DRAFT

Pawnee Montane Skipper Post-fire Habitat Assessment Survey - September 2005

Prepared For

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1.0 INTRODUCTION

The Hayman and Schoonover forest fires burned across a large fraction of the historical habitat of the Pawnee montane skipper butterfly (*Hesperia leonardus montana*) during the summer of 2002 in Jefferson and Douglas counties, Colorado. These fires burned approximately 40% of the Pawnee montane skipper's known habitat from southeast of Cheesman Reservoir, north around both sides of the reservoir, continuing north along the west side of the South Platte river to Oxyoke, and south of Deckers along Horse Creek for approximately six miles. The U.S. Forest Service (USFS), the U.S. Fish and Wildlife Service (USFWS), and Denver Water funded a post-fire habitat monitoring study within the range of this listed Threatened species to make an initial estimate of the post-fire habitat effects and to detect presence of skippers. The multi-agency team (USFS, USFWS, and Denver Water) conducted the sampling in mid-September 2002 (ENSR 2002).

In early September 2003, these same transects were again sampled by the multi-agency team to gauge the rate of recovery of skipper populations and their habitats. To increase the temporal scope of these post-fire habitat surveys, new transects were established in 2003 in areas of skipper habitat burned by two earlier fires - the Buffalo Creek Fire of May 1996 and the High Meadow Fire of June 2000 (ENSR 2003).

A subset of the transects surveyed in 2003 were sampled in 2004 and again in 2005 to continue assessing the rate of recovery of skipper populations and their habitat within the four burn areas (Hayman, Schoonover, Buffalo Creek, and High Meadow).

In 2002, the South Platte River drainage received very little precipitation in fall, winter, and spring. This, along with the almost decade-long dry conditions of the area, provided an opportunity to study the influence that abnormally low precipitation levels have on Pawnee montane skipper habitat and populations. It is likely that the Pawnee montane skipper is adapted to both short- and longer-term droughts, but at small population sizes, like those exhibited by this threatened butterfly, stochastic abiotic factors such as fire and drought, can severely compromise population persistence and may lead to extinction. The current monitoring effort offers an opportunity to examine how capable, given its current population size, is the Pawnee montane skipper of withstanding the dual effects of both fire and drought.

2.0 PROJECT OBJECTIVES

This project was established to implement a monitoring program to document Pawnee montane skipper habitat condition and trends of population abundance, in both burned and unburned skipper habitat, on the Hayman and Schoonover fire areas in 2002 and subsequent years. Monitoring was expanded to the Buffalo Creek and High Meadow fire areas for monitoring in 2003 and subsequent years. Assessing the habitat requirements, trends in abundance, and the recolonization dynamics of Pawnee montane skippers into burned areas are important to understanding the conservation status of this butterfly over the entire extent of its known distribution within the South Platte River drainage, and are the purposes of this monitoring effort.

3.0 PROJECT AREA

For purposes of estimating fire-caused habitat reductions over the entire known range of the Pawnee montane skipper in the South Platte River drainage, the amount of skipper habitat burned by four recent past major fires (Buffalo Creek, High Meadow, Hayman, and Schoonover) were included in the project area (**Figure 3-1**). The Schoonover fire burned a small portion of Pawnee montane skipper habitat in 2002, and monitoring plots were placed within its boundary, and within adjacent suitable habitat burned by the Hayman Fire.

The USFS prepared a burn severity map for the Hayman Fire, based on interpretation of aerial photography and satellite imagery (USFS 2002). This burn severity map, combined with the map of occupied skipper habitat (**Figure 3-1**), was used to establish the 2002 sampling study area. The original geographical area of this study in 2002 encompassed the entirety of the Hayman Fire within the estimated suitable Pawnee montane skipper habitat, the global extent of which occurs in the South Platte River drainage, Jefferson, Douglas, Park, and Teller counties, Colorado. Sampling plots were randomly located within each of two sampling units within the project area. The north unit of sampling plots follows the South Platte drainage between the confluence of Wigwam Creek and the northern boundary of the Hayman Fire in the vicinity of Oxyoke (**Figure 3-2a**), and the south unit includes plots placed on both sides of Cheesman Reservoir and in the Horse Creek drainage southeast of Deckers (**Figure 3-2b**). Areas unburned by the Hayman fire within the South Platte drainage were sampled from Trumbull on the south, to Long Scraggy Peak on the north (**Figure 3-2a**).

In 2003, new transects were added to this post fire study to assess the level of recovery of skipper habitat and skipper populations in the Buffalo Creek Fire area (**Figure 3-3**) and the High Meadow Fire area (**Figure 3-4**) that burned in 1996 and 2000, respectively. Each of these two areas experienced low severity burns and are similar in forest structure to the Hayman low severity burn areas of 2002. Comparisons among low severity burn sites differing in the length of time since burning (Buffalo Creek 1996, High Meadow 2000, and Hayman 2002) were possible with the addition of transects in these two areas.

Figure 3-1. Skipper Habitat burned by major fire since 1996. Wildfire areas (1996-2002) and skipper habitat.

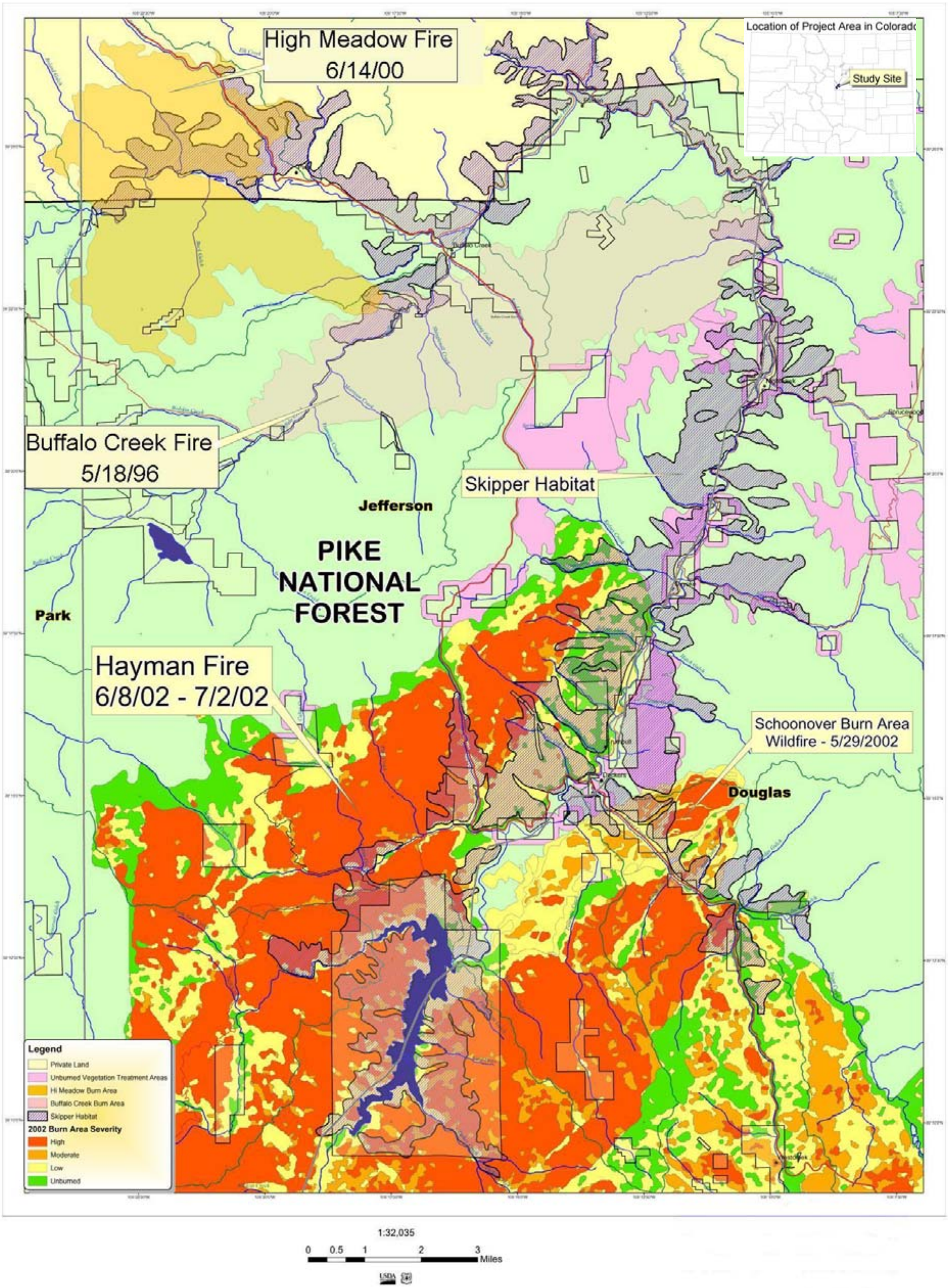


Figure 3-2a. Pawnee montane skipper post-fire habitat monitoring study, north sampling unit.

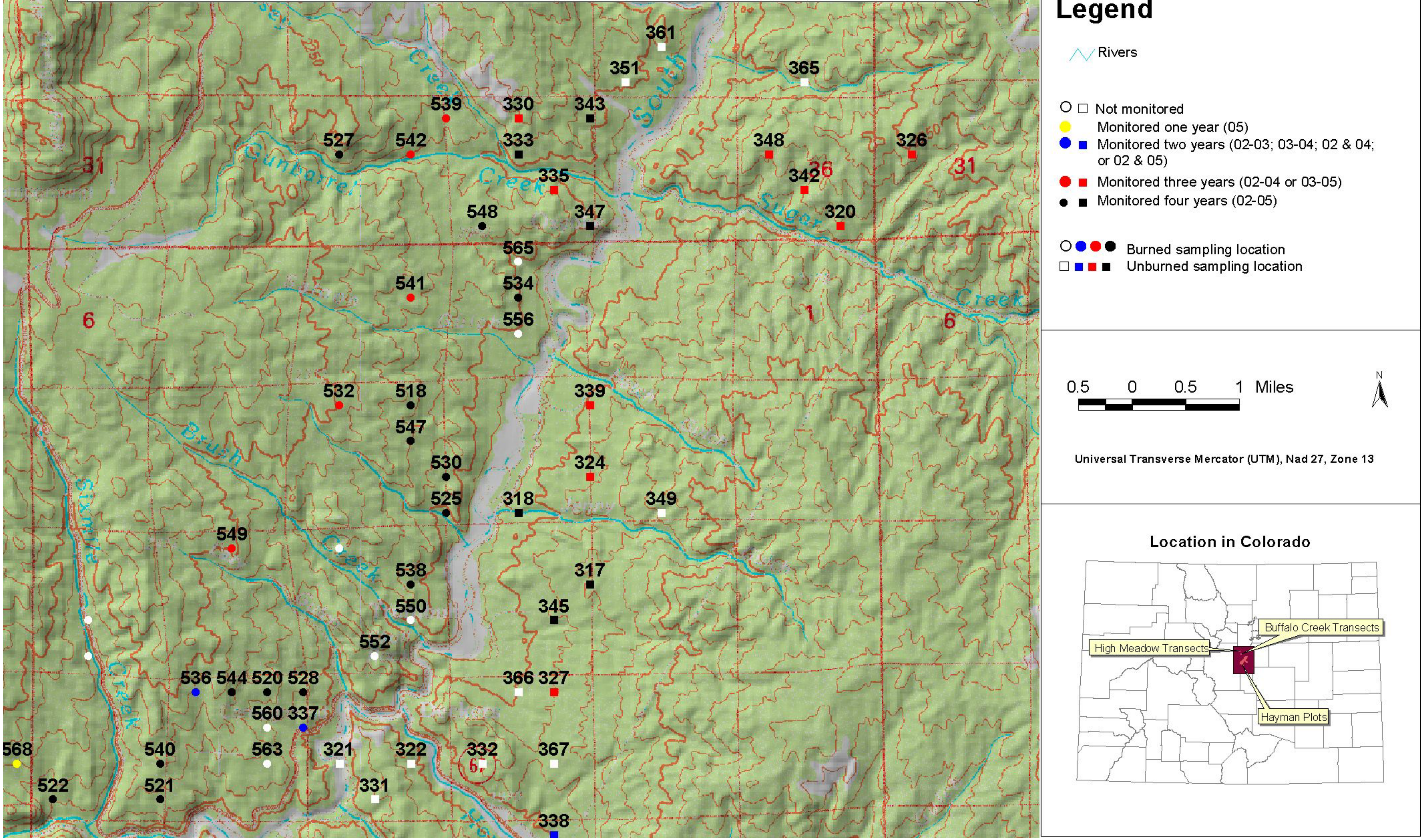
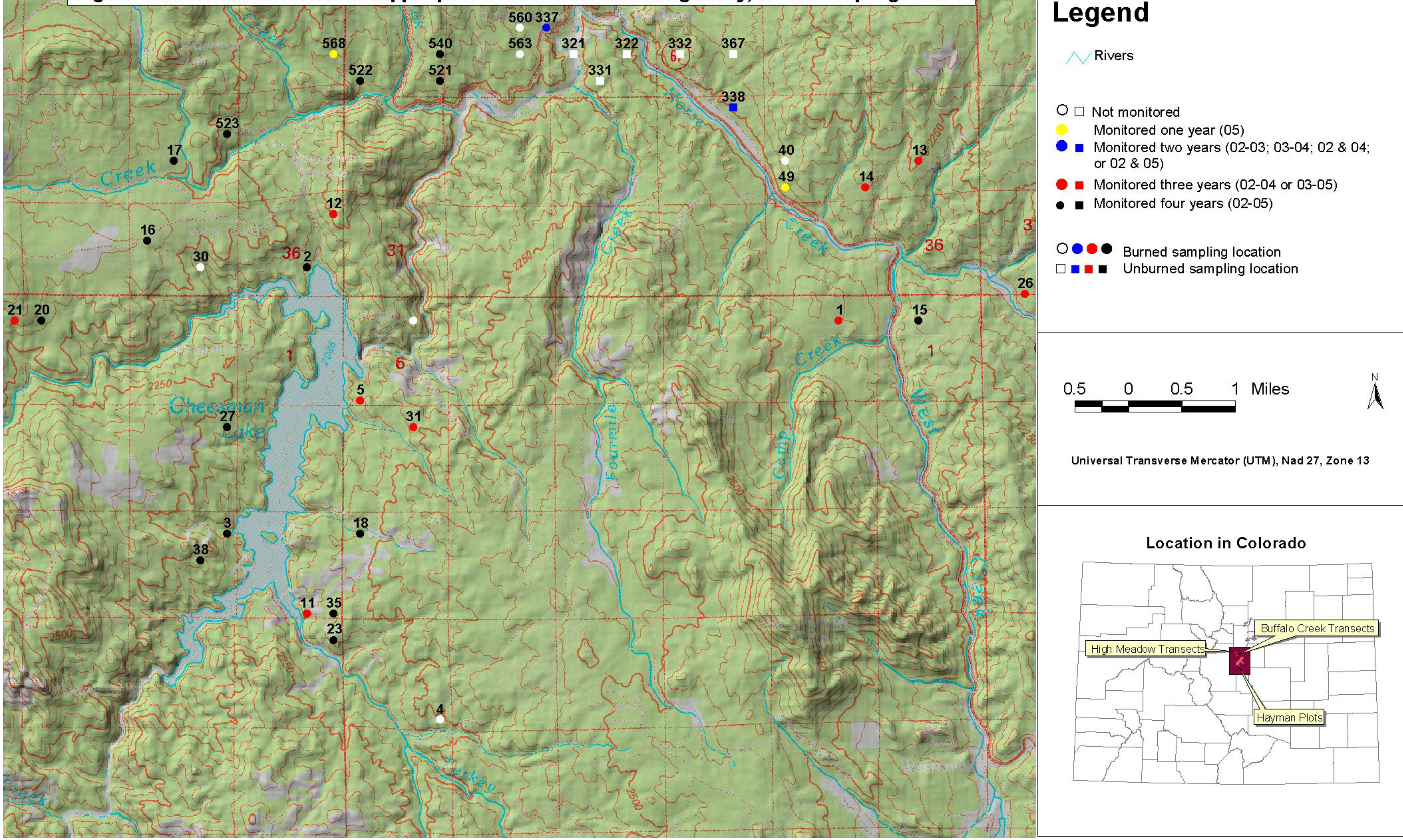


Figure 3-2b. Pawnee montane skipper post-fire habitat monitoring study, south sampling unit.



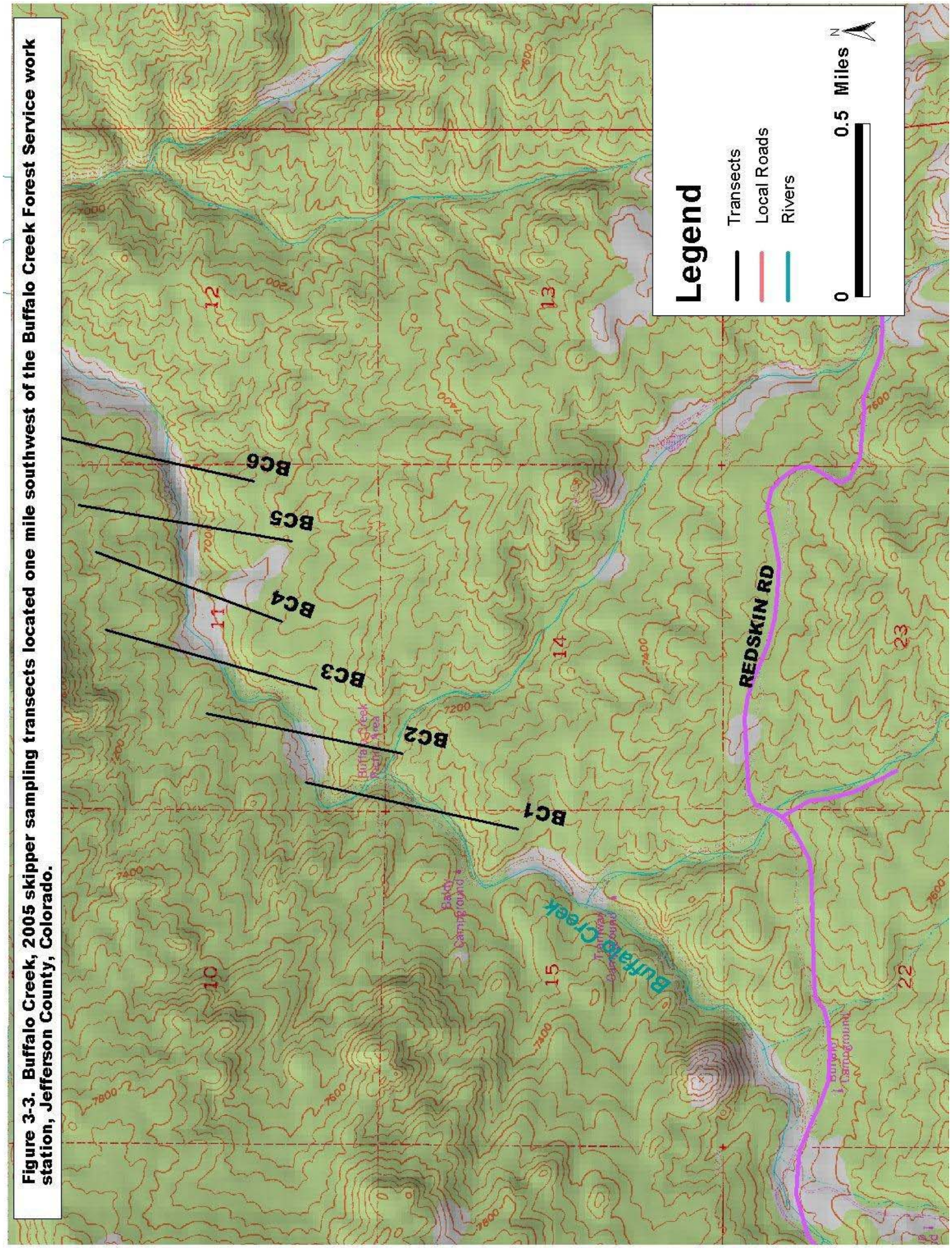
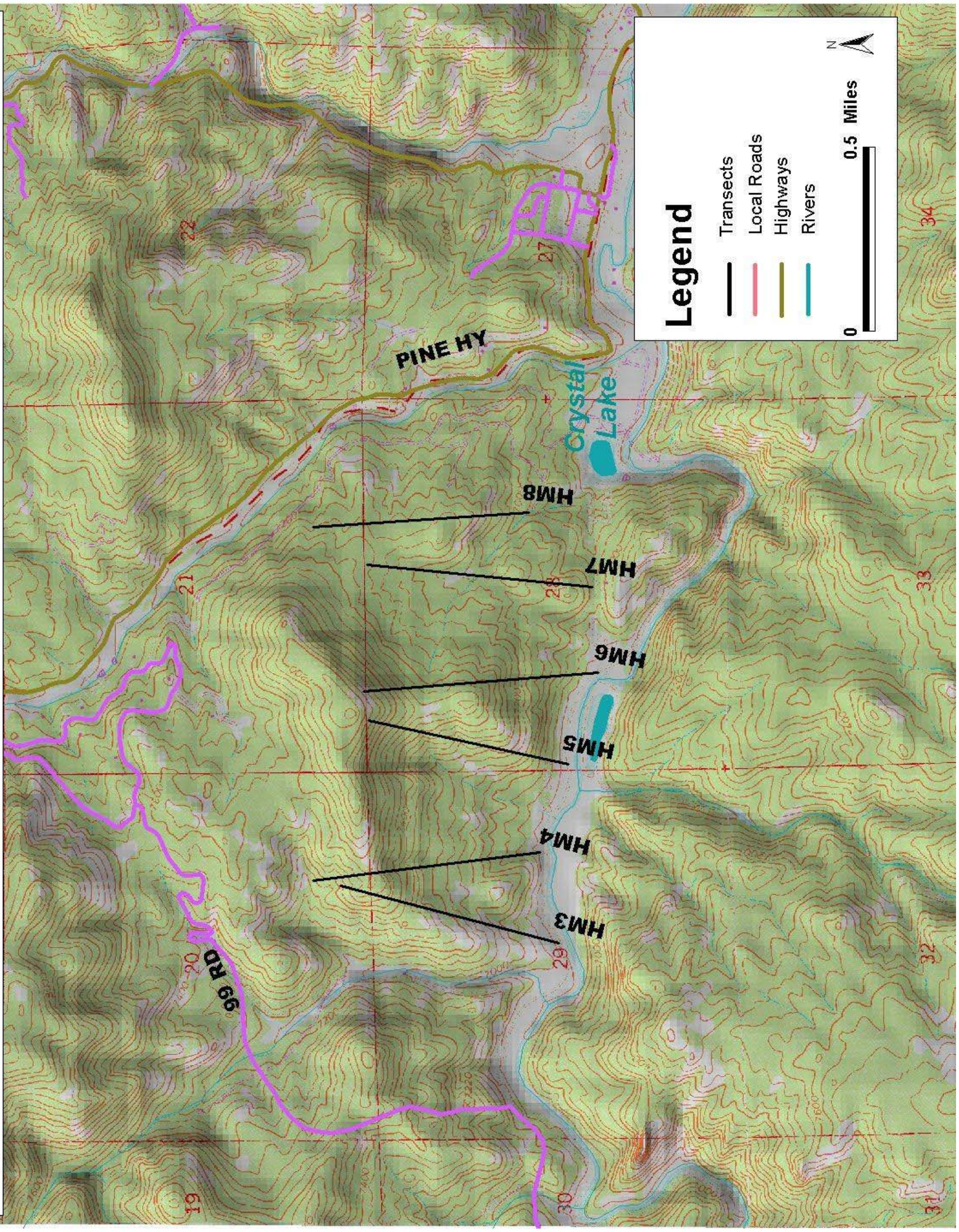


Figure 3-3. Buffalo Creek, 2005 skipper sampling transects located one mile southwest of the Buffalo Creek Forest Service work station, Jefferson County, Colorado.

Figure 3-4. High Meadow Fire, 2005 skipper sampling transects located at Pine Valley Ranch Park, Jefferson County, Colorado.



4.0 FIELD DATA COLLECTED AND PROJECT OUTPUTS

1. Measured in the monitoring effort were a) an estimate of skipper numbers based on belt transect counts; b) an estimate of the number of blooming *Liatris* stems (primary adult skipper nectar source); c) the frequency of blue grama grass clumps (skipper larval foodplant); d) living and dead trees in larger size classes (>6" DBH) within burned and unburned areas; and e) records of BAER treatments (surface stabilization activities such as scarification) observed on transects. Measurement of these parameters was not consistent across years (**Table 4-1**).

2. Photographic records were made of each transect sampled, and transect location coordinates (universal transverse mercator [UTM]) were recorded with Global Positioning System (GPS) instruments.

3. Currently suitable skipper habitat in the upper South Platte drainage was recalculated based on these field studies and interpretation of post-fire satellite imagery.

4. Assessments were made of habitat recovery and factors influencing skipper reoccupation of burned habitat in areas that experienced different burn intensities and fire intervals.

Table 4-1. Parameters measured during the post-fire monitoring project (2002 to 2005).

	Year of collection			
Parameter	**2002**	**2003**	**2004**	**2005**
Estimate of skipper numbers	Yes	Yes	Yes	Yes
Estimate of blooming *Liatris* stems	Yes	Yes	Yes	Yes
Frequency of blue grama grass clumps	Yes	Yes	Yes	Yes
Living trees	Yes	Yes	Yes	Yes
Standing dead trees[1]	--	Yes	Yes	Yes
BAER treatments[2]	Yes	Yes	--	--

[1]New to the 2003 sampling effort and continued through 2005 was a census of standing dead trees in the same larger size class used for live trees, as a means of better characterizing the forest structure of skipper habitat.
[2]Dropped from the 2004 and later field studies were recording of BAER treatments observed on transects.

5.0 PROJECT DESIGN AND SAMPLING METHODS

5.1 Sampling Area Dimensions and Selection

The field sampling methods used from 2002 to 2005 are similar to those used for rapid assessment sampling of skipper habitat and occurrence developed for the 1986 Two Forks Dam field study program (Environmental Research and Technology [ERT] 1986).

The unit of sampling was a 40-acre habitat block within estimated suitable skipper habitat. The study area was divided into a grid of 40-acre blocks in Geographic Information System (GIS). A unique number was then assigned to each 40-acre unit within the grid. An overlay of the fire intensity maps (Hayman and Schoonover) was placed over the grid to establish the boundaries of burned versus unburned areas. Then the skipper habitat suitability map layer was placed over the burn map to establish the location of burned versus unburned skipper habitat. The grid numbers that corresponded to locations within suitable skipper habitat (burned and unburned) were selected as a subset of the total grid. These grid numbers were reordered through a randomization routine in Microsoft Excel. The randomized 40-acre units were then listed as a sampling order for three subareas: 1) Cheesman Reservoir and Horse Creek; 2) burned areas between Cheesman Reservoir and the northern boundary of the Hayman Fire; and 3) unburned areas from the vicinity of Deckers northward to the northern boundary of the Hayman Fire. Eliminating blocks that were predominantly on private lands, and blocks where estimated habitat was less than 75 percent of the block further reduced potential sampling areas.

In each 40-acre block selected for sampling, a sub-sample was taken that consisted of an 800-meter (m) belt transect with four segments forming a diamond 200 m to a side. The survey area width for each belt transect was 10 m (5 m on either side of the transect center line). Fifty-three transects were sampled between August 29, and September 8, 2005 (**Figure 5-1**). Of this number, 15 were located in unburned areas, 19 were located in low severity burn areas, and 19 were located in moderate to high severity burned areas (see Appendix B for dates of sampling). Transects sampled in 2002, 2003, and/or 2004 that were not re-sampled in 2005, included transects 338 (an unburned plot); and 12, 13, 14, 26, 337, and 536 (all low severity burn plots). In addition, two plots never before sampled were added in 2005, 49 and 568 (both moderate-to-high severity burn plots).

The transects at the Buffalo Creek Fire (1996) are located on either side of South Buffalo Creek and Forest Road 543 about 1.2 miles southwest of the USFS Buffalo Creek Work Station on Highway 126. The High Meadow Fire transects are on south-facing slopes just north of the North Fork of the South Platte River in Pine Valley Ranch Park (Jefferson County Open Space). The Buffalo Creek and High Meadow fires were moderate-to-high severity burns, but the full range of burn intensities was unavailable for these two fires in known skipper habitat. Monitored transects in these two burn areas were placed in known low severity burn areas. The Buffalo Creek and High Meadow plots are compared to Hayman low severity burn plots in the analyses that follow (see Section 8.0). These transects were established in 2003 and data were collected on them from 2003 to 2005. In each study area, six 1,000-m linear transects were established in

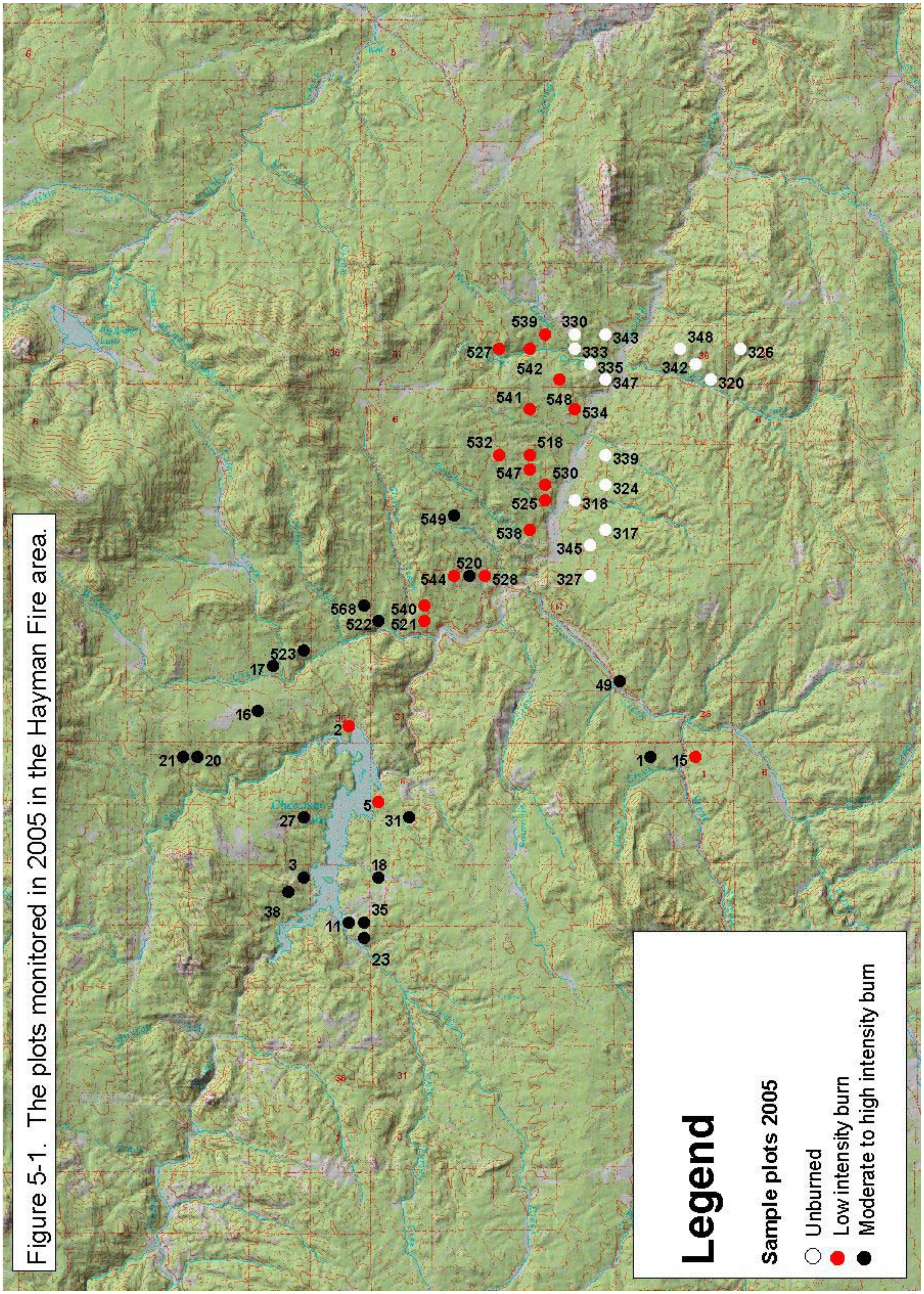


Figure 5-1. The plots monitored in 2005 in the Hayman Fire area.

parallel (**Figures 3-3** and **3-4**). The protocols for habitat assessment and skipper counts on these 12 new transects were the same as those used on the Hayman Fire transects, except that the transects were linear instead of diamond-shaped, and the total area surveyed was 2.5 acres (1,000 x 10 m) instead of 2 acres (800 x 10 m). These linear transects were divided into four legs of 250 m each, which in turn were subdivided into 10 segments of 25 m each for recording purposes. The data obtained were expressed as frequency data (for blue grama) and density per acre (for trees, gayfeather, and skippers), and were directly comparable to the Hayman plots.

5.2 Field Sampling Methods

A sampling protocol was provided to each sampling team to provide consistency in data collection (the protocol is attached as Appendix A). The following section outlines the methods for establishing transects and describes the parameters measured along each transect.

5.2.1 Sampling Site locations

The UTM coordinates for the center point of each 40-acre sampling plot were included on the sampling list in the protocol supplied to each field crew. Each team used a GPS instrument to find this center point, and then made a determination on how best to sample the habitat variation within the 40-acre block (i.e., a starting point was established at or near the center point of the block so that a diamond-shaped transect [200 m on a side] could be located within the designated 40-acre block). To complete the transect, an initial heading was established using a compass. The first 200-m leg was walked, and data were recorded for each of 10 20-m sub-segments along each 200-m transect leg. At the end of each 200-m leg, a 90-degree turn was made, and a new compass heading established. To walk each transect in a reasonable time frame, each 200-m leg of the transect was paced (each observer determined the number of paces needed to cover 200 m, based on the individual pace length of the observer). A GPS reading was taken at the beginning, and then at each 90-degree turning point along the transect. Digital photographs were taken forward and backward from each turning point along the axis of the transect (i.e., each 200-m segment was documented at both ends). The transect number and segment being photographed was indicated on a chalk or white board included in the foreground of each photograph.

5.2.2 Data Collection

The following section describes the information that was collected and compiled on the data sheet (**Figure 5-1**). All data were taken within the area of the belt transect (800 x 10 m) with the exception of other observations that were useful in analyzing habitat conditions. These other observations were written on the back of the data sheet.

- Observers, weather conditions, location. The following information was filled in at the top of the data sheet: sample block # from the sampling order table and the UTM coordinate of the starting point; observers; date and time of sampling; weather conditions (percent cloud cover), measured or estimated temperature, and wind speed (L [low] = none to taller grass in motion; M [medium] = leaves and limbs of flexible shrubs in motion; H [high] = limbs of larger trees in motion). The UTM coordinates for each corner of the diamond transect were recorded.

Figure 5-2. Distribution of *Bouteloua gracilis* (**Bogr**), *Liatris punctata* (**Lipu**), *Hesperia comma* (**Hco**), *Hesperia leonardus montana* (**Hlm**)

Observers: ______________________________ Sample Block # ________ Date: ____________

Weather: % Cloud Cover (0-100%): ______ Temperature: ________ Wind (√): Low ___ Medium ___ High ___ **GPS: NAD27 CONUS**

First 200m leg (A) | Photos (√): ☐ start ☐ finish | **Start time:** _____

Compass bearing: ______ | **End time:** _____

GPS Coordinates at start (UTM): ______________________________

Sample Segment	Trees >6" DBH		plants		skippers								
	# live	**# dead**	**Bogr**	**Lipu**	**Hlm**			**Hco**			**UNK**		
[illegible]					.:	?	?	.:	?	?	.:	?	?
0-20													
20-40													
40-60													
60-80													
80-100													
100-120													
120-140													
140-160													
160-180													
180-200													
[illegible]:	#	#	√	#	#	#	#	#	#	#	#	#	#

Second 200m leg (B) | Photos (√): ☐ start ☐ finish | **Start time:** _____

Compass bearing: ______ | **End time:** _____

GPS Coordinates at start (UTM): ______________________________

Sample Segment	Trees >6" DBH		plants		skippers								
	# live	**# dead**	**Bogr**	**Lipu**	**Hlm**			**Hco**			**UNK**		
[illegible]					.:	?	?	.:	?	?	.:	?	?
0-20													
20-40													
40-60													
60-80													
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140-160													
160-180													
180-200													
[illegible]:	#	#	√	#	#	#	#	#	#	#	#	#	#

Third 200m leg (C) | Photos (√): ☐ start ☐ finish | **Start time:** _____

Compass bearing: ______ | **End time:** _____

GPS Coordinates at start (UTM): ______________________________

Sample Segment	Trees >6" DBH		plants		skippers								
	# live	**# dead**	**Bogr**	**Lipu**	**Hlm**			**Hco**			**UNK**		
[illegible]					.:	?	?	.:	?	?	.:	?	?
0-20													
20-40													
40-60													
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180-200													
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Fourth 200m leg (D) | Photos (√): ☐ start ☐ finish | **Start time:** _____

Compass bearing: ______ | **End time:** _____

GPS Coordinates at start (UTM): ______________________________

Sample Segment	Trees >6" DBH		plants		skippers								
	# live	**# dead**	**Bogr**	**Lipu**	**Hlm**			**Hco**			**UNK**		
[illegible]					.:	?	?	.:	?	?	.:	?	?
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20-40													
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180-200													
[illegible]:	#	#	√	#	#	#	#	#	#	#	#	#	#

- BAER Treatments. If the transect intersects areas where surface stabilization activities were being undertaken, the type of activity (e.g., scarification), and the percentage of the 200-m segment that has been affected by these activities were indicated (recorded only in 2002 and 2003).

- Habitat measurements. The following data were collected in 20-m sub-segments along each 200-m leg of the overall transect:

  - Burn status. These data [percent of transect burned; type and amount of sprouting] were collected in 2002 and were not in subsequent years.

  - Tree counts. Live trees greater than 6 inches diameter at breast height (DBH) within the belt transect were counted to document the larger living trees along the transect in both burned and unburned areas. In 2002, the tree was scored as living if 25 percent or more of the needles remaining on the tree at the time of sampling were green. In subsequent years, a tree was scored as living if any green needles were present, regardless of the amount. Also from 2003 to 2005, dead standing trees greater than 6 inches DBH were counted and recorded in a separate category.

  - Blue grama (Bogr) frequency. The presence or absence of blue grama (*Bouteloua gracilis*) was documented within a visually estimated 0.5-m-square rectangular quadrant that extended 0.5 m on either side of the observer's toe, and 0.5 m in front of the toe at the endpoint of each 20-m interval along the transect (10 recordings per 200-m segment). The observer marked + or √ for presence, 0 for absence in the appropriate space on the data sheet.

  - Prairie gayfeather (*Liatris punctata*) (Lipu) stem counts. Stems of blooming Prairie gayfeather were counted in each 20-m segment within the 10-m wide survey area. Commonly there were multiple blooming stems emanating from the crown of an individual *Liatris* plant. Each stem was counted as a separate occurrence.

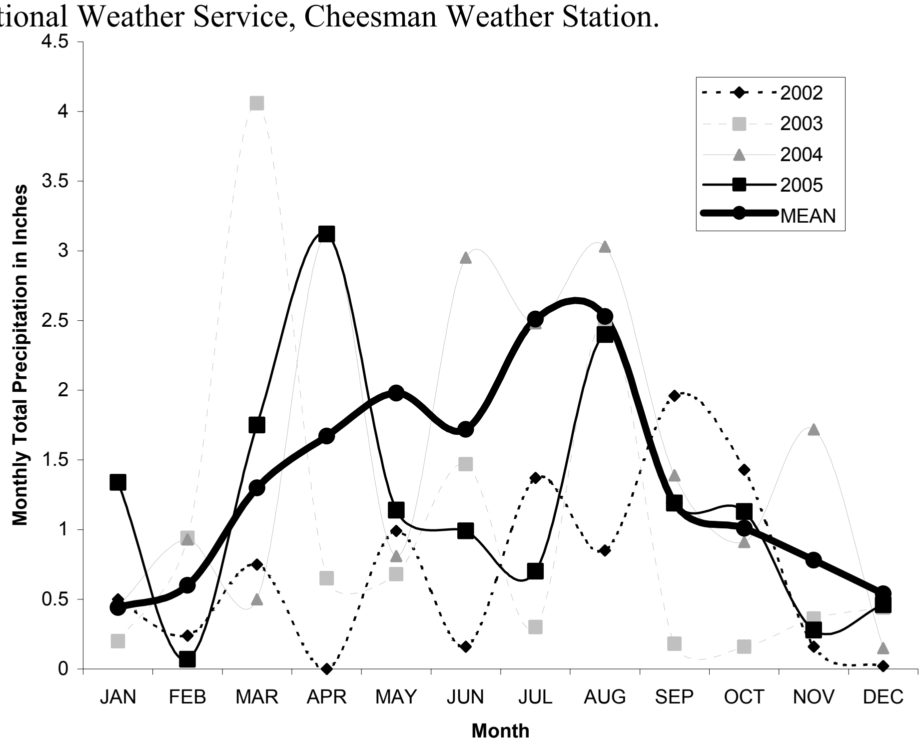
  - Adult skipper butterfly counts (Hlm and Hco). Individual skipper butterflies of either the common branded skipper (*Hesperia comma*) or the Pawnee montane skipper (*Hesperia leonardus montana*) were counted in each 20-m segment along the transect. The sex of the skipper was entered into the appropriate box (for each skipper species, male on left, female in the middle, and unknown on the right). If the skipper species was unknown, its occurrence was entered in the UNK box, and the sex (if it could be determined) was entered into the appropriate box. All skippers observed during transit between transects were recorded with GPS coordinates or notes on data sheets.

6.0 STUDY AREA CONDITIONS in 2005

In 2005, the study area continued a recovery initiated in 2004 from an extreme drought the South Platte ecosystem experienced during 2002 and 2003 (**Figure 6-1**). Accumulated precipitation for the water year (Oct. 2002 to Sept. 2003) at the U.S.G.S. National Weather Service's Cheesman Weather Station was the lowest ever recorded during the period of record keeping (1904 to 2005) (Colorado Climate Center 2005). In 2002 and 2003, nine and eight months, respectively, experienced rainfall below their 57-year mean, while 2004 experienced nine months and 2005 experienced seven months with precipitation near, or above, the 57-year monthly mean (**Figure 6-1**). During the spring of 2005 precipitation was above normal, but May through July experienced below normal precipitation, followed by cooler temperatures and increased rainfall in August and September. The abundant spring and late summer moisture in the South Platte valley produced an abundant cover of gayfeather and blue grama, the primary adult and larval foodplants, respectively, of the Pawnee montane skipper.

Skipper counts were conducted on August 29, 30, 31, and September 1, 2, 6, 7, and 8 from approximately 10 AM to 3 PM each day. Most surveys were conducted at temperatures ranging from approximately 65ºF to 84ºF. On four days, August 29, 30, and September 1 and 2 temperatures were approximately 90ºF for the last plots surveyed on those days. All plots were surveyed under low to medium wind conditions and most with cloud cover of less than 40 percent. On two days, September 7 and 8, surveys were conducted under skies that were over 80 percent covered in clouds.

Figure 6-1. The 57-year (1948-2005) mean monthly precipitation in inches (Western Regional Climate Center 2005), and the total monthly precipitation for the years 2002 to 2005 at the U.S.G.S. National Weather Service, Cheesman Weather Station.



7.0 DATA MANAGEMENT AND ANALYSIS

7.1 Data Management

Data sheets were copied and distributed to the sponsoring agencies. Transect GPS locations were entered into the USFS GIS database. Transect photographs were compiled, labeled, and stored on compact disks and given to the USFS for storage on their internal file server. A data summary listing transects, burn classification, and values of parameters measured is included in Appendix B.

7.2 Transect Grouping for Analysis

USFS burn intensity classes were based on the appearance of the burned and unburned trees on satellite and aerial photo imagery. After completing the skipper habitat sampling, and reviewing the collected data in 2002, the USFS map was found to be quite accurate in depicting the condition of the overstory trees. Since stands classified as high or moderate burn severity were associated with an understory that was nearly always 100 percent burned, it seemed most appropriate to analyze these transects together because in 2002 there was no skipper occupancy of these areas, and overstory recovery will require many years. The low severity burn category included a mosaic of unburned and partially to completely burned trees, with both burned and unburned understory patches. Because there is potential that some skippers still occupied these low severity burn areas immediately following the burn in 2002, and some overstory trees remain, it is likely that skipper abundance will differ from that in high or moderate severity burn areas. Consequently, transects located within low burn severity areas mapped by the USFS were analyzed as a single group. Thus, in the Hayman fire area, there were transects distributed among three burn classification categories: unburned, low severity burn, and moderate-to-high severity burn

7.3 Statistical Analysis

As indicated above, the burn severity classification appears biologically useful in evaluating skipper habitat condition and potential for skipper re-occupancy. The effects of the fire on forest vegetation were relatively similar in the high and moderate severity burn areas, and highly variable in the low severity areas, depending on the local behavior of the fire. As was done in 2002, each skipper habitat variable was examined in relation to burn intensity (which has been mapped, and can be remapped over time). For purposes of comparison, the means and standard deviations were computed for each parameter (e.g., blue grama frequency), and for each transect group (unburned, low severity, and moderate-to-high severity). For the Hayman Fire area, data were analyzed using a two factorial design with four levels of year (2002, 2003, 2004, and 2005), and three levels of burn severity (unburned, low severity, and moderate-to-high severity). For the Buffalo Creek, High Meadow, and Hayman fire areas, data were analyzed using a two factorial design with three levels of year (2003, 2004, and 2005) and one level of burn severity (low severity burn). Multiple comparisons among pairs of means of different treatments (burn severity and year), were performed using least square means, the Tukey-Kramer method for unequal sample sizes, and using a significant level of P=0.05. All analyses were conducted using Statistix 8.1.

Setting a level of significance in statistics determines the likelihood of committing a Type I Error, or in our study the probability a difference between sample means will be declared significant, when no difference exits. Such errors can occur, because some samples will show a relationship just by chance. When performing many tests comparing differences between multiple sample means (post-hoc tests), as in this study, the tendency is to inflate the overall Type I Error rate, and it is advisable to set a lower significance level. Although assignment of significance level is somewhat arbitrary, levels of 0.05 and 0.01 are most commonly used.

The possibility also exists of missing a difference between compared means, when a difference actually exists (a Type II Error). Type II Error rates are most influenced by sample size, with small sample sizes equating to larger Type II Error rates. To a lesser extent, the probability associated with a Type I Error will inversely affect Type II Error rate. By relaxing your restriction on commission of a Type I Error you can decrease your likelihood of a Type II Error, and increase statistical power, or the ability to detect the smallest worthwhile difference between compared means.

8.0 RESULTS AND DISCUSSION

8.1 Post-fire Habitat Conditions and Skipper Abundance on the Hayman Burn Area

8.1.1 Current versus Historic Habitat Use

The total suitable habitat for the Pawnee montane skipper (*Hesperia leonardus montana*) in the South Platte River drainage is approximately 24,831 acres (ENSR 2003). Between 1996 and 2002, approximately 48.4 percent (12,026 acres) of the habitat was burned in four separate fires: the Buffalo Creek, High Meadow, Schoonover, and Hayman fires. See ENSR (2003) for an in-depth discussion of changes to historic skipper habitat resulting from these four fires. Determining the conservation status of the Pawnee montane skipper over its entire range requires measuring the recolonization dynamics of burned areas and monitoring changes in population abundance.

8.1.2 Post-fire Changes in Forest Structure

Counts of standing live trees in the Hayman Burn area in 2002 showed significant differences among all three burn severity categories: unburned, low severity, and moderate-to-high severity, with the greatest density of trees occurring in the unburned transects (**Table 8-1**). In 2003 and subsequent years, the unburned and low burn transects were statistically indistinguishable form each other, but both had significantly higher numbers of live trees than did the moderate-to-high burn transects. As it takes many years for ponderosa pine to reach the 6-inch diameter size class, this difference between burn areas is expected to continue for decades if no other source of catastrophic mortality (e.g., fire, bark beetles) occurs in the region

Table 8-1. Standing live trees on Hayman Burn transects. Live tree stems (>6 inches DBH) per acre compared among habitat condition types (unburned, low, and moderate-to-high severity burns) within sample years (2002, 2003, 2004, and 2005) for Hayman fire transects.

Year	Burn Intensity	Sample Size (# of Transects)	Mean (stems per acre)	Standard Deviation	Homogenous Groups (P=0.05)[1]
2005	unburned	15	73.42	28.50	**A**
	low	19	53.12	35.44	**A**
	moderate-to-high	19	1.33	2.68	**B**
2004	unburned	11	84.07	56.94	**A**
	low	20	67.43	50.01	**A**
	moderate-to-high	15	2.13	5.03	**B**
2003	unburned	14	79.53	58.02	**A**
	low	25	47.73	40.83	**A**
	moderate-to-high	17	0.30	0.76	**B**

Year	Burn Intensity	Sample Size (# of Transects)	Mean (stems per acre)	Standard Deviation	Homogenous Groups (P=0.05)[1]
2002	unburned	13	127.84	58.61	**A**
	low	25	80.69	63.40	**B**
	moderate-to-high	17	0.92	2.44	**C**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.

When counts of live tree were compared within treatments across all four years (**Table 8-2**), no significant differences were found within the two burned area categories. In the unburned transects, however, there has been a significant (43%) decrease in the density of live trees between 2002 and 2005. This decline in tree mortality is probably a result of severe drought; a similar degree of decrease occurred over the same time period in the low burn transects (34%, although not significant at the P=0.5 level).

Table 8-2. Standing live trees on Hayman Burn transects. Live tree stems (>6 inches DBH) per acre compared among sample years (2002, 2003, 2004, and 2005) within habitat condition types (unburned, low, and moderate-to-high severity burns) for Hayman fire transects.

Year	Burn Intensity							
	Unburned			Low			Moderate-to-high	
	Means	Homogenous Groups (P=0.05)[1]		Means	Homogenous Groups (P=0.05)		Means	Homogenous Groups (P=0.05)
2005	73.42	**A**		53.12	**A**		1.33	**A**
2004	84.07	**AB**		67.43	**A**		2.13	**A**
2003	79.53	**AB**		47.73	**A**		0.30	**A**
2002	127.84	**B**		80.69	**A**		0.92	**A**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.

Standing dead trees were not counted during the first year of the post-fire study, but data 2003, 2004, and 2005 show statistically significant differences among the three burn classes for all three years (**Table 8-3**). Comparing counts within burn categories shows no significant differences between 2003 and 2005 (**Table 8-4**). However, there was a 23% increase (not significant) in the number of standing dead trees between 2003 and 2004 in the low burn transects, suggesting that the combined stress of fire and drought resulted in increased mortality among trees that survived in 2002 and 2003, when many trees classified as "live" had green needles on less than a quarter of their branches. Although sample sizes are very small, the number of standing dead trees in the unburned transects also increased (by 50%) between 2003 and 2004, suggesting that drought probably contributed to tree death in both burn class areas. The number of standing dead trees in the moderate-to--high burn transects has decreased every year as weakened stems have fallen to the ground, an effect also seen between 2004 and 2005 in the other two burn class areas (**Table 8-4**).

Table 8-3. Standing dead trees on Hayman Burn transects. Standing dead tree stems (>6 inches DBH) per acre compared among habitat condition types (unburned, low, and moderate-to-high severity burns) within sample years (2003, 2004, and 2005) for Hayman fire transects.

Year	Burn Intensity	Sample Size (# of Transects)	Mean (stems per acre)	Standard Deviation	Homogenous Groups (P=0.05)[1]
2005	unburned	15	2.90	3.44	**A**
	low	19	24.41	22.91	**B**
	moderate-to-high	19	56.44	45.31	**C**
2004	unburned	11	5.38	8.53	**A**
	low	20	35.54	26.01	**B**
	moderate-to-high	15	58.48	32.93	**C**
2003	unburned	14	2.64	2.96	**A**
	low	25	27.40	24.08	**B**
	moderate-to-high	17	62.16	29.19	**C**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.

Table 8-4. Standing dead trees on Hayman Burn transects. Standing dead tree stems (>6 inches DBH) per acre compared among sample years (2002, 2003, 2004, and 2005) within habitat condition types (unburned, low, and moderate-to-high severity burns) for Hayman fire transects.

Year	Burn Intensity						
	Unburned			Low			Moderate-to-high	
	Means	Homogenous Groups (P=0.05)[1]		Means	Homogenous Groups (P=0.05)		Means	Homogenous Groups (P=0.05)
2005	2.90	**A**		24.41	**A**		56.44	**A**
2004	5.38	**A**		35.54	**A**		58.48	**A**
2003	2.64	**A**		27.40	**A**		62.16	**A**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.

Overall tree stem densities (live trees and dead trees combined) in the three burn class areas were not much different in 2005, with unburned, low burn, and moderate-to-high burn areas having 76.3, 77.5, and 57.8 stems per acre, respectively. In terms of apparent habitat quality, however, the difference between the moderate-to-high burn areas and the other two burn classes (unburned and low burn) is dramatic. The lack of canopy foliage in the former areas results in more sun, less shade, and lower soil moisture (for already scorched topsoil). The challenge is to determine the relative importance of these forest characteristics to skipper recolonization and survival.

8.1.3 Blue Grama (Bouteloua gracilis) Occurrence

Blue grama frequencies in 2005 were nearly identical in the three burn class areas, at just under 10% (**Table 8-5**). This continues the pattern of the previous two years, which saw no significant differences among burn class areas. Only in 2002 was the frequency of blue grama significantly less in the moderate-to-high burn areas than in the other two burn classes. Thus, it appears that the severe effects of the 2002 fire suppressed blue grama growth significantly that year but not in subsequent years.

Table 8-5. Blue grama (Bouteloua gracilis) frequency on Hayman burn transects. Blue grama frequency compared among habitat condition types (unburned, low, and moderate-to-high severity burns) within sample years (2002, 2003, 2004, and 2005) and for Hayman fire transects.

Year	Burn Intensity	Sample Size (# of Transects)	Mean (% frequency)	Standard Deviation	Homogenous Groups (P=0.05)[1]
2005	unburned	15	9.73	6.84	**A**
	low	19	9.47	5.72	**A**
	moderate-to-high	19	9.58	5.74	**A**
2004	unburned	11	11.82	7.61	**A**
	low	20	11.20	8.64	**A**
	moderate-to-high	15	16.00	24.48	**A**
2003	unburned	14	8.29	6.68	**A**
	low	25	7.72	4.60	**A**
	moderate-to-high	17	5.76	3.29	**A**
2002	unburned	13	23.31	12.10	**A**
	low	25	23.48	9.83	**A**
	moderate-to-high	17	9.35	9.87	**B**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.

Drought in 2002 reduced frequency of blue grama below historical levels observed in 1986 (ENSR 2003), and the lingering effects of drought suppressed frequencies even further in 2003. A modest increase in blue grama in 2004 across all conditions of burn severity (CNHP 2005) was reversed in 2005. In 2005 blue grama frequency dropped in all three burn class areas (**Table 8-6**). In the unburned and low burn areas, the 2005 levels were significantly lower than all previous years.

Table 8-6. Blue grama (Bouteloua gracilis) frequency on Hayman burn transects. Blue grama frequency compared among sample years (2002, 2003, 2004, and 2005) within habitat condition types (unburned, low, and moderate-to-high severity burns) for Hayman fire transects.

Year	Burn Intensity							
	Unburned			Low			Moderate-to-high	
	Means	Homogenous Groups (P=0.05)[1]		Means	Homogenous Groups (P=0.05)		Means	Homogenous Groups (P=0.05)
2005	9.73	A		9.47	A		9.58	A
2004	11.82	B		11.20	B		16.00	A
2003	8.29	B		7.72	B		5.76	A
2002	23.31	B		23.48	B		9.35	A

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.

8.1.4 Prairie Gayfeather (Liatris punctata) Occurrence

Gayfeather has continued to increase every year since the catastrophic combination of drought and fire suppressed its aboveground abundance in 2002. In 2005, densities ranged from 111 to 212 flowering stems per acre (**Table 8-7**). These numbers represent a range of increase over 2004 of 39% to 169%, respectively. As stated in previous reports, this perennial plant is well adapted for such a response, with its massive subterranean crown and deep root system that allow gayfeather to survive both drought and fire (ENSR 2003). Indeed, since 2002, the above-ground densities of gayfeather, as measured by number of flowering stems, have increased by a factor of 30 in the unburned areas, by a factor of 617 in the low burn intensity areas, and by a factor of 142 in the moderate-to-high burn areas.

Table 8-7. Prairie gayfeather (Liatris punctata) flowering stems on Hayman burn transects. Gayfeather flowering stems compared among habitat condition types (unburned, low, and moderate-to-high severity burns) within sample years (2002, 2003, 2004, and 2005) and for Hayman fire transects.

Year	Burn Intensity	Sample Size (# of Transects)	Mean (stems per acre)	Standard Deviation	Homogenous Groups (P=0.05)[1]
2005	unburned	15	146.83	173.86	A
	low	19	111.21	86.13	A
	moderate-to-high	19	212.81	161.83	A
2004	unburned	11	71.65	83.42	A
	low	20	79.85	63.63	A
	moderate-to-high	15	79.69	135.64	A
2003	unburned	14	27.97	25.68	A
	low	25	12.89	14.17	B

Year	Burn Intensity	Sample Size (# of Transects)	Mean (stems per acre)	Standard Deviation	Homogenous Groups (P=0.05)[1]
	moderate-to-high	17	20.50	17.68	**AB**
2002	unburned	13	4.63	7.40	**A**
	low	25	0.18	0.44	**B**
	moderate-to-high	17	1.43	4.57	**AB**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.

The 2005 densities are significantly higher than those of 2002 and 2003 for all burn intensity categories (**Table 8-8**), but are significantly higher than last year's (2004) only in the moderate-to-high burn transects. Favorable moisture conditions in the area in 2004 and generous moisture last year (2005) appear to have freed this species from constraints on growth due to drought. The greater increase in gayfeather densities in the moderate-to-high burn severity areas over the past year, compared to areas where fire was absent or less severe, probably reflects either a release from competition from other plants for moisture and resources, or greater recruitment of new individuals to the population, or both.

Table 8-8. Prairie gayfeather (Liatris punctata) flowering stems on Hayman burn transects. Gayfeather flowering stems compared among sample years (2002, 2003, 2004, and 2005) within habitat condition types (unburned, low, and moderate-to-high severity burns) for Hayman fire transects.

Year	**Burn Intensity**							
	Unburned			**Low**			**Moderate-to-high**	
	Means	**Homogenous Groups (P=0.05)[1]**		**Means**	**Homogenous Groups (P=0.05)**		**Means**	**Homogenous Groups (P=0.05)**
2005	146.83	**A**		111.21	**A**		212.81	**A**
2004	71.65	**AB**		79.85	**A**		79.69	**B**
2003	27.97	**B**		12.89	**B**		20.50	**B**
2002	4.63	**B**		0.18	**B**		1.43	**B**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.

8.1.5 Pawnee Montane Skipper (Hesperia leonardus montana) Occurrence

In 2005, 98 Pawnee montane skippers (*H. l. montana*) were observed on the Hayman study area transects. There were 49 skippers recorded from 8 of 15 (53%) unburned plots, 46 skippers recorded from 11 of 19 (58%) low severity burn plots, and 3 skippers recorded from 1 of 19 (5%) moderate-to-high burn plots. This corresponds to a mean of 0.94 Pawnee montane skippers per acre for 53 sampled transects, exactly twice the 0.47 skippers per acre recorded from 46 transects in 2004, 9.4 times the 0.10 skippers per acre recorded from 56 transects in

2003, and a whopping 47 times the 0.02 skippers per acre recorded from 55 transects in 2002. This overall steady increase in Pawnee montane skipper densities over the past four years is most likely the result of increasing abundance of the favored adult nectar source, prairie gayfeather (**Tables 8-7 and 8-8**), which has responded dramatically to increased soil moisture after the catastrophic drought of 2002.

In all four years of monitoring, densities of Pawnee montane skippers have been highest in the unburned areas and lowest in the moderate-to-high burn areas (**Table 8-9**). During the first three years (2002, 2003, and 2004) these differences were not significantly different. In 2005 skipper density in unburned transects (1.65 skippers per acre) was significantly greater than that in the moderate-to-high burn areas (0.08). This seems to suggest that skipper habitat quality has improved in the unburned and low severity burn areas as the effects of drought have become less pronounced in the region, but have improved very little in the moderate-to-high burn areas.

Table 8-9. Pawnee montane skipper (Hesperia leonardus montana) densities on Hayman burn transects. Pawnee montane skippers per acre among habitat condition types (unburned, low, and moderate-to-high severity burns) within sample years (2002, 2003, 2004, and 2005) for all Hayman transects.

Year	Burn Intensity	Sample Size (# of Transects)	Mean (skippers per acre)	Standard Deviation	Homogenous Groups (p=0.05)[1]
2005	unburned	15	1.65	2.09	**A**
	low	19	1.22	1.92	**AB**
	moderate-to-high	19	0.08	0.35	**B**
2004	unburned	11	0.83	0.88	**A**
	low	20	0.66	1.42	**A**
	moderate-to-high	15	0	0	**A**
2003	unburned	14	0.18	0.38	**A**
	low	35	0.08	0.24	**A**
	moderate-to-high	17	0.03	0.12	**A**
2002	unburned	13	0.08	0.28	**A**
	low	25	0	0	**A**
	moderate-to-high	17	0	0	**A**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.

Similarly, the increase in Pawnee montane skippers between 2002 and 2005 has been largely confined to the unburned and low intensity burn areas (**Table 8-10**). Rates of recovery in these two areas have been similar, with unburned areas showing slightly greater densities. Slowest to recover has been the moderate-to-high burned areas, in which no Pawnee montane skippers were seen in 2002 and 2004, and only 4 in 2003 and 3 in 2005. Monitoring the recolonization of these moderate-to high severity burn areas is important to the assessing the conservation status of this species in the South Platte River drainage. The 3 individuals seen in 2005 were all in transect plot 549, which is closely bordered by a low severity burn area, suggesting that proximity to such a relatively intact area may be crucial to the rate of recolonization.

Table 8-10. Pawnee montane skipper (Hesperia leonardus montana) densities on Hayman burn transects. Pawnee montane skippers per acre among sample years (2002, 2003, 2004, and 2005) within habitat condition types (unburned, low, and moderate-to-high severity burns) for all Hayman transects.

Year	Burn Intensity							
	Unburned			Low			Moderate-to-high	
	Means	Homogenous Groups (P=0.05)[1]		Means	Homogenous Groups (P=0.05)		Means	Homogenous Groups (P=0.05)
2005	1.65	**A**		1.22	**A**		0.08	**A**
2004	0.83	**AB**		0.66	**AB**		0	**A**
2003	0.18	**B**		0.08	**B**		0.03	**A**
2002	0.08	**B**		0	**B**		0	**A**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown

Distribution of Pawnee montane skippers observed in low severity burn transects in the Hayman and Schoonover burn areas in 2005 further support the importance of proximity to unburned areas. Pawnee montane skippers were found on 11 (of 19) low intensity burn transects (**Table 8-11**). Seven of these transects directly bordered unburned areas. Three of the other four (521, 541, and 547) were less than 200 meters from an unburned area; only one (544) was as much as one kilometer away from the nearest unburned areas.

Table 8-11. Skipper habitat condition in low severity burn areas occupied by Pawnee montane skippers (Hesperia leonardus montana) in 2005.

Transect number	# of flowering gayfeather stems	# of live trees	# of dead trees	Blue grama frequency (%)	# of Pawnee montane skippers present
518	275	136	14	4	7
521	484	74	33	12	3
525	206	44	13	6	2
530	155	294	157	10	4
534	397	95	37	3	4
539	73	68	14	8	1
541	76	35	11	18	3
542	77	102	19	24	2
544	495	79	52	18	2
547	381	138	27	12	16
548	229	58	41	6	2
Mean	259	102	38	11	4.18

Parameters of skipper habitat quality measured in this study show that all three burn severity currently support equal frequencies of blue grama, the larval foodplant (**Table 8-5**), and all support abundant prairie gayfeather, the favored adult nectar source (**Table 8-7**). What distinguishes the moderate-to-high burn areas from the unburned and low severity burn areas is the dearth of live trees on the former (**Table 8-1**). This means that the moderate-to-high burn areas have less canopy cover, more sun, less shade, and greatly reduced spatial heterogeneity, including patterns of light and dark, all of which may make these areas less attractive to Pawnee montane skippers. The intense crown fire experienced on these plots probably killed all skipper life stages (eggs, larvae, and adults) and it may require a few years of dispersal from unburned or low severity burn areas into moderate-to-high severity burn areas before skippers become successfully established in areas where crown fires occurred. Movement patterns of Pawnee montane skippers are unknown (Opler 1998), but maximum movements of approximately one kilometer are not unlikely (NatureServe 2005).

Despite the strong increase in overall Pawnee montane skipper densities in 2004 and 2005, these latest counts are still lower than densities recorded in the 1980's, when 2.1 to 3.6 Pawnee montane skippers per acre were counted on unburned plots (ERT 1986, 1988, 1989). A multiyear comparison of Pawnee montane skipper densities on unburned transects reveals that, although the density recorded in 2005 (1.65 skippers per acre) was twice the density recorded in 2004 (0.83), it was still only about 60% of the 2.60 skippers per acre recorded in 1986.

8.2 Skipper Dispersal into Burned Areas: Comparison of the Hayman Fire (2002) with the Buffalo Creek Fire (1996) and High Meadow Fire (2000).

8.2.1 Fire History in Skipper Habitat

Four separate fires, occurring in three different years, have burned approximately 50% of the suitable Pawnee Montane Skipper habitat since 1996. Low severity burns in three of these fire areas have been monitored, in varying degrees, since 2002 (**Table 8-12**). Analysis of the data from these fire areas offers information on host plant recovery and re-colonization by skipper butterflies, at varying times post-fire. The areas monitored were the Buffalo Creek, High Meadow, and Hayman fire areas. The Hayman Fire created a mosaic of low, moderate, and high severity burns across the landscape, and for the following analyses only Hayman low severity burn plots are included. As stated previously, the Buffalo Creek and High Meadow fires were predominately moderate-to-high severity burns, but we placed transects in known low severity burn areas within these fires. Analysis shows that numbers of live trees on transects between these two areas (Buffalo Creek and High Meadow), were statistically similar to the Hayman low severity plots, indicating our placement of plots at Buffalo Creek and High Meadow successfully captured low severity burns. Reference?

Table 8-12. Number of transects sampled in low severity burn sites (1996, 2000, 2002) in 2002 (Hayman) and in 2003, 2004, and 2005 (Buffalo Creek, High Meadow, and Hayman).

Fire	Year of Burn	Transects Monitored 2002	Transects Monitored 2003	Transects Monitored 2004	Transects Monitored 2005
Buffalo Creek	1996	0	6	6	6
High Meadow	2000	0	6	6	6
Hayman	2002	25	25	20	19

8.2.2 Blue grama (*Bouteloua gracilis*) Occurrence

Within each year (2003, 2004, and 2005) that all three low severity burn areas were monitored, blue grama frequencies were statistically similar among all three areas (Buffalo Creek, Hayman, High Meadow) (**Table 8-13**). Because each plot burned in different years, this suggests that blue grama recovers rapidly after fire. In 2003, one year after burning, the frequency of blue grama on the Hayman plots was statistically indistinguishable from those on the Buffalo Creek plots, which burned in 1996.

Table 8-13. Blue grama (Bouteloua gracilis) frequencies on low severity burn sites. Blue grama frequencies compared among low severity burn areas (Buffalo Creek, High Meadow, and Hayman) within sample years (2002, 2003, 2004, 2005).

Year	Site	Year of Burn	Sample Size (# of Transects)	Mean (% frequency)	Standard Deviation	Homogenous Groups (P=0.05)[1]
2005	Buffalo Creek	1996	6	7.00	2.10	**A**
	High Meadow	2000	6	11.00	3.90	**A**
	Hayman	2002	19	9.47	5.72	**A**
2004	Buffalo Creek	1996	6	9.83	4.26	**A**
	High Meadow	2000	6	29.5	35.45	**A**
	Hayman	2002	20	11.20	8.64	**A**
2003	Buffalo Creek	1996	6	6.00	2.37	**A**
	High Meadow	2000	6	9.50	4.46	**A**
	Hayman	2002	25	7.72	4.60	**A**
2002	Hayman[2]	2002	25	23.48	9.83	----

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.
[2]Only the Hayman burn area was sampled in 2002; Buffalo Creek and High Meadow burn areas were first sampled in 2003.

Over the three years (2003-2005) in which all three areas were monitored, no significant differences in blue grama frequencies were observed within each burn severity class (**Table 8-14**). However, mean frequency of blue grama in 2002 on the Hayman transects, was significantly higher than the three years following the fire and drought.

Table 8-14. Blue grama (Bouteloua gracilis) frequencies on low severity burn sites. Blue grama frequencies compared among sample years (2002, 2003, 2004, 2005) within three low-severity burn areas (Buffalo Creek, High Meadow, and Hayman).

Year	Burn Area					
	Buffalo Creek		High Meadow		Hayman[2]	
	Means	Homogenous Groups (P=0.05)[1]	Means	Homogenous Groups (P=0.05)	Means	Homogenous Groups (P=0.05)
2005	7.00	**A**	11.00	**A**	9.47	**B**
2004	9.83	**A**	29.50	**A**	11.20	**B**
2003	6.00	**A**	9.50	**A**	7.72	**B**
2002	---	---	---	----	23.48	**A**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.
[2]Only the Hayman burn area was sampled in 2002; Buffalo Creek and High Meadow burn areas were first sampled in 2003.

8.2.3 Prairie Gayfeather (*Liatris punctata*) Occurrence

Within each year (2003, 2004, 2005) that all three areas were monitored, gayfeather stems per acre were statistically similar among all three low severity areas (Buffalo Creek, Hayman, High Meadow) (**Table 8-15**). Similar to blue grama, this suggests that gayfeather recovers rapidly after fire, because in 2003, one year post-fire, counts on Hayman plots are similar to Buffalo Creek and High Meadow, which burned in 1996 and 2000, respectively.

Table 8-15. Prairie gayfeather (Liatris punctata) stems per acre on low severity burn sites. Gayfeather flowering stems per acre compared among low severity burn sites (Buffalo Creek, High Meadow, and Hayman) within sampling years (2002, 2003, 2004, and 2005).

Year	Site	Year of Burn	Sample Size (# of Transects)	Mean (stems per acre)	Standard Deviation	Homogenous Groups (P=0.05)[1]
2005	Buffalo Creek	1996	6	72.64	53.93	**A**
	High Meadow	2000	6	40.81	32.53	**A**
	Hayman	2002	19	111.21	86.13	**A**
2004	Buffalo Creek	1996	6	56.59	57.76	**A**
	High Meadow	2000	6	45.66	51.11	**A**
	Hayman	2002	20	79.85	63.63	**A**
2003	Buffalo Creek	1996	6	17.81	18.53	**A**
	High Meadow	2000	6	6.14	5.51	**A**
	Hayman	2002	25	12.89	14.17	**A**

Year	Site	Year of Burn	Sample Size (# of Transects)	Mean (stems per acre)	Standard Deviation	Homogenous Groups (P=0.05)[1]
2002	Hayman[2]	2002	25	0.18	0.44	----

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.
[2]Only the Hayman burn area was sampled in 2002; Buffalo Creek and High Meadow burn areas were first sampled in 2003.

Among the three years in which all three areas were monitored, there were no significant differences in gayflower densities at the sites of the two oldest fires, Buffalo Creek and High Meadow (**Table 8-16**). In the Hayman area, stem densities were significantly greater in 2004 and 2005 than in the drought and post-drought years of 2002 and 2003, indicating that it took two years for this perennial plant, with its rhizomatous root system and vegetative regeneration, to show significant recovery from the combined effects of drought and fire.

Table 8-16. Prairie gayfeather (Liatris punctata) stems per acre on low severity burn sites. Gayfeather flowering stems per acre compared among sampling years (2002, 2003, 2004, and 2005) within low severity burn sites (Buffalo Creek, High Meadow, and Hayman).

Year	Burn Area							
	Buffalo Creek			High Meadow			Hayman[2]	
	Means	Homogenous Groups (P=0.05)[1]		Means	Homogenous Groups (P=0.05)		Means	Homogenous Groups (P=0.05)
2005	72.64	**A**		40.81	**A**		111.21	**A**
2004	56.59	**A**		45.66	**A**		79.85	**A**
2003	17.81	**A**		6.14	**A**		12.89	**B**
2002	---	----		---	-----		0.18	**B**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.
[2]Only the Hayman burn area was sampled in 2002; Buffalo Creek and High Meadow burn areas were first sampled in 2003.

8.2.4.1 Effects of Fire on Forest Structure

By decreasing forest canopy cover through removal of some live trees, low severity fire might benefit *Hesperia* butterflies, which prefer open dry forests with an understory of native grasses (NatureServe 2004). The effect that landscape-scale, stand-replacing fire, like the Hayman Fire, had on *Hesperi*a butterflies is less clear. Numbers of live, dead, and all standing tree stems were statistically similar among all of the low severity burn areas in all years sampled (**Table 8-17, 8-18**). This was expected and indicated that the Forest Service's classification of the burn areas was accurate. As discussed previously, significantly more dead trees were recorded on low severity burn plots of the Hayman fire than on unburned plots (**Table 8-3**), suggesting that in low severity burn areas fire did influence forest canopy cover.

Table 8-17. Tree density comparison on low severity burn sites. Live, dead, and all tree stems (>6 in DBH) per acre compared among low severity burn sites (Buffalo Creek, High Meadow, and Hayman) within sample years (2002, 2003, 2004, and 2005).

Year	Site	Year of Burn	Sample Size (# of Transects)	Mean (stems per acre)	Standard Deviation	Homogenous Groups (P=0.05)[1]
Live Standing Tree Stems						
2005	Buffalo Creek	1996	6	34.53	21.37	A
	High Meadow	2000	6	26.57	19.04	A
	Hayman	2002	19	53.12	35.44	A
2004	Buffalo Creek	1996	6	41.28	24.06	A
	High Meadow	2000	6	33.25	16.40	A
	Hayman	2002	20	67.43	50.01	A
2003	Buffalo Creek	1996	6	41.41	8.48	A
	High Meadow	2000	6	39.59	22.99	A
	Hayman	2002	25	47.73	40.83	A
2002	Hayman	2002	25	80.69	63.40	----
Dead Standing Tree Stems						
2005	Buffalo Creek	1996	6	19.16	9.64	A
	High Meadow	2000	6	36.15	12.64	A
	Hayman	2002	19	24.41	22.91	A
2004	Buffalo Creek	1996	6	24.75	14.06	A
	High Meadow	2000	6	50.86	28.53	A
	Hayman	2002	20	35.54	26.01	A
2003	Buffalo Creek	1996	6	26.64	15.92	A
	High Meadow	2000	6	57.40	28.47	A
	Hayman	2002	25	27.40	24.08	A
All Standing Tree Stems						
2005	Buffalo Creek	1996	6	53.69	19.91	A
	High Meadow	2000	6	62.73	15.70	A
	Hayman	2002	19	77.53	53.53	A
2004	Buffalo Creek	1996	6	66.03	13.52	A
	High Meadow	2000	6	84.11	33.67	A
	Hayman	2002	20	102.97	52.61	A
2003	Buffalo Creek	1996	6	68.05	12.33	A
	High Meadow	2000	6	96.99	39.70	A
	Hayman	2002	25	75.13	47.00	A

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown. Data recalculated to correct errors in last year's report.

Table 8-18. Tree density comparison on burn sites. Live, dead, and all tree stems (>6 in DBH) per acre compared among sample years (2002, 2003, 2004, and 2005) within three low severity burn sites (Buffalo Creek, High Meadow, and Hayman).

	Burn Area							
Year	**Buffalo Creek (1996)**			**High Meadow (2000)**			**Hayman (2002)**	
	Means	**Homogenous Groups (P=0.05)[1]**		**Means**	**Homogenous Groups (P=0.05)**		**Means**	**Homogenous Groups (P=0.05)**
Live Standing Tree Stems								
2005	34.53	**A**		26.57	**A**		53.12	**A**
2004	41.28	**A**		33.25	**A**		67.43	**A**
2003	41.41	**A**		39.59	**A**		47.73	**A**
2002	---	----		---	----		80.69	**A**
Dead Standing Tree Stems								
2005	19.16	**A**		36.15	**A**		24.41	**A**
2004	24.75	**A**		50.86	**A**		35.54	**A**
2003	26.64	**A**		57.40	**A**		27.40	**A**
All Standing Tree Stems								
2005	53.69	**A**		62.73	**A**		77.53	**A**
2004	66.03	**A**		84.11	**A**		102.97	**A**
2003	68.05	**A**		96.99	**A**		75.13	**A**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown. Data recalculated to correct errors in last year's report.

8.2.4.2 Effects of Forest Structure on Skipper Occurrence

When observations of both skipper species (Pawnee montane skipper and the common branded skipper) are combined, there were no differences in overall skipper densities among the three burn areas (Buffalo Creek, High Meadow, and Hayman) for any of the years monitored (2003, 2004, 2005) (**Table 8-19**).

Table 8-19. Hesperia skippers (H. comma and H. leonardus montana) per acre compared among low severity burn sites (Buffalo Creek, High Meadow, and Hayman) within sample years (2002, 2003, 2004, 2005).

Year	**Site**	**Year of Burn**	**Sample Size (# of Transects)**	**Mean (skippers per Acre)**	**Standard Deviation**	**Homogenous Groups (P=0.05)[1]**
2005	Buffalo Creek	1996	6	1.75	1.04	**A**
	High Meadow	2000	6	2.63	1.88	**A**
	Hayman	2002	19	5.22	5.14	**A**
2004	Buffalo Creek	1996	6	1.15	2.62	**A**
	High Meadow	2000	6	0.68	1.30	**A**
	Hayman	2002	20	1.37	2.08	**A**

Year	Site	Year of Burn	Sample Size (# of Transects)	Mean (skippers per Acre)	Standard Deviation	Homogenous Groups (P=0.05)[1]
2003	Buffalo Creek	1996	6	0.00	0.00	**A**
	High Meadow	2000	6	0.27	0.66	**A**
	Hayman	2002	25	0.08	0.24	**A**
2002	Hayman	2002	25	0.00	0.00	----

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown. Data recalculated to correct errors in last year's report.

There are, however, differences in the timing of fire events on each area, with the Haymen fire occurring in 2002, High Meadow in 2000, and Buffalo Creek in 1996. This may suggest that low intensity fires influence skipper numbers little, that recovery from them is quick, or that the 2002 drought reduced skipper numbers on older burn areas to levels observed on the Hayman area during the year of burn. Significant increases in skipper numbers on the Hayman transects in 2004 (CNHP 2004) and again in 2005 (**Table 8-20**), suggest that populations there are recovering, probably as a result of improving habitat conditions, evidenced by a stabilized increased frequency of blue grama (**Table 8-14**) and a significant increase in gayfeather density on these plots (**Table 8-16**). Skipper densities have also increased since 2003 in the older fire areas as well, with a significant (almost ten-fold) increase between 2003 and 2005 in the High Meadow area and a 150% (but not statistically significant) difference between 2004 and 2005 in the Buffalo Creek area (Table 7-20). The fact that all three areas have had substantial or significant increases in skipper densities since 2003 suggests that increased moisture after the 2002 drought is primarily responsible for recovery in both species.

Table 8-20. Hesperia skippers (H. comma and H. leonardus montana) per acre compared among sample years (2002, 2003, 2004, 2005) within low severity burn sites (Buffalo Creek, High Meadow, and Hayman).

Year	Burn Area							
	Buffalo Creek			High Meadow			Hayman[2]	
	Means	Homogenous Groups (P=0.05)[1]		Means	Homogenous Groups (P=0.05)		Means	Homogenous Groups (P=0.05)
2005	1.75	**A**		2.63	**A**		5.22	**A**
2004	1.15	**A**		0.67	**AB**		1.37	**B**
2003	0	**A**		0.27	**B**		0.10	**B**
2002	---	----		---	----		0	**B**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.

Without recent pre-fire estimates of skipper densities, it is impossible to statistically test whether the more open forest canopy following the Hayman low severity burns is responsible for increasing skipper abundance. However, ongoing monitoring of forest thinning in the Trumbull area provides strong evidence that controlled thinning increases abundance of the skippers' adult food plant (prairie gayfeather), which in turn is correlated with increases in skipper densities (Natural Perspectives 2004, 2005).

8.3 Post-fire Skipper Habitat Conditions and Trends in Skipper Population Abundance on the entire Project Area

8.3.1 Skipper (*Hesperia*) Occurrence

Populations of all *Hesperia* skippers (*H. l. montana* and *H. comma*) have increased throughout the project area during all four years of monitoring, with statistically significant increases during each of the last two years (**Table 8-21**). The mean number of all *Hesperia* skippers observed on all study plots (including Buffalo Creek and High Meadow), in 2002, 2003, 2004, and 2005 was 0.02, 0.17, 1.58, and 4.20 per acre, respectively. As overall skipper numbers have increased, the differences in skipper densities between the three burn severity types have also increased (**Table 8-22**). In 2004, skipper densities in the unburned areas were significantly greater than those in the low burn and moderate-to-high burn areas. In 2005, differences between all three burn intensity classes were significant, ranging from a low of 0.71 skippers per acres in the moderate-to-high burn areas to a high of 8.50 skippers per acre in the unburned areas (**Table 8-22**).

Table 8-21. Hesperia skippers (H. comma and H. leonardus montana) per acre among sample years (2002, 2003, 2004, and 2005) for all transects.

Year	Sample Size (# of Transects	Mean (skippers per acre)	Standard Deviation	Homogenous Groups (P=0.05) [1]
2005	65	4.20	4.77	**A**
2004	58	1.58	3.20	**B**
2003	68	0.17	0.41	**C**
2002	55	0.02	0.14	**C**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.

Table 8-22. Hesperia skippers (H. comma and H. leonardus montana) per acre compared among burn intensities (unburned, low, and moderate-to-high) within sample years (2002, 2003, 2004, and 2005) and for all transects sampled.

Year	Burn Intensity	Sample Size (# of Transects)	Mean (skippers per acre)	Standard Deviation	Homogenous Groups (P=0.05)[1]
2005	unburned	15	8.50	4.97	**A**
	low	31	4.05	4.35	**B**
	moderate-to-high	19	0.71	1.29	**C**
2004	unburned	11	4.78	5.52	**A**

Year	Burn Intensity	Sample Size (# of Transects)	Mean (skippers per acre)	Standard Deviation	Homogenous Groups (P=0.05)[1]
	low	32	1.20	2.02	B
	moderate-to-high	15	0.07[2]	0.26	B
2003	unburned	14	0.40	0.57	A
	low	37	0.11	0.33	A
	moderate-to-high	17	0.12	0.39	A
2002	unburned	13	0.08	0.28	A
	low	25	0	0	A
	moderate-to-high	17	0	0	A

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown. Data recalculated to correct errors in last year's report.

[2] Two skippers of unknown identify were recorded from plot 1 in 2004. No Pawnee montane skippers were identified from moderate-to-high severity burn plots in 2004.

Pooling data for all three burn areas (Hayman, Buffalo Creek, and High Meadow) over the four years of this study shows that skipper densities have increased significantly in all three burn intensity areas (**Table 8-23**), with the greatest change (more than a hundred-fold increase) occurring in the unburned areas. As mentioned earlier for Pawnee montane skippers alone, these increases in skipper abundance are correlated with dramatic increases in gayfeather densities following the drought of 2002 (**Table 8-8**), approaching the historic levels observed in 1986 (ERT 1986). Pooling data for all three burn areas and all four years of the study (**Table 8-24**) shows that the mean density of all *Hesperia* skippers is greater in the unburned areas (3.52 skippers per acre) than in either the low burn (1.34 skippers per acre) or moderate-to-high burn areas (0.34 skippers per acre).

Table 8-23. Hesperia skippers (H. comma and H. leonardus montana) per acre compared among sample years (2002, 2003, 2004, and 2005) within burn intensities (unburned, low, and moderate-to-high) for all transects sampled.

Year	Burn Intensity							
	Unburned			Low			Moderate-to-high	
	Mens	Homogenous Groups (P=0.05)[1]		Means	Homogenous Groups (P=0.05)		Means	Homogenous Groups (P=0.05)
2005	8.50	A		4.05	A		0.71	A
2004	4.78	A		1.20	B		0.07	AB
2003	0.40	B		0.11	B		0.13	AB
2002	0.08	B		0	B		0	B

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown. Data recalculated to correct errors in last year's report.

Table 8-24. Hesperia skippers (H. comma and H. leonardus montana) per acre among transects of differing burn intensity (unburned, low, and moderate-to-high) for all transects sampled in 2002, 2003, 2004, and 2005.

Burn Intensity	Sample Size (# of Transects)	Mean (skippers per acre)	Standard Deviation	Homogenous Groups (P=0.05) [1]
unburned	53	3.52	5.07	**A**
low	125	1.34	2.88	**B**
moderate-to-high	68	0.34	1.20	**B**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown

Influences of fire on skipper populations might result from changes of population densities of plants important in the skipper life cycle. For *Hesperia* in the South Platte River drainage these include the larval foodplant, blue grama, and the primary adult nectar plant, prairie gayfeather.

Blue grama appears to be more susceptible to the long-term effects of severe drought than gayfeather. Blue grama frequencies were significantly lower in the moderate-to-high burn transects in 2002, the year of the Hayman fire (**Table 8-25**). The average frequency of blue grama on the unburned transects of the Hayman area and on the low burn transects in all three areas (Buffalo Creek, High Meadow, and Hayman) was just over 23%, but on the moderate-to-high burn transects it was less than half of that (9.35%). In the years following 2002, blue grama frequency dropped in 2003, rose slightly in 2004, and dropped again in 2005 (**Table 8-26**). Currently, all areas have a similar frequency (just under 10%), suggesting that the drought reduced blue grama frequency and that it has been slow to recover, stabilizing at less than half the frequency it had before the drought.

Table 8-25. Frequency of blue gramma (Bouteloua gracilis) among sample years (2002, 2003, 2004, and 2005) and burn intensity (unburned, low, and moderate-to-high) for all transects sampled in 2002, 2003, 2004, and 2005.

Year	Burn Intensity	Sample Size (# of Transects)	Mean (% frequency)	Standard Deviation	Homogenous Groups (p=0.05)[1]
Among Years for all burn intensities combined (df= 3, F=13.3, P<0.0000)					
2005	**ALL**	65	9.48	5.57	**BC**
2004	**ALL**	58	14.31	18.05	**AB**
2003	**ALL**	68	7.35	4.71	**C**
2002	**ALL**	55	19.07	12.14	**A**
Among Burn Intensities for all years combined (df=2, F=1.59, P<0.2060)					
ALL	unburned	53	13.11	10.23	**A**
ALL	low	125	12.97	11.87	**A**
ALL	moderate-to-high	68	9.99	13.14	**A**

Year	Burn Intensity	Sample Size (# of Transects)	Mean (% frequency)	Standard Deviation	Homogenous Groups (p=0.05)[1]
Among Burn Intensities by sample year					
2005	unburned	15	9.73	6.84	**A**
	low	31	9.29	4.95	**A**
	moderate-to-high	19	9.58	5.74	**A**
2004	unburned	11	11.82	7.61	**A**
	low	32	14.38	17.50	**A**
	moderate-to-high	15	16.00	24.48	**A**
2003	unburned	14	8.29	6.68	**A**
	low	37	7.73	4.32	**A**
	moderate-to-high	17	5.76	3.29	**A**
2002	unburned	13	23.31	12.10	**A**
	low	25	23.48	9.83	**A**
	moderate-to-high	17	9.35	9.87	**B**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.

Table 8-26. Frequency of blue gramma (Bouteloua gracilis) among burn intensities (unburned, low, and moderate-to-high) within sample years (2002, 2003, 2004, and 2005) and for all transects sampled.

Year	Burn Intensity							
	Unburned			Low			Moderate-to-high	
	Means	Homogenous Groups (P=0.05)[1]		Means	Homogenous Groups (P=0.05)		Means	Homogenous Groups (P=0.05)
2005	9.73	**B**		9.29	**BC**		9.58	**A**
2004	11.82	**B**		14.38	**B**		16.00	**A**
2003	8.29	**B**		7.73	**C**		5.76	**A**
2002	23.31	**A**		23.48	**A**		9.35	**A**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.

Gayfeather showed a similar strong decrease as a result of drought, but, unlike blue grama, recovered swiftly and dramatically as soil moisture increased over the past three years. Gayfeather flowering stem densities were lowest in 2002 and have risen every year since in all burn severity classes (**Table 8-27**). Here an important distinction needs to be made. Blue grama frequencies were determined by recording frequency of occurrence of entire plants; gayfeather counts were of stems that bore open flowers at the time of sampling. In late summer of the drought year (2002), many gayfeather plants were seen but very few had active flowers, which senesced quickly in the dry hot conditions of that year. Thus, the rapid increases recorded in gayfeather densities over the past three years reflect increases in the number of stems with flowers, not necessarily an increase in the number of new plants on the transects.

Table 8-27. Stems per acre of gayfeather (Liatris punctata) compared among sample years (2002, 2003, 2004, and 2005) and burn intensities (unburned, low, and moderate-to-high) for all transects sampled in 2002, 2003, 2004, and 2005.

Year	Burn Intensity	Sample Size (# of Transects)	Mean (stems per acre)	Standard Deviation	Homogenous Groups (P=0.05)[1]
Among Years for all burn intensities combined (df=3, F=26.7, P<0.0000)					
2005	**ALL**	65	128.60	146.42	**A**
2004	**ALL**	58	61.73	90.06	**B**
2003	**ALL**	68	15.02	18.95	**C**
2002	**ALL**	55	1.62	4.65	**C**
Among Burn Intensities for all years combined (df=2, F=3.5, P>0.0317)					
	unburned	53	64.95	113.47	**AB**
	low	125	43.80	61.51	**B**
	moderate-to-high	68	82.52	135.72	**A**
Among Burn Intensities by sample year (df=, F=P>0.)					
2005	unburned	15	146.83	173.86	**AB**
	low	31	68.16	86.51	**B**
	moderate-to-high	19	212.81	161.83	**A**
2004	unburned	11	71.65	83.42	**A**
	low	32	49.91	63.44	**A**
	moderate-to-high	15	79.69	135.64	**A**
2003	unburned	14	27.97	25.68	**A**
	low	37	8.71	13.08	**B**
	moderate-to-high	17	20.50	17.68	**AB**
2002	unburned	13	4.63	7.40	**A**
	low	25	0.18	0.44	**B**
	moderate-to-high	17	1.43	4.57	**AB**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown. Data recalculated to correct errors in last year's report.

Gayfeather flowering stem counts have increased dramatically in all three burn classes, showing significant increases between 2003 and 2005 in the unburned transects, between 2003 and 2004 in the low intensity burn areas, and between 2004 and 2005 in the moderate to-high intensity burn areas (**Table 8-28**). The increases have been greatest in the moderate-to-high burn intensity transects, which probably reflects a response to increased soil moisture both from increased precipitation (enjoyed by all areas) and to decreased competition after elimination by fire of other plant species.

Table 8-28. Stems per acre of gayfeather (Liatris punctata) among burn intensities (unburned, low, and moderate-to-high) within sample years (2002, 2003, 2004, and 2005) and for all transects sampled.

Year	Burn Intensity							
	Unburned			Low			Moderate-to-high	
	Means	Homogenous Groups (P=0.05)[1]		Means	Homogenous Groups (P=0.05)		Means	Homogenous Groups (P=0.05)
2005	146.83	**A**		68.16	**A**		212.81	**A**
2004	71.65	**AB**		49.91	**A**		79.69	**B**
2003	27.97	**B**		8.71	**B**		20.50	**B**
2002	4.63	**B**		0.18	**B**		1.43	**B**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown. Data recalculated to correct errors in last year's report.

The fact that larval foodplants were equally abundant in all areas and that adult nectar plants were most abundant in moderate-to-high severity burn areas suggests that neither of these is responsible for the significantly fewer skippers found on the moderate-to-high burned transects. As mentioned earlier, low skipper densities in burned areas most likely result from negative changes in habitat structure resulting from loss of living trees, or from a lack of recolonization of these areas by skippers, or both.

8.3.2 Skipper (*Hesperia leonardus montana*) Occurrence

Over the entire study area, and combining data from all locations and burn intensities, Pawnee montane skipper densities increased every year, with significant increases in 2004 and again in 2005 (**Table 8-29**). Virtually all skippers recorded were seen in unburned and low severity burn areas; in moderate-to-high severity burn areas only 7 skippers have been recorded during the four years of the study, 4 in 2003 and 3 in 2005. Although Pawnee montane skippers have been least abundant in moderate-to-high severity burn areas during every year of the study, 2005 is the first year in which this difference has been statistically significant.

Table 8-29. Pawnee montane skippers (Hesperia leonardus montanus) per acre compared among sample years (2002, 2003, 2004, and 2005) and burn intensities (unburned, low, and moderate-to-high) for all transects sampled in 2002, 2003, 2004, and 2005.

Year	Burn Intensity	Sample Size (# of Transects	Mean (skippers per acre)	Standard Deviation	Homogenous Groups (p=0.05)[1]
Among Years for all burn intensities combined (df=3, F=8.67, P<0.0000)					
2005		65	0.80	1.59	**A**
2004		58	0.49	1.08	**AB**
2003		68	0.09	0.26	**B**
2002		55	0.02	0.14	**B**
Among Burn Intensities for all years combined (df=2, F=2.94, P<0.0545)					
	unburned	53	0.71	1.35	**A**
	low	125	0.51	2.11	**A**
	moderate-to-high	68	0.03	0.19	**A**
Among Burn Intensities by sample year					
2005	unburned	15	1.65	2.09	**A**
	low	31	1.00	1.61	**AB**
	moderate-to-high	19	0.08	0.35	**B**
2004	unburned	11	0.83	0.88	**A**
	low	32	0.60	1.42	**A**
	moderate-to-high	15	0	0	**A**
2003	unburned	14	0.18	0.38	**A**
	low	37	0.08	0.23	**A**
	moderate-to-high	17	0.03	0.12	**A**
2002	unburned	13	0.08	0.28	**A**
	low	25	0	0	**A**
	moderate-to-high	17	0	0	**A**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown. Data recalculated to correct errors in last year's report.

It appears that Pawnee montane skippers are recovering in unburned and low severity burn areas with statistically significant increases in density in both 2004 (CNHP 2004) and 2005 (**Table 8-30**). Changes in availability of larval foodplants and adult nectar plants after the Hayman Fire do not explain the significantly fewer Pawnee montane skippers counted on moderate-to-high severity burn plots (see Section **8.3.1** Skipper (*Hesperia*) Occurrence). Instead, reduction in abundance of live trees in moderate-to-highly burned areas probably creates habitat less suitable for Pawnee montane skippers. In addition, recovery of Pawnee montane skipper populations in the moderate-to-high severity burn areas may depend on dispersal and recolonization by skippers from unburned and low severity burn areas, a process that may happen on a time scale greater than the four-year length of our study to date. Continued monitoring of the Hayman fire area is necessary to determine if, and when, re-occupation of intensely burned areas by Pawnee montane skippers occurs.

Table 8-30. Pawnee montane skippers (Hesperia leonardus montanus) per acre compared among burn intensities (unburned, low, and moderate-to-high) within sample years (2002, 2003, 2004, and 2005) for all transects sampled.

Year	Burn Intensity							
	Unburned			Low			Moderate-to-high	
	Means	Homogenous Groups (P=0.05)[1]		Means	Homogenous Groups (P=0.05)		Means	Homogenous Groups (P=0.05)
2005	1.65	**A**		1.00	**A**		0.08	**A**
2004	0.83	**AB**		0.60	**AB**		0	**A**
2003	0.18	**B**		0.08	**B**		0.03	**A**
2002	0.08	**B**		0	**B**		0	**A**

[1]Tukey's pairwise comparison test of means. Means followed by the same letter are not significantly different from one another; means followed by different letters are significantly different at the level of probability shown.
Data recalculated to correct errors in last year's report

8.3.3 Current versus Historic Habitat Condition

Total Pawnee montane skipper habitat within the South Platte River drainage was estimated at 24,831 acres, based upon extensive sampling and analysis of aerial photography completed within the drainage in the 1980s (ENSR 2003). Since 1996, forest fires have burned approximately 12,486 acres or approximately 48% of the mapped suitable habitat (ENSR 2003) (**Table 8-31**). Roughly half this amount, or 25% of total mapped skipper habitat, has been classified as low or low-to-moderate intensity burn. On such sites, the present monitoring study indicates that Pawnee montane skipper populations are recovering gradually in the Hayman area (**Table 8-30**), with 1.0 skippers acre on low burn intensity transects, and in the Buffalo Creek and High Meadow fire areas, where 0.25 and 1.01 skippers per acre, respectively, were recorded in 2005.

Table 8-31. Acres of Pawnee montane skipper habitat burned since 1996.[1]

Fire	Severity	Date	Acres Burned	Percent of Total Habitat
Buffalo Creek	Moderate-to-high[2]	May 1996	724	2.9
High Meadow	Moderate	June 2000	984	3.9
	High --- June	June 2000	604	2.4
Schoonover	Low --- May	May 2002	365	1.5
	Moderate and high	May 2002	124	0.5

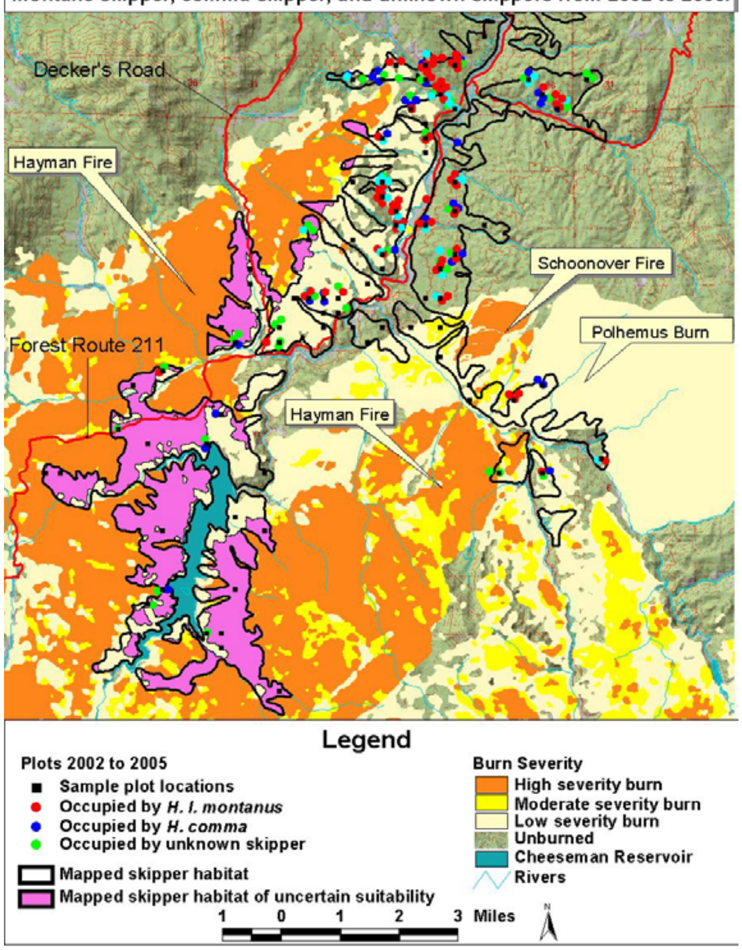
Fire	Severity	Date	Acres Burned	Percent of Total Habitat
Hayman	Low	June 2002	4,191	16.8
	Moderate	June 2002	1,011	4.1
	High	June 2002	4,033	16.2
Total			**12,026**	**48.3**

[1]Total estimated Pawnee montane skipper habitat: 24,831 acres.
[2]Assumed; no severity classification available.

8.4 Remapping Pawnee montane skipper habitat within the Hayman Fire

The majority of the records collected from 2002 to 2005 occur outside the moderate-to-high severity burn areas for both the comma skipper and Pawnee montane skipper (Figure 8-1). Removing areas of moderate-to-high severity burn from the estimated suitability map for the Pawnee montane skipper eliminates 4,823 acres, or roughly 20%, of the total habitat estimated as suitable for the butterfly (Figure 8-1).

Figure 8-1. Locations of the estimated suitable habitat of the Pawnee montane skipper, Hayman Fire sample plots, and plots occupied by Pawnee montane skipper, comma skipper, and unknown skippers from 2002 to 2005.



9.0 SUMMARY

Understanding the trends in population abundance of the Pawnee montane skipper, and the patterns of re-occupation in the Hayman, Buffalo Creek, and High Meadow fire areas, are important to planning for conservation of the Pawnee montane skipper in the South Platte River drainage. On the Hayman Fire Area, the number of Pawnee montane skippers observed in unburned and low severity burn plots increased in 2005, continuing the trend observed throughout this monitoring program. The number of Pawnee montane skippers per acre on unburned and low severity burn plots from 2002 to 2005 has increased from 0.08 to 1.65, and from 0 to 1.22, respectively. It appears that both Pawnee montane skipper abundance and habitat in unburned plots and low severity burn plots of the Hayman Fire, are continuing to recover from the severe drought and fire that both occurred in 2002. Gayfeather and live trees were at greater numbers on low severity burn plots occupied by Pawnee montane skippers in 2005 than on the average low severity burn plot. In fact, low severity burn plots occupied by Pawnee montane skippers were more similar to unburned plots in the average number of gayfeather and live trees, and in blue grama frequencies, than to the average low severity burn plot. The total number of Pawnee montane skippers observed per acre on all plots of the project area in 2005 was 0.8, a number that has steadily increased from 0.02 in 2002, to 0.09 in 2003, and to 0.49 in 2004. This is still far below the 2.1 to 3.6 Pawnee montane skippers per acre recorded in the 1980's (ERT 1986, 1988, 1989)

In 2005, Pawnee montane skippers in the Hayman Fire area were observed on eight of 15 unburned plots and 11 of 19 low severity burn plots, but on only one of 19 moderate-to-high severity burn plots.. Pawnee montane skippers are still not re-occupying moderate-to-high severity burn plots in any numbers. The observation of three Pawnee montane skippers on one moderate-to-high severity burn plot (549) in 2005 is difficult to interpret, because one moderate-to-high severity burn plot was also occupied in 2003, but this was followed in 2004 by a monitoring season that saw no skippers on any moderate-to-high severity burn plots. Additional monitoring will be needed to determine if, and when, the moderate-to-high severity burn plots are consistently re-occupied by Pawnee montane skippers at abundances comparable to unburned and low severity burn plots.

After four years it is evident that at this temporal scale the moderate-to-high severity burn areas represent habitat of poor suitability for Pawnee montane skippers. Suitability of these areas in the future is uncertain. Figure 8.1 illustrates that habitat previously mapped as suitable for the Pawnee montane skipper surrounding Cheesman Reservoir, south of Forest Route 211 (ERT 1986), is now of uncertain suitability for the butterfly. Also, the area north of Forest Route 211 along both sides of Decker's Road, previously mapped as suitable habitat, is now of uncertain suitability. Removing these areas of questionable suitability from the total previously mapped skipper habitat results in a current area of suitable skipper habitat that is that is roughly 20%, or 4,823 acres , less than that of 20 years ago. A potential habitat loss of 20% is important because this subspecies of butterfly is limited in its distribution, and is Federally Listed as Endangered. Preservation of the remaining 80% (20,221 acres) of the habitat currently estimatedas suitable will benefit the conservation of this subspecies of butterfly, and will require management of fire and forest thinning to preserve low density stands of ponderosa pine with a healthy herbaceous understory that includes both blue grama and gayfeather.

It is impossible to state with any certainty why Pawnee montane skippers are not re-occupying moderate–to-high severity burn areas. However, of the vegetation parameters we measured, there were significantly greater numbers of standing dead trees on moderate-to-high severity burns, and correspondingly fewer live trees in this burn condition, compared to unburned and low severity burn plots. Blue grama recovered quickly within moderate-to-high severity burn plots with frequencies being statistically the same among all habitat conditions except for in the year of the fire, 2002, when blue grama frequencies were significantly lower on the moderate-to-high severity burn plots. The same was true for the number of gayfeather stem counts, which were not statistically different on moderate-to-high severity burn plots compared to unburned and low severity burn plots in any year of monitoring. However, gayfeather did show increasing trends in flowering stem counts on all burn conditions of the Hayman Fire plots from 2002 to 2005. Why an absence of live ponderosa pine trees would discourage use of an area by Pawnee montane skippers is unknown. There are several possibilities. Live trees may supply microhabitat required by the butterfly to thermoregulate, during both hot afternoons and cool mountain nights. The loss of shade represented by a living forest may change local temperature and humidity regimes to the extent they are not longer suitable for the butterfly. Susceptibility to predation may be increased in such an open landscape and past evolutionary pressures may have lead to behavior that such such terrain by forest dwelling skippers. Whatever factors are responsible, four years of monitoring data suggest that something is significantly slowing Pawnee montane skipper re-occupation of moderate-to-high severity burn areas.

Four years of monitoring data show no differences in Pawnee montane skipper abundance or in the habitat parameters we measured for any of the low severity burn plots, which includes low severity burn plots in the Hayman Fire area and all transects within the Buffalo Creek and High Meadow fire areas. Within these plots and transects there were no significant differences in measured parameters among either the areas monitored or across years of the study. The abundance of *Hesperia* skippers (*H. comma* and *H. l. montana*) showed increasing trends within these fire areas form 2002 to 2005 with average numbers increasing from a low of zero in 2002 to a high 5.22 skippers per acre in 2005 on Hayman low severity burn plots; although, these changes were not statistically significant. Within low severity burn areas blue grama frequencies have fluctuated from 7.7 (± 4.6) to 29.5 (±35.5) percent without a clear trend in direction of change across years of the study. Flowering stem counts of gayfeather showed increasing trends from 2002 to 2005 on all the low severity burn areas, but these increases were not significant. The numbers of live and dead trees were similar on all three fire areas and remained consistent throughout the four years of monitoring. Skipper numbers and gayfeather appear to be recovering from both drought and fire on all low severity burn areas.

[BAD1]When data from all burn conditions and all three fire areas (Hayman, Buffalo Creek, and High Meadow) are combined, the abundance of pooled *Hesperia* skippers (*H. comma* and *H. l. montana*) is shown to have increased significantly every year from 2003 to 2005, and the abundance of Pawnee montane skippers increased significantly between 2003 and 2004. Frequencies of blue grama fluctuated from year to year, without a clear trend in direction of change across years of the study, but have converged in all three burn categories to a level of just under 10%. Flowering stem counts of gayfeather increased significantly every year from 2003 to 2005.

Trends among the burn conditions for the parameters measured, when data from all three fire areas (Hayman, Buffalo Creek, and High Meadow) are combined, tended to parallel those trends observed in the Hayman Fire areas. Increasing abundance both of pooled *Hesperia* skippers (*H. comma* and *H. l. montana*) and of Pawnee montane skippers alone were observed in unburned and low severity burn plots throughout the four years of monitoring. Pawnee montane skipper abundance was greater on unburned and low severity burn plots than on moderate-to-high severity burn plots. This difference in Pawnee montane skippers was statistically significant between unburned plots and moderate-to-high severity burn plots in 2005. The pooled *Hesperia* skipper sample did appear to rebound in moderate-to-high severity burn plots in 2005, when there were six times as many skippers observed (0.71/acre ± 1.29) than in any other year of monitoring. This suggests that common branded skippers may have begun re-occupying the moderate-to-high severity burn plots, whereas the Pawnee montane skipper has not. This is an important observation and might suggest that Pawnee montane skippers may also recolonize these areas in future years as conditions become more suitable. A corollary conclusion of this theory is that Pawnee montane skipper is less tolerant of changes in crucial habitat characteristics than is the common branded skipper.

Frequencies of blue grama did not differ among any of the burn conditions in any year of monitoring and fluctuated among years without a trend in direction of change. Flowering stem counts of gayfeather were also similar among all burn conditions in every year, but counts consistently increased from 2002 to 2005 in every burn condition. Considering all three fire areas together, gayfeather counts in 2005 were actually significantly greater in moderate-to-high severity burn plots than in low severity burn plots,- - suggesting that a lack of nectar source availability is not the factor impeding re-occupation of moderate-to-high severity burn areas by Pawnee montane skippers.

10.0 CONCLUSIONS

The abundance of *Hesperia* skippers, including the Pawnee montane skipper, has increased throughout all four years of this monitoring project. In 2005, Pawnee montane skippers were at the highest densities recorded during the four years of this project. The condition of gayfeather and blue grama, the butterflies' primary adult and larval food plants, respectively, continue to improve throughout the study area from the poor conditions recorded in 2002, when severe drought and the Hayman Fire caused a decline in herbaceous cover of the forest understory in the South Platte Valley. Normal amounts of soil moisture in future years may allow *Hesperia* skippers to continue their upward trend in population abundance by insuring adequate densities of larval and adult foodplants. With 0.8 Pawnee montane skippers per acre recorded on all monitored plots in 2005, densities are still below the 2.1 to 3.6 per acre observed in the 1980s in the South Platte River Valley.

Pawnee montane skippers have not re-occupied moderate-to-high severity burn areas of the Hayman Fire. Numbers of Pawnee montane skipper per acre within this burn condition were 0 in 2002, 0.03 in 2003, 0 in 2004, and 0.08 in 2005. Lack of re-occupancy appears not to result from loss of host and nectar plant populations, as those populations are similar over all burn conditions in monitored plots. It is more likely that the reduction of live trees to near zero on moderate-to-high severity burn areas created habitat that is of reduced suitability for *Hesperia* skippers. A healthy forest overstory may provide microhabitat attributes that are essential to butterfly survival and reproduction. If so, areas currently estimated as suitable habitat for the Pawnee montane skipper (roughly 80% of that identified as suitable 20 years ago), must be managed to preservelow density stands of ponderosa pine with a healthy herbaceous understory that includes both blue grama and gayfeather. .

AlthoughPawnee montane skippers are not yet re-occupying the moderate-to-high severity burn plots, common branded skippers did show a six-fold increase in number in these plots in 2005, suggesting that this species has less stringent habitat requirements than the Pawnee montane skipper. Continued monitoring will be required to verify if Pawnee montane skippers recolonize these moderate-to-high severity burn areas.

11.0 RECOMMENDATIONS

The Pawnee montane skipper occupation map should be updated with the new map represented in **Figure 8-1**, which is based on the 1986 map. All low severity burn areas are included, with occupation of these areas having been verified through our monitoring, while all high severity burn areas are highlighted separately and identified as uncertainty in their occupancy by Pawnee montane skippers. Pawnee montane skipper occurrence data collected since 2002, showing the extent of skippers in both the recently burned areas, and the entire South Platte River drainage, confirms this mapping coverage.

A habitat occupation survey should continue to verify if, and when, Pawnee montane skipper reoccupy the moderate-to-high severity burn plots. Survey work should be focused on moderate-to-high severity burn areas, to document occupation of these areas by Pawnee montane skippers, but should also include some low severity burn plots and some unburned plots to verify that skippers within these areas continue their recovery to abundances observed in the 1980s. This occupation survey should continue over several years, to determine distribution of skippers in burned areas, and for reference need include only a reduced number of unburned areas, where the current monitoring effort has confirmed that populations are increasing.

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APPENDIX A: 2005 FIELD PROTOCOL PAWNEE MONTANE SKIPPER POST-FIRE HABITAT ASSESSMENT SURVEY AUGUST/SEPTEMBER 2005

Adult Skipper and Skipper Habitat Monitoring in the Burn Areas of the Hayman, Schoonover, Buffalo Creek, and High Meadow Forest Fires+

1. Study Purpose and Scope

The Hayman and Schoonover forest fires burned across a large fraction of the suitable Pawnee Montane Skipper habitat during the summer of 2002. The primary purpose of this monitoring program is to document skipper survival and habitat condition in both burned and unburned skipper habitat in 2005, the fourth flight season for this butterfly species after the fire. Thus, a secondary purpose is to continue the sampling program begun in 2002 as the next step in a long-term monitoring program that can be repeated regularly as the habitat recovers from the fires. The geographical area of this study includes both sides of Cheesman Reservoir, the South Platte drainage between the confluence of Wigwam Creek and the northern boundary of the Hayman Fire in the vicinity of Oxyoke, and the Horse Creek drainage southeast of Deckers. Unburned areas within the South Platte drainage to be sampled extend from Trumbull on the south to Long Scraggy Peak on the north.

The USFS has prepared a burn severity map for the study area outlined above. This burn severity map, combined with the map of skipper habitat suitability, has been used to establish the sampling study area.

The field sampling methods and sampling units are the same as those used for rapid assessment sampling of skipper habitat and occurrence developed for the 1986 Two Forks Dam field study program (ERT 1986). Sample sites were selected randomly so that comparative statistical analyses can be conducted. Because many of the sites are located within burn areas, other parameters (ground stratum burn percentage, number of live and standing dead trees greater than 6 inches DBH, evidence of BAER treatment work) were added to the data collection program in previous years. The sampling methods to be used in 2005 are modifications of those used in previous years.

The primary outputs of this 2005 program will be a quantitative estimate of skipper numbers based on belt transect counts, an estimate of the number of blooming *Liatris* stems (primary adult skipper nectar source), the frequency of Blue Grama grass clumps (skipper larval foodplant), and both living and standing dead trees within the study area outlined above. Another output of this work will be a revised map of suitable skipper habitat in the upper South Platte drainage, based on these field studies and interpretation of post-fire satellite imagery.

+ See 2005 Addendum for the Buffalo Creek and High Meadow fires on page six.

Sampling Design and Sampling Order

The unit of sampling is a 40-acre habitat block. In 2002 the study area was divided into a grid of 40-acre blocks in GIS. A unique number was then assigned to each 40-acre unit within the grid. An overlay of the fire intensity maps (Hayman and Schoonover) was placed over the grid to establish the boundaries of burned versus unburned areas. Then the skipper habitat suitability map layer was placed over the burn map to establish the location of burned versus unburned skipper habitat. The grid numbers that corresponded to locations within suitable skipper habitat (burned and unburned) were selected as a subset of the total grid. These grid numbers were reordered through a randomization program in Microsoft Excel. The randomized 40-acre units were then listed as a sampling order for three sub-areas: (1) Cheesman Reservoir and Horse Creek, (2) burned areas between Cheesman Reservoir and the northern boundary of the Hayman Fire, and (3) unburned areas from the vicinity of Deckers northward to the northern boundary of the Hayman Fire. Potential sampling areas were further reduced by eliminating blocks that were predominantly on private lands, and blocks where estimated suitable habitat was less than 75 percent of the block. The following maps are to be used in this protocol:

- An index map showing the 40-acre blocks proposed for sampling (plus some extra sites);
- The numbered sampling sites over: (a) topography and legal land base; (b) land ownership; and (c) skipper suitable habitat polygons;
- The numbered sampling sites over: (a) fire intensity map; and (b) skipper suitable habitat polygons.

To collect data comparable to those obtained during the first two monitoring efforts, this year's monitoring effort will be within the same 55 sampling units visited in 2002, 2003, and 2004. However, instead of the sampling all 55 units, budget constraints have reduced the number of units guaranteed to be sampled to 40, although more (up to the total of 55) will be sampled if possible. Consistent with the goals for this program, developed collaboratively in 2002 - 2005 with USFS and USFWS, the 2005 monitoring effort will assess habitat conditions as well measure skipper activity as an estimate of population density.

Field teams will consist of a minimum of 2 persons each, although the number of field teams to participate during the study are not yet known with certainty, pending finalization of funding for independent contractors and establishment of availability of agency personnel.

It is anticipated that consultation with Denver Water will lead to suitable dates for teams to work in the restricted Cheesman Reservoir area. One or two crews will need boat support; the other crews will work north of the dam and will not require additional vehicle or boat support.

2. Field Sampling Methods

Sampling site locations. The UTM coordinates for the center point of each sampling site are indicated on the sampling order lists located behind the Sampling Order table in the protocol. Each team will use GPS to find this center point, and then start the diamond-shaped transect at a point 50 meters south of the center point. Each team will sample the transect in a clockwise direction, starting on a compass bearing of 315°, and completing four 200-meter legs at 90°-angles to create the diamond-shaped transect within the 40-acre block.

Sampling Transect. The attached protocol ***Pawnee Montane Skipper: 2005 Instructions for Post Fire Transects*** provides guidance for establishing the 800-meter belt sampling transect (four 200-meter legs), establishing the intermediate sampling intervals along the transect, and taking documentary photographs.

Data Collection. This section provides guidance for filling in information on the data sheet "PAWNEE MONTANE SKIPPER SURVEY DATA SHEET 2005 --- Hayman Burn Area." The width of the belt transect is 10 meters (5 meters on each side of the center line). All data will be taken within this area with the exception of other observations that would be useful in analyzing habitat conditions. These additional observations should be written on the back of the data sheet.

➢ **Heading (top of data sheet): Observers, weather conditions, etc.**

- Record the date and the names of members of the survey team, fill in the sample block # from the sampling order table, and record the UTM coordinates of the center point in the upper right-hand corner of the data sheet (you should also enter this coordinate into your team's GPS unit if it has not already been inputted; also, ***be certain*** that your GPS unit is set to map datum **NAD27 CONUS** and that you adjust your compass use to an **+11° declination)**.
- When you are ready to start the transect, record the prevailing weather conditions: estimate Cloud Cover to the nearest 10%, actual (or estimated) Temperature, and relative Wind speed (L = none to taller grass in motion; M = leaves and limbs of flexible shrubs in motion; H = limbs of larger trees in motion).

➢ **At the top of the individual form for each 200-meter leg, record:**

- The starting compass bearing (should be 315°)
- Start and end times for the leg.
- After taking the requisite two photographs at each corner of the transect diamond, check the photo boxes for start and finish photos.
- Record the GPS coordinates at the beginning point of each leg (i.e., the four corners of the diamond transect).

- **In the body of the form for each 200-meter leg, record data by 20-meter segments along each 200-meter leg of the overall transect.**

- **Trees:** Count only those trees over 6" DBH (diameter at breast height). A tree is scored as living if there are green needles remaining on the tree at the time of sampling, even though the tree may be partially or mostly burned, or may be dying for other reasons. Dead trees should meet the same diameter criteria and should be standing or leaning, even if supported by other trees. Do not count trees lying on the ground. (The purpose of recording both dead and live trees is to characterize the forest architecture of the skipper habitat.)
- **Bogr:** At the start of each 20-meter segment, document the presence or absence of Blue Grama (*Bouteloua gracilis*) within a visually estimated 0.5 meter-square rectangular quadrat that extends 0.5 m on either side of the observer's toe, and 0.5 meter in front of the toe. Mark √ for presence in the appropriate space on the data sheet.
- **Lipu:** Stems of blooming Prairie Gayfeather (*Liatris punctata*) will be counted in each 20-meter segment within the 10-meter wide survey area. Commonly there will be multiple blooming stems emanating from the crown of an individual *Liatris* plant. Count all flowering stems, but only those stems that have open flowers.
- **Skipper butterflies (Hlm and Hco):** Individual skipper butterflies of either the Common Branded Skipper (*Hesperia comma*) or the Pawnee Montane Skipper (*Hesperia leonardus montana*) should be counted as they are encountered in each 20-meter segment along the transect. The sex of the skipper (if determined) should be entered into the appropriate box (for each skipper species, male on left, female in the middle, and unknown on the right). If the skipper species is unknown, it should be entered in the UNK column, where the sex (if it can be determined) will be entered into the appropriate box. All skippers observed during transit between transects should be recorded with GPS coordinates on the back of a data sheet. **See color illustrations of these two species (attached).**

3. Program Coordination and Safety

Field teams will meet at the Trumbull public park (Dott Park) at 9:00 AM each day of sampling to review progress and to resolve problems. The field teams will meet back at the start location at the end of field sampling to insure that all teams are safely out of the field, and that all data sheets are turned over to the field coordinator (Boyce Drummond: 970-690-7455). Steve Culver (303-275-5614) of USFS will have the overall responsibility for insuring team compliance with fire-related access restrictions and worker safety requirements. Ms. Jenny McCurdy (303-628-6542) will be the Denver Water representative for access needed to Denver Water Cheesman Reservoir property, and other DW property along the river.

Much of the terrain to be sampled is quite steep and rocky; participants should have sturdy footwear with ankle support. Each participant must take adequate water to prevent dehydration and should have sunscreen to prevent sunburn.

4. Equipment List

The following is the minimum equipment needed by each team:

- GPS unit (preferably Garmin with a minimum of 5-10 meter accuracy) set to map datum NAD27 CONUS.
- Compass (rotating dial required for changing bearings), with declination set to 11^{o} east ($+11^{o}$).
- Digital Camera (film camera is ok, but digital prints on CD must be ordered at the time of processing.)
- Clipboard and data sheets
- Two hand counters for counting trees and *Liatris* stems
- Thermometer
- White board and marking pen
- Walking stick with a ½ meter/ meter interval to check Blue Grama quadrat size. A short meter tape is also acceptable, and may be easier to carry.
- 5-meter length of string to illustrate extent of transect on either side of center line.
- USFS radio for inter-team communication
- Color photographs for identifying and distinguishing *Hesperia comma* and *Hesperia leonardus montana.*
- Copy of ***Pawnee Montane Skipper: 2005 Instructions for Post-fire Transects*** (yellow double-sided sheet)

2005 Addendum: Buffalo Creek and High Meadow Fire Transects

To better interpret the response of Pawnee Montane Skipper populations to forest fires, monitoring transects were established in 2003 in the areas affected by the Buffalo Creek (1996) and High Meadow (2000) fires. These 1000-meter linear transects were established on roughly parallel N-S axes, located approximately 400 meters apart. There are 6 transects in each of two areas (see attached maps). The 6 Buffalo Creek transects are centered on the Buffalo Creek drainage as it parallels Douglas County Road 543 about 2 miles southwest of the Buffalo Creek USFS Work Station (USFS lock access required). The 6 High Meadow transects are located in Pine Valley Ranch Park and are start just west of the Picnic Shelter on the south side of the North Fork of the South Platte River.

These 12 transects were sampled in 2003 and 2004 using the methods described above for the Hayman Fire blocks, except that they **are linear instead of diamond-shaped** and are **1000m in length instead of 800 meters**. There are 4 transect "legs," each of 250 meters length. Each "leg" is subdivided into 10 sample units, each of 25 meters in length. (Compare this with the diamond transects, whose four 200-meter legs are subdivided into 10 sample units, each of 20 meters length.)

A Survey Data Sheet has been designed for the Buffalo Creek and High Meadow transectsthat closely follows the Survey Data Sheet for the Hayman Post-Fire Surveys, *viz.* **"PAWNEE MONTANE SKIPPER SURVEY DATA SHEET 2005 --- Buffalo Creek (BC) and High Meadow (HM) Burn Areas."**

APPENDIX B: Hayman Transect Data

2005

Pers/Unburn	Pers Intensit	Transect I	Date Sampled	Live Tree	Live Trees/	Dead Trees	Dead Trees/	All Trees/A	Pogo X P	Lips	Lips/A	Hlm	Hes	UNK	Total Skipper	Skippers/A	OFFSITE
0	0	317	82905	66	33	16	8	41	21	1284	650	0	2	9	11	6	0
0	0	318	82905	173	88	7	4	91	24	643	325	0	0	4	4	2	2
0	0	320	90805	210	106	2	1	107	5	48	24	8	2	2	12	6	0
0	0	324	82905	112	57	4	2	59	1	64	32	0	6	8	14	7	0
0	0	326	90805	164	83	5	3	85	8	0	0	3	5	5	13	7	0
0	0	327	92905	118	60	0	0	60	3	424	214	0	4	17	21	11	0
0	0	330	83005	69	35	0	0	35	10	0	0	0	2	7	9	5	0
0	0	333	83005	159	80	0	0	80	13	263	133	4	0	5	9	5	27
0	0	335	83005	206	104	21	11	115	5	24	12	4	12	13	29	15	0
0	0	339	82905	133	67	2	1	68	3	374	189	1	15	15	31	16	1
0	0	342	90805	246	124	6	3	127	5	60	30	0	2	3	5	3	4
0	0	343	83005	72	36	17	9	45	14	320	162	12	4	16	32	16	2
0	0	345	82905	89	45	2	1	46	6	360	182	7	9	16	32	16	0
0	0	347	90805	175	89	0	0	89	16	473	239	10	7	0	17	9	0
0	0	348	90805	185	94	4	2	96	12	17	9	0	10	3	13	7	0
1	1	2	90105	25	13	88	45	57	0	563	285	0	0	4	4	2	0
1	1	5	90105	27	14	40	20	34	9	256	129	0	0	0	0	0	0
1	1	15	90605	133	67	57	29	96	7	128	65	0	3	0	3	2	0
1	1	518	83105	136	69	14	7	76	4	275	139	7	3	20	30	15	1
1	1	521	90705	74	37	33	17	54	12	484	245	3	3	3	9	5	2
1	1	525	83105	44	22	13	7	29	6	206	104	2	0	8	10	5	0
1	1	527	83005	253	128	169	85	213	8	18	9	0	0	1	1	1	0
1	1	528	90605	131	66	50	25	92	12	108	55	0	0	4	4	2	0
1	1	530	83105	294	149	157	79	228	10	155	78	4	2	10	16	8	0
1	1	532	83105	123	62	9	5	67	9	52	26	0	0	0	0	0	2
1	1	534	83105	95	48	37	19	67	3	397	201	4	3	1	8	4	11
1	1	538	83105	101	51	7	4	55	4	86	44	0	0	4	4	2	0
1	1	539	83005	68	34	14	7	41	8	73	37	1	1	1	3	2	0
1	1	540	90705	38	19	55	28	47	17	176	89	0	0	3	3	2	0
1	1	541	83105	76	38	35	18	56	11	18	9	3	4	1	8	4	12
1	1	542	83005	102	52	19	10	61	24	77	39	2	4	10	16	8	3
1	1	544	90605	79	40	52	26	66	18	495	250	2	6	12	20	10	0
1	1	547	83105	138	70	27	14	83	12	381	193	16	5	13	34	17	0
1	1	548	83005	58	29	41	21	50	6	229	116	2	1	20	23	12	2
1	2	1	90605	0	0	163	82	82	1	783	396	0	0	0	0	0	0
1	2	3	90105	4	2	122	62	64	9	366	185	0	0	3	3	2	0
1	2	11	90105	0	0	45	23	23	11	222	112	0	0	0	0	0	0
1	2	16	90605	0	0	21	11	11	9	694	351	0	1	5	6	3	0
1	2	17	90205	18	9	116	59	68	5	221	112	0	0	0	0	0	0
1	2	18	90105	0	0	42	21	21	14	708	358	0	0	0	0	0	0
1	2	20	90705	0	0	47	24	24	3	1110	562	0	0	0	0	0	0
1	2	21	90605	0	0	101	51	51	0	0	0	0	0	0	0	0	0
1	2	23	90105	0	0	127	64	64	13	67	34	0	0	0	0	0	0
1	2	27	90105	0	0	82	41	41	18	841	425	0	0	0	0	0	0
1	2	31	90105	0	0	85	43	43	18	373	189	0	0	0	0	0	0
1	2	35	90105	0	0	43	22	22	4	101	51	0	0	0	0	0	0
1	2	38	90105	2	1	75	38	39	8	245	124	0	0	0	0	0	1
1	2	49	90705	0	0	136	69	69	2	858	434	0	0	0	0	0	0
1	2	520	90605	0	0	139	70	70	12	186	94	0	2	3	5	3	0
1	2	522	90605	0	0	114	58	58	16	369	187	0	2	6	8	4	0
1	2	523	90205	11	6	83	42	48	12	127	64	0	1	1	2	1	0
1	2	549	90605	2	1	137	69	70	11	502	254	3	1	12	16	8	0
1	2	568	90705	13	7	442	224	230	16	220	111	0	0	0	0	0	0
			Totals/Mean	177/41	2136/40	3123/59	1580/30	3716/70	508/10	524/312	8359/158	98/2	22/2	58/5	488/9	247/5	70/1

2004

Burn/Unburn	Burn intensity	Transect #	Date sampled	live trees	live trees/A	dead trees	dead trees/A	all trees/A	Bogr % F	Lipu	Lipu/A	Hlm	Hco	UNK	OFFSITE	total skip	skip/acre
0	0	317	90204	33	17	3	2	320	10	494	250	0	0	0	0	0	0.00
0	0	318	90704	122	62	0	0	318	5	38	19	1	0	0	0	1	0.51
0	0	320	90204	255	129	8	4	328	18	101	51	4	6	2	0	12	6.07
0	0	324	83104	93	47	4	2	328	26	32	16	0	0	3	0	3	1.52
0	0	330	90104	66	33	1	1	331	23	28	14	3	1	0	2	4	2.02
0	0	335	90704	377	191	58	29	393	1	7	4	0	4	2	0	6	3.04
0	0	339	83104	98	50	1	1	340	8	172	87	5	13	10	0	28	14.16
0	0	342	90204	265	134	8	4	350	8	153	77	0	1	2	0	3	1.52
0	0	343	90104	136	69	13	7	356	13	85	43	2	1	0	3	3	1.52
0	0	345	90204	85	43	1	1	346	8	417	211	1	1	30	0	32	16.19
0	0	347	90704	298	151	20	10	367	10	31	16	2	5	5	0	12	6.07
1	1	2	90804	0	0	111	56	113	8	257	130	0	0	0	0	0	0.00
1	1	5	90804	17	9	25	13	30	3	5	3	0	0	0	0	0	0.00
1	1	12	90804	0	0	205	104	217	5	36	18	0	0	0	2	0	0.00
1	1	13	90704	72	36	74	37	87	8	68	34	0	0	2	2	2	1.01
1	1	14	90704	32	16	97	49	111	8	357	181	1	0	0	4	1	0.51
1	1	15	90104	183	93	92	47	107	9	173	88	0	1	0	1	1	0.51
1	1	26	90104	161	81	4	2	30	9	166	84	1	2	1	0	4	2.02
1	1	337	90704	185	94	13	7	350	9	38	19	0	0	2	0	2	1.01
1	1	518	90204	114	58	47	24	565	43	99	50	1	2	3	1	6	3.04
1	1	521	90304	176	89	55	28	576	15	285	144	0	1	1	0	2	1.01
1	1	525	90104	172	87	85	43	610	4	298	151	0	0	0	0	0	0.00
1	1	527	90704	379	192	154	78	681	15	14	7	0	2	1	0	3	1.52
1	1	528	90704	242	122	63	32	591	10	91	46	0	0	0	0	0	0.00
1	1	530	90304	158	80	5	3	535	19	300	152	11	0	0	0	11	5.56
1	1	534	90204	249	126	27	14	561	6	228	115	0	0	0	0	0	0.00
1	1	538	90304	205	104	12	6	550	10	28	14	3	0	0	1	3	1.52
1	1	540	90304	6	3	57	29	597	12	423	214	0	0	0	0	0	0.00
1	1	544	90204	67	34	92	47	636	15	112	57	1	1	0	1	2	1.01
1	1	547	90304	103	52	84	42	631	13	121	61	7	6	3	0	16	8.09
1	1	548	90204	145	73	103	52	651	3	58	29	1	0	0	0	1	0.51
1	2	1	90104	0	0	138	70	139	8	1062	537	0	0	2	0	2	1.01
1	2	3	90804	0	0	185	94	188	12	13	7	0	0	0	0	0	0.00
1	2	11	90804	0	0	45	23	56	12	115	58	0	0	0	0	0	0.00
1	2	16	90204	10	5	20	10	36	94	152	77	0	0	0	0	0	0.00
1	2	17	90104	0	0	130	66	147	0	285	144	0	0	0	0	0	0.00
1	2	18	90804	0	0	90	46	108	14	49	25	0	0	0	0	0	0.00
1	2	20	90204	0	0	196	99	216	1	2	1	0	0	0	0	0	0.00
1	2	23	90804	0	0	84	42	107	6	61	31	0	0	0	0	0	0.00
1	2	27	90804	18	9	56	28	83	48	321	162	0	0	0	0	0	0.00
1	2	31	90804	0	0	30	15	61	11	11	6	0	0	0	0	0	0.00
1	2	35	90804	0	0	71	36	106	3	15	8	0	0	0	0	0	0.00
1	2	38	90804	0	0	106	54	144	8	52	26	0	0	0	1	0	0.00
1	2	520	90204	35	18	192	97	712	2	62	31	0	0	0	0	0	0.00
1	2	522	90704	0	0	195	99	717	17	37	19	0	0	0	0	0	0.00
1	2	523	90104	0	0	196	99	719	4	126	64	0	0	0	0	0	0.00
			Totals/Means	4557/99	2305/50	3256/71	1647/36	15545/338	594/13	7078/154	3580/78	44/1	47/1	69/2	NA/18	160/3	80.94/1.76

2003

Burn/Unburn	Burn intensity	Transect #	Date sampled	live trees	live trees/A	dead trees	dead trees/A	all trees/A	Bogr % F	Lipu	Lipu/A	Hlm	Hco	UNK	OFFSITE	total skip	skip/acre
0	0	317	90204	33	17	3	2	320	10	494	250	0	0	0	0	0	0.00
0	0	318	90704	122	62	0	0	318	5	38	19	1	0	0	0	1	0.51
0	0	320	90204	255	129	8	4	328	18	101	51	4	6	2	0	12	6.07
0	0	324	83104	93	47	4	2	328	26	32	16	0	0	3	0	3	1.52
0	0	330	90104	66	33	1	1	331	23	28	14	3	1	0	2	4	2.02
0	0	335	90704	377	191	58	29	393	1	7	4	0	4	2	0	6	3.04
0	0	339	83104	98	50	1	1	340	8	172	87	5	13	10	0	28	14.16
0	0	342	90204	265	134	8	4	350	8	153	77	0	1	2	0	3	1.52
0	0	343	90104	136	69	13	7	356	13	85	43	2	1	0	3	3	1.52
0	0	345	90204	85	43	1	1	346	8	417	211	1	1	30	0	32	16.19
0	0	347	90704	298	151	20	10	367	10	31	16	2	5	5	0	12	6.07
1	1	2	90804	0	0	111	56	113	8	257	130	0	0	0	0	0	0.00
1	1	5	90804	17	9	25	13	30	3	5	3	0	0	0	0	0	0.00
1	1	12	90804	0	0	205	104	217	5	36	18	0	0	0	2	0	0.00
1	1	13	90704	72	36	74	37	87	8	68	34	0	0	2	2	2	1.01
1	1	14	90704	32	16	97	49	111	8	357	181	1	0	0	4	1	0.51
1	1	15	90104	183	93	92	47	107	9	173	88	0	1	0	1	1	0.51
1	1	26	90104	161	81	4	2	30	9	166	84	1	2	1	0	4	2.02
1	1	337	90704	185	94	13	7	350	9	38	19	0	0	2	0	2	1.01
1	1	518	90204	114	58	47	24	565	43	99	50	1	2	3	1	6	3.04
1	1	521	90304	176	89	55	28	576	15	285	144	0	1	1	0	2	1.01
1	1	525	90104	172	87	85	43	610	4	298	151	0	0	0	0	0	0.00
1	1	527	90704	379	192	154	78	681	15	14	7	0	2	1	0	3	1.52
1	1	528	90704	242	122	63	32	591	10	91	46	0	0	0	0	0	0.00
1	1	530	90304	158	80	5	3	535	19	300	152	11	0	0	0	11	5.56
1	1	534	90204	249	126	27	14	561	6	228	115	0	0	0	0	0	0.00
1	1	538	90304	205	104	12	6	550	10	28	14	3	0	0	1	3	1.52
1	1	540	90304	6	3	57	29	597	12	423	214	0	0	0	0	0	0.00
1	1	544	90204	67	34	92	47	636	15	112	57	1	1	0	1	2	1.01
1	1	547	90304	103	52	84	42	631	13	121	61	7	6	3	0	16	8.09
1	1	548	90204	145	73	103	52	651	3	58	29	1	0	0	0	1	0.51
1	2	1	90104	0	0	138	70	139	8	1062	537	0	0	2	0	2	1.01
1	2	3	90804	0	0	185	94	188	12	13	7	0	0	0	0	0	0.00
1	2	11	90804	0	0	45	23	56	12	115	58	0	0	0	0	0	0.00
1	2	16	90204	10	5	20	10	36	94	152	77	0	0	0	0	0	0.00
1	2	17	90104	0	0	130	66	147	0	285	144	0	0	0	0	0	0.00
1	2	18	90804	0	0	90	46	108	14	49	25	0	0	0	0	0	0.00
1	2	20	90204	0	0	196	99	216	1	2	1	0	0	0	0	0	0.00
1	2	23	90804	0	0	84	42	107	6	61	31	0	0	0	0	0	0.00
1	2	27	90804	18	9	56	28	83	48	321	162	0	0	0	0	0	0.00
1	2	31	90804	0	0	30	15	61	11	11	6	0	0	0	0	0	0.00
1	2	35	90804	0	0	71	36	106	3	15	8	0	0	0	0	0	0.00
1	2	38	90804	0	0	106	54	144	8	52	26	0	0	0	1	0	0.00
1	2	520	90204	35	18	192	97	712	2	62	31	0	0	0	0	0	0.00
1	2	522	90704	0	0	195	99	717	17	37	19	0	0	0	0	0	0.00
1	2	523	90104	0	0	196	99	719	4	126	64	0	0	0	0	0	0.00
			Totals/Means	4557/99	2305/50	3256/71	1647/36	15545/338	594/13	7078/154	3580/78	44/1	47/1	69/2	NA/18	160/3	80.94/1.76

2002

Burn/Unburn	Burn intensity	Transect #	Date sampled	live trees	live trees/A	Bagr X F	Lipu	Lipu/A	Hlm	Hco	UNK	OFFSITE	totalskip	skip/acre
0	0	317	90302	288	146	25	25	13	0	0			0	0.00
0	0	318	90302	201	102	23	2	1	0	0			0	0.00
0	0	324	90302	337	171	13	23	12	2	0			2	1.01
0	0	327	90302	469	237	8	1	1	0	0			0	0.00
0	0	330	90302	121	61	45	0	0	0	0			0	0.00
0	0	335	90302	292	148	18	2	1	0	0			0	0.00
0	0	339	90402	377	191	15	4	2	0	0			0	0.00
0	0	343	90402	120	61	30	49	25	0	0			0	0.00
0	0	345	91102	178	90	10	8	4	0	0			0	0.00
0	0	347	90402	246	124	35	2	1	0	0			0	0.00
0	0	348	91102	384	194	38	1	1	0	0			0	0.00
0	0	1757	91102	156	79	33	2	1	0	0			0	0.00
0	0	1857	91102	115	58	10	0	0	0	0			0	0.00
1	1	337	91102	260	132	43	1	1	0	0			0	0.00
1	1	2	90602	41	21	30	1	1	0	0			0	0.00
1	1	5	90602	303	153	25	0	0	0	0			0	0.00
1	1	12	90602	36	18	5	0	0	0	0			0	0.00
1	1	13	90502	45	23	25	1	1	0	0			0	0.00
1	1	14	90502	48	24	23	0	0	0	0			0	0.00
1	1	15	90902	99	50	0	0	0	0	0			0	0.00
1	1	26	91002	88	45	20	4	2	0	0			0	0.00
1	1	518	90402	155	78	28	0	0	0	0			0	0.00
1	1	521	90402	91	46	23	1	1	0	0			0	0.00
1	1	525	90402	81	41	10	0	0	0	0			0	0.00
1	1	527	90502	91	46	25	0	0	0	0			0	0.00
1	1	528	90402	58	29	15	0	0	0	0			0	0.00
1	1	530	90402	161	81	23	0	0	0	0			0	0.00
1	1	532	90402	260	132	30	0	0	0	0			0	0.00
1	1	534	91102	494	250	15	0	0	0	0			0	0.00
1	1	536	90502	75	38	28	0	0	0	0			0	0.00
1	1	538	90502	298	151	25	0	0	0	0			0	0.00
1	1	539	90502	175	89	20	0	0	0	0			0	0.00
1	1	540	90502	73	37	38	0	0	0	0			0	0.00
1	1	541	90902	318	161	28	0	0	0	0			0	0.00
1	1	542	91102	60	30	38	0	0	0	0			0	0.00
1	1	544	90902	88	45	30	1	1	0	0			0	0.00
1	1	547	90902	404	204	25	0	0	0	0			0	0.00
1	1	548	91102	184	93	15	0	0	0	0			0	0.00
1	2	1	91002	13	7	3	3	2	0	0			0	0.00
1	2	3	90602	0	0	10	0	0	0	0			0	0.00
1	2	11	90602	0	0	15	0	0	0	0			0	0.00
1	2	16	90902	1	1	25	37	19	0	0			0	0.00
1	2	17	90902	0	0	3	8	4	0	0			0	0.00
1	2	18	90602	0	0	13	0	0	0	0			0	0.00
1	2	20	90902	0	0	3	0	0	0	0			0	0.00
1	2	21	90902	0	0	0	0	0	0	0			0	0.00
1	2	27	90602	0	0	28	0	0	0	0			0	0.00
1	2	31	90602	0	0	0	0	0	0	0			0	0.00
1	2	35	90602	0	0	0	0	0	0	0			0	0.00
1	2	38	90602	0	0	0	0	0	0	0			0	0.00
1	2	23	90602	0	0	3	0	0	0	0			0	0.00
1	2	520	90402	1	1	23	0	0	0	0			0	0.00
1	2	522	90402	0	0	5	0	0	0	0			0	0.00
1	2	523	90502	16	8	23	0	0	0	0			0	0.00
1	2	549	91002	0	0	5	0	0	0	0			0	0.00
				7301/133	3695/67	1049/19	176/3	89/2	2/0.04	0/0			2/0.04	1/0.02

APPENDIX C: Buffalo Creek and High Meadow Transect Data

BC Transects 2005

Burn intensity	Transect #	Date sampled	live trees	live trees/A	dead trees	dead trees/A	all trees_A	Bogr_F	Lipu	Lipu_A	Hlm	Hco	UNK	total skip	skip/acre	OFFSITE
1	BC1	38597	75	30	85	34	65	5	108	44	0	3	2	5	2	0
1	BC2	38597	108	44	55	22	66	4	38	15	0	2	6	8	3	0
1	BC3	38597	161	65	25	10	75	7	74	30	2	1	3	7	3	0
1	BC4	38597	113	46	30	12	58	8	345	140	1	1	2	4	2	0
1	BC5	38597	36	15	28	11	26	9	338	137	0	0	1	1	0	0
1	BC6	38597	19	8	61	25	32	9	174	70	1	1	0	2	1	0
		Total/Mean	512/85	207/35	284/47	115/19	322/54	42/7	1077/180	436/73	4/1	8/1	14/2	28/5	11/2	0/0

HM Transects 2005

Burn intensity	Transect #	Date sampled	live trees	live trees/A	dead trees	dead trees/A	all trees_A	Bogr_F	Lipu	Lipu_A	Hlm	Hco	UNK	total skip	skip/acre	OFFSITE
1	HM3	38602	24	10	83	34	43	10	131	53	2	3	6	12	5	0
1	HM4	38602	12	5	146	59	64	8	147	59	1	0	0	1	1	0
1	HM5	38602	63	25	91	37	62	6	3	1	2	3	0	6	2	3
1	HM6	38602	61	25	56	23	47	16	36	15	0	3	0	3	1	0
1	HM7	38602	141	57	67	27	84	15	221	89	9	0	4	17	7	3
1	HM8	38602	93	38	93	38	75	11	67	27	1	1	4	6	3	0
		Total/Mean	394/66	159/27	536/89	217/36	376/63	66/11	605/101	245/41	15/3	10/2	14/2	45/8	18/3	6/1

BC Transects 2003

Burn intensity	Transect #	Date sampled	live trees	live trees/A	dead trees	dead trees/A	all trees_A	Bogr_F	Lipu	Lipu_A	Hlm	Hco	UNK	total skip	skip/acre	OFFSITE
1	BC1	91003	76	31	106	43	13	5	3	1	0	0	0	0	0	1
1	BC2	91003	129	52	74	30	22	6	32	13	0	0	0	0	0	0
1	BC3	91003	112	45	38	15	19	10	8	3	0	0	0	0	0	0
1	BC4	91003	111	45	54	22	19	7	38	15	0	0	0	0	0	0
1	BC5	91003	78	32	112	45	13	3	129	52	0	0	0	0	0	0
1	BC6	91003	108	44	11	4	18	5	54	22	0	0	0	0	0	0
		Totals/Mean	614/102	248/41	395/66	160/27	103/17	36/6	264/44	107/18	0/0	0/0	0/0	0/0	0/0	1/0.17

HM Transects 2003

Burn intensity	Transect #	Date sampled	live trees	live trees/A	dead trees	dead trees/A	all trees_A	Bogr_F	Lipu	Lipu_A	Hlm	Hco	UNK	total skip	skip/acre	OFFSITE
1	HM3	91003	28	11	98	40	5	7	11	4	0	0	0	0	0.00	0
1	HM4	91003	73	30	200	81	12	7	0	0	0	0	0	0	0.00	0
1	HM5	91003	70	28	92	37	12	7	18	7	2	2	0	4	1.62	2
1	HM6	91003	132	53	51	21	22	11	22	9	0	0	0	0	0.00	0
1	HM7	91003	191	77	186	75	32	18	37	15	0	0	0	0	0.00	0
1	HM8	91003	93	38	224	91	16	7	3	1	0	0	0	0	0.00	0
		Totals/Mean	587/98	238/40	851/142	344/57	99/16	57/10	91/15	37/6	2/0.33	2/0.33	0/0	4/0.67	1.62/0.27	2/0.33

BC Transects 2004

Burn intensity	Transect #	Date sampled	live trees	live trees/A	dead trees	dead trees/A	all trees_A	Bogr_F	Lipu	Lipu_A	Hlm	Hco	UNK	total skip	skip/acre	OFFSITE
1	BC1	83004	43	17	112	45	7	10	28	11	0	0	0	0	0.00	0
1	BC2	83004	153	62	39	16	25	11	0	0	0	0	0	0	0.00	0
1	BC3	83004	168	68	35	14	28	3	232	94	0	0	0	0	0.00	0
1	BC4	83004	146	59	29	12	24	14	6	2	0	0	0	0	0.00	0
1	BC5	83004	44	18	96	39	8	7	273	110	0	0	1	1	0.40	0
1	BC6	83004	58	23	56	23	10	14	300	121	8	2	6	16	6.47	0
		Totals/Mean	612/102	248/41	367/61	149/25	103/17	59/10	839/140	340/57	8/1.33	2/0.33	7/1.17	17/2.83	7/1.15	0/0

HM Transects 2004

Burn intensity	Transect #	Date E1sampled	live trees	live trees/A	dead trees	dead trees/A	all trees_A	Bogr_F	Lipu	Lipu_A	Hlm	Hco	UNK	total skip	skip/acre	OFFSITE
1	HM3	83004	48	19	71	29	8	22	38	15	0	0	0	0	0.00	0
1	HM4	83004	86	35	258	104	14	101	3	1	0	0	0	0	0.00	0
1	HM5	83004	62	25	111	45	11	8	163	66	0	0	0	0	0.00	0
1	HM6	83004	67	27	73	30	11	10	113	46	0	0	0	0	0.00	0
1	HM7	83004	161	65	95	38	27	20	339	137	7	1	0	8	3.24	0
1	HM8	83004	69	28	146	59	12	16	21	8	0	2	0	2	0.81	0
		Totals/Mean	493/82	200/33	754/126	305/51	83/14	177/30	677/113	274/46	7/1.17	3/0.50	0/0	10/1.67	4/0.67	0/0