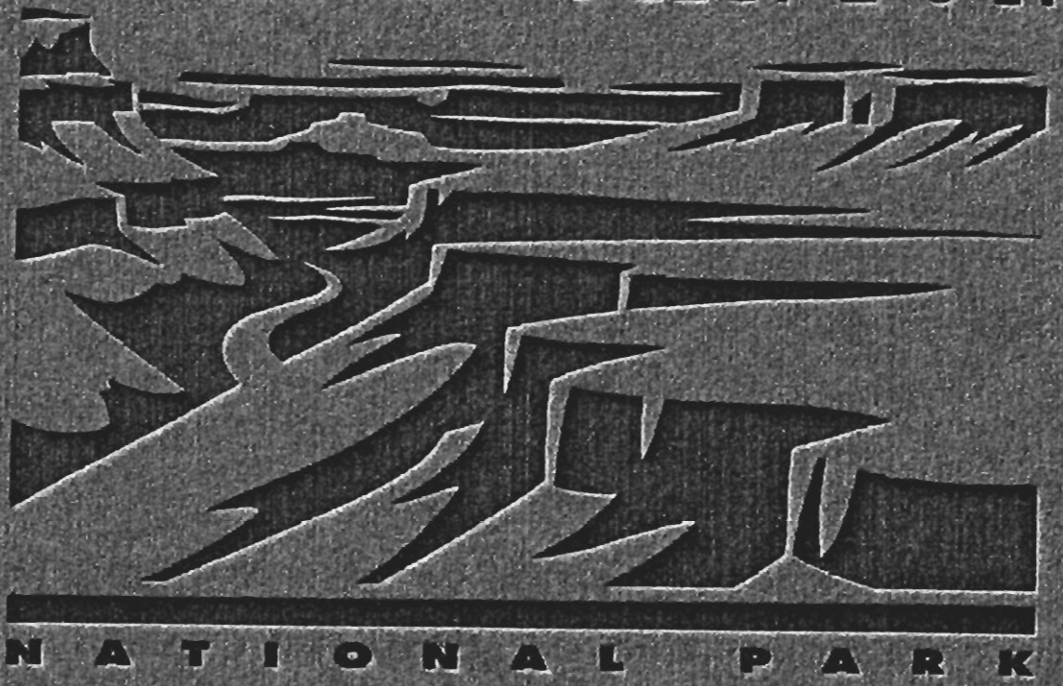
GRCA FES

GRAND CANYON



NATIONAL PARK

Prescribed Fire Annual Summary
1996

National Park Service
Grand Canyon National Park
Branch of Aviation and Fire Management
P.O. Box 129
Grand Canyon, AZ 86023-0129

Grand Canyon National Park
Prescribed Fire Annual Summary
1996

Prepared by: Tonja Opperman for Jim Schroeder **Date:** 8/29/97
Lead Fire Effects Technician, GRCA

Prepared by: _____ **Date:** 8/31/97
Prescribed Fire Manager, GRCA

Approved by: _____ **Date:** 9/2/97
Fire Management Officer, GRCA

Acknowledgements

The success of the 1996 prescribed fire program is attributed to numerous people. First, we would like to thank Paul Reeburg for his continued support of the Grand Canyon fire effects monitoring program. We would also like to thank the Fred Harvey Fire and Safety staff who helped in the seemingly endless wildland/urban interface project around the South Rim developed area. In addition, we would like to acknowledge the efforts of the Kaibab National Forest fire personnel--notably those at the Tusayan Ranger District--whose aid and cooperation was imperative to the completion of several of the South Rim burns. Special thanks go to the Arrowhead Interagency Hotshot Crew, Zion Prescribed Fire Support Module, Lake Mead fire personnel, and all the other visiting crews and engines for their invaluable aid in burn unit prep and support. However, we could not have provided for these crews throughout the season if not for a number of people, notably Rene Morey who dealt with the housing issues on the North Rim; the TW Services Employee Dining Room staff who kept everyone well fed; and especially Norm Clark and Rick Miller who were at the forefront of the logistics. Finally, thanks to the Grand Canyon Aviation and Fire staff, in particular the North and South Rim suppression crews for their help in burn unit preparation and execution.

Introduction

This report summarizes accomplishments in Grand Canyon National Park's prescribed fire program during the 1996 season. Statistics from wildland fire operations, prescribed natural fires, management ignited prescribed fires, fuel and fire weather monitoring, and fire effects monitoring are included.

All scheduled Management Ignited Prescribed Fires were postponed due to a dry winter and spring, but preparation work for other burns was completed instead. Later in the season, the staff managed to get over 1600 acres burned. PNF designations were also compromised due to the low Palmer Drought Indices extending into October as well as the high national fire preparedness levels throughout most of the fire season.

The Fire Effects crew worked hard to install 18 new monitoring plots during 1996, increasing the number of plots by over 25% for a total of 70 plots. Again, all plot re-reads were completed on schedule and the crew also assisted local researchers in efforts to install vegetation monitoring plots for a fire history study on the North Rim. The Fuels crew created helpful graphs of seasonal fuel moisture trends on the North and South Rims and shared this information with neighboring agencies. For the first time, weather information was used to correct fuel values generated by the National Fire Danger Rating System. In addition, crewmembers experienced a number of training opportunities and were involved in numerous out-of-park assignments in both wildfire and prescribed fire operations.

miles of burn unit perimeter were ignited on October 17. The piles were allowed to creep, but it was checked approximately one chain in from the perimeter, crating a fairly continuous blackline. Due to uncooperative weather, we were unable to broadcast burn. In the hopes that the weather would move into prescription, the crews were held on the North Rim. However, a series of low pressure systems moved through the northern Arizona area, creating pulses of high wind events and low humidity, thus prohibiting ignition. At the end of October, a significant snowstorm dropped over a foot of snow, shutting down plans to broadcast burn.

This snow, however, created an excellent opportunity to burn more piles on the Widforss I and Transept burn units. The Widforss I unit is similar to Tiyo I in that the perimeter is being treated by thinning and piling, and over 200 piles were burned along its perimeter. The Transept burn is a ten acre thinning and piling unit adjacent to the North Rim Lodge area. Only half of the unit had been prepped, but all piles in those five acres were burned. In the event that prescription windows open, further pile burning may be completed on the North Rim.

The uncooperative weather conditions this season did not allow for any ignitions in spring or early fall. Despite this, the Grand Canyon Prescribed Fire program managed to complete a total of 1,625 acres of management ignited prescribed fires in a seven week period this fall.

Table 2. Management Ignited Prescribed Fire Proposed Three-year Schedule

Project	*FY*	*Acres*	*Location*
Watson IV	97	575	S Rim
Village Fuel Break	97	80	S Rim
Widforss I	97	1030	N Rim
Hospital	97	55	S Rim
Tiyo I	97	814	N Rim
NW IV	97	314	N Rim
Lonetree	97	1125	S Rim
Quarry	97	2	S Rim
Owen	98		
Angel	98		
Tiyo II	98	707	N Rim
Long Jim I	98	1000	S Rim
Kanabownits	98		N Rim
RX300	98		
N Rim Dynamite Cache	98		N Rim
Manzanita	99	800	N Rim
Uncle Jim	99		N Rim
Northwest V	99		N Rim
Long Jim II	99		S Rim
Topeka	99		S Rim
Santa Fe	99		S Rim

Prescribed Natural Fire Summary

No fires were designated as PNF's in 1996. However, a study of the fire detail list reveals several fires that would have qualified as prescribed natural fires under wetter conditions either locally or nationally. Unfortunately, low Palmer Drought Indices and national preparedness levels exceeded prescription parameters preventing designation of these fires as PNF's. These fires are discussed here to give an indication of the potential PNF workload.

Palmer Drought Index

The winter of 95-96 brought little moisture to the Grand Canyon country. Palmer drought indices were indicating moderate drought in eastern portions of the park and extreme drought in western portions of the park as early as April (Figure 1). (The dividing line for eastern and western zones passes through the Toroweap valley.) By the time lightning arrived with the first pulses of monsoonal moisture at the end of June, drought indices showed extreme drought over the entire park. September saw an gradual increase of the drought indices for the eastern portion of the park, yet the moisture deficit was so large that even in October the Palmer drought index was still indicating severe drought. Western portions of the park were still in extreme drought into October. Such dry conditions are well below the prescriptions established for prescribed natural fires at the Grand Canyon.

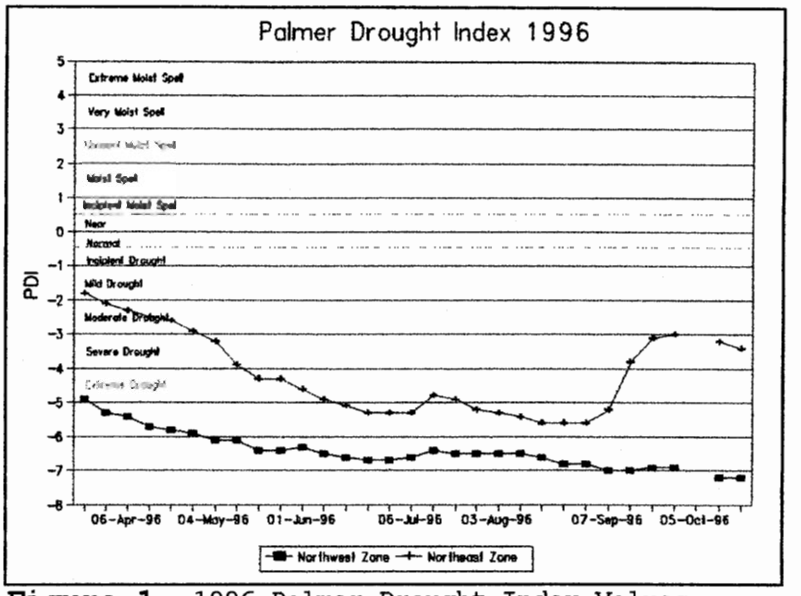


Figure 1. 1996 Palmer Drought Index Values.

National Preparedness Levels

A second obstacle to PNF designation was the busy national fire scene. Due to the need to avoid committing scarce resources to prescribed natural fires, national preparedness levels figure in to PNF decision making. The country was in national preparedness level 4 and 5 for a significant portion of our potential PNF season which limited our flexibility in declaring fires as PNF's.

Wildfire Activity in PNF Zones

Nine lightning caused fires were observed in PNF zones that under wetter conditions would have been managed as prescribed natural fires. These fires were designated as wildfires. Seven were managed under confine strategies with observation from both aircraft and prominent points being the only action taken. Two fires (Great Thumb and Mesa) occurred on the great thumb mesa and were on land managed by both BIA and NPS. The Elaine Castle fire was suppressed exclusively by helicopter bucket drops with no fireline constructed and no people on the ground at the fire's edge. The Rainbow fire was suppressed by ground crews with helicopter support. In addition to

these nine lightning starts, the Hance fire was a human-caused start (toilet paper burning) within a PNF zone that was managed under a confine strategy.

Conclusions and Recommendations

Managing fires as a wildfire under a confine strategy after the decision is made against PNF designation brings up some questions about PNF prescription parameters. If no suppression action needs to be taken to confine a wildfire to acceptable limits, then it is in effect managed as a PNF. Possibly PNF prescriptions could allow drier conditions. However, prescriptions were written to avoid declaring fires as PNF's under too dry conditions only to have them escape maximum allowable perimeters and be declared wildfires.

The 1995 Matthes fire was declared a wildfire without ever exceeding its maximum allowable perimeter. The Bridger Knoll fire succeeded in crossing a 300 foot bare rock cliff that had been considered an effective barrier. Both outcomes are reminders that very few decisions in fire management can be considered to be bullet-proof, even when backed up by prescriptions and experience. Events during 1996 certainly highlight the need for continued refinement of our prescription.

New federal fire policy may change the nature of the whole question by removing the distinction between prescribed fires and wildfires. Decisions would then by guided by the question whether to suppress, contain, or confine, without the additional burden of deciding between prescribed and wildfire designation. The question of appropriate prescriptions for strategy determination will still remain.

Plot Network Information

Plot Statistics

Table 3. Plot installations to date.

Number of Plots Installed Previous Years	*Number of Plots Installed 1996*	*Total Number Plots Installed*
51	18	69

Table 4. Plot rereads by plot type for 1996 and 1997.

Total Plots Reread 1996				*Total Plots to Reread 1997*				
PIED	PIPO	PIPN	Total	PIED	PIPO	PIPN	PIPN *	Total
2	5	1	8	6	9	11	3	29 (5 P)

(P) = Preburn Rereads

Table 5. Three-year projected number of plot rereads by year.

Number of Plots		
1997	1998	1999
26	21	8

Table 6. Projected plot installation.

1997 Plots to Install		*Projected Totals for 1997*					
PIPO	Total	PIED	PIEN	PIPO	PIPN	PIPN *	Total
2	2	15	15	20	19	15	84

* Sum of NAU fire history plot types PIPN2, PIPN3, and PIPN4.

Minimum Plot Calculations

Table 10. Minimum plot calculations by monitoring type and variable.

	Fuel Loading Total tons/acre			*Overstory Tree Density*	
	20	25	Overstory Species	20	25
FPIED1D02	10	6	Juniperus osteosperma	12	8
			Pinus edulis	5	3
FPIPO1D09	18	12	Pinus ponderosa	25	16
			Pinus edulis	107	69
FPIEN1D10	40	26	Abies concolor	9	6
			Picea engelmanni	69	44
FPIPN1D09	18	12	Pinus ponderosa	22	14
			Abies concolor	23	15
FPIPN2D09	17	11	Pinus ponderosa	2	1
			Abies concolor	8	5
FPIPN3D09	10	7	Pinus ponderosa	39	25
			Abies concolor	1	1
FPIPN4D09	14	9	Pinus ponderosa	25	16
			Abies concolor	120	77

Program Information

Staffing Information

Table 11. 1996 Prescribed Fire Staff

Staff Participants	*Position Title*	*Grade*	*Funding Source*
Jesse Duhnkrack	Prescribed Fire Specialist	GS-0401-9	RX Perm staffing
Jim Schroeder	Prescribed Fire Technician	GS-0462-7	Hazard Fuels
Craig Letz	Helibase Manager	GS-0462-7	Base Fire Pro
Carl Helquist	Lead Biological Technician	GS-0404-6	Fire Effects
Mike Lewelling	Lead Fuels Technician	GS-0462-5	Hazard Fuels
Brenda Zimpel	Lead Fuels Tech	GS-0462-5	Hazard Fuels
Tonja Carriere	Fuels Technician	GS-0462-5	Hazard Fuels
Kelly Corbett	Fuels Technician	GS-0462-5	Hazard Fuels
Elizabeth Miller	Biological Technician	GS-0404-5	Fire Effects
Stacey Wickland	Biological Technician	GS-0404-5	Fire Effects
Andy Thorstenson	Biological Technician	GS-0404-5	Fire Effects
Sean Molina	Fuels Technician	GS-0462-5	Hazard Fuels
Amy Bess	SCA VIP	AD-2	Hazard Fuels

Table 12. Number of pay periods in field season devoted to fire effects.

Monitor	*Starting Date*	*Ending Date*	*Pay periods*
Carl Helquist	4/23/96	11/23/96	12
Elizabeth Miller	4/14/96	ll/9/96	11
Stacey Wickland	5/12/96	11/23/96	10
Andy Thorstenson	5/12/96	11/23/96	10

* Due to 1996 Extreme Fire Danger and extended need for firefighters working longer time periods, the 1040 rule of hours was waived for seasonal employees.

Changes in Protocol

There were no changes in fire monitoring protocol this season, nor are there any recommendations.

Equipment Information

All necessary FMH equipment and supplies (tags, forms, tapes, etc.) are stored in large backpacks at the Prescribed Office near the South Rim Fire Cache. Raw data files and copies generated from FMH software are also stored in file cabinets in this office, and they are labeled accordingly. Copies of all database files have been duplicated with one set at Fire Support and the other in the Prescribed Office. Database files are also given to the Intermountain Region Fire Effects Specialist. Next year there will be additional equipment on the North Rim for FMH plot reading because there will be an increased North Rim prescribed fire staff during the 1997 season.

Equipment can be purchased from the following suppliers. Catalogs are in the Prescribed Office.

Band and Tag Co.
721 York Street
P.O. Box 430
Newport KY 41072-0430

Trimble Navigation
2105 Donely Drive
Austin TX 78758

National Wildfire Coordinating Group
1849 C Street
Washington DC 20240

Patricia Ledley Bookseller Inc.
1 Bean Road
P.O. Box 90
Buckfield ME 04220

Fuel Moisture and Fire Weather Monitoring Summary

The 1996 fuels and weather monitoring program built upon and reinforced that which was initiated in 1995. As summarized on the following page, weather and fuel data was collected at various locations throughout the park. This information became an integral part of the Grand Canyon Fire Management Program.

Weather and fuel moisture values were utilized in a number of ways throughout the fire program. The Grand Canyon Wildland Fire Emergency Communications Center processed fire weather information in the Weather Information Management System (WIMS). Both 1000 hour time lag fuel moisture (TLFM) and live fuel moisture measured values were used to correct the values generated in WIMS, using the National Fire Danger Rating System (NFDRS). Energy Release Component (ERC) values for a key representative fuel model/slope class at each of the three primary NFDRS fire weather stations in the park were plotted by computer in graph form. The fuel moisture results from North and South Rims were faxed bi-weekly to various local agencies including Southwest Coordination Center (SWCC) where the data was used for fire behavior predictions. All of the above material, including the ERC values, was displayed on the center's bulletin board.

There are plans to continue refinement of the existing program for 1997. The standardized approach to fuel sampling and weather monitoring which was well established in 1995 and 1996 will be continued, further developing the already existing fuel database.

Weather Monitoring

Weather was recorded at several locations throughout the park and the USFS Tusayan Ranger District. The primary source of information on the South Rim, was a combination of the data collected by a Forest Technology System (FTS) and a Remote Automated Weather Station (RAWS) at the Tusayan Ranger District. On the North Rim, a micro-RAWS was moved from Walhalla Plateau to Bright Angel Point, replacing the longest running manual weather station in the park. A mini-RAWS remained at Lindberg Hill. Precipitation values were well below normal for most of the fire season. Figure 2. from the National Weather Service in Phoenix illustrates this point.

Figure 2. Precipitation shown as percent of normal for the 1996 season, ending October 1996.

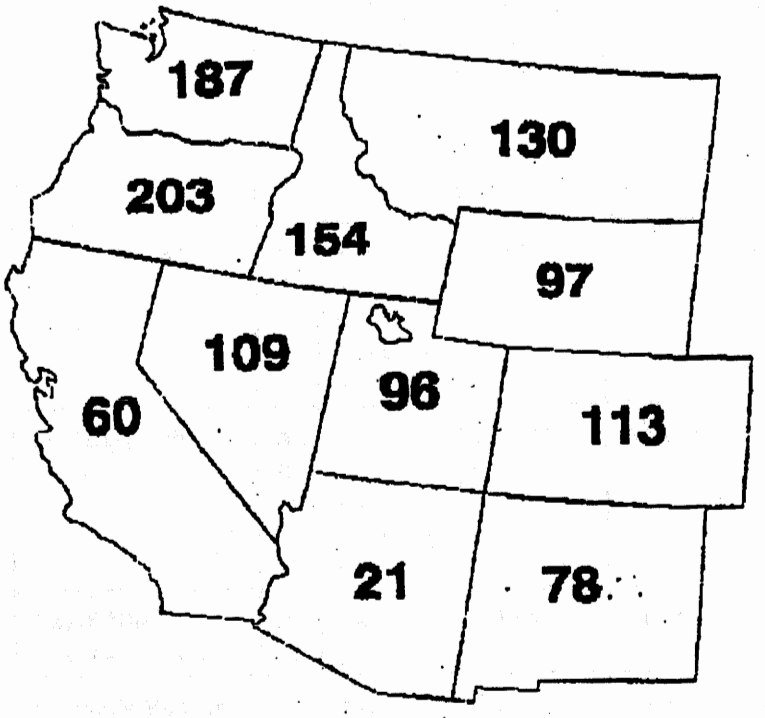


Table 13. 1996 Fuel Moisture and Fire Weather Monitoring Plan

Station Name Station I.D.	Location	RIM	10 hour TLFM	1000 hour TLFM	Live F.M.	Wx Station Type	Rain Gauge	Hygro
Bright Angel (020211)	N.Rim Helibase	NR	Yes 1 and calculated	PIPO	PIPO	RAWS	Y	N
Lindberg (020220)	Lindberg Hill	NR	Yes 1 and calculated	ABCO	ABCO	RAWS	Y	N
Tower	North Rim Entrance Tower	NR	No	PIEN	PIEN	None	N	N
Walhalla	Walhalla Plateau	NR	Yes 1	No	ARPU	MANUAL	Y	Y
Buddha	W1-D Road	NR	Yes 1	No	No	MANUAL	Y	Y
Swamp Ridge	Swamp Ridge Road West of NW-IV RX Burn Unit	NR	Yes 1	No	No	MANUAL	Y	N
Tusayan (020207)	Tusayan D-4 U.S.F.S	SR	Calculated	No	No	FTS/RAWS	Y	N
Long Jim	Long Jim Canyon Road	SR	Yes 1	PIPO	PIPO PIED QUGA ARTR	MANUAL	Y	Y

PIPO *Pinus ponderosa (ponderosa pine)*
ABCO *Abies concolor (white fir)*
PIEN *Picea engelmanni (Englemann spruce)*
ARPU *Arcotostaphylos pungens (manzanita)*
PIED *Pinus edulis (pinyon pine)*
QUGA *Quercus gambelii (gambel oak)*
ARTR *Artemisia tridentata (big sagebrush)*

Fuels Program

The 1996 Fuels program built upon and reinforced that which was initiated in 1995. The tasks that were accomplished and the data were gathered became an integral part of the prescribed fire program at Grand Canyon. There was a crew of three plus one SCA on the South Rim, and a crew of two on the North Rim. The primary prescribed duties of these crews were to ensure the fuel sampling was accomplished according to schedule, that protocols were followed, and to oversee preparation work on burn units.

Weather and Fuel Sampling

The program consisted of tracking live and dead fuel moistures and corresponding weather conditions at prescribed burn areas. Standard sampling procedures were outlined in a document written by Tonja Carriere and Mike Lewelling of the South Rim prescribed fire crew. A sampling sheet for field use was also designed. These items are permanently filed in the South Rim Prescribed Office for reference.

Site Locations. The South Rim had one established fuel sampling station located in the Long Jim Canyon area. At this station, there was a hygrothermograph, rain bucket, and two sets of 10-hour TLFM sticks (shaded and unshaded). All necessary fuel variables were available at this site. The primary source of weather information on the South Rim was a combination of the data collected by a Forest Technology System (FTS) and a Remote Automated Weather Station (RAWS) at the Tusayan Ranger District. The North Rim had six sites, two of which were solely for weather information (Swamp Ridge and Buddha Box), and four for weather and fuel information (Walhalla, Lindberg, North Rim Entrance Tower, and Bright Angel).

South Rim

- Long Jim Canyon—5.8 miles down East Rim Drive to Long Jim Canyon turn-off on right; turn right through a locked gate and proceed 0.8 miles to junction with Power Line Road; turn right up the steep hill under power line and park at top on left; site is west of power line and north of Long Jim Canyon.

North Rim

- Swamp Ridge—From developed area, north on Highway 67 out of park, west on FS422, south on FS270, west on FS223, south on FS268, then FS268B into the park. On Swamp Ridge Road, 3.5 miles west of Kanabownits turn-off on south side of road.

- Buddha Box (Tiyo I)—On W-1D, 1.1 miles south from gate; on west side of read across from southern boundary of Tiyo I burn unit.

- Tree Tower 13 (Walhalla)—On E-5, 1.4 miles south of E5-E6 Y. On west side of read, just past Tree tower 13 which now has a broken top. Manzanita was collected four chains south of gate, just off highway, on west side of road.

- Lindberg—On Lindberg Hill, just north of RAWS station, beyond locked gate.

- North Rim Entrance Tower—Park at tower and walk down road approximately 50 yards.

- Bright Angel—Just south of North Rim helibase, across access road.

Results. The fuel moisture results from 1996 are summarized in Figures 3-8. The live fuel moistures (LFM) reflected the extreme drought that this area experienced. Whereas LFM for conifers should be well over 200% in the spring and then gradually decline over the summer, our fuel moisture results showed that they did not even reach 150% and had a gradual increase in LFM throughout the summer. These types of observations will become more evident and quantifiable as our fuel moisture database grows throughout the upcoming years.

Considerations for 1997

Equipment

- North Rim must obtain a convection oven.
- Hygrothermographs should be replaced with an instrument designed for field use which is more reliable and easier to maintain.
- More 10-hour TLFM fuel scales should be purchased for engines so crews could check remote sites.
- Need 1000-hour sampling tins—paper bag method is confusing and not always accurate.
- Need additional pairs of shears for sampling long-needles species.
- An additional saw is needed (preferably an 044) for the North Rim to be used by visiting crews for prep-work.

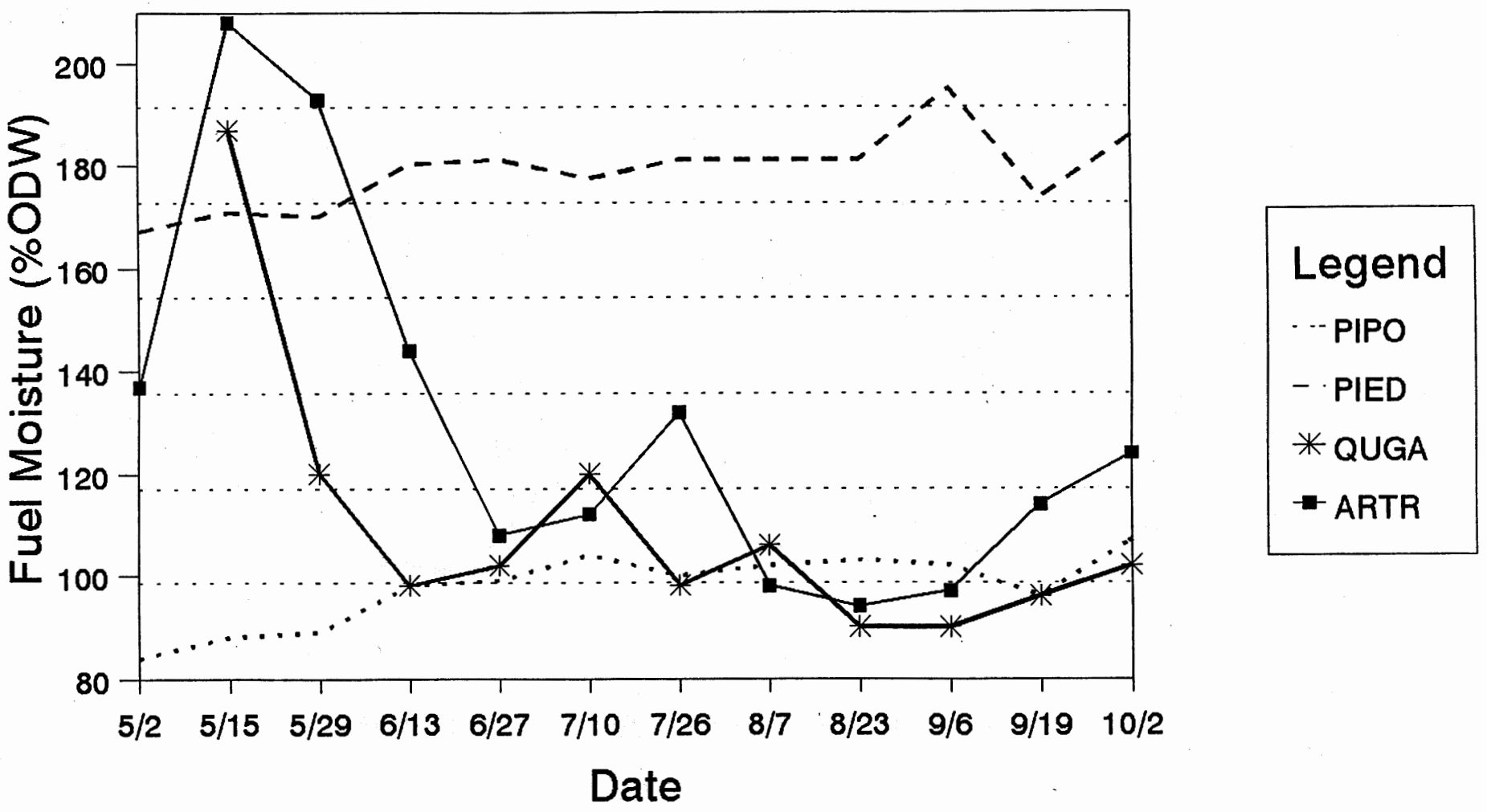
Procedures

- Assuming the North Rim acquires a convection oven, fuel sampling should be done on both rims the same day of the same week. This would allow crews to travel between rims, when necessary, with a two-week window. Information would also be more consistent.
- On the North Rim all sample species should be collected at each weather station site, with additional sites representative of current burn units and potential PNF areas.
- Investigate using a chainsaw for 1000-hour TLFM sampling. The handsaw is time-consuming. Compare methods with first set of samples in 1997.
- Determine if *Picea englemannii* is necessary to sample—it is time consuming to do so.
- Sample *Quercus gambelii* in lieu of manzanita as it is a more common species on and just below the rim. Furthermore, as oak is sampled on the South Rim, comparisons could be readily made between the two rims. Two major fires—Bridger/Knoll (Type I)and Lancelot II (Type II)—originated below the rim and exhibited extreme fire behavior in this vegetation type. Understanding fuel moisture changes in this vegetation type could help predict fire behavior more accurately in fires originating below the rim.
- Collecting three species for 1000-hour TLFM fuel samples on the North Rim is unnecessary. In the future, only ponderosa pine will be sampled on both rims.
- The North and South Rim fuel scales should be calibrated, if possible. Errors will result with sampling if they are not the same.

Figure 3.

1996 South Rim Fuel Moisture Values

Live Vegetation

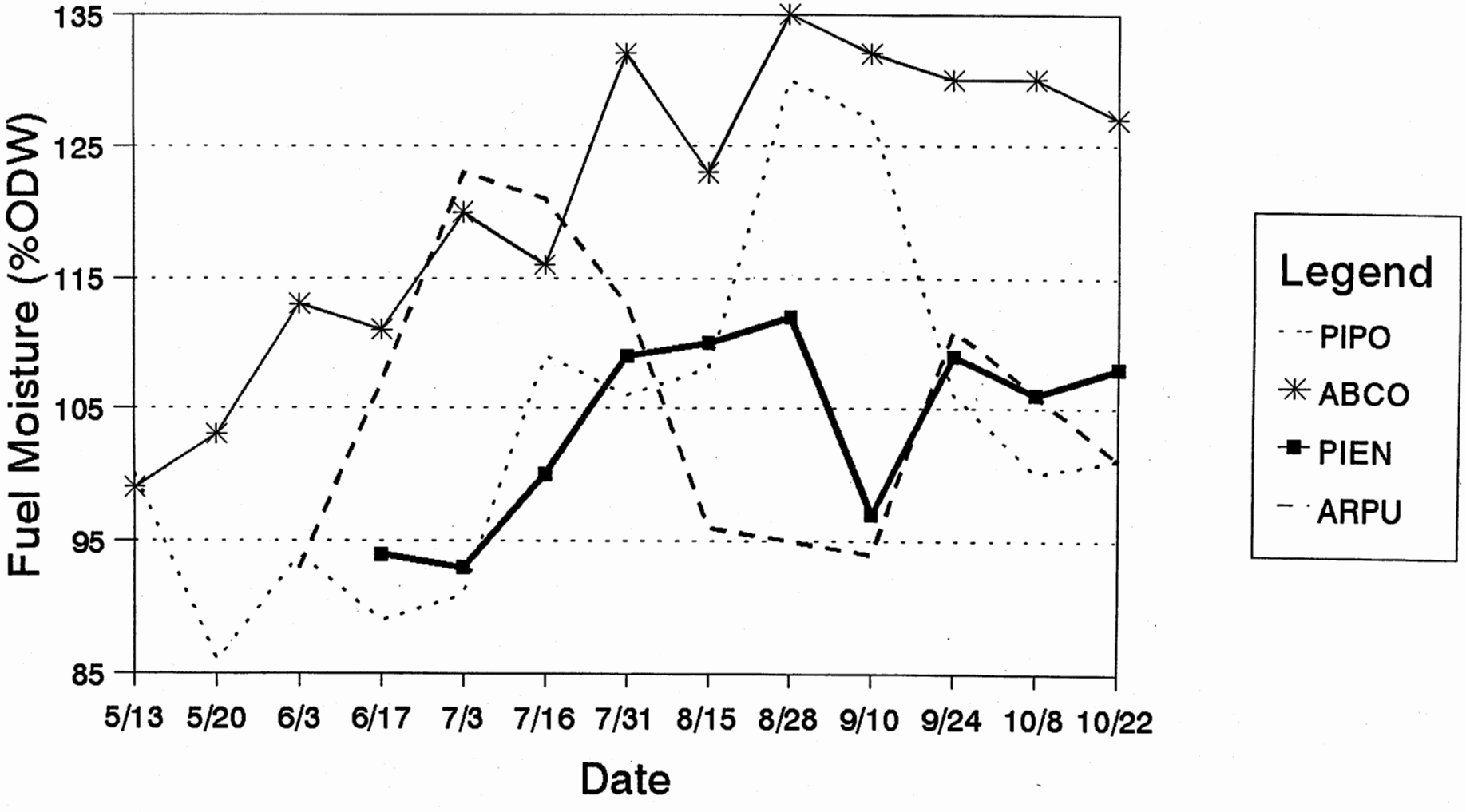


Long Jim Canyon Sampling Station
PIPO=Ponderosa pine, PIED=Pinyon pine, QUGA=Gambel Oak, ARTR=Big sagebrush
%ODW=Percent oven dry weight

Figure 4.

1996 North Rim Fuel Moisture Values

Live Vegetation

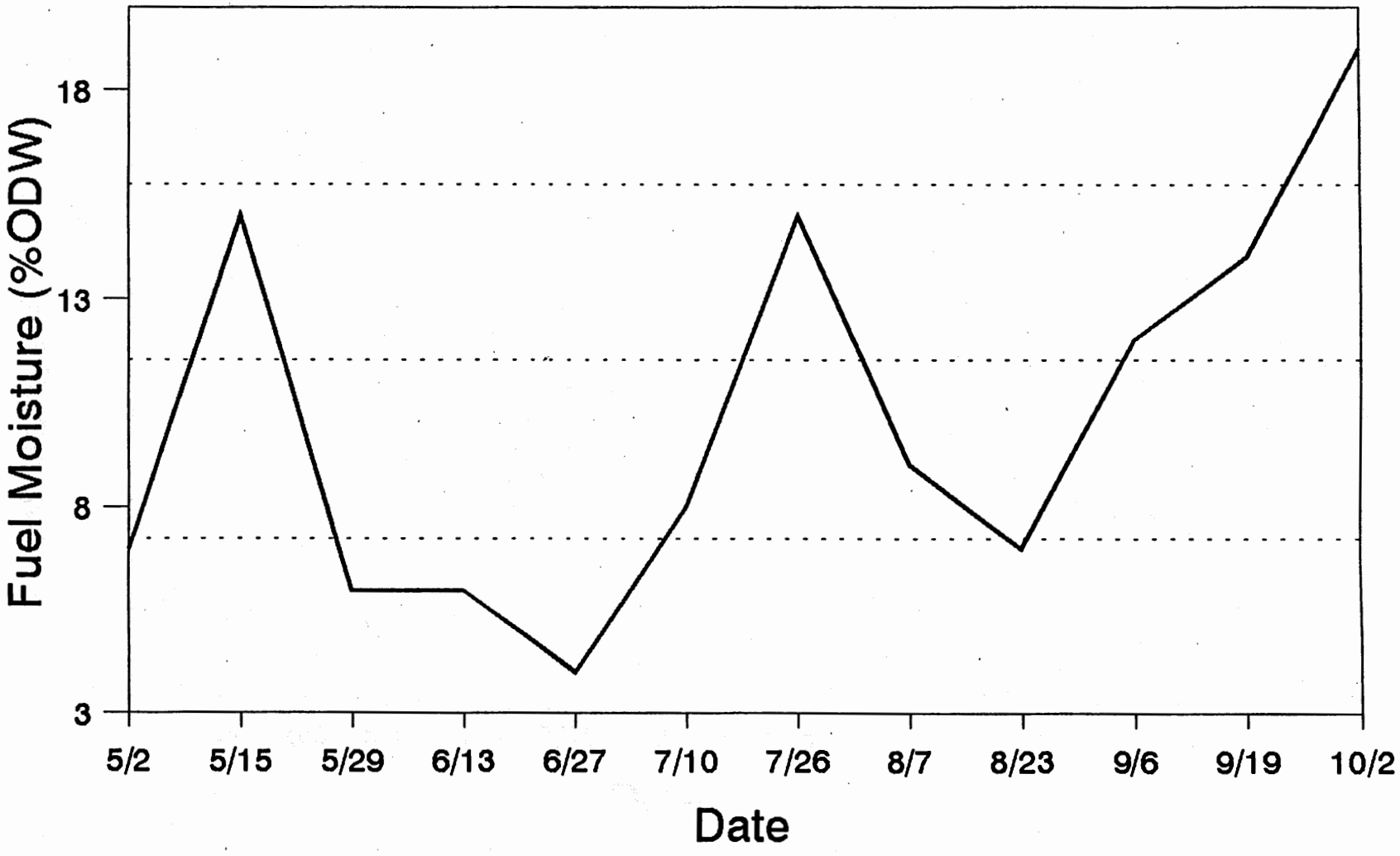


Bright Angel, N.R. Tower, Lindberg, and Walhalla Sampling Stations
PIPO=Ponderosa pine ABCO=White fir, PIEN=Englemann spruce, ARPU=Manzanita
%ODW=Percent oven dry weight

Figure 5.

1996 South Rim Fuel Moisture Values

1000-hour TLFMs

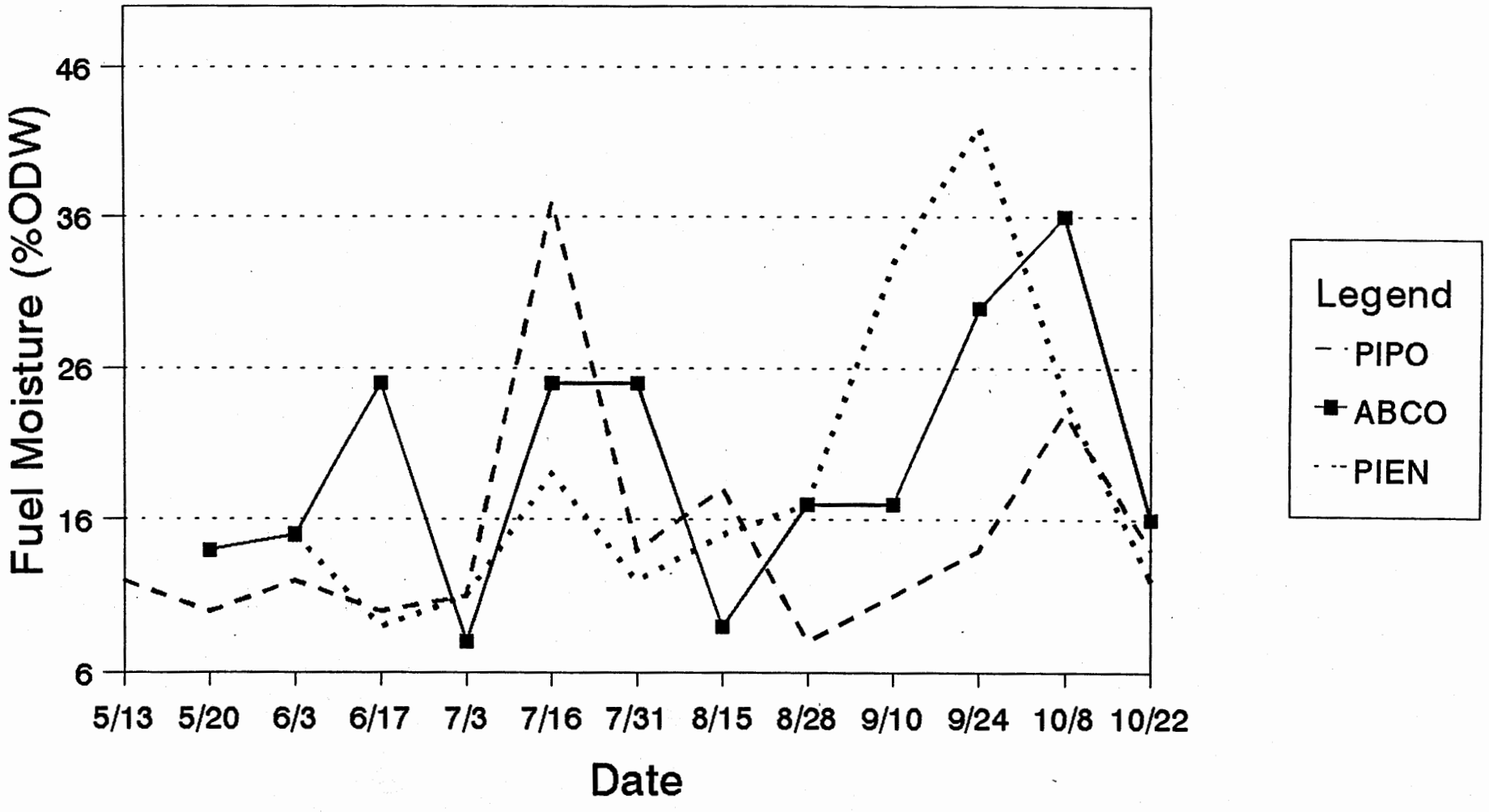


Long Jim Canyon Sampling Station
%ODW=Percent oven dry weight

Figure 6.

1996 North Rim Fuel Moisture Values

1000-Hour TLFMs

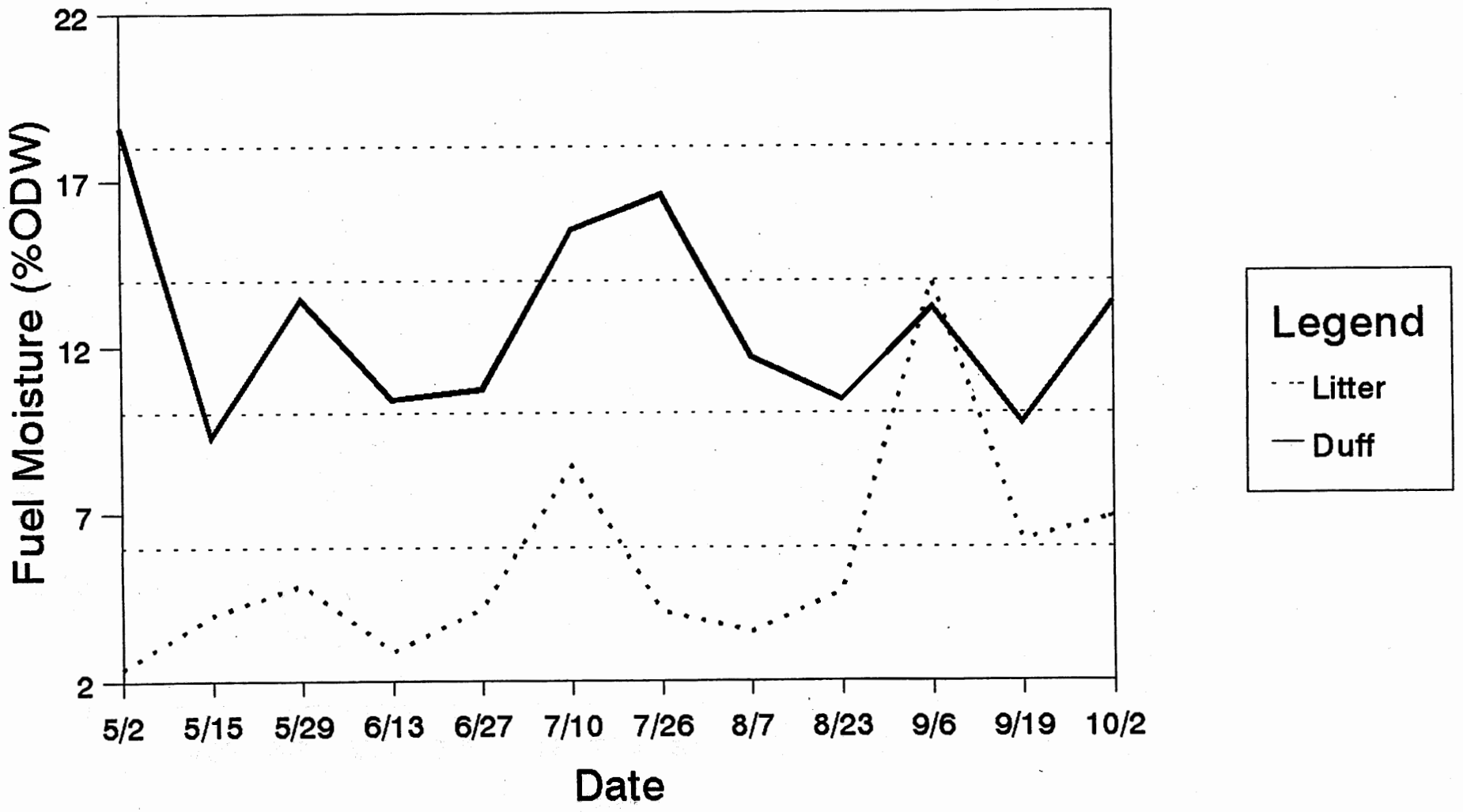


Bright Angel, Lindberg, and N.R. Tower Sampling Stations
PIPO=Ponderosa pine, ABCO=White fir, PIEN=Englemann spruce
%ODW=Percent oven dry weight

Figure 7.

1996 South Rim Fuel Moisture Values

Litter and Duff

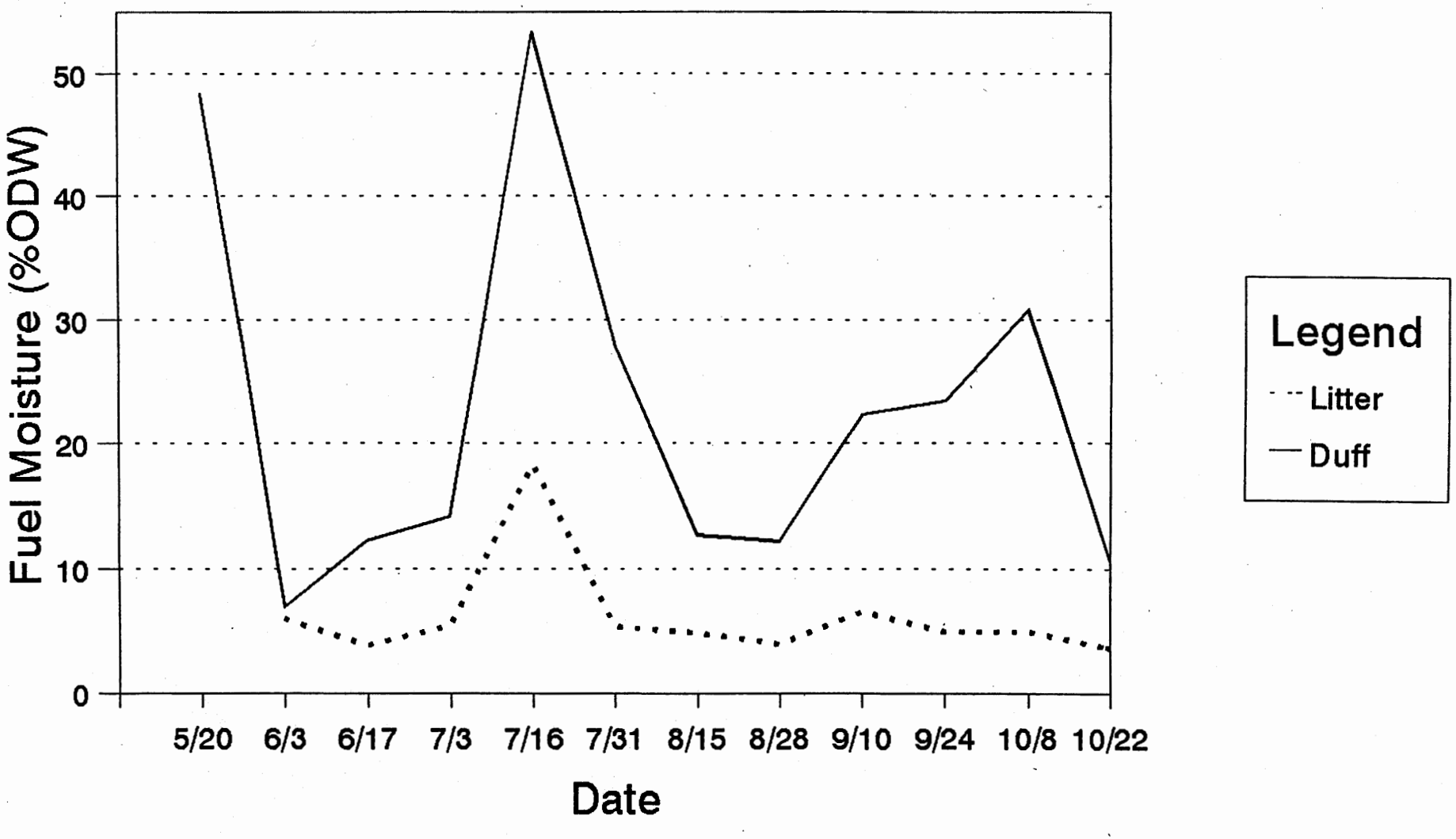


Long Jim Canyon Sampling Station
%ODW=Percent oven dry weight

Figure 8.

1996 North Rim Fuel Moisture Values

Litter and Duff



Bright Angel Sampling Station
%ODW=Percent oven dry weight

Preparation Work for Burn Units

Most prep-work was accomplished by the prescribed crew although they were assisted by several other crews at various times throughout the season. On the South Rim, prep-work was completed on the Watson III, Lonetree, and Moqui burn units; and on the North Rim, prep-work was completed on Tiyo I, Widforss I, and Transept. Work was done in accordance with protocols established in the burn plans. As 1996 was an extreme wildfire year, many of the prescribed crew members took active roles in suppression activities, both in and out of the park in addition to regular prescribed fire duties.

Future Crew Needs

With the overwhelming amount of burn unit prep-work on the North Rim, it is obvious that the prescribed crew should be larger. Whether it is more biological technicians or fuels technicians, a prescribed fire staff of five would be sufficient for next year on the North Rim.

The prescribed crew should remain on the same schedule on both Rims to facilitate project work for the entire crew. During prep-work, one prescribed person should be in charge and work in conjunction with the holding specialist to ensure one set of specifications is followed.

1996 Prescribed Fire Crew Activities

In addition to prescribed fire activities and wildfire suppression in Grand Canyon National Park, the entire crew was able to participate individually and as members of other crews on out of park assignments. Training opportunities were also readily taken advantage of. Task books were initiated and some even signed off and completed. All of these activities, assignments, and training were valuable as they increased the crew's fire experience and knowledge. The following summarizes the activities the crew participated in for the 1996 fire season.

Fire Training

S-130 FIRE FIGHTER TRAINING
Amy Bess

S-190 INTRODUCTION TO FIRE BEHAVIOR
Amy Bess

S-205 FIRE OPERATIONS IN THE URBAN INTERFACE
Mike Lewelling
Craig Letz

S-212 POWER SAWS
Kelley Corbett
Carl Helquist
Andy Thorstenson
Stacey Wickland
Brenda Zimpel

S-217 INTERAGENCY HELICOPTER TRAINING GUIDE
Elizabeth Miller
Andy Thorstenson

S-290 INTERMEDIATE FIRE BEHAVIOR
Andy Thorstenson
Stacey Wickland

RX-96 IGNITION SPECIALIST
Glenn Bartter
Mark Camisa
Tim Catlin
Mike Lewelling

*Note: all training listed above was offered by Grand Canyon National Park, except for S-205 and S-290, which were offered by Grand Canyon Zone; Williams, AZ.

Grand Canyon Wilderness Workshop

Workshop to provide Park staff with a working knowledge of wilderness policies and wilderness management techniques.
Kelley Corbett, Carl Helquist, Mike Lewelling, Craig Letz, Elizabeth Miller, Jim Schroeder, Andy Thorstenson, Stacey Wickland

Out of Park Assignments

White Springs Complex; White Mountains, Arizona; one week
Mike Lewelling, FFT2
Engine Crew: Western Great Basin; Winnemucca, NV; two weeks
Amy Bess, FFT2
Zion Prescribed Fire Support Module detail; Idaho, Montana; two weeks
Kelley Corbett, FFT2, RXCM, RXFM
Engine Crew: Level 4 Pre-Suppression; Grand Teton National Park, WY; three weeks
Carl Helquist, FFT1, ENGB(T)
Elizabeth Miller, FFT2
Andy Thorstenson, FFT2
Castle PNF Complex; Sequoia-Kings National Park, CA; three weeks
Tonja Carriere, HECM
ALPINE Hotshot Crew detail; Rocky Mountain National Park, CO; three weeks
Brenda Zimpel, FFT1
Kaweah, Reservoir, Marple Wildfires, CA; Castle PNF Complex, CA; three weeks
Stacey Wickland, HECM
Ackerson Complex; Yosemite National Park, CA; three weeks
Kelley Corbett, HECM
Mike Lewelling, HECM

North Rim Fire History Study

In order to properly utilize fire in forest management, the relationship between fire intensity and climatic conditions must be analyzed, as well as the correlation between fire and other disturbances. A study proposed by researchers from Northern Arizona University will help Grand Canyon Fire Management realize goals to restore the natural fire regime within the Park. This study has been an excellent opportunity for the Park's prescribed fire program and crew to work with NAU, an excellent neighboring resource.

A one-year study headed by Dr. Joy Nystrom Mast, Assistant Professor, and Joy Wolf, a masters student in the Department of Geography and Public Planning, College of Ecosystem Science and Management at Northern Arizona University, was designed to determine the fire history and forest dynamics in the mixed-conifer zone in the Walhalla Plateau region. The Walhalla Plateau, a designated natural fire and prescribed natural fire area, was selected in consultation with the Park's prescribed fire specialist, botanist, and wildlife expert. Dr. Mast, Joy Wolf, Jesse Duhnkrack, and the prescribed fire crew combined talents and efforts to install plots and collect the necessary data for successful completion of this study.

Data obtained from this study will incorporate fire history, forest ecology, and vegetative dynamics on the Walhalla Plateau. This study includes spatial and temporal analysis of species composition and densities, changes in the physical environment, and impacts of human land use on the forest landscape.

Unlike the South Rim ecotone of the Park, there has been little research on the North Rim ecotone, especially in the mixed-conifer forest areas. Vegetation on the North Rim consists primarily of mixed-conifer forests, dominated by *Pinus ponderosa*, *Pseudotsuga menziesii*, *Abies concolor*, *Abies lasiocarpa*, *Picea engelmanni*, and *Picea pungens*. Specific research questions include the following: (1) range of timing intervals between fires; (2) size, intensity, and seasonality of fires; (3) effects of past fires of forest vegetation; and (4) effects of fire suppression. To answer these and other research questions, dendrochronological analysis of fire scars will be completed with fire scars taken with a chainsaw. Preferably from *Pinus ponderosa* catfaces, the "best" fire scar is defined as a sample with multiple scars in sound wood and, where possible, from a dead stump or snag to prevent injuring live trees and to extend the fire chronology back in time.

In addition to fire scar sampling, permanent vegetation monitoring plots were established, following the National Park Service's Western Region Fire Monitoring Handbook guidelines (1992 edition). This allows these plots to be added to the current fire monitoring program. Along with standard monitoring plot specifications, all trees (live and dead) within each plot boundary had a non-destructive core sample taken by hand with increment borers for age structure analysis. Five of the fifteen plots were installed near the Basin region on the North Rim on the Tiyo I prescribed burn unit. This was necessary in order to obtain data from all relevant ecotones (specifically to include *Picea engelmanni* and *P. pungens*). Based on the fifteen permanent FMH plot locations, four fire scars per plot were sampled within a 100-meter circular radius from the

plot's origin for a total of 60 fire scar samples. GPS was used to record all plot origins and the majority of fire scar locations.

According to the study schedule, results will be presented to the National Park Service on or around June 30, 1997. Specific products and information to be provided to the park include the following:

(1) permanent FMH plot information
(2) fire history information, in the form of graphs and a statistical analysis report
(3) forest structure information, in the form of graphs and statistical analysis, plus tree-ring chronologies
(4) information will be submitted as a final report to the park, and as professional papers to be peer reviewed for journals

In addition to the Grand Canyon National Park, data obtained in this study will be presented either to the American Geographers National Meeting or the Ecological Society of America Meeting. Chronologies developed in this project will also be submitted to the International Tree-ring Data Bank to make this data readily available to other interested parties. The samples will be archived in coordination with the Park, the Museum of Northern Arizona, and Northern Arizona University. Future grant proposals will be submitted to continue this project on a broader scale.

The Grand Canyon prescribed fire crew devoted over 300 hours to help researchers carry out this study. During May and June, 26 days were utilized for plot installation, data collection, fire scar sampling, and GPS coordinate location (approximately 235 hours). FMH plot data was then entered into FMH files on the computer (approximately 70-80 hours). The Zion Prescribed Fire Support Module assisted for an entire day in May with plot installation and fire scar sampling.

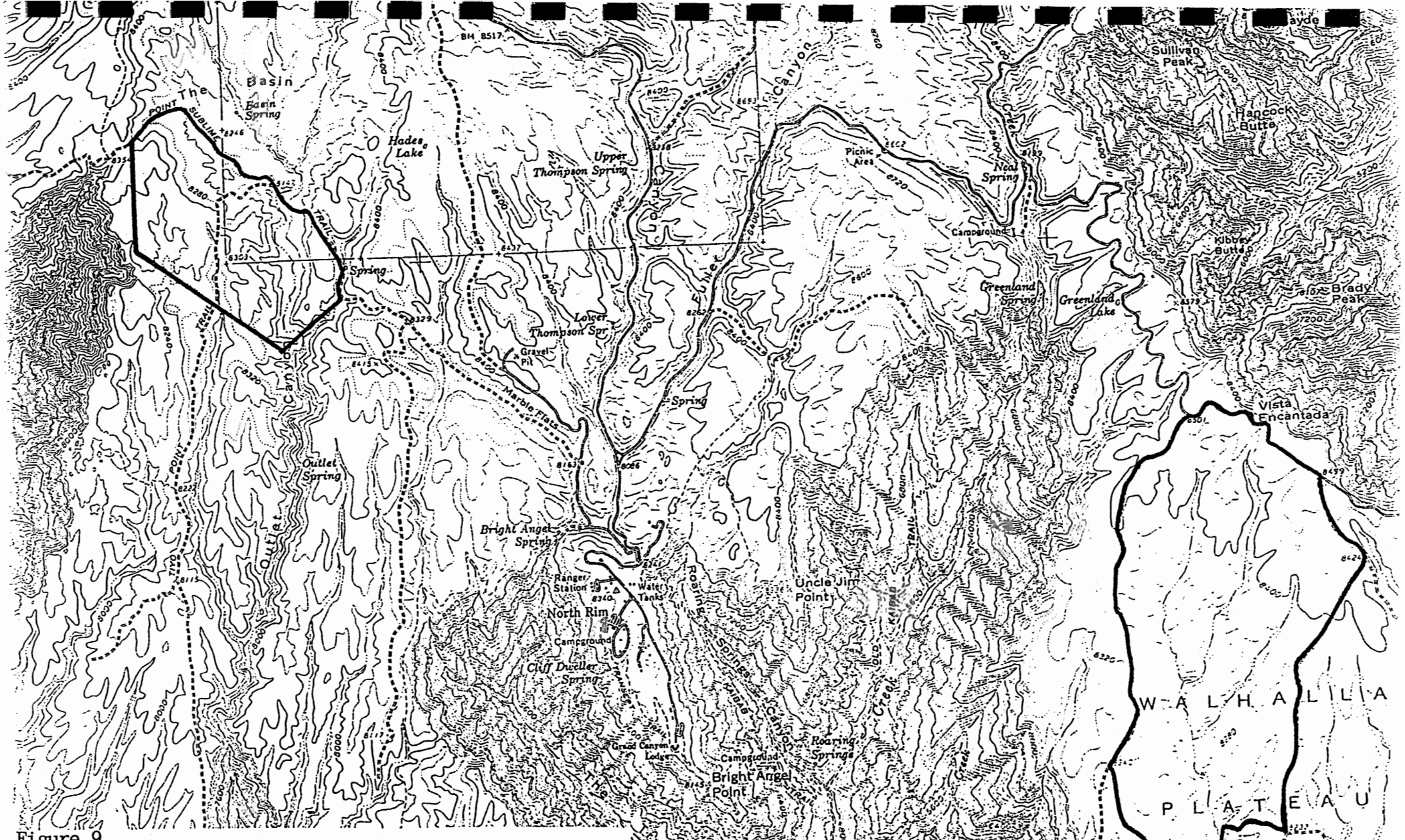


Figure 9.

NAU MIXED CONIFER FIRE HISTORY STUDY

BASIN AND WALHALLA UNITS

NORTH RIM GRAND CANYON NP

SCALE 1:62 500

Appendix A. Species Code List

Species Code List FMH Data - GRCA
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Code	Nat.	Perennial	Genus	Species	Subspecies	Variety	Common name
AASH1	--	--	*ASH				
ABCO1	Y	Y	Abies	concolor			White fir
ABLA1	Y	Y	Abies	lasiocarpa			Subalpine Fir
ACLA1	Y	Y	Achillea	lanulosa			Western Yarrow
ACMI1	Y	Y	Achillea	millefolium			
AGAR1	Y	Y	Agoseris	arizonica			Arizona Mountain dandel
ALMA1	N	N	Aletes	macdougali			MacDougal's Aletes
AMUT1	N	N	Amelanchier	utahensis			Utah Serviceberry
ANOC1	Y	N	Androsace	occidentalis			Western Rock Jasmine
ANPA1	Y	Y	Antennaria	parvifolia			Pussy-toes
ANRO1	Y	Y	Antennaria	rosulata			Pussytoes
ARAB1	Y	Y	Arenaria	aberrans			Sandwort
ARAC1	Y	Y	Arenaria	aculeata			Needleleaf sandwort
ARCA1	N	N	Arnica				
ARCA2	Y	Y	Artemisia	carruthii			
ARCO1	Y	Y	Arenaria	confusa			Sandwort
ARCO2	Y	Y	Arnica	cordifolia			Heartshaped Arnica
ARDR1	N	N	Artemisia	dracunculus		dragontongue sage or	false tarragon
ARFE1	Y	Y	Arabis	fendleri			Fendler rock cress
ARGR1	Y	Y	Arabis	gracilipes			Slender Rock Cress
ARPL1	Y	Y	Argemone	pleicanthta			Prickle poppy
ARPU1	N	Y	Arctostaphylos	pungens		Pointleaf manzanita	Manzanita
ARTR1	Y	Y	Artemisia	tridentata			Big sage
ARXX1	N	N	Arenaria	spp.			Sandwort
ASAR1	Y	Y	Aster	arenosus			aster
ASAS1	Y	Y	Asclepias	asperula	capricornu		Antelope Horns
ASCA1	Y	Y	Aster	canescens			Hoary Aster
ASHE1	--	--	*Ash				Ash
ASLE1	Y	Y	Astragalus	lentiginosus			Specklepod locoweed
ATCA1	Y	Y	Atriplex	canescens			Four-wing saltbush
BARE1	--	--	*Bare	ground			Bare Soil
BARK1	--	--	*Bark				Tree Bark
BAXX1	Y	N	Bahia	sp.			
BEFR1	Y	Y	Berberis	fremontii			Fremont barberry
BERE1	Y	Y	Berberis	repens			Creeping barberry
BOCU1	Y	Y	Bouteloua	curtipendula			
BOGR1	Y	Y	Bouteloua	gracilis			Blue gramma
BOLE1	--	--	*Bole of a	Tree			Tree Bole
BRAN1	Y	Y	Bromus	anomalus			Cheat grass
BRCI1	Y	Y	Bromus	ciliatus			
BRFE1	N	N	Bracken	fern			
BRFR1	Y	Y	Bromus	frondosus			Brome, North Rim
BRRU1	N	N	Bromus	rubens			
BRTE1	N	N	Bromus	tectorum			Cheat Grass
BRXX1	Y	N	Bromus	spp.			
CAAM1	Y	Y	Calachortus	ambiguus			Arizona Mariposa lily
CAFL1	Y	Y	Calochortus	flexuosus			Weakstem mariposa
CAIN1	Y	Y	Castilleja	integra			Southwestern paint brus
CALA1	Y	Y	Calylophus	lavandulifolius			Evening Primrose
CANU1	Y	Y	Calachortus	nuttallii			Sego lily
CARO1	Y	Y	Carex	rossii			Carex rossii
CASI1	Y	Y	Carex	siccatta			Sedge,grows individualy
CASP1	Y	Y	Carex	(species)			Sedge

CASP2	Y	Y	carex	spp.	
CAXX1	Y	Y	Carex	spp.	Sedge
CAXX3	Y	Y	carex	xx	sedge
CEFE1	Y	Y	Ceanothus	fendleri	Fendler Buckbrush
CELE1	Y	Y	Cercocarpus	ledifolius	Curlleaf Mt-mahogany
CHMI1	Y	Y	Chamaebatiaria	millefolium	Fernbrush
CHNA1	Y	Y	Chrysothamnus	nauseosus	Rabbitbrush
CHUM1	Y	N	Chimaphila	umbellata	
CIBU1	N	N	Cirsium	vulgare	Bull Thistle

Continued

Species Code List FMH Data - GRCA
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Code	Nat.	Perennial	Genus	Species	Subspecies	Variety	Common name
CIUN1	Y	Y	Cirsium	undulatum			Wavyleaf Thistle
CIVU1	N	N	Cirsium	vulgare			Bull Thistle
CIWH1	Y	N	Cirsium	wheeleri			Thistle
CIXX1	N	N	Cirsium	spp.			Thistle
CLHI1	Y	Y	Clematis	hirutissima			Leather flower
CLSE1	Y	Y	Cleome	serrulata			Rocky Mountain Beeplant
COAR1	Y	Y	Convolvulus	arvensis			field bindweed
COLI1	Y	N	Collomia-like	annual			Unnknown Forb
COME1	Y	Y	Cowania	mexicana			Cliffrose
COPA1	Y	N	Colinsia	parvifolia			blue eyed mary
COVI1	Y	Y	Corypantha	vivpara		arizonica	Arizona Beehive
CRSE1	Y	Y	Cryptantha	setosissima			
CRYP1	Y	Y	Cryptogammic	soil			
CXXX1	N	Y	Unknown	Composite	PIED11 PIPO6		
DENE1	Y	Y	Delphinium	nelsonii			larkspur
DEPI1	Y	N	Descuraiana	pinnata			Yellow Tansy Mustard
DUFF1	--	--	*Duff				Duff
ERCA1	Y	N	Erigeron	canus			
ERCI1	N	N	Erodium	cicutarium			Redstem storksbill
ERDI1	Y	Y	Erigeron	divergens			Spreading fleabane
EREA1	Y	Y	Erigeron	eatoni			
ERFL1	Y	Y	Erigeron	flagellaris			Trailing Fleabane
ERFO1	Y	Y	Erigeron	formosissimus			
ERMO1	Y	Y	Erigeron	modestus			Plains daisy
ERRA1	Y	Y	Eriogonum	racemosum			Redroot buckwheat
ERSP3	Y	Y	Erigonium	unknown			Buckwheat
ERUM1	N	Y	Eriogonum	umbellatum			sulphur flower
ERXX1	Y	Y	Eriogonum	spp.			
EUAL1	Y	Y	Euphorbia	albomarginata			
EUFE1	Y	Y	Euphorbia	fendleri			Fendler spurge
FAPA1	Y	Y	Fallugia	paraqdoxa			Apache plume
FERU1	Y	Y	Fendlera	rupicola			False mockorange
FRAT1	Y	Y	Fritillaria	atropurpurea			Fritillary
FROV1	Y	Y	Fragaria	ovalis			Strawberry
GADI1	Y	N	Gayophytum	diffusa			
GAPH1	Y	Y	Gayophytum	spp.			
GAPI1	Y	Y	Gaillardia	pinnatifida			Blanketflower
GARA1	Y	N	Gayophytum	ramosissimum			
GERI1	Y	Y	Geranium	richardsonii			White Cranesbill
GIFL1	Y	N	Gilia	flavocincta		same as G.tenuiflora	
GIOP1	Y	N	Gilia	ophthalmoides			
GRAP1	Y	Y	Grindelia	aphanactis			Rayless gumweed
GRAS1	Y	Y	Unknown Grass				
GRXX1	N	N	Unknown	grass	PIPO15		
GUSA1	Y	Y	Gutierrezia	sarothrae			Broom snakeweed
HEDR1	N	Y	Hedeoma	drummondii			Mock Pennyroyal
HEVI1	Y	Y	Heterotheca	villosa			Hairy golden aster
HYAC1	Y	Y	Hymenoxys	acaulis			Bitterweed
HYFI1	Y	Y	Hymenopappus	filiflius			Fineleaf woolywhite
IPAG1	Y	Y	Ipomopsis	aggregata			Arizonia Gilia
IPMU1	Y	Y	Ipomopsis	multiflora			Many-flowered gilia
JUCO1	Y	Y	Juniperus	communis		depressa	Common Juniper
JUOS1	Y	Y	Juniperus	osteosperma			Utah juniper

KOCR1	Y	Y	Koeleria	cristata			June Grass
KONI1	Y	Y	Koeleria	nitida		same as K.cristata	June grass
LAAR1	Y	Y	Lathyrus	arizonicus			Peavine
LAEU1	Y	Y	Lathyrus	brachycalyx	eucosmos		Pea
LALA1	Y	Y	Lathyrus	lanzwertii		arizonicus	peavine
LEAR1	Y	Y	Lesquerella	arizonica			Arizona bladderpod
LECA1	Y	Y	Leptodactylon	californicum			
LEER1	Y	Y	Leucelene	ericoides			White Aster
LEIN1	Y	Y	Lesquerella	intermedia			Bladderpod

Continued

Species Code List FMH Data - GRCA
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Code	Nat.	Perennial	Genus	Species	Subspecies	Variety	Common name
LEPU1	Y	Y	Lesquerella	purpurea			Purple bladderpod
LICH1	Y	Y	Crustose	Lichen		flat, cling to rock	Crustose Lichen
LICH2	Y	Y	Foliose	Lichen		leafy, cabbagelike	Foliose Lichen
LICH3	Y	Y	Fruticose	Lichen		hanging, stringy	Fruitcose Lichen
LIIN1	Y	Y	Lithospermum	incisum			Narrowleaf gromwell
LILE1	Y	Y	Linum	lewisii			Blue flax
LIPO1	Y	Y	Ligusticum	porteri			
LITE1	Y	Y	Lithophragma	tenellum			Woodland star
LITT1	--	--	*Litter				
LOFO1	Y	Y	Lomatium	foenicuaceum	macdougalii		
LOLE1	Y	Y	Lomatium	bicolor	leptocarpum		Biscuit root
LOMA1	Y	Y	Lomatium	foenicuaceum	macdougalii		
LOUT1	Y	Y	Lotus	utahensis			Utah deervetch
LUHI1	Y	Y	Lupinus	hillii			Lupine
LUKI1	Y	N	Lupinus	kingii			
LUPA1	Y	Y	Lupinus	palmeri			Palmer Lupine
LUPU1	Y	Y	Lupinus	pusillus			Dwarf lupine
MAVU1	N	Y	Marrubium	vulgare			Horehound
MEOF1	N	N	Melilotus	officinalis			Yellow sweet clover
MIGR1	Y	N	Microsteris	gracilis			Little White Phlox
MOSS1	Y	Y	Star-like	Moss			
NITR1	Y	Y	Nicotiana	trigonophylla			Desert tobacco
NONE1	N	N	No	Brush			Brush not present
OECA1	Y	N	Oenothera	caespitosa		marginata	white evening primrose
OPBA1	Y	Y	Opuntia	basilaria			
OPSP1	Y	Y	Opuntia	spp.			
ORHY1	Y	Y	Oryzopsis	hymenoides			
ORPU1	Y	N	Orhtocarpus	purpureo-albus			Purple owl cover
PAMY1	Y	Y	Pachystima	myrsinites			Mountain Lover
PARS1	N	N	parsley				unknown parsley
PECA1	N	N	Petrophytum	caespitosum			Rockmat
PECE1	Y	Y	Pedicularis	centranthera			Wood betony
PEEA1	Y	Y	Penstemon	eatonii			Eaton's firecracker
PELI1	Y	Y	Penstemon	linarioides			Toadflax Penstemon
PEPA1	Y	Y	Penstemon	pachyphyllus			Thickleaf Penstemon
PHAU1	Y	Y	Phlox	austromontana			Desert mountain phlox
PHDI1	Y	Y	Phlox	diffusa			Spreading phlox
PHLO1	Y	Y	Phlox	longifolia			Longleaf phlox
PHXX1	Y	Y	phlox	xx			phlox
PIED1	Y	Y	Pinus	edulis			Pinyon pine
PIEN1	Y	Y	Picea	engelmanni			Engelman Spruce
PIPN1	Y	Y	Pinus	ponderosa			N. Rim veg. designator
PIPN2	Y	Y	Pinus	ponderosa			N. Rim veg. NAU fire st
PIPN4	Y	Y	Pinus	ponderosa			North Rim Monitor Type
PIPO1	Y	Y	Pinus	ponderosa			Ponderosa pine
PIPU1	Y	Y	Picea	pungens			Blue Spruce
POAR1	Y	Y	Potentilla	arguta			Cinquefoil
POBI1	Y	N	Potentilla	biennis			cinquefoil
POFE1	Y	Y	Poa	fendleriana			Mutton grass
POPR1	Y	Y	Poa	pratensis			
POTR1	Y	Y	Populus	tremuloides			quaking aspen
POXX1	N	Y	Poa	spp.			
PSME1	Y	Y	Pseudotsuga	menziesii			Douglas fir

PTAQ1	Y	Y	Pteridium	aquilinum	bracken fern
PYPI1	Y	Y	Pyrola	picta	wintergreen
QUGA1	Y	Y	Quercus	gambelii	Gambel oak
RHTR1	Y	Y	Rhus	trilobata	Squawbrush
RICE1	Y	Y	Ribes	cereum	Wax currant
RIIN1	Y	Y	Ribes	inebrian	Wax currant
ROAR1	Y	Y	Rosa	Arizonica	Arizona Rose
ROCK1	--	--	*Rock		Rock
RONE1	Y	Y	Robinia	neomexicana	New Mexican locust

Continued

Species Code List FMH Data - GRCA
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Code	Nat.	Perennial	Genus	Species	Subspecies	Variety	Common name
SAAE1	N	N	Salvia	aethiopsis			Mediterranian sage
SARH1	Y	Y	Saxifragia	rhomboidea			
SCAT1	--	--	*Scat				
SEDO1	Y	Y	Senecio	douglasii		monoensis	Groundsel
SEFE1	Y	Y	Senecio	fendleri			Fendler's butterweed
SEMA1	Y	Y	Senecio	macdougalii			
SEMU1	Y	Y	Senecio	multilobatus			Butterweed
SEWE1	Y	Y	Senecio	Werneriaefolius			
SIHY1	Y	Y	Sitanion	hystrix			Squirreltail
SOCA1	Y	N	Solidago	canadensis			
SOSP1	Y	Y	Solidago	sparsiflora			
SOXX1	Y	Y	Solidago	sp			
SPFE1	Y	Y	Sphaeralcia	fendleri			Fendler Globe Mallow
SPGR1	Y	Y	Sphaeralcea	grossulariaefolia			Gooseberryleaf globe ma
SPPA1	Y	Y	Spaeralcia	parvifolia			Littleleaf globe mallow
STGO1	Y	Y	Stellaria	gonomischa			Chickweed
STJA1	Y	Y	Stellaria	jamesiana			Tuber Starwort
STXX1	Y	Y	Stipa	spp.			Unknown Stipa
SWAL1	Y	Y	Swertia	albomarginata			Green gentian
SWRA1	Y	Y	Swertia	radiata			Deers Ears, Green Genti
SYLO1	Y	Y	Symphoricarpos	longiflorus			snowberry
SYOR1	Y	Y	Symphoricarpos	oreophilus			
TAOF1	Y	N	Taraxacum	officinale			Common Dandelion
TECA1	Y	Y	Tetradyma	camescens			Spineless horsebrush
THFE1	Y	Y	Thlaspi	fendleri			Fendler's pennycress
THFE2	Y	Y	Thalictrum	fendleri			Meadow rue
THLI1	Y	N	Thelypodiopsis	linearfolia			
TOEX1	Y	N	Townsendia	exscapa			Stemless townsendia
TRBI1	Y	N	Trifolium	Bicolor			
TRDU1	Y	Y	Tragopogon	dubius			Goatsbeard or Salsify
TRGY1	Y	Y	Trifolium	gymnocarpon	gymnocarpon		Clover
UNAN1	N	N	Unknown	annual			
UNCO9	N	Y	unknown	composite	andy pipo 15		
UNCR1	N	N	Unknown	Crucifrae			
UNGR1	N	N	Unknown	Grass	FPIEN1D0902		SILVERSTONE
UNGR2	N	N	unknown	grass	likely koni		
UNGR3	N	N	unknown	grass	large ligule		sample collected
UNGR4	N	N	unkown	grass			
UNKW1	N	N	UNKNOWN				PIPN2 7 6/2/96Q4-Q1 43.
UNKW6	--	--				TO VERIFY	Helquist/Zimpel/Klasset
UNKW7	--	--				TO VERIFY	Helquist/Zimpel/Klasset
UNKW8	N	N	UNKNOWN	PLANT			
UNKW9	N	N	UNKNOWN	PLANT			
UNTH1	N	N	unknown	thistle			
UNTH2	N	N	unknown	thisle			
UNUM1	Y	N	unknown	umbeliferae		ask Andy	
UNXX1	N	N	UNKNOWN	PLANT		PIPO15	
VEMA1	Y	N	Verbena	macdougalii			Tall verbena
VETH1	Y	Y	Verbascum	thapsus			Wooly mullien
WOOD1	--	--	*Downed Woody	Litter			
YUAN1	Y	Y	Yucca	angustissima			Fine-leaf yucca
YUBA1	Y	Y	Yucca	bacatta			Bannana yucca