

National Park Service
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Natural Resource Stewardship and Science

Prescribed Fire Monitoring Report

*Tallgrass Prairie National Preserve (IQCS fire number:
194570, 194571)*

Natural Resource Data Series NPS/HTLN/NRDS—2012/227

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List of Acronyms

<u>Term</u>	<u>Definition</u>
AAR	After-action review
ENGB (t)	Engine Boss (trainee)
FL	Flame length
FDFM	Fine dry fuel moisture
FEMO	Fire Effects Monitor (operational position)
FF	Fire Fighter type 2
FIRB	Firing Boss
FFT1t	Fire Fighter type 1 trainee
FZD	Flame zone depth
HTLN	Heartland Inventory and Monitoring Network
RAWS	Remote Automated Weather Station
READ	Resource Advisor
RH	Relative humidity
ROS	Rate of spread
RxB2 (t)	Prescribed Fire Burn Boss Type 2 (trainee)
STEN	Strike Team Leader Engine
TAPR	Tallgrass Prairie National Preserve, also preserve.
TFLD	Task Force Leader
TNC	The Nature Conservancy
TREX	Training Exchange

Burn Operations Summary

Burns at Tallgrass Prairie National Preserve (TAPR), Kansas were coordinated and conducted through a Training Exchange Program (TREX). TREX is an interagency program funded by cooperative agreement between the USDA Forest Service, Department of Interior and The Nature Conservancy. The program, led by Jeremy Bailey, was designed to facilitate learning and aid participants in completing National Wildfire Working Group (NWCG) task books while accomplishing locally scheduled burns. The program was scheduled for March 28 through April 8th, 2011. Burns were planned at TAPR and Flint Hills and Marais des Cygnes refuges through this cooperation. White Memorial Camp, Council Grove, Kansas served as the base of operations.

April 6, 2011

A briefing occurred at 0800 in the staging area near the Ranchhand House in the historic ranch headquarters of TAPR. Predicted weather for the day was not consistent with the prescription for the scheduled units: Big Pasture-North and the SW Windmill-Red House complex. To take advantage of the number of crews present, the plan was to burn out a small area along a steep drainage on the western boundary of the SW Windmill unit because the burn line in this area was difficult to prepare mechanically. Securing this section of the fireline would allow the firing operation in the Red House unit to be conducted in a more safe and efficient manner.

Crews were divided into two task forces with Task Force B working on the east side of the fence (TAPR) and Task Force A working on the west side of the fence (private ranch). The drainage was burned out on both sides of the fence. The burn extended one chain on the west side. The burned area was 100% cold-trailed for safety. Ignitions were ceased after weather conditions were forecasted to be out of the burn prescription. An AAR was conducted in the field. One crew boss recalled forgetting to mention the potential for snakes to be present in his safety briefing. Also, before the burnout one engine became inoperable but crews were able to compensate by shifting resources. Furthermore, one crew boss recognized that water units with less water were chosen to bring to the burn site rather than ones with larger capacity. Larger capacity water units were prioritized for future burns. Crews returned to the staging area at 1300. The burnout operation provided an opportunity for crews to gain experience working as a unit and proved valuable as larger and more complex fire operations were undertaken in the days that followed.

That afternoon, weather became critical in the area and conditions on-site were out of the burn prescription. Area dispatch was notified that crews were available for local wildfire duty. Crews reconfigured for initial attack and were soon called upon to suppress a grassland fire on private land. Preserve/TNC administrators and HTLN staff remained onsite during the wildfire event.

The initial attack crew returned and equipment was again rehabilitated for prescribed fire. The Big Pasture-North unit was truncated at Palmer Creek to include everything from the south side of the creek to the southwest corner of the unit (Figure 1). At 1920, crews mobilized to the southernmost point of the Big Pasture-North unit. A test fire (Task Force B) was lit at the southwest corner of the unit. Task Force B progressed along the two-track ranch road making up the south and east line of the unit. Task Force A initiated their operation on the west side of the unit, south of Palmer Creek. No ignition was done between points S and P on the west side of the unit because the fire was expected to burn across the unit into the black on the private land to the

west (Figure 2). Task Force A completed ignition along Palmer Creek to meet Task Force B at the northeast corner of the unit (south of Palmer Creek). The burn was tied up at 2334. A quick AAR was conducted at the point of initial ignition on the south side of the unit. Crews expressed that things went well. Spot ignitions were effective on task force B, but care must be taken to avoid expanding the fire too quickly.

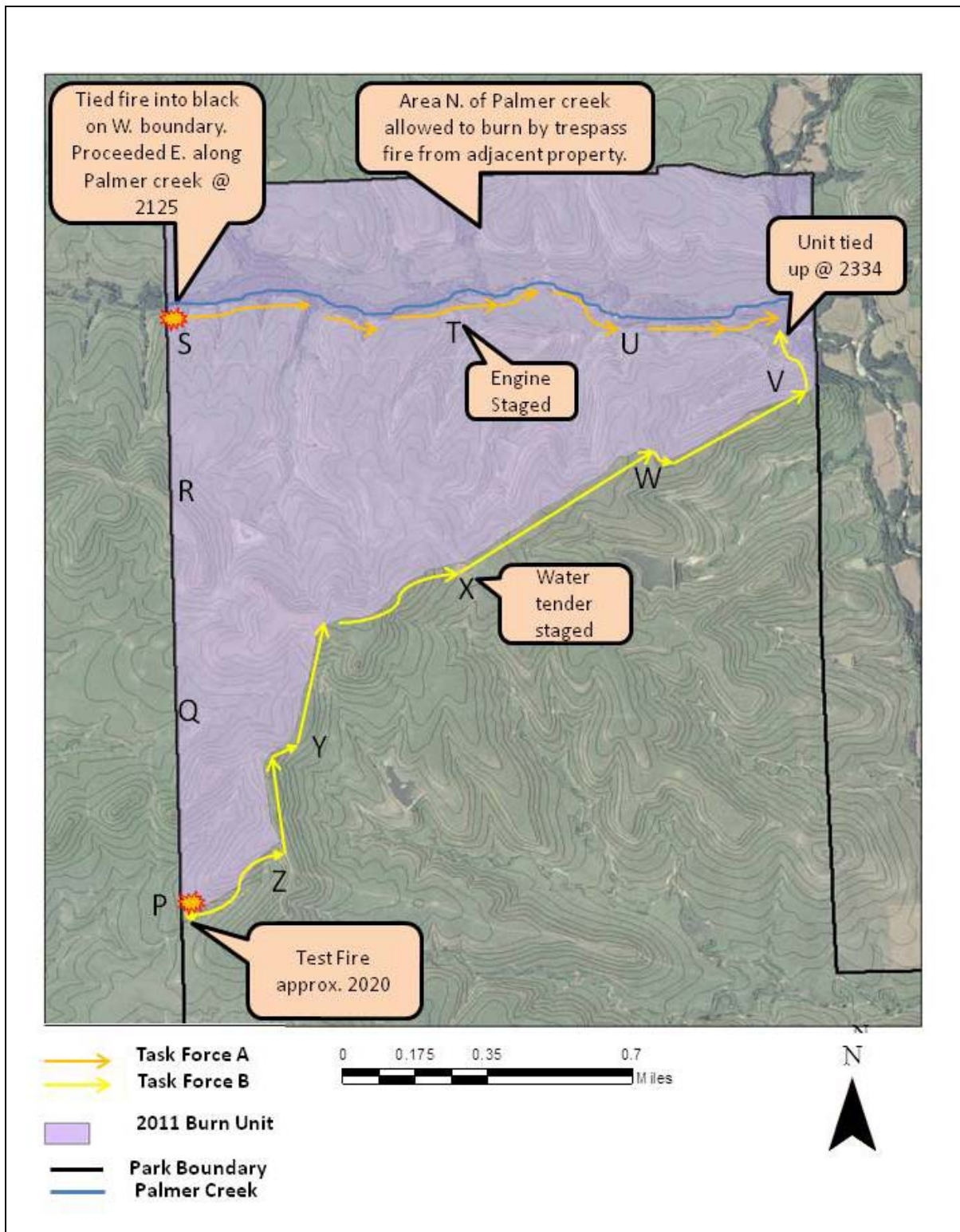


Figure 1. Ignition progression for Big Pasture-North Unit (#194570) at Tallgrass Prairie National Preserve, Kansas on April 6, 2011. Note, no ignition was done on the unit's west side between points P and S.

April 7, 2011

Light rain occurred during the morning, but ceased at 1330. A briefing occurred at the staging area (Ranchhand House) at 1350. During the night, fire had trespassed onto the preserve from the adjacent private property burning the remainder of the Big Pasture-North unit on the north side of Palmer Creek (Figure 1). Crews mobilized to the SW Windmill-Red House complex at 1450.

Crews were divided into two task forces with Task Force A working on the north side of the unit (SW Windmill Pasture) and Task Force B working on the south side of the unit (Red House Pasture) (Figure 2). The test fire was ignited from the Windmill/Red House pasture fence line on the western boundary of Red House Pasture (Figure 2). Task Force A proceeded north along the fence towards the north fenceline of Windmill Pasture, tying into the burned area on private land to the west. Task Force B proceeded south along the fence toward the south fenceline of Red House Pasture. Tim Menard was sent along the Windmill/Red House fence to light low intensity fire in hopes of protecting the fence insulators. A water tender was staged at Red House Ruins near the old corral system. Because of the moist conditions, it took nearly three hours to secure the west boundary of the burn unit. The winds shifted to the south before crews turned toward their eastern corners. Task Force B engines were shifted to new points as the crews progressed eastward. The corral system was burned around to protect the remaining structures. The burn was tied up at 2135. Crews departed for the staging area. Much of the interior of the Red House Pasture portion of the unit was still burning.

An AAR was initiated at 2230 under the storage area due to steadily increasing rain. Participants related observations such as progression of the burn from mild to intense behavior during operations. An area along the stone fence on the west side remained unburned because of the mild behavior in the beginning of the burn. There was also heavy smoke along the fire line at times. One UTV tire was repaired in the field. It was also noted that some torches didn't work. Burning on the preserve was concluded for the TREX event because of the impending government shutdown. Weather intensified to strong thundershowers as crews departed the preserve. Upon inspection on April 8th, 25-30% of the eastern part of Red House remained unburned.

Other burn activities

Although this report will focus primarily on the Big Pasture-North and SW Windmill-Red House units, data for fuel load in the eastern pastures is also presented. Preserve staff in conjunction with local crews, successfully burned the East Traps-Two section complex (East Fox Creek Unit #194659) on April 12, 2011. Unburned portions on the east side of the Red House Unit were also burned on April 12 to accommodate cattle grazing management objectives for Red House Pasture.

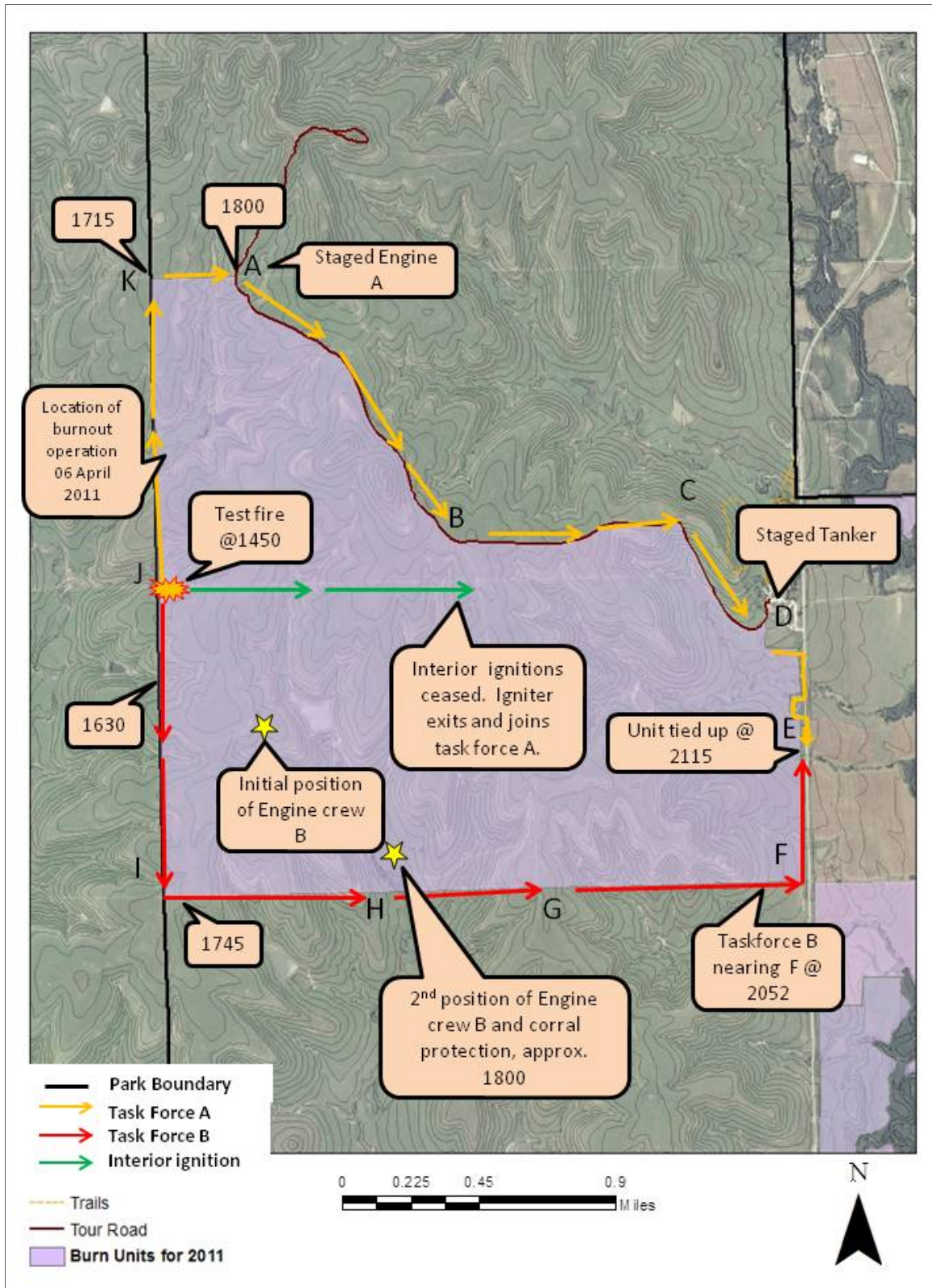


Figure 2. Ignition progression for SW Windmill/Redhouse complex (#194571) at Tallgrass Prairie National Preserve, Kansas on April 17, 2011.

Burn Unit Measurements

Big Pasture-North Unit Measurements (IQCS # 194570)

Date: 4/6/11

Size: Total planned acres = 1204.68

Total burned acres = 1048.16

Vegetation type (Beacham 2011, based on Scott and Burgen 2005): Tallgrass prairie (fuel models GR5, GR6)

Personnel (see Acronyms for qualification definitions):

Burn Boss: Jeremy Bailey RXB2, Eddy Romero RXB2t

FEMO: Ross Hauck FEMOt

Task Force A: Deon Steinle TFLD

Darin McCullough FF, Terry Heiser FF, Paul Mancuso FF, Brett Parsons FFT1t, Chris Kopek FF, Troy Mueller ENGBt, Rodney Redinger ENGB, Paula Matile FF, Kristen Hase READ

Task Force B: Jason Pankratz STENT

Miller Bailey FF, Trig Morley FFT1t, Dennis Carril ENGBt, Jason Hartman FIRB, Tom Duckworth FF, Tim Menard FF, Mathew Franklin ENGB, Lee Glanville FFT1t, Sherry Leis FF, David Wollman FF, Jim Hays FF

Staged Engine: Eric Ward ENGB, Cole Starkey FF, Andrew Pierce FF

SW Windmill/Redhouse Unit Measurements (IQCS # 195571)

Date: 4/6/11 (small burnout on western edge of unit)

4/7/11 primary burn day

4/12/11 (unburned portions of east side completed by preserve and USFWS firefighters)

Size: Total planned acres = 1906.13

Total burned acres = 1625.83

Vegetation type: Tallgrass prairie (fuel models GR5, GR6)

Personnel (see Acronyms for qualification definitions):

Burn Boss: Jeremy Bailey RXB2, Eric Ward RXB2t

FEMO: Ross Hauck FEMOt, Dennis Carril FEMOt

Task Force A: Jason Hartman TFLD

Darin McCullough FF, Jason Pankratz FF, Chris Kopek, FF, Jim Hays FF, Brett Parsons FFT1t, Paul Mancuso FIRB, Miller Bailey FF, Kristen Hase READ

Staged Engine: Troy Mueller ENGBt, Rodney Redinger ENGB

Task Force B: Matthew Franklin TFLD

Trig Morely ENGBt, Cole Starkey FF, David Woolman FF, Deon Steinle ENGB, Lee Glanville FFT1t, Andrew Pierce FF, Tom Duckworth FFT1t, Tim Menard FF, Paula Matile FF,

Staged Engine: Eddy Romero ENGB, Terry Heiser FF, Sherry Leis FF

Burn Unit Goals

Goals were taken from the burn plan (Beacham 2011) and the incident action plan provided by the burn boss.

1. Increase biological diversity by promoting varied plant structure to improve wildlife habitat by implementing a varied fire and grazing regime.
2. Secondary objectives include controlling woody and undesirable vegetation, removing dead or old growth vegetation build-up, promoting re-growth of warm season grass species, and increasing native plant diversity.
3. Safely and effectively contain fire within identified boundaries.
4. Train and evaluate firefighter performance.
5. Integrate private, state, and federal fire practitioners in burn organization.

Table 1. Tallgrass Prairie National Preserve 2011 prescribed fire environmental prescription. The full prescription can be found in the burn plan (Beacham 2011).

Variables	Low Fire Intensity	Desired Fire Intensity	High Fire Intensity
Relative Humidity	60	30-45	25
Wind Direction	N/A	Keep smoke off K-177, US 50 and Strong City	N/A
Wind Speed (midflame)	5	7-10	15
Fuel Moisture (%) 1-hour	12	8	6
Live Fuel Moisture	75	60	30

Table 2. Tallgrass Prairie National Preserve 2011 prescribed fire behavior prescription. The full prescription can be found in the burn plan (Beacham 2011).

	Fuel Model	
	GR5 (#105)	GR6 (#106)
Surface Rate of Spread (ch/h)	370	581
Headfire Flame Length (ft)	24	33
Backfire Flame Length (ft)	3	4
Backfire Rate of Spread (ch/h)	5	7

Methods

Sampling methods for fire ecology monitoring are described in detail in Fire Ecology Monitoring Protocol for the Heartland Inventory and Monitoring Network (Leis et al. 2011). Fuel load monitoring was conducted in August of 2010 for Big Pasture-North (6 sites), SW Windmill (4 sites), Red House (5 sites), East Traps (3 sites) and Two Section (5 sites) pastures (SOP 7) (Figure 8 or Appendix A). We expect a 10-20% degradation of the fuel bed over the winter months; however, the anticipated degradation is within the measurement error of most pastures at TAPR. The remaining pre-burn monitoring of fuel moisture and soil moisture (SOP 5 and 8 respectively) was completed on April 5, 2011, while post-burn monitoring was completed on April 8, 2011 (SOP 13, Appendix A). Soil and fuel moisture sampling was restricted to sites in the Big Pasture-North unit (N= 6) and the SW Windmill/Red House (N = 9) unit.

Burn day weather and fire behavior data were collected by the designated FEMO (see Burn Unit Measurements section). Data collected included temperature and wind speed and direction (Table 3). A Remote Automated Weather Station (RAWS; TGSK1) is located at the preserve and was used for some observations.

GPS collection of the preserve-wide burn perimeter was completed by preserve staff between April 11 and 7 May 2011 (Figure 7). Minimum mapping units were set at 1-acre (SOP 3, Leis et.al. 2011). Burn perimeters were walked or driven (UTV) as soon after burning as possible, depending mostly on staff availability. GPS coordinates were taken using a Garmin Map 60C or Trimble GeoXT. The coordinates were recorded in a geodatabase using the Fire Incident Management Tool (USDA Forest Service 2007).

Fuel moisture was tested with an ANOVA and Least Significant Difference procedure in SPSS (SPSS Inc. 2008) to determine whether fuel moisture was different than expected by chance and if so, whether there were differences between pastures. Topographic features such as slope, aspect, soil type, amount of surface rock, fuel load, grazing system, and proportion of litter could all contribute to potential differences between pastures. Regression analysis was used to determine relationships of fire severity to fuel moisture, soil moisture, and fuel load (SPSS Inc. 2008). Alpha was set at 0.05 for determination of significance on all tests and a Bonferroni adjustment was applied to correct for multiple comparisons where needed (Rice 1988).

Mean fire severity rankings for each site were used to infer fuel reduction. Proportions of categories for severity were assigned a fuel reduction percent and the sum for all the sites was converted to percent. Substrate fuels (litter, duff, soil surface) considered to be eliminated were in severity class 1, 2, and 50% of class 3; while vegetation fuels (standing plant matter) in severity class 1, 2, and 75% of class 3 were considered eliminated. The sum total for all sites was converted to a percentage for both substrate and vegetation to infer fuels reduced.

Results

Fuel Load

Mean fuel loads were very similar across the preserve differing only by ± 1 ton, but variability differed by pasture (Figure 3, Table 3). SW Windmill Pasture was the most variable with Big Pasture-north also highly variable. Both of these pastures have been burned in a patch system since 2006 with the goal of increasing structural heterogeneity. Heterogeneity of vegetation structure will be analyzed in a separate report, but heterogeneity of fuels presented here, contributes to the discussion of preserve goals (see monitoring plan of draft FMP). Heterogeneity of fuel loads refers to variability both within and among pastures. Values given here along with fuel loads in 2010 serve as a baseline for future comparisons.

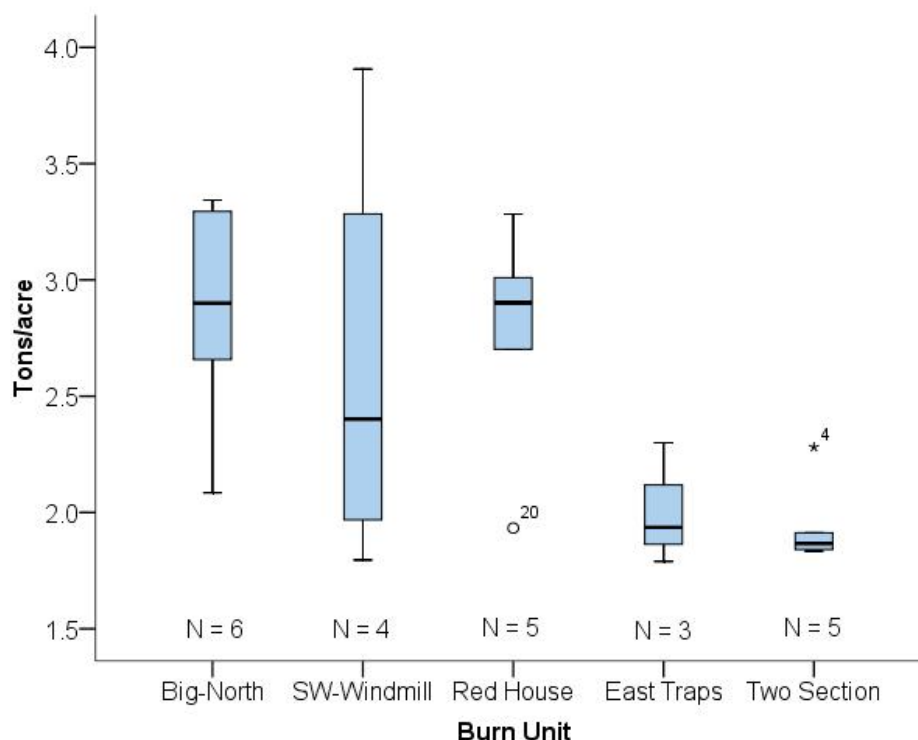


Figure 3. Box plot of 2011 fuel loads for burn units at Tallgrass Prairie National Preserve, Kansas. Horizontal bar in the center of plots is the median value. Circle and star indicate outliers. Vertical bars are ± 1 SD.

Table 3. 2011 mean fuel load values by burn unit for Tallgrass Prairie National Preserve, Kansas. Fuel load includes standing live, standing dead, as well as litter, and duff.

Burn Unit	N	Mean ton/acre	Stdev (ton/acre)
Big Pasture-North	6	2.9	0.5
SW Windmill	4	2.6	0.9
Red House	5	2.8	0.5
East Traps	3	2.0	0.3
Two Section	5	1.9	0.2
Preserve	5	2.4	0.4

Soil Moisture

Soil moisture may affect fire severity by contributing to moisture within the duff and litter layers. Soil moisture was relatively consistent throughout the preserve (Figure 4). Soils were moist, but not saturated because of rains that occurred within a day or two of burning (Table 4).

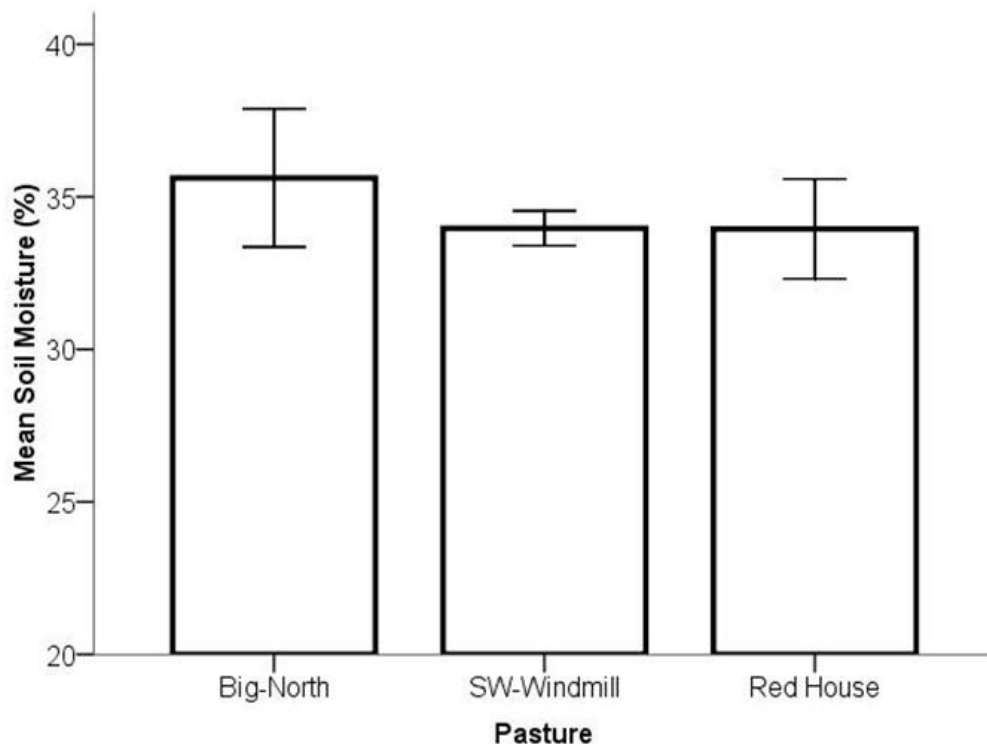


Figure 4. 2011 mean volumetric soil moisture for western pastures at Tallgrass Prairie National Preserve, Kansas. Volumetric soil moisture of 50% is considered a saturated condition, while 25% is the field capacity for plant available water and 10% indicates the permanent wilting point for plants. Error bars are ± 1 SE

Table 4. Soil moisture prior to prescribed fires on April 6 and 7, 2011 at Tallgrass Prairie National Preserve, Kansas. Volumetric soil moisture of 50% is considered a saturated condition, while 25% is the field capacity for plant available water and 10% indicates the permanent wilting point for plants.

Burn Unit	N	% volumetric moisture	Stdev
Big Pasture-North	5	35.6	6.5
SW Windmil	4	34.0	3.2
Red House	5	33.9	4.4
Preserve	3	34.7	5.2

Fuel Moisture

Fuel moisture was greater in Big Pasture-North than the other two pastures (Figure 5, Table 5) and was between the low and desired fire intensity outlined in the burn plan (Table 1; Beacham 2011). Fuel moisture in Windmill and Red House pastures was between the desired and high fire

intensity prescriptions. However, samples for Windmill and Red House pastures were collected the day prior to burning. This time delay could have allowed for changes to the fuels prior to ignition especially since some light precipitation was received the morning of the burn. A regression analysis showed no significant relationship between fuel moisture and soil moisture, however.

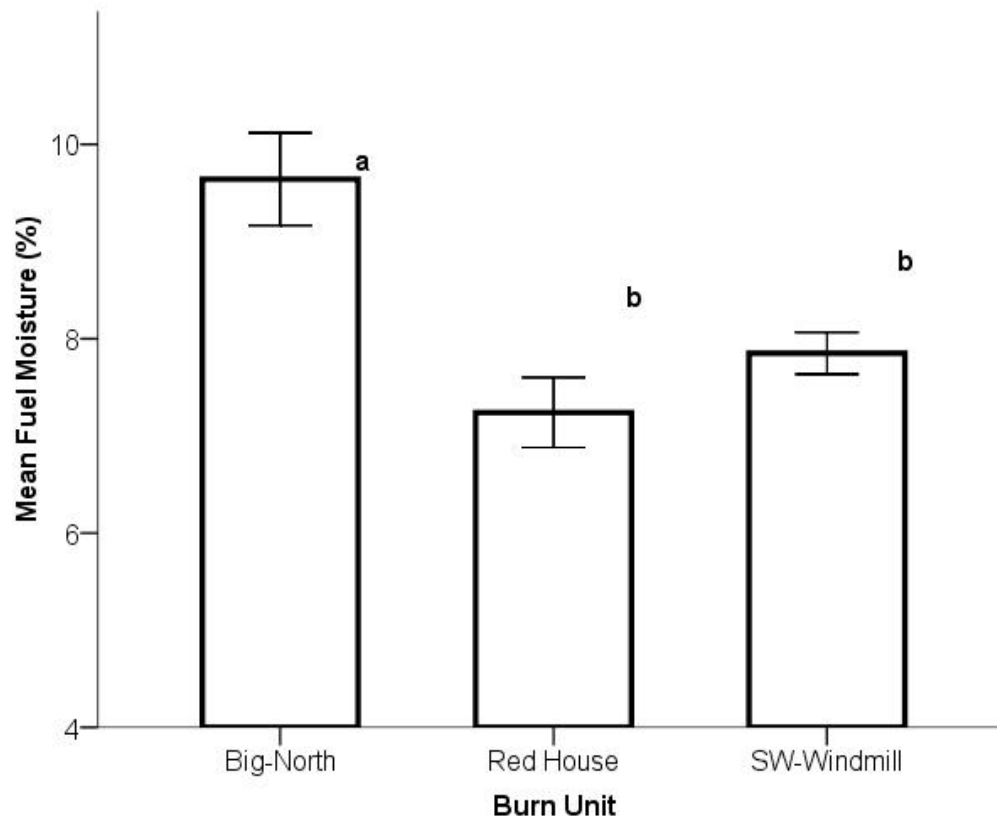


Figure 5. Mean fuel moisture prior to prescribed fires on April 6 and 7, 2011 at Tallgrass Prairie National Preserve, Kansas. Bars are ± 1 std error. $P < 0.01$, $df = 13$, $F = 11.4$, LSD: Big Pasture-North significantly different than SW Windmill ($P = 0.01$, and Red house $P < 0.01$ units. SW Windmill and Red House were not different at $P > 0.63$.

Table 5. Fuel moisture prior to prescribed fires on April 6 and 7, 2011 at Tallgrass Prairie National Preserve, Kansas. Fuel moisture samples included both live and dead materials from the standing and litter portions of the fuel bed. Superscripts indicate a significant difference between Big Pasture-North and the other two units.

Site	N	Mean % moisture	Stdev	sterr
Big Pasture-North ^a	5	10.9	3.0	1.3
SW Windmill ^b	4	7.9	0.4	0.2
Red House ^b	5	7.2	0.8	0.4
Preserve	14	8.7	2.4	0.7

Weather Observations

On April 6, onsite weather observations (Table 6) generally fell in the desired fire intensity range, but on April 7 weather observations (Table 7) indicated low fire intensity in the prescription model (Table 1; Beacham 2011). Relative humidity (RH) and wind speeds on the 7th were primarily in the low fire intensity range. Although calculated fuel moisture varied throughout the day on the 6th, sampled fuel moisture indicated the desired model for Big Pasture. For the SW Windmill/Red House unit, the burn day calculations for fine dead fuel moistures fell within the low fire intensity model, but sampled fuel moistures were in the high intensity range. Winds were favorable for keeping smoke off of highways and sensitive areas during both days.

Table 6. Weather observations on April 6, 2011 during the SW Windmill/Red House burnout and Big Pasture-North burn at Tallgrass Prairie National Preserve, Kansas. Data for reporting periods with a location "RAWS" were taken from the RAWS instrument onsite. All other observations were taken by the designated FEMO. FDFM was calculated using the Fire Line manual. Refer to fire progression maps (Figure 1) for location reference points.

Time	Location	Temperature (°F)		Dew Point	RH	Wind (mph)		Fine Dead Fuel Moisture (%) (Unshaded)	Prob. Of Ignition %	Comments
		Dry	Wet			Speed*	Direction			
0740	staging	51	42	31	46	<1	none	11	20	
0945	Pt. K-J	63	49	34	34	1(4)	SW	7	50	No shade
1045	Pt. K-J	70	52	34	27	3(7)	W/NW	5	60	
1230	Pt. A-Gate	70	52	34	27	6(10)	N	5	60	
1400	staging	72	35	34	25	3(8)	N/NE	5	60	
1500	staging	77	56	38	24	5(14)	NE	4	70	
1700	Pt. Z	77	56	38	24	13(16)	NE	7	50	
1800	Pt. Z	73	55	39	30	NA	6(9)	9	40	
1930	staging	65	52	40	40	NA	2(4)	10	30	
2000	RAWS	60	48	39	46	7(11)	N	11	20	
2100	RAWS	58	48	39	49	9(15)	NE	11	20	
2200	RAWS	59	48	40	40	13(19)	NE	10	30	
2300	RAWS	57	47	40	52	10(19)	NE	11	20	
2400	Pt. V	58	49	40	52	3	NE	12	20	

*Wind speed given as mean speed (gust).

Table 7. Weather observations on April 7, 2011 during the SW Windmill/Red House unit burn at Tallgrass Prairie National Preserve, Kansas. Refer to fire progression maps (Figure 1) for location reference points.

Time	Location	Temperature (°F)		Dew Point	RH	Wind (mph)		Fine Dead Fuel Moisture (%) (Unshaded)	Prob. Of Ignition %	Comments
		Dry	Wet			Speed*	Direction			
1400	Pt. J	63	55	49	60	5(10)	E/NE	9	30	Taken open, green
1500	Pt. J up-slope 100yd	61	58	58	84	8(10)	E	12	20	Raining
1515	300yd S. of Pt. J	69	63	60	72	4(12)	E	10	30	Body shade
1600	50yd S. of #1 drainage	70	61	55	60	3(13)	E/SE	9	40	Body shade
1700	Pt. J 200yd S. of #2 drainage	66	60	56	71	5(8)	SE	10	30	Body shade
1800	300 N. of Pt. I	68	62	59	72	5(8)	E/SE	11	20	Body shade
1900	300yd W. of Pt. H	68	62	59	72	5(8)	E	11	20	
2000	2 nd gate E. of Pt. H	62	59	57	84	13(15)	NE	13	20	Sundown
2100	1/4mi W. of Pt. F	59	56	54	83	7(12)	NE	17	10	

*Wind speed given as mean speed (gust).

Smoke Observations

Few observations of smoke were made by the FEMOs on the burn days, which indicated smoke was within the desired parameters of the burn plan (Beacham 2011). Smoke was heavy on the firelines at times but did not impact sensitive resources such as roads and communities.

Fire Behavior

Fire behavior was only collected for the burn on the April 7th (Table 8). Rates of spread (ROS) for both head and back fires were less than the prescribed model indicating low fire intensity (Table 2; Beacham 2011). Flame lengths (FL) were within range of the prescription for head and backfires, however.

Table 8. Fire behavior for SW Windmill/Red House burn at Tallgrass Prairie National Preserve, Kansas April 7, 2011. Intensity was calculated using the formula $3(10FH)^2$. However, flame length was substituted for flame height (FH; flame height was not recorded).

Time	Location	Fire type	ROS (Ch/hr)	FL (ft)	FZD (ft)	Fuel model	Intensity (Btu/ft/s)
n/a	J Corner 300°	n/a	n/a	n/a	n/a	1	n/a
n/a	J Corner 300°	Back	3.2	2.0	1.0	1	32.2
n/a	J Corner 150 yd S	Flank	3.2	3.0-4.0	1.0	1	72.5
n/a	J Corner 150 yd S.	Head	22.7	2.5	4.0	1	50.3
n/a	J Corner 150 yd S.	Back	2.3	2.0	2.0	1	32.2
n/a	J Corner 200 yd S.	Flank	3.2	3.0	1.5	1	72.5
1830	½ mi. W. of corrals	Head	13.6	4.5	3.0-4.0	1	163.0
1900	300 yd. W. of corrals	Head	40.9	5.0	6.0	1	201.3
2030	200 yd. E. of pt. G	Head	7.3	3.0	1.5	1	72.5
2100	¼ mi. W. of pt F	Head	20.9	2.5	2.0	1	50.3

ROS - rate of spread, FL - flame length, FZD - flame zone depth

Fire Severity

Fire severity as measured in the monitoring plots in Big Pasture-North was moderate for standing vegetation and light for substrate (duff, litter, soil surface) (Table 9). This result was consistent with the desired model (Table 1 and 2; Beacham 2011). The weather data also predicted the desired intensity in Big Pasture-North. Sampled fire severity for the SW Windmill-Red House unit was more variable, but generally was moderate for vegetation and light for substrate. Interestingly, burn day calculations for weather and fire behavior indicated a low intensity burn.

One plot in the Red House unit was unburned at the time of measurement and likely was the source for greater variability. An additional burn in the Red House unit on April 12 resulted in more area being burned, but we were unable to measure that event.

Table 9. Fire severity values by pasture for prescribed fires at Tallgrass Prairie National Preserve, Kansas April 6 and 7, 2011. Values in parenthesis are 1 ±std error. Vegetation severity refers to standing live and dead plants while substrate refers to litter, duff, and soil surface.

Pasture	N	Mean Severity Class Vegetation	Mean Severity Class Substrate
Big Pasture-North	6	1.8 (0.04)	3.1 (0.04)
SW Windmill	4	1.9 (0.1)	2.8 (0.1)
Red House	4	2.7 (0.8)	3.4 (0.5)
Preserve	14	2.1 (0.2)	3.1 (0.2)

Severity classes: 0 = NA, 1 = heavy, 2 = moderate, 3= light, 4 = scorched, 5 = unburned.

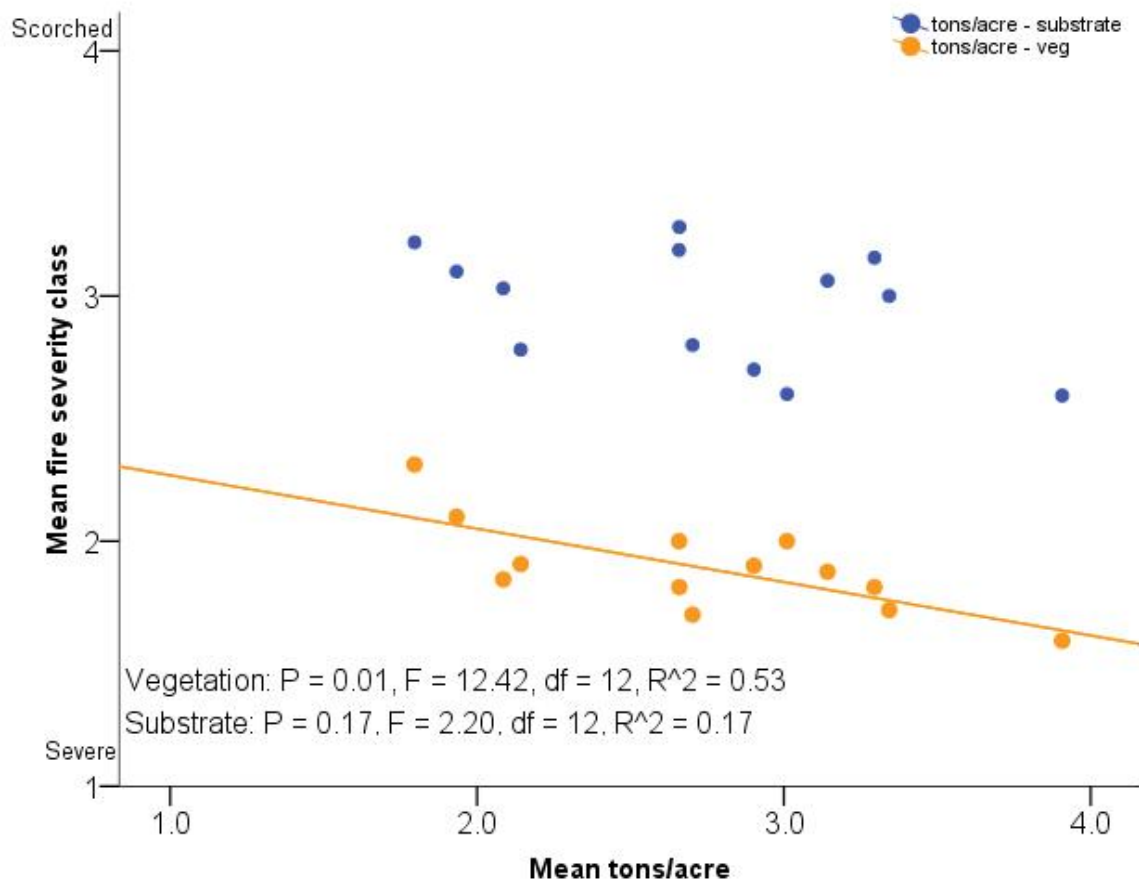


Figure 6. Relationship of fire severity with total fuel load in 2011 at Tallgrass Prairie National Preserve, Kansas. Severity classes: 0 = NA, 1 = heavy, 2 = moderate, 3= light, 4 = scorched, 5 = unburned. Two severity data points were excluded from the analysis as outliers.

We hypothesized that fuel load is a contributing factor in determining fire severity. The relationship between fuel load and mean severity was significant for the vegetation severity measurement, but not for substrate (Figure 6). As fuel load increased, fire severity also increased. Although significant, the coefficient of determination was only moderate. This pattern was also true for 2010 data (Appendix B). Regression analysis indicated no significant relationships between fuel moisture and soil moisture with fire severity.

Hazard fuel reduction is often a concern for natural resource managers and an objective for conducting burns. The proportion of fuels reduced during the Big Pasture-North and SW Windmill/Red House burns was estimated using the fire severity data (see Methods section). *Substrate* fuels in the burned units were reduced by 48% and *vegetation* fuels were reduced by about 91%. The values for substrate and vegetation cannot be combined because the proportion of the fuel load contributed by both elements is not known. The proportion of fuel reduction calculation is an indirect analysis and should be used cautiously.

Burn extent

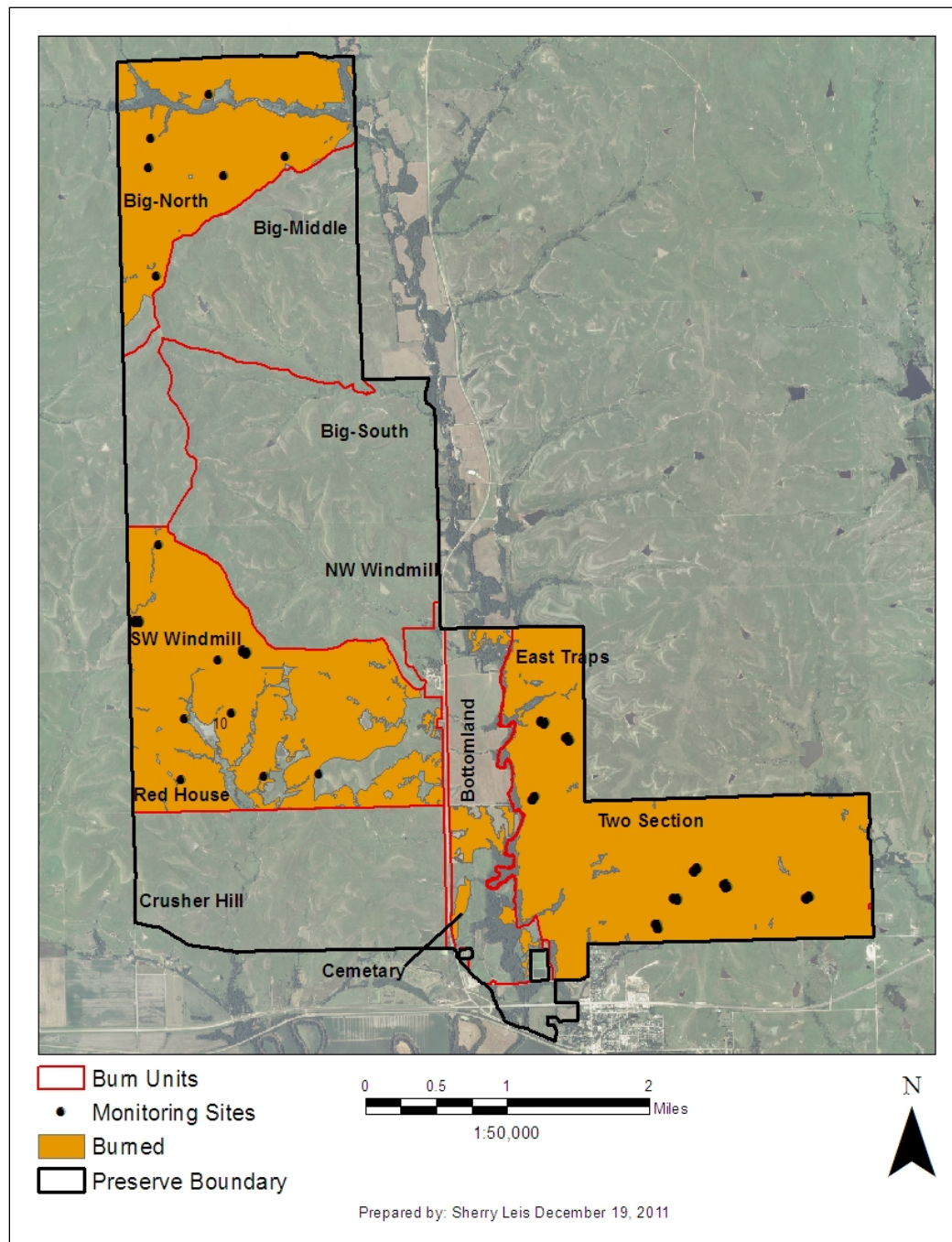


Figure 7. Areas burned at the Tallgrass Prairie National Preserve, Kansas in 2011. This report focuses on the prescribed burns in Big Pasture-North, and the SW Windmill /Red House complex. Cemetery pasture was an unplanned ignition.

The total number of acres burned in 2011 was 4784.5. The greatest portion of the target area left unburned was in Red House Pasture. Some drainages in both Big Pasture and Red House remained unburned (Figure 7).

Summary

The primary goals for prescribed fires in 2011 included safety, training, and natural resource elements (Beacham 2011). All burns were conducted safely with regard to fire fighters and the public (goal 3). All minimum numbers for required personnel and necessary qualifications were met. Despite the large size of the units, the number of trainees and organizations, participants were able to carry out operations efficiently (goals 4 and 5). The effort to integrate a facilitated learning program within preserve fire operations was effective and valuable.

Although not explicitly stated as a goal, completing the prescribed fires within the criteria set by the prescription was important to the operations. As practitioners of prescribed fire know, the ability to meet objectives is balanced with staying within the defined prescriptions. The prescription was flexible enough to allow operations to continue safely during variable weather conditions while meeting burn objectives.

Spring fire season in the Flint Hills can be unpredictable at best with regard to ever-changing weather conditions. The goal of implementing a varied fire regime owes much to this and can be accounted for with consistent soil moistures, low/desirable fuel moistures, fire behavior that was less than the predictive models and light to moderate fire severity (goal 1). The evaluation of objectives concerning the improvement of nesting bird habitat, control of woody and undesirable vegetation, and increasing native plant diversity will be addressed in Heartland Inventory and Monitoring program's monitoring reports (goal 1). The most recent plant community report (James 2011) indicated a positive trend towards increased structural heterogeneity and consistent community level diversity (beta diversity). Conducting prescribed burns in this region, with its unique cultural legacy of landscape-style burning and grazing also satisfies management objectives of controlling woody vegetation, removing old growth thatch, and promoting re-growth of native warm season plants (goal 2) (James 2011).

An evaluation of the primary objective of promoting varied structure is in-progress and will likewise be addressed in a separate report. However, the patchiness of the burn in Red House Pasture may contribute to pasture level diversity in habitat structure if similar stocking rates are maintained. Fuel load, while consistent across the preserve (within 2 tons/acre preserve-wide), varied by pasture and may be accounted for by the different grazing disturbance intensity and frequencies across the preserve. In comparison to fuel loads presented in this report, a 10 year average of live peak biomass in burned upland sites at Konza Prairie, Kansas was 1.64 tons/acre, somewhat less than the 2.4 tons/acre average at TAPR in 2011 (Abrams et. al. 1986). However, the maximum, about 2.7 tons/acre, in the 10-year period was within range of the TAPR values. Measurements in this report reflect a combination of both live and dead biomass and so are expected to be greater, but the preserve has demonstrated greater variability than the Konza study. Furthermore, biomass is highly correlated with precipitation (Milchunas and Lauenroth

1993). Precipitation in 2010 was 6.8 in. greater than the 30-yr average (National Climatic Data Center 2011).

The data presented here will serve as a baseline to compare fuel heterogeneity in the future. Within pasture variability may be the result of inherent differences such as topography and soils and/or grazing and burning treatments. Greater variability in fuel loads in both Big and Windmill pastures suggest the potential effectiveness of the varied burning and grazing treatments. Fuel loads were substantially reduced by the burns in the monitored pastures (Big Pasture-North and the SW Windmill/Red House unit).

Greater fuel loads also coincided with greater fire severity. This relationship could be useful in aiding in the development of burn plans. To achieve a desired severity, for example, the fuel load could be manipulated through grazing or deferment. Although we suspected there should also be a relationship between sampled fuel moisture and fire severity, none was observed. The lack of relationship may be the result of changing weather conditions between the day sampling was done and the completion of the burn one day later (e.g., a light rain fell at the beginning of the SW Windmill/Red House burn). The calculated fine dead fuel moistures on burn day indicated slightly moister conditions than the samples. Other factors, such as time of day, adequate wind speeds, and continuous fuels, may have been able to override the fuel moistures as well. As the Windmill-Red House complex continued to burn into the night, relative humidity and fuel moistures increased decreasing the probability of ignition. These burns were successful in meeting the stated objectives of the plan.

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Appendix A: Sample Site Photographs



Figure 8. Windmill Pasture, Tallgrass Prairie National Preserve, Kansas, August 2010 Pre-burn Site V209 AS-AF

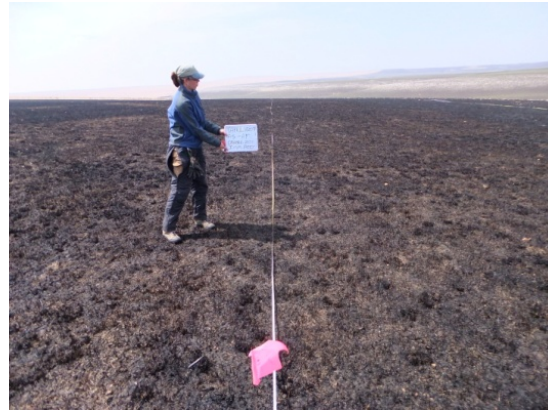


Figure 9. Windmill Pasture, Tallgrass Prairie National Preserve, Kansas, April 2011 Post-burn Site V209 AS-AF

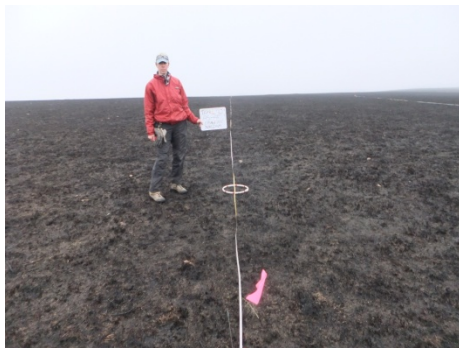


Figure 10. Big Pasture Tallgrass Prairie National Preserve, Kansas, April 2011. Post-burn Site 70 AS-AF.

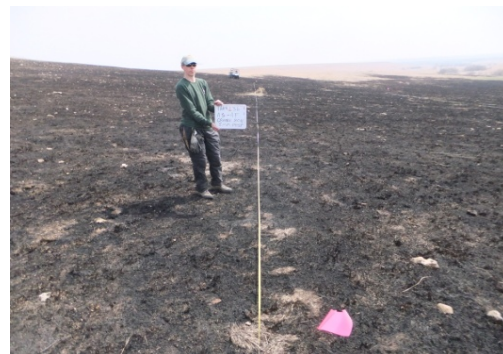


Figure 11. Red House Pasture, Tallgrass Prairie National Preserve, Kansas, April 2011. Post-burn Site 30 AS-AF.



Figure 12. Big Pasture-North, Tallgrass Prairie National Preserve, Kansas.



Figure 13. Ignitions on Red House Unit April 2011, Tallgrass Prairie National Preserve, Kansas

Appendix B:

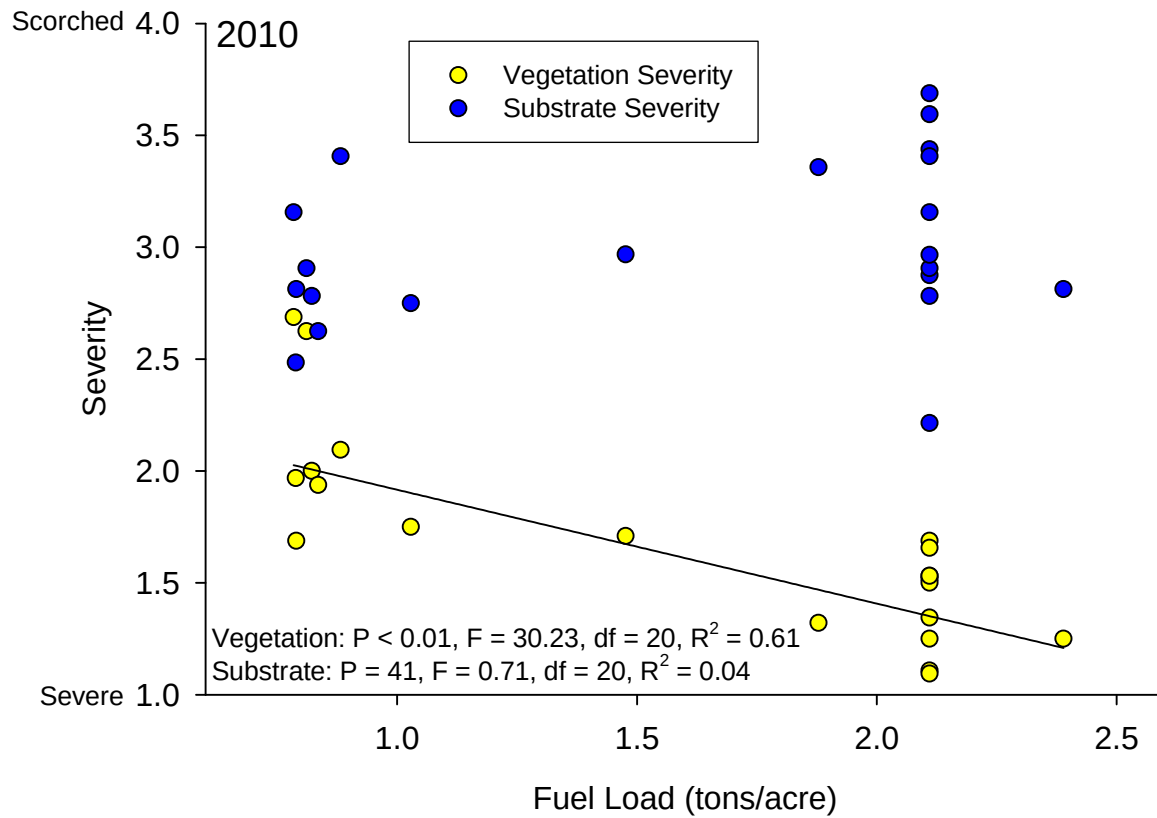


Figure 14. Relationship of fire severity with total fuel load in 2010 at Tallgrass Prairie National Preserve, Kansas. Severity classes: 0 = NA, 1 = heavy, 2 = moderate, 3= light, 4 = scorched, 5 = unburned.