

NORTH DAKOTA GAME AND FISH DEPARTMENT

Final Report
**Restoration of fire regimes on the Missouri Coteau to support native prairie and prairie
obligate species**
Project T2-11-HM

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THE NATURE CONSERVANCY

Restoration of fire regimes on the Missouri Coteau
to support native prairie and prairie obligate species.

Final Report to North Dakota Game and Fish

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6/30/2013

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Project Background

Need:

High quality native prairie is essential to a large suite of grassland birds and many other species, and the use of fire as a management tool is an essential component to maintaining high quality native prairie. While the use of fire is not a new management technique on North Dakota grasslands, the use of fire has been primarily restricted to the spring due to logistical, financial and traditional reasons. Higgins (1984) found that prior to European settlement of the Great Plains, fire was particularly common during the months of April, September and October.

A comprehensive management strategy for conserving biological diversity must focus not just on saving the components but also the processes that characterize these systems. To sustain these ecosystems, management activities should conserve or restore historic disturbance patterns (Kaufmann et al. 1994). Fire is widely believed to have been one of the primary forces which shaped the prairies of the Great Plains. The use of fire for grassland management should vary the interval between fires as well as the seasons of application (Sieg, 1997)

Native prairies of the Missouri Coteau also face significant threats from encroachment of invasive grasses and brush, particularly Smooth Brome (*Bromus inermis*), Kentucky Bluegrass (*Poa pratensis*) and



Western snowberry (*Symphoricarpos occidentalis*). Some rangeland ecologists consider the encroachment of Kentucky Bluegrass as the second most serious threat to native prairie behind direct conversion (Prinz, 2009). However, the traditional use of fire management in the early spring may not always be the most beneficial time to suppress cool season invasive grasses. The use of late season fire followed by grazing over a 2-3 year period has been shown to more successfully control the spread of Kentucky bluegrass (Smith, 2009) compared to

spring burns.

There is interest and need for late-summer/fall burning among other natural resource management agencies, however, due to financial constraints, agency priorities, and logistical issues most agencies have not fully applied fire management in ways that replicate the historical role fire played in maintaining grasslands. TNC proposes to develop a late-summer/fall fire team to implement prescribed burning on the Missouri Coteau. Biologists and Fire Managers from both the U.S. Fish and Wildlife Service - Audubon Wetland Management District and Ducks Unlimited, Inc. believe such a team would be useful. Successful implementation and ecological response will serve as a catalyst to motivate other grassland managers to diversify current management practices.

Expected Results or Benefits:

The North Dakota Comprehensive Wildlife Conservation Strategy (Hagen et al., 2005) as well as TNC planning efforts (Rosenquist, 2006) have identified the lack of a natural fire regime and encroachment of invasive grasses and woody shrubs as a conservation threat on the Missouri Coteau. This project will improve native prairie areas on one of the largest conservation areas on the Missouri Coteau by improving native prairie composition through the reduction of the presence of invasive grasses

and woody species. Many prairie obligate species have been shown to prefer large, high quality areas. These include: Northern Pintail, Ferruginous Hawk, Sharp-tailed Grouse, Upland Sandpiper, Marbled Godwit, Short-eared owl, Sedge Wren, Sprague's Pipit, Lark Bunting, Grasshopper Sparrow, Bairds Sparrow, Bobolink, Le Conte's Sparrow, and Nelson's Sharp-tailed Sparrow.

This project will also serve to facilitate agency desires to improve ecological fire management by implementing fire at ecologically appropriate seasons. Demonstrated success with this project will provide agency biologists and fire managers with proven results needed to drive institutional shifts in attitudes, priorities and funding.

Approach:

TNC will hire and manage a 6-8 person burn crew capable of implementing ecologically-based prescribed burns on the Missouri Coteau. This crew will implement prescribed burns primarily on TNC property in McLean, Oliver and Sheridan Counties in N.D., but other privately owned or federal lands may also be used as available. TNC currently has memoranda of understanding with U.S. Fish and Wildlife Service, Ducks Unlimited Inc., U.S. Forest Service, N.D. Parks and Recreation Department and National Parks Service allowing each party to assist the other with fire management projects. Ducks Unlimited and USFWS have expressed the need for such a crew. TNC will provide all equipment needed to implement burn activities and all burn crew members and burn bosses will be trained to at least the minimum standard as described in the TNC Fire Management Manual (www.tncfiremanual.org).

Project Objectives:

1. **Conduct ecological burns on 1000 acres in the spring season and 500 acres in the late-summer/fall season each year of the grant period.**
2. **Collect monitoring data.**
3. **Conduct field day for landowners and resource managers.**
4. **Produce Final Report.**
5. **Based on results, use experience and data to encourage late-summer/fall burning among other natural resource agencies and private landowners over a larger landscape.**

Implementation Schedule

CY 2010

Spring- TNC will hire and train burn crew members.

Spring- Collect baseline monitoring data on burn units to be burned in 2010

Field season- burn at least 5 burn units- 3 spring, 2 fall

Fall- Collect post treatment monitoring data.

Winter 2010-2011- Submit progress report

CY 2011

Spring- Collect base line monitoring data on unit to be burned in 2011

Field season- burn at least 6 burn units- 3 spring, 3 fall

Field season- conduct point counts of grassland passerines

Fall- Collect post treatment monitoring data on 2010 and 2011 burn units.

Winter- 2011-2012-Submit progress report

CY 2012

Field season- Repeat burning of 2010 units

Summer- Host field day, discuss preliminary results/observations.

Field season- Monitoring of all burned units

Winter- Final Report submitted

Location

Activities will take place primarily on TNC properties in McLean, Sheridan, and Oliver Counties (Figure 1). Other private or agency lands may also be used depending on availability. Davis Ranch and Cross Ranch were the primary TNC properties in which activities were conducted.

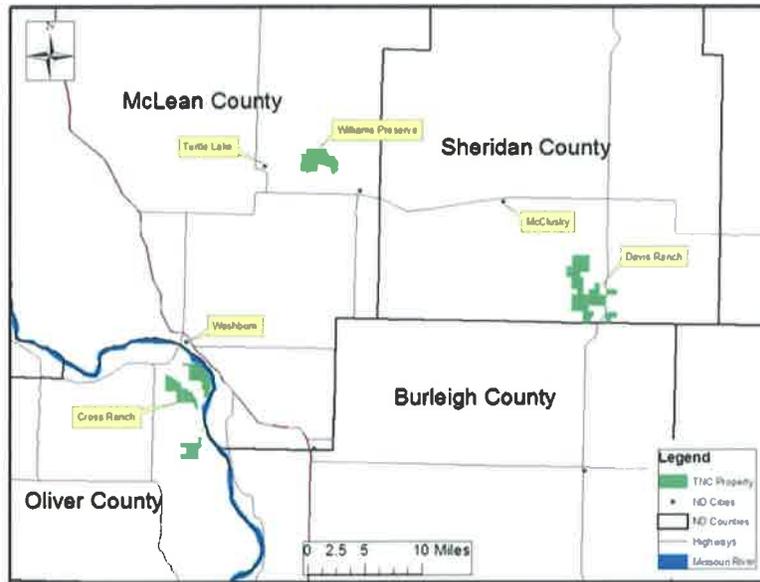


Figure 1. Project Area.

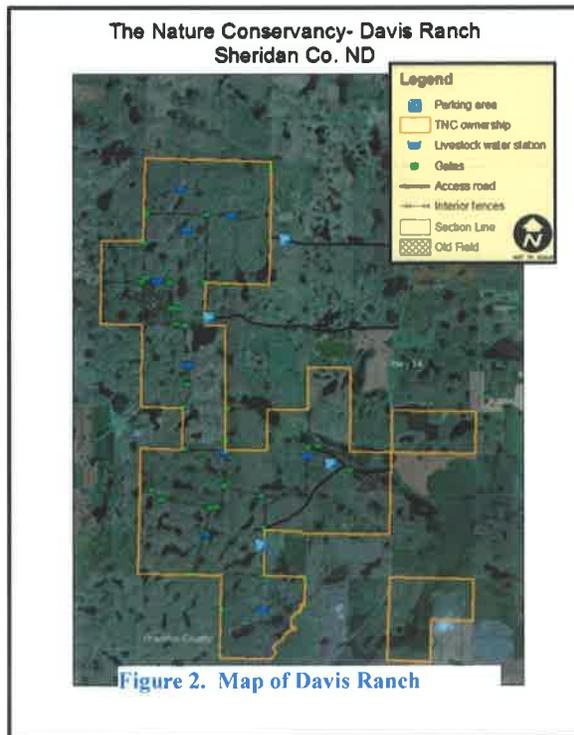


Figure 2. Map of Davis Ranch

Davis Ranch description

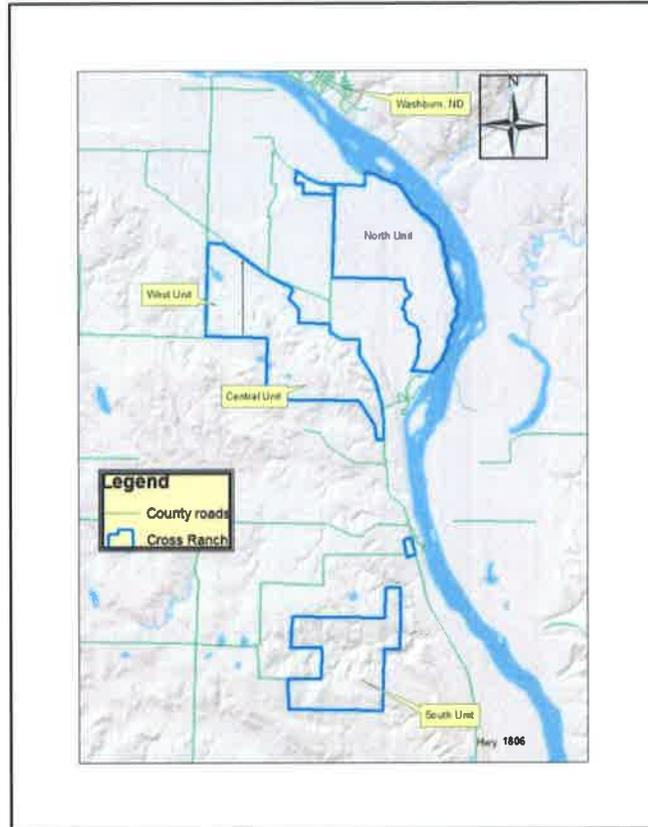
Davis Ranch (Figure 2) is a 7,000 acre property which has been owned by TNC since 1997. This property is located on the Missouri Coteau in southern Sheridan County. Most of the property is considered to be native prairie, however there are areas that were cropped at one time and have since been seeded back to grass, mostly brome. The native prairie of this area is generally considered to have been dominated by *Stipa sp.* and western wheatgrasses. The Missouri Coteau of this area is characterized by numerous wetlands surrounded by grasslands on rocky glacial moraine hills. This area is in MLRA 53B (NRCS, 2006).

Management at Davis Ranch was primarily by cattle grazing prior to TNC ownership. Current management includes rotational grazing by cattle and prescribed fire. Management goals are to provide a mosaic of grass structure for grassland birds and enhance native prairie.

Cross Ranch description

Cross Ranch (Figure 3) is a 5,500 acre property owned by TNC since 1982. This property is located within an area described as the Missouri River breaks. Cross Ranch is also considered to have been dominated by a *Stipa sp./western wheatgrass* community. Unlike the Missouri Coteau, the Missouri breaks area does not have numerous wetlands and rolling topography and is characterized by rolling plains with terraces and ridges associated with the Missouri River. This area is in MLRA 54 (NRCS, 2006).

Cross Ranch is managed primarily by grazing by cattle and bison as well as prescribed burning. Bison graze the Central and South units and cattle are rotated thru the North and West units. About 1200 acres of Cross Ranch North Unit is Cottonwood forest along the Missouri River and is not grazed or burned.



Project Activities and Results

Prescribed Fire

Project goals of burning 1000 acres in the spring (April-May) and 500 acres in the fall (Sept.-Oct.) were met every year of the project. From 2010-2012 fire crews employed by TNC completed prescribed fires on 7,272 acres within the project area (Table 1). The complete list and maps of completed fires in the project area is listed in the appendix. Twenty-nine units (4,990 ac.) were completed during the spring fire season and 20 (2,282 acres) units were burned in fall fire season. Over the course of this project TNC fire crews completed burns primarily on TNC owned property, but also completed burns on other private lands (i.e. Ducks Unlimited, Inc. and other conservation minded landowners.) in the grant area. TNC fire crews also assisted Cross Ranch State Park, the National Park Service at Teddy Roosevelt NP and Knife River Indian Villages; US Fish and Wildlife Service at McLean Co. Waterfowl Production Areas and Lake Ilo Refuge.

Figure 3. Map of Cross Ranch.

Table 1. Total acres burned as part of project. 2010-2012.

Year/Season	Spring	Fall	Total
2010	2,211	822	3,033
2011	1,004	540	1,544
2012	1,775	920	2,695
Total	4,990	2,282	7,272

Monitoring

Belt Transects

In an effort to determine the current state of the vegetation of Davis Ranch and Cross Ranch we elected to use belt transects. Belt transects were used because they could be done quickly by staff with basic botany and plant identification skills. Belt transects also provide a large number of samples over a large geographic area to describe the current state of the vegetation with high confidence. We followed

protocol developed by Grant et al., 2004, with the goal of collecting one belt transect per 10 acres of grassland. In total, 1060 transects were collected (Table 2). Both sites combined produced more than 50,000 individual sample points. Belt transect data were used to determine the extent of invasive grasses and determine which invasive grasses were most prevalent.

Table 2. Number of belt transects completed, 2010-2012.

	Pre-grant	2010	2011	2012	Total
Cross Ranch	0	423	0	0	423
Davis Ranch	181	20	117	319	637

Individual sample points from the belt transects were grouped based on dominate cover, given a code from a predetermined list of expected plant associations, and entered into an Access Database (Appendix B). These plant association codes were then grouped into one of four categories listed in Table 3.

Table 3. Vegetative cover categories.

Plant Association	Category
Vegetative cover with only native grass or forb species.	Pristine Prairie.
Vegetative cover mostly native species with some presence of invasive grasses.	More than 50% native.
Vegetative cover has some native but mostly invasive grasses.	Less than 50% native.
No native vegetative cover.	All invaded.

Belt transect Results.

Both properties showed a high level of invasiveness, with more than 50% of all points to be less than 50% native (Table 4). Personal observation suggests that areas of steep topography or dry hilltops to have the best samples of pristine prairie. Low, flat areas, often with loamy soils generally had very high levels of invasive grasses. These data are quite similar to data collected by U.S. Fish and Wildlife Service on Waterfowl Production Areas (WPA) in North Dakota in which they found only 20% of WPA's have areas of pristine prairie (Grant et al, 2007).

Table 4. Results of belt transects at Davis and Cross Ranch.

	Cross Ranch (Missouri Breaks)	Davis Ranch (Missouri Coteau)
Pristine prairie	35.6%	20.1%
< 50% native	8.4%	19.6%
>50% native	18.5%	26.9%
Mostly invaded	34.8%	30.4%

In an effort to characterize the vegetation at the scale of management treatments with high, or low, levels of invasiveness we broke down the data into individual management units and conducted the same analysis as above. At Cross Ranch, only the South unit was shown to have levels of invasiveness less than 40% (Figure 4). At Davis Ranch all units were shown to have levels of at least 40% invaded, often more (Figure 5).

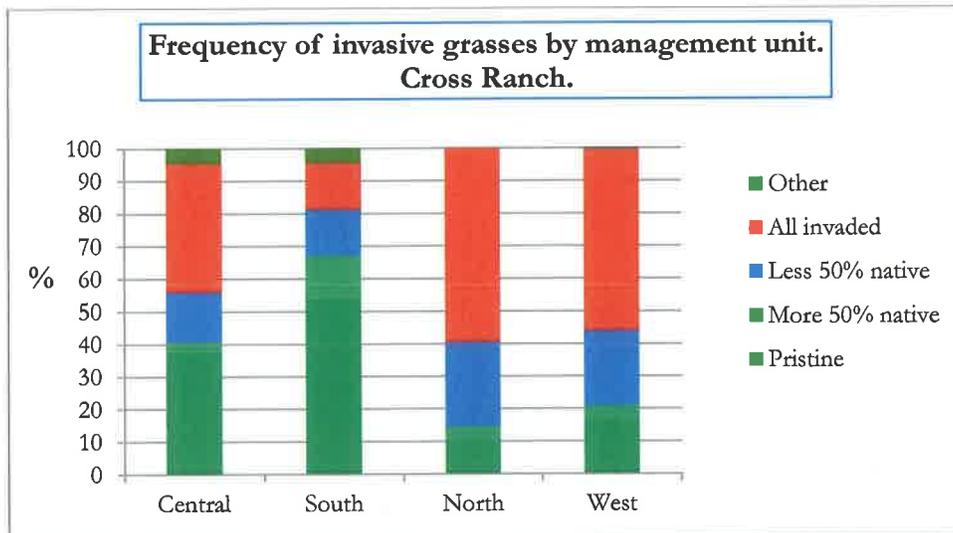


Figure 4. Extent of invasive grass by management unit at Cross Ranch.

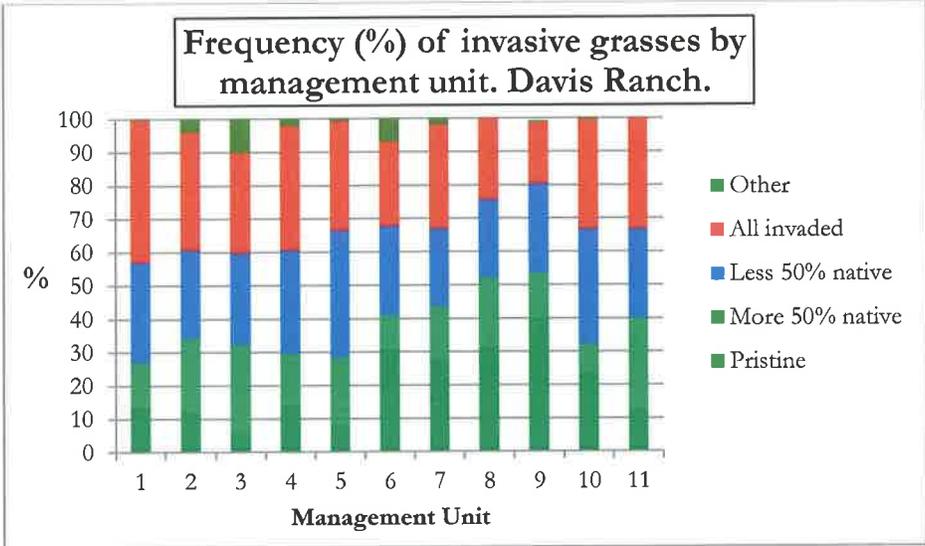


Figure 5. Frequency invasive grasses by management unit at Davis Ranch.

Further analysis of the data clearly shows Kentucky bluegrass, (sometimes called ‘June grass’ by local ranchers), to be the dominate invasive grass in all management units, at both properties (Figure 6 & 7). Grant et. al (2007) also documented relatively high frequency of Kentucky bluegrass however they also showed much higher frequencies of Smooth Brome then what we have detected.

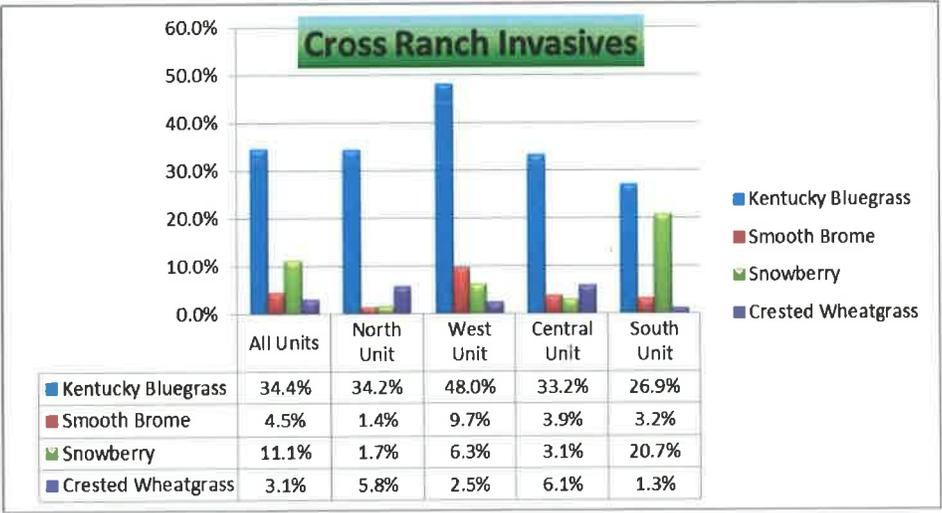


Figure 6. Dominant invasive grasses at Cross Ranch.

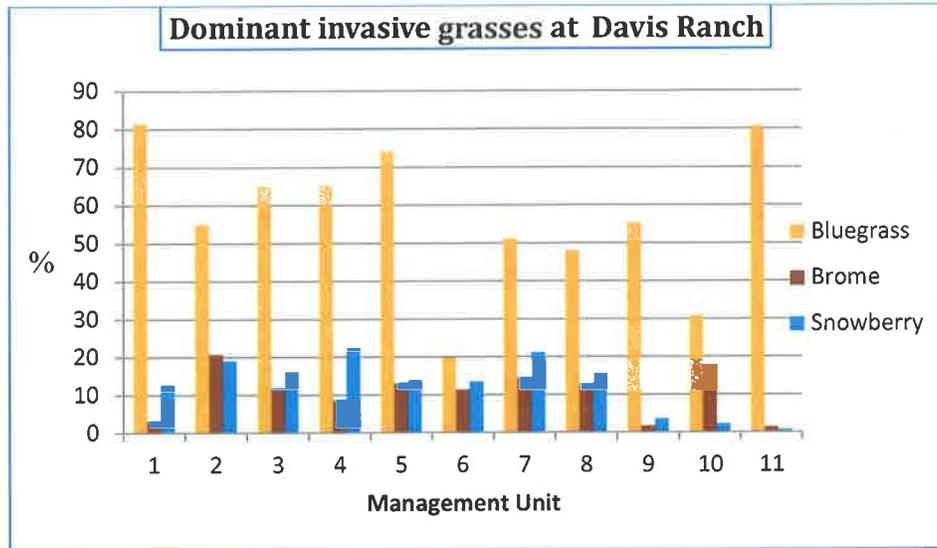


Figure 7. Dominant invasive grasses at Davis Ranch.

Snowberry

We also documented the presence of Snowberry in the belt transects. At Davis Ranch snowberry was found in about 16% of all samples. At Cross Ranch snowberry was found in about 11% of all samples. Our concern with snowberry is the general association of snowberry and KBG. In most cases dense stands of snowberry are found with understory of KBG. One thought is that as snowberry density increases it creates a micro-climate which is cooler and wetter- a perfect climate for KBG. Grant et al. (2007) suggest that historically brush, such as snowberry, would be present on about 5% of grassland areas.

Fire Monitoring Plots

Following the analysis of a limited number of belt transects in 2009 (Rosenquist, 2010) we became quite concerned of the ubiquitous nature of Kentucky bluegrass on the landscape, even in areas that were treated with spring prescribed fire treatments. As part of this project we aimed to use fire management in the fall with the idea that fall burning and the lack of residual plant matter over the winter may eliminate the moist conditions required by Kentucky bluegrass (K. Smith, personal comm.).

Three burn units were selected for fire treatments in both the spring (April- May) and fall (Sept- October), 6 unit's total. These units were burned in 2010 and 2012 and monitored to determine if there was a difference between spring and fall fire treatments (Table 5).

Table 5. Date of fires on monitoring plots.

Spring Burn dates on monitoring plots	Fall burn dates on monitoring plots
Rx 3 (Davis Ranch) 4/20/2010 5/9/2012	Rx Gaines (Cross Ranch) 10/4/2010 10/11/2012
Rx 6 (Davis Ranch) 5/3/2010 5/1/2012	Rx 5 (Davis Ranch) 9/30/2010 9/24/2012
Rx 10 (Cross Ranch) 5/5/2010	Rx 7 (Davis Ranch) 10/14/2010

To evaluate the impact of fires and vegetation, 6-50 meter transects with permanent plots every 10 meters were established in pre-determined spring and fall burn units. These transects were stratified

by upland and lowland. 15 upland and 15 lowland sampling plots were created in each management unit. All burn units were exposed to either bison (Cross Ranch) or cattle (Davis Ranch) grazing.

The permanent sampling plots are 1 meter² in which the vegetative cover of the following categories were measured: Kentucky Bluegrass, Smooth Brome, native grasses, native forbs, and woody vegetation. Cover was estimated and placed into 1 of the 6 cover classes. Plots were sampled once each summer of 2010-2013. Generally data was collected in mid-summer (July).

Fire Monitoring Plots Results. *(All error bars are 1 Standard Error)*

The graphs below show the response of several different vegetation groupings following spring and fall burning. Since this project started the spring of 2010 monitoring data was not able to be collected prior to burning spring units. Lightning bolt icons mark the relation to the fire event to collection of monitoring data. It is important to note that fire units Rx 10 and Rx 7 were only burned in 2010. All error bars represent 1 standard error. For a change to be considered statistically significant we need to compare confidence intervals, which requires doubling of the error bars. If there is no overlap of the doubled error bars the change can be considered statistically significant.

Kentucky bluegrass was reduced from 2010-2012 in both spring and fall burning treatments however those decreases were lost by 2013 in which Kentucky bluegrass increased in almost all plots. In most cases however these changes were not statistically significant. One interesting observation is that fire units Rx 10 and Rx 7 were not burned in 2012 and also showed the greatest increase of bluegrass in 2013 data (Figure 8 & 9). Weather may play a significant role in Kentucky bluegrass invasion (Appendix H). 2012 was generally hot and dry in the project area, possibly creating unfavorable conditions for bluegrass. The spring of 2013 was cool and had regular rain events perhaps creating ideal conditions for cool season grasses like Kentucky bluegrass. Smooth brome showed much less variation over time (Figure 10 & 11).

Native grasses and forbs did not change significantly under either spring or fall burning treatments however there were some interesting trends (Figures 12-15). Native forbs showed a steady decline in the spring fire treatments. Native forbs in the fall treatment showed early increases but ended slightly lower. Native grasses also showed slight increases in 2012 monitoring however those increases were lost in 2013 and ended slightly lower. Of particular note, unburned plots in units Rx 10 and Rx 7 showed greater decreases in native grasses and forbs. It is possible that the sharp increase of Kentucky bluegrass shown in 2013 accounts for the decrease in natives. This data suggests that fire is important to maintaining native prairie communities but is perhaps a less effective when environmental conditions are cool and wet.

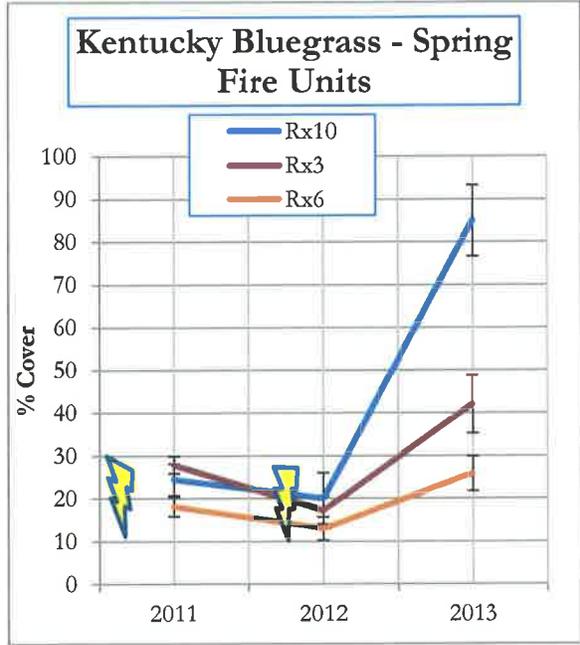


Figure 8.

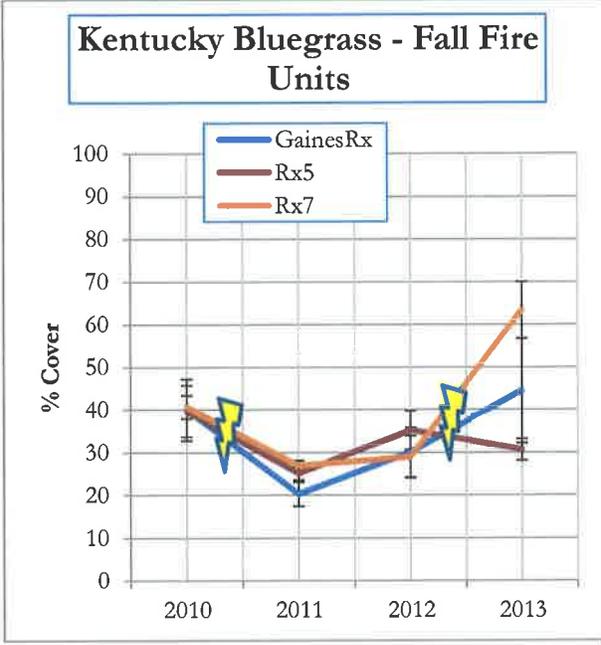


Figure 9.

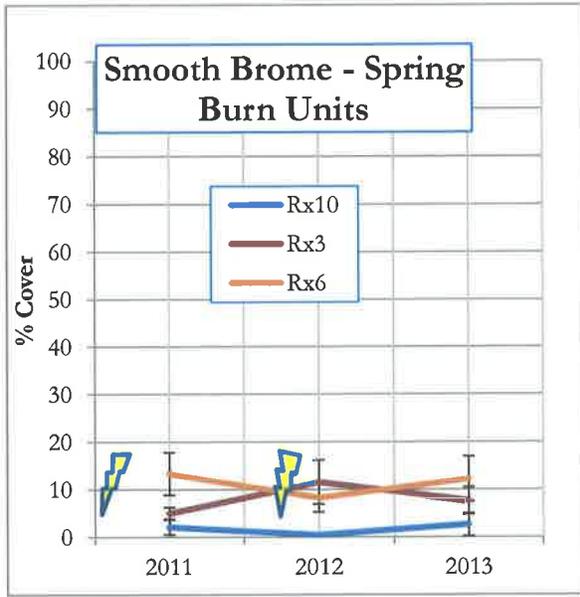


Figure 10.

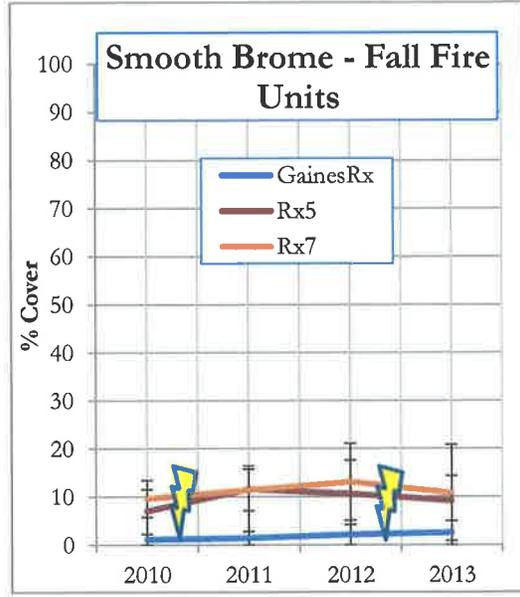


Figure 11.

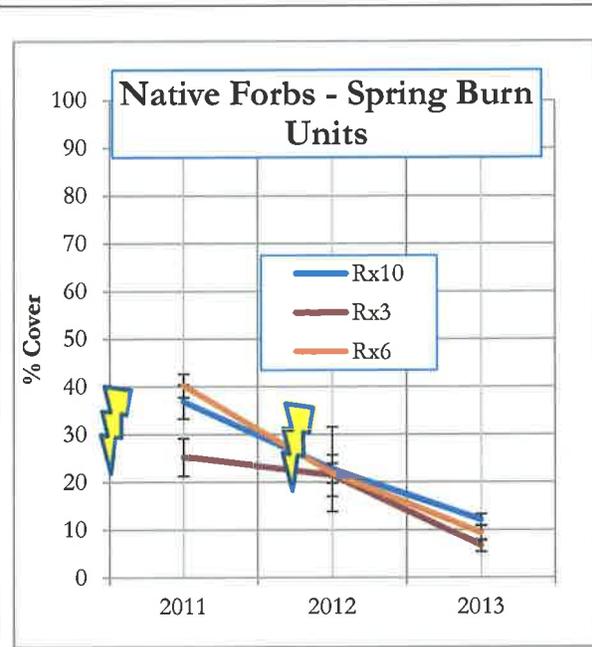


Figure 12

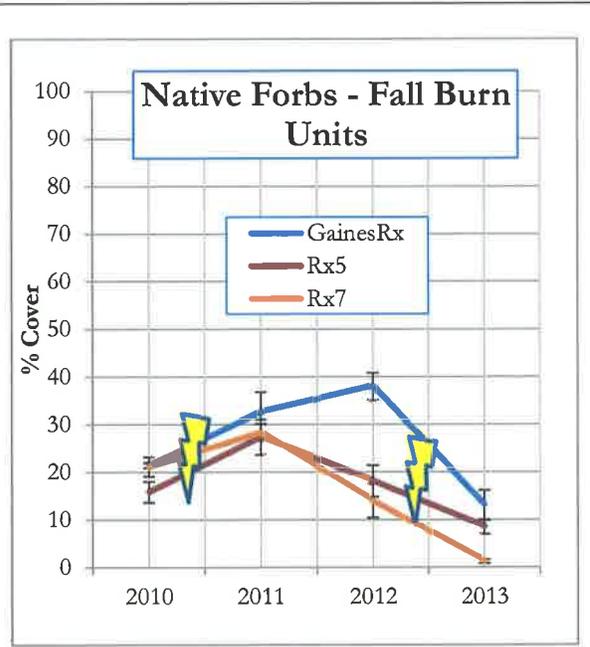


Figure 13

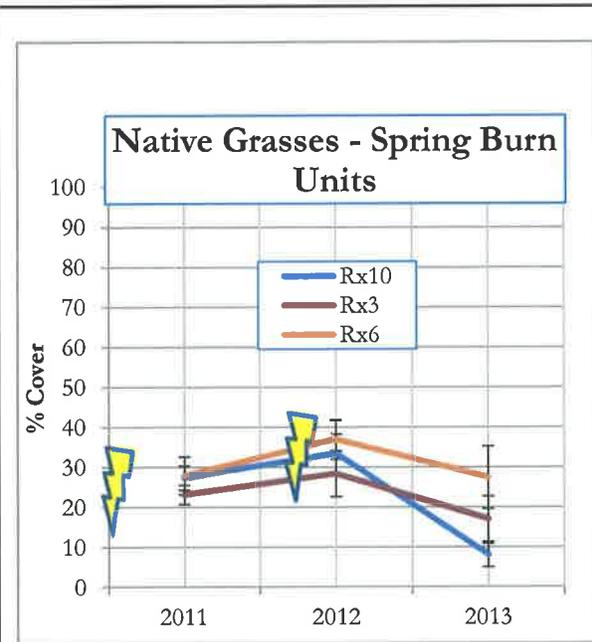


Figure 14

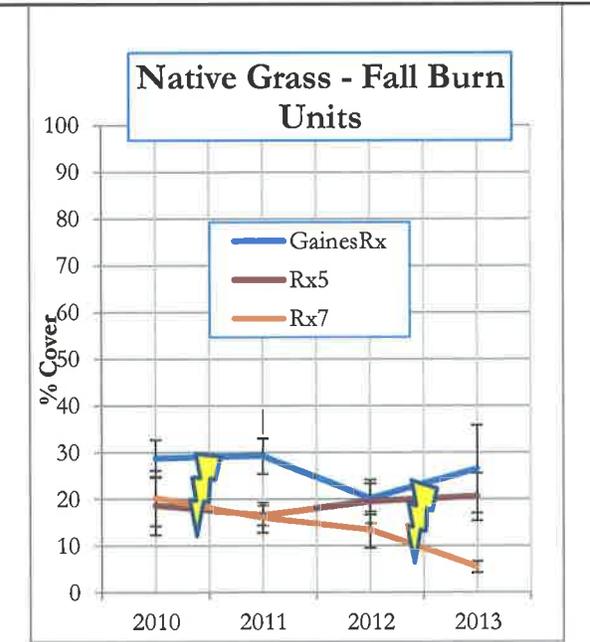


Figure 15

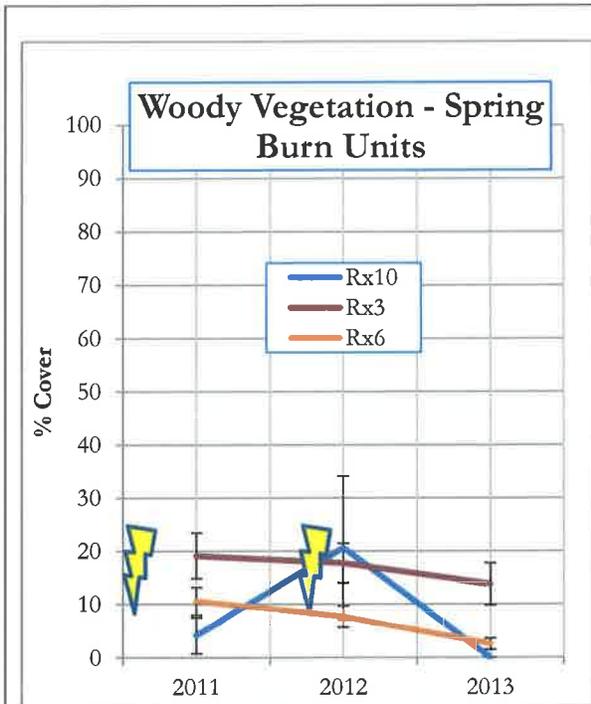


Figure 12.

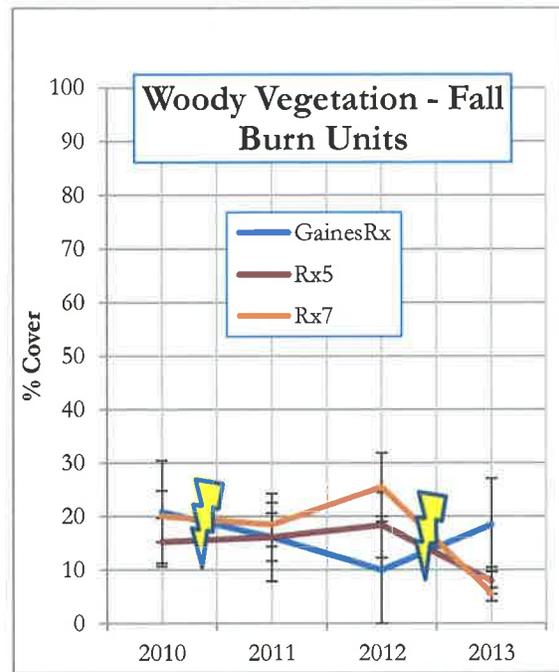


Figure 13.

Woody Vegetation appears to have been generally reduced in both the spring and fall treatments (Figure 16 & 17).

Impact to Species of Concern (Bird Counts)

One of the management goals at both Davis and Cross Ranch is to provide a mosaic of grass structures which would be favorable to a diverse suite of grassland birds. Point counts were conducted by personnel from the Wildlife Conservation Society (WCS) summers of 2010-2012 at both Cross Ranch and Davis Ranch to determine species presence/absence and density.

Cross Ranch:

2012, WCS technicians surveyed 71 survey points finding high densities of Grasshopper Sparrow, Western Meadowlark, Clay-colored Sparrow, Upland Sandpiper, Dickcissel, Bobolink, Savannah Sparrow and Horned Lark. Upland Sandpiper, in particular, was strongly associated with areas that had been burned.

In 2011, across the 58 survey points we found high numbers of Grasshopper Sparrow, Bobolink, and Western Meadowlark. Two target species, Grasshopper Sparrow and Upland Sandpiper, were regularly detected. Rare species of note included the Le Conte's Sparrow and Brewer's Blackbird.

In comparison with 2010, we found fewer Grasshopper Sparrows and Western Meadowlarks and more Bobolinks. Restricting our comparison with 2010 to only the 58 points that were surveyed in 2011, the inter-annual differences are diminished slightly. However, the absence of Lark Sparrow, Field Sparrow, Baird's Sparrow, and Sprague's Pipit and significant increase in number of Bobolink could be attributed to very wet spring and summer conditions.

The presence of Bobolinks, Upland Sandpipers, Savannah Sparrows and Dickcissels demonstrates that Cross Ranch maintains vertical habitat structure suitable for good number of these species. Upland Sandpipers and Grasshopper Sparrows are two of the best indicators that good quality patches of grassland habitat are present (Ellison, 2012).

Davis Ranch

Thirty-one points were surveyed by WCS technicians in 2012. The shrub-associated Clay-colored Sparrow continued to decline as woody vegetation was reduced by prescribed burning. Birds commonly found in 2012 include, Grasshopper Sparrow, Clay-colored Sparrow, Western Meadowlark and Chestnut-collared Longspur. Also found were Savannah Sparrow, Upland Sandpiper and Bobolink.

In 2011, across 28 survey points, we found high densities of Grasshopper Sparrow, Clay-colored Sparrow and Bobolink. Three target species, Grasshopper Sparrow, Upland Sandpiper, and Chestnut-collared Longspur were regularly detected. Rare species included the Baird's Sparrow, LeConte's Sparrow, McCown's Longspur and Brewer's Blackbird.

In addition to the singing birds detected, we recorded an additional 10 Chestnut-colored Longspurs and a Sprague's Pipit. The bird species data largely reflected the habitats available: Clay-colored Sparrows need a mix of grass and shrubs; Horned Larks prefer bare areas; Grasshopper and Savannah sparrows use areas with slightly more grass; and Vesper Sparrows and meadowlarks use mixtures of grass and some shrubs (Ellison, 2012).

Outreach

May 23, 2013 The Nature Conservancy hosted a "Range Forum" event focusing on Kentucky bluegrass issues such as the scale and scope of invasion, ecological thresholds, and response to management actions. This event was attended by about 40 individuals representing the following agencies and organizations.

- North Dakota Game and Fish
- Ducks Unlimited
- The Nature Conservancy
- ND Public Service Commission
- US Natural Resources Conservation Service
- US Fish and Wildlife Service
- ND Trust Lands Department
- US Forest Service
- Private Landowners
- North Dakota State University
- US Department of Agriculture-Agriculture Research Station
- National Park Service



Figure 14. Participants to the workshop discuss grass and soil biology on a recently burned unit at Cross Ranch.

In addition to the Range Forum event TNC will be hosting the Oliver County Soil Conservation Service annual grasslands tour July 12, 2013 and discussing results of this project.

Summary

The scale and scope of invasive grasses over the landscape should be of great concern for grassland managers. The loss of the diversity of our native grasslands will likely have negative consequences for not only our native grassland wildlife but also ranchers who depend on healthy and resilient grasslands. There is still much we need to learn about what factors are driving the invasion of Kentucky bluegrass (climate, hydrology, management ect.). Data collected by North Dakota Public Service Commission on land in northern McLean Co. for nearly 20 years show a dramatic increase in Kentucky bluegrass around year 2000 with rapid increases since that point (Humann, 2013).

While results of our monitoring do not show a statistically significant reduction in Kentucky bluegrass, they do show that burning will reduce bluegrass at least for the short term. It is well documented that no management (rest) will lead to continued degradation of the native vegetation community. We also recognize that grazing is an important management tool for our grasslands. However, considering the high levels of bluegrass on a landscape which has been exposed to grazing for decades suggests that grazing alone is not sufficient to maintain diverse native grasslands.

The results and other observations from this project will help to direct our management of grasslands in several ways:

- Prescribed fire must remain a primary management tool. We will need to continue to refine fire timing, avoiding dormant season fires and striving to conduct burns during the growing season when Kentucky bluegrass is most vulnerable. Fall fires did not appear to show a significantly different response than spring burning, however fall burning provides an additional window of opportunity to apply fire treatments.
- Placing personnel dedicated to conducting prescribed fire at focus areas was an effective strategy to implementing burn plans.
- Permanent monitoring transects will be resampled annually to build a more robust data set to evaluate management treatments. Belt transects will be resampled every 5 years to show trends across the properties.

Acknowledgements

We are extremely grateful to North Dakota Game and Fish Department- State Wildlife Grants program for this opportunity. We feel we were very effective at deploying fire management over a large area among several landowners. This would not have been possible without your support.

Special thanks to the following people who played key roles throughout this project:

Chris Gordon- TNC Field Steward/ Burn Boss managed our fire crews and was the burn boss on record for most of the burns completed. We would not have met our fire goals without Chris's dedication to the project. Chris also developed GIS maps used in this report.

Marissa Ahlering- TNC Prairie Ecologist set up permanent monitoring plots, conducted data entry and analysis.

LaTosha Randall- TNC Grants Specialist managed the grant budget and provided regular reports.

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Appendix A. Prescribed burns completed, 2010-2012.

2010 Completed burn units

<u>Managed Area name</u>	<u>County</u>	<u>Unit Name</u>	<u>Date of fire</u>	<u>Acres burned</u>
Davis Ranch	Sheridan	3-1	4/20/10	470
Davis Ranch	Sheridan	Goose Lake	4/25/10	120
Davis Ranch	Sheridan	8-3	4/27/10	370
Davis Ranch	Sheridan	6-1	5/3/10	350
John E. Williams	McLean	30-3	4/21/10	85
John E. Williams	McLean	S. Elbow	4/23/10	128
John E. Williams	McLean	N. Pelican	4/16/10	60
Private Land- Dryer	Sheridan	Bucky Badger	5/14/10	323
Private Land- TLC LLP	Sheridan	34-1	5/14/10	197
Private Land- TLC LLP	Sheridan	11-1	5/15/10	82
Cross Ranch State Park	Oliver		4/27/2010	9
Cross Ranch State Park	Oliver		4/30/2010	17
Cross Ranch	Oliver	Corner	9/14/10	20
Cross Ranch	Oliver	CRP	9/1/10	40
Davis Ranch	Sheridan	5-3	9/30/10	464
Cross Ranch	Oliver	Gaines	10/4/10	145
Cross Ranch	Oliver	Peninsula	10/6/10	53
Davis Ranch	Sheridan	7-2	10/14/10	100

2011 Completed burn units

<u>Property</u>	<u>County</u>	<u>Burn Unit</u>	<u>Date</u>	<u>Acres</u>
Cross Ranch	Oliver	7-1	5/4/2011	150
Cross Ranch	Oliver	North Prairie	4/12/2011	185
Cross Ranch	Oliver	North Unit Park	6/15/2011	43
Williams Preserve	McLean	East Pelican	5/15/2011	120
Williams Preserve	McLean	W. Peterson	4/24/2011	230
USFWS-Koenig	McLean	Koenig WDA 6	5/3/2011	80
Keith Trego- Private	Sheridan	Kruger Lake	4/26/2011	101
TLC LLC-Buckmueller	Sheridan	34-2	5/4/2011	95
John E. Williams	McLean	N. Elbow	9/6/2011	90
Davis Ranch	Sheridan	4	9/25/2011	100
Ducks Unlimited	Sheridan	Coteau Ranch 7-4	10/1/2011	90
Ducks Unlimited	Sheridan	Coteau Ranch 7-3	10/1/2011	160
John E. Williams	McLean	Beaches	9/18/2011	10
John E. Williams	McLean	Spot Lake	9/30/2011	50
Cross Ranch	Oliver	Ravine	9/26/2011	40

2012 Completed burn units

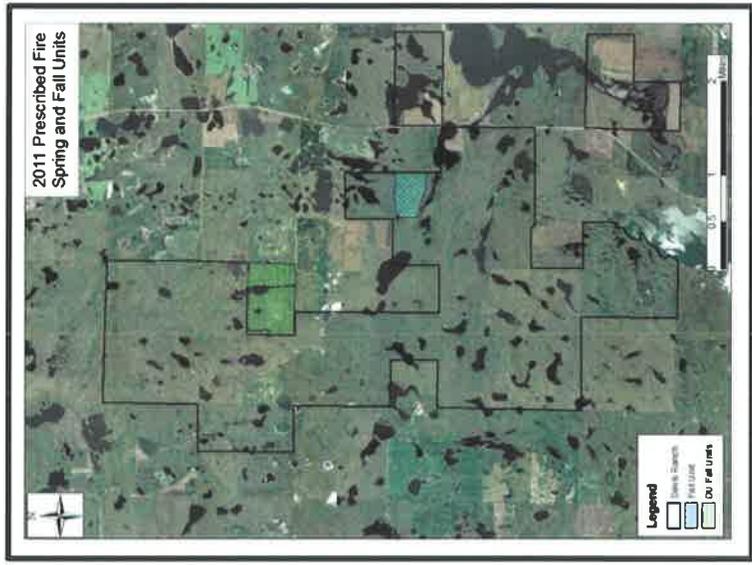
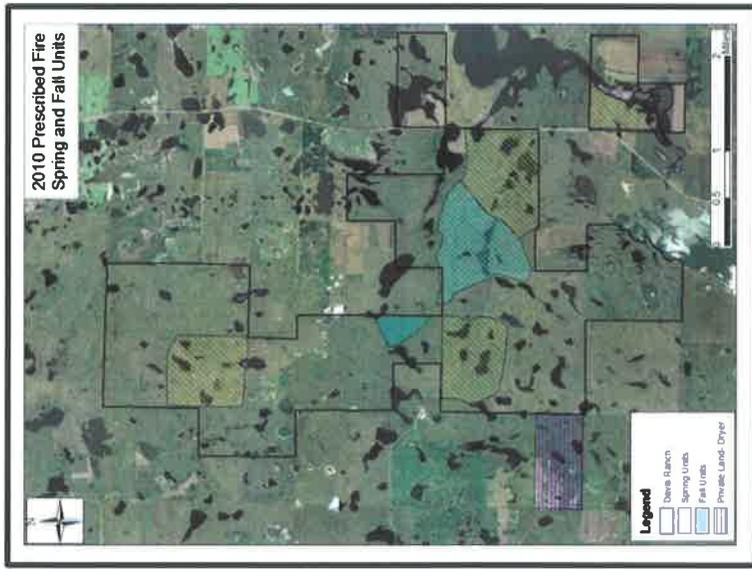
Property	UNIT NAME Wildlife Mgmt. Area	COUNTY	ACRES BURNED	BURN DATES
J.E. Williams	NE Pelican	McLean	140	4/18/2012
Cross Ranch	36-1	Oliver	280	4/22/2012
J.E. Williams	NE Williams	McLean	170	4/23/2012
Davis Ranch	6-1	Sheridan	350	4/25 & 5/1 2012
Cross Ranch	Gilberts Corner	Oliver	60	4/30/2012
Cross Ranch	NW Gaines	Oliver	160	5/3 & 5/11 2012
Davis Ranch	3-1	Sheridan	255	5/9/2012
Davis Ranch	9-1	Sheridan	85	5/10/2012
Cross Ranch	Windmill Corner	Oliver	275	5/15/2012
J.E. Williams	Beaches	McLean	25	9/14/2012
J.E. Williams	NW Restoration	McLean	25	9/17/2012
J.E. Williams	W. Pelican	McLean	100	9/20/2012
Davis Ranch	5-1	Sheridan	460	9/24/2012
Davis Ranch	DU 8-1	Sheridan	150	9/26/2012
Davis Ranch	S Salt Lake	Sheridan	150	9/27/2012
Cross Ranch	Gaines	Oliver	10	10/11/2012

Appendix B. Maps of Cross Ranch burn units 2010-2012.



Maps created by Chris Gordon, 2013.

Appendix C. Maps of Davis Ranch burn units, 2010-2012.



Maps created by Chris Gordon, 2013.

Appendix D. Maps of Williams Preserve burn units, 2010-2012.



Map created by Chris Gordon, 2013.

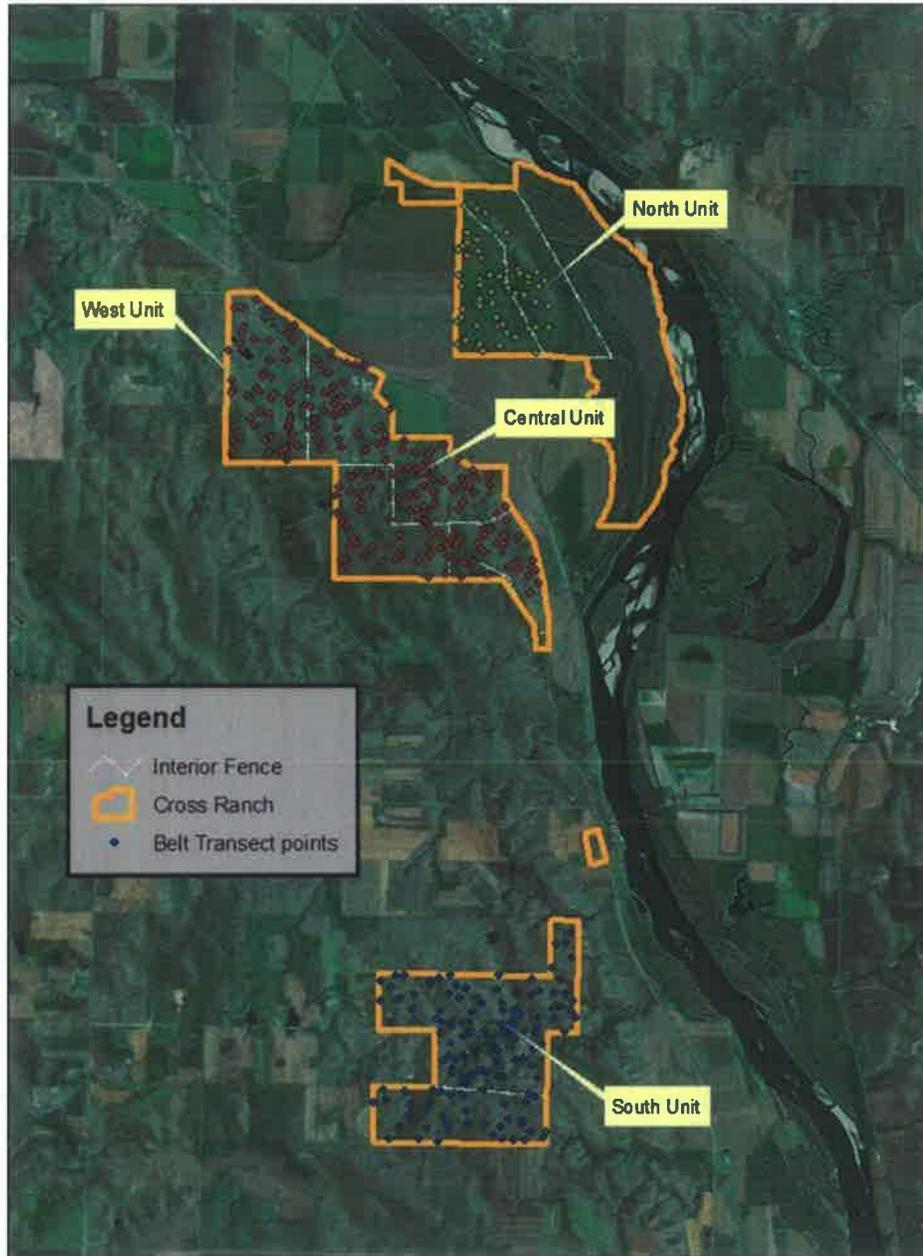
Appendix E. Locations of belt transects at Davis Ranch.



Map created by Chris Gordon, 2010.

Appendix F. Locations of belt transects at Cross Ranch.

Cross Ranch Management Units



Map created by Chris Gordon, 2010.

Appendix G. Vegetation groupings used in Belt Transects (Grant et al. 2004).

Long Lake NWR Complex Upland Plant Associations (Modified from Grant et. al 2004)

- Record 1 of the below codes per 0.5 meter segment
- Based on $\geq 50\%$ canopy cover dominance, unless otherwise specified

SHRUB and TREE TYPES

low shrub (generally <1.5m tall)

- 11 snowberry *dense* (other low shrub species total 0-25%); *other plants few or none*
- 12 snowberry (and other low shrub spp.); remainder mostly NATIVE grass-forb types
- 13 snowberry (and other low shrub spp.); remainder mostly Kentucky bluegrass
- 14 snowberry (and other low shrub spp.); remainder mostly smooth brome (or quackgrass)
- 15 silverberry; add modifier -15[2] = NATIVE grass-forb, 15[3] = KY bluegrass, 15[4] = brome (or quack)
- 18 meadowsweet; add modifier as above 18[2], 18[3], or 18[4]

tall shrub/tree (generally ≥ 1.5 m tall)

- 21 chokecherry, buffaloberry, hawthorn, willow
- 23 exotic shrub: caragana, Russian olive, Siberian elm
- 33 shade-tolerant woodland tree: green ash, box elder, elm
- 31 aspen

NATIVE GRASS-FORB and FORB TYPES (>95% dominance by native herbaceous plants, including forbs)^{a,b}

- 41 dry cool season (sedges, green needlegrass, needle-and-thread, wheatgrass spp., prairie junegrass, forbs)
- 42 dry warm season (little bluestem, prairie sandreed, blue gramma, forbs)
- 43 mesic cool-warm mix (big bluestem, switchgrass, porcupine grass, prairie dropseed, forbs)
- 47 cactus
- 48 clubmoss

EXOTIC and INVADDED NATIVE GRASS-FORB TYPES^{a,b}

- 51 Kentucky bluegrass >95% (or >50% if mixed with other non-natives)
- 52 Kentucky bluegrass and NATIVE grass-forbs, *KY bluegrass 50-95%*
- 53 NATIVE grass-forbs and Kentucky bluegrass, *KY bluegrass 5-50%*
- 61 smooth brome (or quackgrass) >95% (or >50% if mixed with other non-natives)
- 62 smooth brome (or quackgrass) and NATIVE grass-forbs, *brome 50-95%*
- 63 NATIVE grass-forbs and smooth brome (or quackgrass), *brome 5-50%*
- 71 crested wheatgrass >95% (or >50% if mixed with other non-natives)
- 72 crested wheatgrass and NATIVE grass-forbs, *crested wheatgrass 50-95%*
- 73 NATIVE grass-forbs and crested wheatgrass, *crested wheatgrass 5-50%*
- 78 tall, intermediate, or pubescent wheatgrass
- 98 tall exotic legume: sweet clover or alfalfa

NOXIOUS WEED TYPES

- 81 leafy spruce
- 83 Canada thistle
- 87 wormwood
- 88 other noxious weeds (user-defined)

OTHER

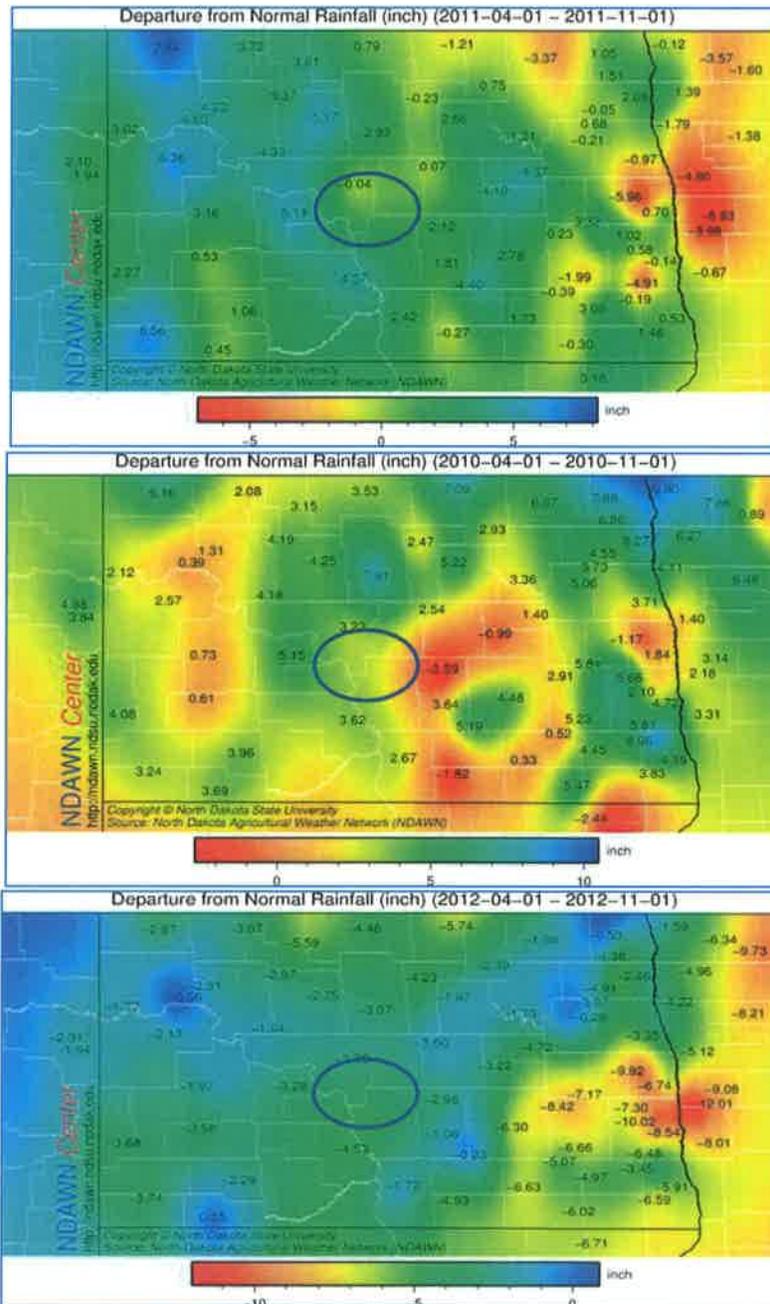
- 99 other – user defined
- 91 barren/unvegetated (e.g., rock, anthill, bare soil); dead, horizontal/flattened litter layer only
- 00 wetland vegetation (e.g., wet-meadow or shallow marsh plants)

^aPrairie rose is considered a native forb with respect to these categories.

^bFor any of the below categories, if the native forb composition is >50%, add a "9" as a modifier (e.g., 41 = 419)

**in the event of an apparent 50:50 mix of KY bluegrass and smooth brome – consider as code 61

Appendix H. Departure from Normal Rainfall, 2010-2012. Project area defined by circle.



Appendix I. Outreach event agenda.

Kentucky Bluegrass Workshop

May 23, 2013

The Nature Conservancy - Cross Ranch Preserve
1401 River Rd
Hensler, ND

9:30 am (CDT)	Eric Rosenquist - TNC	Welcome
9:45 study	Eric Rosenquist - TNC	Results of fall and spring burning
10:15 am	Cami Dixon - USFWS	Native Prairie Adaptive Mgt Project
10:45 am	Mike Humann – ND Dept of Trust Lands	Update on McLean County Kentucky bluegrass Studies
11:05 am	Dr. Ken Spaeth - NRCS bluegrass	Extent and impact of Kentucky
11:50 am	Discussion and lunch	Lunch will be “bring-your-own”
1:00 pm	Eric, Cami, Ken, Mike	Field review of prescribed burn review and discussion of results.
3:30 pm	Return to TNC headquarters and adjourn	