $7.44*

H.P. = Historic Properties

* Final cost includes charges for personnel, equipment, travel, and all other expenses.

** Horsethief cost is by survey acres rather than project since it is the larger acreage.

GRAND CANYON NATIONAL PARK
Natural Branch-Wildlife
FY99 Rx Accomplishments

Field Projects completed by October 1, 1999:

Unit Clearances

Shoshone
Horsethief
Outlet
Widforss
Walhalla
Topeka

Project	Project Acres	Survey Acres	Final Cost	Cost/Survey Acres
Shoshone	1,308	~800	7,240.	~9.05.
Horsethief	5,341	~200	1,560.	~7.80
Outlet	10,034	~400	1,680.	~4.20
Widforss	600	~200	908.	~4.54
Walhalla	13,858	~400	3,200.	~8.00
Topeka	2,145	~700	1,500	~2.14
TOTAL	**33,286**	**~2,700**	**16,088.**	**~5.95**

Final Cost includes personnel, travel and misc. equip.

Cost Breakdown:

GS-11 permanent
R.V. Ward-1 pay period

GS-7 permanent
Elaine Leslie-1 pay period

GS-5 seasonal
Juliandra Watt-5 pay periods
Valerie Vigil-3 pay periods
Stacey Kish-5 pay periods

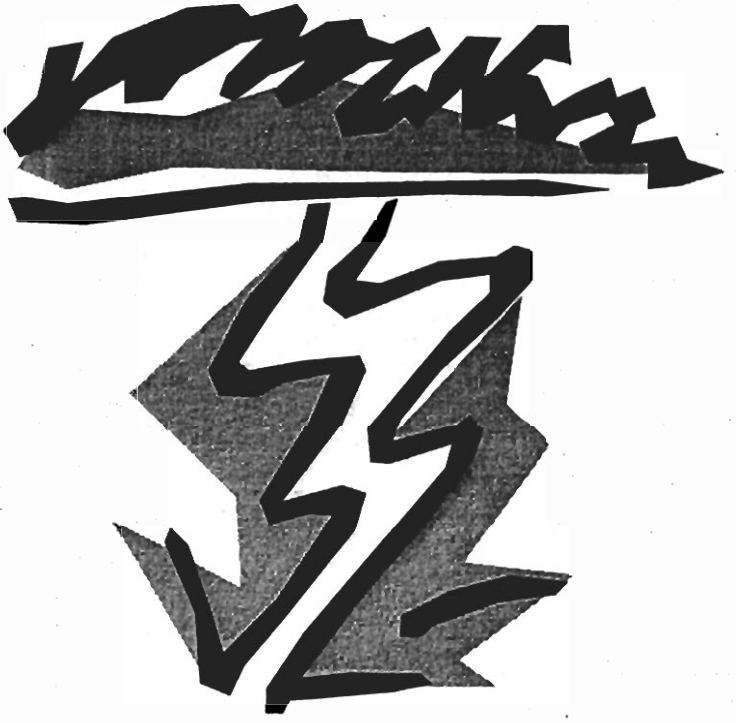
Outlet/Widforss
Personnel costs- 2,188.
Travel, equipment- 400.

Horsethief
Personnel costs-1,560.

Shoshone/Walhalla/Topeka
Personnel Costs- 11,440.
Travel, equip.- 500.

*This document does not reflect wildland fire acres surveyed.

Appendix A: Grand Canyon National Park Fuel Moisture and Fire Weather Monitoring Program



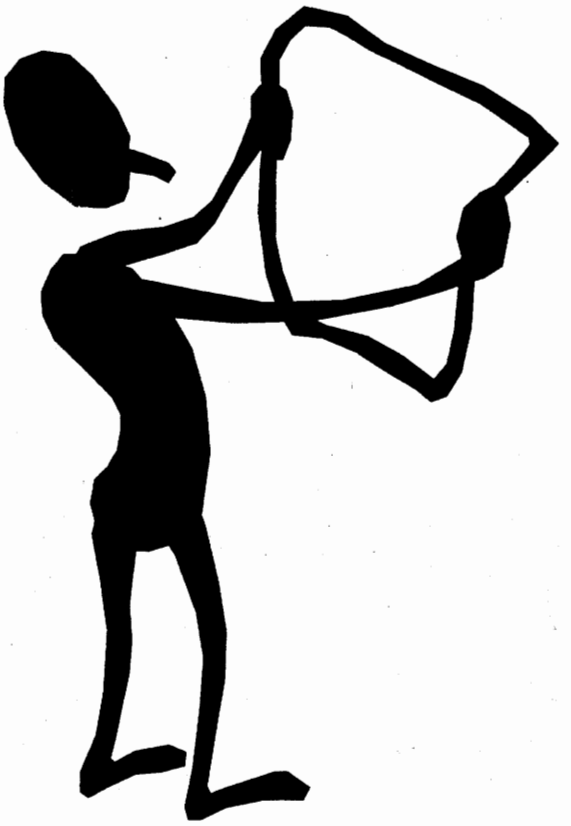
Grand Canyon National Park
Branch of Fire and Aviation Management
Fuel Moisture and Fire Weather Monitoring Plan
1999

Station Name/ID	Location Elevation	R I M	Litter/ Duff	10 hour TLFM	1000 hour TLFM	Live FM	Wx Station	Rain Gauge
Bright Angel 020211	N.Rim 8300'	North	Duff Only	Yes RAWS	Yes RAWS	No	RAWS	N
Lindberg 020220	Lindberg Hill 8800'	North	Duff Only	Yes RAWS	Yes RAWS	No	RAWS	N
Tower	N.Rim Entrance Tower 9165'	North	Duff Only	No	YES	No	Manual	Y
Walhalla 020222	Walhalla Plateau 8332'	North	Duff Only	Yes RAWS	YES	QUGA	RAWS Hygro if RAWS moved	Y
Swamp Ridge	Swamp Ridge Road 7960'	North	Duff Only	NO	YES	QUGA	Manual	Y
South Gate	South Gate Road 7000'	South	Duff Only	NO	Yes	No	Manual	Y
Tusayan 020207	Tusayan USFS	South	No	Yes RAWS	Yes RAWS	No	RAWS	N

C:/Fire/Fuel sampling/Fuel Moisture Schedule

02/26/00

Appendix B: Year End Summary: Fuel Moistures Live and Dead



GRAND CANYON NATIONAL PARK FUEL MOISTURE RESULTS
NORTH RIM AREAS:

NR Tower ***WALHALLA***
Swamp Ridge ***Lindberg***

LIVE FUEL MOISTURE - QUGA		
WEEK OF	Walhalla	Swamp Ridge
06/05/99	None Taken - no leaves	
06/19/99	206.8%	213.7%
07/03/99	119.3%	103.8%
07/17/99	98.7%	109.5%
07/31/99	111.8%	77.9%
08/14/99	61.3%	88.3%
08/28/99	105.4%	121.4%
09/11/99	92.6%	121.3%
09/25/99		120.6%
10/09/99	101.4%	
10/23/99		

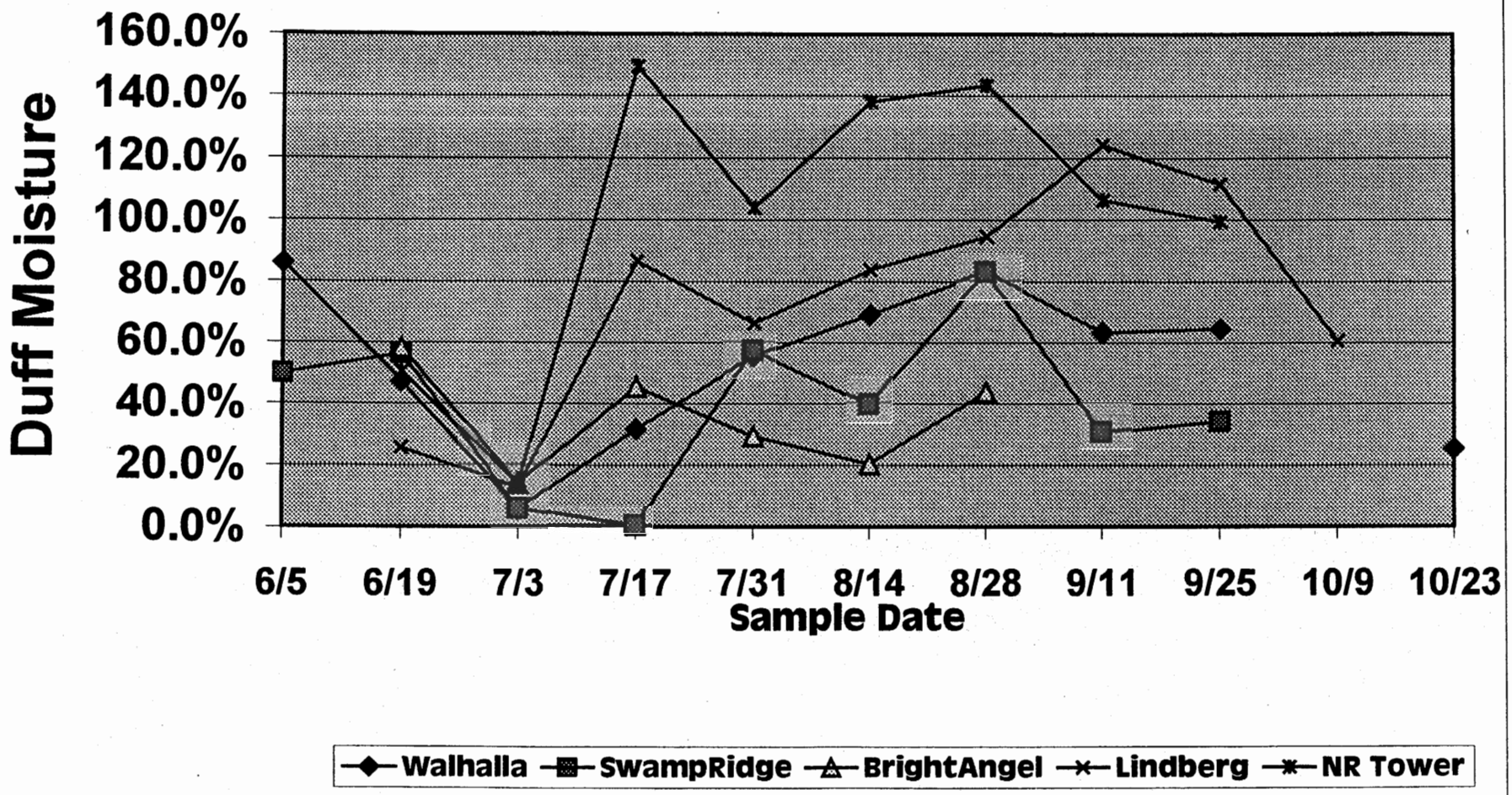
DUFF					
WEEK OF:	Walhalla	SwampRidge	BrightAngel	Lindberg	NR Tower
06/05/99	85.9%	49.7%			
06/19/99	47.2%	56.2%	58.0%	25.6%	50.4%
07/03/99	5.7%	5.8%	14.0%	12.6%	13.5%
07/17/99	31.5%		45.4%	86.4%	149.6%
07/31/99	55.2%	56.9%	29.3%	66.2%	103.9%
08/14/99	68.9%	39.4%	20.2%	83.6%	138.0%
08/28/99	82.7%	82.4%	43.8%	94.6%	143.5%
09/11/99	63.1%	30.3%		124.1%	106.4%
09/25/99	64.3%	34.2%		111.5%	99.4%
10/09/99				60.5%	
10/23/99	25.4%				

1000hr TLFM			
WEEK OF:	NR Tower	Walhalla	SwampRidge
06/05/99		58.5%	17.3%
06/19/99	38.0%	32.4%	12.2%
07/03/99	47.6%	28.8%	35.6%
07/17/99	36.4%	40.3%	
07/31/99	48.5%	77.7%	18.7%
08/14/99	62.8%	48.2%	50.2%
08/28/99	36.0%	54.3%	36.8%
09/11/99	45.2%	39.7%	21.1%
09/25/99	69.4%	44.5%	32.0%
10/09/99			
10/23/99		127.6%	

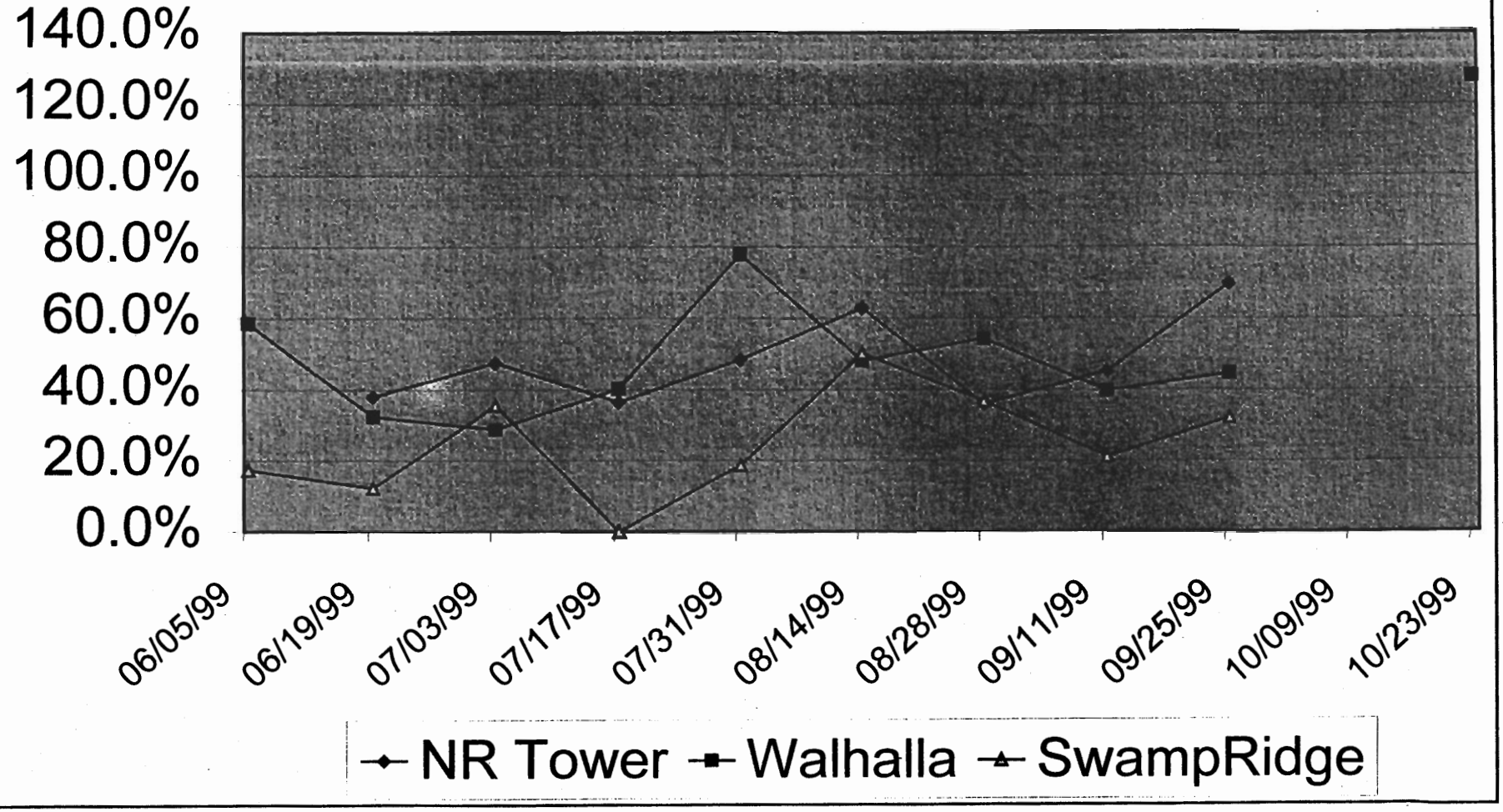
Rainfall (inches)		
Wal	SR	Tower
NA	NA	NA
0.0	0.0	0.0
0.6	0.6	0.0
0.1	0.1	0.2
0.8	0.4	0.0
1.0	2.4	1.4
0.9	0.3	0.0
0.0		0.0
0.0		

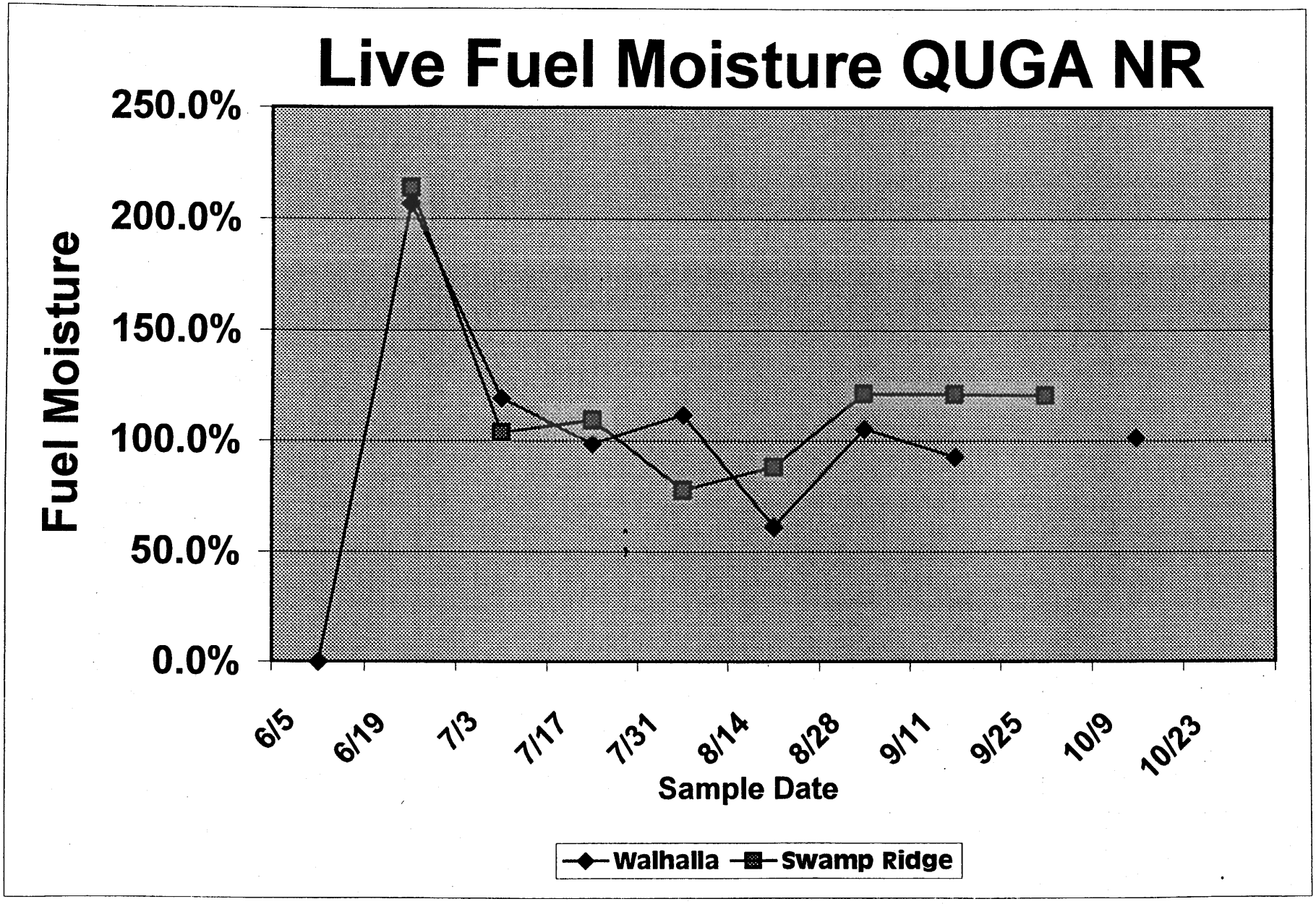
QUGA - Quercus gambellii (Oak)

Duff Fuel Moisture North Rim



1000 TLFM North Rim 1999




Live Fuel Moisture QUGA NR
Fuel Moisture
250.0%
200.0%
150.0%
100.0%
50.0%
0.0%
6/5
6/19
7/3
7/17
7/31
8/14
8/28
9/11
9/25
10/9
10/23
Sample Date
Walhalla
Swamp Ridge

GRAND CANYON NATIONAL PARK FUEL MOISTURE RESULTS
NORTH RIM AREAS: Special Needs only for Rx units

Widforss

DUFF		1000hr TLFM				Rainfall (inches)		
Date	Widforss	Date	Widforss Fir	Widforss Pine	Wid. Aspen	Date	Widforss	
09/17/99	52.2%	06/11/99	23.0%	62.0%		6/11/99	0.0	
10/03/99	42.2%	06/25/99	11.0%	28.8%		06/25/99	0.0	
		07/29/99		17.6%	42.4%	07/29/99	1.9	
		08/12/99		17.0%	56.0%	08/12/99	0.4	
		08/25/99		44.1%		08/25/99	0.7	
		09/17/99		31.4%		09/17/99	0.3	
		10/03/99		66.7%		10/03/99		

GRAND CANYON NATIONAL PARK FUEL MOISTURE RESULTS
NORTH RIM AREAS: ***Special Needs only for Rx units***

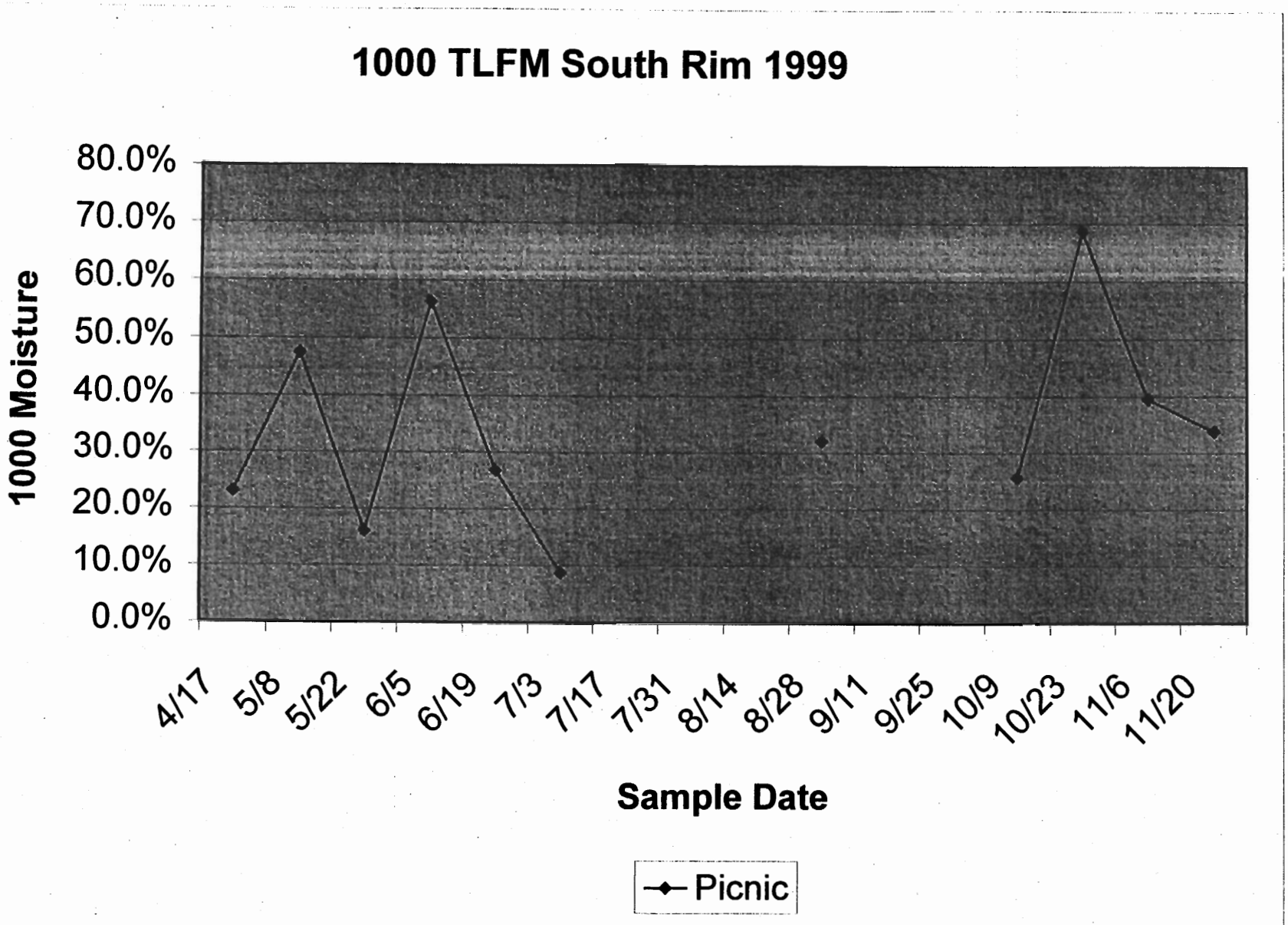
Atoko Point

DUFF		1000hr TLFM				Rainfall (inches)		
Date	**Atoko Pt.**	**Date**	**Atoko Pt.**	**Atoko North**	**Atoko South**	**Date**		
09/17/99	73.4%	**09/17/99**	31.8%			**09/17/99**	N/A	
10/03/99	70.3%	**10/03/99**	32.6%			**10/03/99**	N/A	
10/20/99	36.3%	**10/20/99**		31.0%	31.1%	**10/20/99**	N/A	

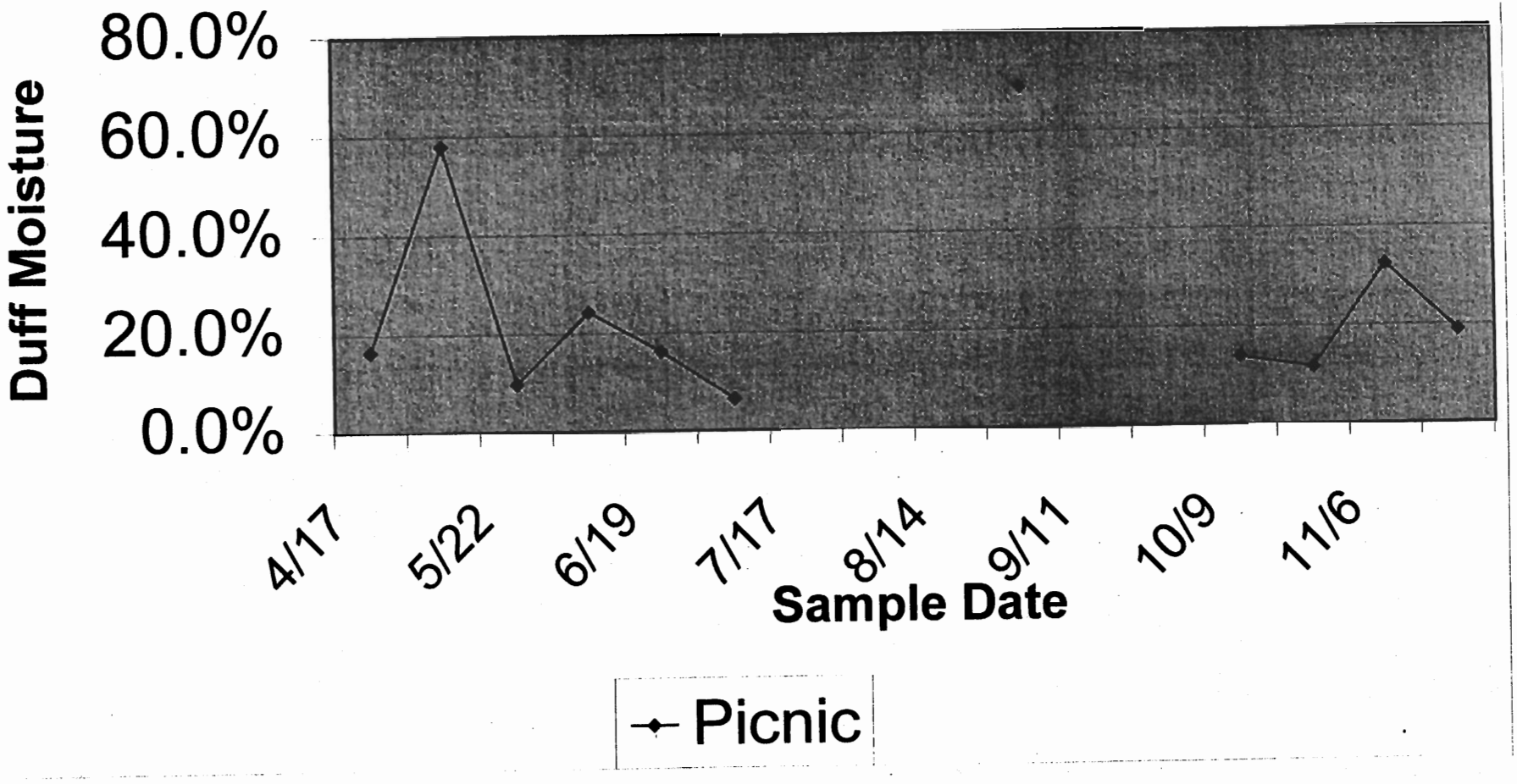
SOUTH RIM AREAS:

Picnic ***(Located in the SouthGate Area)***

	DUFF		1000hr TLFM	RAINFALL (inches)	COMMENTS
WEEK OF:	Picnic	WEEK OF:	Picnic	Picnic	
04/17/99	16.5%	04/17/1999	23.0%	0.00	C.Moore
05/08/99	58.0%	05/08/99	47.5%	0.60	FMH Crew
05/22/99	9.9%	05/22/99	16.0%	0.00	C.Moore/K.Leonard
06/05/99	24.4%	06/05/99	56.3%	0.00	
06/19/99	16.2%	06/19/99	26.8%	0.00	L.Brannfors
07/03/99	6.5%	07/03/99	8.7%	0.00	FMH Crew/ENG Crew
07/17/99		07/17/99			
07/31/99		07/31/99			
08/14/99		08/14/99			
08/28/99	69.0%	08/28/99	32.0%	not checked	B.Smith/J.Yurcik
09/11/99		09/11/99			
09/25/99		09/25/99			
10/09/99	13.9%	10/09/99	25.6%	0.00	FMH Crew
10/23/99	11.7%	10/23/99	68.6%	0.00	L.Brannfors
11/06/99	32.4%	11/06/99	39.5%	0.00	L.Brannfors
11/20/99	19.0%	11/20/99	33.8%	gauge broken	K.Leonard


1000 TLFM South Rim 1999
1000 Moisture
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
4/17
5/8
5/22
6/5
6/19
7/3
7/17
7/31
8/14
8/28
9/11
9/25
10/9
10/23
11/6
11/20
Sample Date
Picnic

Duff Fuel Moisture South Rim 1999



Appendix C: 5-Year Burn Plan and South Rim Burn Rotation Schedule

GRAND CANYON NATIONAL PARK

LONG RANGE PRESCRIBED FIRE AND MECHANICAL FUEL REDUCTION PLAN

FISCAL YEAR	PROJECT NAME	PRIORITY	SACS#	ADEQ#	FUEL TYPE	ACRES TO BE TREATED	SEASON OF BURN	NATURAL RESOURCE CLEARANCE	CULTURAL RESOURCE CLEARANCE	RIM
2000	NORTH RIM MECHANICAL	1	9901	0220	9/10	50	ALL	UPDATE	COMPLETE	N
2000	SOUTH RIM MECHANICAL	2	0001	0128	6/9	50	ALL	NEEDED	NEEDED	S
2000	WALHALLA	3	9902	0219	9/10	3000	SP/S/F	UPDATE	COMPLETE	N
2000	OUTLET	4	0002	0221	9/10	2000	SP/S/F	UPDATE	NEEDED	N
2000	PICNIC	5	0003	0144	9	231	SP/S/F	UPDATE	UPDATE	S
2000	ENTRANCE	6	0004	0156	9	693	SP/S/F	UPDATE	UPDATE	S
2000	QUARRY	7	0005	0154	9	341	SP/S/F	UPDATE	UPDATE	S
2000	HORSETHIEF	8	9905	0125	6/9	500	SP/S/F	UPDATE	NEEDED	S
2000	COVINGTON S RIM	9	0006	0130	9	60	SP/S/F	UPDATE	COMPLETE	S
2000	COVINGTON N RIM	10	0007	0232	9/10	60	SP/S/F	UPDATE	COMPLETE	N
2000	NANKOWEAP/KIBBEY	11	0008	0223	10	500	S/F	NEEDED	NEEDED	N
2000	NW IV	12	9909	0206	10	314	S/F	UPDATE	COMPLETE	N
					TOTAL ACRES	7799				

GRAND CANYON NATIONAL PARK

LONG RANGE PRESCRIBED FIRE AND MECHANICAL FUEL REDUCTION PLAN

1/20/00

FISCAL YEAR	PROJECT NAME	PRIORITY	SACS#	ADEQ#	FUEL TYPE	ACRES TO BE TREATED	SEASON OF BURN	NATURAL RESOURCE CLEARANCE	CULTURAL RESOURCE CLEARANCE	RIM
2001	NORTH RIM MECHANICAL	1	9901	0220	9/10	50	ALL	UPDATE	COMPLETE	N
2001	SOUTH RIM MECHANICAL	2	0001	0128	6/9	100	ALL	NEEDED	NEEDED	S
2001	WALHALLA	3	9902	0219	9/10	3000	SP/S/F	UPDATE	COMPLETE	N
2001	OUTLET	4	0002	0221	9/10	3000	SP/S/F	UPDATE	COMPLETE	N
2001	HANCE 2ND ENTRY	5	0101	0146	9	406	SP/S/F	UPDATE	UPDATE	S
2001	NANKOWEAP/KIBBEY	6	0008	0223	10	500	S/F	NEEDED	COMPLETE	N
2001	HORSETHIEF	7	9905	0125	6/9	500	SP/S/F	UPDATE	NEEDED	S
2001	WATSON 1 2ND ENTRY	8	0102	0153	9	297	SP/S/F	UPDATE	UPDATE	S
2001	LONG JIM III	9	0103	0132	9	1675	SP/S/F	NEEDED	NEEDED	S
2001	WALLA VALLEY	10	0104	0222	9/10	500	SP/S/F	NEEDED	NEEDED	N
2001	UNCLE JIM	11	0105	0225	9/10	1000	SP/S/F	NEEDED	UPDATE	N
2001	BLACKBERRY	12	0106	0159	2/6	10	F/W/SP	NEEDED	COMPLETE	S
					TOTAL ACRES	11038				

GRAND CANYON NATIONAL PARK

LONG RANGE PRESCRIBED FIRE AND MECHANICAL FUEL REDUCTION PLAN

1/20/00

FISCAL YEAR	PROJECT NAME	PRIORITY	SACS#	ADEQ#	FUEL TYPE	ACRES TO BE TREATED	SEASON OF BURN	NATURAL RESOURCE CLEARANCE	CULTURAL RESOURCE CLEARANCE	RIM
2002	NORTH RIM MECHANICAL	1	9901	0220	9/10	50	ALL	UPDATE	COMPLETE	N
2002	SOUTH RIM MECHANICAL	2	0201	0128	6/9	100	ALL	NEEDED	NEEDED	S
2002	GRAPEVINE/RX300 (2ND)	3	0202	0145	9	1243	SP/S/F	UPDATE	UPDATE	S
2002	NANKOWEAP/KIBBEY	4	0203	0223	10	500	S/F	NEEDED	COMPLETE	N
2002	HORSETHIEF	5	0204	0125	6/9	500	SP/S/F	UPDATE	NEEDED	S
2002	WATSON II/III 2ND ENTRY	6	0205	0152	9	1573	SP/S/F	UPDATE	UPDATE	S
2002	LONG JIM I	7	0206	0132	9	1695	SP/S/F	NEEDED	NEEDED	S
2002	WALLA VALLEY	8	0207	0222	9/10	500	SP/S/F	NEEDED	NEEDED	N
2002	UNCLE JIM	9	0208	0225	9/10	1000	SP/S/F	NEEDED	UPDATE	N
2002	THOMPSON	10	0209	0224	9/10	1000	SP/S/F	NEEDED	NEEDED	N
2002	RANGE	11	0210	0226	9/10	2340	SP/S/F	NEEDED	NEEDED	N
					TOTAL ACRES	10501				

GRAND CANYON NATIONAL PARK

LONG RANGE PRESCRIBED FIRE AND MECHANICAL FUEL REDUCTION PLAN

1/20/00

FISCAL YEAR	PROJECT NAME	PRIORITY	SACS#	ADEQ#	FUEL TYPE	ACRES TO BE TREATED	SEASON OF BURN	NATURAL RESOURCE CLEARANCE	CULTURAL RESOURCE CLEARANCE	RIM
2003	NORTH RIM MECHANICAL	1	9901	0220	9/10	50	ALL	UPDATE	COMPLETE	N
2003	SOUTH RIM MECHANICAL	2	0201	0126	6/9	100	ALL	NEEDED	NEEDED	S
2003	WALLA VALLEY	5	0202	0222	9/10	1000	SP/S/F	UPDATE	COMPLETE	N
2003	NANKOWEAP/KIBBEY	6	0203	0223	10	500	S/F	NEEDED	COMPLETE	N
2003	THOMPSON	7	0204	0224	9/10	3000	S/F	NEEDED	NEEDED	N
2003	UNCLE JIM	8	0205	0225	9/10	1500	SP/S/F	NEEDED	NEEDED	N
2003	LONG JIM II	9	0206	0132	9	1730	SP/S/F	NEEDED	NEEDED	S
2003	WATSON 4 2ND ENTRY	10	0207	0152	9	857	SP/S/F	UPDATE	UPDATE	S
2003	ROOST	11	0208	0227	9/10	2000	SP/S/F	NEEDED	NEEDED	N
					TOTAL ACRES	10737				

GRAND CANYON NATIONAL PARK

LONG RANGE PRESCRIBED FIRE AND MECHANICAL FUEL REDUCTION PLAN

1/20/00

FISCAL YEAR	PROJECT NAME	PRIORITY	SACS#	ADEQ#	FUEL TYPE	ACRES TO BE TREATED	SEASON OF BURN	NATURAL RESOURCE CLEARANCE	CULTURAL RESOURCE CLEARANCE	RIM
2004	NORTH RIM MECHANICAL	1	9901	0220	9/10	50	ALL	UPDATE	COMPLETE	N
2004	SOUTH RIM MECHANICAL	2	0301	0128	6/9	100	ALL	NEEDED	NEEDED	S
2004	WALLA VALLEY	3	0302	0222	9/10	1000	SP/S/F	UPDATE	COMPLETE	N
2004	ROOST	4	0303	0227	9/10	3000	S/F	NEEDED	COMPLETE	N
2004	THOMPSON	5	0304	0224	9/10	3000	S/F	NEEDED	NEEDED	N
2004	TOPEKA 3RD ENTRY	6	0306	0160	9	2115	SP/S/F	UPDATE	UPDATE	S
2004	TUSAYAN 2ND ENTRY	7	309	0135	9	572	SP/S/F	NEEDED	UPDATE	S
2004	LONETREE 2ND ENTRY	8	0310	0150	9	892	SP/S/F	NEEDED	UPDATE	S
2004	WALHALLA 2ND ENTRY	9	0311	0234	9/10	4000	SP/S/F	UPDATE	UPDATE	N
					TOTAL ACRES	14729				

GRAND CANYON NATIONAL PARK

LONG RANGE PRESCRIBED FIRE AND MECHANICAL FUEL REDUCTION PLAN

1/20/00

FISCAL YEAR	PROJECT NAME	PRIORITY	SACS#	ADEQ#	FUEL TYPE	ACRES TO BE TREATED	SEASON OF BURN	NATURAL RESOURCE CLEARANCE	CULTURAL RESOURCE CLEARANCE	RIM
2005	NORTH RIM MECHANICAL	1	0501	0220	9/10	50	ALL	UPDATE	COMPLETE	N
2005	SOUTH RIM MECHANICAL	2	0502	0128	6/9	100	ALL	NEEDED	NEEDED	S
2005	WALLA VALLEY	3	0503	0222	9/10	1000	SP/S/F	UPDATE	COMPLETE	N
2005	ROOST	4	0509	0227	9/10	2000	SP/S/F	NEEDED	NEEDED	N
2005	THOMPSON	5	0505	0224	9/10	3000	S/F	NEEDED	NEEDED	N
2005	WALHALLA 2ND ENTRY	6	0506	0234	9/10	3000	SP/S/F	UPDATE	UPDATE	N
2005	OUTLET 2ND ENTRY	7	0507	0235	9/10	3000	SP/S/F	UPDATE	UPDATE	N
2005	SHOSHONE 2ND ENTRY	8	0508	0148	9	1300	SP/S/F	UPDATE	UPDATE	S
2005	MOQUI 2ND ENTRY	9	0509	0147	9	841	SP/S/F	UPDATE	UPDATE	S
					TOTAL ACRES	14291				

GRAND CANYON NATIONAL PARK

LONG RANGE PRESCRIBED FIRE AND MECHANICAL FUEL REDUCTION PLAN

1/20/00

FISCAL YEAR	PROJECT NAME	PRIORITY	SACS#	ADEQ#	FUEL TYPE	ACRES TO BE TREATED	SEASON OF BURN	NATURAL RESOURCE CLEARANCE	CULTURAL RESOURCE CLEARANCE	RIM
2006	NORTH RIM MECHANICAL	1	0601	0220	9/10	50	ALL	UPDATE	COMPLETE	N
2006	SOUTH RIM MECHANICAL	2	0602	0128	6/9	100	ALL	NEEDED	NEEDED	S
2006	BOUNDARY	3	0603	0228	9/10	500	SP/S/F	NEEDED	NEEDED	N
2006	ROOST	4	0604	0227	9/10	2000	SP/S/F	NEEDED	NEEDED	N
2006	THOMPSON	5	0605	0224	9/10	3000	S/F	NEEDED	NEEDED	N
2006	WALHALLA 2ND ENTRY	6	0606	0234	9/10	3000	SP/S/F	UPDATE	UPDATE	N
2006	OUTLET 2ND ENTRY	7	0607	0235	9/10	3000	SP/S/F	UPDATE	UPDATE	N
2006	PICNIC 3RD ENTRY	8	0608		9	231	SP/S/F	UPDATE	UPDATE	S
2006	ENTRANCE 3RD ENTRY	9	0609		9	693	SP/S/F	UPDATE	UPDATE	S
2006	QUARRY 3RD ENTRY	10	0610		9	341	SP/S/F	UPDATE	UPDATE	S
2006	HORSETHIEF 2ND ENTRY	11	0611	0149	9	400	SP/S/F	UPDATE	UPDATE	S
					TOTAL ACRES	13315				

Needed Information when Reviewing South Rim Burn Rotation

1. Desired Future Conditions (DFC) have not yet been established for GRCA monitoring types for South Rim Ponderosa Pine or Pinyon Juniper Fuel Types. When adopted, this burn plan will reflect these DFC.
2. This burn rotation is set for FY00. It is flexible for all other FY.
3. There is currently a South Rim Second Entry Burn plan being written for ALL Ponderosa Pine units. Individual units will still show as needing plans until this is done. First entry burns will need individual burn plans.
4. Season of Burn: SP = Spring; S = Summer; F = Fall; All = All seasons
5. Wildlife Clearances: MSO = Mexican Spotted Owl; U = Update surveys for species of concern
6. Archeological clearances: U= Update of past clearance; TBC = To Be Completed
7. This plan will serve as a guide for planning prescribed fire projects at GRCA NP. The actual year a project is completed will be dependent on a variety of factors including current wildland fire load, project prescription parameters, and completion of NEPA project clearances.
8. Priorities for clearances will be coordinated through the Prescribed Fire Manager.
9. Incomplete projects will be moved to the next Fiscal Year.
10. Names of burn projects reflect current project map.

Name of Prescribed Fire Burn Plan	*Whom the Plan is assigned to*
South Rim Mechanical	D.Ottosen
Grand View I, II	T. Oppermann

South Rim 18-year Burn Plan *MASTER*	Fiscal Year	SACS#	ADEQ#	Project Name	Fuel Type	Acres to be treated	Season of Burn	Wildlife Clearance	Archeology Clearance
	1999	9905	0125	Horsethief	PP	500	ALL	Update	TBC
	1999	9906	0129	Shoshone	PP	1300	SP/S/F	Update	TBC
	1999	9907	0121	Lonetree	PP	400	SP/S/F	Update	Update
	1999	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
FY99 TOTAL ACRES						**2300**			
	2000	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2000			Picnic	PP	231	SP/S/F	Update	Update
	2000			***Entrance***	***PP***	693	SP/S/F	Update	Update
	2000			***Quarry***	***PP***	341	SP/S/F	Update	Update
	2000			Village	***PP***	110	SP/S/F	Update	Update
	2000	9905	0125	Horsethief	PP	1000	ALL	Update	TBC
FY00 TOTAL ACRES						**2475**			
	2001	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2001	9905	0125	Horsethief	PP	500	ALL	Update	TBC
	2001			***Hance***	PP	406	SP/S/F	Update	Update
	2001		0117	***Watson 1***	PP	297	SP/S/F	Update	Update
	2001			Long Jim III	PP	1675	SP/S/F	Update	TBC
FY01 TOTAL ACRES						**2978**			
	2002	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2002			***Watson III***	PP	712			Update
	2002		0134	***Grandview***	PP	1129	SP/S/F	Update	TBC
	2002		0119	***Rx-300/GrapeVine***	PP	1243	SP/S/F	Update	Update
	2002			***Watson II***	PP	861	SP/S/F	Update	Update
FY02 TOTAL ACRES						**4045**			

South Rim 18-year Burn Plan *MASTER*	Fiscal Year	SACS#	ADEQ#	Project Name	Fuel Type	Acres to be treated	Season of Burn	Wildlife Clearance	Archeology Clearance
	2003	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2003		0132	Long Jim I	PP	1695	SP/S/F	Update	Update
	2003		0122	***Watson IV***	PP	857	SP/S/F	Update	Update
	2003		0132	Long Jim II	PP	1730	SP/S/F	Update	Update
FY03 TOTAL ACRES						**4382**			
	2004	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2004			***Topeka***	PP	2115	SP/S/F	Update	Update
	2004			***Tusayan***	PP	572	SP/S/F	Update	Update
	2004	9907	0121	***Lonetree***	PP	892	SP/S/F	Update	Update
FY04 TOTAL ACRES						**3679**			
	2005	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2005		0129	***Shoshone***	PP	1300	SP/S/F	Update	Update
	2005			***Moqui***	PP	841	SP/S/F	Update	Update
FY05 TOTAL ACRES						**2241**			

South Rim 18-year Burn Plan *MASTER*	Fiscal Year	SACS#	ADEQ#	Project Name	Fuel Type	Acres to be treated	Season of Burn	Wildlife Clearance	Archeology Clearance
	2006	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2006			*Picnic*	PP	231	SP/S/F	Update	Update
	2006			*Entrance*	PP	693	SP/S/F	Update	Update
	2006			*Quarry*	PP	341	SP/S/F	Update	Update
	2006			*Village*	PP	110	SP/S/F	Update	Update
	2006		0125	Horsethief	PP	1000	ALL	Update	Update
FY06 TOTAL ACRES						**2475**			
	2007	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2007			*Hance*	PP	406	SP/S/F	Update	Update
	2007		0117	*Watson 1*	PP	297	SP/S/F	Update	Update
	2007			*Long Jim III*	PP	1675	SP/S/F	Update	Update
FY07 TOTAL ACRES						**2478**			
	2008	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2008			*Watson III*	PP	712			Update
	2008		0134	*Grandview*	PP	1129	SP/S/F	Update	Update
	2008		0119	*Rx-300/GrapeVine*	PP	1243	SP/S/F	Update	Update
	2008			*Watson II*	PP	861	SP/S/F	Update	Update
FY08 TOTAL ACRES						**4045**			
	2009	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2009		0132	*Long Jim I*	PP	1695	SP/S/F	Update	Update
	2009		0122	*Watson IV*	PP	857	SP/S/F	Update	Update
	2009		0132	*Long Jim II*	PP	1730	SP/S/F	Update	Update
FY09 TOTAL ACRES						**4382**			

South Rim 18-year Burn Plan *MASTER*	Fiscal Year	SACS#	ADEQ#	Project Name	Fuel Type	Acres to be treated	Season of Burn	Wildlife Clearance	Archeology Clearance
	2010	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2010			*Topeka*	PP	2115	SP/S/F	Update	Update
	2010			*Tusayan*	PP	572	SP/S/F	Update	Update
	2010	9907	0121	*Lonetree*	PP	892	SP/S/F	Update	Update
FY10 TOTAL ACRES						**3679**			
	2011	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2011		0129	*Shoshone*	PP	1300	SP/S/F	Update	Update
FY11 TOTAL ACRES						**1400**			
	2012	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2012			*Picnic*	PP	231	SP/S/F	Update	Update
	2012			*Entrance*	PP	693	SP/S/F	Update	Update
	2012			*Quarry*	PP	341	SP/S/F	Update	Update
	2012			*Village*	PP	110	SP/S/F	Update	Update
	2012		0125	*Horsethief*	PP	1000	ALL	Update	Update
FY12 TOTAL ACRES						**2475**			

South Rim 18-year Burn Plan *MASTER*	Fiscal Year	SACS#	ADEQ#	Project Name	Fuel Type	Acres to be treated	Season of Burn	Wildlife Clearance	Archeology Clearance
	2013	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2013	9905	0125	***Horsethief***	PP	1500	ALL	Update	Update
	2013			***Hance***	PP	406	SP/S/F	Update	Update
	2013		0117	***Watson 1***	PP	297	SP/S/F	Update	Update
	2013			***Long Jim III***	PP	1675	SP/S/F	Update	Update
FY13 TOTAL ACRES						**3978**			
	2014	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2014			***Watson III***	PP	712			Update
	2014		0134	***Grandview***	PP	1129	SP/S/F	Update	Update
	2014		0119	***Rx-300/GrapeVine***	PP	1243	SP/S/F	Update	Update
	2014			***Watson II***	PP	861	SP/S/F	Update	Update
FY14 TOTAL ACRES						**4045**			
	2015	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2015		0132	***Long Jim I***	PP	1695	SP/S/F	Update	Update
	2015		0122	***Watson IV***	PP	857	SP/S/F	Update	Update
	2015		0132	***Long Jim II***	PP	1730	SP/S/F	Update	Update
FY15 TOTAL ACRES						**4382**			

South Rim 18-year Burn Plan *MASTER*	Fiscal Year	SACS#	ADEQ#	Project Name	Fuel Type	Acres to be treated	Season of Burn	Wildlife Clearance	Archeology Clearance
	2016	9908	0128	*SRim Mechanical*	PP	100	ALL	Update	TBC
	2016			*Topeka*	PP	2115	SP/S/F	Update	Update
	2016			*Tusayan*	PP	572	SP/S/F	Update	Update
	2016	9907	0121	*Lonetree*	PP	892	SP/S/F	Update	Update
FY16 TOTAL ACRES						**3679**			
	2017	9908	0128	*SRim Mechanical*	PP	100	ALL	Update	TBC
	2017		0129	*Shoshone*	PP	1300	SP/S/F	Update	Update
FY17 TOTAL ACRES						**1400**			
	2018	9908	0128	*SRim Mechanical*	PP	100	ALL	Update	TBC
	2018			*Picnic*	PP	231	SP/S/F	Update	Update
	2018			*Entrance*	PP	693	SP/S/F	Update	Update
	2018			*Quarry*	PP	341	SP/S/F	Update	Update
	2018			*Village*	PP	110	SP/S/F	Update	Update
	2018		0125	*Horsethief*	PP	1500	ALL	Update	Update
FY18 TOTAL ACRES						**2975**			
	2019	9908	0128	*SRim Mechanical*	PP	100	ALL	Update	TBC
	2019	9905	0125	*Horsethief*	PP	500	ALL	Update	Update
	2019			*Hance*	PP	406	SP/S/F	Update	Update
	2019		0117	*Watson 1*	PP	297	SP/S/F	Update	Update
	2019			*Long Jim III*	PP	1675	SP/S/F	Update	Update
FY19 TOTAL ACRES						**2978**			

South Rim 18-year Burn Plan *MASTER*	Fiscal Year	SACS#	ADEQ#	Project Name	Fuel Type	Acres to be treated	Season of Burn	Wildlife Clearance	Archeology Clearance
	2020	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2020			***Watson III***	PP	712			Update
	2020		0134	***Grandview***	PP	1129	SP/S/F	Update	Update
	2020		0119	***Rx-300/GrapeVine***	PP	1243	SP/S/F	Update	Update
	2020			***Watson II***	PP	861	SP/S/F	Update	Update
FY20 TOTAL ACRES						**4045**			
	2021	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2021		0132	***Long Jim I***	PP	1695	SP/S/F	Update	Update
	2021		0122	***Watson IV***	PP	857	SP/S/F	Update	Update
	2021		0132	***Long Jim II***	PP	1730	SP/S/F	Update	Update
FY21 TOTAL ACRES						**4382**			
	2022	9908	0128	SRim Mechanical	PP	100	ALL	Update	TBC
	2022			***Topeka***	PP	2115	SP/S/F	Update	Update
	2022			***Tusayan***	PP	572	SP/S/F	Update	Update
	2022	9907	0121	***Lonetree***	PP	892	SP/S/F	Update	Update
FY22 TOTAL ACRES						**3679**			

Appendix D: Cost Tracking Forms

Burn Name	Fuel Treatment-to-date by Acre			Total Acres	Total Cost	Acre Cost
	Rx Fire	*Mech.*	*Combo (pile burning)*			
Calendar 99						
Walhalla	3989			3989	$191,007.04	$27.56
NR Mechanical		81	34	115	$64,266.00	$558.83
NW 4				0	$10,457.00	
NR Piles			5	5		
SR Mechanical			7.5	7.5	$976.00	$130.13
Widforss				0		
Tiyo I				0	$40,659.00	
Lonetree	318			318	$38,260.00	$100.16
Horsethief	400			400	$46,729.00	$116.82
Shoshone	1297			1297	$79,084.00	$60.97
Outlet	3842			3842	$51,348.23	$13.36
Totals	9846	81	46.5	**9973.5**	**$522,786.27**	$52.42

Burn Name	Fuel Treatment-to-date by Acre			Total Acres	Cost to date	Projected Cost	Total Cost	Authorized Amount	*Difference*	Project Cost/Acre
	Rx Fire	*Mech.*	*Combo (pile burning)*							
FY99										
Walhalla	3705			3705	$147,905.00		$147,905.00	$104,420.00	-$43,485.00	$39.92
NR Mechanical		81	34	115	$64,266.00		$64,266.00	$71,370.00	$7,104.00	$558.83
NW 4				0	$10,457.00		$10,457.00	$48,250.00	$37,793.00	#DIV/0!
NR Piles			5	5			$0.00		$0.00	$0.00
SR Mechanical			7.5	7.5	$976.00		$976.00	$68,680.00	$67,704.00	$130.13
Widforss	38			38	$132,601.00		$132,601.00	$132,396.00	-$205.00	$3,489.50
Tiyo I				0	$40,659.00		$40,659.00	$40,680.00	$21.00	#DIV/0!
Horsethief	400			400	$46,729.00		$46,729.00	$49,660.00	$2,931.00	$116.82
Lonetree	382			382	$38,260.00		$38,260.00	$45,210.00	$6,950.00	$100.16
Shoshone	1297			1297	$79,084.00		$79,084.00	$54,890.00	-$24,194.00	$60.97
Totals	5822	81	46.5	**5949.5**	$560,937.00	$0.00	**$560,937.00**	$615,556.00	$54,619.00	$94.28

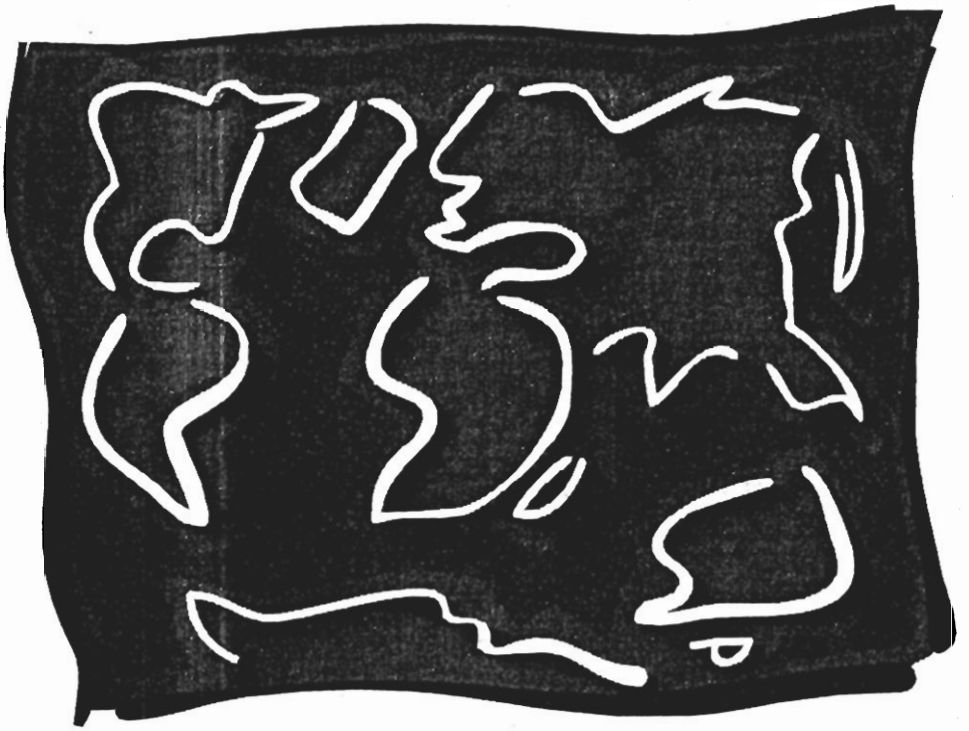
Cost per Acre **$94.28**

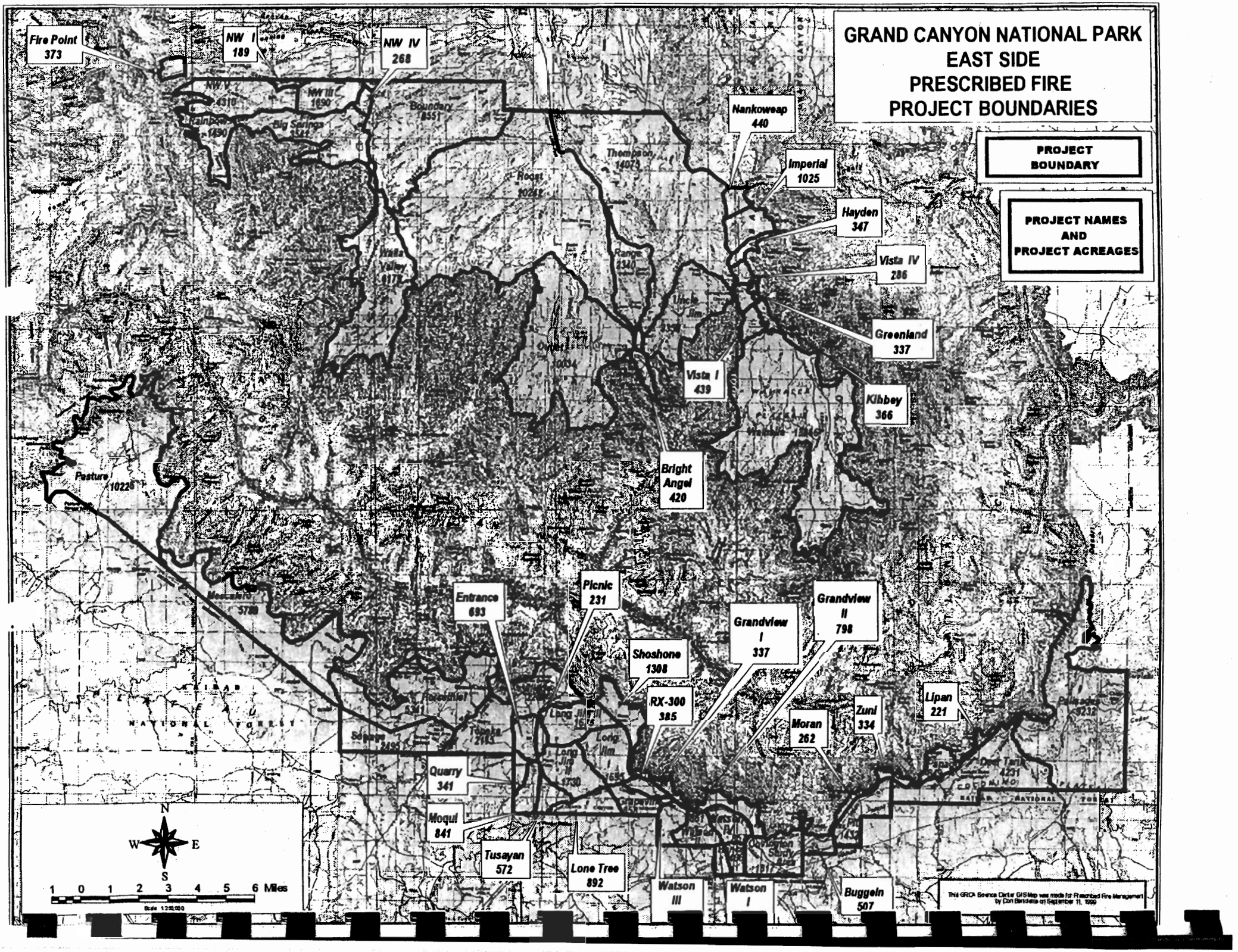
Burn Name	SACS Project #	Fuel Treatment-to-date by Acre			Total Acres	Cost to date	Projected Cost	Total Cost	Authorized Amount	*Difference*	Project Cost/Acre
		Rx Fire	*Mech.*	*Combo (pile burning)*							
FY00											
SR Mechanical	**0001**				0			$0.00	$34,900.00	$34,900.00	#DIV/0!
Walhalla	**0003**	3225			3225			$0.00	$71,296.00	$71,296.00	$22.11
Outlet	**0004**	3842			3842			$0.00	$64,160.00	$64,160.00	$16.70
Picnic	**0005**				0			$0.00	$14,420.00	$14,420.00	#DIV/0!
Entrance	**0006**				0			$0.00	40,020.00	$40,020.00	#DIV/0!
Horsethief	**0007**				0			$0.00	$21,720.00	$21,720.00	#DIV/0!
Nankoweap/Kibbey	**0008**				0			$0.00	$43,720.00	$43,720.00	#DIV/0!
NR Mechanical	**9901**				0			$0.00	$42,480.00	$42,480.00	#DIV/0!
NW 4	**9909**				0			$0.00	$48,250.00	$48,250.00	#DIV/0!
Totals		7067	0	0	**7067**	$23,418.54	$71,031.73	**$94,450.27**	$380,966.00	$286,515.73	$53.91 **if spent all of authorized**

Cost per Acre **Operations Only** **$13.36**

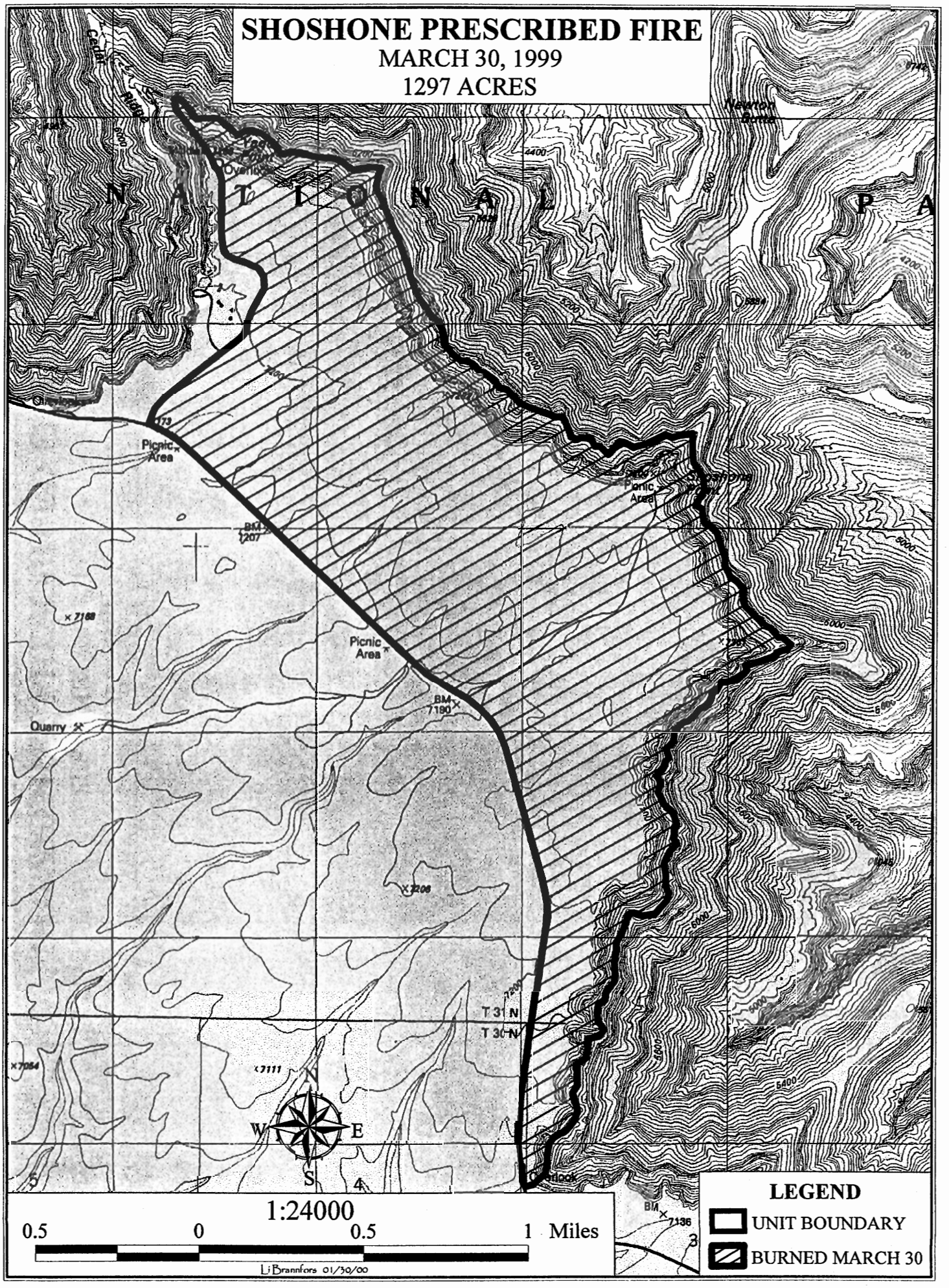
8227-0003-252

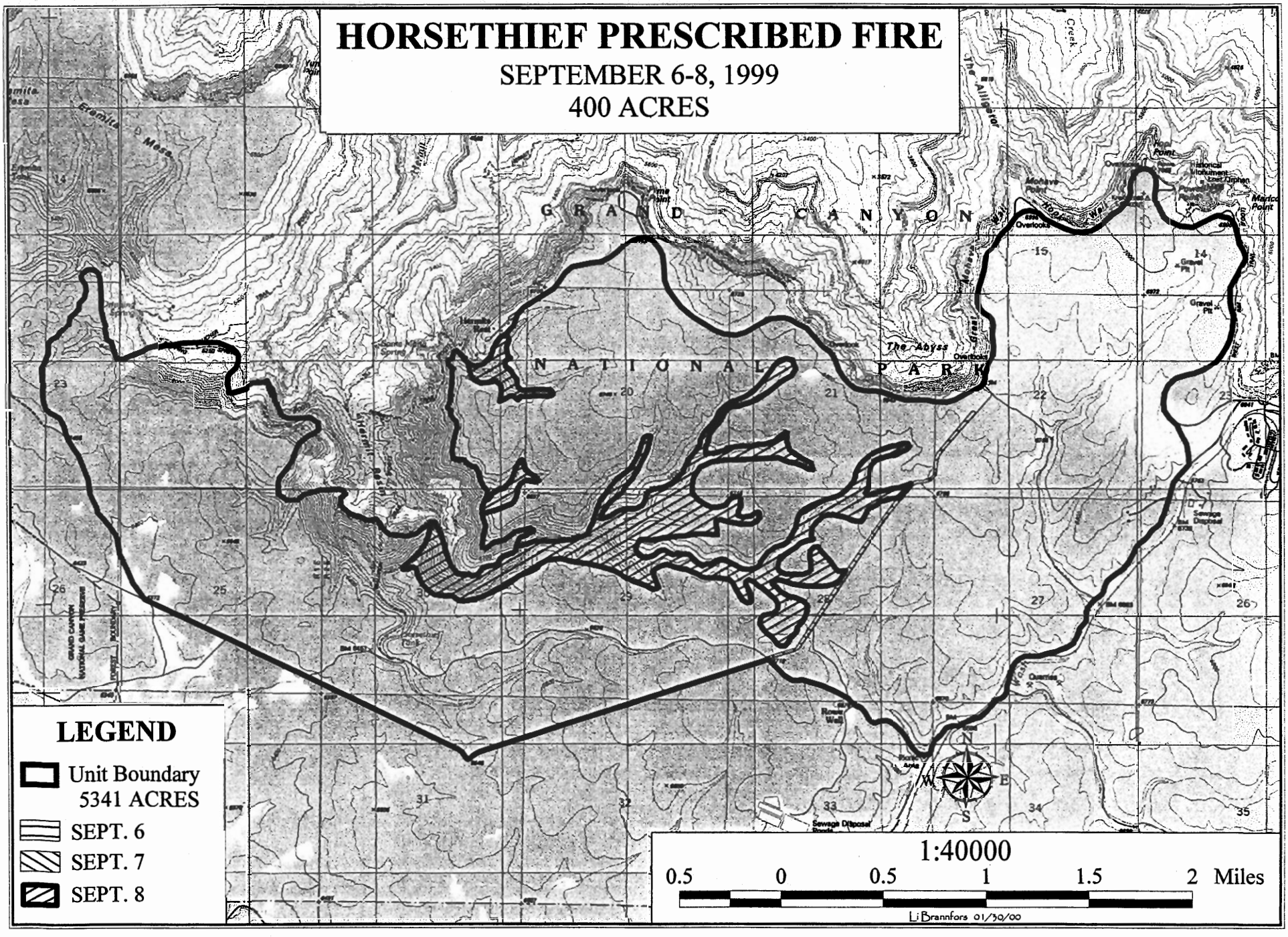
Appendix E: Grand Canyon Prescribed Burn Units Map

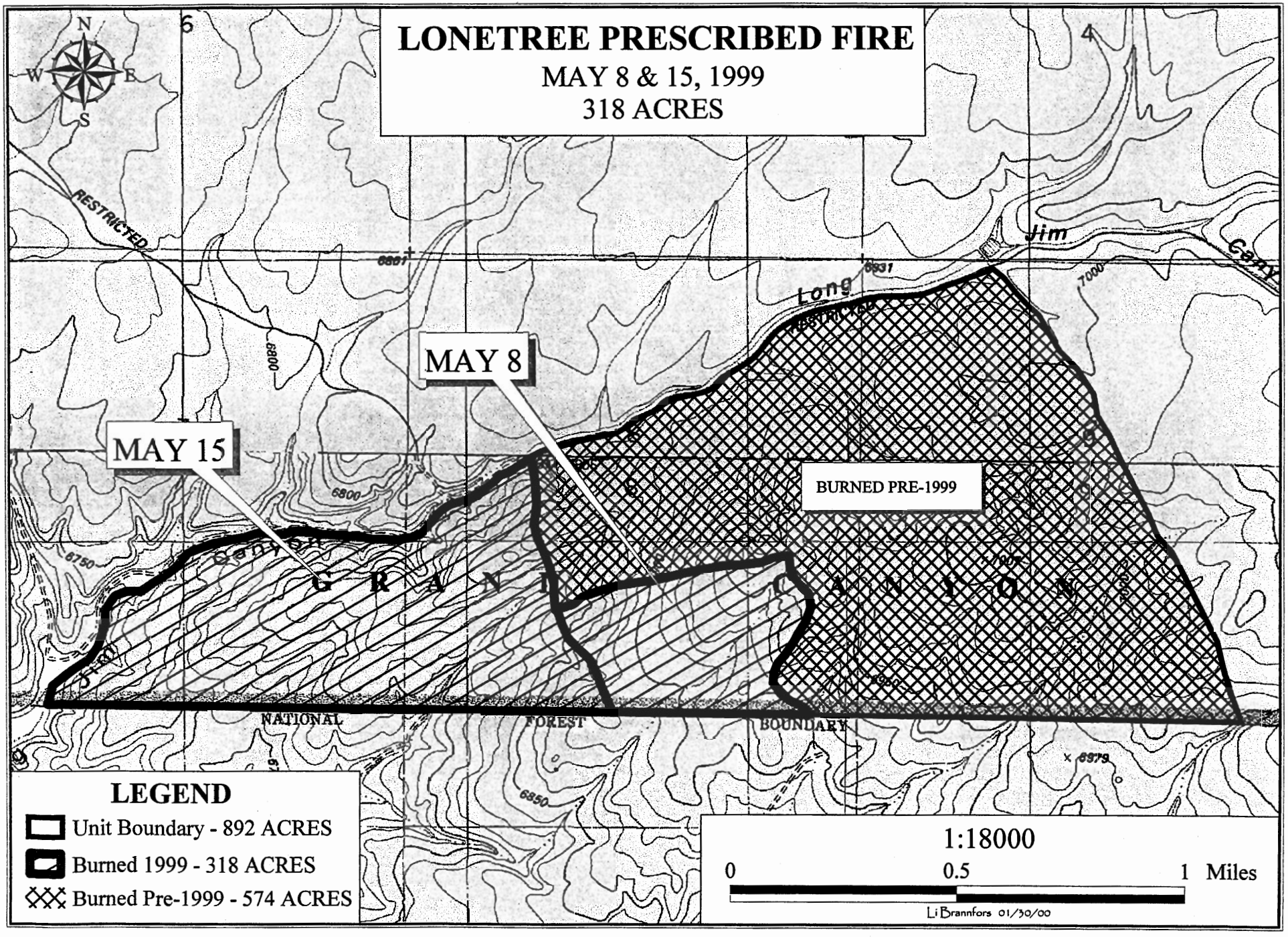


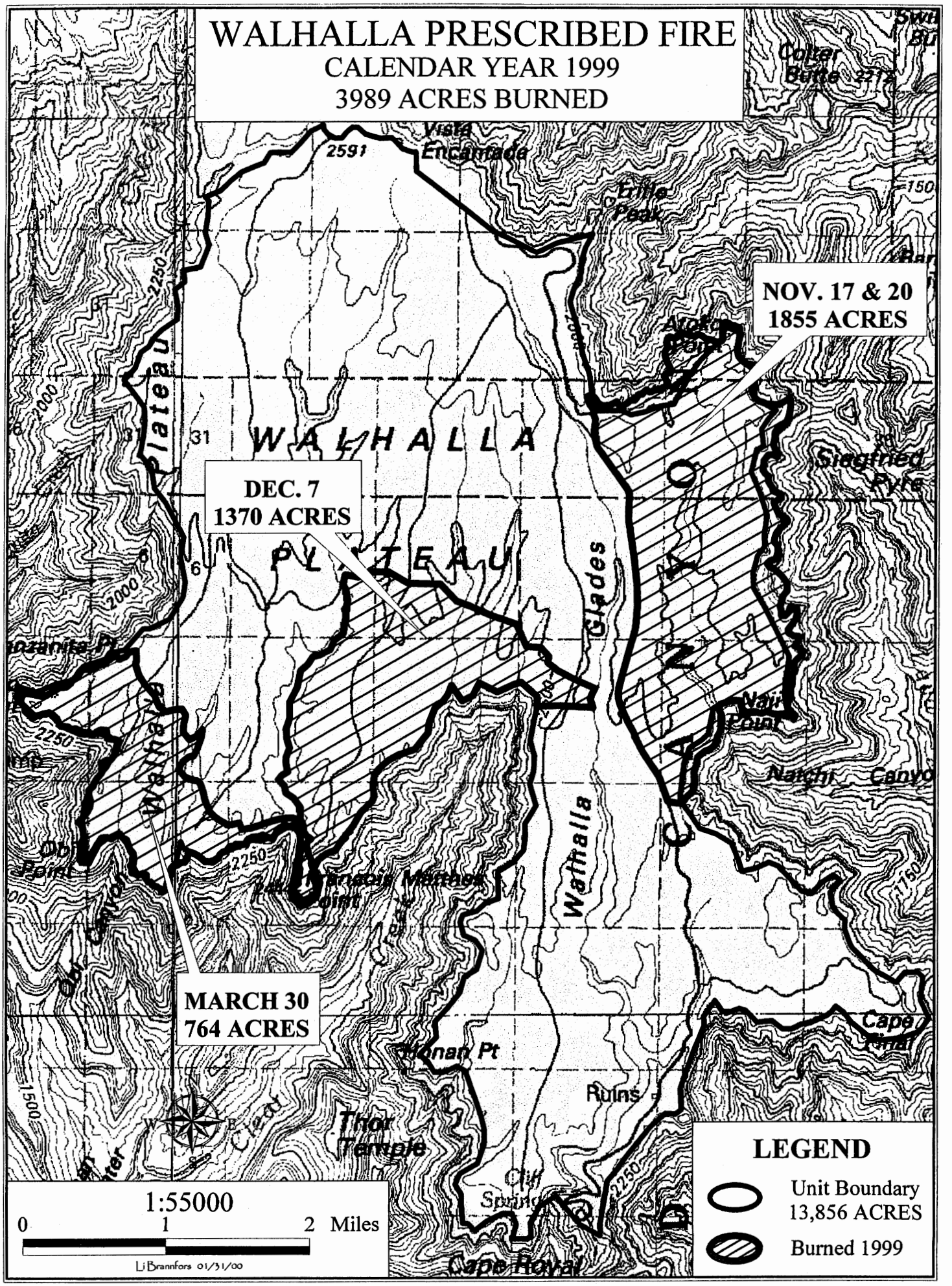

GRAND CANYON NATIONAL PARK
EAST SIDE
PRESCRIBED FIRE
PROJECT BOUNDARIES
PROJECT BOUNDARY
PROJECT NAMES AND PROJECT ACREAGES
Fire Point 373
NW I 189
NW IV 268
Nankoweap 440
Imperial 1025
Hayden 347
Vista IV 286
Greenland 337
Vista I 439
Kibbey 366
Bright Angel 420
Pasture 1022
Entrance 693
Picnic 231
Grandview II 798
Grandview I 337
Shoshone 1308
RX-300 385
Zuni 334
Lipan 221
Moran 262
Quarry 341
Moqui 841
Tusayan 572
Lone Tree 892
Watson III
Watson I
Buggein 507
N
W
E
S
1 0 1 2 3 4 5 6 Miles

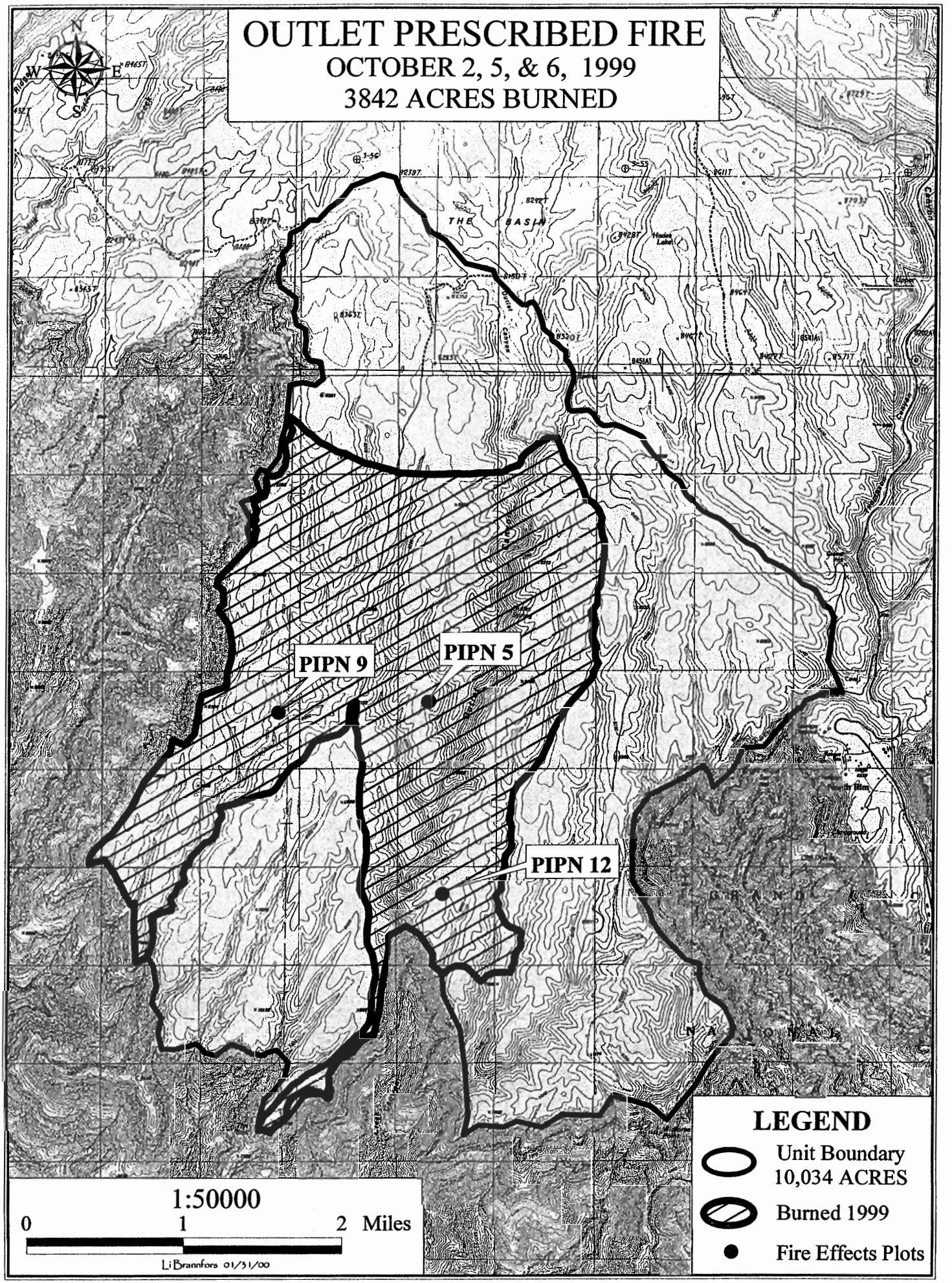
Appendix F: Prescribed Burn Unit Maps


SHOSHONE PRESCRIBED FIRE
MARCH 30, 1999
1297 ACRES
NATIONAL PARK
Picnic Area
Picnic Area
Picnic Area
Quarry
Overlook
T 31 N
T 30 N
1:24000
0.5 0 0.5 1 Miles
LI Brannfors 01/30/00
LEGEND
UNIT BOUNDARY
BURNED MARCH 30


HORSETHIEF PRESCRIBED FIRE
SEPTEMBER 6-8, 1999
400 ACRES
GRAND CANYON NATIONAL PARK
LEGEND
Unit Boundary
5341 ACRES
SEPT. 6
SEPT. 7
SEPT. 8
1:40000
0.5 0 0.5 1 1.5 2 Miles
Li Brannfors 01/30/00


LONETREE PRESCRIBED FIRE
MAY 8 & 15, 1999
318 ACRES
MAY 8
MAY 15
BURNED PRE-1999
RESTRICTED
Jim
Long
Canyon
GRANITOS
NATIONAL
FOREST
BOUNDARY
LEGEND
Unit Boundary - 892 ACRES
Burned 1999 - 318 ACRES
Burned Pre-1999 - 574 ACRES
1:18000
0
0.5
1 Miles
Li Brannfors 01/30/00

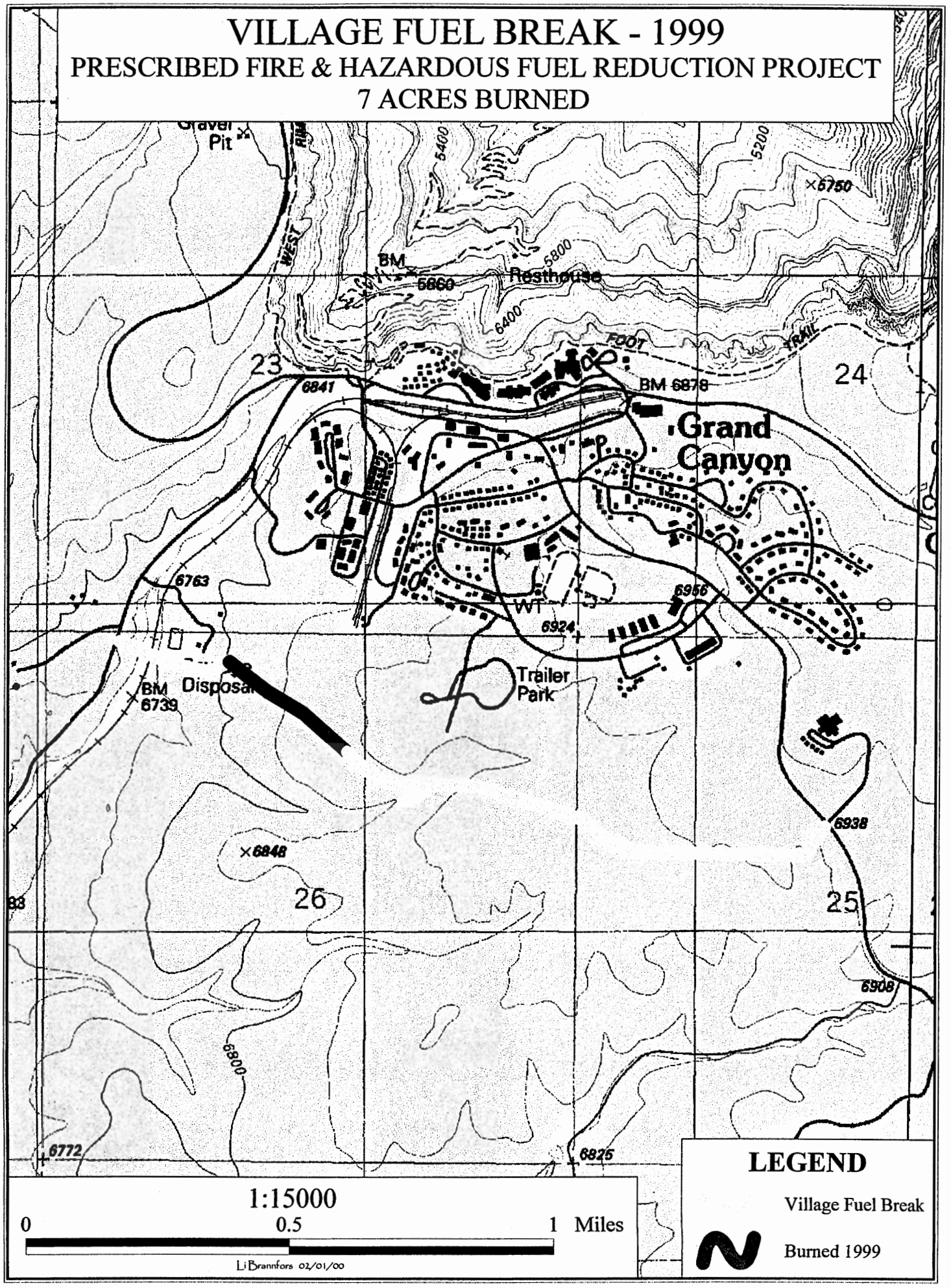

WALHALLA PRESCRIBED FIRE
CALENDAR YEAR 1999
3989 ACRES BURNED
NOV. 17 & 20
1855 ACRES
DEC. 7
1370 ACRES
MARCH 30
764 ACRES
WALHALLA
PLATEAU
Vista Encantada
Colter Butte
Siegfried Pyre
Wathalla Glades
Natchi Canyon
Cape Royal
Thor Temple
Ruins
1:55000
0 1 2 Miles
LJ Brannfors 01/31/00
LEGEND
Unit Boundary
13,856 ACRES
Burned 1999


OUTLET PRESCRIBED FIRE
OCTOBER 2, 5, & 6, 1999
3842 ACRES BURNED
N
W
E
S
THE BASIN
Hades Lake
PIPN 9
PIPN 5
PIPN 12
GRAND
1:50000
0
1
2 Miles
LiBrannfors 01/31/00
LEGEND
Unit Boundary
10,034 ACRES
Burned 1999
Fire Effects Plots

VILLAGE FUEL BREAK - 1999

PRESCRIBED FIRE & HAZARDOUS FUEL REDUCTION PROJECT

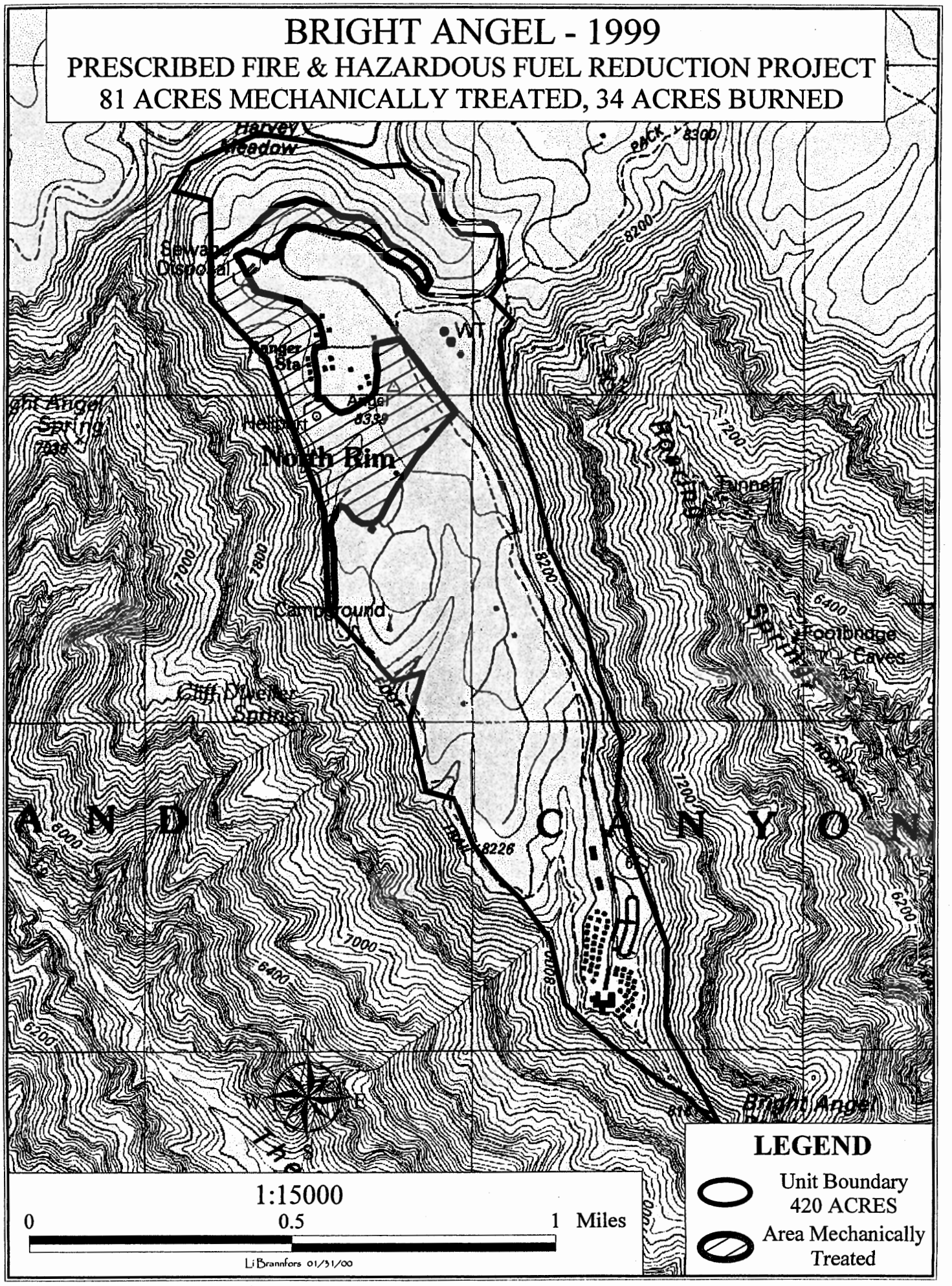
7 ACRES BURNED



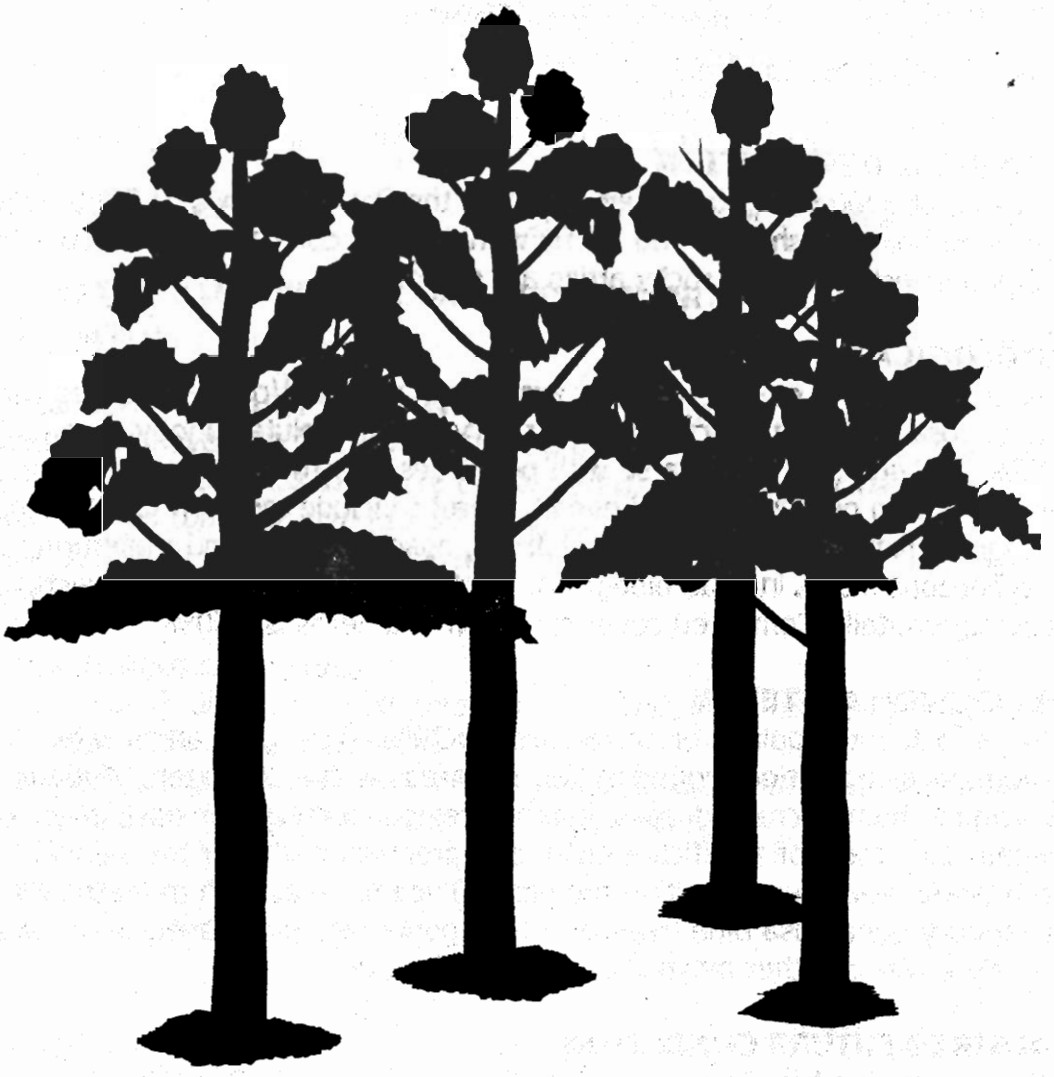
BRIGHT ANGEL - 1999

PRESCRIBED FIRE & HAZARDOUS FUEL REDUCTION PROJECT

81 ACRES MECHANICALLY TREATED, 34 ACRES BURNED



Appendix G. FMH-4 Monitoring Type Descriptions



FMH-4 MONITORING TYPE DESCRIPTION SHEET
Grand Canyon National Park

Monitoring Type Code: FPIED1D02

Monitoring Type Name: Great Basin Conifer Woodland

Prepared by: Duhnkrack, Schroeder, Kuenzi, Kaplan in 1991 and 1993

Updated by: Tonja Opperman and Ken Kerr

Date: December 18, 1999

PHYSICAL DESCRIPTION
Located at 6400 to 7000 feet elevation on the South Rim with 0-20% slope, all aspects. Soils are shallow and loamy with gravelly consistency derived from Kaibab limestone. Bare, rocky areas are common.

BIOLOGICAL DESCRIPTION
Ninety percent of overstory stems are pinyon pine and/or Utah juniper with ponderosa pine as an occasional overstory tree; absolute canopy cover is 20-60%. The understory is sparse with pole trees of same species as overstory except for an occasional Gambel oak. Shrubs include mormon tea, banana yucca, snakeweed, serviceberry, cliffrose, apache plume, and rabbitbrush. Herbaceous plants include bluegrass, paintbrush, blue grama, locoweed, lupine, and squirreltail. Combined cover for brush and herbs is <50%.

REJECTION CRITERIA
Large rock outcroppings or barren areas >20% of the plot; areas with anomalous vegetation, boundary fences; areas within 30 meters of roads, utility corridors, human-created trails, human-created clearings, or slash piles; areas within 10 meters of significant historic or prehistoric sites or transitional ecotones; areas burned within the past 10 years; areas with more than 3 overstory ponderosa pine trees or >10% ponderosa pine cover; areas with >75% cover of either pinyon pine or Utah juniper.

DESIRED FUTURE CONDITION
This monitoring type is mainly located around the South Rim Village area and is being treated to reduce hazardous fuel conditions that could present an urban interface problem. One goal for this monitoring type is to maintain the fuel load at a level that does not exceed 20 tons/acre. A second goal is to limit the overstory tree mortality to 20%, but at this time there has not been a comprehensive literature search to determine what a realistic overstory density goal should be. A study in northern Arizona suggests an average of 360 trees/ha (145 trees/acre) (Klopatek 1986) on 3 plots. This monitoring type is

not burned with a true underburn in many instances, but is instead pile burned due to concerns around developed areas.

BURN PRESCRIPTION

Units will be burned during the monsoon season or from September until May or until green-up using head, flanking, and backing fires as needed to meet burn objectives.

Fire Prescription Elements	
RH = 20-50%	Live Fuel Moisture = 60-120%
Dry Bulb = 50-90 F	Average Flame Length = 1-6 feet
Average Mid-flame Winds=0-7mph G15mph	Average Rate of Spread = 1-28 chs/hour
10-hour TLFM = 6-12%	1000-hour TLFM = 9-20%

MONITORING VARIABLES IN ORDER OF IMPORTANCE

1. Fuel Loading

PRESCRIBED FIRE PROJECT OBJECTIVES—First Entry Burn

1. Reduce total average fuel load (including all woody material, litter, and duff) so as not to exceed 20 tons/acre (49 tons/ha). *Preburn fuel loads range from 6 to 26 tons per acre (15-64 tons/ha) on 5 plots.*
2. Limit overstory mortality of all species to an average of 20% within 5 years post-burn.

FIRE MONITORING OBJECTIVES

1. Install enough plots to sample total fuel load with 80% confidence that totals are within 20% of the true population mean.
2. Install enough plots to sample overstory tree density with 80% confidence that values are within 20% of the true population mean.

DATA ANALYSIS

See FMH-4 Data Analysis Checklist

Literature Cited

Klopatek, J.M. 1986. Nutrient patterns and succession in pinyon-juniper ecosystems of northern Arizona. In: Proceedings—pinyon-juniper conference. USDA Forest Service GTR-INT-215 pp 391-396.

Plot Protocols for PIED

GENERAL PROTOCOLS		YES (√)	NO (√)		YES (√)	NO (√)
Preburn	Control Plots/Opt		√	Herb Height/Rec	√	
	Herbaceous Density/Opt		√	Abbreviated Tags	√	
	OP/Origin Buried		√	Crown Intercept/Opt		√
	Voucher Specimens/Rec	√		Herb. Fuel Load/Opt		√
	Stereo Photography/Opt		√	Brush Individuals/Rec	√	
	Belt Transect Width	2 x 50 meters		Stakes Installed: All		
	Number of Belts recorded	2				
	Herbaceous Data and Brush Data Collected at: Q4-Q1 and Q3-Q2					
Burn and Postburn	Duff Moisture/Rec		√	Flame Zone Depth/Rec	√	
	Herbaceous Data/ Opt		√	Herb. Fuel Load/Opt		√
	100 Pt. Burn Severity/Opt	√				

FOREST PLOT PROTOCOLS		YES (√)	NO (√)		YES (√)	NO (√)
Overstory Note: DRC on JUOS trees with multiple stems >2/tree.	Area sampled	50 x 20 m		Quarters Sampled	Q1,Q2,Q3,Q4	
	Tree Damage/Rec	√		Crown Position/Rec	√	
	Dead Tree Damage/Opt		√	Dead Crown Position/Opt	√	
Pole-size	Area Sampled	25 X 20 m		Quarters Sampled	Q1 & Q2	
	Height/Rec	√		Poles Tagged/Rec	√	
Seedling	Area Sampled	25 X 10 m		Quarters Sampled	Q1	
	Height/Rec	√		Seedlings Mapped/Opt		√
Fuel Load	Sampling Plane Length	100 feet		Fuel Continuity/Opt		√
	Aerial Fuel Load/Opt		√			
Postburn	Char Height/Rec	√		Mortality/Rec	√	

FMH-4 MONITORING TYPE DESCRIPTION SHEET
Grand Canyon National Park

Monitoring Type Code: FPIPO1D09

Monitoring Type Name: South Rim Ponderosa Pine

Prepared by: Tonja Opperman and Ken Kerr

Date: December 18, 1999

PHYSICAL DESCRIPTION
Located at 6000 to 7500 feet elevation on the South Rim on level to rolling terrain, including all aspects. Soils are moderately shallow with a silty loam texture. All are derived from Kaibab limestone parent material. Occasional barren rock outcrops.

BIOLOGICAL DESCRIPTION
Total overstory[1] stems are 50-100% Pinus ponderosa. Pinus edulis, Juniperus osteosperma, and Quercus gambelli may be present. Absolute canopy cover is 20-60%. The understory is a mix of the same overstory species. Common shrubs include Artemisia tridentata, Gutierrezia sarothrae, and Cowania mexicana. Common herbaceous plants include Bouteloua gracilis, Poa fendlariana, and Lupinus spp.

REJECTION CRITERIA
Large rock outcroppings or areas >20% of the plot with <10% ground cover; areas with anomalous vegetation, boundary fences; areas within 30 meters of roads, utility corridors, human-created trails, human-created clearings, or slash piles; areas burned within past 10 years; areas within 10 meters of significant historic or prehistoric sites or transitional ecotones. Areas with greatest amount of basal area contained in a species other than ponderosa pine.

DESIRED FUTURE CONDITION
At this time a literature search has been initiated to determine the desired future condition of ponderosa forests at Grand Canyon National Park, but it is not complete. Preliminary research suggests that there were anywhere from 19-25 overstory trees per acre (47-62 trees/ha) during pre-settlement and ponderosa pine comprised over 90% of the basal area, with the remainder occupied by pinyon, juniper, and Gambel oak (Covington 1994, Covington et al. 1998). Usually crown cover was less than 25% with trees clumped in groups of 2-44 individuals (Woolsey 1911, White 1985). All size classes were typically represented, but it was not a continuous pattern—trees were arranged in distinct

[1] Overstory trees are defined in the Fire Monitoring program as trees with a diameter at breast height of 15 cm (6 in) or greater. This definition does not take individual tree dominance or crown position into account.

size groups due to a number of decades between regeneration events (White 1985).
Frequent openings occurred, dominated by grasses and other herbaceous plants. Total fuel loads were typically 2 to 8 tons/acre (5-20 tons/ha) with averages estimated from 0.2 to 9.3 tons/acre (0.5-23 tons/ha) (Covington 1992, Covington 1994, Harrington and Sackett 1992). A postburn increase in fuel loads is acceptable after the initial prescribed fire treatments.

BURN PRESCRIPTION
Units will be burned during the growing, transition, and dormant seasons with head, flanking, and backing fires as needed to meet burn objectives. Units may be burned at six-year intervals for up to three consecutive treatments or until a Desired Future Condition is met. Prescription element ranges and treatment objectives developed using past experience, BEHAVE program, and FOFEM program.

Fire Prescription Elements	
RH = 10-80%	Live Fuel Moisture = n/a
Dry Bulb = 40-80 F	Average Flame Length = 1-10 feet
Average Mid-flame Winds=0-15mph G30mph	Average Rate of Spread = 1-40 chs/hour
10-hour TLFM = 3-15%	1000-hour TLFM = 9-25%

MONITORING VARIABLES IN ORDER OF IMPORTANCE
1. Overstory density
2. Fuel Load
3. Pole density

PRESCRIBED FIRE PROJECT OBJECTIVES—First Entry Burn
Immediately Post-Burn:
1. Reduce total fuel load by at least 30% on average, as measured over the landscape immediately post-burn (fuel reduction efforts will continue until the Desired Future Condition of 0.2-9.3 tons/acre is achieved).
2. Limit crown scorch to 30% on *Pinus ponderosa* with dbh greater than or equal to 16" (40 cm).

Two Years Post-Burn:
1. Reduce *Pinus ponderosa* poles with dbh of 1-6 inches (2.5-15 cm) to average 0-200 trees/acre (0-494 trees/ha). *This is a conservative target and more research is needed to define a better pole density target; there are currently 0-730 poles/ac (0-1800 poles/ha) of* Pinus ponderosa *in this size class.*

Five Years Post-Burn
1. Achieve and maintain a five-year post-burn density of 19-25 trees/acre of *Pinus ponderosa* in the 16"+ size class.

PRESCRIBED FIRE PROJECT OBJECTIVES—Second Entry Burn
Objectives will be written for this section, once results from first entry burn are known.

PRESCRIBED FIRE PROJECT OBJECTIVES—Third Entry Burn
Objectives will be written for this section, once results from first and second entry burns are known.

FIRE MONITORING OBJECTIVES
1. Install enough plots to be 80% confident that overstory ponderosa pine density figures are within 20% of the true population mean.
2. Install enough plots to be 80% confident that total fuel load estimates are within 20% of the true population mean.
3. With less than 30 plots, estimate pole densities with the most confidence possible. At this time over 70 plots are needed to monitor poles due to a high variation in the preburn pole densities.

DATA ANALYSIS
See FMH-4 Data Analysis Checklist

Literature Cited

Covington, W.W. and M.M. Moore. 1992. Postsettlement changes in natural fire regimes: implications for restoration of old-growth ponderosa pine forest. *In* Old-growth forests in the Southwest and Rocky Mountain regions: proceedings of a workshop, p. 81-99. USDA For. Serv. Gen. Tech. Rep. RM-213. 201p.

Covington, W.W. and M.M. Moore. 1994. Southwestern ponderosa pine forest structure. J. For. 39-47.

Covington, W.W., M.M. Moore, P.Z. Fule, H.B. Smith. 1998. Grand Canyon Forest Ecosystem Restoration Report on Pre-treatment measurements of experimental blocks. Northern Arizona University unpublished manuscript.

Harrington M.G.and S.S. Sackett. 1992. Past and present fire influences on southwestern ponderosa pine old growth. *In* Old-growth forests in the Southwest and Rocky Mountain regions: proceedings of a workshop, p. 81-99. USDA For. Serv. Gen. Tech. Rep. RM-213. 201p.

White, A.S. 1985. Presettlement regeneration patterns in a southwestern ponderosa pine stand. Ecology 66:589-94.

Woolsey, T.S. Jr. 1911. Western yellow pine in Arizona and New Mexico. USDA For. Serv. Bull. 101. 64pp.

Plot Protocols for PIPO

GENERAL PROTOCOLS		YES (√)	NO (√)		YES (√)	NO (√)
Preburn	Control Plots/Opt		√	Herb Height/Rec	√	
	Herbaceous Density/Opt		√	Abbreviated Tags	√	
	OP/Origin Buried		√	Crown Intercept/Opt		√
	Voucher Specimens/Rec	√		Herb. Fuel Load/Opt		√
	Stereo Photography/Opt		√	Brush Individuals/Rec	√	
	Belt Transect Width	2 x 50 meters		Stakes Installed: All		
	Number of Belts recorded	2				
	Herbaceous Data and Brush Data Collected at: Q4-Q1 and Q3-Q2					
Burn and Postburn	Duff Moisture/Rec		√	Flame Zone Depth/Rec	√	
	Herbaceous Data/ Opt		√	Herb. Fuel Load/Opt		√
	100 Pt. Burn Severity/Opt	√				

FOREST PLOT PROTOCOLS		YES (√)	NO (√)		YES (√)	NO (√)
Overstory	Area sampled	50 x 20 m		Quarters Sampled	Q1,Q2,Q3,Q4	
Note: DRC for multiple-stemmed JUOS >2 stems/tree.	Tree Damage/Rec	√		Crown Position/Rec	√	
	Dead Tree Damage/Opt		√	Dead Crown Position/Opt	√	
Pole-size	Area Sampled	25 X 20 m		Quarters Sampled	Q1 & Q2	
	Height/Rec	√		Poles Tagged/Rec	√	
Seedling	Area Sampled	25 X 10 m		Quarters Sampled	Q1	
	Height/Rec	√		Seedlings Mapped/Opt		√
Fuel Load	Sampling Plane Length	100 feet		Fuel Continuity/Opt		√
	Aerial Fuel Load/Opt		√			
Postburn	Char Height/Rec	√		Mortality/Rec	√	

FMH-4 MONITORING TYPE DESCRIPTION SHEET
Grand Canyon National Park

Monitoring Type Code: FPIPN1D09

Monitoring Type Name: North Rim Ponderosa Pine

Prepared by: Tonja Opperman and Ken Kerr

Date: December 18, 1999

PHYSICAL DESCRIPTION

Located at 6,900 to 8,900 feet elevation on the North Rim with slopes from 0% to 60%, including all aspects and depending on elevation. Soils are moderately shallow on ridgetops with silty loams occurring in drainage bottoms. All soils are derived from Kaibab limestone parent material.

BIOLOGICAL DESCRIPTION

Total canopy cover is at least 25%. *Pinus ponderosa* dominates the overstory[2], comprising at least 80% of overstory species. Other possible overstory species include occasional *Abies concolor*, *Populus tremuloides*, *Pseudotsuga menziesii*, and *Picea engelmanni*. The understory is composed of mostly (75% or more) *Pinus ponderosa* poles. Common brush species are *Robinia neomexicana*, *Berberis repens, Rosa fendleri*, and *Ceanothus fendleri*. Common herbaceous plants include *Achillia lanulosa, Carex* spp., *Poa fendleriana, Sitanion hystrix,* and *Viguiera multiflora.*

REJECTION CRITERIA

Large rock outcroppings or barren areas >20% of the plot; areas with anomalous vegetation, boundary fences; areas within 30 meters of roads, utility corridors, human-created trails, human-created clearings, or slash piles; areas within 10 meters of significant historic or prehistoric sites or transitional ecotones; areas burned in the last 10 years; areas with >20% overstory cover of trees other than ponderosa pine; areas with pole densities including >25% species other than ponderosa pine, and areas with >50% canopy cover of Robinia neomexicana.

DESIRED FUTURE CONDITION

At this time a literature search has been initiated to determine the desired future condition of North Rim *Pinus ponderosa* at Grand Canyon National Park, but it is not complete. These forests were likely open stands with relatively few, large overstory trees, dominated by an herbaceous understory. Research suggests in one study that there were 56 *Pinus ponderosa* trees per acre (138 trees/ha) in North Rim *Pinus ponderosa* stands (Covington 1992), and in another study that

[2] Overstory trees are defined in the Fire Monitoring program as trees with a diameter at breast height of 15 cm (6 in) or greater. This definition does not take individual tree dominance or crown position into account.

there were 40-55 trees/acre (99-136 trees/ha) on the Kaibab Plateau during presettlement times. Pole-sized trees less than six inches in diameter (15 cm) were estimated to be in groups of 200-400 but no density figures are given (Rasmussen 1941). The fire frequency on the North Rim is estimated at 2 to 15 years for these elevations (Wolf and Mast 1998) but this study did not incorporate forests on the very southernmost parts of the plateaus. It is likely that the forests on the edges of the North Rim plateaus were less dense due to drier conditions and more frequent lightning-caused fires. Fuel loads ranged from 0.2 to 9.3 tons/acre (0.5-23 tons/ha) (Covington 1992). An increase in postburn fuel loads is acceptable after the initial prescribed fire treatments.

BURN PRESCRIPTION

Units will be burned during the growing, dormant, and transition seasons from summer (June) to fall (November). In drier years the time period may move into April and/or December. The following values present a range of conditions that may be used to accomplish objectives. Optimal values and relationships exist between these ranges that relate to on-the-ground fire effects achieved as well as resistance to control. Prescription element ranges and objectives were developed using past experience, BEHAVE program, and FOFEM program.

Fire Prescription Elements	
RH = 10-80%	Live Fuel Moisture = n/a
Dry Bulb = 40-80 F	Average Flame Length = 1-10 feet
Average Mid-flame Winds=0-15mph G30mph	Average Rate of Spread = 1-40 chs/hour
10-hour TLFM = 3-15%	1000-hour TLFM = 9-25%

MONITORING VARIABLES IN ORDER OF IMPORTANCE

1. Overstory density
2. Fuel Load
3. Pole density

PRESCRIBED FIRE PROJECT OBJECTIVES—First Entry Burn

Immediately Post-Burn:

1. Reduce total fuel load by at least 30% on average, as measured over the landscape immediately post-burn (fuel reduction efforts will continue until the Desired Future Condition of 0.2-9.3 tons/acre is achieved).
2. Limit crown scorch to 30% on *Pinus ponderosa* with dbh greater than or equal to 16" (40 cm).

Two Years Post-Burn:

1. Reduce Pinus ponderosa poles with dbh of 1-6 inches (2.5-15 cm) to average 0-200 trees/acre (0-494 trees/ha). *This is a conservative target and more research is needed to define a better pole density target; Preburn pole*

densities range from 0-500 Pinus ponderosa *trees/acre (1235 trees/ha) and average of 51 trees/acre (126 trees/ha) in this monitoring type on 6 plots.*

Five Years Post-Burn

1. Achieve and maintain a five-year post-burn density of 19-25 trees/acre of *Pinus ponderosa* in the 16"+ size class.

PRESCRIBED FIRE PROJECT OBJECTIVES—Second Entry Burn

Objectives will be written for this section, once results from first entry burn are known.

PRESCRIBED FIRE PROJECT OBJECTIVES—Third Entry Burn

Objectives will be written for this section, once results from first and second entry burns are known.

FIRE MONITORING OBJECTIVES

1. Install enough plots to be 80% confident that overstory ponderosa pine density figures are within 20% of the true population mean.
2. Install enough plots to be 80% confident that total fuel load estimates are within 20% of the true population mean.
3. Install enough plots to be 80% confident that pole density estimates are within 20% of the true population mean.

DATA ANALYSIS

See FMH-4 Data Analysis Checklist

Literature Cited

Covington, W.W. and M.M. Moore. 1992. Postsettlement changes in natural fire regimes: implications for restoration of old-growth ponderosa pine forest. *In* Old-growth forests in the Southwest and Rocky Mountain regions: proceedings of a workshop, p. 81-99. USDA For. Serv. Gen. Tech. Rep. RM-213. 201p.

Rasmussen, D.I. 1941. Biotic communities of Kaibab Plateau, Arizona. Ecol. Monogr. 11:229-76.

Wolf, J. and J. Mast. 1998. Fire history of mixed-conifer forests on the North Rim, Grand Canyon National Park, Arizona. Physical Geography, 19, 1, pp. 1-14.

Plot Protocols for PIPN

GENERAL PROTOCOLS		YES (√)	NO (√)		YES (√)	NO (√)
Preburn	Control Plots/Opt		√	Herb Height/Rec	√	
	Herbaceous Density/Opt		√	Abbreviated Tags	√	
	OP/Origin Buried		√	Crown Intercept/Opt		√
	Voucher Specimens/Rec	√		Herb. Fuel Load/Opt		√
	Stereo Photography/Opt		√	Brush Individuals/Rec	√	
	Belt Transect Width	2 x 50 meters		Stakes Installed: All		
	Number of Belts recorded	2				
	Herbaceous Data and Brush Data Collected at: Q4-Q1 and Q3-Q2					
Burn and Postburn	Duff Moisture/Rec		√	Flame Zone Depth/Rec	√	
	Herbaceous Data/ Opt		√	Herb. Fuel Load/Opt		√
	100 Pt. Burn Severity/Opt	√				

FOREST PLOT PROTOCOLS		YES (√)	NO (√)		YES (√)	NO (√)
Overstory	Area sampled	50 x 20 m		Quarters Sampled	Q1,Q2,Q3,Q4	
	Tree Damage/Rec	√		Crown Position/Rec	√	
	Dead Tree Damage/Opt		√	Dead Crown Position/Opt	√	
Pole-size	Area Sampled	25 X 20 m		Quarters Sampled	Q1 & Q2	
	Height/Rec	√		Poles Tagged/Rec	√	
Seedling	Area Sampled	25 X 10 m		Quarters Sampled	Q1	
	Height/Rec	√		Seedlings Mapped/Opt		√
Fuel Load	Sampling Plane Length	50 feet		Fuel Continuity/Opt		√
	Aerial Fuel Load/Opt		√			
Postburn	Char Height/Rec	√		Mortality/Rec	√	

Rec = Recommended Opt = Optional

FMH-4 MONITORING TYPE DESCRIPTION SHEET
Grand Canyon National Park

Monitoring Type Code: FPIAB1D09

Monitoring Type Name: Ponderosa Pine with White Fir Encroachment

Prepared by: Tonja Opperman and Ken Kerr

Date: December 18, 1999

PHYSICAL DESCRIPTION
Located at 8000 to 9000 feet elevation on the North Rim with slopes from 0% to 60%, including all aspects. Soils are moderately shallow on ridgetops with silty loams occurring in drainage bottoms. All soils are derived from Kaibab limestone parent material.

BIOLOGICAL DESCRIPTION
Total canopy cover is at least 25% but can near 100%. It is a mixed conifer forest dominated by *Pinus ponderosa, Abies concolor*, and *Populus tremuloides* with the greatest basal area in *Pinus ponderosa* even though there may be more overstory[3] *Abies concolor* stems per acre. Other possible overstory species include *Pseudotsuga menziesii*, *Picea pungens*, *Abies lasiocarpa,* and *Picea engelmanni.* The understory is composed of mostly *Abies concolor* (25 to 100%), *Pinus ponderosa, Populus tremuloides*, and *Pseudotsuga menziesii.* Common brush species are *Amelanchier utahensis*, *Berberis repens,* and *Robinia neomexicana.* Common herbaceous plants include *Bouteloua gracilis*, *Carex* spp., *Fragaria ovalis, Lotus utahensis, Pedicularis centranthera,* and *Poa fendleriana.*

REJECTION CRITERIA
Large rock outcroppings or barren areas >20% of the plot; areas with anomalous vegetation, boundary fences; areas within 30 meters of roads, utility corridors, human-created trails, human-created clearings, or slash piles; areas within 10 meters of significant historic or prehistoric sites or transitional ecotones; areas burned in the last 10 years; areas where majority of basal area is not in ponderosa pine; areas with pole densities that do not include white fir as a major component.

DESIRED FUTURE CONDITION
At this time a literature search has been initiated to determine the desired future condition of North Rim *Pinus ponderosa* forests at Grand Canyon National Park, but it is not complete. Forests in the PIAB monitoring type are at a slightly higher elevation and experience slightly wetter conditions and cooler

[3] Overstory trees are defined in the Fire Monitoring program as trees with a diameter at breast height of 15 cm (6 in) or greater. This definition does not take individual tree dominance or crown position into account.

temperatures than the North Rim Ponderosa Pine (PIPN) monitoring type. *Pinus ponderosa* likely dominated these stands but occasionally other mixed conifer species were present as well as pockets of *Populus tremuloides*. At the 8200' elevation on the North Rim, research suggests the stands were comprised of 51 overstory *Pinus ponderosa* per acre (126 trees/ha) with a mixture of *Abies concolor* and *Populus tremuloides* equally occupying the remaining 40 overstory trees per acre (99 trees/ha) (Covington et. al. 1998). Fire likely occurred in these stands every 4-15 years (Wolf and Mast 1998). Pre-European settlement fuel load estimates are unknown, but are likely greater than the PIPN forest type to the south. A conservative estimate for desired average fuel load is 0.2 to 20 tons/acre, but this figure should be revised as new information is available. Pole density figures for this forest type are also unknown, but again, are likely to be more dense than the drier forests to the south.

BURN PRESCRIPTION

Units will be burned during the growing and dormant seasons from summer (June) to fall (November). In drier years the time period may move into April and/or December. The following values present a range of conditions that may be used to accomplish objectives. Optimal values and relationships exist between these ranges that relate to on-the-ground fire effects achieved as well as resistance to control. Prescription element ranges and objectives were developed using past experience, BEHAVE program, and FOFEM program.

Fire Prescription Elements	
RH = 10-80%	Live Woody Fuel Moisture = 60-250%
Dry Bulb = 40-80 F	Average Flame Length = 0.5 – 30 feet
Mid-flame Winds=0-15mph G30mph	Average Rate of Spread = 1-40 chs/hour
10-hour TLFM = 3-15%	1000-hour TLFM = 9-25%

MONITORING VARIABLES IN ORDER OF IMPORTANCE

1. Overstory density
2. Fuel Load
3. Pole density

PRESCRIBED FIRE PROJECT OBJECTIVES—First Entry Burn

Immediately Post-Burn:

1. Reduce total fuel load by at least 30% on average, as measured across the landscape immediately post-burn (fuel reduction efforts will continue until the Desired Future condition of 0.2 to 20 tons/acre (average) is achieved).
2. Limit crown scorch to 30% on *Pinus ponderosa* with dbh greater than or equal to 16" (40 cm).

Two Years Post-Burn:

1. Reduce *Abies concolor* poles in 1-6" (2.5-15 cm) size class by 20-70% to average less than 100 trees/ac (247 trees/ha). *This is a conservative target until more research indicates a better target. Preburn* Abies concolor *pole densities average 237 trees/ac, and* Pinus ponderosa *poles average 31 trees/ac (77 trees/ha) in this monitoring type on 21 plots.*

Five Years Post-Burn

1. Achieve and maintain a five-year post-burn density of 19-25 trees/acre of *Pinus ponderosa* in the 16"+ size class.

PRESCRIBED FIRE PROJECT OBJECTIVES—Second Entry Burn

Objectives will be written for this section, once results from first entry burn are known.

PRESCRIBED FIRE PROJECT OBJECTIVES—Third Entry Burn

Objectives will be written for this section, once results from first and second entry burns are known.

FIRE MONITORING OBJECTIVES

1. Install enough plots to be 80% confident that overstory ponderosa pine density figures are within 20% of the true population mean.
2. Install enough plots to be 80% confident that total fuel load estimates are within 20% of the true population mean.
3. Install enough plots to be 80% confident that white fir pole density estimates are within 25% of the true population mean.

DATA ANALYSIS

See FMH-4 Data Analysis Checklist

Literature Cited

Covington, W.W., M.M. Moore, P.Z. Fule, H.B. Smith. 1998. Grand Canyon Forest Ecosystem Restoration Report on Pre-treatment measurements of experimental blocks. Northern Arizona University unpublished manuscript.

Wolf, J. and J. Mast. 1998. Fire history of mixed-conifer forests on the North Rim, Grand Canyon National Park, Arizona. Physical Geography, 19, 1, pp. 1-14.

Plot Protocols for PIAB

GENERAL PROTOCOLS		YES (√)	NO (√)		YES (√)	NO (√)
Preburn	Control Plots/Opt		√	Herb Height/Rec	√	
	Herbaceous Density/Opt		√	Abbreviated Tags	√	
	OP/Origin Buried		√	Crown Intercept/Opt		√
	Voucher Specimens/Rec	√		Herb. Fuel Load/Opt		√
	Stereo Photography/Opt		√	Brush Individuals/Rec	√	
	Belt Transect Width	2 x 50 meters		Stakes Installed: All		
	Number of Belts recorded	2				
	Herbaceous Data and Brush Data Collected at: Q4-Q1 and Q3-Q2					
Burn and Postburn	Duff Moisture/Rec		√	Flame Zone Depth/Rec	√	
	Herbaceous Data/ Opt		√	Herb. Fuel Load/Opt		√
	100 Pt. Burn Severity/Opt	√				

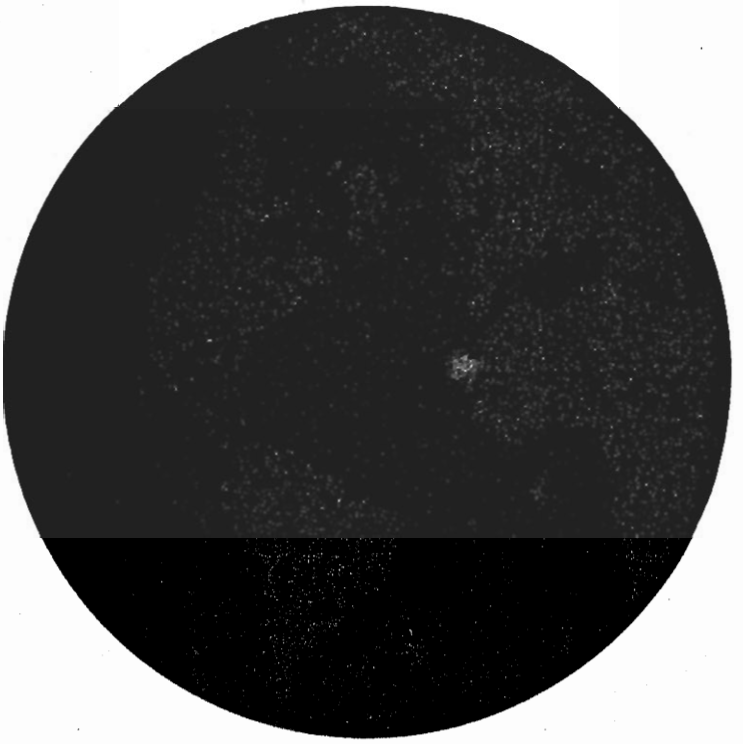
FOREST PLOT PROTOCOLS		YES (√)	NO (√)		YES (√)	NO (√)
Overstory	Area sampled	50 x 20 m		Quarters Sampled	Q1,Q2,Q3,Q4	
	Tree Damage/Rec	√		Crown Position/Rec	√	
	Dead Tree Damage/Opt		√	Dead Crown Position/Opt	√	
Pole-size	Area Sampled	25 X 20 m		Quarters Sampled	Q1 & Q2	
	Height/Rec	√		Poles Tagged/Rec	√	
Seedling	Area Sampled	5 X 10 m		Quarters Sampled	Q1	
	Height/Rec	√		Seedlings Mapped/Opt		√
Fuel Load	Sampling Plane Length	50 feet		Fuel Continuity/Opt		√
	Aerial Fuel Load/Opt		√			
Postburn	Char Height/Rec	√		Mortality/Rec	√	

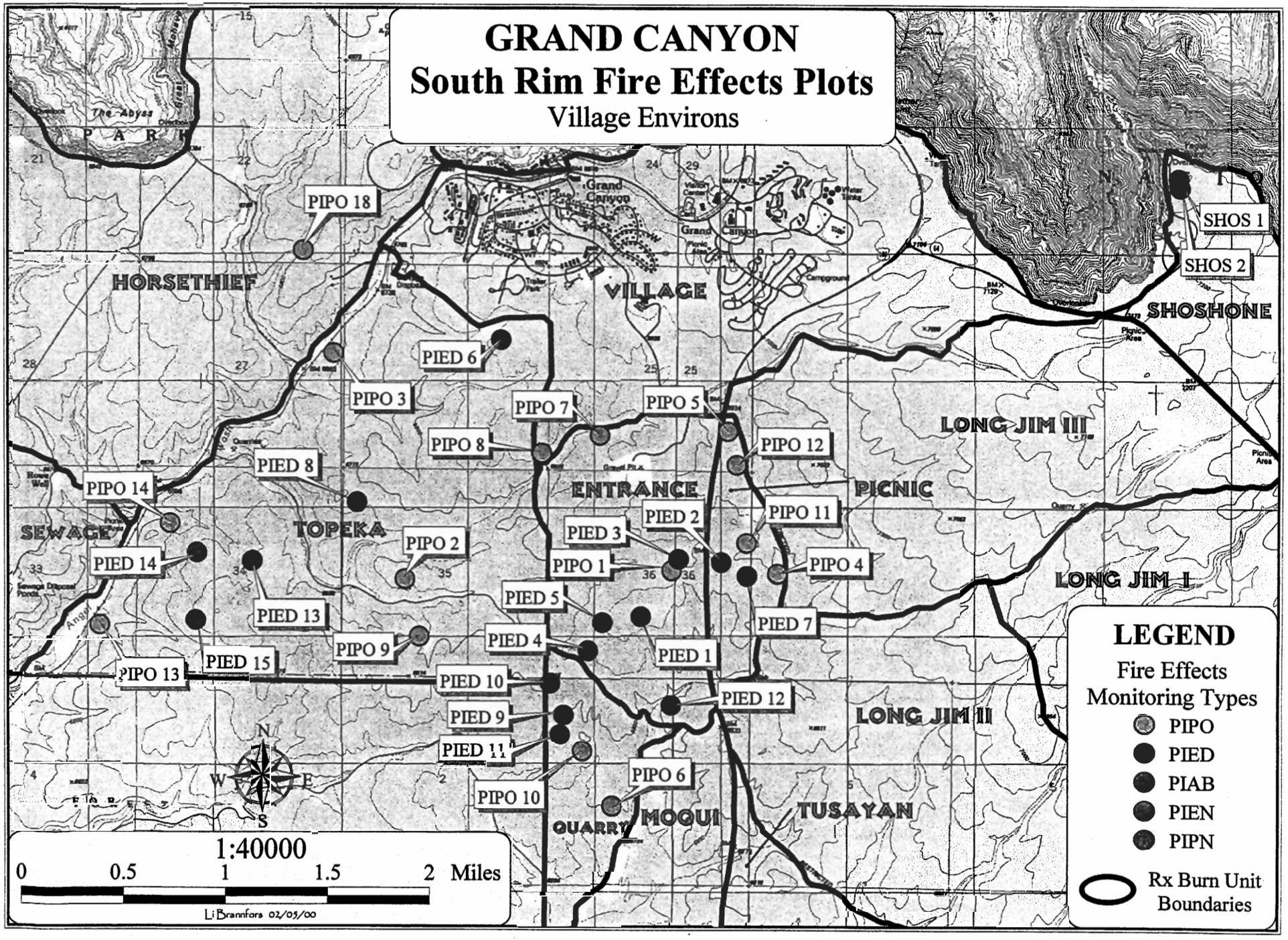
Rec = Recommended Opt = Optional

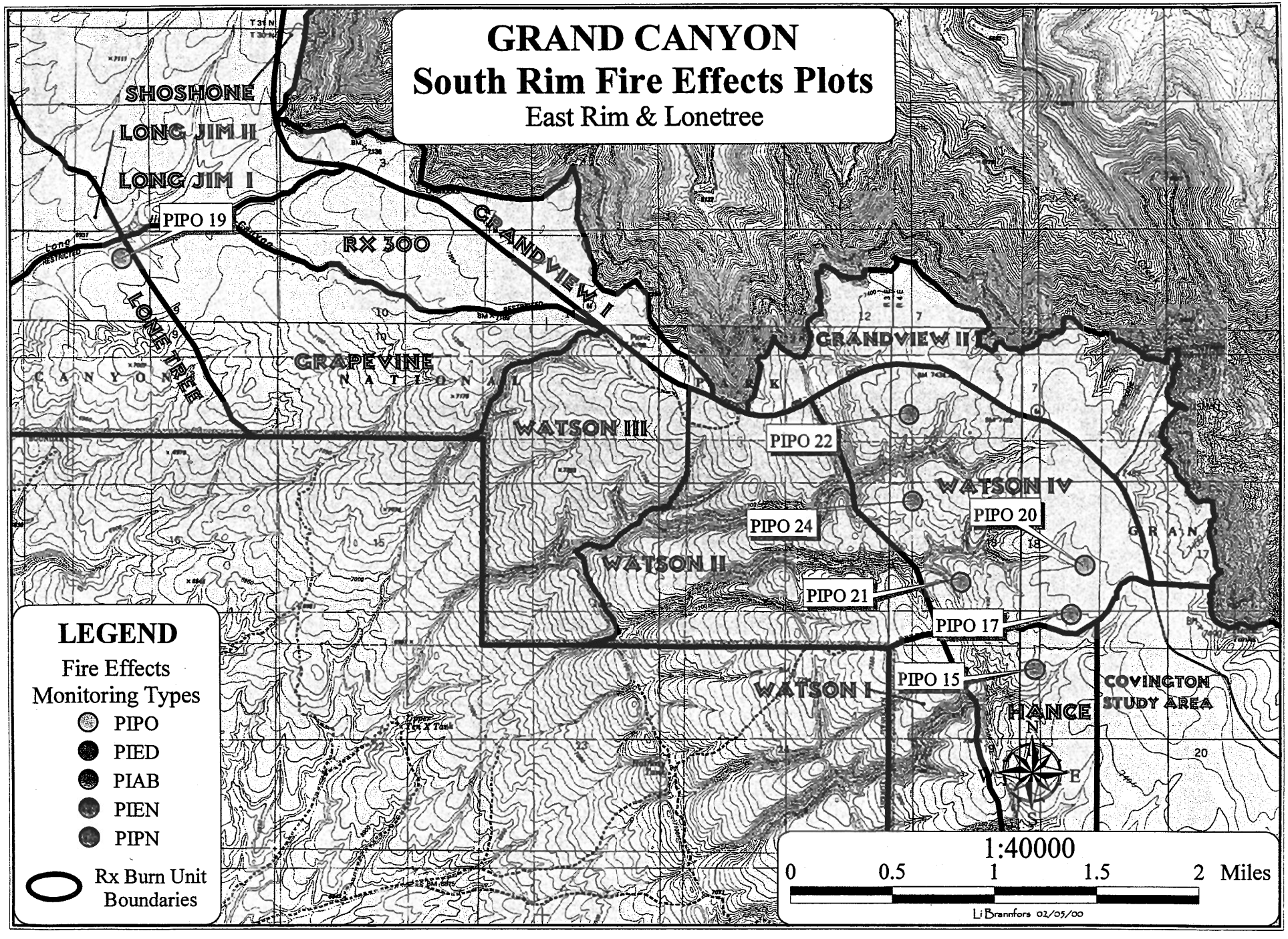
FMH-4 Data Analysis Checklist

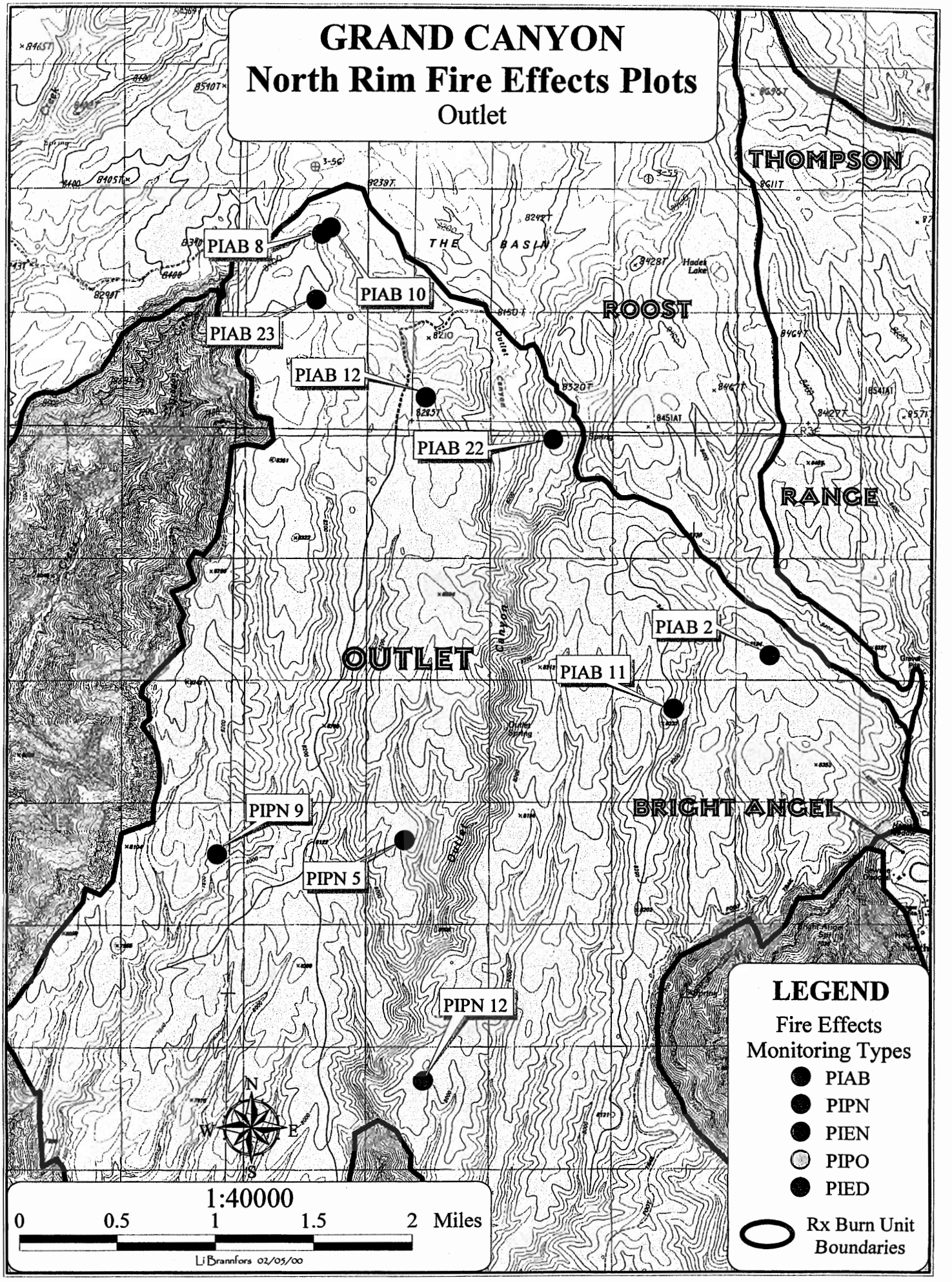
	PIED	PIPO	PIPN	PIAB	PIEN	Graphics
Overstory density PRE-YR05 all species combined	x					stacked bar
Overstory density for PIPO by size class (6-15.9" and 16"+) for each year.		x	x	x		stacked bar
Scorch percent, PIPO overstory only, avg and range	Can't do this analysis at this time using the FMH database.					
Overstory snag density by size class (6-15.9" and 16"+) for each year.		x	x	x		stacked bar
Total fuel load by year w/%change in all size classes through YR05	x	x	x	x		stacked bar and separate % table
Pole density, 1-6", PRE-YR02 each year.		PIPO only	PIPO only	ABCO only		bar graph
Changes in herbaceous layer species composition; show species; native v. non-native.		x	x	x		???
Seedling density by species		x	x	x		stacked bar

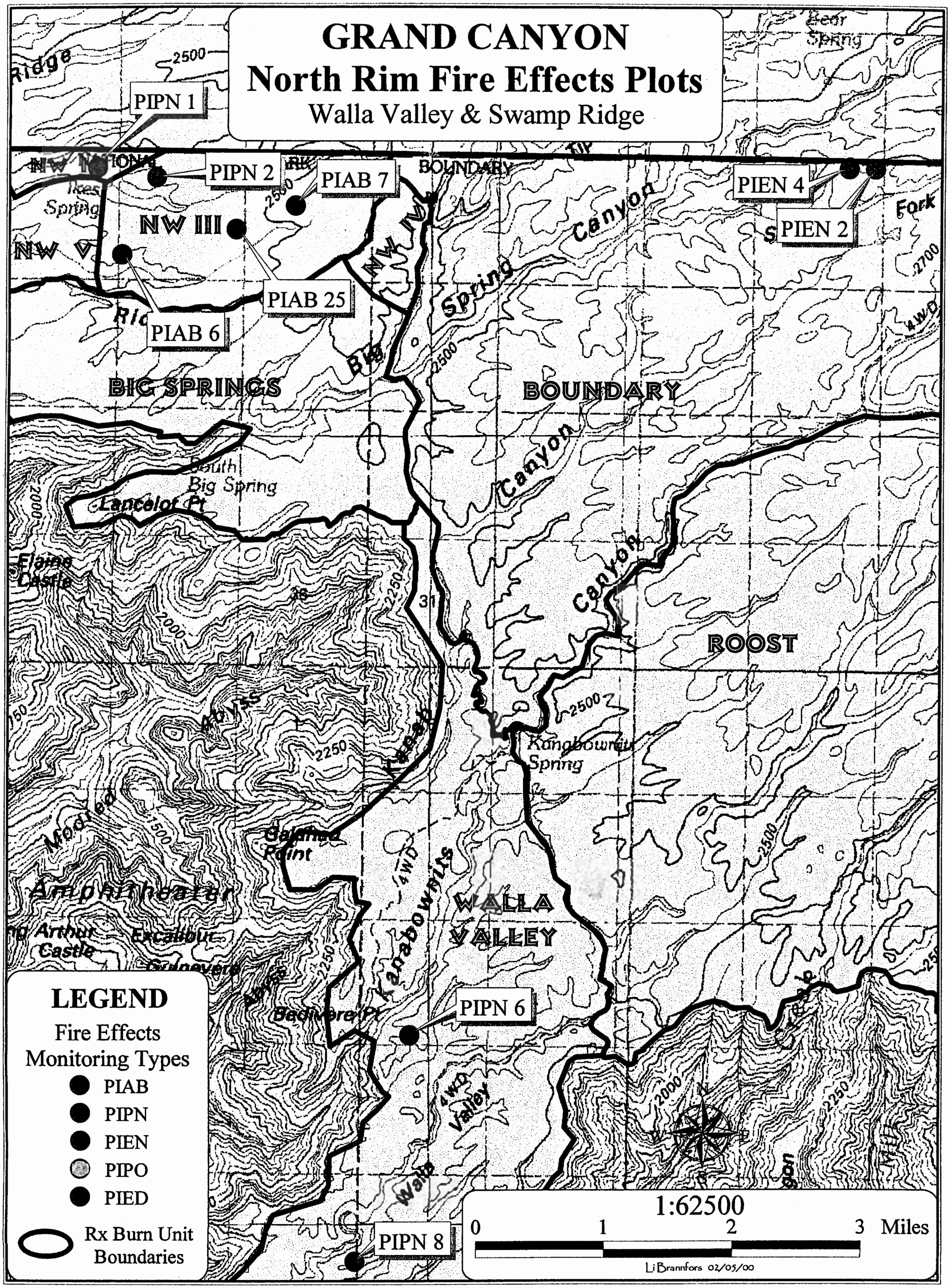
Appendix H: Plot Location Maps

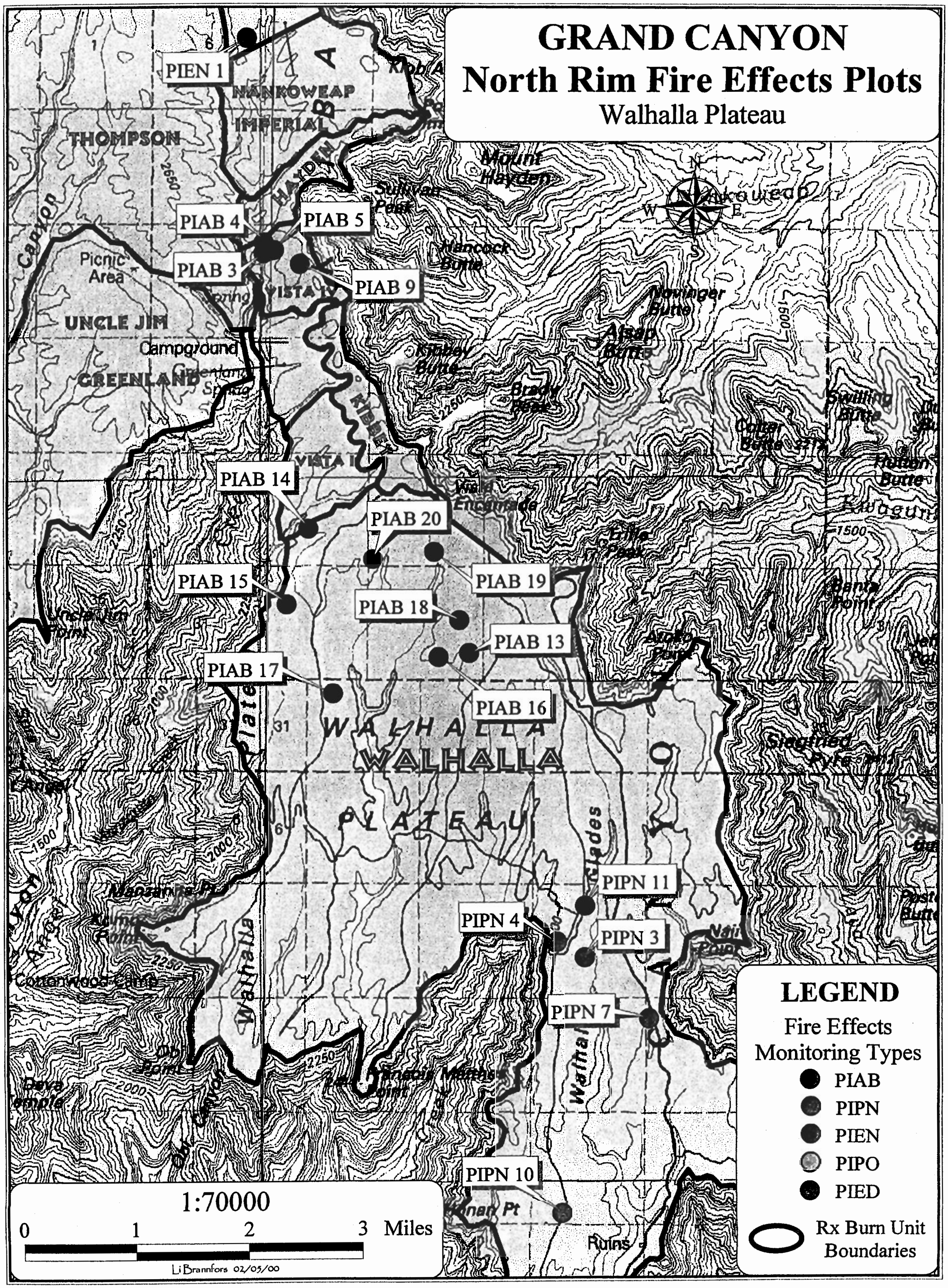



GRAND CANYON
South Rim Fire Effects Plots
Village Environs
PIPO 18
HORSETHIEF
VILLAGE
SHOS 1
SHOS 2
SHOSHONE
PIED 6
PIPO 3
PIPO 7
PIPO 5
PIPO 8
LONG JIM III
PIPO 12
PIED 8
PIPO 14
ENTRANCE
PICNIC
PIED 2
PIPO 11
SEWAGE
TOPEKA
PIED 3
PIPO 2
PIPO 1
PIPO 4
PIED 14
LONG JIM I
PIED 5
PIED 13
PIED 7
PIPO 9
PIED 4
PIED 1
PIED 15
PIPO 13
PIED 10
PIED 12
PIED 9
LONG JIM II
PIED 11
PIPO 6
PIPO 10
QUARRY
MOQUI
TUSAYAN
N
W
E
S
1:40000
0 0.5 1 1.5 2 Miles
LiBrannfors 02/05/00
LEGEND
Fire Effects
Monitoring Types
PIPO
PIED
PIAB
PIEN
PIPN
Rx Burn Unit
Boundaries

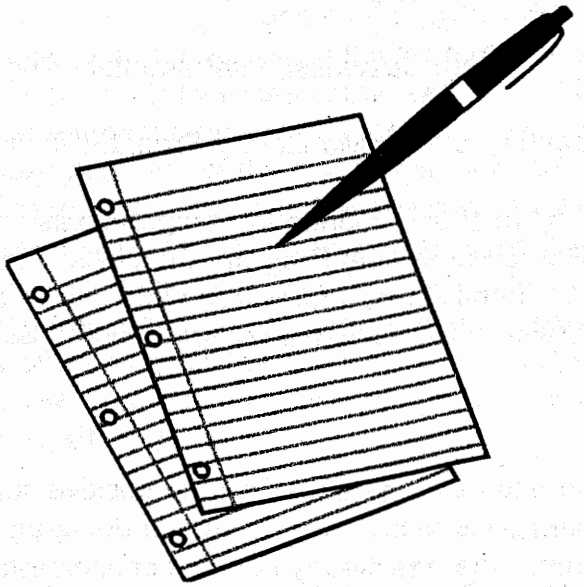

GRAND CANYON
South Rim Fire Effects Plots
East Rim & Lonetree
SHOSHONE
LONG JIM II
LONG JIM I
PIPO 19
RX 300
GRANDVIEW I
GRANDVIEW II
LONE TREE
GRAPEVINE
CANYON
NATIONAL
PARK
WATSON III
PIPO 22
WATSON IV
PIPO 20
PIPO 24
WATSON II
PIPO 21
PIPO 17
PIPO 15
WATSON I
HANCE
COVINGTON
STUDY AREA
LEGEND
Fire Effects
Monitoring Types
PIPO
PIED
PIAB
PIEN
PIPN
Rx Burn Unit
Boundaries
1:40000
0 0.5 1 1.5 2 Miles
Li Brannfors 02/05/00

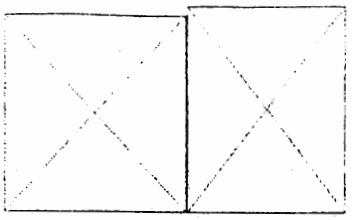

GRAND CANYON
North Rim Fire Effects Plots
Outlet
THOMPSON
THE BASIN
ROOST
RANGE
OUTLET
BRIGHT ANGEL
PIAB 8
PIAB 10
PIAB 23
PIAB 12
PIAB 22
PIAB 2
PIAB 11
PIPN 9
PIPN 5
PIPN 12
N
W
E
S
1:40000
0 0.5 1 1.5 2 Miles
Li Brannfors 02/05/00
LEGEND
Fire Effects Monitoring Types
PIAB
PIPN
PIEN
PIPO
PIED
Rx Burn Unit Boundaries


GRAND CANYON
North Rim Fire Effects Plots
Walla Valley & Swamp Ridge
PIPN 1
PIPN 2
PIAB 7
PIEN 4
PIEN 2
NW III
PIAB 25
PIAB 6
BIG SPRINGS
BOUNDARY
ROOST
WALLA VALLEY
PIPN 6
PIPN 8
Lancelot Pt
South Big Spring
Galahad Point
Amphitheater
Excalibur
Bedivere Pt
LEGEND
Fire Effects Monitoring Types
PIAB
PIPN
PIEN
PIPO
PIED
Rx Burn Unit Boundaries
1:62500
0 1 2 3 Miles
Li Brannfors 02/05/00


GRAND CANYON
North Rim Fire Effects Plots
Walhalla Plateau
PIEN 1
PIAB 4
PIAB 5
PIAB 3
PIAB 9
PIAB 14
PIAB 20
PIAB 19
PIAB 15
PIAB 18
PIAB 13
PIAB 17
PIAB 16
PIPN 11
PIPN 4
PIPN 3
PIPN 7
PIPN 10
NANKOWEAP
IMPERIAL
THOMPSON
HAYDEN
UNCLE JIM
GREENLAND
VISTA II
VISTA I
KIBBEY
WALHALLA
WALHALLA
PLATEAU
Picnic Area
Campground
Mount Hayden
Sullivan Peak
Hancock Butte
Kibbey Butte
Brady Peak
Alsap Butte
Atoko Point
Cottonwood Camp
Ruins
LEGEND
Fire Effects Monitoring Types
PIAB
PIPN
PIEN
PIPO
PIED
Rx Burn Unit Boundaries
1:70000
0
1
2
3
Miles
Li Brannfors 02/05/00

Appendix I: Regional Review Comments





United States Department of the Interior

NATIONAL PARK SERVICE
INTERMOUNTAIN REGION
Intermountain Support Office - Denver
12795 West Alameda Parkway
Post Office Box 25287
Denver, Colorado 80225-0287

IN REPLY REFER TO: Y14-(IMR-FMO)

To: Superintendent, Grand Canyon National Park

From: Fire Monitoring Program Specialist, Intermountain Region – Denver Support Office

Subject: Trip Report from Fire Effects Monitoring Program Review

A review of the Grand Canyon fire effects monitoring program was conducted on January 20-21, 1999 by Elizabeth Anderson - IMR Fire Monitoring Program Specialist, Marybeth Keifer - Fire Ecologist, Sequoia and Kings Canyon National Parks, and Karen Ogle - Fire Ecologist, Dixie National Forest. The purpose of the program review was to take a comprehensive look at the administration of the fire effects monitoring program.

General Comments

Dan Oltrogge and Ken Kerr are to be commended for the positive support and guidance they provide for the program. Tonja Opperman is to be commended for doing an outstanding job of managing the fire effects monitoring program. She has clearly put a lot of effort into organizing the program, selecting effective seasonal employees, and making improvements to the program that have benefited the park. Her scientific background, focus on quality, attention to detail, and keen understanding of the program have clearly made a big difference for the fire management program.

The current fire effects monitoring program at Grand Canyon National Park began in 1989. The program was one of the pilot programs using the Western Region Fire Monitoring Handbook (FMH) monitoring protocols. The monitoring program suffered many problems inherent to new programs: protocols not being followed, data not consistently collected, and seasonal personnel changes that resulted in a lack of consistency. Tonja Opperman has been the crew leader since 1996, first as a seasonal and now is a permanent subject-to-furlough lead crew person (GS-7 Biological Science Technician). Tonja has worked very hard to rectify the past problems and, in most cases, has been successful. The GRCA program is a solid example of a successful fire effects monitoring program.

Issues & Recommendations

Several issues arose during the review that need to be identified and addressed. A corresponding recommendation will follow each issue.

1. The fire effects monitoring crew is used to staff fire-use fires and monitor smoke for fire-use and prescribed fire. These duties are impacting the ability of the crew to perform the fire effects monitoring duties for which they were hired. **According to the position descriptions for the GS-7 lead crew person (Biological Science Technician) and the GS-6 Biological Science Technician these duties should occupy no more than 20% of the employees time.** We strongly recommend that the crew notebook from the 1998 field season be analyzed to assess how much time was spent on fire effects monitoring activities and other duties. We also recommend that the park call in monitors (through normal dispatch channels) to assist with fire-use fires if the fire effects monitoring crew has pressing fire effects work to do.
2. Tonja and Kara Leonard **do not currently have the time to do comprehensive analyses** of the data to provide optimal feedback to the fire management program. **It is recommended that** the fire and resource management staffs decide what they need from the data analyses, and that Tonja and Kara be given the time to accomplish this. Tonja also needs time to stay current with the fire ecology literature applicable to the Grand Canyon.
3. Ken and Tonja have done a great job incorporating the Science Center into the fire management program. This interaction needs to continue and be strengthened. **We recommend that the Science Center provide more focused direction, in the form of an interdisciplinary team, for the fire effects monitoring program than currently exists in the Resource Management Plan (RMP).** More clearly defined resource management direction concerning the relationship of fire and vegetation would help provide more clear direction for the fire effects monitoring program.
4. Since GRCA is burning in such a manner that any plot can be burned in multiple seasons, the recognition needs to be made that FMH was not intended to monitor fire effects in this manner. The fuels and overstory mortality data are still useful, however the seasonal ecological effects on other vegetation are lost. **We recommend that the park document the rationale used to determine seasonality of burning, and document the recognition that some ecological effects on the vegetation will be lost. We also recommend that other monitoring methods be explored to capture the vegetation trends that are being lost.**

<u>Other Recommendations</u>

1. **The park needs a new vegetation map.** An updated map with increased accuracy will greatly facilitate the work of the fire effects monitoring program in efficiently locating monitoring plots.
2. Tonja and Kara need to be given the opportunity to **attend botany short courses and other trainings** that will increase their knowledge in vegetation, monitoring and fire ecology.
3. **The Fire Monitoring Plan needs to be developed and added as an appendix to the Fire Management Plan.**
4. Tonja needs to attend supervisory training.

Please call me at (303) 969-2883 if you have any questions or if I can provide any assistance.

United States Department of the Interior

National Park Service
Intermountain Support Office - Denver
12795 West Alameda Parkway
Post Office Box 25287
Denver, Colorado 80225-0287

IN REPLY REFER TO:

Y14 (IMR-FMO)

AUG 31 1999

Memorandum

To: Superintendent, Grand Canyon National Park

From: Fire Monitoring Program Specialist, Intermountain Region Support Office Denver

Subject: Trip Report from July Fire Effects Monitoring Field Visit

Excellent report!

This field visit is a follow-up to a programmatic review I conducted of the Grand Canyon fire effects monitoring program in January 1999. The programmatic review was conducted with the assistance of an NPS fire ecologist from Sequoia and Kings Canyon National Parks and a fire ecologist from the Dixie National Forest. The trip report was transmitted on March 24, 1999. The purpose of the July field visit was to observe and work with the fire effects monitoring crew in the field.

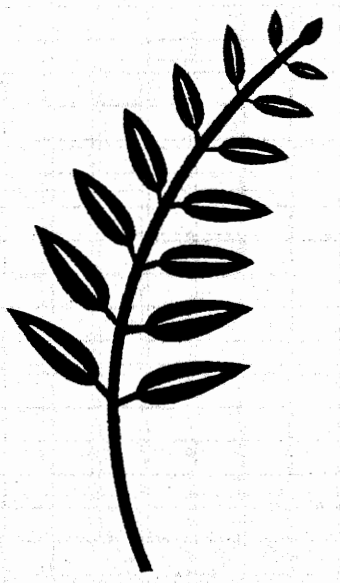
The visit was successful and the fire effects monitoring crew should be commended for their field proficiency and enthusiasm. The crew is highly motivated, well trained and well qualified to perform the often-tedious tasks that are required of the crew.

Ken Kerr and Tonja Opperman are to be commended for the excellent direction they provide the program. Ken Kerr's commitment to implementing a prescribed fire program with a strong scientific basis provides a solid foundation for the fire effects program. Tonja Opperman clearly demonstrates a commitment to having a high-quality program, selecting very effective seasonal employees, and providing good field leadership.

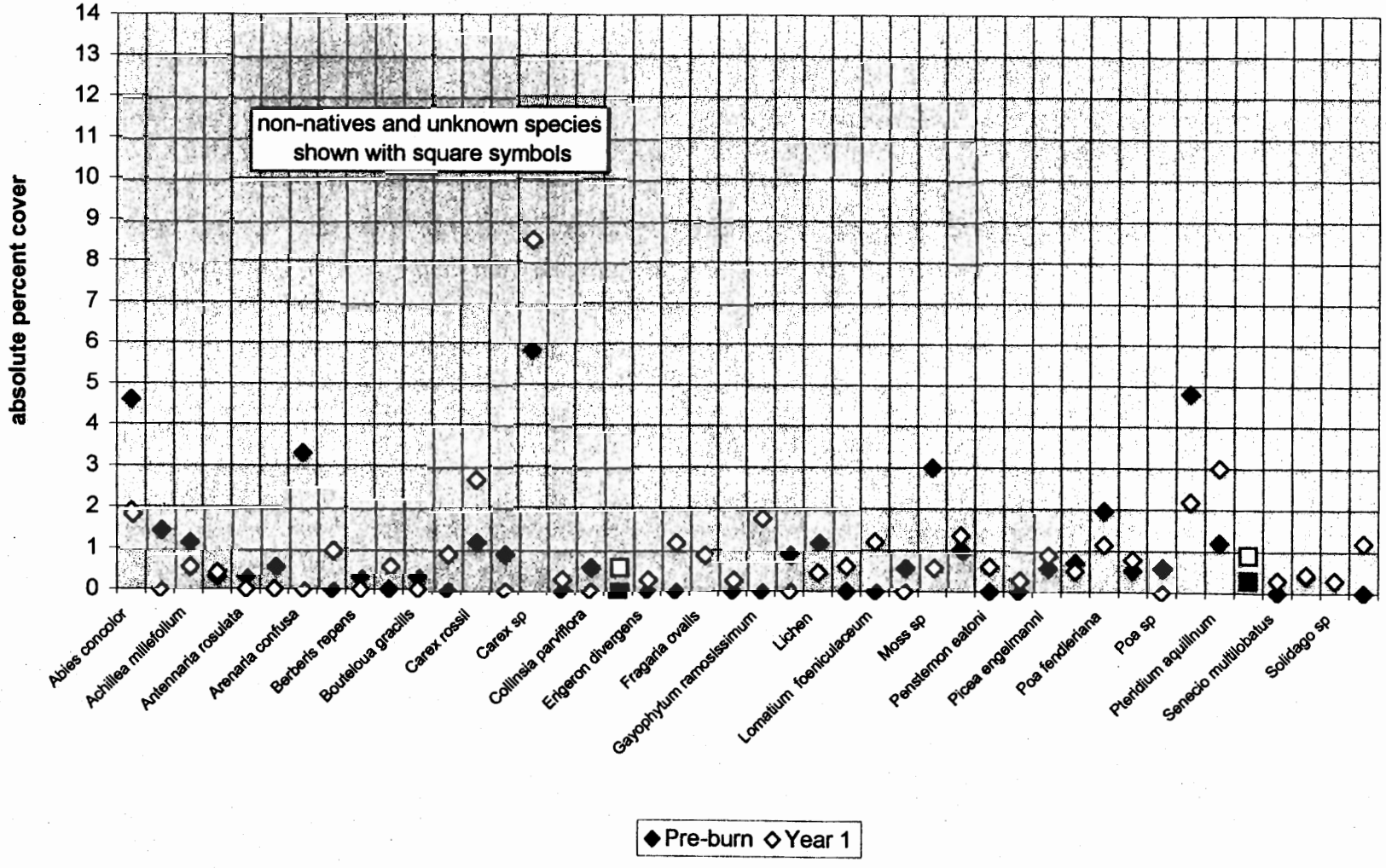
I do not have any issues or recommendations concerning the field part of the fire effects monitoring program. Please call me at (303) 969-2883 if you have any questions or if I can provide any assistance.

Elizabeth Anderson

Appendix J: Preliminary Herbaceous Information



PIAB Herbaceous cover -- pre to year 1
n = 7



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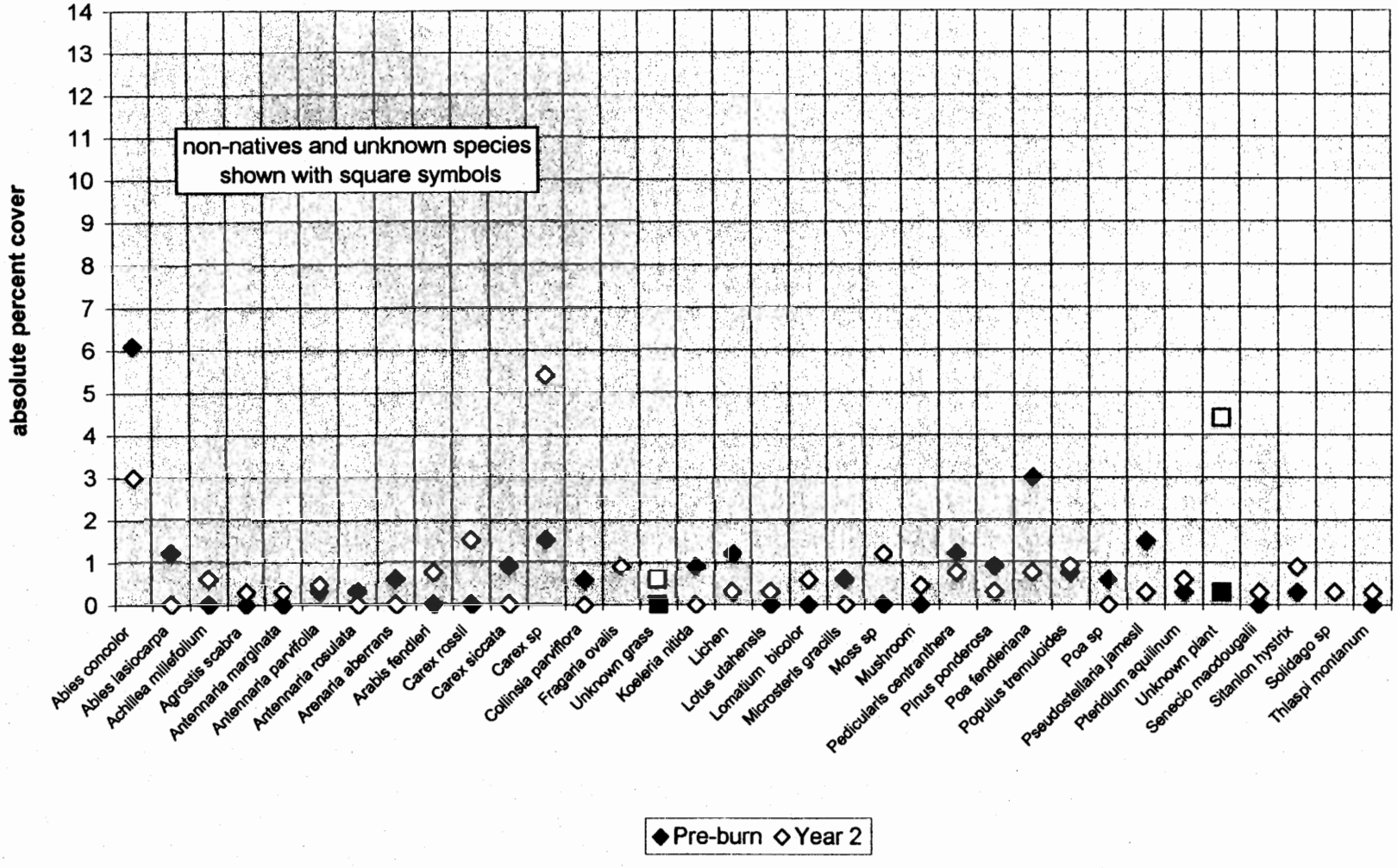
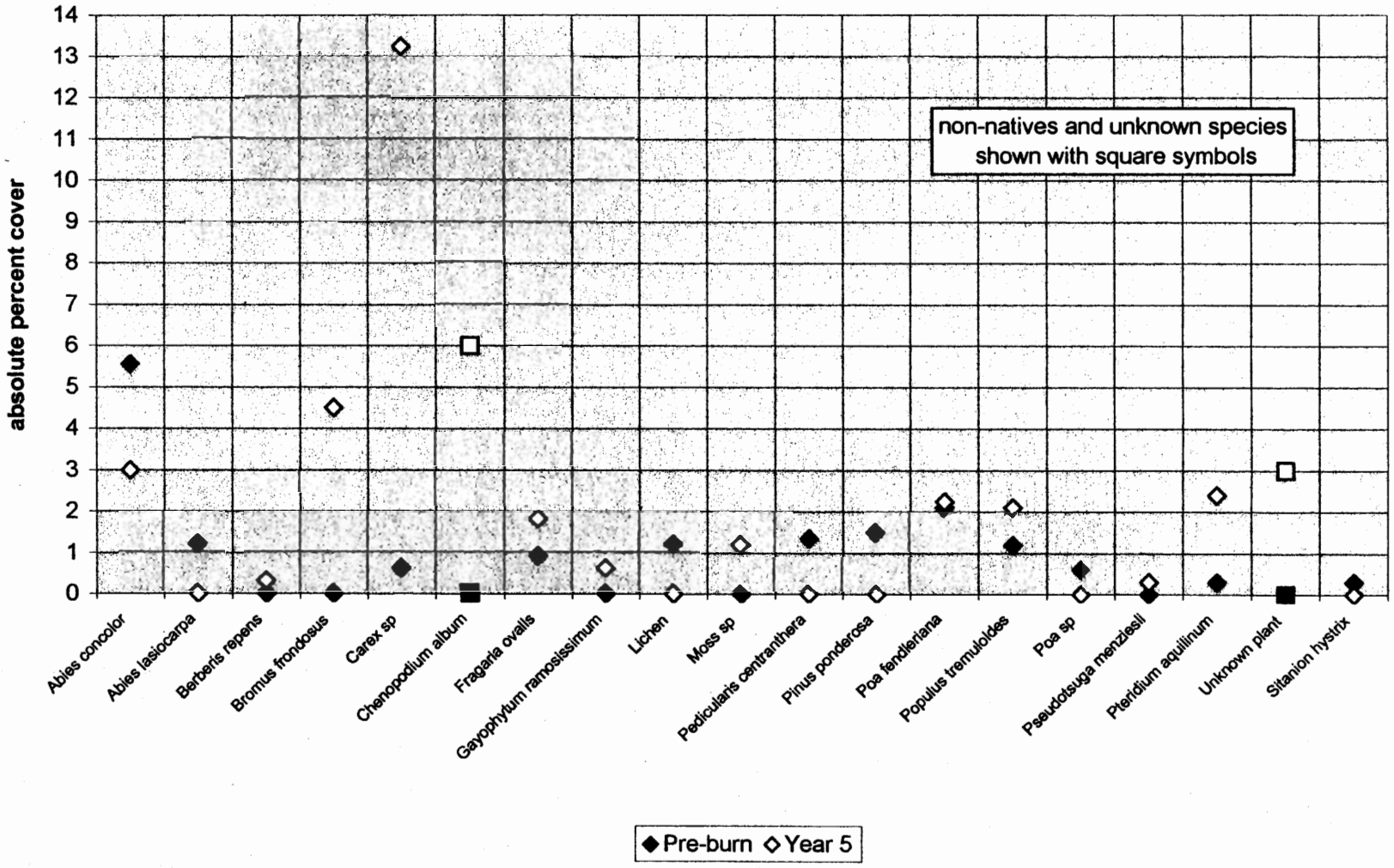
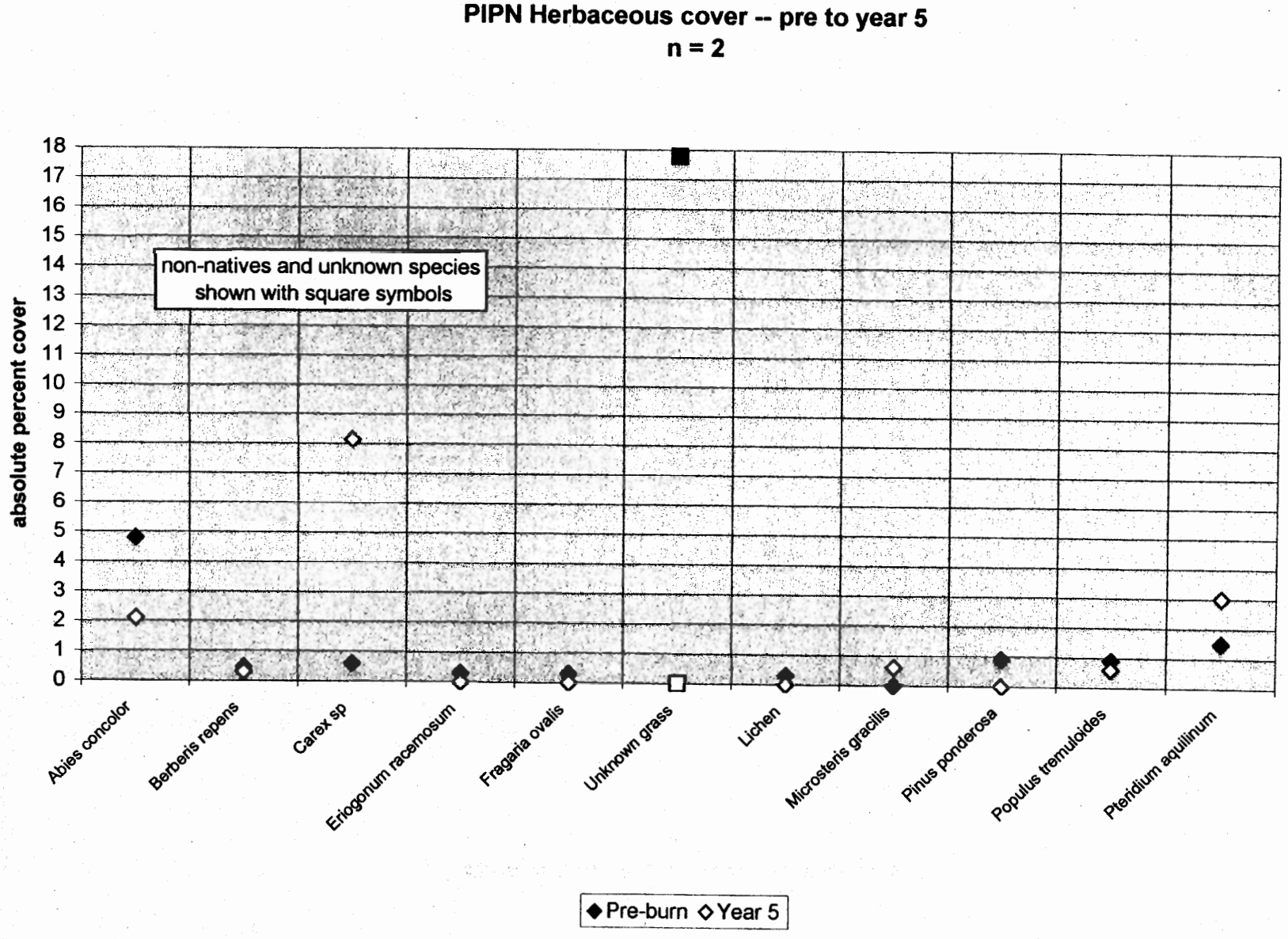
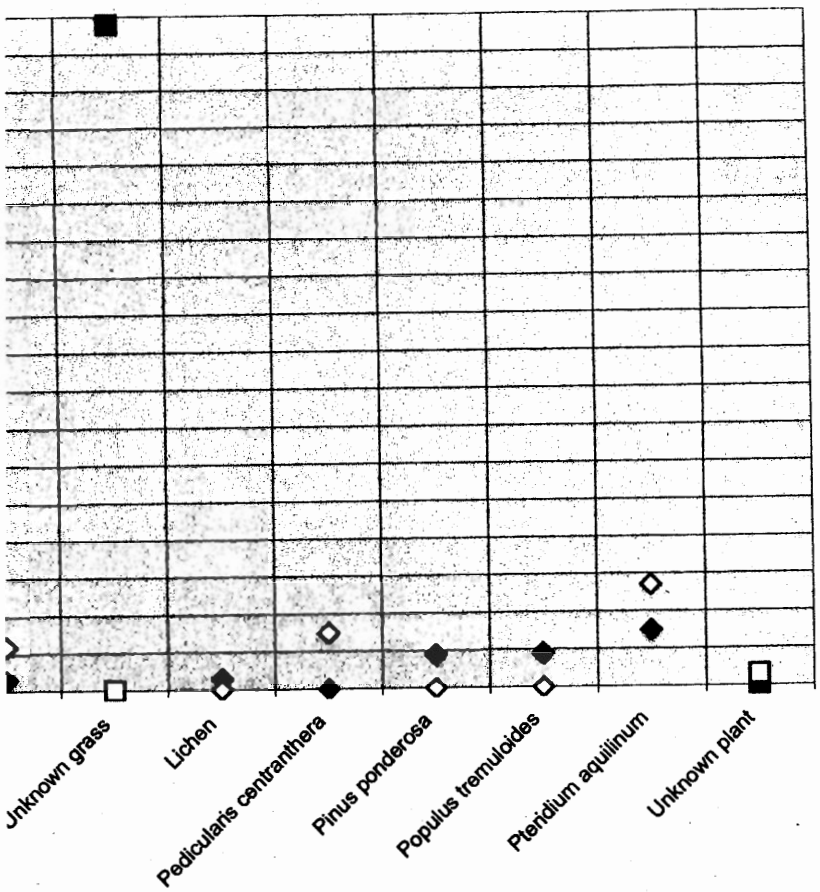


PIAB Herbaceous cover -- pre to year 5
n = 2




PIPN Herbaceous cover -- pre to year 5
n = 2
absolute percent cover
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
non-natives and unknown species shown with square symbols
Abies concolor
Berberis repens
Carex sp
Eriogonum racemosum
Fragaria ovalis
Unknown grass
Lichen
Microsteris gracilis
Pinus ponderosa
Populus tremuloides
Pteridium aquilinum
Pre-burn
Year 5

ıs cover -- pre to year 2
n = 2



e-burn ◇Year 2

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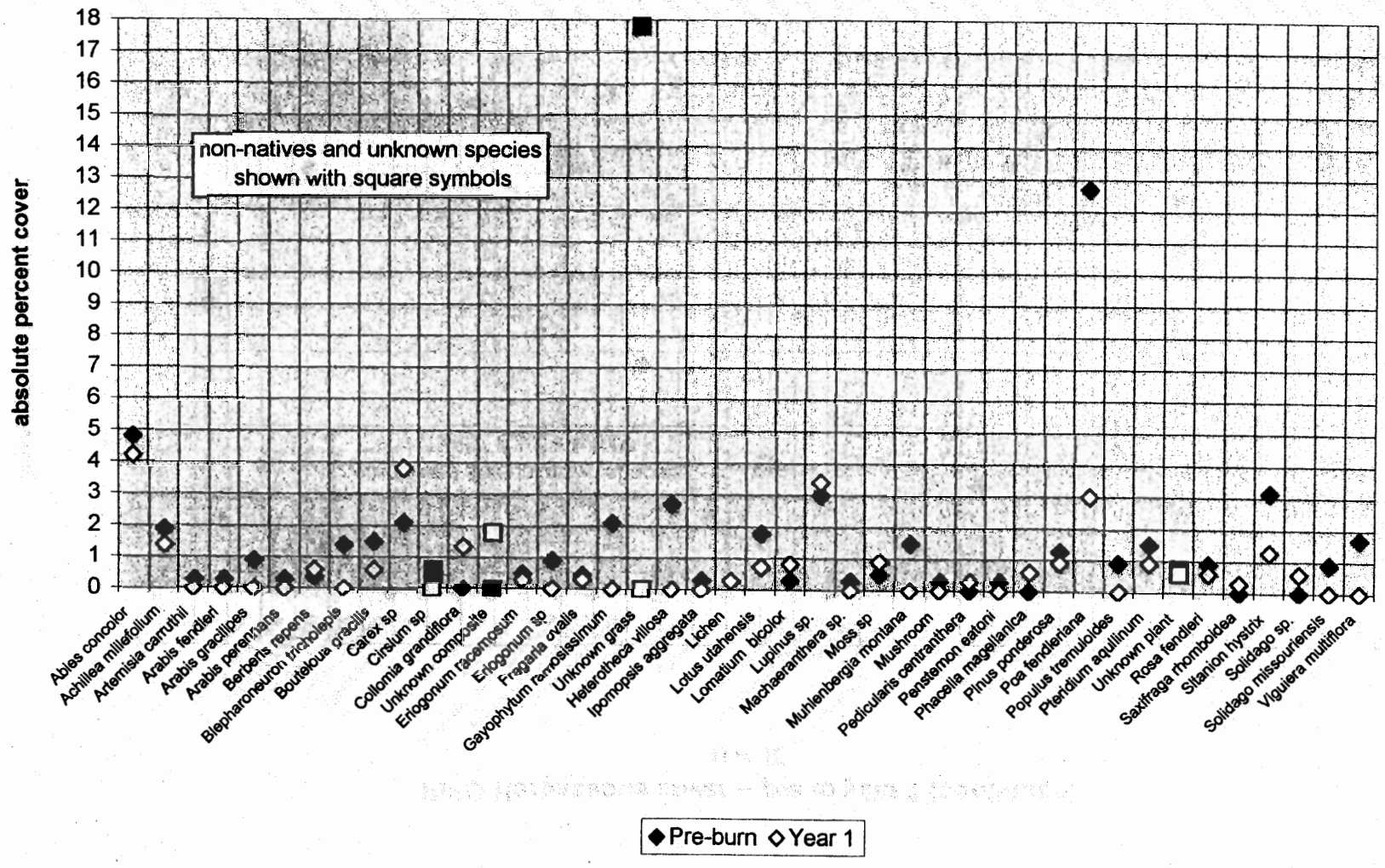

PIPO Herbaceous cover -- pre to year 1 (continued)
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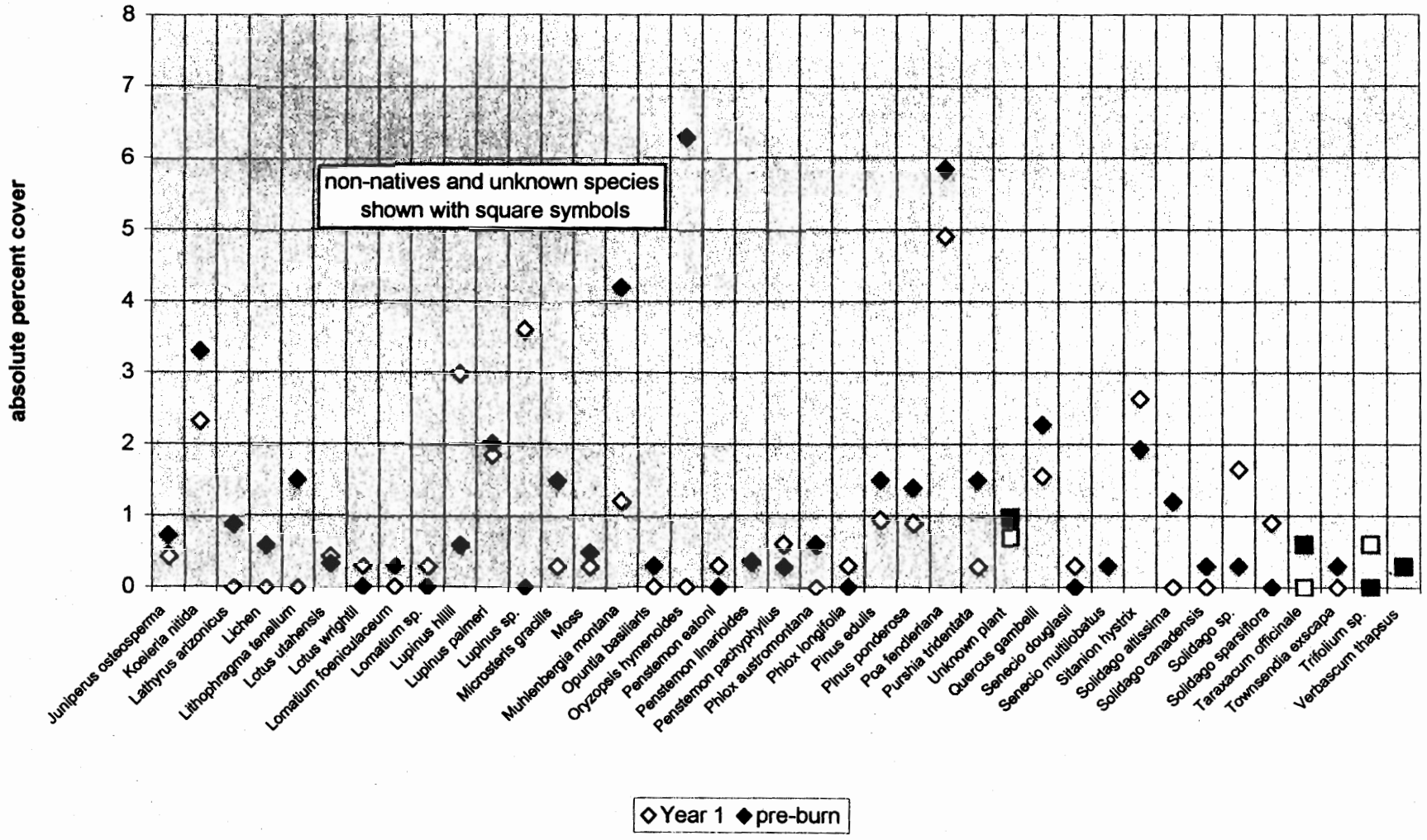
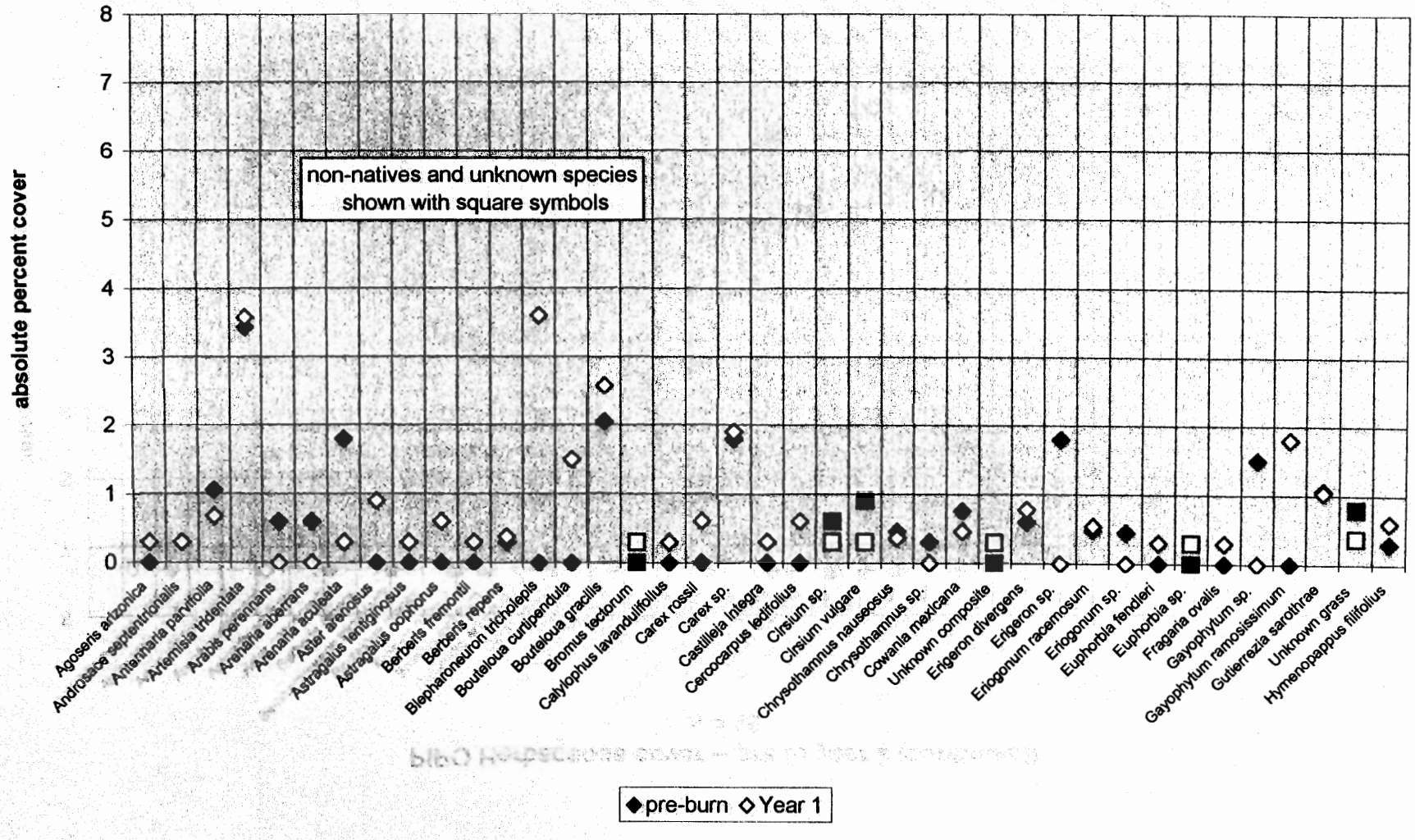


PIPO Herbaceous cover -- pre to year 1
n = 18



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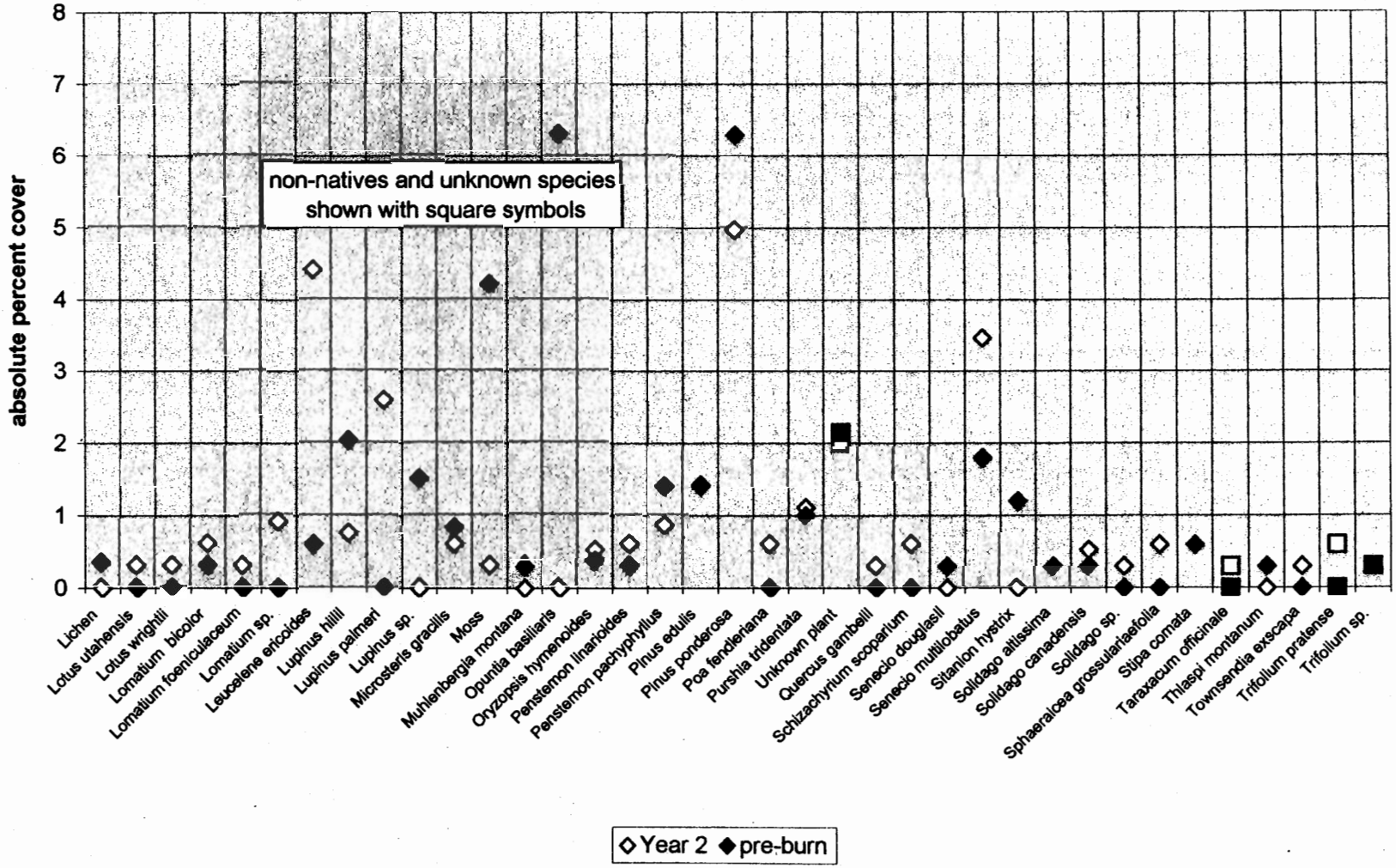

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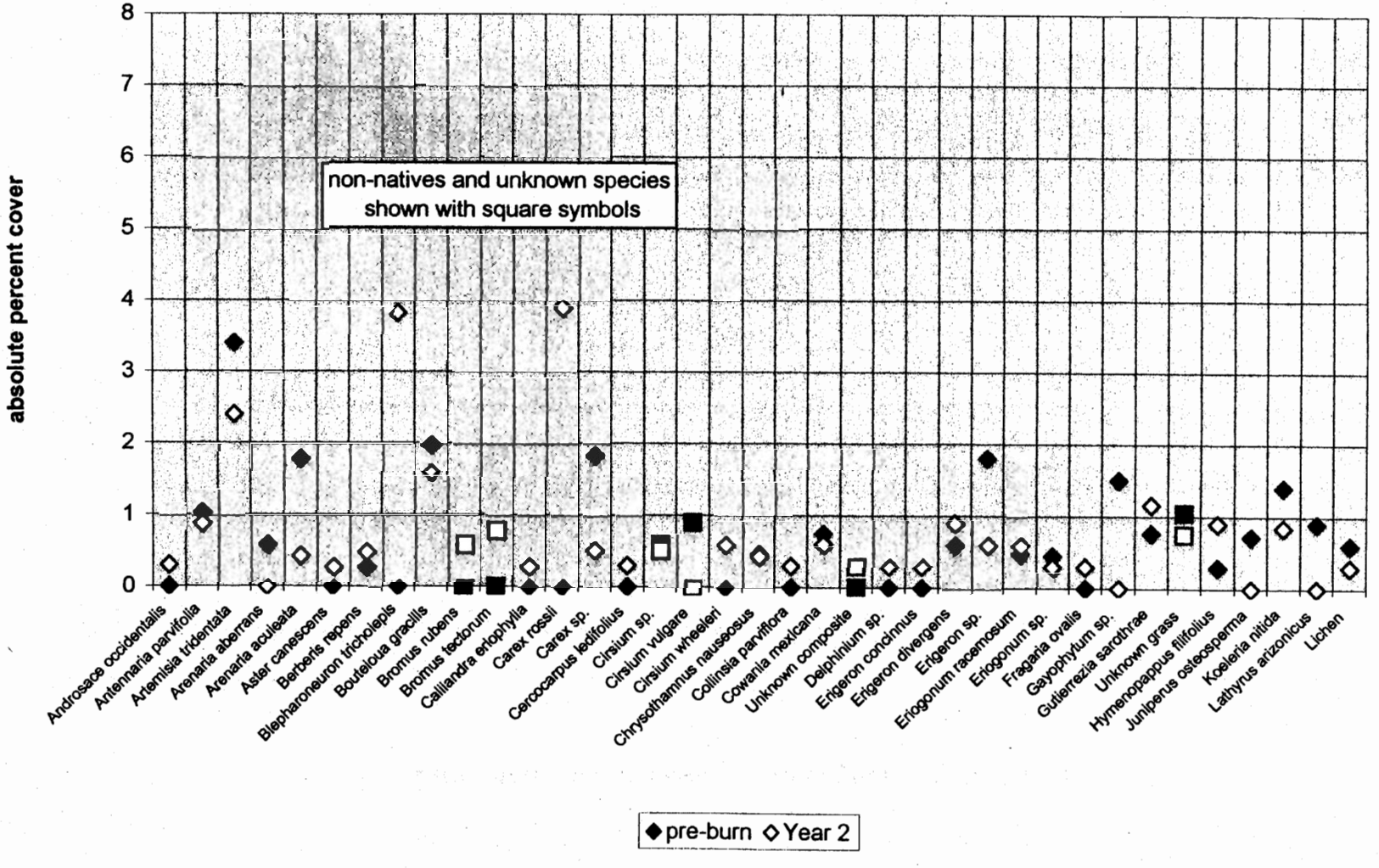
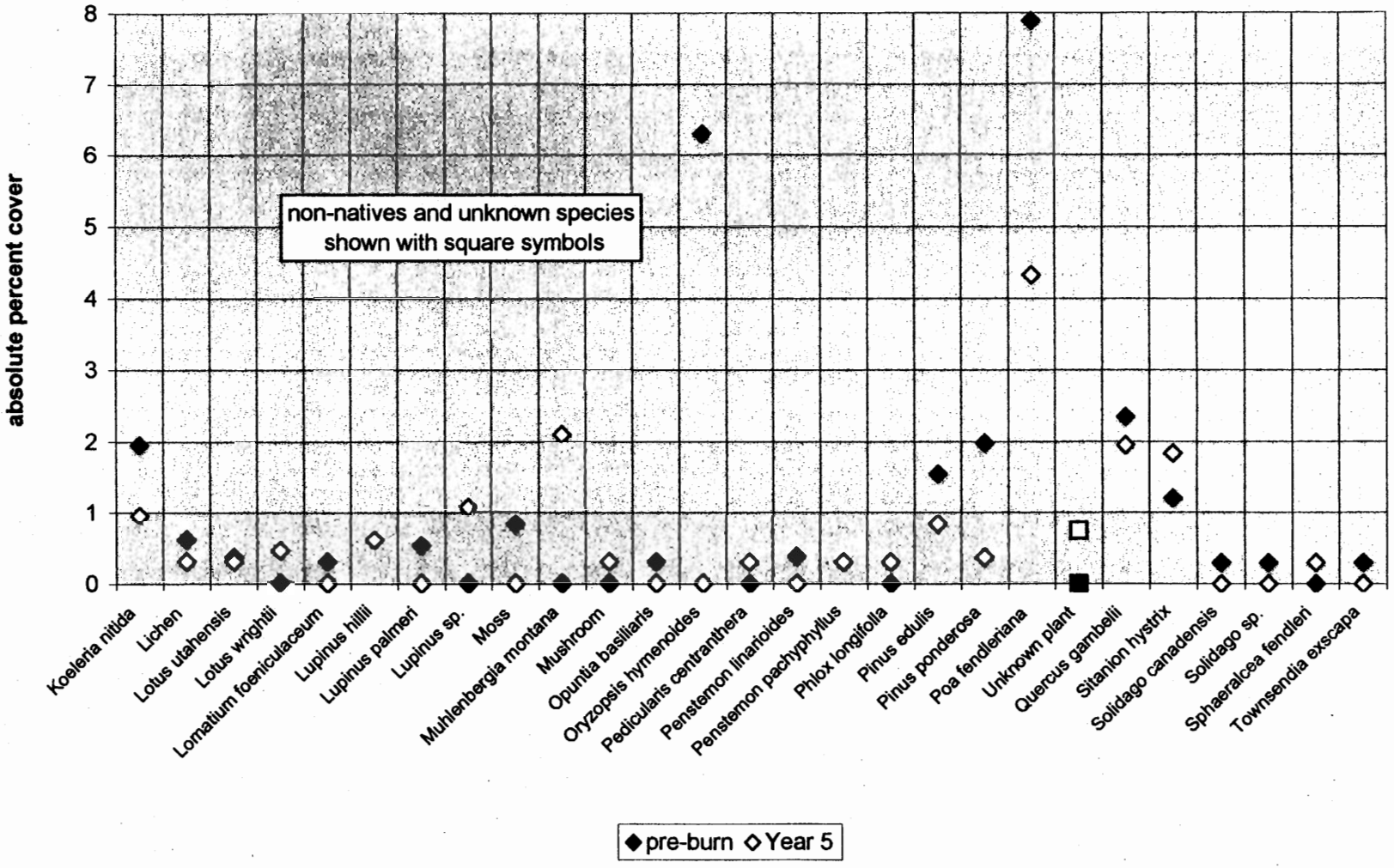


PIPO Herbaceous cover -- pre to year 5 (continued)
n = 12



PIPO Herbaceous cover -- pre to year 5
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