National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Grassland and Fire Effects Monitoring in the Southern Plains

Southern Plains Network and Southern Plains Fire Group Collaboration Project Report 2012

Natural Resource Technical Report NPS/SOPN/NRTR—2013/XXX

ON THE COVER

Prescribed fire in Bent's Old Fort National Historic Site, 2006. NPS photo.

Grassland and Fire Effects Monitoring in the Southern Plains

Southern Plains Network and Southern Plains Fire Group Collaboration Project Report 2012

Natural Resource Technical Report NPS/SOPN/NRTR—2013/XXX

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March 2013

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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This report is available from the Southern Plains Network website, http://www.nature.nps.gov/im/units/SOPN, as well as at the Natural Resource Publications Management web site, http://www.nature.nps.gov/publications/NRPM.

Please cite this publication as:

Folts-Zettner, T. , H. Sosinski, and R. Gatewood. 2012. Grassland and fire effects monitoring in the Southern Plains Network: Southern Plains Network and Southern Plains Fire Group Collaboration Project Report 2012. Natural Resource Technical Report NPS/SOPN/NRTR—2013/XXX. National Park Service, Fort Collins, Colorado.

NPS XXX/XXXXXX, Month 2013

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Executive Summary

Grassland vegetation is the most widespread vegetation type occurring in the Southern Plains. Exotic species invasions, expanding row-crop agriculture, overgrazing, mineral exploration, and establishment of woodlots and shelterbelts, and alteration of natural disturbance regimes have all contributed to grassland degradation and loss of genetic diversity. Monitoring grassland vegetation communities will help Southern Plains park managers better understand the dynamic nature of these ecosystems and the processes that control them.

From the perspectives of both fire management and ecological health, it is important to understand the effects of fire as a process that shapes our grassland communities. Given the high overlap in each program's goals in monitoring these ecosystems, it makes sense for the Inventory & Monitoring (I&M) Program and the NPS Fire Program to join in a collaborative monitoring effort. This project represents the continuing effort toward establishing that collaboration (Folts-Zettner et al. 2007).

During 2012, a crew funded by both the I&M and Fire programs continued work on a pilot of the collaborative field efforts. In addition to surveying standard Fire Program shrub transects and forest measurements when appropriate, the crew fielded by the Southern Plains Fire Group sampled species composition and abundance using methods employed by the Southern Plains Inventory & Monitoring Network. A total of 114 permanent transects were monitored across the Southern Plains during the summer of 2012.

The results presented in this three-year report represent very different growing conditions. 2010 was a year of average to above normal rainfall and green vegetation, but the winter was dry and the following two years have brought persistent severe drought for many parks across the southern plains. This has generally resulted in a decrease of relative cover for all native perennial grasses and forbs while exotic annuals have increased. The combination of limited annual data and varying growing conditions observed over these three years limit what inferences can be made to trends or drought effects.

Chapter 1: Introduction

Grassland vegetation is the most widespread vegetation type occurring in the Southern Plains. Exotic species invasions, expanding row-crop agriculture, overgrazing, mineral exploration, and establishment of woodlots and shelterbelts have all contributed to grassland degradation and loss of native(?) genetic diversity. Monitoring grassland vegetation communities will help Southern Plains park managers better understand the dynamic nature of these ecosystems and the processes that control them. Monitoring may also provide an early warning of abnormal conditions, which will allow managers to make effective decisions for mitigation. This effort should also be a source of contributing information to the planning of any prairie restoration efforts.

Fire is a critical natural process and a primary influence on the plant and wildlife communities of national parks and the Southern Plains ecosystem. Fire, along with climate, is also the biggest determinant of whether grasslands preclude forests in the Southern Plains (Axelrod 1985; Anderson 1990). Monitoring the effects of fire on park ecosystems is an important part of the National Park Service (NPS) Fire Program. Fire managers need to accurately predict fire behavior under varying weather conditions, and predict how fuel loads will affect fire behavior, plant populations, and tree regeneration and mortality. From the perspectives of both fire management and ecological health, it is important to understand the effects of fire as a process that shapes our grassland communities. Given the high overlap in each program's goals in monitoring these ecosystems, it makes sense for the Inventory & Monitoring (I&M) Program and the NPS Fire Program to join in a collaborative monitoring effort. This project represents the continuing effort toward establishing that collaboration (Folts-Zettner et al. 2007).

NPS photo

Monitoring grassland vegetation communities will help Southern Plains region park managers better understand the dynamic nature of these ecosystems and the processes that control them.

Chapter 2: Collaborative Framework

2.1. Goals and objectives

The overall goal of monitoring Southern Plains grassland communities is to help park managers better understand the dynamic nature of grassland vegetation ecosystems and the processes that influence them. The specific monitoring objectives are:

2.1.1. Objective 1

Determine status and trends in plant species population and plant community composition (richness and diversity) and structure (relative abundance, frequency, distribution, ground cover) of remnant, disturbed, and/or restored grasslands.

2.1.2. Objective 2

Document the location, extent, and timing of wildland and prescribed fires or other management treatments in Southern Plains parks. The sampling for this objective will combine the program goals of the I&M Program for ecosystem health with the goals of the NPS Fire Program for using fire and other treatments to manage grassland systems.

2.1.3. Objective 3

Determine status and trends in soil structure (erosion potential, infiltration rate, compaction, texture, stability) and soil chemistry (bulk soil carbon to nitrogen ratios).

2.2. Collaborative model

The collaboration between the I&M and Fire programs is intended to gain efficiency from each program's strengths, programmatic goals, and legacy (Table 2.1). The I&M Program approaches grassland monitoring with an emphasis on long-term ecosystem health. In contrast, the Fire Program approaches monitoring with an emphasis on understanding the effects of wildland fire, prescribed fire, or mechanical treatment as a management or "natural" treatment on the ecosystem. Not surprisingly, the parameters that would be monitored from each of these perspectives overlap considerably. Furthermore, most of the park units are subject to fire or other treatments at some point in time. Consequently, there is no inherent difference between land managed with fire or other treatments and land for which ecosystem health is being assessed. It also follows that there is considerable efficiency to be gained from a combined effort whereas complementary types of sampling can add value to the sampling designs that might otherwise occur independently.

Table 2-1. Primary roles and contributions of the Inventory & Monitoring and Fire programs toward the collaborative effort

Contribution	Description	Lead Group
Field crew	Oversight	Fire
Field crew	Day-to-day	Fire[1]
Data analysis	As per I&M and Fire needs	I&M
Data management	Maintain database with shared access	I&M
Reporting	See Table 3-1	I&M

[1] I&M will contribute to the cost of one or two field technicians.

Chapter 3: Methods

3.1. Site selection

The I&M and Fire programs monitor grassland ecosystems though the emphasis differs between both programs. The Fire Program historically emphasized monitoring immediately before, during, and after fire events, with the goal of understanding the response of grasslands to fire. In contrast, the I&M Program monitoring emphasizes long-term ecosystem health, focusing on the cumulative effects of a fire regime, including secondary effects from fire events that manifest themselves over an extended period of time (Figure 3.1-1). This does not mean the Fire Program is not interested in long-term effects of fire regimes, or that the I&M Program is not interested in the immediate effects of a fire event. Rather, it implies that, with limited resources, there may information needs that require the allotted resources be directed toward the aspects of fire ecology and management that provide the greatest benefit to managers and the public.

During the spring of 2009, representatives of both programs selected grassland monitoring sites for all Southern Plains parks. The group used vegetation maps of each park to identify grassland communities, areas where type conversions to grassland were occurring, and areas of special concern to the parks—primarily cottonwood communities. In some cases, these communities already contained existing fire-event monitoring transects, which were maintained in the sampling scheme for this monitoring project to provide historic data (Figure 3.1-2). The group randomly selected additional plots in the same area of the existing fire-event monitoring transects for long-term monitoring, selecting a number of "long-term" transects equal to the number of "fire-event" transects. Every fire-event transect in a particular habitat has a similar long-term transect that "mirrors" it. Fire-event transects will continue to be sampled on the Fire Program's pre- and post-burn schedule, while long-term transects will be

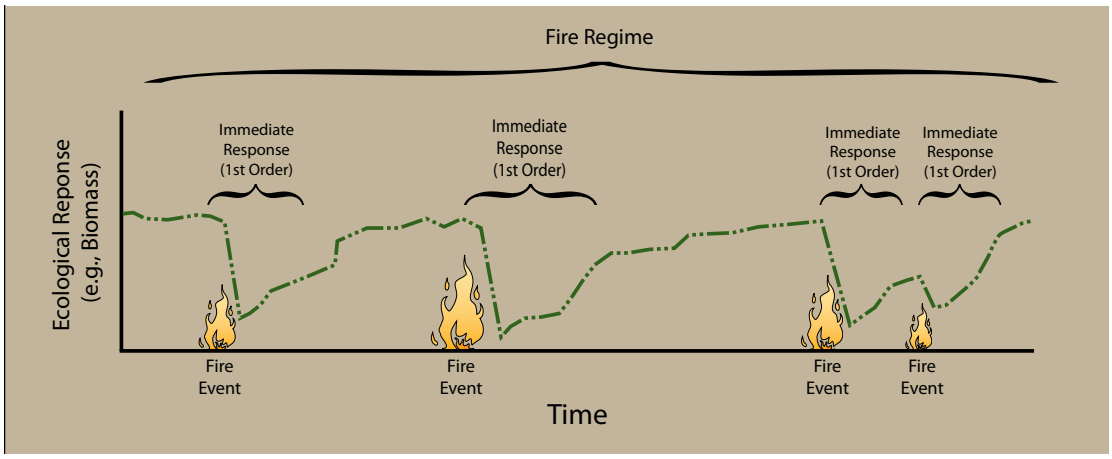


Figure 3.1-1. The cumulative effects of multiple fires over space and time can be considered a higher order scale of the regime, which may be appropriate for some monitoring objectives.

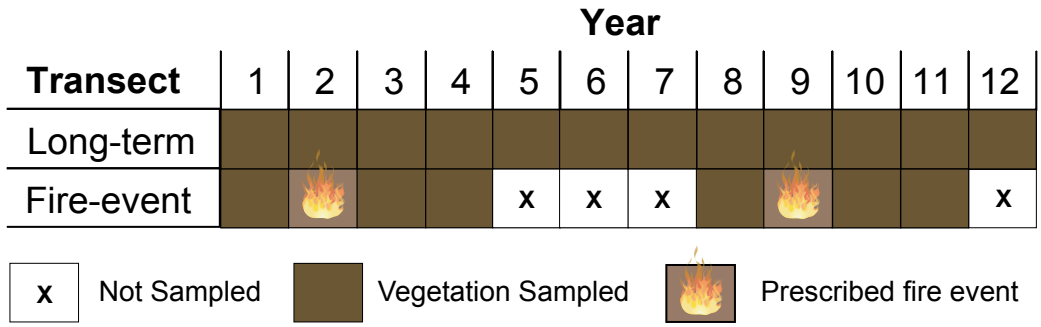


Figure 3.1-2. All long-term and fire-event transects are subject to fire. Although fire is expected and will even be prescribed on long-term transects, the fire-event sampling pattern is designed to assist the Southern Plains assess our first order immediate response.

sampled annually to ensure we have samples from all successional stages relative to fire (or other treatment) events and help to interpret the potential confounding effects of year (e.g., environmental effects) and fire events.

3.2. Sampling design

During 2010 and 2012, a crew funded by both the I&M and Fire programs worked on a pilot of the collaborative field efforts. In addition to surveying standard Fire Program shrub transects and conducting biomass sampling (USDI National Park Service 2003), the crew sampled species composition and abundance using the nested plot method employed by the Southern Plains Inventory & Monitoring Network. This consists of a permanent 50-meter transect with a nested plot sampled at 0-, 10-, 20-, 30- and 40-meters (Figure 3.2-1). Conditions were such in 2011 that each program had to field a monitoring team, but each team followed the integrated protocol and data was pooled for analysis.

In general, the monitoring teams consisted of interns from the Student Conservation Association (SCA), a NPS seasonal and one NPS crew leader; an NPS project manager is available to train and assist the team with clarifications of the protocol and identification of plant species. The interns received training in monitoring techniques and plant identification. Refinements to the monitoring techniques have been implemented throughout the past field seasons in an effort to balance data quality with time efficiency. These refinements have been incorporated into the draft Integrated Grassland Monitoring Protocol.

The Principal Investigators have made a determination that the 1m^2 and 2x1 m plots gained the most efficiency while providing the most robust data for the nested plots. The prolonged drought has shown the necessity to account for dormant/dead grass cover separately from live material. This procedure was fully implemented in 2012.

3.3. Hierarchal reporting

Reporting will be hierarchical and intended for multiple audiences and media. The primary delivery system for all reports will be the Internet, via the Learning Center of the American Southwest (LCAS), http://www.soutwestlearning.org, as well as the Southern Plains Network Internet site (http://science.nature.nps.gov/im/units/sopn/index.cfm) and the Integrated Resource Management Application (IRMA), https://irma.nps.gov. The individual products available on these web sites will be available in a format (PDF) that will facilitate easy printing or enable us to deliver a printed version to appropriate audiences.

For this monitoring effort, we anticipate products at both the resource and project level, each of which are described below and summarized in (Table 3.3-1). At the resource level we expect to produce a resource brief annually. At the project level, we anticipate producing a project summary and report annually, and a synthesis report approximately every five years.

The synthesis report is a more in depth assessment of the status and trend of the resource. This annual report, while also synthesizing project results, is a generally limited to a data summary and estimates of the core parameters. In contrast, the synthesis report will provide a much more in depth assessment, including more comprehensive analyses and broader interpretation of the implications of the results to other resources.

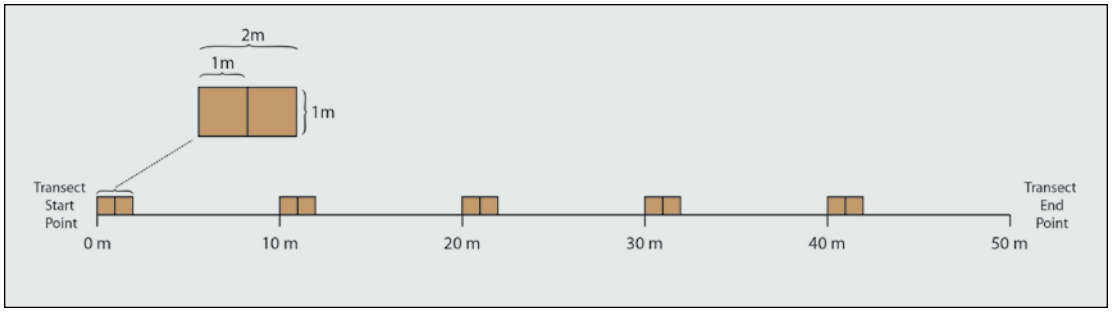


Figure 3.2-1. Primary sample units for sampling grasslands.

Table 3.3-1. Hierarchy of primary products produced for the collaborative effort

Product	Primary purpose/scope	Primary target audience(s)	Scale	Length	Frequency
Resource brief	Status and trend of grassland habitat	Superintendents/Resources managers	Park	1 page	Annual
Project summary	Summary of a project; accomplishments and results for a given year, extracted from Annual Report	Resource managers	Park	2 pages	Annual
Annual report	Project accomplishments and results for a given year	Resource managers	Southern Plains with individual park sections	Variable	Annual
Synthesis report	In depth synthesis of data and supporting evidence; primary focus on trends and influence on those trends	Resource managers/science community	Southern Plains with individual park sections	Variable	Every five years

3.4. Dissemination of Spatial Data

In addition to the hierarchy of reports, spatial products will be disseminated through IRMA (https://irma.nps.gov). IRMA is designed to act as a "one stop" location for natural resources information in the NPS. This allows for spatial data to be linked to all reporting products and made available for download.

Chapter 4: Results

The results presented in this report represent the 2012 field season in conjunction with results from previous monitoring. Growing conditions among all years have been varied greatly: 2010 was a year of average to above normal rainfall and green vegetation; 2011 was a year of extreme drought across the southern plains; and 2012 brought minimally improved drought conditions for some parks and intensified for others. The uncertainty of identifying dormant grasses increased with the severity of the drought. At times during 2011, certain grasses could be identified as present, but often it was problematic to estimate cover of specific genus or species. Identification was easier in 2012 and two cover measures may have been assigned to a genus – one for live plants and another for dormant plants. For the purpose of this report, these two measures have been combined to give one measure per species.

A second refinement was made when looking at the plot substrate. In 2011, soil was divided into two separate categories: bare soil exposed to the elements/open sky (SOILOPEN) and bare soil found under a vegetation canopy (SOILUNDER). Soil not protected by a canopy or litter is more susceptible to rain-drop impact, sheet, rill and wind erosion. 2010 soil measurement (SOILBARE) combined these two measurements.

Additional species have been identified in transects each year, while other species have disappeared. This can be attributed to 1) annual variation of plant species, particularly annuals; 2) minor realignment of the transects when a permanent rebar has been removed; or 3) better identification of species due to improved and/or expanded field identification materials. Some species are difficult to distinguish at particular life stages and efforts continue to refine field materials.

We are beginning to examine certain components of biotic integrity as applied to vegetation communities. As defined by Pellant et al. (2005), biotic integrity is the capacity of the biotic community to support ecological processes within the normal range of variability expected for the site, to resist a loss in the capacity to support these processes and to recover this capacity when losses do occur. Initial indicators chosen for examination include:

- **Local Scale Species Composition**
  The intent behind this indicator is to see if the species composition is generally consistent with what might be expected for the site, given the local conditions (soils, disturbance, moisture, etc). We considered the degree to which the local species consisted of native vs exotic species. Details about which exotic species are present and their effect on the site are presented in the Annual Exotic Reports (Folts-Zettner 2009; Folts-Zettner and Sosinski 2011, 2012). Here we provide an initial indicator of the extent of invasion by exotic species by looking at the proportion of native and exotic species. This assessment is based primarily on percent foliar cover, rather than the number of individual species because most species are quite rare and cover provides a more realistic assessment of the impact of exotic invasion. However, we do present the proportion of individual species (Appendices A-J) as an ancillary reference.

- **Response of Annual Species to Disturbance**
  It is generally expected that the number of annual species at a given site would be higher immediately following a disturbance, and would shift toward an increasing number of perennials as time passes since a disturbance. The persistence of large quantities of annuals after a disturbance could indicate some basis for concern. For example roadside areas that are frequently and unnaturally disturbed might be expected to have a greater persistence of annual species compared to interior sites.

Table 4-1. Numbers of transects of each type monitored at each Southern Plains park, 2012

Park	Transects Monitored		
	2010	2011	2012
Bent's Old Fort NHS	13	13	14
Capulin Volcano NM	6	6	11
Chickasaw NRA	13	12	11
Fort Larned NHS	12	8	11
Fort Union NM	6	6	6
Lake Meredith NRA/ Alibates Flint Quarries NM	27	20	25
Lyndon B. Johnson NHP	2	2	2
Pecos NHP	16	7	8
Sand Creek Massacre NHS	12	12	12
Washita Battlefield NHS	10	9	12
Total	117	95	116

- **Relative Proportion of Functional Groups**
  The composition of functional groups can have a dramatic effect of grassland ecosystems and their associated processes (Tilman et al. 1997, Pellant et al. 2005). Tilman et al. (1997) found that functional composition and functional diversity were principal factors explaining plant productivity, plant percent nitrogen, plant total nitrogen, and light penetration. They further concluded that habitat modifications and management practices that change functional diversity and functional composition would likely have a dramatic effect on ecosystem processes.

The indicators chosen are robust to the sometimes significiant year to year variation in seasonal or annual rainfall or disturbance such as herbivory. These indicators can vary significantly from year to year in response to these environmental factors yet remain within the range of natural variability. The monitoring conducted over the past three years will serve as a baseline to determine trends in the coming years.

Table 4-2. Plant species observed in specific parks during 2012 Southern Plains grassland monitoring

Vegetation code	Scientific name	Common name	Life cycle	Park unit									
				BEOL	CAVO	CHIC	FOLS	FOUN	LAMR/ ALFL	LYJO	PECO	SAND	WABA
TREE													
ACENEG	*Acer negundo*	box elder	P			•							
BROPAP	*Broussonetia papyrifera*	paper mulberry	P			•							
CELLAE	*Celtis laevigata*	sugarberry	P			•			•	•			
CELOCC	*Celtis occidentalis*	hackberry	P						•				
CELSSP	*Celtis species*	hackberry species	P			•							
CERCAN	*Cercis canadensis*	eastern redbud	P			•							
CERMON	*Cercocarpus montanus*	mountain mahogany	P		•								
CORDRU	*Cornus drummondii*	roughleaf dogwood	P			•							
DIOVIR2	*Diospyros virginiana*	common persimmon	P			•							
FRAAME	*Fraxinus americana*	white ash	P			•							
FRACAR	*Frangula caroliniana*	Carolina buckthorn	P			•							
FRAPEN	*Fraxinus pennsylvanica*	green ash	P			•							
FRAXSSP	*Fraxinus species*	ash species	P			•					•		•
JUNASH	*Juniperus ashei*	Ashe juniper	P							•			
JUNMON	*Juniperus monosperma*	one-seed juniper	P		•						•		
JUNSCO	*Juniperus scopulorum*	Rocky Mountain juni[er	P		•								
JUNVIR	*Juniperus virginiana*	eastern red cedar	P			•							
MORRUB	*Morus rubra*	red mulberry	P			•							
MORUS	*Morus species*	mulberry species	P			•							
PINEDU	*Pinus edulis*	pinyon pine	P								•		
PINPON	*Pinus ponderosa*	ponderosa pine	P								•		
POPALB	*Populus alba*	white poplar	P	•									
POPDEL	*Populus deltoides*	plains cottonwood	P						•			•	
PROGLA	*Prosopis glandulosa*	honey mesquite	P						•				
PRUANG	*Prunus angustifolia*	Chickasaw plum	P			•							•
PRUSER	*Prunus serotina*	black cherry	P			•							
PRUVIR	*Prunus virginiana*	chokecherry	P			•							
QUEFUS	*Quercus fusiformis*	Texas live oak	P							•			
QUEGAM	*Quercus gambelii*	gambel oak	P		•								
QUEMAR	*Quercus marilandica*	blackjack oak	P			•							
QUEMUH	*Quercus muhlenbergii*	chinkapin oak	P			•							
QUESHU	*Quercus shumardii*	shumard oak	P			•							
QUESTE	*Quercus stellata*	post oak	P			•							
SAPSAP	*Sapindus saponaria*	western soapberry	P										•
ULMALA	*Ulmus alata*	winged elm	P			•							
ULMAME	*Ulmus americana*	American elm	P			•							
ULMPUM	*Ulmus pumila*	Siberian elm	P										•
VINE													
PARQUI	*Parthenocissus quinquefolia*	Virginia creeper	P			•							
SMIBON	*Smilax bona-nox*	saw greenbriar	P			•				•			
SMIHER	*Smilax herbacea*	smooth greenbriar	P			•							
TOXRAD	*Toxicodendron radicans*	eastern poison ivy	P			•				•			

Note: Exotic species are highlighted.

Table 4-2. Plant species observed in specific parks during 2012 Southern Plains grassland monitoring, cont.

Vegetation code	Scientific name	Common name	Life cycle	Park unit									
				BEOL	CAVO	CHIC	FOLS	FOUN	LAMR/ ALFL	LYJO	PECO	SAND	WABA
VITMUS	*Vitis mustangensis*	mustang grape	P							•			
VITSSP	*Vitis species*	grape species	P			•							
VITVUL	*Vitis vulpina*	fox grape	P			•							
SHRUB													
ARTFIL	*Artemisia filifolia*	sand sagebrush	P	•					•		•	•	
BACSAL	*Baccharis salicina*	willow baccharis	P	•									
CEPOCC	*Cephalanthus occidentalis*	buttonbush	P				•						
ERINAU	*Ericameria nauseosa*	rubber rabbitbrush	P								•	•	
MIMBOR	*Mimosa borealis*	fragrant mimosa	P						•				
RHUCOP	*Rhus copallinum*	winged sumac	P			•				•			•
RHUGLA	*Rhus glabra*	smooth sumac	P			•							
RHUTRI	*Rhus trilobata*	skunkbush sumac	P		•	•							
SALEXI	*Salix exigua*	coyote willow	P	•									
SUBSHRUB													
ECHREI	*Echinocereus reichenbachii*	lace hedgehog cactus	P						•				
ECHVIR	*Echinocereus viridiflorus*	nylon hedgehog cactus	P		•			•			•		
ESCVIV	*Escobaria vivipara*	spinystar	P			•					•	•	
OPUENG	*Opuntia engelmannii*	Texas pricklypear cactus	P			•							
OPUFRA	*Opuntia fragilis*	brittle cactus	P									•	
OPULEP	*Opuntia leptocaulis*	pencil cactus	P						•	•			
OPUMAC	*Opuntia macrorhiza*	twistspine pricklypear cactus	P			•							•
OPUPHA	*Opuntia phaeacantha*	brownspine pricklypear cactus	P		•				•		•		
OPUPOL	*Opuntia polyacantha*	plains pricklypear cactus	P		•			•	•		•	•	
YUCGLA	*Yucca glauca*	soft soapweed yucca	P		•				•		•	•	
GRASS and GRASS-LIKE													
ACHHYM	*Achnatherum hymenoides*	Indian ricegrass	P	•									
ACHROB	*Achnatherum robustum*	sleepygrass	P		•			•					
ANDGER	*Andropogon gerardii*	big bluestem	P		•	•	•		•				•
ANDGLO	*Andropogon glomeratus*	bushy bluestem	P			•							
ANDHAL	*Andropogon hallii*	sand bluestem	P						•				•
ANDVIR	*Andropogon virginicus*	broomsedge bluestem	P			•							
ARIDIV	*Aristida divaricata*	poverty threeawn	P					•					
ARIPUR	*Aristida purpurea*	purple threeawn	P	•	•	•	•	•	•	•	•	•	•
BOTISC	*Bothriochloa ischaemum*	K.R. bluestem	P			•				•			•
BOTLAG	*Bothriochloa laguroides*	silver bluestem	P			•	•		•	•			•
BOUCUR	*Bouteloua curtipendula*	sideoats grama	P	•	•	•	•	•	•	•	•	•	•
BOUGRA	*Bouteloua gracilis*	blue grama	P	•	•			•	•		•	•	
BOUHIR	*Bouteloua hirsuta*	hairy grama	P			•			•		•		
BROCAT	*Bromus catharticus*	rescue grass	A/P			•							
BROINE	*Bromus inermis*	smooth brome	P		•		•				•		
BROJAP	*Bromus japonicus*	Japanese brome	A		•	•	•		•	•			•
BROPOR	*Bromus porteri*	Porter brome	P		•								

Note: Exotic species are highlighted.

Table 4-2. Plant species observed in specific parks during 2012 Southern Plains grassland monitoring, cont.

Vegetation code	Scientific name	Common name	Life cycle	Park unit									
				BEOL	CAVO	CHIC	FOLS	FOUN	LAMR/ ALFL	LYJO	PECO	SAND	WABA
BROTEC	*Bromus tectorum*	cheatgrass	A		•	•							•
BUCDAC	*Buchloe dactyloides*	buffalograss	P		•	•	•	•	•		•	•	•
CALGIG	*Calamovilfa gigantea*	big sandreed	P										•
CARALB	*Carex albolutescens*	greenwhite sedge	P			•							
CARCEP	*Carex cephalophora*	ovalleaf sedge	P			•							
CARGRA1	*Carex gravida*	heavy sedge	P				•						•
CARGRA2	*Carex granularis*	limestone meadow sedge	P			•							
CARINO	*Carex inops*	sun sdege	P		•								
CARPLA	*Carex planostachys*	cedar sedge	P							•			
CARSSP	*Carex species*	sedge species	P		•	•						•	•
CYNDAC	*Cynodon dactylon*	Bermudagrass	P			•				•			•
CYPFEN	*Cyperus fendlerianus*	Fendler flat sedge	P					•			•		
CYPODO	*Cyperus odoratus*	fragrant flat sedge	A/P										•
DICACU	*Dichanthelium acuminatum*	tapered panicgrass	P			•			•				
DICBOS	*Dichanthelium boscii*	BOSC's panicgrass	P			•							
DICCLA	*Dichanthelium clandestinum*	deertongue	P			•							
DICLAX	*Dichanthelium laxiflorum*	openflower panicgrass	P			•							
DICLIN	*Dichanthelium linearifolium*	slimleaf panicgrass	P			•							
DICOLI	*Dichanthelium oligosanthes*	Heller's panicgrass	P							•			•
DIGCOG	*Digitaria cognata*	Carolina crabgrass	P						•	•			
DISSPI	*Distichlis spicata*	inland saltgrass	P	•				•	•	•		•	
ELYCAN	*Elymus canadensis*	Canada wildrye	P	•		•			•	•		•	•
ELYELY	*Elymus elymoides*	bottlebrush squirreltail	P	•	•	•		•	•		•	•	
ELYTRA	*Elymus trachycaulus*	slender wildrye	P					•					
ELYVIR	*Elymus virginicus*	Virginia wildrye	P			•	•			•		•	•
EQULAE	*Equisetum laevigatum*	smooth scouring rush	P						•				
ERABAR	*Eragrostis barrelieri*	Mediterranean lovegrass	A						•				
ERACAP	*Eragrostis capillaris*	lacegrass	A			•							
ERAINT	*Eragrostis intermedia*	plains lovegrass	P			•				•			
ERASES	*Eragrostis sessilispica*	tumble lovegrass	P						•				
ERASPE	*Eragrostis spectabilis*	purple lovegrass	P			•			•				•
ERIPIL	*Erioneuron pilosum*	hairy tridens	P						•				
FESARI	*Festuca arizonica*	Arizona fescue	P		•								
GRSSLNG		grass seedling				•				•			•
HESCOM	*Hesperostipa comata*	needle and thread	P						•				
HORJUB	*Hordeum jubatum*	foxtail barley	P			•							
JUNMAR	*Juncus marginatus*	grassleaf rush	P			•							
JUNTEN	*Juncus tenuis*	field rush	P			•							
LEPFUS	*Leptochloa fusca*	bearded sprangletop	A										•
LEPPAN	*Leptochloa panicea*	mucronate sprangletop	A/P			•				•			
LOLARU	*Lolium arundinaceum*	tall fescue	P						•				
LOLPER	*Lolium perenne*	perennial ryegrass	A/P			•							

Note: Exotic species are highlighted.

Table 4-2. Plant species observed in specific parks during 2012 Southern Plains grassland monitoring, cont.

Vegetation code	Scientific name	Common name	Life cycle	Park unit									
				BEOL	CAVO	CHIC	FOLS	FOUN	LAMR/ ALFL	LYJO	PECO	SAND	WABA
LYCPHL	*Lycurus phleoides*	wolfstail	P					•					
LYCSET	*Lycurus setosus*	bristly wolfstail	P		•						•		
MONSQU	*Monroa squarrosa*	false buffalograss	A						•				
MUHASP	*Muhlenbergia asperifolia*	alkali muhly	P	•					•				
MUHMON	*Muhlenbergia montana*	mountain muhly	P		•						•		
MUHSYL	*Muhlenbergia sylvatica*	woodland muhly	P			•							
MUHTOR	*Muhlenbergia torreyi*	ring muhly	P		•			•	•		•		
MUHWRI	*Muhlenbergia wrightii*	spike muhly	P		•						•		
NASLEU	*Nassella leucotricha*	Texas wintergrass	P			•				•			
PANCAP	*Panicum capillare*	annual witchgrass	A			•					•	•	
PANHAL	*Panicum hallii*	Hall's panicgrass	P						•				
PANMIL	*Panicum miliaceum*	proso millet	A	•									
PANOBT	*Panicum obtusum*	vine mesquite	P	•					•				
PANVIR	*Panicum virgatum*	switchgrass	P	•		•	•		•	•		•	•
PASDIL	*Paspalum dilatatum*	dallisgrass	P							•			
PASLAE	*Paspalum laeve*	field paspalum	P			•							
PASSMI	*Pascopyrum smithii*	western wheatgrass	P	•	•		•	•	•		•	•	•
PLEJAM	*Pleuraphis jamesii*	James' galleta grass	P	•							•		
POAARA	*Poa arachnifera*	Texas bluegrass	P			•							
POABIG	*Poa bigelovii*	Bigelow bluegrass	A								•		
POAFEN	*Poa fendleriana*	lontongue muttongrass	P		•						•		•
POAPRA	*Poa pratensis*	Kentucky bluegrass	P				•					•	
RHYGLO	*Rhynchospora globularis*	globe beakrush	A/P			•							
SCHAME	*Schoenoplectus americanus*	American bulrush	P									•	
SCHPAN	*Schedonnardus paniculatus*	tumblegrass	P	•							•	•	
SCHSCO	*Schizachyrium scoparium*	little bluestem	P		•	•	•		•	•			•
SETPAR	*Setaria parviflora*	knotroot bristlegrass	P			•							•
SETPUM	*Setaria pumila*	yellow bristlegrass	A				•						
SORHAL	*Sorghum halepense*	Johnsongrass	P	•		•			•	•			•
SORNUT	*Sorghastrum nutans*	Indiangrass	P			•	•		•	•			•
SPHOBT	*Sphenopholis obtusata*	prairie wedgescale	A/P			•							
SPOAIR	*Sporobolus airoides*	alkali sacaton	P	•				•	•			•	
SPOCOM	*Sporobolus compositus*	tall dropseed	P			•							
SPOCOR	*Sporobolus coromandelianus*	Madagascar dropseed	A/P						•				
SPOCRY	*Sporobolus cryptandrus*	sand dropseed	P	•	•	•	•	•	•		•	•	•
TRIALB	*Tridens albescens*	white tridens	P						•				
TRIMUT	*Tridens muticus*	slim tridens	P			•							
VULOCT	*Vulpia octoflora*	sixweeks fescue	A			•						•	•
FORB													
ACAANG	*Acacia angustissima*	prairie acacia	P			•							

Note: Exotic species are highlighted.

Table 4-2. Plant species observed in specific parks during 2012 Southern Plains grassland monitoring, cont.

Vegetation code	Scientific name	Common name	Life cycle	Park unit									
				BEOL	CAVO	CHIC	FOLS	FOUN	LAMR/ ALFL	LYJO	PECO	SAND	WABA
ACHMIL	*Achillea millefolium*	yarrow	P		•	•							
AGAHET	*Agalinis heterophylla*	prairie false foxglove	A							•			
ALLCER	*Allium cernuum*	nodding onion	P		•			•					
ALLDRU	*Allium drummondii*	Drummond onion	P						•				
AMAHYB	*Amaranthus hybridus*	slim amaranth pigweed	A		•								
AMAPAL	*Amaranthus palmeri*	careless pigweed	A				•						
AMBART	*Ambrosia artemisiifolia*	common ragweed	A			•				•			
AMBCON	*Ambrosia confertiflora*	weakleaf burr ragweed	P					•					
AMBPSI	*Ambrosia psilostachya*	western ragweed	A/P	•		•	•		•	•		•	•
AMBTRI	*Ambrosia trifida*	giant ragweed	A										•
AMMPOP	*Ammoselinum popei*	plains sand parsley	A			•							
AMPDRA	*Amphiachyris dracunculoides*	prairie broomweed	A			•			•				
ANTPAR1	*Antennaria parlinii*	Parlin's pussytoes	P			•							
APOCAN	*Apocynum cannabinum*	hemp dogbane	P	•		•							
ARESER	*Arenaria serpyllifolia*	thymeleaf sandwort	A			•							
ARGHIS	*Argemone hispida*	rough pricklypoppy	P		•								
ARNPLA	*Arnoglossum plantagineum*	groovestem Indian plantain	P			•							
ARTCAR	*Artemisia carruthii*	Carruth's sagewort	P		•	•		•			•		
ARTDRA	*Artemisia dracunculus*	false tarragon	P		•							•	
ARTFRI	*Artemisia frigida*	fringed sagebrush	P		•			•			•	•	
ARTLUD	*Artemisia ludoviciana*	Louisiana sagewort	P		•	•		•	•			•	•
ASCASP	*Asclepias asperula*	antelope horns milkweed	P			•						•	
ASCENG	*Asclepias engelmanniana*	Engelmann's milkweed	P						•				
ASCINV	*Asclepias involucrata*	dwarf milkweed	P					•					
ASCLAT	*Asclepias latifolia*	broadleaf milkweed	P									•	
ASCOEN	*Asclepias oenotheroides*	zizotes milkweed	P							•			
ASCPUM	*Asclepias pumila*	plains milkweed	P				•						
ASCSPE	*Asclepias speciosa*	showy milkweed	P	•								•	
ASCSUB	*Asclepias subverticillata*	horsetail milkweed	P	•					•		•	•	
ASCSYR	*Asclepias syriaca*	silky milkweed	P				•						
ASCVIR1	*Asclepias viridis*	green antelope horn milkweed	P			•							
ASCVIR2	*Asclepias viridiflora*	green comet milkweed	P			•						•	
ASTBIS	*Astragalus bisulcatus*	two-grooved milkvetch	P	•									
ASTBOD	*Astragalus bodinii*	Bodin's milkvetch	P									•	
ASTCRA	*Astragalus crassicarpus*	ground plum milkvetch	P									•	
ASTFLE	*Astragalus flexuosus*	pliant milkvetch	P		•								
ASTHUM	*Astragalus humistratus*	ground cover milkvetch	P								•		
ASTLON	*Astragalus lonchocarpus*	great rushy milkvetch	P									•	
ASTMIS1	*Astragalus missouriensis*	Missouri milkvetch	P						•		•		
ASTMIS2	*Astragalus miser*	timber milkvetch	P	•									
ASTMOL	*Astragalus mollissimus*	wooly milkvetch	P				•		•		•		

Note: Exotic species are highlighted.

Table 4-2. Plant species observed in specific parks during 2012 Southern Plains grassland monitoring, cont.

Vegetation code	Scientific name	Common name	Life cycle	Park unit									
				BEOL	CAVO	CHIC	FOLS	FOUN	LAMR/ ALFL	LYJO	PECO	SAND	WABA
ASTNUT	*Astragalus nuttallianus*	Nuttall's milkvetch	A/P						•				
ASTPLA	*Astragalus plattensis*	Platte milkvetch	P										•
ASTPRA	*Aster praealtum*	willowleaf aster	P			•							
BAPALB	*Baptisia alba*	white wild indigo	P			•							
BAPAUS	*Baptisia australis*	blue wild indigo	P			•							
BAPSPH	*Baptisia sphaerocarpa*	yellow wild indigo	P			•							
BRASSP	*Brassicaceae species*	mustard species	A						•		•		
CALBER	*Calylophus berlandieri*	Berlandier's sundrops	P			•							
CALBUS	*Callirhoe bushii*	bush poppymallow	P									•	
CALINV	*Callirhoe involucrata*	winecup	P			•	•		•	•		•	
CALSER	*Calylophus serrulatus*	halfshrub sundrop	P			•							
CASINT	*Castilleja integra*	wholeleaf Indian paintbrush	P		•						•		
CENAME	*Centaurea americana*	American basketflower	A			•			•				
CENLON	*Cenchrus longispinus*	longspine sandbur	A						•				
CENTEX	*Centaurium texense*	Lady Bird's centaury	A							•			
CHAALB	*Chamaesyce albomarginata*	rattlesnake weed	P								•		
CHACOR	*Chamaesaracha coronopus*	green false nightshade	P					•					
CHAERI	*Chaetopappa ericoides*	baby white aster	P		•			•	•		•		
CHAFAS	*Chamaecrista fasciculata*	showy partridge pea	A			•							
CHAFEN	*Chamaesyce fendleri*	Fendler's sandmat	P		•				•		•		
CHAGLY	*Chamaesyce glyptosperma*	reb-seed sandmat	A	•					•				•
CHALAT1	*Chamaesyce lata*	hoary sandmat	P						•				
CHALAT2	*Chasmanthium latifolium*	Indian wood oats	P			•							
CHAMAC	*Chamaesyce maculata*	spotted sandmat	A			•	•		•				
CHAMIS	*Chamaesyce missurica*	prairie sandmat	A			•			•			•	
CHANIC	*Chamaecrista nictitans*	partridge pea	A/P			•							
CHANUT	*Chamaesyce nutans*	nodding spurge	A/P			•				•			
CHAPRO	*Chamaesyce prostrata*	prostrate sandmat	A/P	•					•				
CHASER1	*Chamaesyce serpens*	matted sandmat	A/P				•	•				•	
CHASER2	*Chamaesyce serpyllifolia*	thymeleaf sandmat	A		•			•					
CHASOR	*Chamaesaracha sordida*	hairy five eyes	P						•				
CHASTI	*Chamaesyce stictospora*	slim-seed sandmat	A										•
CHATAI	*Chaerophyllum tainturieri*	hairy fruited chervil	A							•			
CHEALB	*Chenopodium album*	common lambsquarters	A				•	•	•			•	•
CHEBER	*Chenopodium berlandieri*	pitseed goosefoot	A	•		•			•				
CHEDES	*Chenopodium desiccatum*	narrowleaf lambsquarters	A				•						•
CHEFRE	*Chenopodium fremontii*	Fremont's goosefoot	A		•								
CHEGLA	*Chenopodium glaucum*	oakleaf goosefoot	A						•				
CHEHIA	*Chenopodium hians*	pinyon goosefoot	A		•						•		
CHEINC	*Chenopodium incanum*	mealy goosefoot	A					•			•		
CHELEP	*Chenopodium leptophyllum*	narrowleaf goosefoot	A		•			•	•				

Note: Exotic species are highlighted.

Table 4-2. Plant species observed in specific parks during 2012 Southern Plains grassland monitoring, cont.

Vegetation code	Scientific name	Common name	Life cycle	Park unit									
				BEOL	CAVO	CHIC	FOLS	FOUN	LAMR/ ALFL	LYJO	PECO	SAND	WABA
CHEPAL	*Chenopodium pallescens*	slimleaf goosefoot	A						•		•		
CHEPRA	*Chenopodium pratericola*	desert goosefoot	A		•			•	•				•
CHESIM	*Chenopodium simplex*	mapleleaf goosefoot	A			•	•					•	
CHEWAT	*Chenopodium watsonii*	Watson's goosefoot	A								•	•	
CHRPIL	*Chrysopsis pilosa*	soft goldenaster	A			•							
CIRALT	*Cirsium altissimum*	roadside thistle	B			•							•
CIRNEO	*Cirsium neomexicanum*	New Mexico thistle	B/P								•		
CIRTEX	*Cirsium texanum*	Texas thistle	B/P							•			
CIRUND	*Cirsium undulatum*	wavyleaf thistle	B/P		•	•	•	•	•			•	•
CLIMAR	*Clitoria mariana*	Atlantic pigeonwings	P			•							
COCCAR	*Cocculus carolinus*	Carolina snailseed	P			•				•			•
COMERE	*Commelina erecta*	erect dayflower	P						•				•
CONARV	*Convolvulus arvensis*	field bindweed	P	•			•	•				•	•
CONCAN	*Conyza canadensis*	Canada horsetail	A/B	•		•	•		•	•	•	•	•
CONRAM	*Conyza ramosissima*	dwarf horseweed	A				•		•				
CORTIN	*Coreopsis tinctoria*	plains coreopsis	A/P			•							
CORVAR	*Coronilla varia*	purple crownvetch	P			•							
CORWRI1	*Cordylanthus wrightii*	Wright's birdbeak	A								•		
CORWRI2	*Coreopsis wrightii*	rock coreopsis	A							•			
CROGLA	*Croton glandulosus*	vente conmigo	A						•				•
CROMON	*Croton monanthogynus*	one-seed croton	A			•			•	•			•
CROTEX	*Croton texensis*	Texas croton	A	•					•			•	•
CRYCIN	*Cryptantha cinerea*	James' cryptantha	P								•		
CUCFOE	*Cucurbita foetidissima*	buffalo gourd	P	•									•
CUSCUTA	*Cuscutaceae species*	dodder species	P			•			•				
DALAUR	*Dalea aurea*	golden dalea	P			•					•		•
DALCAN	*Dalea candida*	slender white prairie clover	P					•	•		•	•	
DALEA	*Dalea species*	prairie clover species	P									•	
DALENN	*Dalea enneandra*	nine-anther dalea	P			•			•				•
DALFOR	*Dalea formosa*	feather dalea	P						•				
DALJAM	*Dalea jamesii*	James' dalea	P								•		
DALNAN	*Dalea nana*	dwarf dalea	P						•				
DALPUR	*Dalea purpurea*	purple prairie clover	P			•	•						
DAUPUS	*Daucus pusillus*	southwest wils carrot	A			•							
DESCOO	*Desmanthus cooleyi*	Cooley's bundleflower	P								•		
DESILL1	*Desmanthus illinoensis*	Illinois bundleflower	P			•	•		•	•			•
DESPAN	*Desmodium paniculatum*	narrowleaf ticktrefoil	P			•				•			
DESPIN	*Descurainia pinnata*	western tansymustard	A/P				•		•				
DESSES	*Desmodium sessilifolium*	sessileleaf tickclover	P			•			•				
DESSOP	*Descurainia sophia*	flixweed	A/B	•									•
DIAARM	*Dianthus armeria*	Deptford pink	A/B			•							
DICCAR	*Dichondra carolinensis*	Carolina ponyfoot	P							•			

Note: Exotic species are highlighted.

Table 4-2. Plant species observed in specific parks during 2012 Southern Plains grassland monitoring, cont.

Vegetation code	Scientific name	Common name	Life cycle	Park unit									
				BEOL	CAVO	CHIC	FOLS	FOUN	LAMR/ ALFL	LYJO	PECO	SAND	WABA
DYSPAP	*Dyssodia papposa*	fetid dogweed	A					•				•	
ENGPER	*Engelmannia peristenia*	Engelmann's daisy	P					•		•			
ERIALA	*Eriogonum alatum*	winged buckwheat	P								•		
ERIANN1	*Erigeron annuus*	annual fleabane	A			•							
ERIANN2	*Eriogonum annuum*	annual buckwheat	A/B			•		•	•		•	•	•
ERIBEL	*Erigeron bellidiastrum*	western fleabane	A									•	•
ERICAN	*Erigeron canus*	hoary fleabane	P					•			•		
ERIDIV	*Erigeron divergens*	spreading fleabane	B		•						•		
ERIFLA	*Erigeron flagellaris*	trailing fleabane	B		•						•		
ERIJAM	*Eriogonum jamesii*	James' buckwheat	P		•			•			•		
ERILON	*Eriogonum longifolium*	longleaf buckwheat	P	•		•			•				
ERIMOD	*Erigeron modestus*	nodding fleabane	P						•				
ERISTR	*Erigeron strigosus*	rough fleabane	A/P			•							
EROCIC	*Erodium cicutarium*	red stem storksbill	A			•							
ERYCAP	*Erysimum capitatum*	western wallflower	B/P									•	
ERYLEA	*Eryngium leavenworthii*	Leavenworth's eryngo	A			•							
EUPBIC	*Euphorbia bicolor*	snow-on-the-prairie	A			•							
EUPDAV	*Euphorbia davidii*	David's spurge	A		•			•	•				
EUPDEN	*Euphorbia dentata*	toothed spurge	A	•		•	•			•			•
EUPHEX	*Euphorbia hexagona*	sixangle spurge	A						•				
EUPMAR	*Euphorbia marginata*	snow-on-the-mountain	A				•			•		•	•
EVONUT	*Evolvulus nuttallianus*	shaggy dwarf morning glory	P			•			•			•	
FRBLNG		forb seedling			•	•	•	•	•		•	•	•
GAIPIN	*Gaillardia pinnatifida*	red dome blanketflower	P								•		
GAIPUL	*Gaillardia pulchella*	Indian blanket	A/P			•				•			•
GALAPA	*Galium aparine*	cleavers bedstraw	A				•						
GALSSP	*Galium species*	bedstraw species				•							
GAMPUR	*Gamochaeta purpurea*	purple everlasting	A			•							
GAUCOC	*Gaura coccinea*	scarlet gaura	P	•	•			•	•	•	•	•	
GAUDRU	*Gaura drummondii*	Drummond's beeblossom	P							•			
GAUMOL	*Gaura mollis*	velvetweed	A	•									•
GAUSIN	*Gaura sinuata*	wavyleaf beeblossom	P			•							
GAUSUF	*Gaura suffulta*	roadside beeblossom	A							•			
GAUVIL	*Gaura villosa*	wooly beeblossom	P				•		•				•
GERCAR	*Geranium carolinianum*	Carolina geranium	A/B			•				•			
GEUCAN	*Geum canadense*	white avens	P			•							
GLABIP	*Glandularia bipinnatifida*	Dakota mock vervain	A/P			•		•		•			
GLYLEP	*Glycyrrhiza lepidota*	wild licorice	P	•					•			•	
GRINUD	*Grindelia nuda*	curlytop gumwood	A/P							•			
GRIPAP	*Grindelia papposa*	wax gumweed	A/B			•			•			•	•
GRISQU	*Grindelia squarrosa*	curlytop gumwood	A/P	•				•					
GUTSAR	*Gutierrezia sarothrae*	broom snakeweed	P		•			•	•		•		

Note: Exotic species are highlighted.

Table 4-2. Plant species observed in specific parks during 2012 Southern Plains grassland monitoring, cont.

Vegetation code	Scientific name	Common name	Life cycle	Park unit									
				BEOL	CAVO	CHIC	FOLS	FOUN	LAMR/ ALFL	LYJO	PECO	SAND	WABA
HACBES	*Hackelia besseyi*	Bessey's stickseed	B/P								•		
HEDACI	*Hedeoma acinoides*	slender false pennyroyal	A							•			
HEDDRU	*Hedeoma drummondii*	Drummond's false pennyroyal	A/P			•							
HEDNIG	*Hedyotis nigricans*	diamond flowers	P			•			•	•			
HELANN	*Helianthus annuus*	common sunflower	A	•	•		•	•	•			•	•
HELCIL	*Helianthus ciliaris*	blueweed sunflower	P						•				
HELCON	*Heliotropium convolvulaceum*	phlox heliotrope	A						•				
HELHIR	*Helianthus hirsutus*	hairy sunflower	P			•							
HELLON	*Heliomeris longifolia*	longleaf false goldeneye	A										•
HELMAX	*Helianthus maximiliani*	Maximillian's sunflower	P				•						
HELMUL	*Heliomeris multiflora*	showy goldeneye	P		•								
HELPET	*Helianthus petiolaris*	prairie sunflower	A	•			•		•		•	•	•
HELSSP	*Helianthus species*	sunflower species											•
HELTEN	*Heliotropium tenellum*	pasture heliotrope	A			•							
HETCAN	*Heterotheca canescens*	gray goldenaster	P										•
HETSTE	*Heterotheca stenophylla*	stiffleaf false goldenaster	P						•				
HETVIL	*Heterotheca villosa*	hairy false goldenaster	P		•	•		•			•	•	
HIELON	*Hieracium longipilum*	hairy hawkweed	P			•							
HOFGLA	*Hoffmannseggia glauca*	hog potato	P						•				
HYBVER	*Hybanthus verticillatus*	whorled nodding violet	P			•				•			
HYMFIL	*Hymenopappus filifolius*	fineleaf woolywhite	P								•		
HYMRIC	*Hymenoxys richardsonii*	Colorado rubberweed	P								•		
INDMIN	*Indigofera miniata*	western indigo	P			•							
IPORUB	*Ipomopsis rubra*	standing cypress	B/P							•			
IVAANG	*Iva angustifolia*	narrowleaf marshelder	A/B							•			
IVAANN	*Iva annua*	annual marshelder	A										•
IVAAXI	*Iva axillaris*	poverty sumpweed	P	•								•	
IVAXAN	*Iva xanthifolia*	burrweed marshelder	A						•				
KOCSCO	*Kochia scoparia*	kochia	A	•	•		•	•	•		•	•	•
KRALAN	*Krameria lanceolata*	trailing ratany	P			•			•				
LACFLO	*Lactuca floridana*	woodland lettuce	A/B			•							
LACSER	*Lactuca serriola*	prickly lettuce	A/B	•	•	•			•		•	•	•
LACTAT	*Lactuca tatarica*	blue lettuce	B/P								•		
LAPOCC	*Lappula occidentalis*	flatspine sticktight	A/B	•	•				•		•	•	
LATHIR	*Lathyrus hirsutus*	sungletary pea	A			•							
LEPDEN	*Lepidium densiflorum*	common pepperweed	A/B				•	•	•				
LEPVIR	*Lepidium virginicum*	Virginia pepperweed	A/P			•			•	•			
LESCUN	*Lespedeza cuneata*	sericea lespedeza	P			•							
LESGOR	*Lesquerella gordonii*	Gordon's bladderpod	A/P						•				
LESPRO	*Lespedeza procumbens*	trailing lespedeza	P			•							
LESVIO	*Lespedeza violacea*	violet lespedeza	P			•							

Note: Exotic species are highlighted.

Table 4-2. Plant species observed in specific parks during 2012 Southern Plains grassland monitoring, cont.

Vegetation code	Scientific name	Common name	Life cycle	Park unit									
				BEOL	CAVO	CHIC	FOLS	FOUN	LAMR/ ALFL	LYJO	PECO	SAND	WABA
LESVIR	*Lespedeza virginica*	slender lespedeza	P			•							
LIAMUC	*Liatris mucronata*	narrowleaf gayfeather	P			•							
LIAPUN	*Liatris punctata*	dotted gayfeather	P		•		•	•	•				
LILSPP	*Lilliaceae species*	lily species	P	•							•		
LINARI	*Linum aristatum*	bristle flax	A	•									
LINBER	*Linum berlandieri*	Berlandier's yellow flax	A/P							•			
LINLEW	*Linum lewisii*	blue flax	P					•					
LINMED	*Linum medium*	stiff yellow flax	A/P			•							
LINPRA	*Linum pratense*	meadow flax	A/P			•							
LINPUB	*Linum puberulum*	desert flax	A								•		
LINRIG	*Linum rigidum*	orange flax	A/P						•	•			•
LINSUL	*Linum sulcatum*	grooved flax	A			•							
LITINC	*Lithospermum incisum*	fringed puccoon	P									•	
LITMUL	*Lithospermum multiflorum*	many-flowered stoneseed	P		•						•		
LUPARG	*Lupinus argenteus*	silver lupine	P		•								
LYGJUN	*Lygodesmia juncea*	rush skeletonplant	P	•				•	•			•	
MACPIN	*Machaeranthera pinnatifida*	lacy tansyaster	P	•	•			•	•		•	•	•
MACTAN	*Machaeranthera tanacetifolia*	tansyleaf tansyaster	A/B	•									
MARVUL	*Marrubium vulgare*	horehound	P		•								
MEDLUP	*Medicago lupulina*	black medic clover	A/P			•							
MEDMIN	*Medicago minima*	burr medic clover	A										•
MELALB	*Melilotus alba*	white sweetclover	A/P	•	•	•			•			•	
MELLEU	*Melampodium leucanthum*	blackfoot daisy	P						•		•		
MELOFF	*Melilotus officinalis*	yellow sweetclover	A/P			•	•	•			•	•	•
MENDEC	*Mentzelia decapetala*	ten-petal blazingstar	B/P						•				
MENMUL	*Mentzelia multiflora*	many-flowered blazingstar	B/P		•			•	•				
MENNUD	*Mentzelia nuda*	bractless blazingstar	B/P	•	•							•	
MENOLI	*Mentzelia oligosperma*	chickenthief	P			•							
MENSCA	*Menodora scabra*	rough menodora	P								•		
MIMNUT	*Mimosa nuttallii*	catclaw sensitivebriar	P						•				
MIMRUP	*Mimosa rupertiana*	prickly sensitivebriar	P						•		•		
MINMIC	*Minuartia michauxii*	Texas stitchwort	A/P			•							
MIRLIN	*Mirabilis linearis*	narrowleaf four o'clock	P		•			•			•		
MIRNYC	*Mirabilis nyctaginea*	heartleaf four o'clock	P	•									
MOLVER	*Mollugo verticillata*	carpetweed	A			•							
MONCIT	*Monarda citriodora*	lemon beebalm	A/P			•				•			
MONFIS	*Monarda fistulosa*	wild bergamont	P			•							
NEPLUT	*Neptunia lutea*	yellowpuff	P			•							
NUTTEX	*Nuttallanthus texanus*	Texas toadflax	A/B			•							
OENCAE	*Oenothera caespitosa*	tufted evening primrose	P		•								

Note: Exotic species are highlighted.

Table 4-2. Plant species observed in specific parks during 2012 Southern Plains grassland monitoring, cont.

Vegetation code	Scientific name	Common name	Life cycle	Park unit									
				BEOL	CAVO	CHIC	FOLS	FOUN	LAMR/ ALFL	LYJO	PECO	SAND	WABA
OENCOR	*Oenothera coronopifolia*	crownleaf evening primrose	P								•		
OENELA	*Oenothera elata*	Hooker's evening primrose	B/P										•
OENJAM	*Oenothera jamesii*	James' evening primrose	B						•				
OENPAL	*Oenothera pallida*	pale evening primrose	P						•				
OENVIL	*Oenothera villosa*	hairy evening primrose	B/P	•									
ORTLUT	*Orthocarpus luteus*	yellow owl clover	A		•								
OXASTR	*Oxalis stricta*	sheep sorrel	P			•	•			•			
PACNEO	*Packera neomexicana*	New Mexico groundsel	P		•							•	
PACOBO	*Packera obovata*	roundleaf grooundsel	P			•							
PARJAM	*Paronychia jamesii*	James' nailwort	P						•				
PECANG	*Pectis angustifolia*	narrowleaf pectis	A		•								
PEDDIG	*Pediomelum digitatum*	palmleaf Indian breadroot	P						•			•	
PENALB	*Penstemon albidus*	white penstemon	P						•			•	
PENAMB	*Penstemon ambiguus*	bush penstemon	P						•				
PENANG	*Penstemon angustifolius*	broad-beard penstemon	P		•								
PENBAR	*Penstemon barbatus*	beardlip penstemon	P						•				
PENCOB	*Penstemon cobaea*	cobaea penstemon	P			•							
PENFEN	*Penstemon fendleri*	Fendler penstemon	P						•				
PENJAM	*Penstemon jamesii*	James' penstemon	P								•		
PENOKL	*Penstemon oklahomensis*	Oklahoma penstemon	P			•							
PENSSP	*Penstemon species*	penstemon species	P		•						•		
PHAHET	*Phacelia heterophylla*	variable leaf scorpionweed	B/P		•								
PHLNAN	*Phlox nana*	Santa Fe phlox	P								•		
PHLTRI	*Phlox triovulata*	three-seed phlox	P								•		
PHYCIN	*Physalis cinerascens*	smallflower groundcherry	P							•		•	•
PHYHED	*Physalis hederifolia*	ivyleaf groundcherry	P					•			•		
PHYHET	*Physalis heterophylla*	clammy groundcherry	P				•						
PHYLAN	*Phyla lanceolata*	lanceleaf frogfruit	P									•	
PHYLON	*Physalis longifolia*	longleaf groundcherry	P				•					•	•
PHYREC	*Physaria rectipes*	straight bladderpod	P								•		
PHYSUB	*Physalis subulata*	New Mexico groundcherry	A		•						•		
PHYVIR	*Physalis virginiana*	lanceleaf groundcherry	P	•									
PICOPP	*Picradeniopsis oppositifolia*	opposite-leaf false bahia	P								•		
PINSSP	*Pinus species*	pine species	P		•								
PLAPAT	*Plantago patagonica*	wooly plantain	A		•	•		•	•		•		•
PLARHO	*Plantago rhodosperma*	red-seed plantain	A			•			•	•			
PLAVIR	*Plantago virginica*	paleseed plantain	A/B			•							
POLCON	*Polygonum convolvulus*	climbing buckwheat	A			•			•				
POLDOD	*Polanisia dodecandra*	western clammyweed	A		•								
POLNUT	*Polytaenia nuttallii*	Nuttal's prairie parsley	P			•							
POROLE	*Portulaca oleracea*	common purslane	A					•			•		

Note: Exotic species are highlighted.

Table 4-2. Plant species observed in specific parks during 2012 Southern Plains grassland monitoring, cont.

Vegetation code	Scientific name	Common name	Life cycle	Park unit									
				BEOL	CAVO	CHIC	FOLS	FOUN	LAMR/ ALFL	LYJO	PECO	SAND	WABA
PSEOBT	*Pseudognaphalium obtusifolium*	rabbit tobacco	A/B			•							
PSOTEN	*Psoralidium tenuiflorum*	slimflower scurfpea	P		•	•		•			•	•	
PYRCAR	*Pyrrhopappus carolinianus*	Carolina desert chicory	A/B			•							
QUILOB	*Quincula lobata*	purple groundcherry	P									•	
RANARB	*Ranunculus abortivus*	small-flower buttercup	B/P			•							
RATCOL	*Ratibida columnifera*	redspike Mexican hat	P	•	•	•			•	•		•	
RATTAG	*Ratibida tagetes*	green Mexican hat	P	•	•		•	•			•	•	
RAYANN	*Rayjacksonia annua*	viscid tansyaster	A	•									
ROSWOO	*Rosa woodsii*	Wood's rose	P		•			•					
RUBABO	*Rubus aboriginum*	garden dewberry	P							•			
RUBFLA	*Rubus flagellaris*	whiplash dewberry	P			•							
RUBTRI	*Rubus trivialis*	southern dewberry	P			•				•			
RUDHIR	*Rudbeckia hirta*	blackeyed Susan	A/P			•				•			
RUMALT	*Rumex altissimus*	pale dock	P			•							
RUMCRI	*Rumex crispus*	curly dock	P	•		•							
SABCAM	*Sabatia campestris*	meadow pink	A			•							
SALCOC	*Salvia coccinea*	tropical sage	A/P							•			
SALCOL	*Salsola collina*	slender Russian thistle	A								•		
SALKAL	*Salsola kali*	prickly Russian thistle	A				•						•
SALTRA	*Salsola tragus*	prickly Russian thistle	A	•	•	•		•	•		•	•	•
SCUDRU	*Scutellaria drummondii*	Drummond's skullcap	A							•			
SCURES	*Scutellaria resinosa*	sticky skullcap	P						•				
SENFLA	*Senecio flaccidus*	Douglas groundsel	P		•						•		
SENSPA	*Senecio spartioides*	broom groundsel	P					•			•		
SESHER	*Sesbania herbacea*	bigpod sesbania	A/P			•							
SIDABU	*Sida abutifolia*	prostrate sida	A/P			•				•			
SILANT	*Silene antirrhina*	sleepy catchfly	A			•	•						
SILLAC	*Silphium laciniatum*	compassplant	P						•				
SOLCAN	*Solidago canadensis*	Canada goldenrod	P		•	•	•						•
SOLCAR	*Solanum carolinense*	Carolina horsenettle	P	•		•							
SOLDIM	*Solanum dimidiatum*	western horsenettle	P			•							•
SOLELA	*Solanum elaeagnifolium*	silverleaf nightshade	P			•			•				•
SOLGIG	*Solidago gigantea*	giant goldenrod	P			•						•	
SOLMIS	*Solidago missouriensis*	Missouri goldenrod	P			•							
SOLMOL	*Solidago mollis*	Ashy goldenrod	P		•			•					
SOLNEM	*Solidago nemoralis*	gray goldenrod	P			•							•
SOLPET	*Solidago petiolaris*	downy goldenrod	P										•
SOLPTY	*Solanum ptychanthum*	eastern black nightshade	A			•							
SOLROS	*Solanum rostratum*	buffalobur	A						•				
SOLULM	*Solidago ulmifolia*	elmleaf goldenrod	P			•							
SOLVEL	*Solidago velutina*	sparse goldenrod	P		•								
SONASP	*Sonchus asper*	spiny sowthistle	A			•	•			•			•

Note: Exotic species are highlighted.

Table 4-2. Plant species observed in specific parks during 2012 Southern Plains grassland monitoring, cont.

Vegetation code	Scientific name	Common name	Life cycle	Park unit									
				BEOL	CAVO	CHIC	FOLS	FOUN	LAMR/ ALFL	LYJO	PECO	SAND	WABA
SPEINE	*Spermolepis inermis*	Red River scaleseed	A			•							
SPHCOC	*Sphaeralcea coccinea*	scarlet globemallow	B/P	•	•		•	•	•		•	•	
SPHFEN	*Sphaeralcea fendleri*	Fendler's globemallow	P								•		
STEMIN	*Stephanomeria minor*	lesser wirelettuce	P		•								
STISYL	*Stillingia sylvatica*	queen's delight	P						•				
STRLEI	*Strophostyles leiosperma*	slickseed fuzzybean	A			•			•				•
SYMERI	*Symphyotrichum ericoides*	white heath aster	P	•		•	•		•	•		•	
SYMFAL2	*Symphyotrichum falcatum*	white prairie aster	P	•				•					
SYMLAN	*Symphyotrichum lanceolatum*	white panicle aster	P					•					
SYMORB	*Symphoricarpos orbiculatus*	buckbrush	P			•	•						
SYMPRA	*Symphyotrichum praealtum*	willowleaf aster	P			•				•			•
SYMSSP	*Symphyotrichum species*	aster species	P										•
TALPAR	*Talinum parviflorum*	prairie flameflower	P					•			•		
TETARG	*Tetraneuris argentea*	perky sue	P								•		
TETLIN	*Tetraneuris linearifolia*	fineleaf four-nerve daisy	A	•	•								
TETSCA	*Tetraneuris scaposa*	stemmy four-nerve daisy	P						•				
TEUCAN	*Teucrium canadense*	American germander	P			•							•
THEMEG	*Thelesperma megapotamicum*	Hopi tea greenthread	P		•			•	•		•		
TIDLAN	*Tidestromia lanuginosa*	wooly tidestromia	A						•				
TORARV	*Torilis arvensis*	spreading hedgeparsley	A			•				•			
TRABRE	*Tragia brevispica*	shortspike noseburn	P							•			
TRADUB	*Tragopogon dubius*	western salsify	A/B	•	•	•	•		•		•		•
TRARAM	*Tragia ramosa*	branched noseburn	P			•			•	•			
TRIARV	*Trifolium arvense*	rabbitfoot clover	A			•							
TRIDUB	*Trifolium dubium*	small hop clover	A			•							
TRIHOL	*Triodanis holzingeri*	western venus' looking-glass	A										•
TRIHYB	*Trifolium hybridum*	Alsike clover	A			•							
TRIPER	*Triodanis perfoliata*	clasping Venus' looking-glass	A			•	•						
VALRAD	*Valerianella radiata*	beaked cornsalad	A			•							
VERBAL	*Vernonia baldwinii*	western ironweed	P			•							
VERBRA1	*Verbena bracteata*	bracted vervain	A/P			•			•		•	•	
VERENC	*Verbesina encelioides*	golden crownbeard	A		•								
VERHAL	*Verbena halei*	Texas vervain	P							•			
VERTHA	*Verbascum thapsus*	mullein	B		•						•		
VICAME	*Vicia americana*	American deervetch	P		•								
VICLUD	*Vicia ludoviciana*	slim vetch	A			•							
VICSAT	*Vicia sativa*	garden vetch	A			•							
ZINGRA	*Zinnia grandiflora*	plains zinnia	P					•	•				

Note: Exotic species are highlighted.

4.1. Bent's Old Fort National Historic Site

4.1.1. 2012 sampling

A total of seven fire and thirteen long-term monitoring transects are slated for monitoring at Bent's Old Fort National Historic Site (BEOL) (Figure 4.1-1). The plant communities monitored at Bent's Old Fort NHS are: Alkali sacaton-inland saltgrass herbaceous vegetation; sand sage-blue grama shrubland; cottonwood-inland saltgrass woodland; cottonwood temporarily flooded woodland alliance; and various grassland restoration areas (including old prairie dog towns) (Stevens et al. 2007) (Table 4.1-1). Park management is interested in monitoring the cottonwood and restoration communities. In 2012, a total of seventeen transects were monitored at BEOL during July. Fourteen of these transects are included in our study area and were used in this analysis.

4.1.2. Results and discussion

These early-monitoring results provide a baseline to measure future trends and should not be viewed as trends themselves. We are beginning to examine certain components of biotic integrity as applied to vegetation communities. Part of our consideration, the indicators chosen are robust to the sometimes significiant year to year variation in seasonal or annual rainfall or disturbance such as herbivory. These indicators can vary significantly from year to year in response to these environmental factors yet remain within the range of natural variability. The monitoring conducted over the past three years will serve as a baseline to determine trends in the coming years.

Table 4.1-1. Plant community and sampling dates for each transect at Bent's Old Fort NHS, 2010-2012.

			Date visited		
Group	Transect	Plant community	2010	2011	2012
Cottonwood	CWOOD-LT01	Populus deltoides Temporarily Flooded Woodland Alliance	7/24	7/15	7/21
	CWOOD-LT02	Populus deltoides Temporarily Flooded Woodland Alliance	7/23	7/14	7/22
	CWOOD-03	Populus deltoides Temporarily Flooded Woodland Alliance	7/25	7/13	7/20
	CWSALT-LT01	Populus deltoides/Distichlis spicata Woodland	7/22	7/12	7/19
	BEOL-05	Populus deltoides Temporarily Flooded Woodland Alliance	NS	NS	7/22
Restoration	RESTN-LT01	Reclaimed Agricultural Land	7/22	7/12	7/19
	RESTS-LT01	Blacktailed Prairie Dog Town Complex	7/23	7/13	7/20
	RESTE-LT01	Sporobolus airioides-Distichlis spicata Herbaceous	7/24	7/15	7/21
Upland	BOUT-LT01	Artemisia filifolia/Bouteloua (curtipendula, gracilis) Shrubland	7/23	7/14	7/23
	BOUT-LT02	Artemisia filifolia/Bouteloua (curtipendula, gracilis) Shrubland	7/25	7/14	7/23
	BOUT-LT03	Artemisia filifolia/Bouteloua (curtipendula, gracilis) Shrubland	7/25	7/13	7/20
	SPOR-LT01	Sporobolus airioides-Distichlis spicata Herbaceous	7/24	7/15	7/21
	SPOR-LT02	Sporobolus airioides-Distichlis spicata Herbaceous	7/25	7/13	7/22
	SPOR-LT03	Sporobolus airioides-Distichlis spicata Herbaceous	7/22	7/12	7/19

*NS = Not Sampled

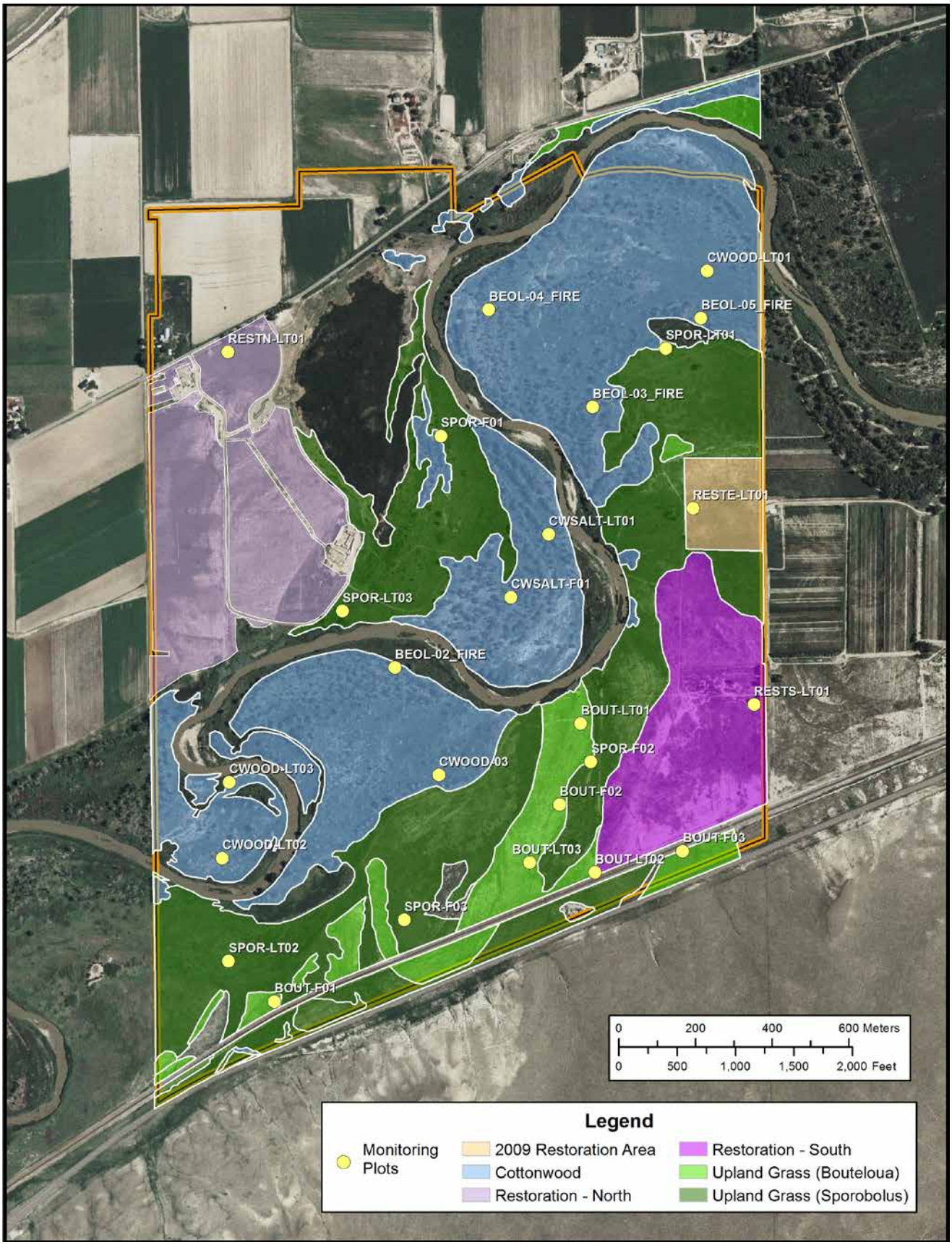


Figure 4.1-1. Monitoring transects at Bent's Old Fort NHS

Appendix A presents the detailed monitoring results for each transect monitored within the study area. This data shows the annual variation of species within a given area, as well as a 3-year comparison of frequency and species cover for each transect. The transects have been grouped according to similarity of gross plant communities. Exotic species are highlighted in pink.

Table 4.1-2 presents the cumulative cover value of the ground strata for each transect monitored in 2012. When recorded correctly, the values for each transect will add up to 100%. SOILOPEN is the measure of bare soil exposed to the sky and the potential for wind and/or water erosion. SOILUNDER is the measure of bare soil beneath plant cover, which provides some protection from potential erosion. LITTER is another important measure, as some litter is to be desired while excessive litter may negatively impact grassland health. CRUST refers to biotic soil crust, an important and delicate component in semi- and arid grasslands.

Biotic Integrity

One of the major threats to grasslands and other plant communities is invasive species. Invasive species have been directly linked to the replacement of dominant native species (Tilman 1999), the loss of rare species (King 1985), changes in ecosystem structure, alteration of nutrient cycles and soil chemistry (Ehrenfeld 2003), shifts in community productivity (Vitousek 1990), and changes in water availability (D'Antonio and Mahall 1991). The proportion of annual, biennial and perennial species provides an indication of the stability of the site, and it is generally expected that the proportion of annual species at a given site would be higher

Table 4.1-2. Percentage of substrate cover for all transects at Bent's Old Fort NHS, 2012

Cover	Transect						
	BEOL-05	BOUT-LT01	BOUT-LT02	BOUT-LT03	CWOOD-LT01	CWOOD-LT02	CWOOD-03
SOILOPEN	–	37	61.6	46	3.4	0.8	–
SOILUNDE	–	9.6	14.6	18.4	1.6	2.2	–
LITTER	74.5	53.4	21.2	32.6	95	77	99
WOOD	25.5	–	2	3	–	20	1
ROCKLG	–	–	–	–	–	–	–
ROCKSM	–	–	0.6	–	–	–	–
LICHEN	–	–	–	–	–	–	–
MOSS	–	–	–	–	–	–	–
CRUST	–	–	–	–	–	–	–
MOSS	1.2	0	0	0	0	0	0

Cover	Transect						
	CWSALT-LT01	RESTE-LT01	RESTN-LT01	RESTS-LT01	SPOR-LT01	SPOR-LT02	SPOR-LT03
SOILOPEN	0.4	55	7.6	70	11	1.25	0.2
SOILUNDE	2.6	41	3.6	19.4	5	1.25	0.4
LITTER	96.2	3	88.2	10.6	84	97.5	99.2
WOOD	0.8	1	–	–	–	–	0.2
ROCKLG	–	–	–	–	–	–	–
ROCKSM	–	–	–	–	–	–	–
LICHEN	–	–	–	–	–	–	–
MOSS	–	–	–	–	–	–	–
CRUST	–	–	–	–	–	–	–
MOSS	0	0	0	0	0	0	0

Table 4.1-3. The number and percentage of native and exotic species of each life form found on Bent's Old Fort NHS during the 2010-2012 grassland monitoring sampling.

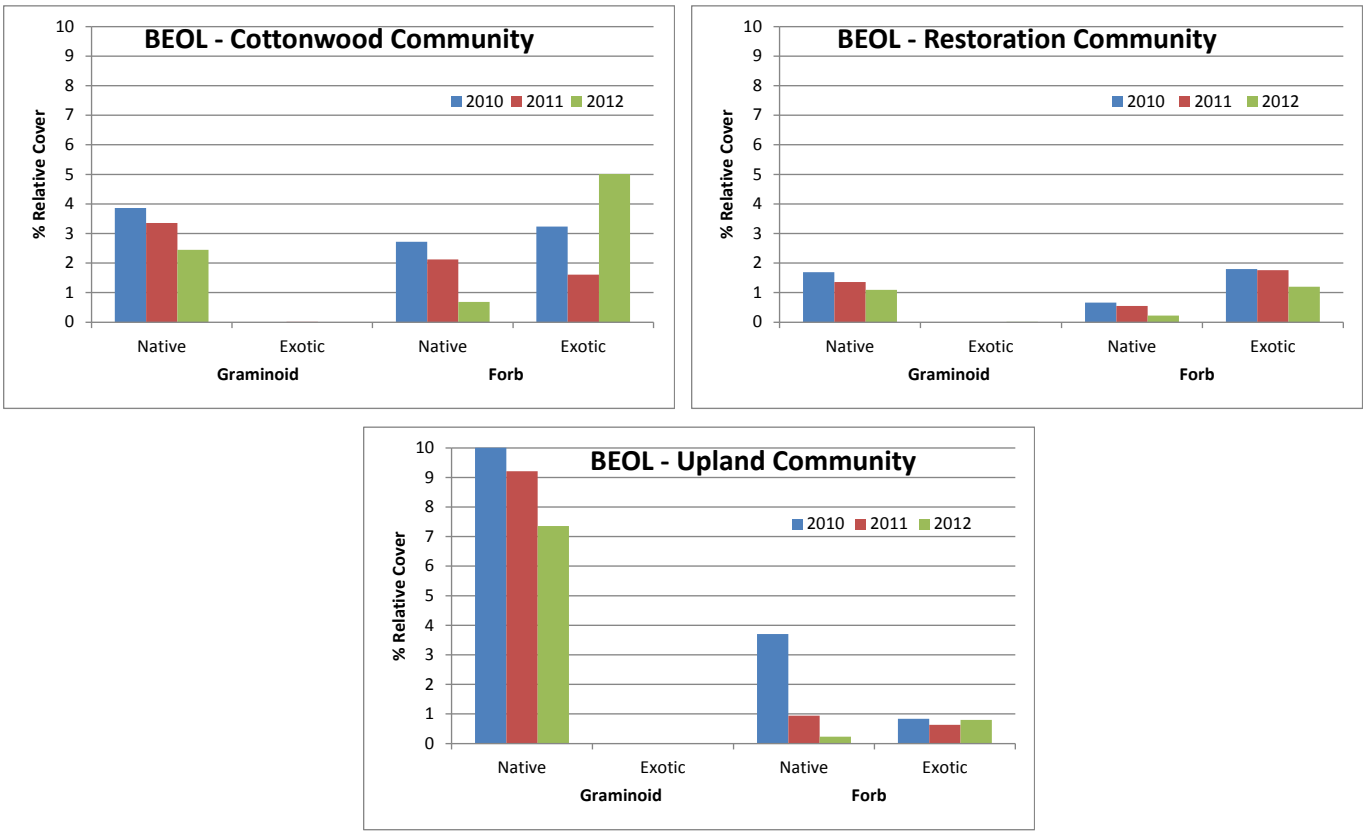
Lifeform	Native	Exotic	Total	% Native
Forb	35	9	44	79.55
Graminoid	15	2	17	88.24
Shrub	2	0	2	100.00
Tree	2	1	3	66.67

immediately following a disturbance, but would shift toward an increased proportion of perennials as time passes since a disturbance.

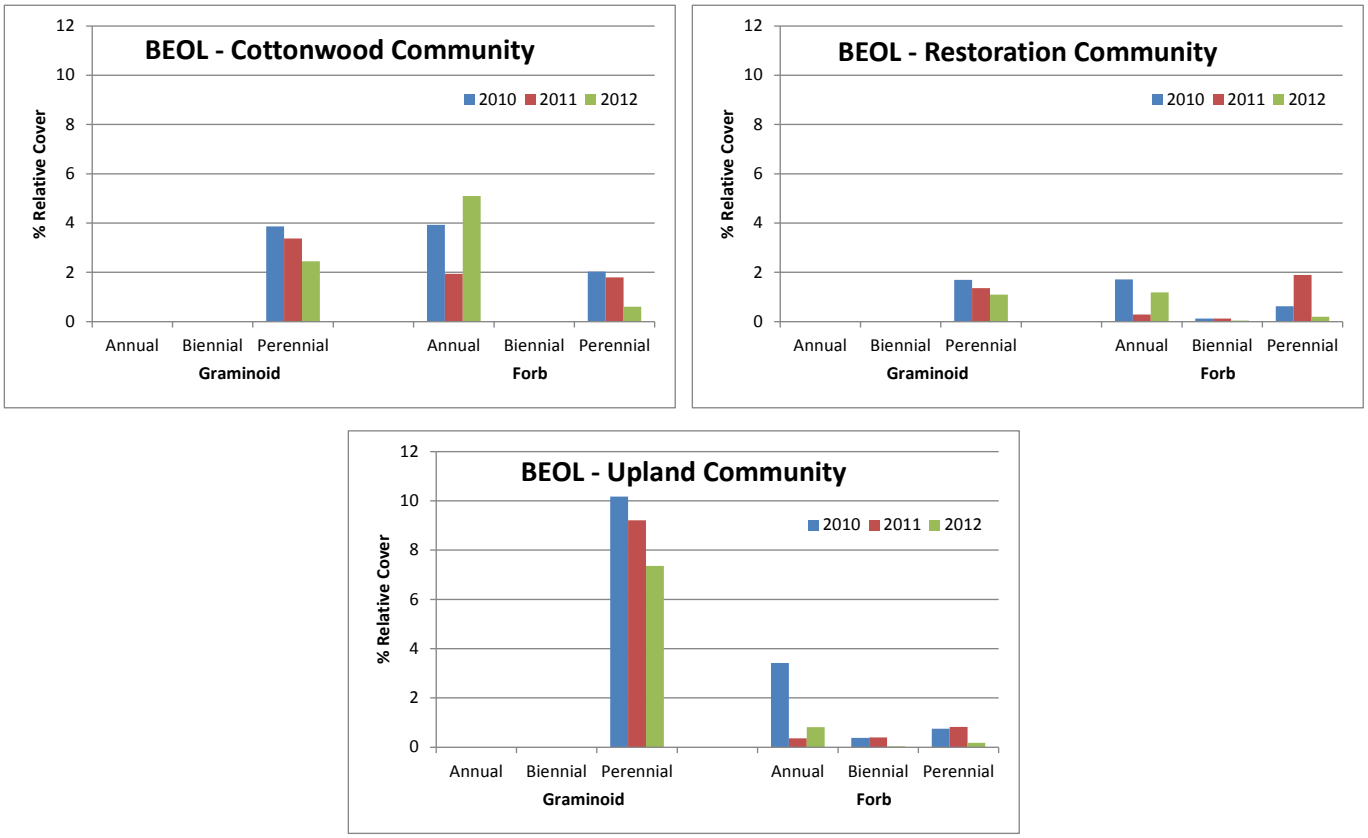
All plant communities are stressed because of the drought, with a decline in cover for all native perennial grasses and forbs, while exotic annuals increased (Graph 4.1-1). This response is to be expected. Based on three years of monitoring, the Upland Community appears to be fairly stable, composed primarily of native perennial grasses (Graph 4.1-2). The Restoration Community continues to be disturbed, with reseeding taking place in abandoned prairie dog towns. There are more forbs than grasses and tend to be exotic annuals (Graph 4.1-2). Overall, plant cover in this community is very low, which contributes to soil erodibility. Continued restoration effort will be required to bring this community to a desirable stable state. The Cottonwood Community in the flood plain of the Arkansas River is often disturbed by flooding that often (re)introduces exotics. Some areas monitored were also affected by wildfire a decade ago. While the majority of grasses in this community are native perennials their relative cover is less than the forbs. (Graph 4.1-3) Grass cover in a cottonwood gallery will not be as dense as an open grassland, but should be much greater than the 2-4% found at BEOL. In addition to holding soil and filtering sediment, the grass understory can provide critical habit for wildlife. The forb component has seen an explosion in annual exotics here (primarily *Kochia scoparia*), while native perennial forbs have steadily declined.

NPS PHOTO

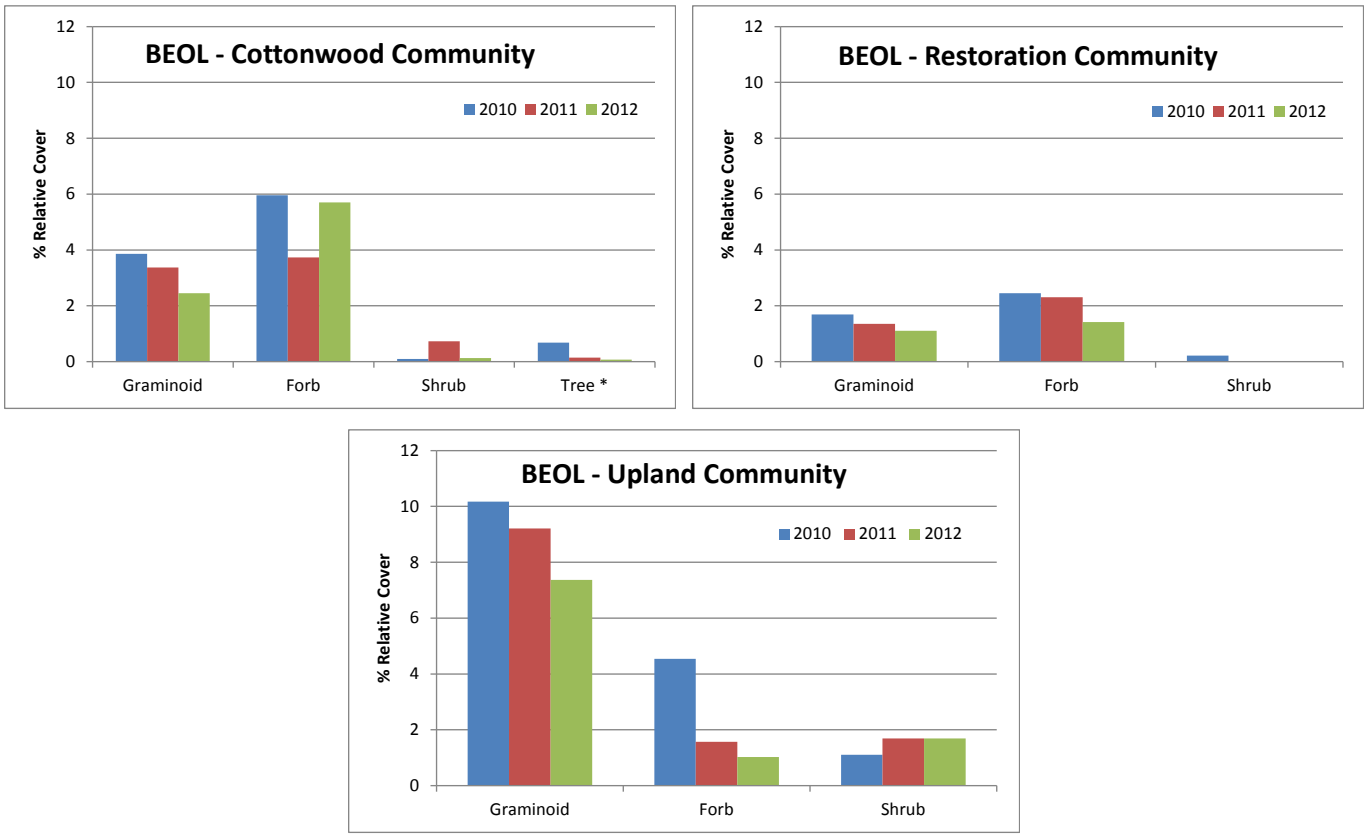
Park management is interested in monitoring the cottonwood and restoration communities in Bent's Old Fort NHS.



Graph 4.1-1. Percent of relative cover of native vs. exotic graminoids and forbs over a 3-year sample period at Bent's Old Fort NHS by plant community



Graph 4.1-2. Percent of relative cover of annual, biennial, and perennial grasses and forbs for each plant community over a 3-year sample period at Bent's Old Fort NHS by plant community.



Graph 4.1-3. Percentage of relative cover for life forms in plant communities sampled in 2010-2012 at Bent's Old Fort NHS. * Tree canopy cover has not been consistently measured across sample years.

As stated previously, this data should serve as baseline data for determining future trend – not as trends themselves.

4.1.3. Prescribed fire treatments or wildfire occurrence

There were no wildfires or prescribed burns conducted in 2012. The last prescribed burn was in 2006 in the northeast quadrant of the park (Figure 4.1-2). A major wildfire in 2002 burned the majority of land south of the Arkansas River. It is unknown at this time when or where the next prescribed fire will be conducted.

4.1.4. Fire effects

Fire effects monitoring is an integral part of the Grassland Monitoring Protocol (Folts-Zettner et al. in review) and current results from monitoring within the scope of this project are reported in the transect data table (Appendix A). As monitoring progresses, any noted effects of burning will be presented in this section.

4.1.5. Known treatments for exotics

The treatment of exotic plant species on grasslands in the southern plains may have a short-term effect on long-term monitoring transects. In order to inform monitoring results, communications have been developed with park itself and the the Southern Plains/Chihuahuan Desert Exotic Plant Management Team to map annual treatment areas. Pertinent information will be presented in this section when treatments are known.

4.1.6. Precipitation Data

Charts reflecting both historic and current precipitation data have been developed (Graphs 4.1-4 and -5). This data was collected from the Las Animas COOP Climate Station.

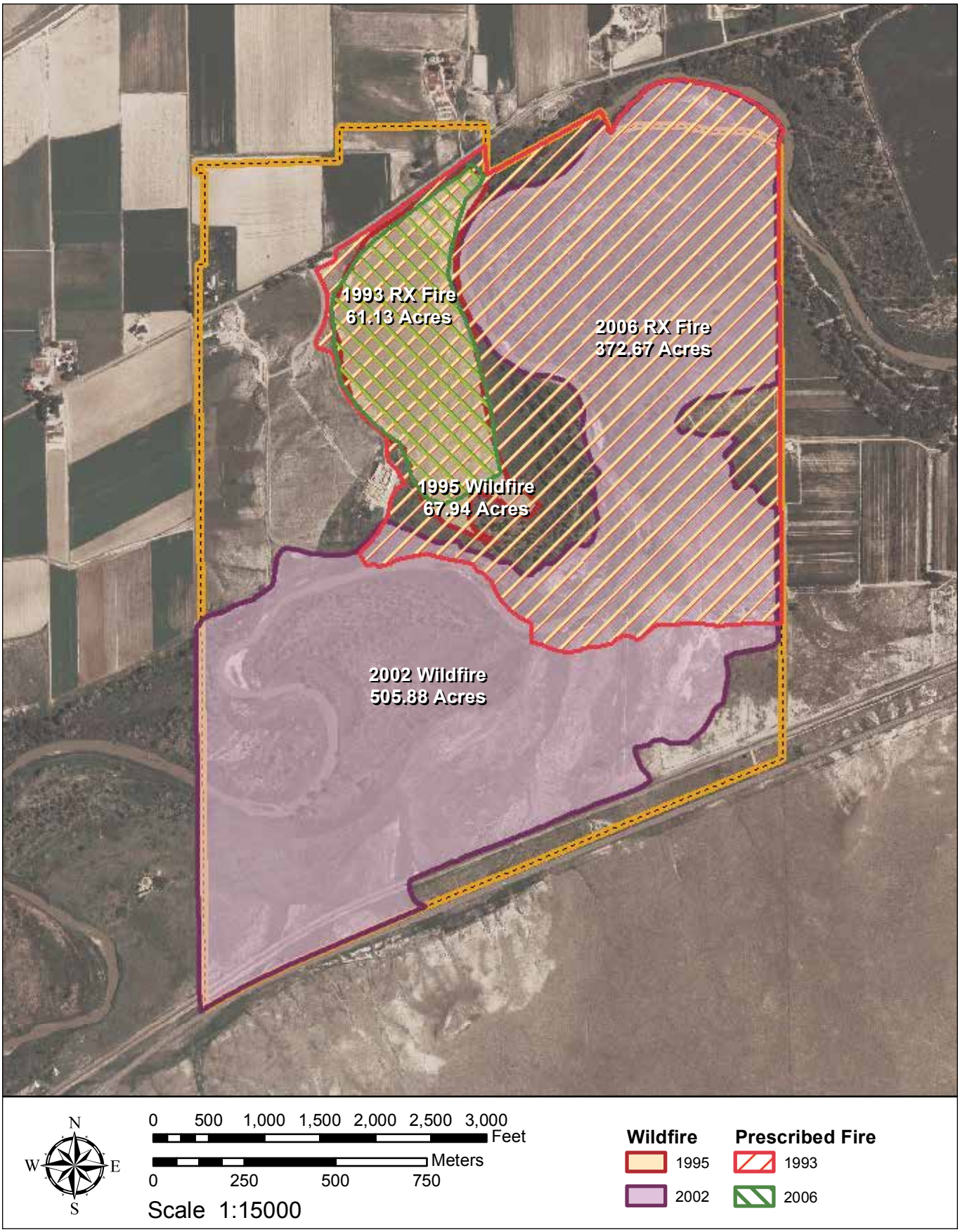
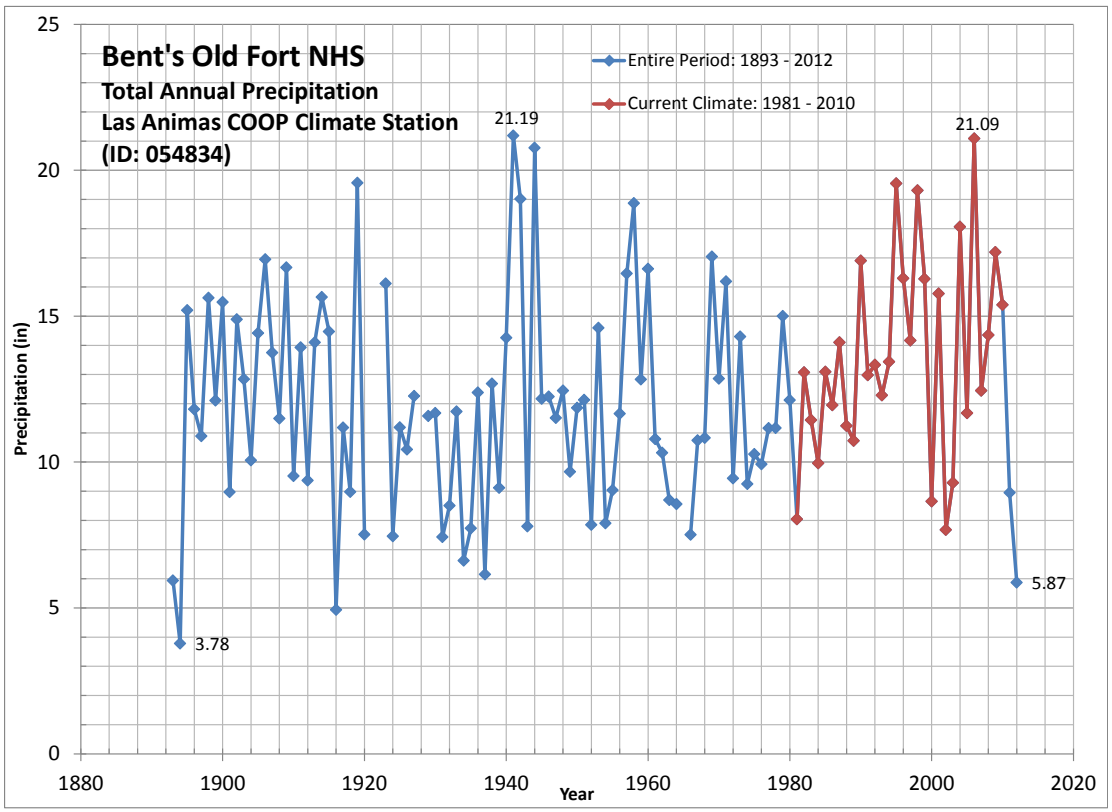
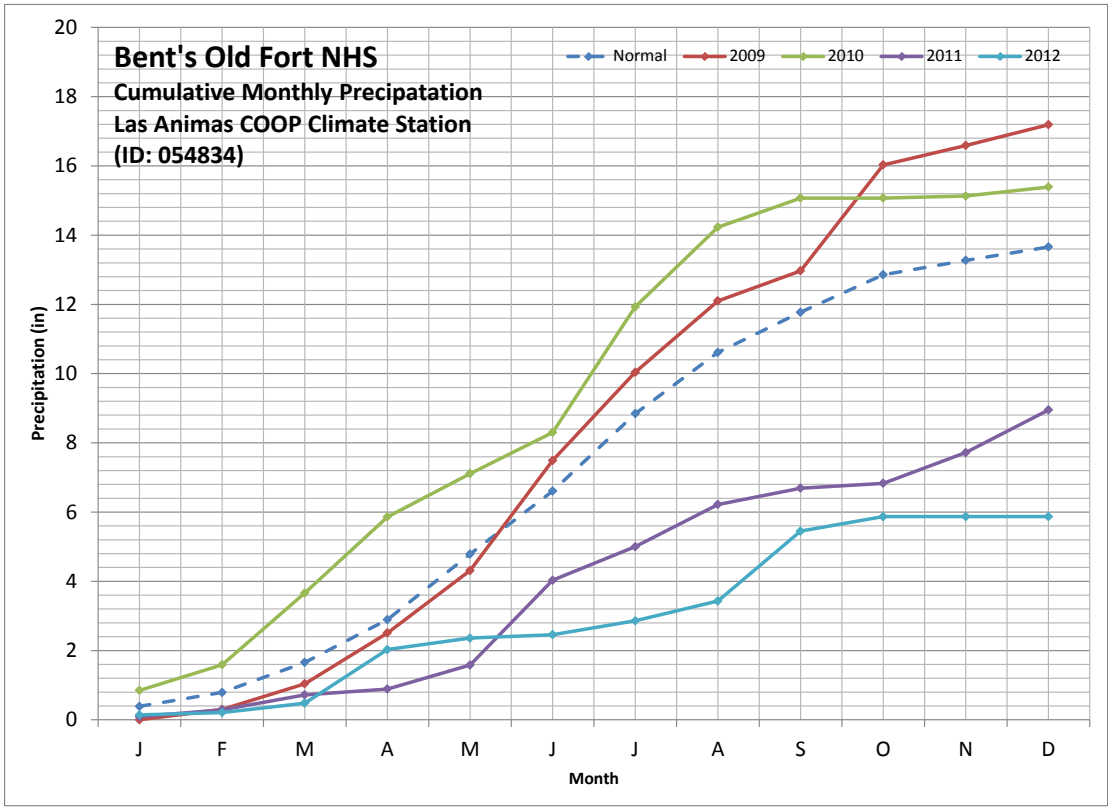


Figure 4.1-2. Prescribed treatment or wildland fires since 1993, Bent's Old Fort NHS.



Graph 4.1-4. Annual precipitation from 1880 to 2012 at Bent's Old Fort NHS.



Graph 4.1-5. Cumulative monthly precipitation for 2009 to 2012 (including normal levels) at Bent's Old Fort NHS.

4.2. Capulin Volcano National Monument

4.2.1. 2012 sampling

A total of six fire and six long-term monitoring transects were established at Capulin Volcano National Monument (CAVO; Figure 4.2-1). The plant communities monitored at CAVO are: shortgrass steppe and pinyon-juniper woodland (Muldavin et al. 2011), which is being thinned and/or type converted to grassland (Table 4.2-1). Twelve transects were monitored at CAVO during early August 2012. Eleven of these transects are included in our study area and were used in this analysis.

4.2.2. Results and discussion

These early-monitoring results provide a baseline to measure future trends and should not be viewed as trends themselves. We are beginning to examine certain components of biotic integrity as applied to vegetation communities. Part of our consideration, the indicators chosen are robust to the sometimes significiant year to year variation in seasonal or annual rainfall or disturbance such as herbivory. These indicators can vary significantly from year to year in response to these environmental factors yet remain within the range of natural variability. The monitoring conducted over the past three years will serve as a baseline to determine trends in the coming years.

Appendix B presents the detailed monitoring results for each transect monitored within the study area. This data shows the annual variation of species within a given area, as well as a 3-year comparison of frequency and species cover for each transect. The transects have been grouped according to similarity of gross plant communities. Exotic species are highlighted in pink.

Table 4.2-2 presents the cumulative cover value of the ground strata for each transect monitored in 2012. When recorded correctly, the values for each transect will add up to 100%. SOILOPEN is the measure of bare soil exposed to the sky and the potential for wind and/or water erosion. SOILUNDER is the measure of bare soil beneath plant cover, which provides some protection from potential erosion. LITTER is another important measure, as some litter is to be desired while excessive litter may negatively impact grassland health. CRUST refers to biotic soil crust, an important and delicate component in semi- and arid grasslands.

<u>Biotic Integrity</u>

One of the major threats to grasslands and other plant communities is invasive species. Invasive species have been directly linked to the replacement of dominant native species (Tilman 1999), the loss of rare species (King 1985), changes in ecosystem structure, alteration of nutrient cycles and soil chemistry (Ehrenfeld 2003), shifts in community productivity (Vitousek 1990), and changes in water availability (D'Antonio and Mahall 1991). The proportion of annual, biennial and perennial species provides an indication of the stability of the site, and it is generally expected that the proportion of annual species at a given site would be higher immediately following a disturbance, but would shift toward an increased proportion of perennials as time passes since a disturbance.

Table 4.2-1. Plant community and sampling dates for each transect at Capulin Volcano NM, 2010-2012.

Group	Transect	Plant community	Date visited		
			2010	2011	2012
Pinyon-Juniper	PJ-LT01	Pinyon Juniper	8/5	7/20	8/2
	PJ-03	Pinyon Juniper	8/7	7/20	8/2
	PJ-LT03	Pinyon Juniper	8/6	7/21	8/4
Steppe	STEP-LT01	Short Grass	8/6	7/21	8/4
	STEP-LT02	Short Grass	8/5	7/20	8/2
	STEP-LT03	Short Grass	8/7	7/21	8/4

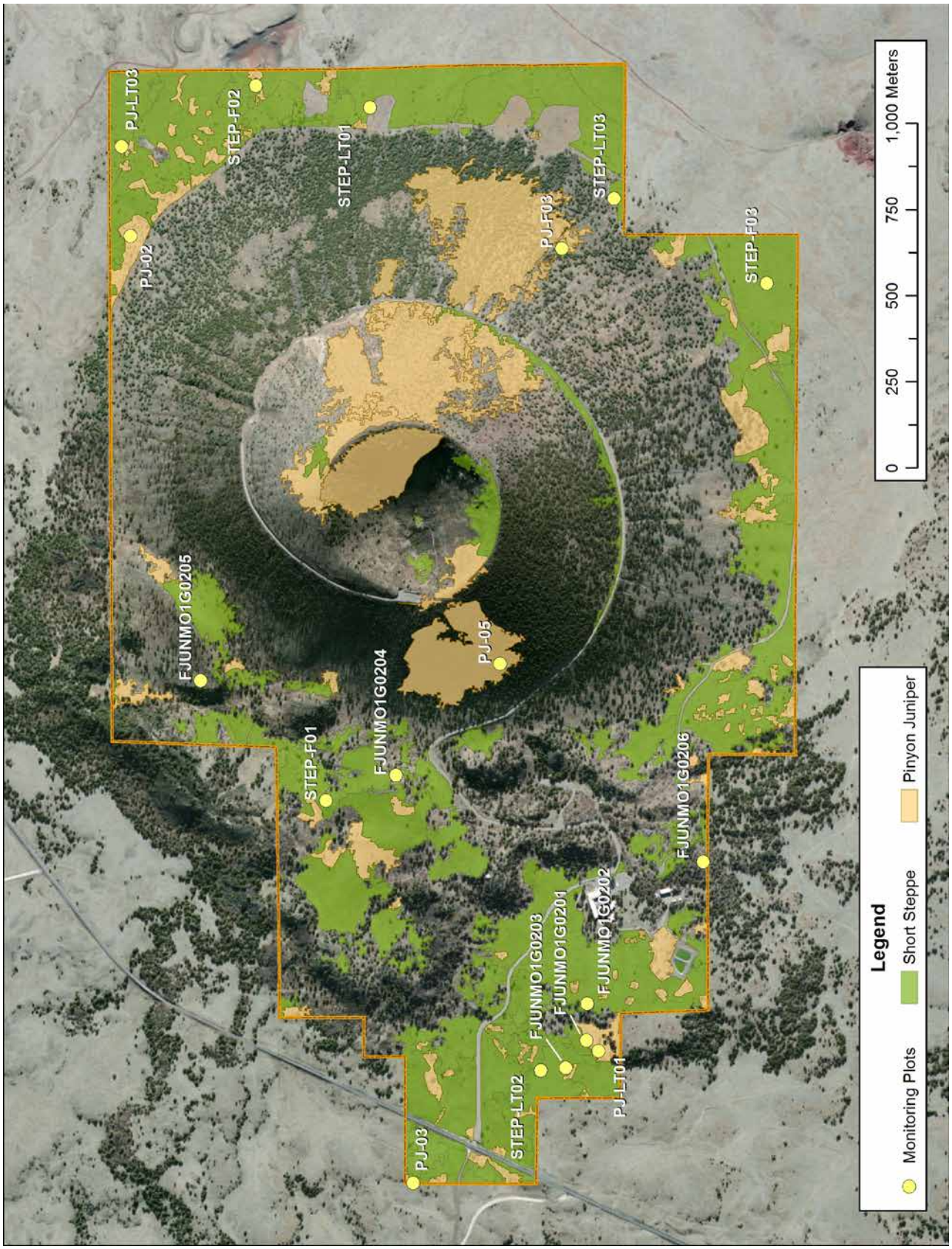


Figure 4.2-1. Monitoring transects at Capulin Volcano NM.

Table 4.2-2. Percentage of substrate cover for each monitoring transect sampled, Capulin Volcano NM, 2012

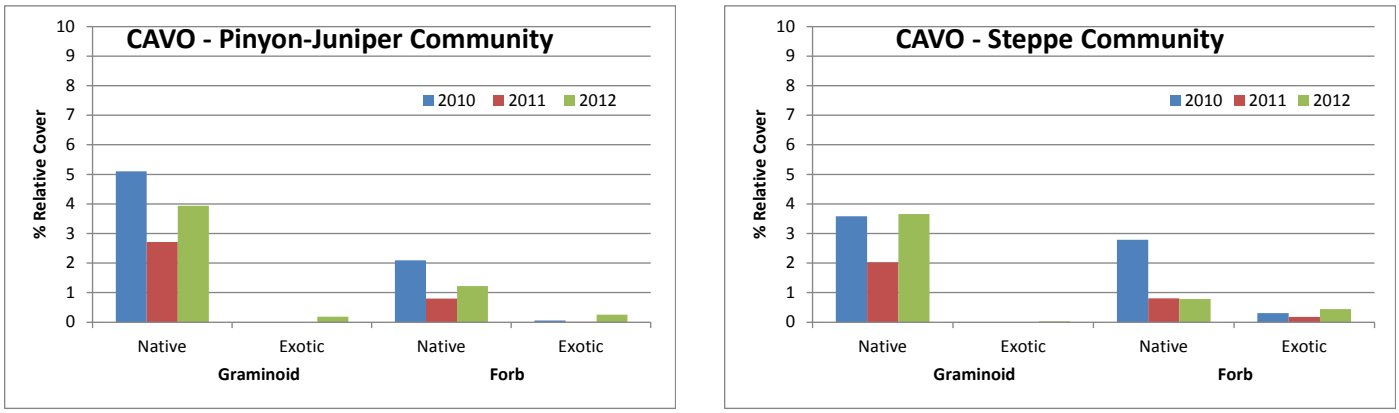
Cover	Transect					
	PJ-LT01	PJ-03	PJ-LT03	STEP-LT01	STEP-LT02	STEP-LT03
SOILOPEN	6.4	6	16.2	8.2	12.4	8.2
SOILUNDER	7.2	5	5.2	4.2	5.6	4.8
LITTER	73.6	60	40.4	56	75.4	41
WOOD	0.2	16	–	–	–	11.8
ROCKLG	12.6	12.8	27	–	5	2.6
ROCKSM	–	0.2	10.2	31.6	1.6	31.6
LICHEN	–	–	1	–	–	–
MOSS	–	–	–	–	–	–
CRUST	–	–	–	–	–	–

Cover	Transect				
	FJUMO1G0202	FJUMO1G0203	FJUMO1G0204	FJUMO1G0205	FJUMO1G0206
SOILOPEN	15	20.4	5.25	14.2	9.6
SOILUNDER	3.2	9.6	1.75	3.6	2.8
LITTER	70	55	43.25	62	47
WOOD	–	–	2.5	10.6	4.6
ROCKLG	8.8	15.8	42.5	3	35
ROCKSM	2.2	0.2	2.5	6.6	0.6
LICHEN	0.8	–	2.25	–	0.2
MOSS	–	–	–	–	0.2
CRUST	–	–	–	–	–

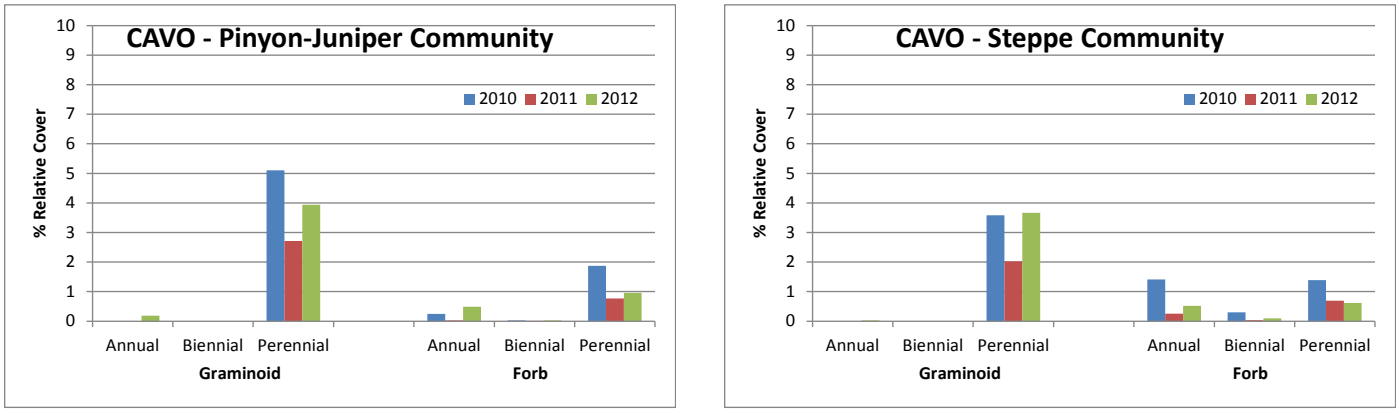
Table 4.2-3. The number and percentage of native and exotic species of each life form found on Capulin Volcano NM during the 2010-2012 grassland monitoring sampling.

Lifeform	Native	Exotic	Total	% Native
Forb	60	7	67	89.55
Graminoid	19	3	22	86.36
Subshrub	3	0	3	100.00
Shrub	2	0	2	100.00
Vine	1	0	1	100.00
Tree	5	0	5	100.00

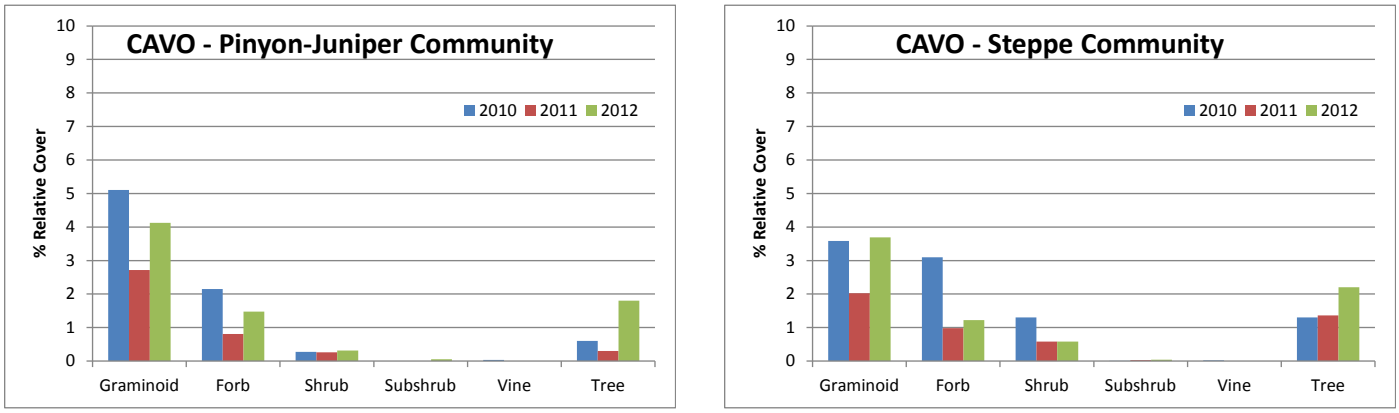
Both plant communities suffered with the drought in 2011, showing a decline in cover for all native perennial grasses and forbs (Graph 4.2-1.). Data collection for 2011 grasses was hampered considerably from the amount of dead/dormant grasses that at times were difficult to identify. Proper cover estimations suffered because of this, which should explain part of the noticeable drop in cover for that year. Unlike other parks in the Southern Plains, there has not been a dramatic increase in annual exotics, which may attest to the stability of the CAVO grasslands and the lack of a widespread seedbank of exotic species. Community stability is also exemplified by the continued dominance of native perennials in both the Pinyon-Juniper and Steppe Communities. The proportion of forbs to grasses is reasonable in both communities (Graph 4.2-2). The increase in cover of trees is attributed to missing data from years past – it was stressed to crews that they must also look up and include tree cover in their cover estimates, resulting in a more true reading in 2012 (Graph 4.2-3).



Graph 4.2-1. Percent of relative cover of native vs. exotic graminoids and forbs over a 3-year sample period at Capulin Volcano NM by plant community.



Graph 4.2-2. Percent of relative cover of annual, biennial, and perennial grasses and forbs for each plant community over a 3-year sample period at Capulin Volcano NM by plant community.



Graph 4.2-3. Percentage of relative cover for life forms in plant communities sampled in 2010-2012 at Capulin Volcano NM.

As stated previously, this data should serve as baseline data for determining future trend – not as trends themselves.

4.2.3. Prescribed fire treatments or wildfire occurrence

Prescribed burns and thinning treatments have occurred at CAVO since 2005 (Figure 4.2-2). The majority of the grasslands in the park have received both treatments, but prescribed burning has not occurred since 2008. Thinning of pinon-juniper has occurred since on the toe-slopes and crest of the cinder cone. There has been no wildfire at CAVO (at least on the cone) for the past century.

4.2.4. Fire effects

Fire effects monitoring is an integral part of the Grassland Monitoring Protocol (Folts-Zettner et al. in review) and current results from monitoring within the scope of this project are reported in the transect data table (Appendix B). As monitoring progresses, any noted effects of burning will be presented in this section.

4.2.5. Known treatments for exotics

The treatment of exotic plant species on grasslands in the southern plains may have a short-term effect on long-term monitoring transects. In order to inform monitoring results, communications have been developed with the Southern Plains/Chihuahuan Desert Exotic Plant Management Team to map annual treatment areas.

Active exotic control by the EPMT focused on the front prairie, developed area, campground and Rim Road in 2012 (Figure 4.2-3). Species targeted with herbicide treatment on the prairie included kochia (*Kochia scoparia*) and field bindweed (*Convolvulus arvensis*). Kochia was handpulled and field bindweed was spot treated with herbicide in the Campground area and the Developed area. Cheatgrass along the Rim Road was treated with herbicide.

The park itself has been actively controlling mullein (*Verbascum thapsus*) for the past several years by hand-pulling in an extensive area. The potential for re-growth exists due to the long-lived seedbank but this treatment appears to have reduced the numbers (Folts-Zettner and Sosinski 2012).

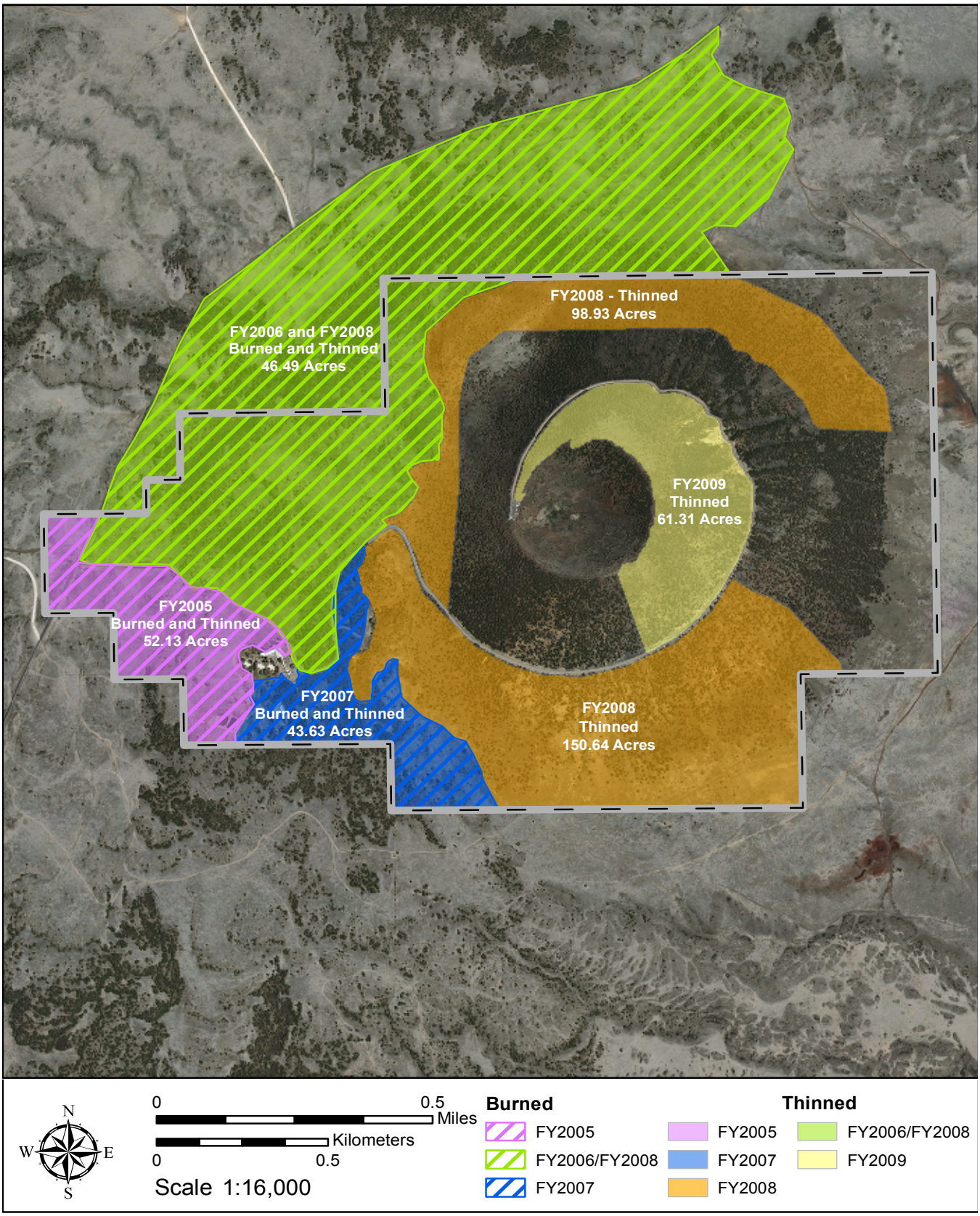


Figure 4.2-2. Prescribed treatment or wildland fires since 2005, Capulin Volcano NM.

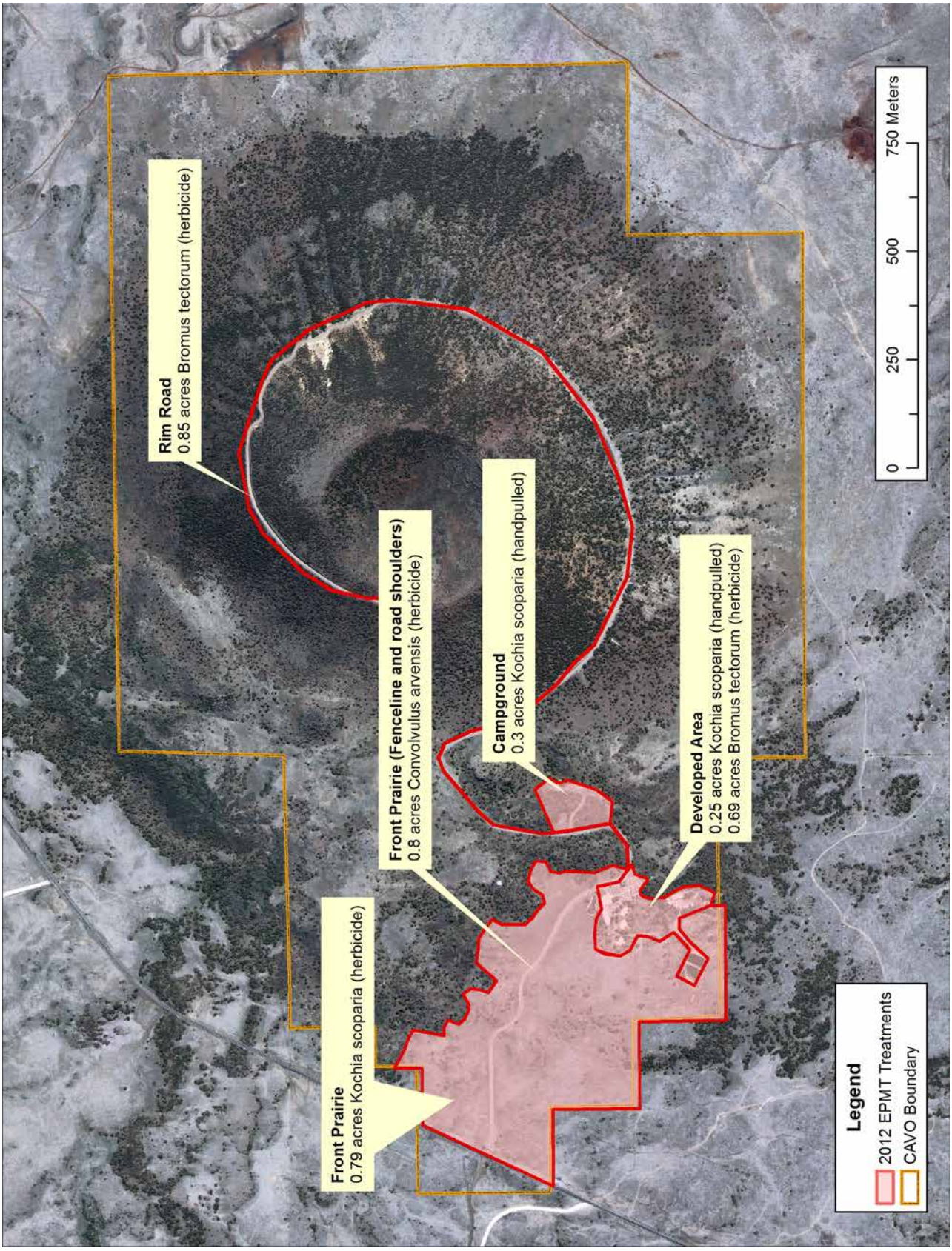


Figure 4.2-3. Exotic plant management team treatment areas at Capulin Volcano NM.

4.3. Chickasaw National Recreation Area

4.3.1. 2012 sampling

A total of ten fire and ten long-term monitoring transects have been established at Chickasaw National Recreation Area (CHIC; Figure 4.3-1). The plant communities monitored are: upland grasslands comprising little bluestem–sideoats grama–blue grama herbaceous vegetation; little bluestem–Indiangrass–sideoats grama herbaceous vegetation; hairy grama–sideoats grama herbaceous vegetation; and seep muhly–sideoats grama–Illinois bundleflower herbaceous vegetation; and an Old Field habitat which contains the Johnsongrass semi-natural herbaceous association (Table 4.3-1). The Old Field habitat is slowly being restored by the park to native grasslands and is an area of specific concern to management. In 2012, seventeen transects were monitored in late May, June and September. Thirteen of these transects are included in our study area and were used in this analysis.

4.3.2. Results and discussion

These early-monitoring results provide a baseline to measure future trends and should not be viewed as trends themselves. We are beginning to examine certain components of biotic integrity as applied to vegetation communities. Part of our consideration, the indicators chosen are robust to the sometimes significiant year to year variation in seasonal or annual rainfall or disturbance such as herbivory. These indicators can vary significantly from year to year in response to these environmental factors yet remain within the range of natural variability. The monitoring conducted over the past three years will serve as a baseline to determine trends in the coming years.

Appendix C presents the detailed monitoring results for each transect monitored within the study area. This data shows the annual variation of species within a given area, as well as a 3-year comparison of frequency and species cover for each transect. The transects have been grouped according to similarity of gross plant communities. Exotic species are highlighted in pink.

Table 4.3-2 presents the cumulative cover value of the ground strata for each transect monitored in 2012. When recorded correctly, the values for each transect will add up to 100%. SOILOPEN is the measure of bare soil exposed to the sky and the potential for

Table 4.3-1. Plant community and sampling dates for each transect at Chickasaw NRA, 2010-2012

			Date visited		
Group	Transect	Plant community	2010	2011	2012
Upland	CHIC-01	Upland Grass	NS	NS	5/27
	LAKE-01	Upland Grass	9/6	6/19	6/11
	LAKE-F02	Upland Grass	6/12	NS	NS
	LAKE-02	Upland Grass	9/5	6/18	6/12
	LAKE-LT01	Upland Grass	6/11	6/22	8/30
	LAKE-LT02	Upland Grass	6/11	6/22	9/1
	LAKE-03	Upland Grass	6/12	6/21	6/12
	WH-F03	Upland Grass	6/15	NS	NS
	WH-01	Upland Grass	6/13	6/23	5/26
	WH-LT01	Upland Grass	6/13	6/20	5/25
	WH-LT02	Upland Grass	NS	6/24	5/28
	WH-LT03	Upland Grass	6/15	6/20	5/25
	WH-LT05	Upland Grass	6/10	6/21	5/26
Restoration	NH-LT01	Old Field	6/10	6/23	5/29
	NH-LT02	Old Field	6/10	6/23	5/29

NS = not sampled

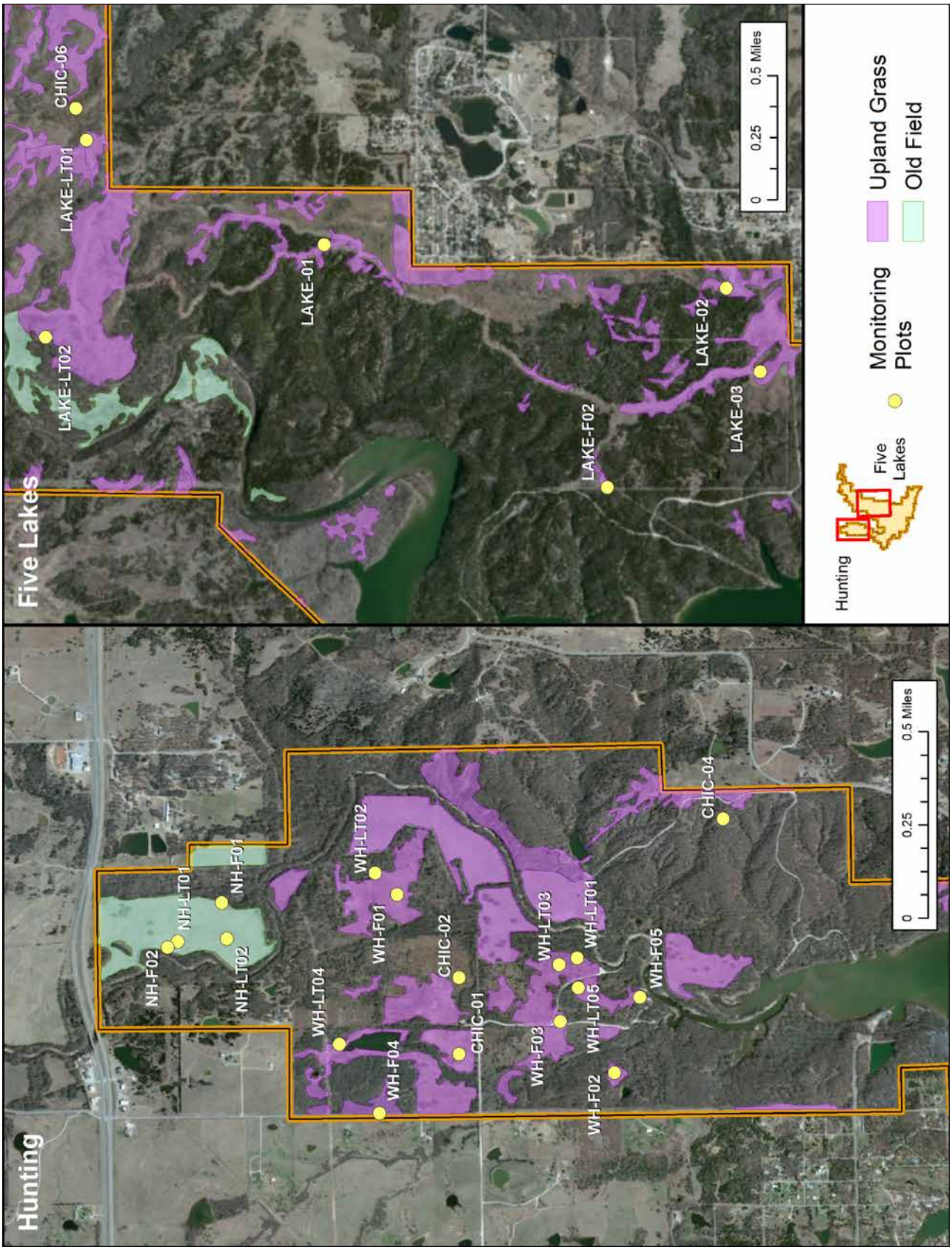


Figure 4.3-1. Monitoring transects at Chickasaw NRA.

Table 4.3-2. Percentage of substrate cover for each long-term monitoring transect sampled, Chickasaw NRA, 2012

Cover	Transect										
	CHIC-01	LAKE-01	LAKE-02	LAKE-LT01	LAKE-LT02	LAKE-03	NH-LT01	NH-LT02	WH-LT01	WH-LT02	WH-LT03
SOILOPEN	13	–	13	6.2	1	–	–	–	1.3	8.2	–
SOILUNDER	13.4	–	5.6	3.6	2.6	–	–	–	9.7	8.4	–
LITTER	72	36	79.8	81	85.6	77.4	100	100	81.6	81.8	100
WOOD	1	64	2	0.4	2.2	24.6	–	–	7.4	0.1	–
ROCKLG	–	–	0.6	1.6	2.2	–	–	–	–	–	–
ROCKSM	–	–	–	5.6	6	–	–	–	–	–	–
LICHEN	–	–	–	–	–	–	–	–	–	–	–
MOSS	–	–	–	–	0.4	–	–	–	–	1.3	–
CRUST	1	–	–	1.6	–	–	–	–	–	0.2	–

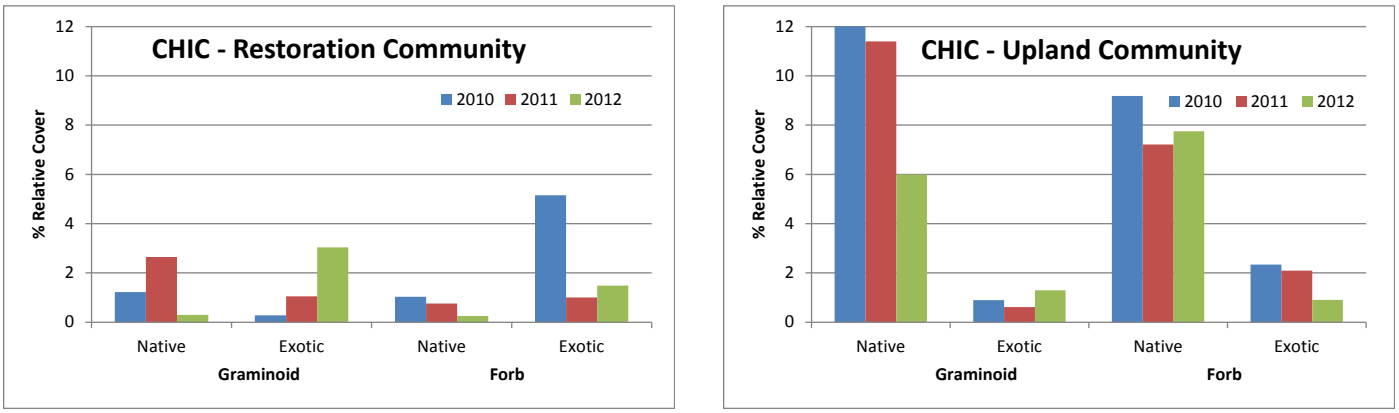
wind and/or water erosion. SOILUNDER is the measure of bare soil beneath plant cover, which provides some protection from potential erosion. LITTER is another important measure, as some litter is to be desired while excessive litter may negatively impact grassland health. CRUST refers to biotic soil crust, an important and delicate component in semi- and arid grasslands.

Biotic Integrity

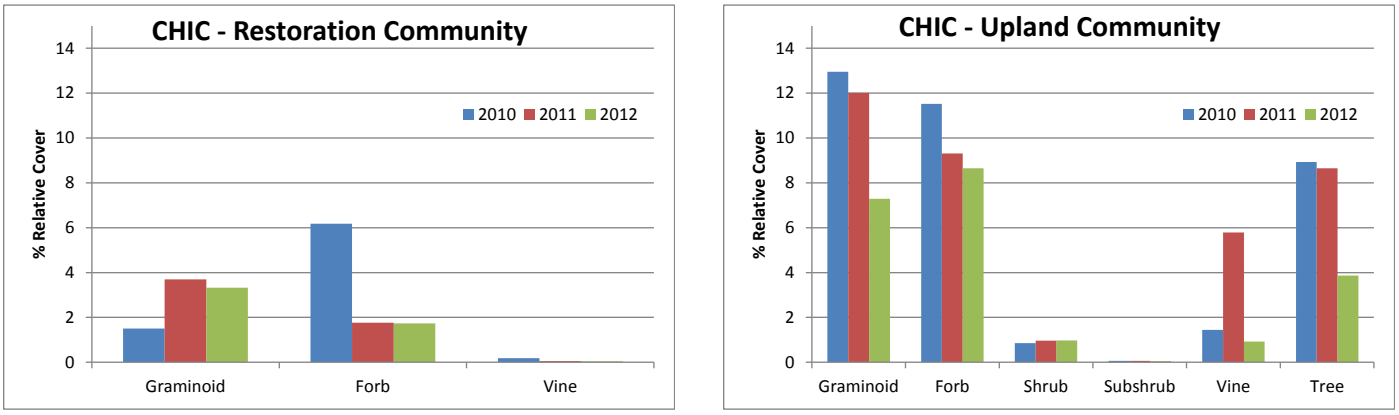
One of the major threats to grasslands and other plant communities is invasive species. Invasive species have been directly linked to the replacement of dominant native species (Tilman 1999), the loss of rare species (King 1985), changes in ecosystem structure, alteration of nutrient cycles and soil chemistry (Ehrenfeld 2003), shifts in community productivity (Vitousek 1990), and changes in water availability (D'Antonio and Mahall 1991). The proportion of annual, biennial and perennial species provides an indication of the stability of the site, and it is generally expected that the proportion of annual species at a given site would be higher immediately following a disturbance, but would shift toward an increased proportion of perennials as time passes since a disturbance.

These initial results have been impacted by a number of disturbances. All plant communities suffered from the drought, showing a decline in cover for all native perennial grasses and forbs from our initial monitoring in 2010 (Graph 4.3.1). This response is to be expected. Another factor to be considered regarding the Upland Community is that several fire effect plots have undergone thinning treatment over the past two years in an effort to convert oak-juniper woodland to oak savannah. It will take several more years for these diminished grasslands to (re)establish with adequate cover. Some areas of the Upland Community have undergone prescribed burning, which may have impacted the relative cover of grasses, vines and trees (a tree seedling is still counted as a tree) (Graph 4.3-2.). The Upland Community is more robust overall than the Restoration Community, which is entering its third year of restoration effort. Forbs currently provide greater relative cover than grass species in the Upland Community, which is not a long-term desired condition. The cover of annual forbs has doubled, which is a typical disturbance response (Graph 4.3-3). However, taking into account the natural and anthropogenic disturbances listed above, this ratio should return to a healthier, grass-dominated community over time.

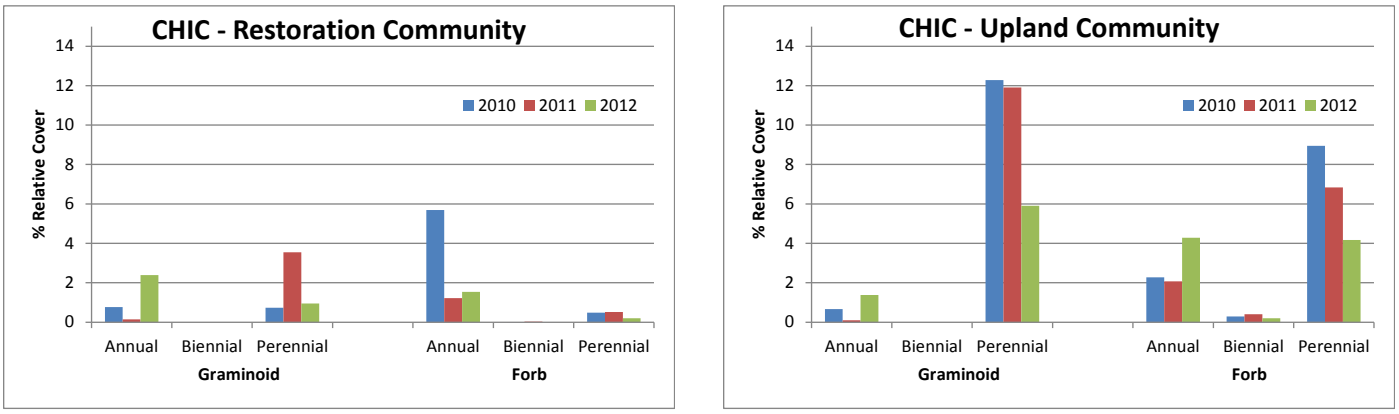
The Restoration Community is an attempt to convert exotic Johnsongrass (*Sorghum halepense*) hayfields to native grasslands (Graph 4.3-1). This effort has been hampered by drought and the inability to apply prescribed fire. Some reseeding has taken place but herbicide control has been the primary management effort to date. Exotic grasses continue to out-compete native grass, while annual exotics dominate that functional group (Graph 4.3-3).



Graph 4.3-1. Percent of relative cover of native vs. exotic graminoids and forbs over a 3-year sample period at Chickasaw NRA by plant community.



Graph 4.3-2. Percentage of relative cover for life forms in plant communities sampled in 2010-2012 at Chickasaw NRA.



Graph 4.3-3. Percent of relative cover of annual, biennial, and perennial grasses and forbs for each plant community over a 3-year sample period at Chickasaw NRA by plant community.

As stated previously, this data should serve as baseline data for determining future trend – not as trends themselves.

4.3.3. Prescribed fire treatments or wildfire occurrence

CHIC supports an active prescribed burning and thinning program with support from ARRA funding (Figures 4.3-2 and -3). Earlier burns have taken place in the Guy Sandy area and north of Veteran's Lake, but no details have been given. Thinning has occurred on approx.. 3400 acres in 2010 and 1900 acres

Table 4.3-3. The number and percentage of native and exotic species of each life form found on Chickasaw NRA during the 2010-2012 grassland monitoring sampling.

Lifeform	Native	Exotic	Total	% Native
Forb	104	17	121	85.95
Graminoid	35	7	42	83.33
Subshrub	3	0	3	100.00
Shrub	3	0	3	100.00
Vine	12	0	12	100.00
Tree	23	1	24	95.83

in 2011. Prescribed burning was applied to approximately 60 acres in 2010, 1900 acres in 2011 and 600 acres in 2012. These treatments have been applied in areas of concern throughout the park. Monitoring transects that may have been affected by these treatments include those in the Guy Sandy area (WH transects) and the Five Lakes area (LAKE transects). A total of three small wildfires (each under 0.5 acres) have occurred within the CHIC boundary during the past five years. None of these fires occured in or around monitoirng plots.

4.3.4. Fire effects

Fire effects monitoring is an integral part of the Grassland Monitoring Protocol (Folts-Zettner et al. in review) and current results from monitoring within the scope of this project are reported in the transect data table (Appendix C). As monitoring progresses, any noted effects of burning will be presented in this section.

4.3.5. Known treatments for exotics

CHIC is a member of the Southeastern Exotic Plant Management Team and performs the majority of exotic plant control themselves. A reporting system has been set up with the park for these treatments and it is anticipated that a similar system will be in place for the SE-EPMT. This information will inform SOPN monitoring programs of potential impact on monitoring transects and provide the park and EPMT supplemental information on the effectiveness of their treatments. In 2011, extensive herbicidal control was implemented by the park for Johnsongrass (Figure 4.3-4). No data has been reported for 2012.

4.3.6. Precipitation Data

Charts reflecting both historic and current precipitation data have been developed. This data was collected from the park weather station (Graphs 4.3-4 and-5).

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A total of ten fire and ten long-term monitoring transects were established at Chickasaw NRA.

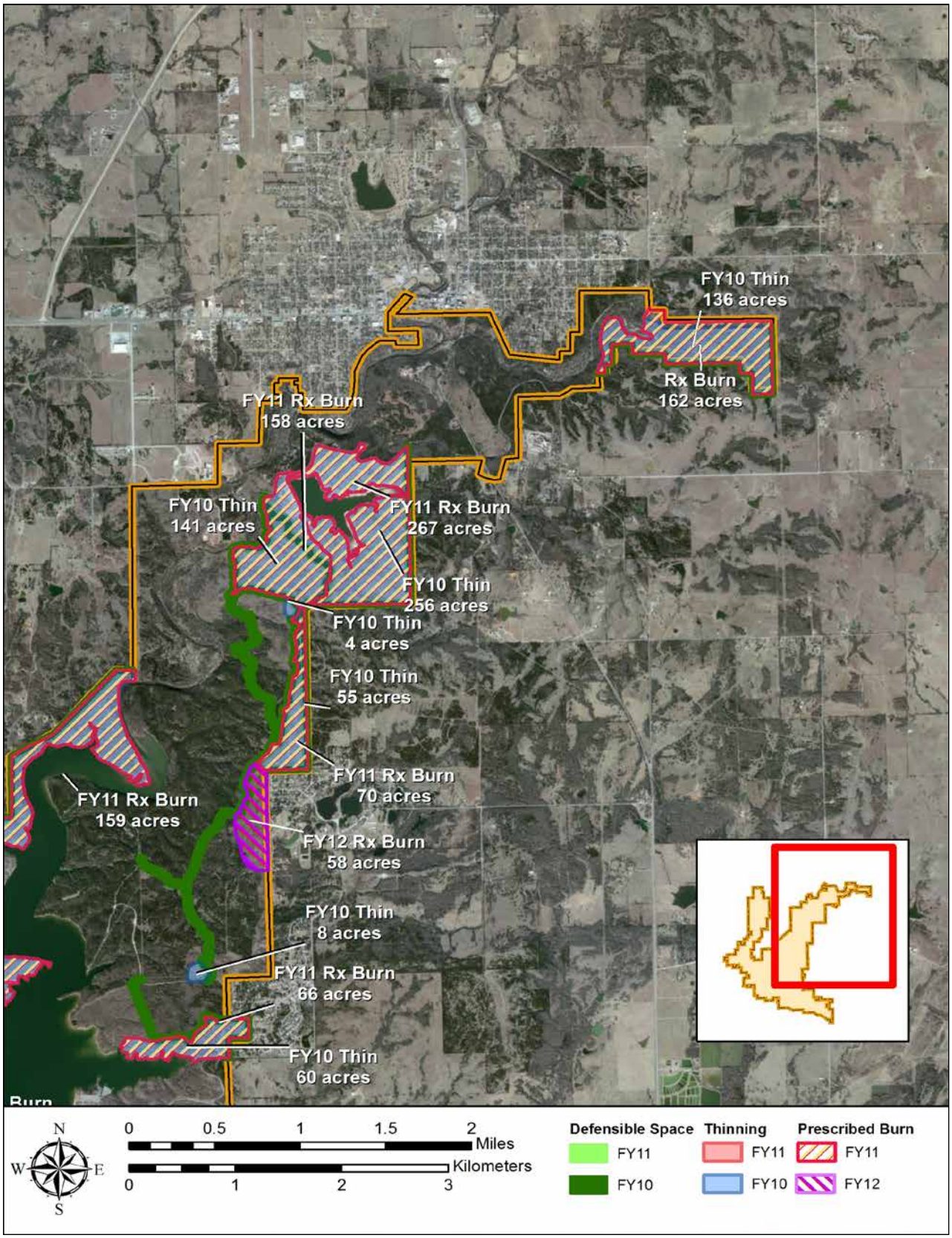


Figure 4.3-2. Prescribed treatment or wildland fires since 2010 at eastern Chickasaw NRA.

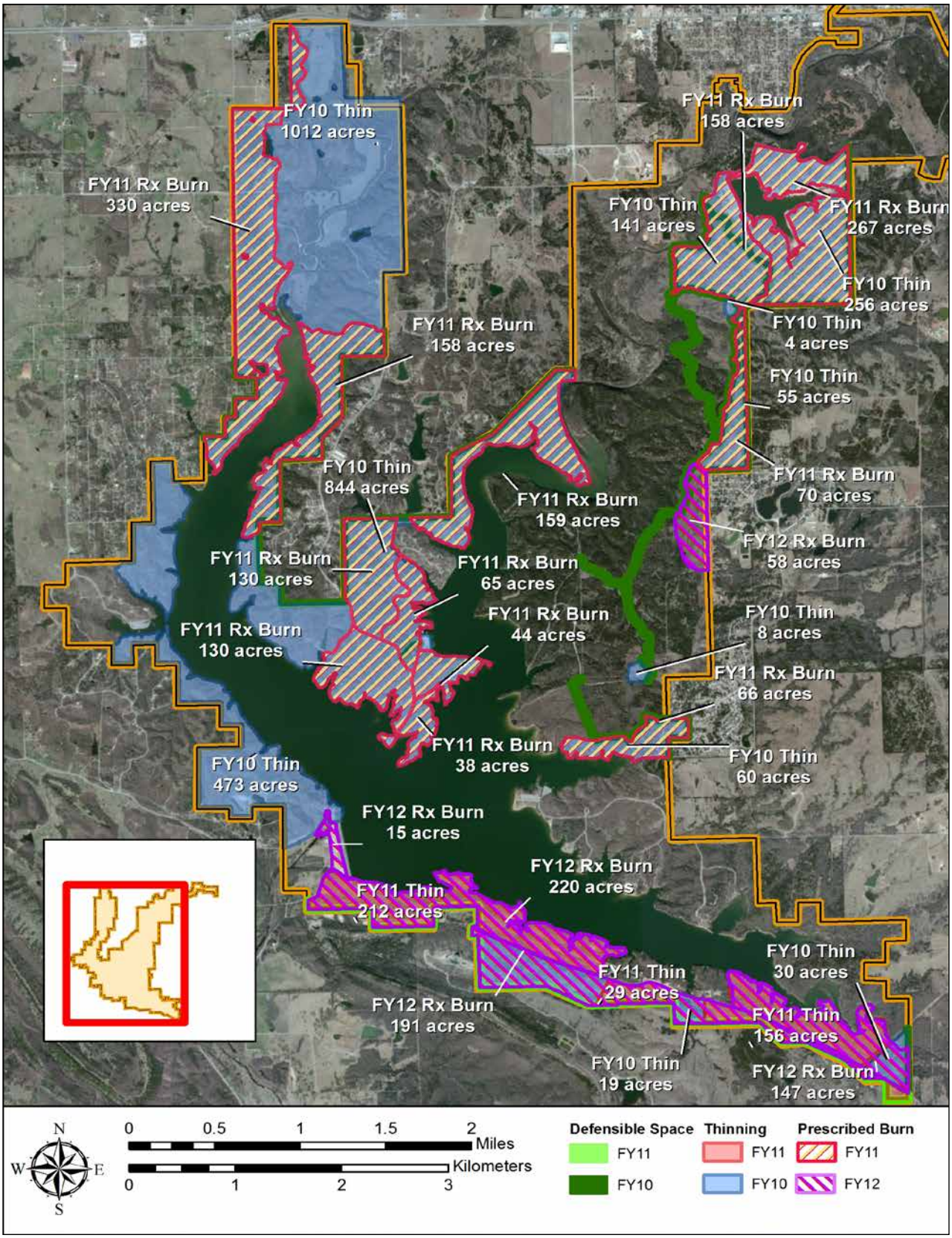
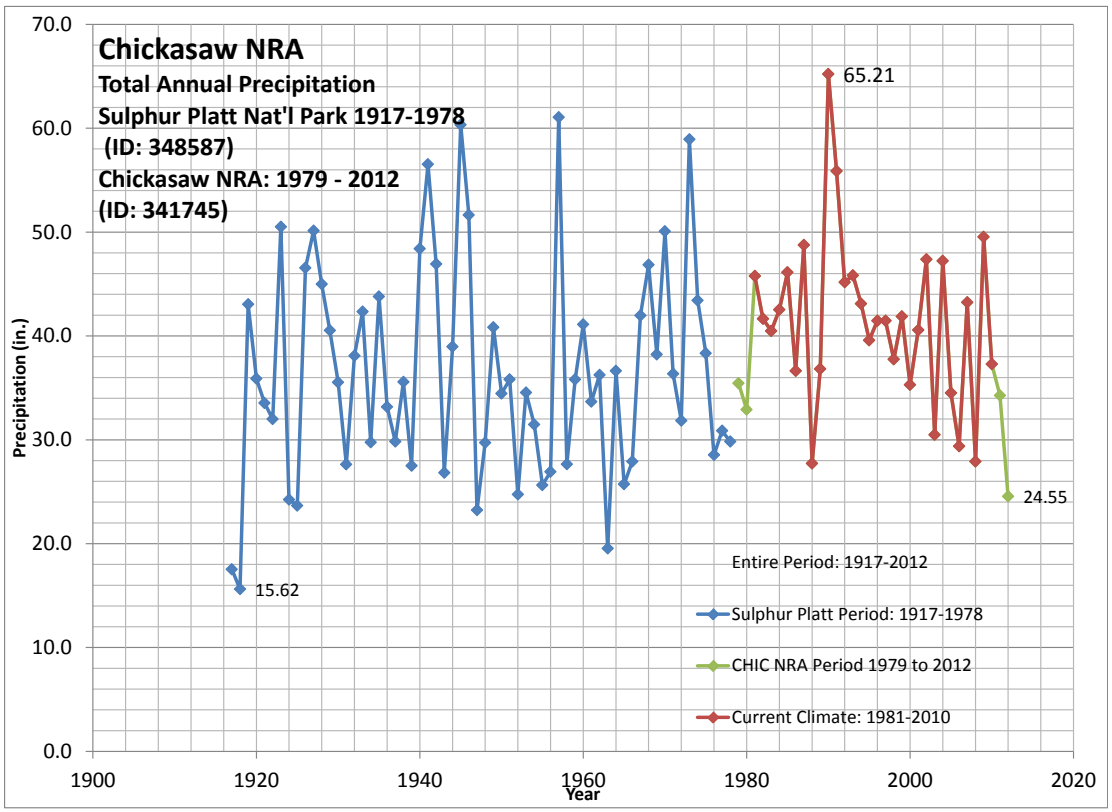
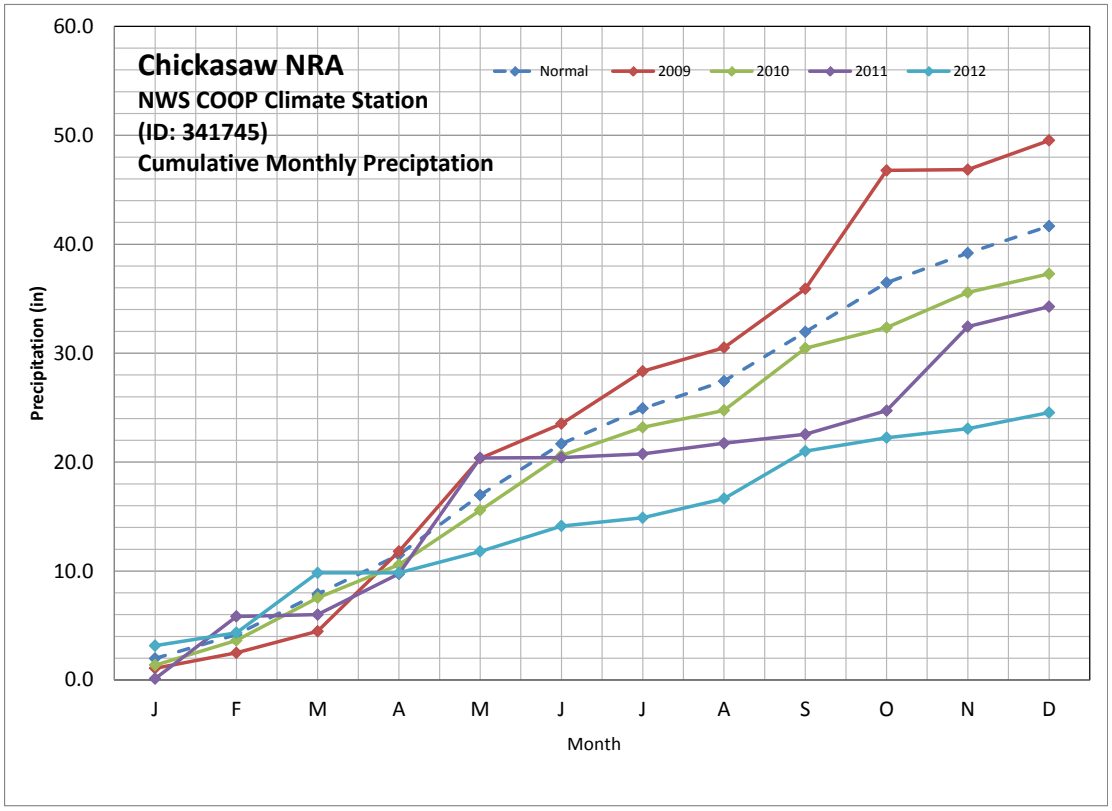


Figure 4.3-3. Prescribed treatment or wildland fires since 2010 at western Chickasaw NRA.

Figure 4.3-4. Johnsongrass treament areas in Chickasaw NRA, 2010.



Graph 4.3-4. Annual precipitation from 1880 to 2012 at Chickasaw NRA.



Graph 4.3-5. Cumulative monthly precipitation for 2009 to 2012 (including normal levels) at Chickasaw NRA.

4.4. Fort Larned National Historic Site

4.4.1. 2012 sampling

A total of seven fire-event transects and eight longterm monitoring transects were established at Fort Larned National Historic Site (FOLS; Figure 4.4-1). The plant communities monitored at FOLS are: restored grasslands consisting of smooth brome semi-natural herbaceous alliance and planted semi-natural restored grassland prairie, and a prairie dog town grassland complex (Cogan et al. 2007) (Table 4.4-1). Prescribed fire is not a part of the management plan within the prairie dog town and the area does not require a fire-event transect. In 2012, eleven transects were monitored at Fort Larned NHS during June and all were included in this analysis.

4.4.2. Results and discussion

These early-monitoring results provide a baseline to measure future trends and should not be viewed as trends themselves. We are beginning to examine certain components of biotic integrity as applied to vegetation communities. Part of our consideration, the indicators chosen are robust to the sometimes significiant year to year variation in seasonal or annual rainfall or disturbance such as herbivory. These indicators can vary significantly from year to year in response to these environmental factors yet remain within the range of natural variability. The monitoring conducted over the past three years will serve as a baseline to determine trends in the coming years.

Appendix D presents the detailed monitoring results for each transect monitored within the study area. This data shows the annual variation of species within a given area, as well as a 3-year comparison of frequency and species cover for each transect. The transects have been grouped according to similarity of gross plant communities. Exotic species are highlighted in pink.

Table 4.4-2 presents the cumulative cover value of the ground strata for each transect monitored in 2012. When recorded correctly, the values for each transect will add up to 100%. SOILOPEN is the measure of bare soil exposed to the sky and the potential for wind and/or water erosion. SOILUNDER is the measure of bare soil beneath plant cover, which provides some protection from potential erosion. LITTER is another important measure, as some litter is to be desired while excessive litter may negatively impact grassland health. CRUST refers to biotic soil crust, an important and delicate component in semi- and arid grasslands.

Table 4.4-1. Habitat type, plant community, and sampling dates for each transect at Fort Larned NHS, 2010-2012.

			Date visited		
Group	Transect	Plant community	2010	2011	2012
Restoration	BU02A-LT01	Upland Restoration	6/4	6/28	6/21
	BU02A-02	Upland Restoration	6/3	NS	6/22
	BU02B-LT01	Upland Restoration	6/3	6/28	6/21
	BU04-F01	Upland Restoration	6/2	NS	6/24
	BU04-LT01	Upland Restoration	6/2	6/27	6/24
	BU05A-LT01	Upland Restoration	6/3	6/27	6/21
	BU06-LT01	Upland Restoration	6/5	6/27	6/23
	BU07-F01	Upland Restoration	6/5	NS	NS
	BU07-LT01	Upland Restoration	6/4	6/27	6/23
	BU08-F01	Upland Restoration	6/1	NS	6/22
	BU08-LT01	Upland Restoration	6/1	6/27	6/22
PrairieDog	RUT-LT01	Upland Prairie Dog Town	6/4	6/28	6/23

NS = not sampled

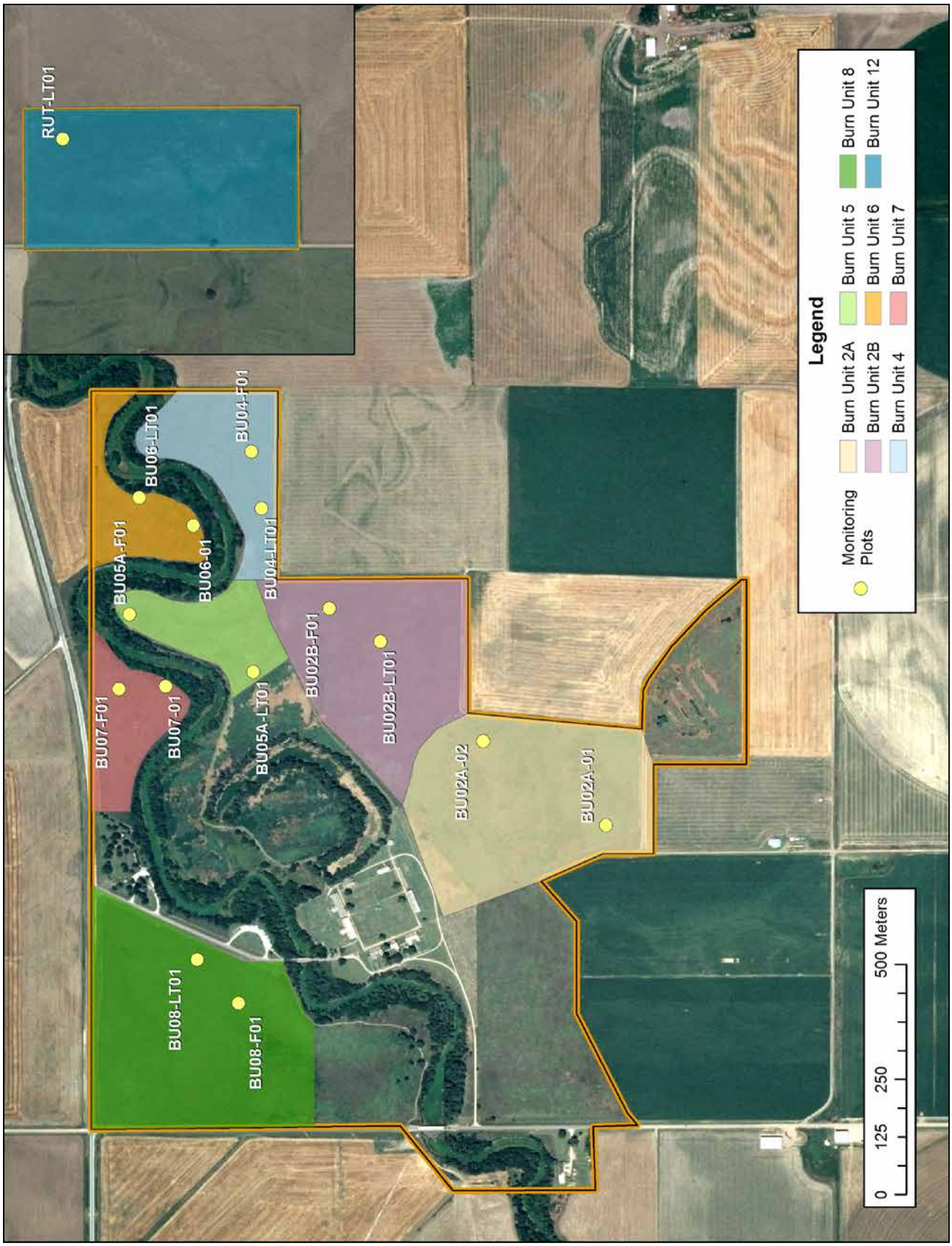


Figure 4.4-1. Monitoring transects at Fort Larned NHS.

Table 4.4-2. Percentage of substrate cover for each long-term monitoring transect sampled, Fort Larned NHS, 2012

Cover	Transect										
	BU02A-01	BU02A-02	BU02B-LT01	BU04-F01	BU04-LT01	BU05A-LT01	BU06-LT01	BU07-01	BU08-F01	BU08-LT01	RUTS-LT01
SOILOPEN	0.2	–	4.2	–	1	–	–	7	20.4	2	5.6
SOILUNDER	0.2	–	5.6	0.4	20.2	–	2.5	2.4	4.6	1.25	3.4
LITTER	99.6	100	90.2	99.6	78.8	100	97.5	90.6	75	96.75	91
WOOD	–	–	–	–	–	–	–	–	–	–	–
ROCKLG	–	–	–	–	–	–	–	–	–	–	–
ROCKSM	–	–	–	–	–	–	–	–	–	–	–
LICHEN	–	–	–	–	–	–	–	–	–	–	–
MOSS	–	–	–	–	–	–	–	–	–	–	–
CRUST	–	–	–	–	–	–	–	–	–	–	–

Table 4.4-3. The number and percentage of native and exotic species of each life form found on Fort Larned NHS during the 2010-2012 grassland monitoring sampling.

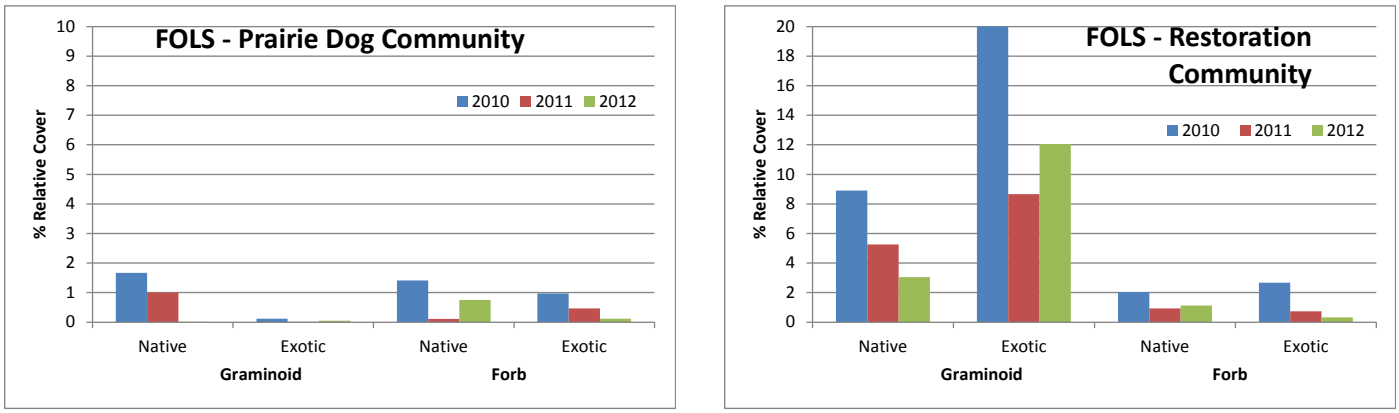
Lifeform	Native	Exotic	Total	% Native
Forb	34	7	41	82.93
Graminoid	12	4	16	75.00
Shrub	1	0	1	100.00
Vine	1	0	1	100.00
Tree	1	0	1	100.00
Tree	23	1	24	95.83

Biotic Integrity

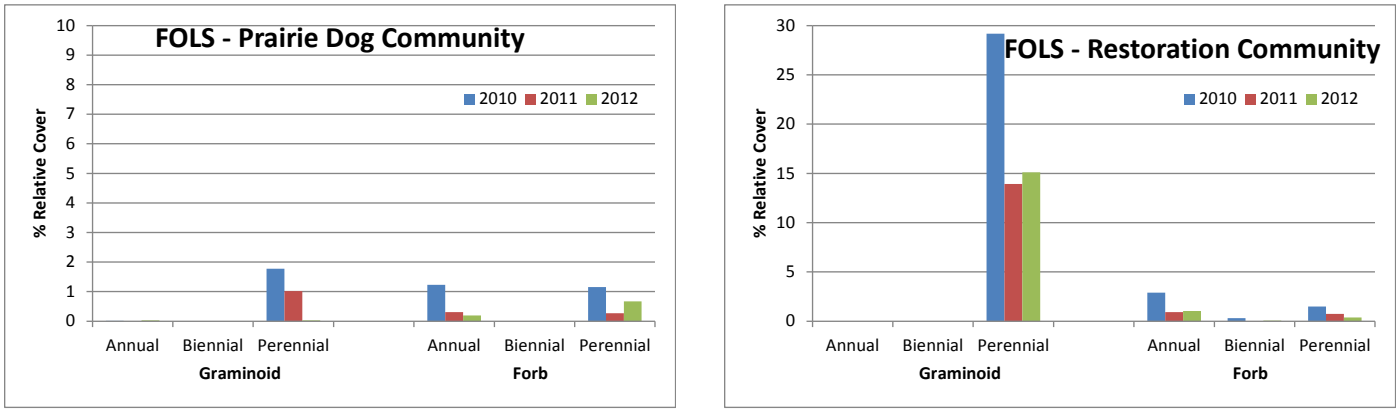
One of the major threats to grasslands and other plant communities is invasive species. Invasive species have been directly linked to the replacement of dominant native species (Tilman 1999), the loss of rare species (King 1985), changes in ecosystem structure, alteration of nutrient cycles and soil chemistry (Ehrenfeld 2003), shifts in community productivity (Vitousek 1990), and changes in water availability (D'Antonio and Mahall 1991). The proportion of annual, biennial and perennial species provides an indication of the stability of the site, and it is generally expected that the proportion of annual species at a given site would be higher immediately following a disturbance, but would shift toward an increased proportion of perennials as time passes since a disturbance.

All plant communities are stressed because of the drought, showing a decline in cover for native perennial grasses (Graphs 4.4-1 and -2). This response is to be expected. The Restoration Community encompasses all grasslands surrounding FOLS. These grasslands continue to be dominated by the perennial exotic grass smooth brome (*Bromus inermis*). Relative cover for forbs is especially sparse, although natives do appear to be out-competing the exotics. The grasses in the Prairie Dog Community have basically disappeared recently, which potentially opens up the soil to increased erosion (Graph 4.4-3). Native forb cover is greater than that of exotics- data shows that relative cover for exotics has dropped considerably in 2012 – although most forbs present are early successional. The continued disturbance of this active prairie dog town will keep this community in an early-successional state.

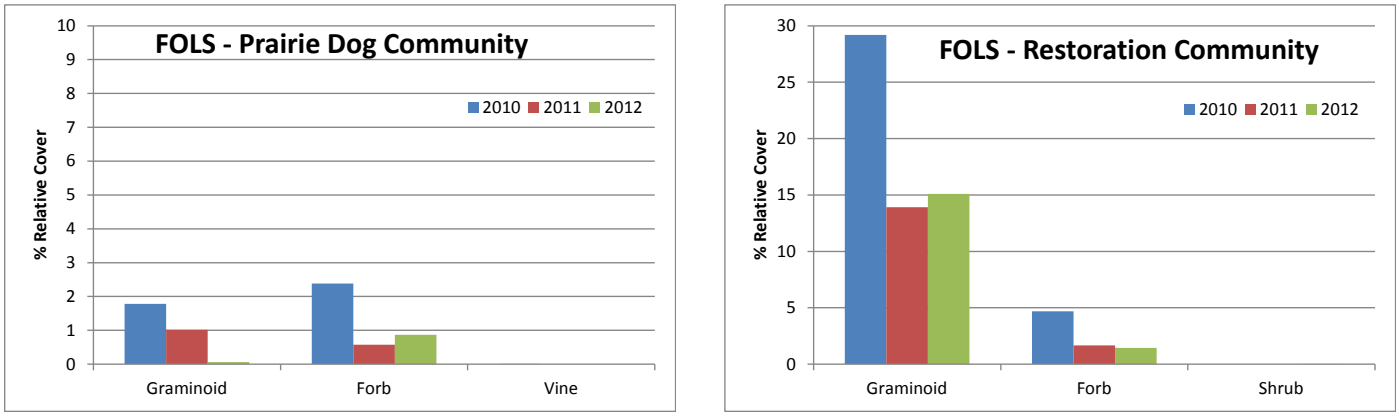
As stated previously, this data should serve as baseline data for determining future trend – not as trends themselves.



Graph 4.4-1. Percent of relative cover of native vs. exotic graminoids and forbs over a 3-year sample period at Fort Larned NHS by plant community. Note change of scale on Restoration Community chart.



Graph 4.4-2. Percent of relative cover of annual, biennial, and perennial grasses and forbs for each plant community over a 3-year sample period at Fort Larned NHS by plant community. Note change of scale on Restoration Community chart.



Graph 4.4-3. Percentage of relative cover for life forms in plant communities sampled in 2010-2012 at Fort Larned NHS. Note change of scale on Restoration Community chart.

4.4.3. Prescribed fire treatments or wildfire occurrence

FOLS is under the Midwest Region Fire Management Office and is not served by the Southern Plains Fire Group. Prescribed burns are carried out in cooperation with Quivera National Wildlife Refuge crew. Prescribed fire has been used at FOLS since 1968, with intermittent breaks. In 2009, the park lands north of the Pawnee River were burned under prescription, while the area to the south of the Pawnee River was burned in 2010. Due to the persistent drought, the burn planned for winter 2011-2012 did not proceed. Only a few wildland fires have occurred at the NHS since NPS took possession of the land, none of an extensive nature. At this time we have no map of the fire history but hope to generate one from park records in the year ahead.

4.4.4. Fire effects

Fire effects monitoring is an integral part of the Grassland Monitoring Protocol (Folts-Zettner et al. in review) and current results from monitoring within the scope of this project are reported in the transect data table (Appendix D). As monitoring progresses, any noted effects of burning will be presented in this section.

4.4.5. Known treatments for exotics

The treatment of exotic plant species on grasslands in the southern plains may have a short-term effect on long-term monitoring transects. In order to inform monitoring results, communications are being developed with the park to map annual treatment areas. There is no Exotic Plant Management Team assigned to FOLS, therefore all exotic treatment is conducted by the park. Pertinent information will be presented in this section when treatments are known.

Current knowledge of treatments includes: eradication of poison hemlock in 2009 within the oxbow area, spraying in 2010 for field bindweed in the southern section of the park, and prescribed burns to control exotics. No data was presented for 2012.

NPS PHOTO

A total of seven fire-event transects and eight long-term monitoring transects were established at Fort Larned NHS.

4.5. Fort Union National Monument

4.5.1. 2012 sampling

A total of six long-term transects were established at Fort Union National Monument (FOUN; Figure 4.5-1). No fire event transects will be established due to the exclusion of fire as a management tool at the park for safety reasons. The plant communities monitored at FOUN comprise shortgrass steppe: fringed sage/blue grama dwarf-shrub herbaceous vegetation; blue grama-purple threeawn herbaceous vegetation; western wheatgrass-blue grama herbaceous vegetation; blue grama herbaceous vegetation; fringed sage/ sleepygrass dwarf-shrub herbaceous vegetation; and fringed sage/hairy grama dwarf-shrub herbaceous vegetation (Muldavin et al. 2009) (Table 4.5-1). In early August of 2012, all transects were monitored and are included in this analysis.

4.5.2. Results and discussion

These early-monitoring results provide a baseline to measure future trends and should not be viewed as trends themselves. We are beginning to examine certain components of biotic integrity as applied to vegetation communities. Part of our consideration, the indicators chosen are robust to the sometimes significiant year to year variation in seasonal or annual rainfall or disturbance such as herbivory. These indicators can vary significantly from year to year in response to these environmental factors yet remain within the range of natural variability. The monitoring conducted over the past three years will serve as a baseline to determine trends in the coming years.

Appendix E presents the detailed monitoring results for each transect monitored within the study area. This data shows the annual variation of species within a given area, as well as a 3-year comparison of frequency and species cover for each transect. The transects have been grouped according to similarity of gross plant communities. Exotic species are highlighted in pink.

Table 4.5-2 presents the cumulative cover value of the ground strata for each transect monitored in 2012. When recorded correctly, the values for each transect will add up to 100%. SOILOPEN is the measure of bare soil exposed to the sky and the potential for wind and/or water erosion. SOILUNDER is the measure of bare soil beneath plant cover, which provides some protection from potential erosion. LITTER is another important measure, as some litter is to be desired while excessive litter may negatively impact grassland health. CRUST refers to biotic soil crust, an important and delicate component in semi- and arid grasslands.

<u>Biotic Integrity</u>

One of the major threats to grasslands and other plant communities is invasive species. Invasive species have been directly linked to the replacement of dominant native species (Tilman 1999), the loss of rare species (King 1985), changes in ecosystem structure, alteration of nutrient cycles and soil chemistry (Ehrenfeld 2003), shifts in community productivity (Vitousek 1990), and changes in water availability (D'Antonio and Mahall 1991). The proportion of annual, biennial and perennial species provides an indication of the stability of the site, and it is generally expected that the proportion of

Table 4.5-1. Plant community and sampling dates for each transect at Fort Union NHS, 2010-2012.

			Date visited		
Group	Transect	Plant community	2010	2011	2012
Steppe	SHORT-LT01	Short Grass Steppe	8/19	7/24	8/6
	SHORT-LT02	Short Grass Steppe	8/19	7/25	8/6
	SHORT-LT03	Short Grass Steppe	8/20	7/24	8/7
	SHORT-LT04	Short Grass Steppe	8/20	7/24	8/6
	SHORT-LT05	Short Grass Steppe	8/19	7/25	8/6
	SHORT-LT06	Short Grass Steppe	8/20	7/24	8/7

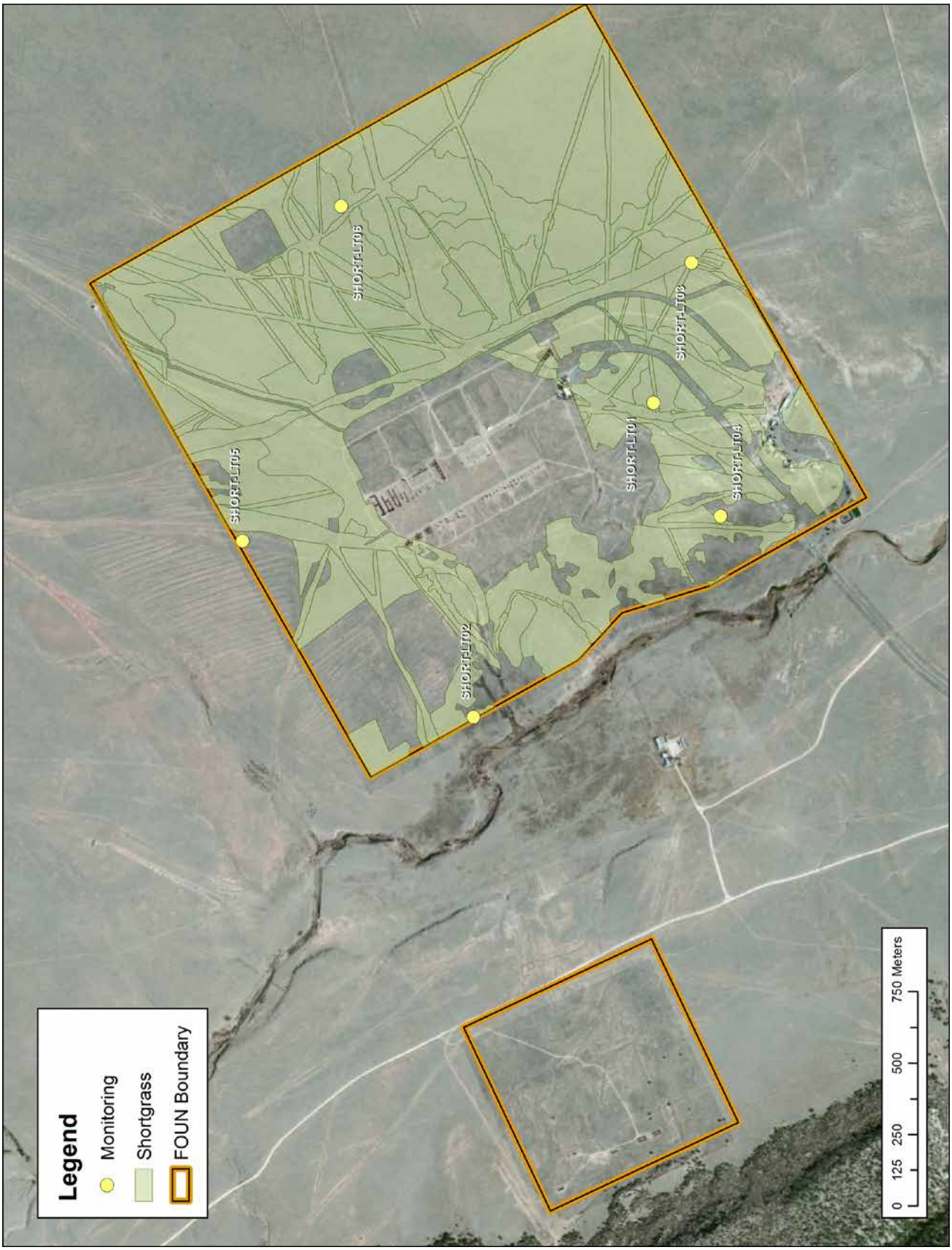


Figure 4.5-1. Monitoring transects at Fort Union NM.

Table 4.5-2. Percentage of substrate cover for each long-term monitoring transect sampled, Fort Union NM, 2012

Cover	Transect					
	SHORT-LT01	SHORT-LT02	SHORT-LT03	SHORT-LT04	SHORT-LT05	SHORT-LT06
SOILOPEN	27	35.4	29.4	12.8	27.6	21.4
SOILUNDER	7	24.6	9	56	11.4	9
LITTER	65.6	39.2	58.4	30.6	56.6	66.4
WOOD	–	–	–	–	–	–
ROCKLG	–	–	0.2	–	–	–
ROCKSM	0.2	0.8	–	0.6	2.6	3.2
LICHEN	–	–	–	–	–	–
MOSS	–	–	–	–	–	–
CRUST	0.2	–	3	–	1.8	–

Table 4.5-3. The number and percentage of native and exotic species of each life form found on Fort Union NM during the 2010-2012 grassland monitoring sampling.

Lifeform	Native	Exotic	Total	% Native
Forb	40	5	45	88.89
Graminoid	16	0	16	100.00
SubShrub	3	0	3	100.00

annual species at a given site would be higher immediately following a disturbance, but would shift toward an increased proportion of perennials as time passes since a disturbance.

All plant communities are stressed because of the drought, showing a decline in cover for native perennial grasses, while exotic annuals are increasing (Graphs 4.5-1 ,-2 and -3). This response is to be expected. The grasses at FOUN are all native perennials, but the increase in exotic forbs is threatening the expected ratio of grasses to forbs. This could change if adequate moisture returns. Kochia (*Kochia scoparia*) accounts for most of the exotic annual increase, but the perennial exotic field bindweed (*Convolvulus arvensis*) exploded in one transect in 2012. Control efforts should be considered in and around this transect (SHORT-LT04) to prevent further degradation of this site. Native forbs that have increased cover since 2011 are primarily early successional species such as goosefoot (*Chenopodium species*) and ragweeds (*Ambrosia species*), although cover of some perennial native forbs appear to be slowly increasing from 2011 levels.

As stated previously, this data should serve as baseline data for determining future trend – not as trends themselves.

4.5.3. Prescribed fire treatments or wildfire occurrence

The Bandelier Fire Group is responsible for prescribed fire treatments at FOUN. Prescribed burning is not considered an option in the park and no wildfires have occurred in recent history. Fuel reduction is carried out only around the cultural areas in the form of mowing.

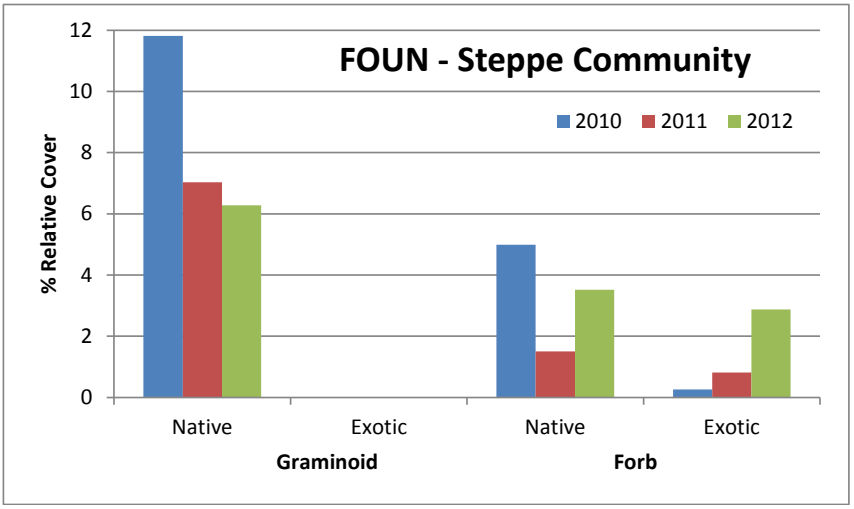
4.5.4. Fire effects

Fire effects monitoring is an integral part of the Grassland Monitoring Protocol (Folts-Zettner et al. in review). As monitoring progresses, any noted effects of burning or treatment will be presented in this section.

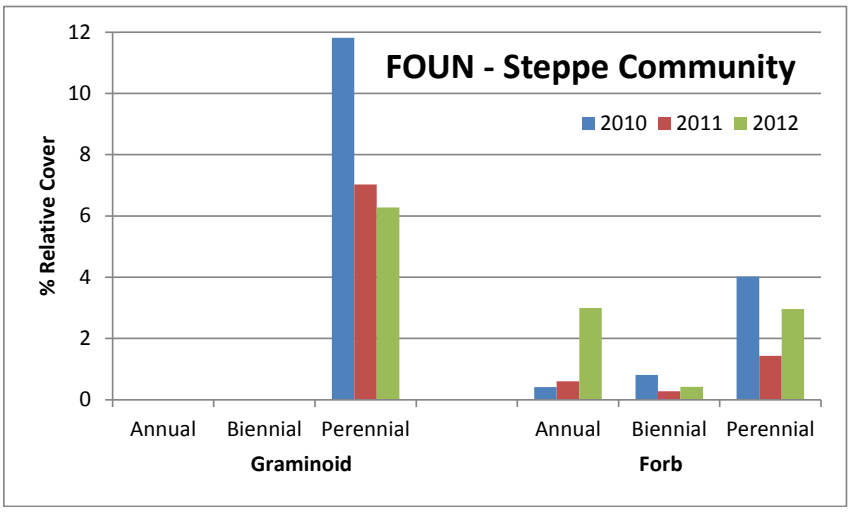
4.5.5. Known treatments for exotics

The treatment of exotic plant species on grasslands in the southern plains may have a short-term effect on long-term monitoring transects. In order to inform monitoring results, communications have been developed

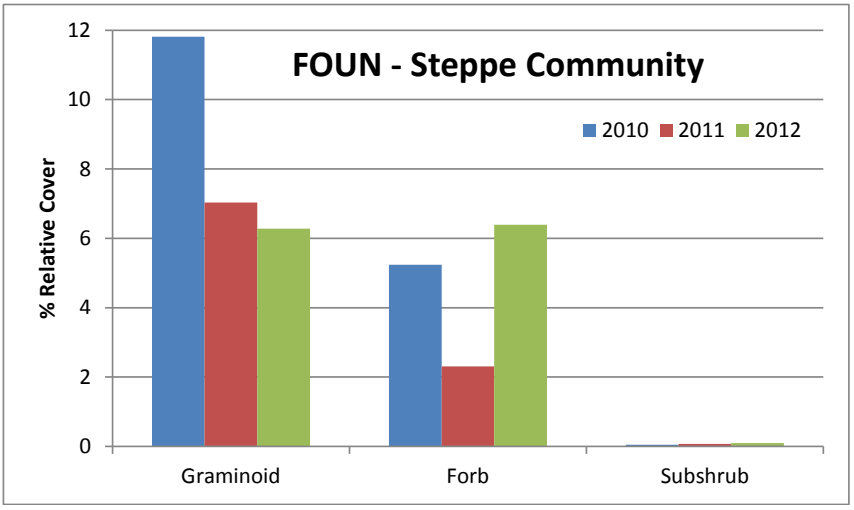
with the Southern Plains/ Chihuahuan Desert Exotic Plant Management Team and the park to map annual treatment areas. Pertinent information will be presented in this section when treatments are known. During 2012, field bindweed control was implemented south of the main Entrance Road, which includes the Residential and Maintenance areas (Figure 4.5-2).



Graph 4.5-1. Percent of relative cover of native vs. exotic graminoids and forbs over a 3-year sample period at Fort Union NM by plant community.



Graph 4.5-2. Percent of relative cover of annual, biennial, and perennial grasses and forbs for each plant community over a 3-year sample period at Fort Union NM by plant community.



Graph 4.5-3. Percentage of relative cover for life forms in plant communities sampled in 2010-2012 at Fort Union NM.

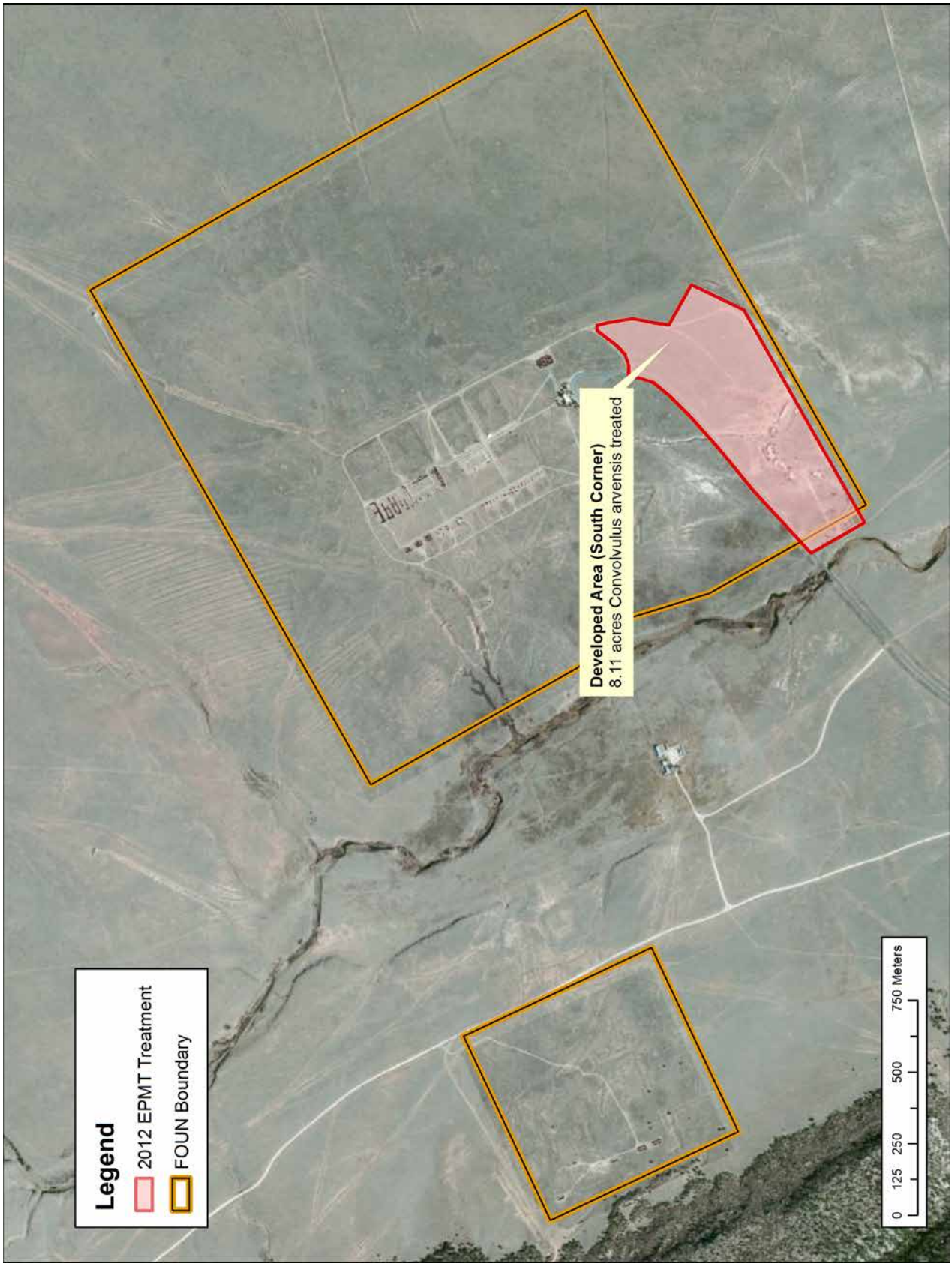


Figure 4.5-2. Exotic plant management team treatment areas at Fort Union NM.

4.6. Lake Meredith National Recreation Area/Alibates Flint Quarries National Monument

4.6.1. 2012 Sampling

A total of 26 fire-event transects and 26 long-term monitoring transects were established at Lake Meredith National Recreation Area (LAMR)/Alibates Flint Quarries National Monument (ALFL) (Figure 4.6-1). The number of long-term plots has been reduced to nineteen to better equalize the field season schedule. The plant communities monitored at Lake Meredith NRA/Alibates Flint Quarries NM are: upland grasslands consisting of blue grama-buffalograss herbaceous vegetation, sand sagebrush/(sideoats grama, hairy grama) shrubland, and upland sloped/rolling hills vegetation complex; perennial bottomland consisting of perennial bottomland grassland complex and perennial bottomland/upper terrace, valley floor grassland complex; honey mesquite shrubland which is being type-converted to grassland; and cottonwood galleries which are of special concern to the park (Fenton et al. 2007) (Table 4.6-1). In 2012, twenty-nine transects were monitored throughout the field season. Twenty-five of these transects are included in our study area and were used in this analysis.

4.6.2. Results and discussion

These early-monitoring results provide a baseline to measure future trends and should not be viewed as trends themselves. We are beginning to examine certain components of biotic integrity as applied to vegetation communities. Part of our consideration, the indicators chosen are robust to the sometimes significiant year to year variation in seasonal or annual rainfall or disturbance such as herbivory. These indicators can vary significantly from year to year in response to these environmental factors yet remain within the range of natural variability. The monitoring conducted over the past three years will serve as a baseline to determine trends in the coming years.

Appendix F presents the detailed monitoring results for each transect monitored within the study area. This data shows the annual variation of species within a given area, as well as a 3-year comparison of frequency and species cover for each transect. The transects have been grouped according to similarity of gross plant communities. Exotic species are highlighted in pink.

Table 4.6-2 presents the cumulative cover value of the ground strata for each transect monitored in 2012. When recorded correctly, the values for each transect will add up to 100%. SOILOPEN is the measure of bare soil exposed to the sky and the potential for wind and/or water erosion. SOILUNDER is the measure of bare soil beneath plant cover, which provides some protection from potential erosion. LITTER is another important measure, as some litter is to be desired while excessive litter may negatively impact grassland health. CRUST refers to biotic soil crust, an important and delicate component in semi- and arid grasslands.

<u>Biotic Integrity</u>

One of the major threats to grasslands and other plant communities is invasive species. Invasive species have been directly linked to the replacement of dominant native species (Tilman 1999), the loss of rare species (King 1985), changes in ecosystem structure, alteration of nutrient cycles and soil chemistry (Ehrenfeld 2003), shifts in community productivity (Vitousek 1990), and changes in water availability (D'Antonio and Mahall 1991). The proportion of annual, biennial and perennial species provides an indication of the stability of the site, and it is generally expected that the proportion of annual species at a given site would be higher immediately following a disturbance, but would shift toward an increased proportion of perennials as time passes since a disturbance.

All plant communities have suffered because of the persistent drought, generally showing a decline in cover for all native perennial grasses and forbs, while exotic annuals increased (Graphs 4.6-1, -2 and -3). This response is to be expected. Bottomland and Cottonwood Communities continued to decrease cover in 2012, while the Upland Community has increased cover from 2011 and the Honey Mesquite Community has a mixed response. These differences can be attributed to

more than the drought. During the summer of 2011, we prsume that the Bottomland and Cottonwood Communities were still exhibiting effects from the aerial spraying for saltcedar (*Tamarix species*). This resulted in large quantities of dormant or dead grass that at times was difficult to identify – therefore cover was often inconsistently recorded. Cover in these communities was correctly recorded in 2012 and can be considered a more accurate measure. This same recording inconsistency also affected the Honey Mesquite and Upland Communities and was corrected in 2012.

The Bottomland Community is comprised primarily by native perennial grasses. A few annual exotic grasses have appeared but should be outcompeted once bunchgrasses recover with adequate moisture. The increase in annual exotic forbs can be attributed to an increase in kochia (*Kochia scoparia*) and, to a lesser extent, prickly Russian thistle (*Salsola*

Table 4.6-1. Plant community and sampling dates for each transect at Lake Meredith NRA/Alibates Flint Quarries NM, 2010-2012.

			Date visited		
Group	Transect	Plant community	2010	2011	2012
Bottomland	BLAND-LT01	Perennial Bottomland	9/27	8/4	9/19
	BLAND-LT02	Perennial Bottomland	9/21	8/4	9/13
	BLAND-LT03	Perennial Bottomland	9/11	8/3	9/17
	BLAND-LT04	Perennial Bottomland	9/26	NS	NS
Cottonwood	CWOOD-LT01	Cottonwood	9/18	8/3	5/25
	CWOOD-LT02	Cottonwood	9/21	8/4	9/13
	CWOOD-LT03	Cottonwood	8/29	NS	NS
	CWOOD-LT04	Cottonwood	9/27	8/4	9/13
Honey-Mesquite	HONEY-F01	Honey Mesquite Shrubland	5/26	NS	5/13
	HONEY-F06	Honey Mesquite Shrubland	6/28	6/6	5/11
	HONEY-F08	Honey Mesquite Shrubland	NS	NS	9/18
	HONEY-F09	Honey Mesquite Shrubland	NS	6/15	9/8
	HONEY-F10	Honey Mesquite Shrubland	NS	NS	9/18
	HONEY-01	Honey Mesquite Shrubland	9/25	8/3	6/26
	HONEY-LT01	Honey Mesquite Shrubland	8/28	NS	NS
	HONEY-LT02	Honey Mesquite Shrubland	8/28	8/5	9/11
	HONEY-LT04	Honey Mesquite Shrubland	6/29	NS	NS
	HONEY-LT05	Honey Mesquite Shrubland	9/14	NS	NS
	HONEY-LT06	Honey Mesquite Shrubland	9/19	8/5	6/25
	HONEY-LT07	Honey Mesquite Shrubland	7/27	8/2	7/25
	HONEY-LT08	Honey Mesquite Shrubland	9/19	NS	NS
	HONEY-LT09	Honey Mesquite Shrubland	6/29	8/1	5/13
	HONEY-LT10	Honey Mesquite Shrubland	6/28	8/1	5/12
Upland	ULAND-02	Upland Grass	9/14	8/2	9/11
	ULAND-03	Upland Grass	8/9	6/7	9/11
	ULAND-LT01	Upland Grass	9/20	NS	NS
	ULAND-LT02	Upland Grass	7/27	8/2	9/16
	ULAND-LT03	Upland Grass	8/29	8/5	9/17
	ULAND-LT05	Upland Grass	7/28	8/1	9/11
	ULAND-LT06	Upland Grass	8/29	8/1	9/10
	ULAND-LT07	Upland Grass	NS	8/2	9/10
	FPRGL1G0225	Upland Grass	NS	NS	9/18
	ULAND-F03	Upland Grass	NS	NS	9/24

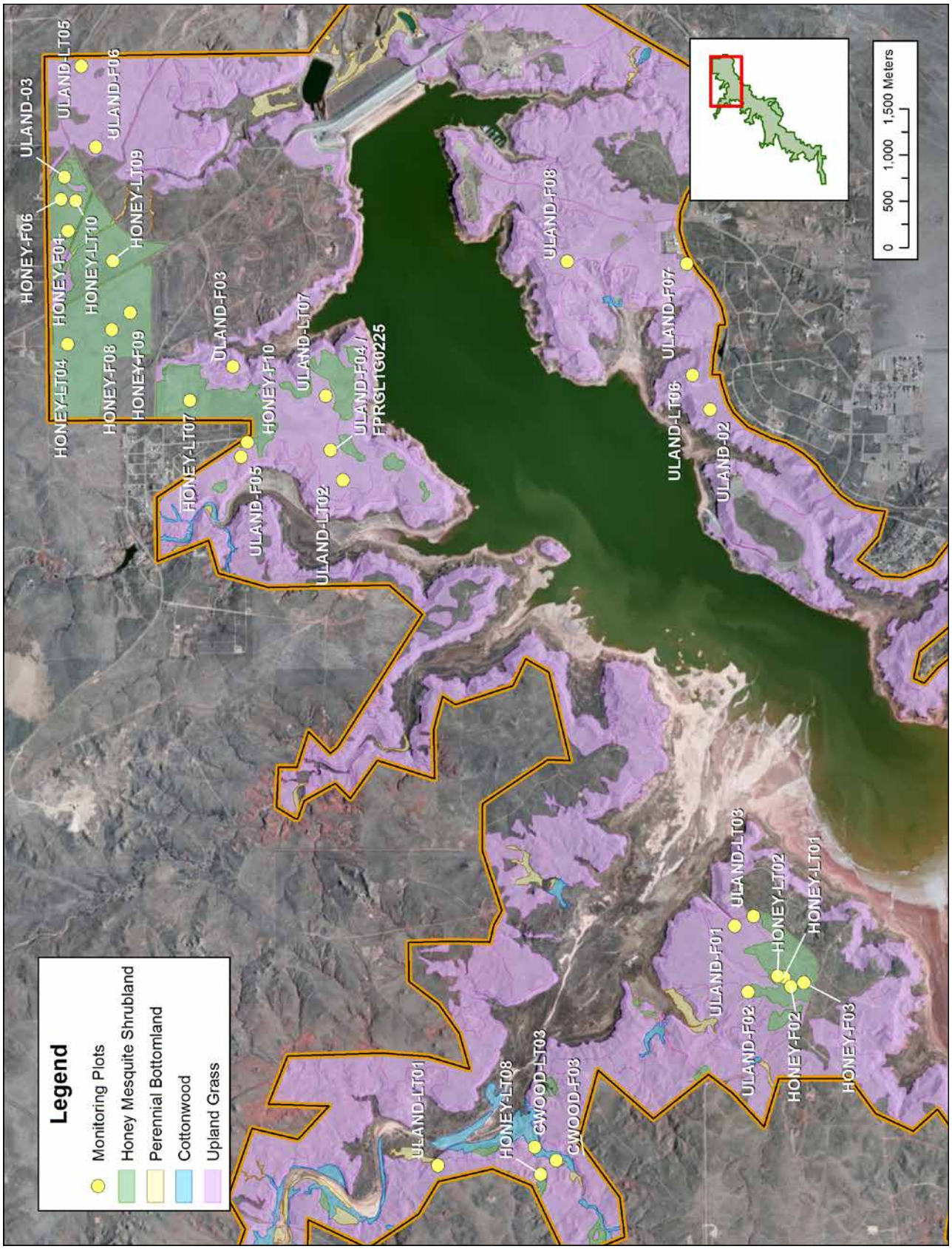


Figure 4.6-1. Upper region monitoring plots at Lake Meredith NRA and Alibates Flint Quarries NM.

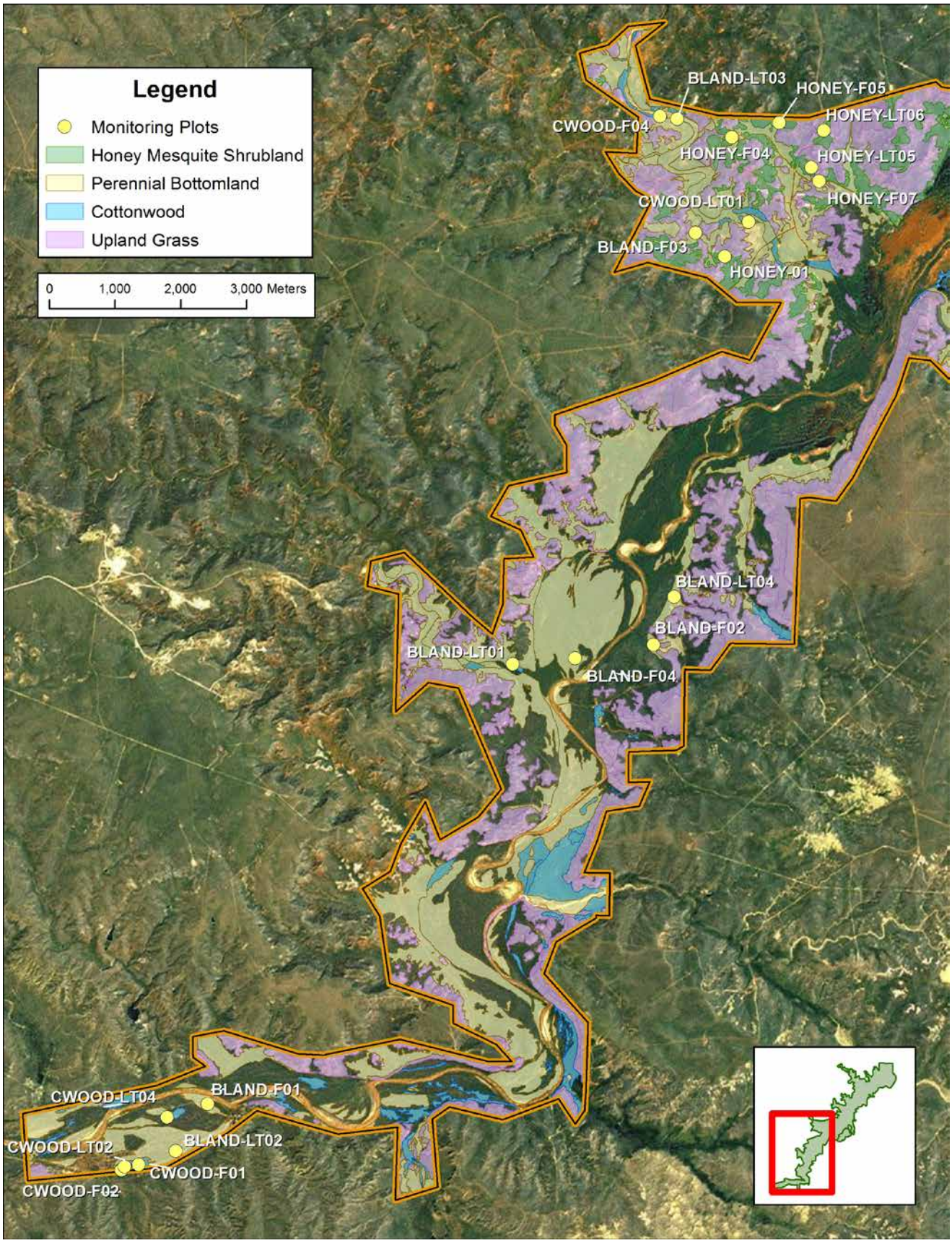


Figure 4.6-2. Lower region monitoring plots at Lake Meredith NRA and Alibates Flint Quarries NM.

Table 4.6-2. Percentage of substrate cover for each long-term monitoring transect sampled, Lake Meredith NRA, 2012

Cover	Transect							
	BLAND-LT01	BLAND-LT03	BLAND-LT04	CWOOD-LT01	CWOOD-LT02	CWOOD-LT04	FPRGL 1G0225	HONEY-01
SOILOPEN	8	48	56.4	7.25	1.8	13.8	18	31.2
SOILUNDER	4.8	8	5.6	9	1.2	10	4.2	11.4
LITTER	84	43.8	37.2	83	91.2	75.2	75.6	57
WOOD	3.2	0.2	–	0.75	3.8	–	0.6	–
ROCKLG	–	–	–	–	–	–	–	–
ROCKSM	–	–	–	–	–	–	–	–
LICHEN	–	–	–	–	–	–	–	–
MOSS	–	–	–	–	–	–	–	–
CRUST	–	–	0.8	–	–	1.2	1.6	0.2

Cover	Transect							
	HONEY-F01	HONEY-F06	HONEY-F08	HONEY-F09	HONEY-LT02	HONEY-LT06	HONEY-LT07	HONEY-LT09
SOILOPEN	50.8	39.8	37.4	33.6	15.8	28.75	15.4	42.6
SOILUNDER	8.6	12	18.8	21.6	4.8	17	16.2	5.4
LITTER	38.4	47.8	40	26.8	75.8	32.25	66.6	37.4
WOOD	1	0.2	3.4	15.6	–	2.75	3.2	14.4
ROCKLG	–	–	–	–	–	3.75	–	–
ROCKSM	–	0.2	–	0.2	2	12	0.6	–
LICHEN	–	–	–	–	–	–	–	–
MOSS	–	–	–	–	–	–	–	–
CRUST	–	–	0.4	–	1.6	3.5	–	0.2

Cover	Transect							
	HONEY-LT10	ULAND-02	ULAND-03	ULAND-LT02	ULAND-LT03	ULAND-LT05	ULAND-LT06	ULAND-LT07
SOILOPEN	31.8	25.8	30.2	32	9	32.2	35.2	57
SOILUNDER	14.4	5.2	6.6	5	7.6	4.8	4.6	3.4
LITTER	47	57	59.6	59.6	82.8	59.4	43	40.6
WOOD	6.8	–	3	3	–	0.4	0.8	–
ROCKLG	–	–	–	–	–	–	4.6	–
ROCKSM	–	1.4	0.6	0.4	0.6	2	12	–
LICHEN	–	–	–	–	–	–	–	–
MOSS	–	–	–	–	–	0.2	–	–
CRUST	–	0.6	–	–	–	–	0.8	–

Table 4.6-3. The number and percentage of native and exotic species of each life form found on Lake Meredith NRA during the 2010-2012 grassland monitoring sampling.

Lifeform	Native	Exotic	Total	% Native
Forb	69	4	73	94.52
Graminoid	26	1	27	96.30
Subshrub	4	0	4	100.00
Shrub	5	0	5	100.00
Vine	1	0	1	100.00
Tree	6	0	6	100.00

tragus). The ratio of forbs to grasses is fairly good considering the drought impact.

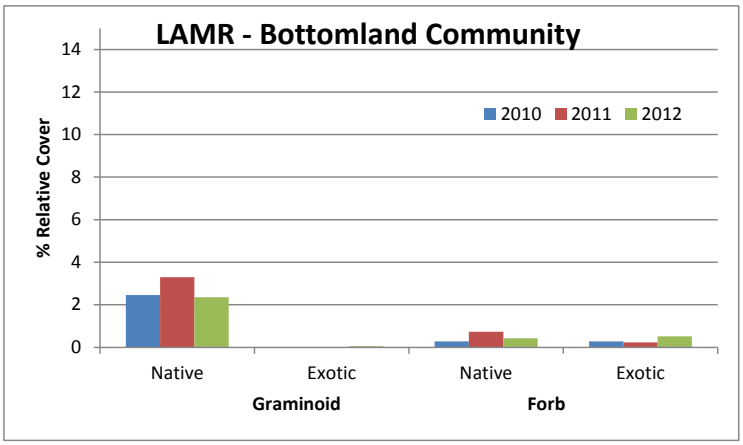
The Cottonwood Community appears to be fairly stable except for the decrease of the native perennial grasses and forbs from drought. Even the grass to forb ratio is good, if diminished. We are determined to get proper cover estimates for tree canopy beginning with the 2013 field season.

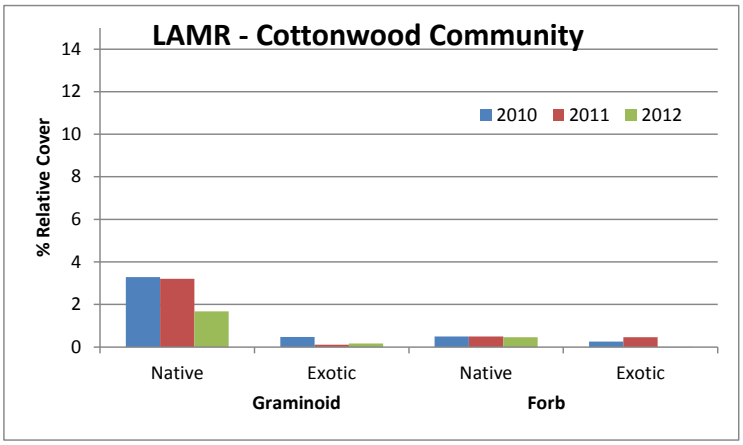
The Honey Mesquite Community receives the greatest anthropogenic disturbance from prescribed burns and cutting for mesquite (*Prosopis glandulosa*) control. This disturbance may account for the elevated cover of forbs in this community. Many forb increasers are early successional species. The grass to forb ratio is out of balance but will possibly improve with increased moisture.

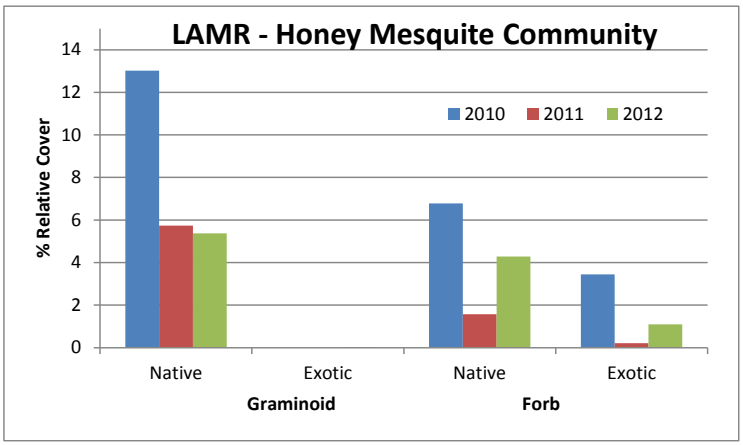
The Upland Community appears drought-stressed but fairly stable – native perennial grasses continue their dominance. Forb cover is elevated but these tend to be early successional species. Prickly Russian thistle continues to be widespread in this community and it's cover has increased during the drought.

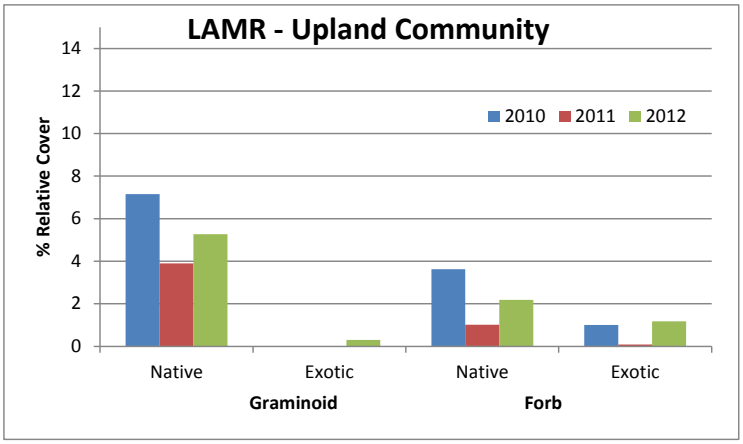
NPS

A total of 26 fire-event transects and 19 long-term monitoring transects were established at Lake Meredith NRA/Alibates Flint Quarries NM.

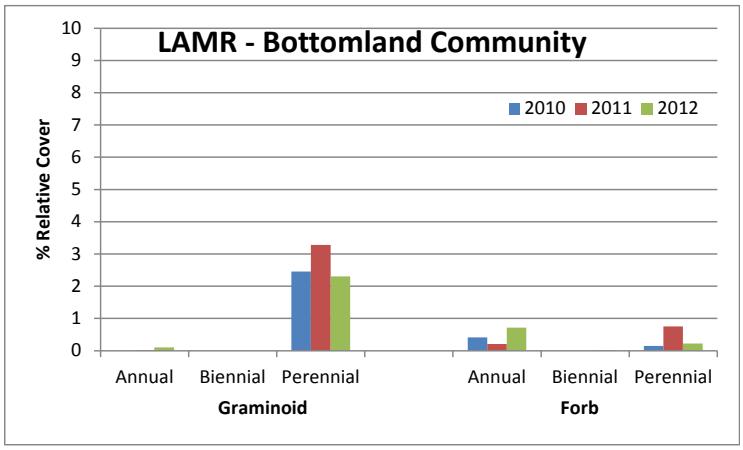


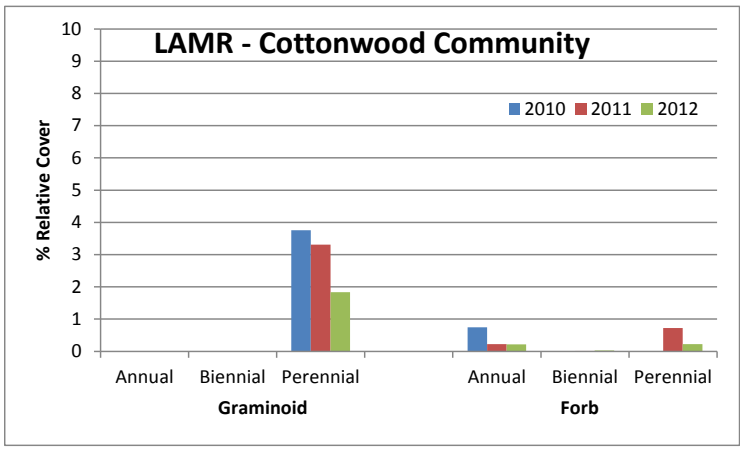


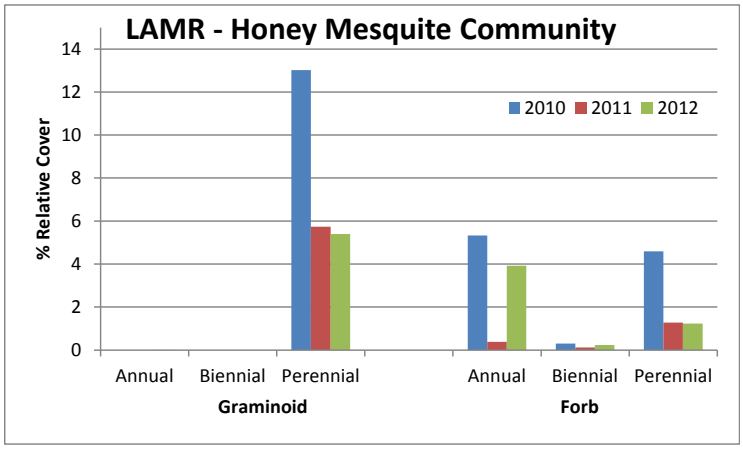


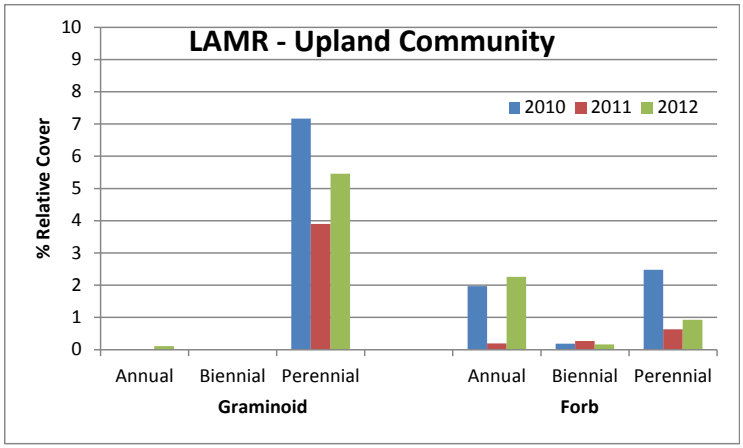


Graph 4.6-1. Percent of relative cover of native vs. exotic graminoids and forbs over a 3-year sample period at Lake Meredith NRA by plant community.

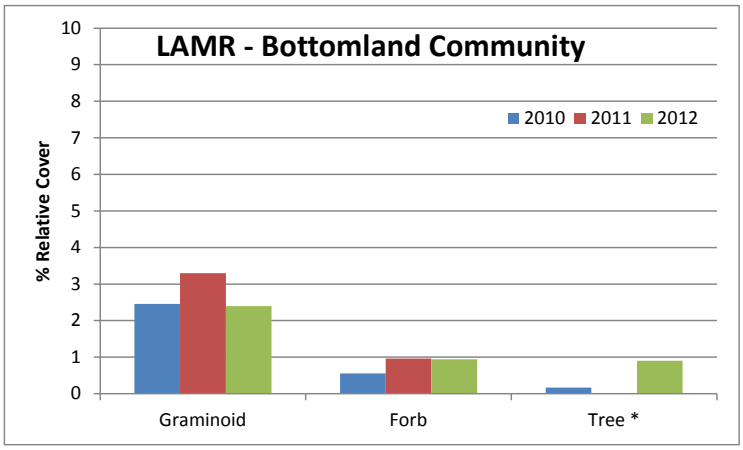


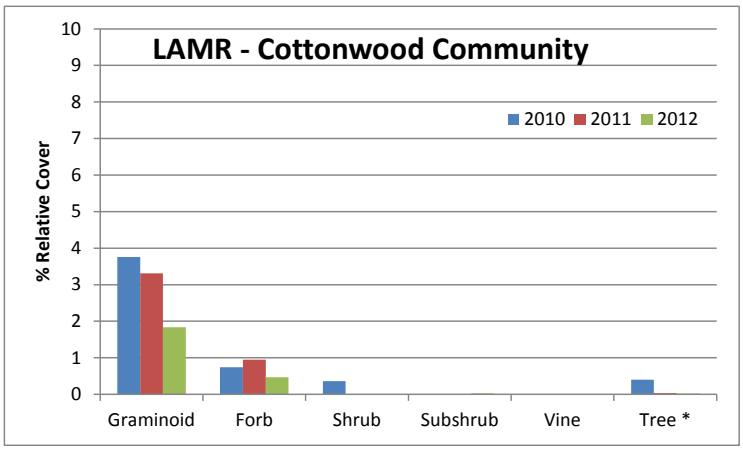


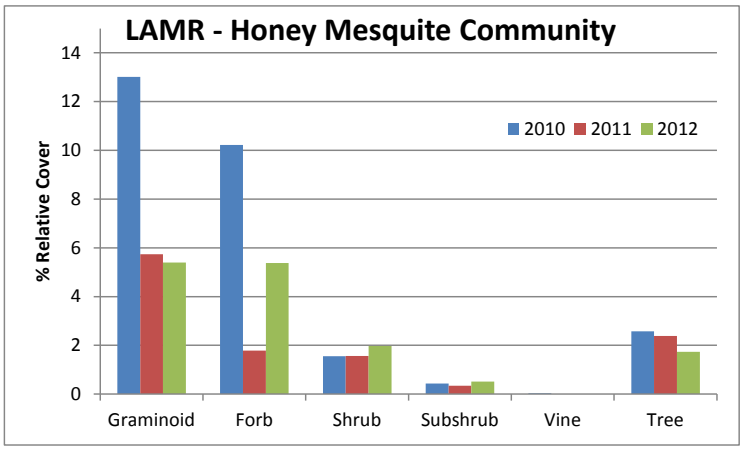


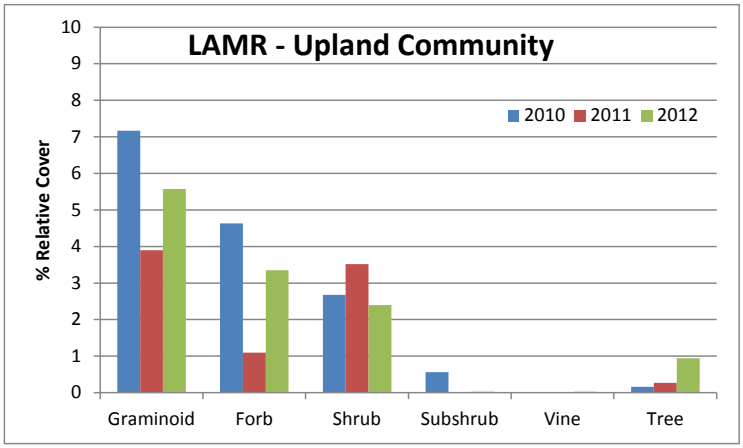


Graph 4.6-2. Percent of relative cover of annual, biennial, and perennial grasses and forbs for each plant community over a 3-year sample period at Lake Meredith NRA by plant community. Note change of scales in Honey Mesquite Community.









Graph 4.6-3. Percentage of relative cover for life forms in plant communities sampled in 2010-2012 at Lake Meredith NRA. Note change of scales in Honey Mesquite Community. * Tree canopy cover has not been consistently measured across sample years.

4.6.3. Prescribed fire treatments or wildfire occurrence

There has been an active prescribed burn program at LAMR since 1998. 2009 saw burning on either side of the dam (Figure 4.6-3) with a goal of reducing mesquite. Four parcels in the Mullinaw Crossing area and one parcel of the Rosita area were burned in 2010. This same year also had prescribed fire applied to over 1300 acres in the area between Mullinaw and Rosita (Figure 4.6-4). A wildfire (the chicken fire) occurred in January 2012 in the Rosita area (Figure 4.6-4). Earlier treatments have taken place but no information is available at this time.

4.6.4. Fire effects

Fire effects monitoring is an integral part of the Grassland Monitoring Protocol (Folts-Zettner et al. in review) and current results from monitoring within the scope of this project are reported in the transect data table (Appendix F). As monitoring progresses, any noted effects of burning will be presented in this section.

4.6.5. Known treatments for exotics

The treatment of exotic plant species on grasslands in the southern plains may have a short-term effect on long-term monitoring transects. In order to inform monitoring results, communications have been developed with the Southern Plains/Chihuahuan Desert Exotic Plant Management Team to map annual treatment areas. Pertinent information will be presented in this section when treatments are known. Saltcedar (Tamarisk) removal and spraying for kochia occurred in 2010 in the Cedar Canyon area. 2010-2011 also saw extensive aerial spraying for saltcedar control. No treatment has been reported for 2012.

4.6.6. Precipitation Data

Charts reflecting both historic and current precipitation data have been developed. The long term data is from the Borger NWS Cooperative Climate station (1949 to 2012) (Graph 4.6-4) and the data from 2009 to 2012 was from the Cedar RAWS (Graph 4.6-5).

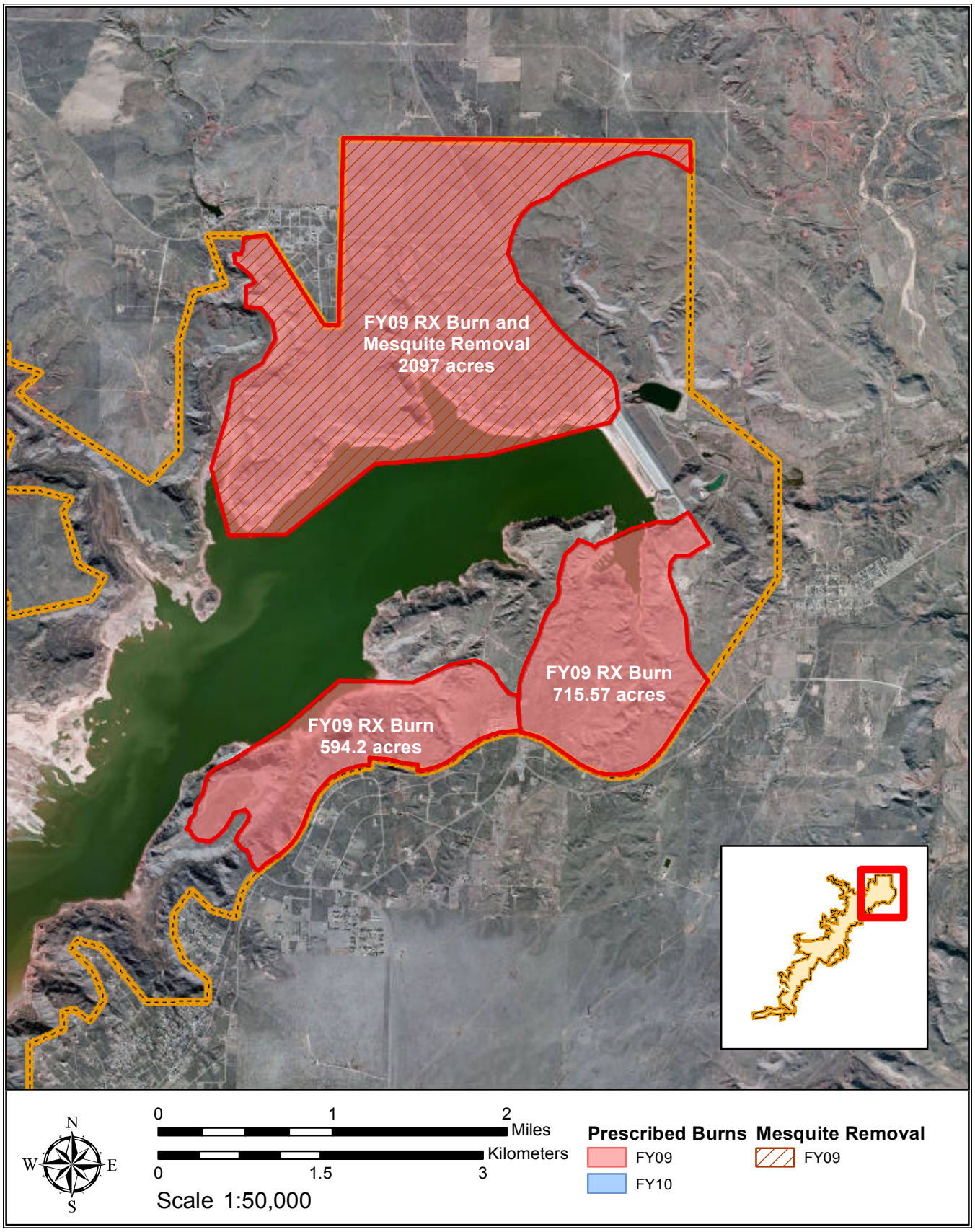


Figure 4.6-3. Prescribed treatment or wildland fires since 2009, Upper Lake Meredith NRA/Alibates Flint Quarries NM.

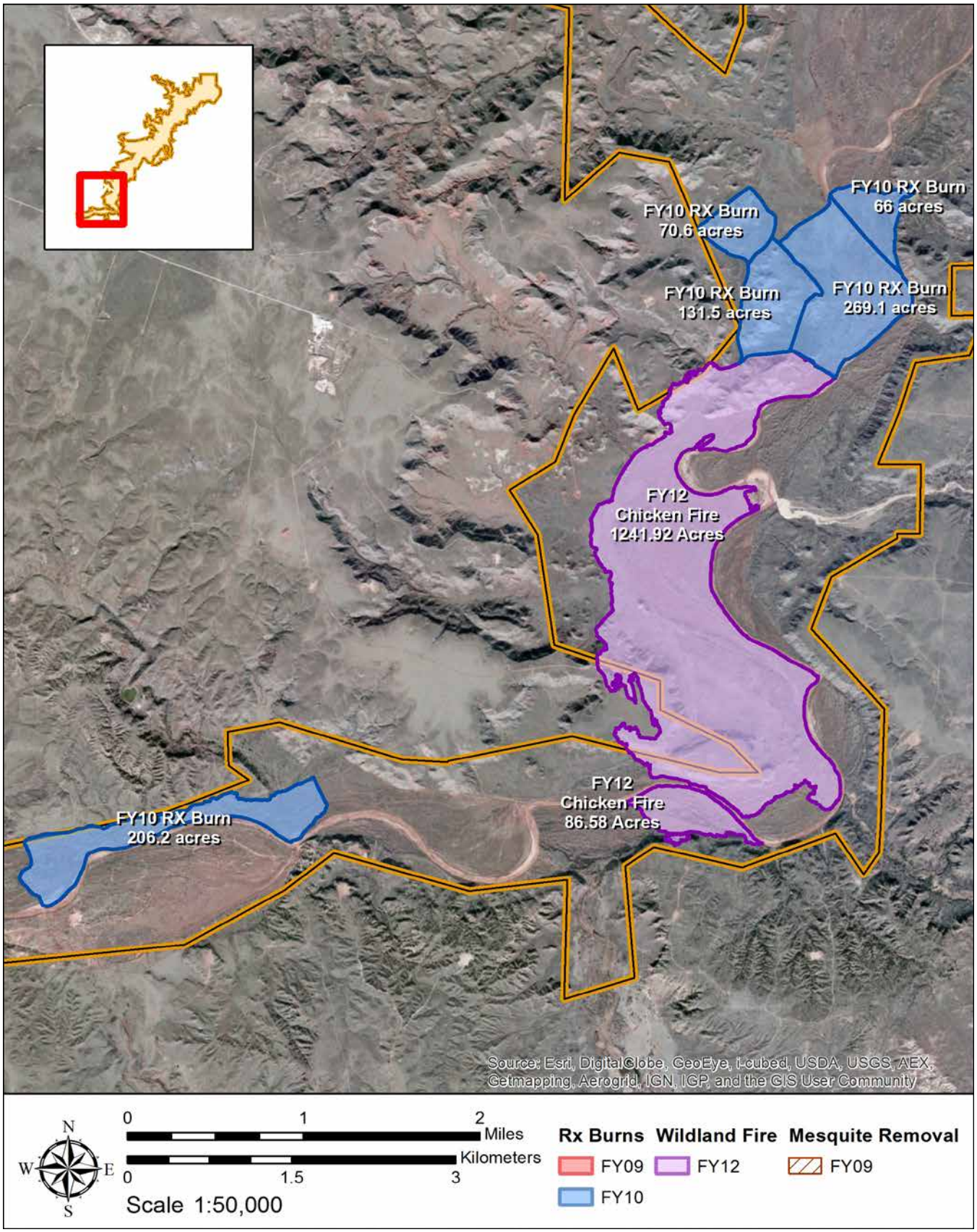
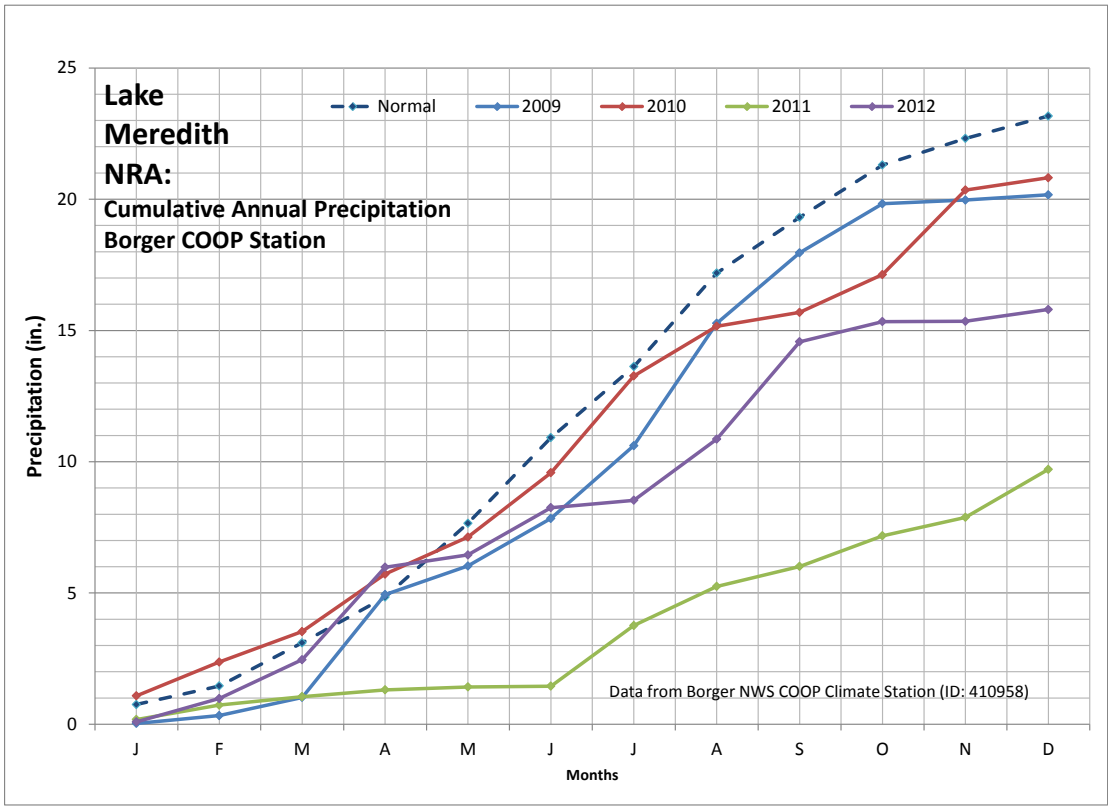
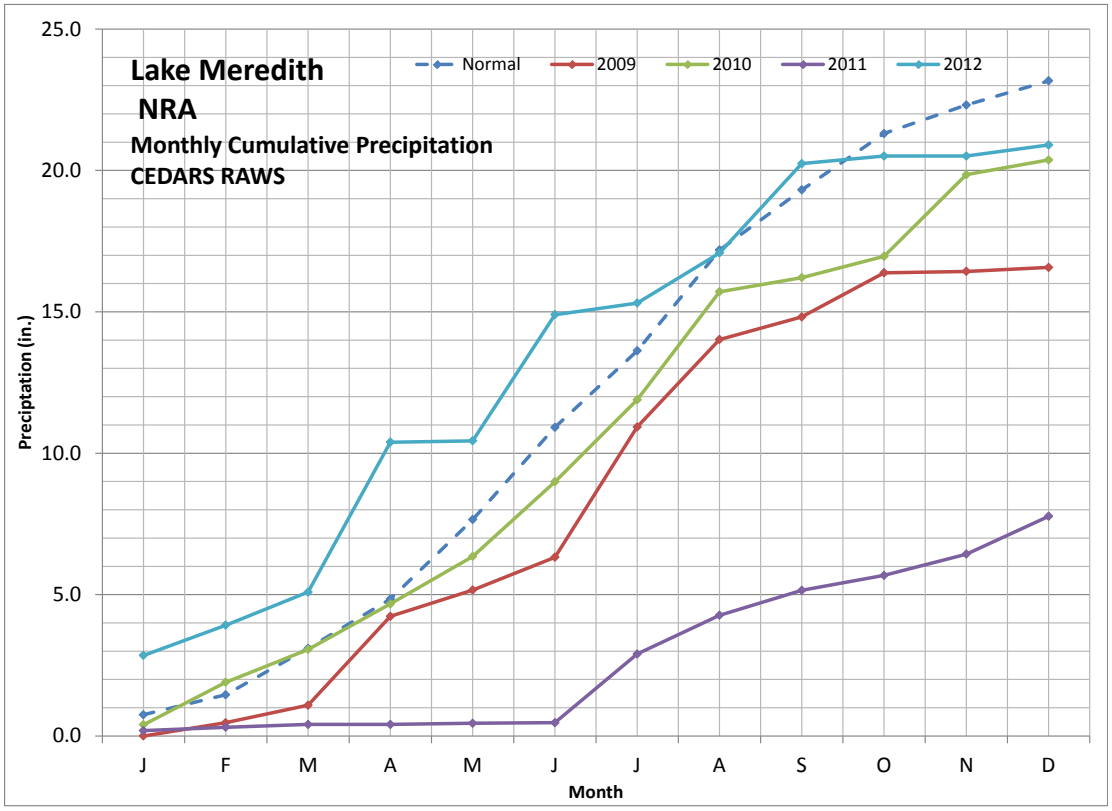


Figure 4.6-4. Prescribed treatment or wildland fires since 2009, Lower Lake Meredith NRA/Alibates Flint Quarries NM.



Graph 4.6-4. Annual precipitation from 1880 to 2012 at Lake Meredith NRA.



Graph 4.6-5. Cumulative monthly precipitation for 2009 to 2012 (including normal levels) at Lake Meredith NRA.

4.7. Lyndon B. Johnson National Historical Park

4.7.1. 2012 sampling

A total of two long-term monitoring transects were established at Lyndon B. Johnson National Historical Park (LYJO; Figure 4.7-1). No fire monitoring transects were established due to the exclusion of fire as a management tool at the park. The plant community monitored at Lyndon B. Johnson NHP is restored grassland (Cogan 2007a) (Table 4.7-1). Both transects were monitored in mid-June of 2012 and are included in this analysis.

4.7.2. Results and discussion

These early-monitoring results provide a baseline to measure future trends and should not be viewed as trends themselves. We are beginning to examine certain components of biotic integrity as applied to vegetation communities. Part of our consideration, the indicators chosen are robust to the sometimes significiant year to year variation in seasonal or annual rainfall or disturbance such as herbivory. These indicators can vary significantly from year to year in response to these environmental factors yet remain within the range of natural variability. The monitoring conducted over the past three years will serve as a baseline to determine trends in the coming years.

Appendix G presents the detailed monitoring results for each transect monitored within the study area. This data shows the annual variation of species within a given area, as well as a 3-year comparison of frequency and species cover for each transect. The transects have been grouped according to similarity of gross plant communities. Exotic species are highlighted in pink.

Table 4.7-2 presents the cumulative cover value of the ground strata for each transect monitored in 2012. When recorded correctly, the values for each transect will add up to 100%. SOILOPEN is the measure of bare soil exposed to the sky and the potential for wind and/or water erosion. SOILUNDER is the measure of bare soil beneath plant cover, which provides some protection from potential erosion. LITTER is another important measure, as some litter is to be desired while excessive litter may negatively impact grassland health. CRUST refers to biotic soil crust, an important and delicate component in semi- and arid grasslands.

Biotic Integrity

One of the major threats to grasslands and other plant communities is invasive species. Invasive species have been directly linked to the replacement of dominant native species (Tilman 1999), the loss of rare species (King 1985), changes in ecosystem structure, alteration of nutrient cycles and soil chemistry (Ehrenfeld 2003), shifts in community productivity (Vitousek 1990), and changes in water availability (D'Antonio and Mahall 1991). The proportion of annual, biennial and perennial species provides an indication of the stability of the site, and it is generally expected that the proportion of annual species at a given site would be higher immediately following a disturbance, but would shift toward an increased proportion of perennials as time passes since a disturbance.

The Restoration community has responded to the drought with increased cover overall, but this has been due primarily to increasing exotic grasses and early successional annual natives (Graphs 4.7-1, -2 and -3). Two-thirds of the relative cover of grasses is native perennials, but exotic grasses account for the other third, particularly the perennial K.R. bluestem (*Bothriochloa ischaemum*). This exotic grass is known to slowly crowd out desirable natives, eventually forming a monoculture, and is

Table 4.7-1. Plant community and sampling dates for each transect at Lyndon B. Johnson NHP, 2010-2012.

			Date visited		
Group	Transect	Plant community	2010	2011	2012
Restoration	REST-LT01	Old Field	9/15	6/16	6/14
	REST-LT02	Old Field	9/14	6/14	6/11

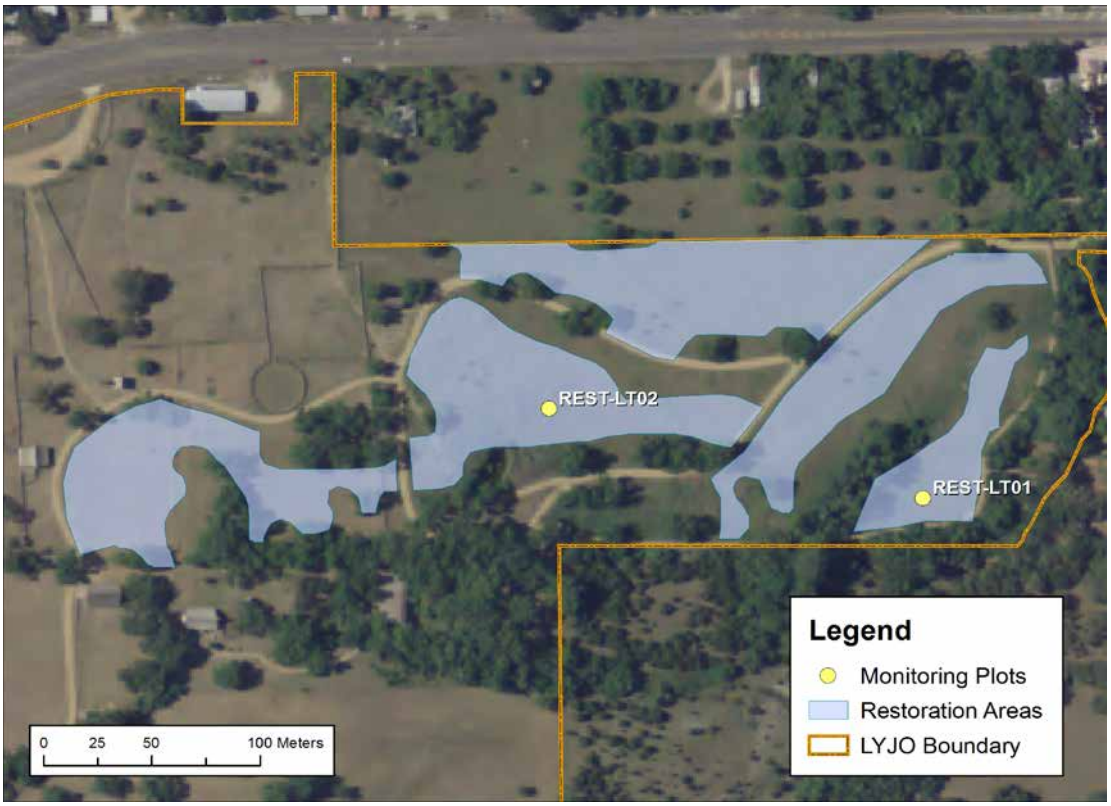


Figure 4.7-1. Monitoring transects at Lyndon B. Johnson NHP.

Table 4.7-2. Percentage of substrate cover for each transect sampled, Lyndon B. Johnson NHP, 2012

Cover	Transect	
	REST-LT01	REST-LT02
SOILOPEN	11.6	7
SOILUNDER	32.4	3
LITTER	55	90
WOOD	1	–
ROCKLG	–	–
ROCKSM	–	–
LICHEN	–	–
MOSS	–	–
CRUST	–	–

very problematic to control. Annual early-successional forbs dominate the community overall, but fortunately they are mainly natives. The grass to forb ratio is completely opposite of what a healthy prairie should be. Several years of diligent management will be required to turn this restoration community around.

Table 4.7-3. The number and percentage of native and exotic species of each life form found on Lyndon B. .Johnson NHP during the 2010-2012 grassland monitoring sampling.

Lifeform	Native	Exotic	Total	% Native
Forb	45	3	48	93.75
Graminoid	17	5	22	77.27
Subshrub	1	0	1	100.00
Vine	6	0	6	100.00
Tree	4	0	4	100.00

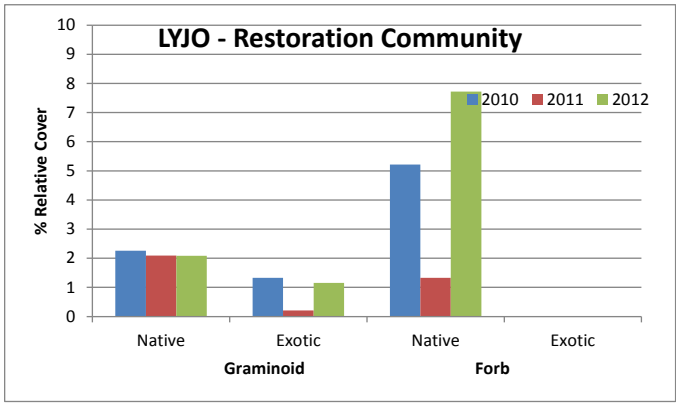
As stated previously, this data should serve as baseline data for determining future trend – not as trends themselves.

4.7.3. Prescribed fire treatments or wildfire occurrence

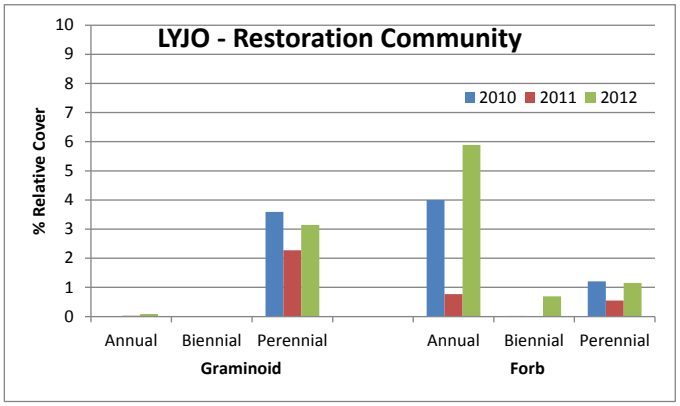
Prescribed burning is currently not an option at LYJO due to the urban location of the restoration prairie. No wildfires have occurred in recent history.

4.7.4. Fire effects

Fire effects monitoring is an integral part of the Grassland Monitoring Protocol (Folts-Zettner et al. in review). Should prescribed



Graph 4.7-1. Percent of relative cover of native vs. exotic graminoids and forbs over a 3-year sample period at Lyndon B. Johnson NHP by plant community.

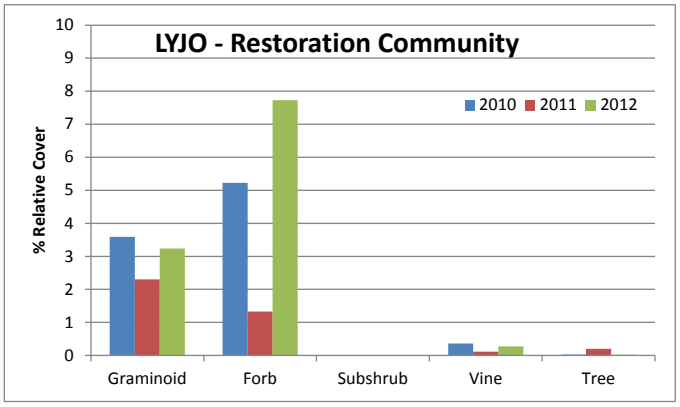


Graph 4.7-2. Percent of relative cover of annual, biennial, and perennial grasses and forbs for each plant community over a 3-year sample period at Lyndon B. Johnson NHP by plant community.

fire again become an option at LYJO, any noted effects of burning will be presented in this section.

4.7.5. Known treatments for exotics

The treatment of exotic plant species on grasslands in the southern plains may have a short-term effect on long-term monitoring transects. In order to inform monitoring results, communications must be established with the park to map annual treatment areas. Pertinent information will be presented in this section when treatments are known. No data was presented regarding treatment in 2012.



Graph 4.7-3. Percentage of relative cover for life forms in plant communities sampled in 2010-2012 at Lyndon B. Johnson NHP.

NPS

A total of two long-term monitoring transects were established at Lyndon B. Johnson NHP.

4.8. Pecos National Historical Park

4.8.1. 2012 sampling

A total of eight fire and eight long-term monitoring transects were established at Pecos National Historical Park (PECO; Figure 4.8-1). The plant community monitored at Pecos NHP is shortgrass steppe. The vegetation map for Pecos NHP (Muldavin 2012) was used for sample selection. In mid-August of 2012, all long-term transects were monitored and used in this analysis. No fire-event transects were monitored by SOPN crew during this time.

4.8.2. Results and discussion

These early-monitoring results provide a baseline to measure future trends and should not be viewed as trends themselves. We are beginning to examine certain components of biotic integrity as applied to vegetation communities. Part of our consideration, the indicators chosen are robust to the sometimes significiant year to year variation in seasonal or annual rainfall or disturbance such as herbivory. These indicators can vary significantly from year to year in response to these environmental factors yet remain within the range of natural variability. The monitoring conducted over the past three years will serve as a baseline to determine trends in the coming years.

Appendix H presents the detailed monitoring results for each transect monitored within the study area. This data shows the annual variation of species within a given area, as well as a 3-year comparison of frequency and species cover for each transect. The transects have been grouped according to similarity of gross plant communities. Exotic species are highlighted in pink.

Table 4.8-2 presents the cumulative cover value of the ground strata for each transect monitored in 2012. When recorded correctly, the values for each transect will add up to 100%. SOILOPEN is the measure of bare soil exposed to the sky and the potential for wind and/or water erosion. SOILUNDER is the measure of bare soil beneath plant cover, which provides some protection from potential erosion. LITTER is another important measure, as some litter is to be desired while excessive litter may negatively impact grassland health. CRUST refers to biotic soil crust, an important and delicate component in semi- and arid grasslands.

<u>Biotic Integrity</u>

One of the major threats to grasslands and other plant communities is invasive species. Invasive species have been directly linked to the replacement of dominant native species (Tilman 1999), the loss of rare species (King 1985), changes in ecosystem structure, alteration of nutrient cycles and soil chemistry (Ehrenfeld 2003), shifts in community productivity (Vitousek 1990), and changes in water availability (D'Antonio and Mahall 1991). The proportion of annual, biennial and perennial species provides an indication of the stability of the site, and it is generally expected that the proportion of annual species at a given site would be higher immediately following a disturbance, but would shift toward an increased proportion of perennials as time passes since a disturbance.

Table 4.8-1. Plant community and sampling dates for each transect at Pecos NHP, 2010-2012.

			Date visited		
Group	Transect	Plant community	2010	2011	2012
Upland	LT04	Blue Grama/Treatment	8/22	7/28	8/18
	LT05	Blue Grama/Treatment	8/23	7/27	8/17
	LT07	Blue Grama/Treatment	8/21	7/27	8/18
	LT10	Blue Grama/Treatment	8/22	7/28	8/21
	LT12	Blue Grama/Treatment	8/21	7/27	8/18
	LT16	Blue Grama/Treatment	8/23	7/28	8/20
	LT17	Blue Grama/Treatment	8/23	7/27	8/17
	LT19	Blue Grama/Old Field	8/22	7/28	8/17

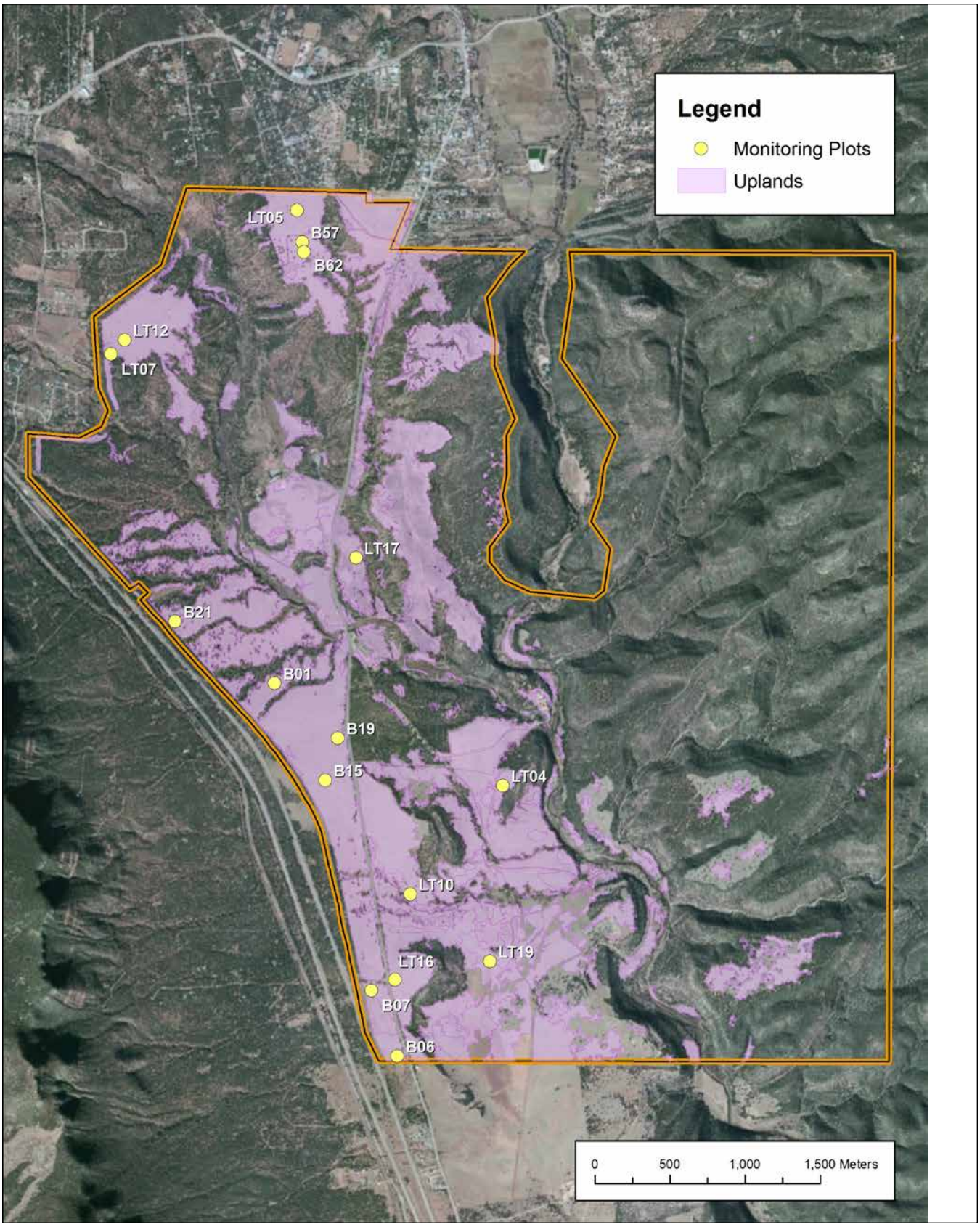


Figure 4.8-1. Monitoring transects at Pecos NHP.

Table 4.8-2. Percentage of substrate cover for each long-term monitoring transect sampled, Pecos NHP, 2012

Cover	Transect							
	LT-04	LT-05	LT-07	LT-10	LT-12	LT-16	LT-17	LT-19
SOILOPEN	52.6	29.4	21.4	34.4	34	20.4	38.2	42.8
SOILUNDE	4.8	7	6.2	4.8	11	4.2	3.8	3.2
LITTER	33.2	45.6	62.8	57	46.8	74.4	52.8	48.4
WOOD	6.2	16.4	6.4	4	8.2	1	1.2	–
ROCKLG	1	–	–	–	–	–	0.2	–
ROCKSM	1.8	0.2	0.3	0.6	0.6	–	0.8	4.8
LICHEN	–	–	–	–	–	–	–	–
MOSS	–	–	1.2	–	0.2	–	–	–
CRUST	0.4	2.4	1.7	0.2	1.2	0.2	3	0.8

Table 4.8-3. The number and percentage of native and exotic species of each life form found on Pecos NHS during the 2010-2012 grassland monitoring sampling.

Lifeform	Native	Exotic	Total	% Native
Forb	72	4	76	94.74
Graminoid	16	0	16	100.00
Subshrub	3	0	3	100.00
Shrub	2	0	2	100.00
Tree	4	0	4	100.00

The Upland Community has been stressed because of the drought, as indicated by the decline in cover for all native perennial grasses and forbs (Graphs 4.8.1, -2 and -3). Relative cover of exotic species remains low within the landscape. The perennial and native characteristics of both forbs and grasses points to a very stable, resilient community. The relative cover of grasses overall should be higher, but that may be achieved with long-term adequate moisture. The amount of exposed soil is currently high, leaving the community vulnerable to wind and water erosion, but this may be yet another result of the persistent drought.

As stated previously, this data should serve as baseline data for determining future trend – not as trends themselves.

4.8.3. Prescribed fire treatments or wildfire occurrence

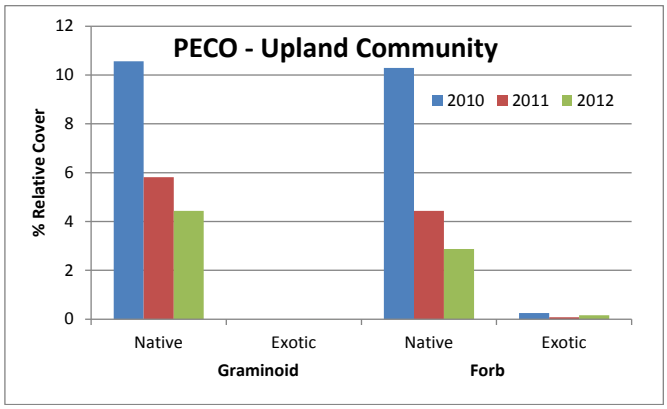
Fire events at PECO are overseen by the Bandelier Fire Group (BFG), a separate unit from the Southern Plains Fire Group. An agreement to share monitoring data has been reached and will be implemented within the next year. Prescribed fire is actively used in PECO and a map of historic burns is being produced for reference. Prescribed burns were planned for 2011 but environmental conditions precluded activity until Fall. There have been no wildfires in PECO within the past 5 years.

4.8.4. Fire effects

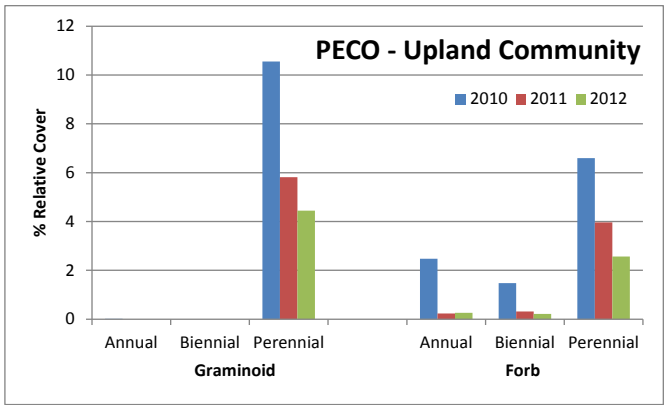
Fire effects monitoring is an integral part of the Grassland Monitoring Protocol (Folts-Zettner et al. in review). As monitoring progresses, any noted effects of burning will be presented in this section.

4.8.5. Known treatments for exotics

The treatment of exotic plant species on grasslands in the southern plains may have a short-term effect on long-term monitoring transects. In order to inform monitoring results, communications have been developed with the Southern Plains/ Chihuahuan Desert Exotic Plant Management Team to map annual treatment areas. Kochia (*Kochia scoparia*) was hand-pulled and field bindweed (*Convolvulus arvensis*) was spot sprayed with herbicide in the upper pastures between the confluence

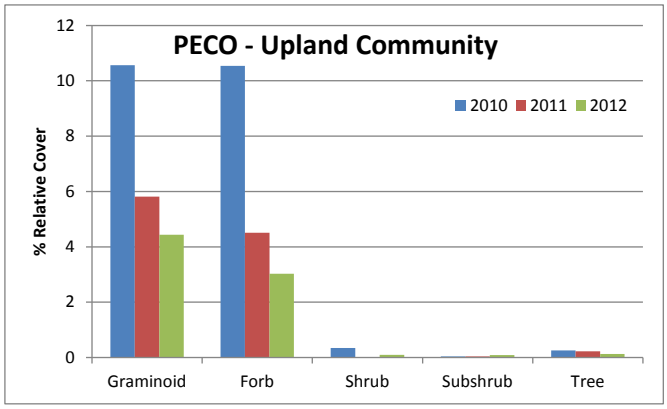


Graph 4.8-1. Percent of relative cover of native vs. exotic graminoids and forbs over a 3-year sample period at Pecos NHP by plant community.



Graph 4.8-2. Percent of relative cover of annual, biennial, and perennial grasses and forbs for each plant community over a 3-year sample period at Pecos NHP by plant community.

of the Pecos River and Glorieta Creek in 2012 (Figure 4.8-2). In the area around the Trading Post, field bindweed also received herbicide treatment. Three acres of cheatgrass (*Bromus tectorum*) was mowed between the Trading Post and Forked Lightening ranch house, while populations of kochia, alfilaree (*Erodium cicutarium*) and field bindweed in this area received herbicide treatment.



Graph 4.8-3. Percentage of relative cover for life forms in plant communities sampled in 2010-2012 at Pecos NHP.

NPS

A total of eight fire and eight long-term monitoring transects were established at Pecos NHP.

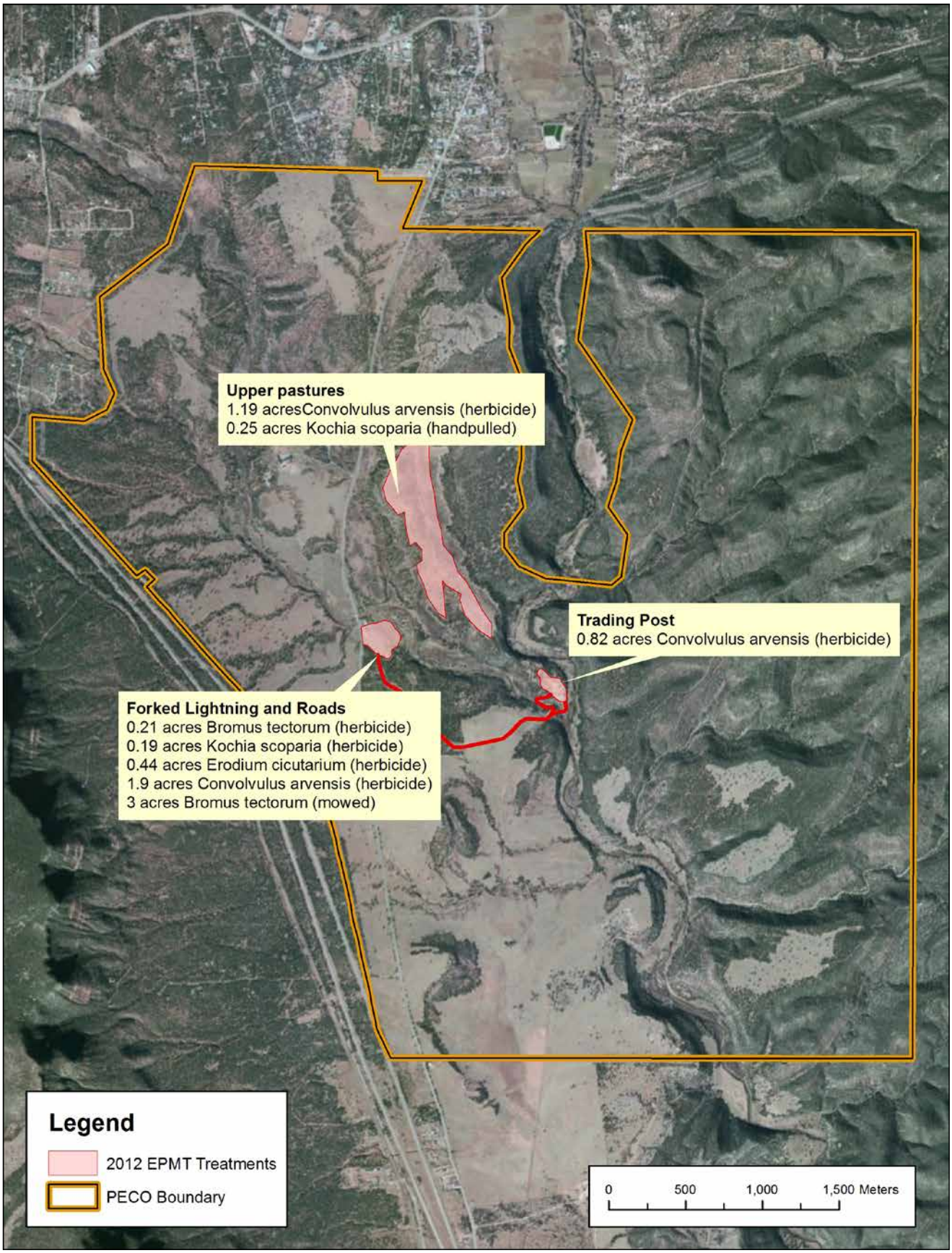


Figure 4.8-3. Exotic plant management team treatment areas at Pecos NHP in 2012.

4.9. Sand Creek Massacre National Historic Site

4.9.1. 2012 Sampling

A total of 11 fire and 11 long-term monitoring transects were established at SandCreek Massacre National Historic Site (SAND). Plant communities monitored at SAND are: upland grasslands consisting of blue grama-buffalograss herbaceous vegetation and alkali sacaton-saltgrass herbaceous vegetation; upland sage consisting of sand sage/ sideoats grama-blue grama shrubland and sand sage/sand bluestem shrubland, which are considered for type conversion; restoration consisting of reclaimed agricultural land which is of particular management interest to the park; cottonwood galleries containing cottonwood/western wheatgrass-switchgrass woodland, also of special interest to the park (Neid et al. 2007) (Table 4.9-1). Twelve transects were monitored in early July of 2012 and used in this analysis.

4.9.2. Results and discussion

These early-monitoring results provide a baseline to measure future trends and should not be viewed as trends themselves. We are beginning to examine certain components of biotic integrity as applied to vegetation communities. Part of our consideration, the indicators chosen are robust to the sometimes significiant year to year variation in seasonal or annual rainfall or disturbance such as herbivory. These indicators can vary significantly from year to year in response to these environmental factors yet remain within the range of natural variability. The monitoring conducted over the past three years will serve as a baseline to determine trends in the coming years.

Appendix I presents the detailed monitoring results for each transect monitored within the study area. These data show the annual variation of species within a given area, as

Table 4.9-1. Plant community and sampling dates for each transect at Sand Creek Massacre NHS, 2010-2012.

			Date visited		
Group	Transect	Plant community	2010	2011	2012
Cottonwood	CWOOD-LT01	Populus deltoides / Pascopyrum smithii- -Panicum virgatum Woodland	7/9	7/8	7/5
	CWOOD-LT02	Populus deltoides / Pascopyrum smithii- -Panicum virgatum Woodland	7/9	7/9	7/9
	CWOOD-LT03	Populus deltoides / Pascopyrum smithii- -Panicum virgatum Woodland	7/11	7/9	7/6
Upland	RESTN-02	Reclaimed Agricultural Land	7/9	7/6	7/5
	UGRASS-05	Sporobolus airoides - Distichlis spicata Herbaceous	7/12	7/7	7/8
	UGRASS-LT01	Boutaloua gracilis - Buchloe dactyloides Herbaceous	7/11	7/9	7/6
	UGRASS-LT02	Sporobolus airoides - Distichlis spicata Herbaceous	7/10	7/8	7/7
	UGRASS-LT04	Boutaloua gracilis - Buchloe dactyloides Herbaceous	7/9	7/7	7/7
	UGRASS-LT05	Boutaloua gracilis - Buchloe dactyloides Herbaceous	7/12	7/7	7/7
Sage	USAGE-LT01	Artemisia filifolia / Andropogon hallii Shrubland	7/11	7/8	7/6
	USAGE-LT02	Artemisia filifolia / Andropogon hallii Shrubland	7/12	7/7	7/8
	RESTS-LT01	Artemisia filifolia / Andropogon hallii Shrubland	7/9	7/6	7/9

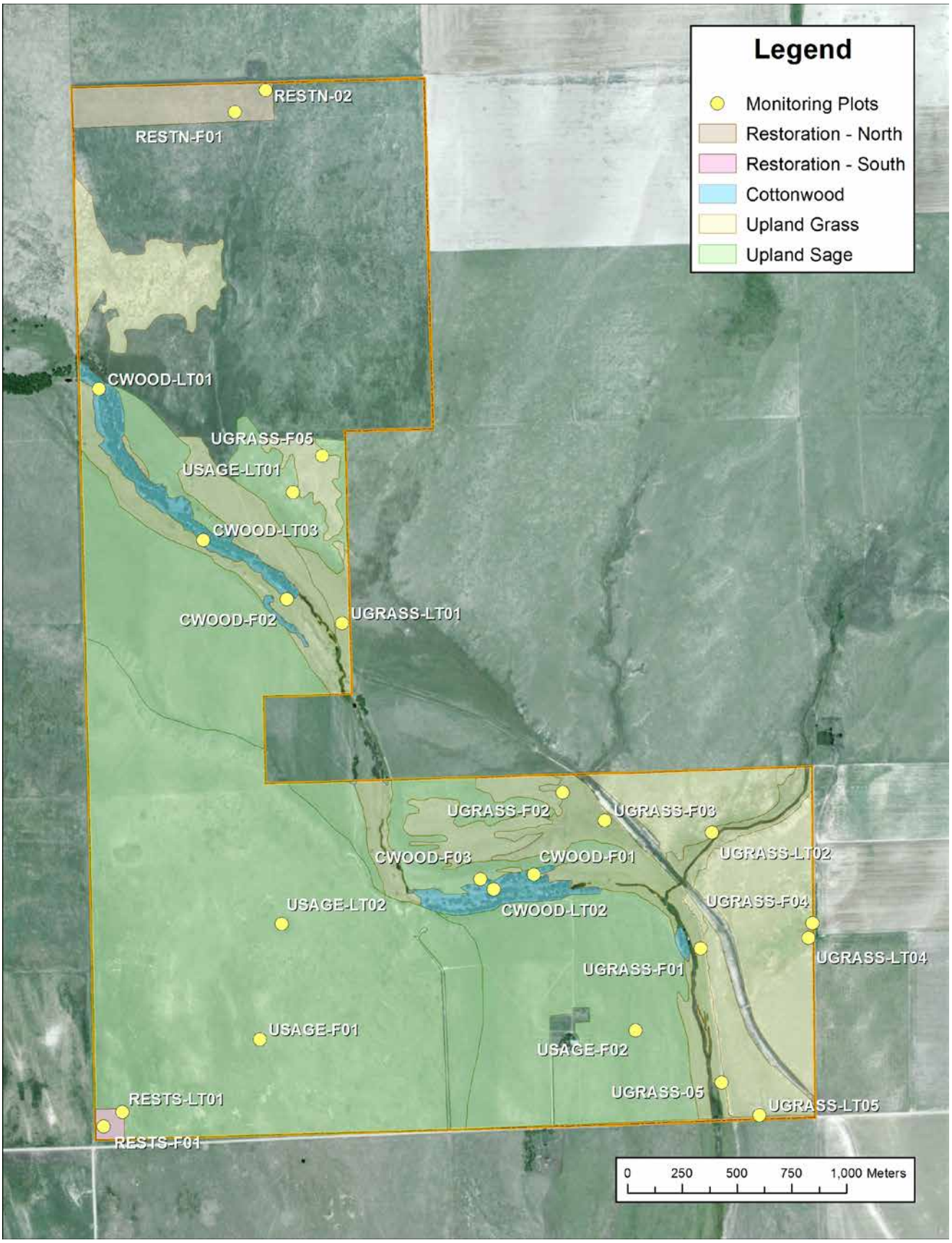


Figure 4.9-1. Monitoring transects at Sand Creek Massacre NHS.

Table 4.9-2. Percentage of substrate cover for each long-term monitoring transect sampled, Sand Creek Massacre NHP, 2012

Cover	Transect				
	CWOOD-LT01	CWOOD-LT02	CWOOD-LT03	RESTN-02	RESTS-LT01
SOILOPEN	16.6	11	0.6	12.2	21.2
SOILUNDER	1.4	1	0.4	4.4	12.2
LITTER	59.6	65	92.6	83.4	60.6
WOOD	22.4	23	6.4	–	1
ROCKLG	–	–	–	–	–
ROCKSM	–	–	–	–	–
LICHEN	–	–	–	–	–
MOSS	–	–	–	–	–
CRUST	–	–	–	–	5

Cover	Transect						
	UGRASS-LT01	UGRASS-LT02	UGRASS-05	UGRASS-LT04	UGRASS-LT05	USAGE-LT01	USAGE-LT02
SOILOPEN	7	1.6	37.8	1.25	42	21.4	7.5
SOILUNDE	4.4	2.4	5.2	0.75	14.25	6.4	3.75
LITTER	87.2	96	52.8	98	43.75	69.2	86.5
WOOD	0.2	–	–	–	–	–	2.25
ROCKLG	–	–	–	–	–	–	–
ROCKSM	–	–	–	–	–	0.2	–
LICHEN	–	–	–	–	–	0.6	–
MOSS	–	–	–	–	–	–	–
CRUST	1.2	–	2.75	–	–	2.2	–

well as a 3-year comparison of frequency and species cover for each transect. The transects have been grouped according to similarity of gross plant communities. Exotic species are highlighted in pink.

Table 4.9-2 presents the cumulative cover value of the ground strata for each transect monitored in 2012. When recorded correctly, the values for each transect will add up to 100%. SOILOPEN is the measure of bare soil exposed to the sky and the potential for wind and/or water erosion. SOILUNDER is the measure of bare soil beneath plant cover, which provides some protection from potential erosion. LITTER is another important measure, as some litter is to be desired while excessive litter may negatively impact grassland health. CRUST refers to biotic soil crust, an important and delicate component in semi- and arid grasslands.

Biotic Integrity

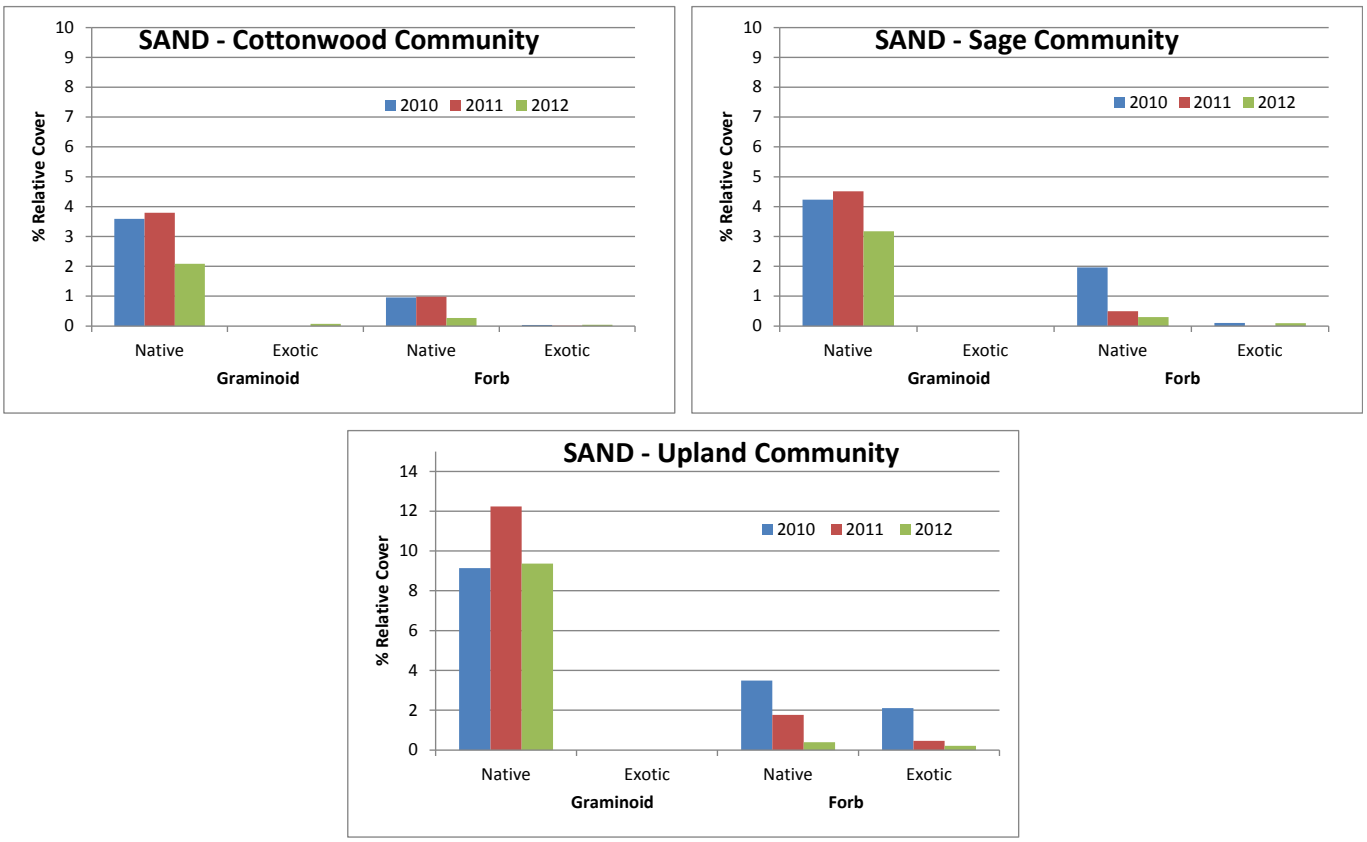
One of the major threats to grasslands and other plant communities is invasive species. Invasive species have been directly linked to the replacement of dominant native species (Tilman 1999), the loss of rare species (King 1985), changes in ecosystem structure, alteration of nutrient cycles and soil chemistry (Ehrenfeld 2003), shifts in community productivity (Vitousek 1990), and changes in water availability (D'Antonio and Mahall 1991). The proportion of annual, biennial and perennial species provides an indication of the stability of the site, and it is generally expected that the proportion of annual species at a given site would be higher immediately following a disturbance, but would shift toward an increased proportion of perennials as time passes since a disturbance.

Table 4.9-3. The number and percentage of native and exotic species of each life form found on Sand Creek Massacre NHS during the 2010-2012 grassland monitoring sampling.

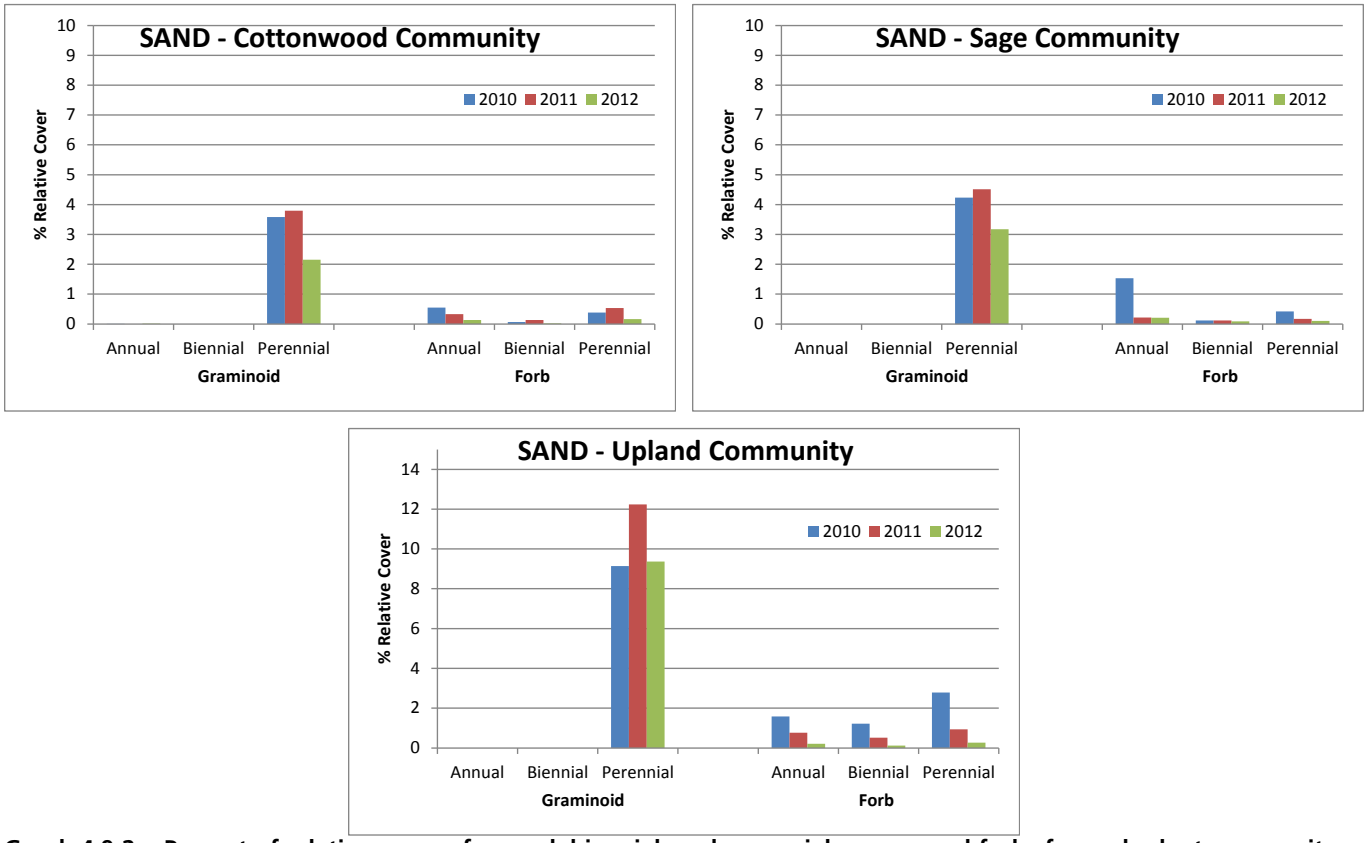
Lifeform	Native	Exotic	Total	% Native
Forb	62	6	68	91.18
Graminoid	17	1	18	94.44
Subshrub	3	0	3	100.00
Shrub	3	0	3	100.00
Tree	1	0	1	100.00

All plant communities at SAND are stressed because of the drought, as demonstrated by the decline in cover for all native perennial grasses and forbs (Graphs 4.9-1, -2 and -3). The preponderance of these perennial natives, even in a drought-degraded state, bodes well for the stability and resilience of all communities. Exotic forbs have remained low; should the drought persist, this may change if there is an established existing seedbank of exotics. Prickly Russian thistle (*Salsola tragus*) appears to be the only exotic that is slowly increasing. However, other parks in the Southern Plains have already seen an increase in the number of annual exotics, so the lack of exotics is a good sign for SAND. The relative cover of forbs in all communities has reached very low levels, but the ratio of fobs to grasses was very good during the last year (2010) with adequate moisture.

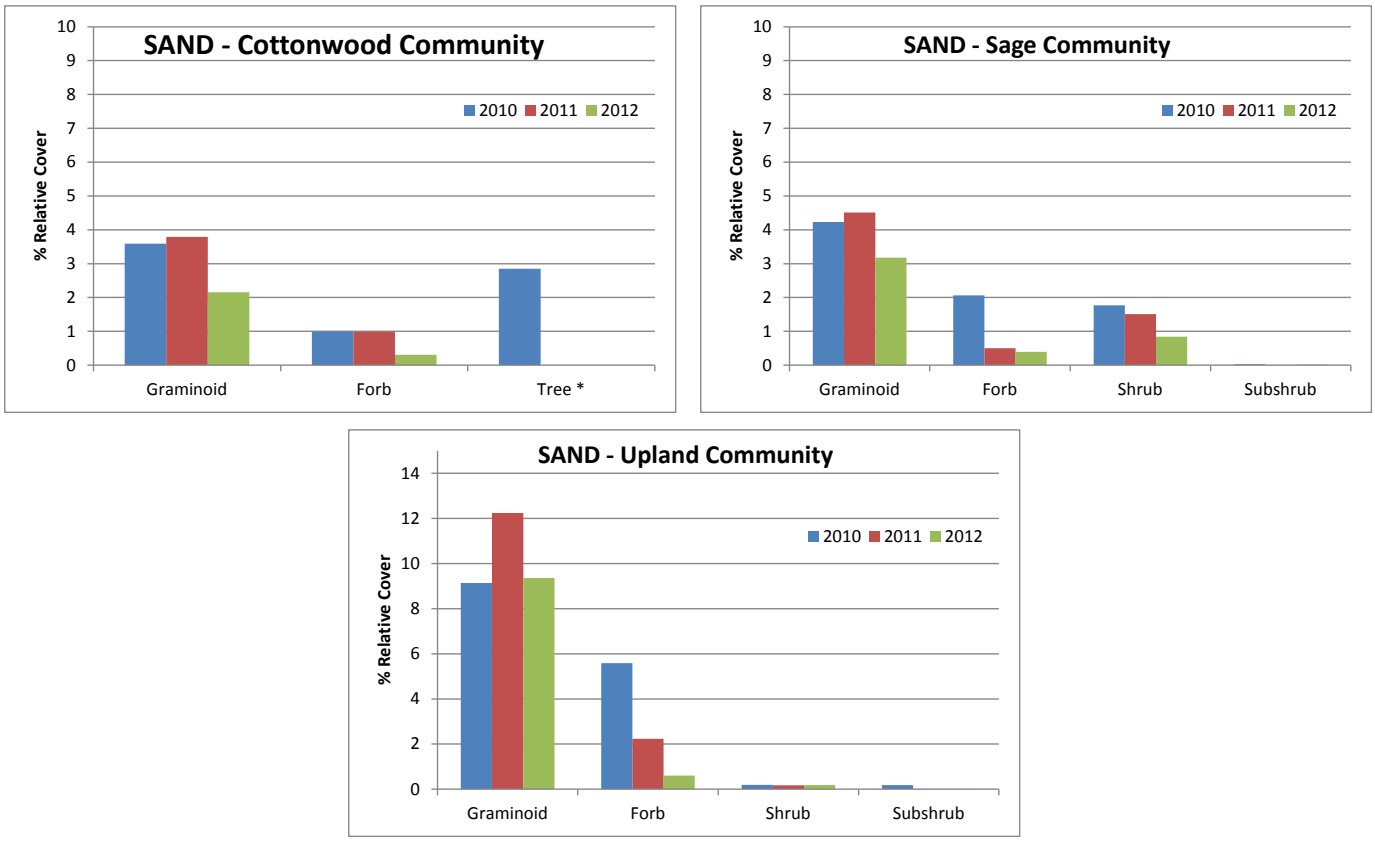
As stated previously, this data should serve as baseline data for determining future trend – not as trends themselves.



Graph 4.9-1. Percent of relative cover of native vs. exotic graminoids and forbs over a 3-year sample period at Sand Creek Massacre NM by plant community. Note the change of scale in the Upland Community chart.



Graph 4.9-2. Percent of relative cover of annual, biennial, and perennial grasses and forbs for each plant community over a 3-year sample period at Sand Creek Massacre NM by plant community. Note the change of scale in the Upland Community chart.



Graph 4.9-3. Percentage of relative cover for life forms in plant communities sampled in 2010-2012 atSand Creek Massacre NM. Note change of scales in Upland Community. * Tree canopy cover has not been consistently measured across sample years.

4.9.3. Prescribed fire treatments or wildfire occurrence

The use of prescribed fire is being considered at SAND but has not been implemented. To date, mowing and debris removal are being used for fuels reduction. No wildfires have occurred during the last 5 years.

4.9.4. Fire effects

Fire effects monitoring is an integral part of the Grassland Monitoring Protocol (Folts-Zettner et al. in review). As monitoring progresses, any noted effects of burning will be presented in this section.

4.9.5. Known treatments for exotics

The treatment of exotic plant species on grasslands in the southern plains may have a short-term effect on long-term monitoring transects. In order to inform monitoring results, communications have been developed with both the park and the Southern Plains/ Chihuahuan Desert Exotic Plant Management Team to map annual treatment areas. Pertinent information will be presented in this section when treatments are known.

4.9.6. Precipitation Data

Charts reflecting both historic and current precipitation data have been developed. The long-term precipitation is from the Cheyenne Wells National Weather Service COOP Station and the short-term from the Eads 16 ENE COOP Station (Graphs 4.9-4 and -5).

NPS

A total of 11 fire and 11 long-term monitoring transects were established at Sand Creek Massacre NHS.

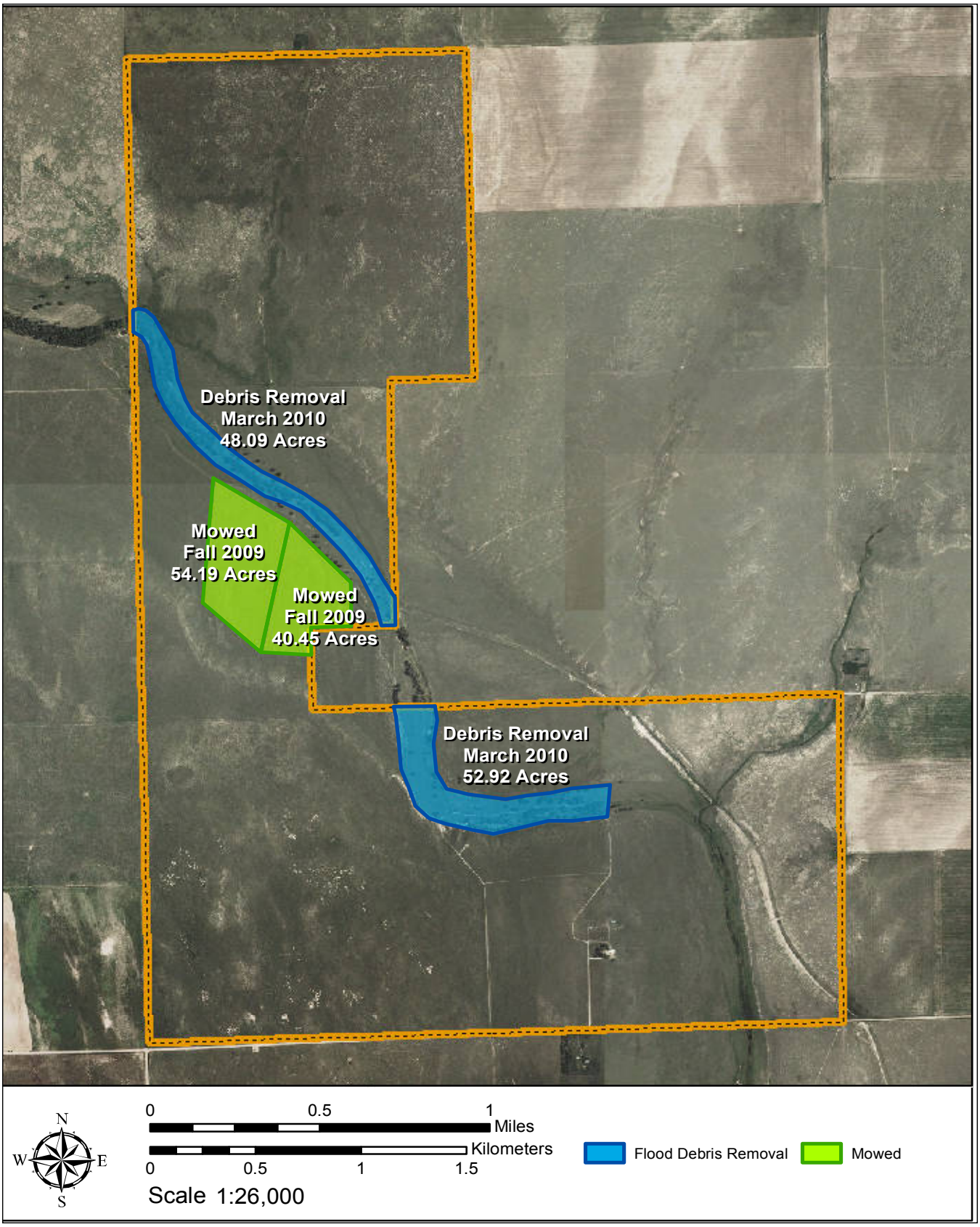
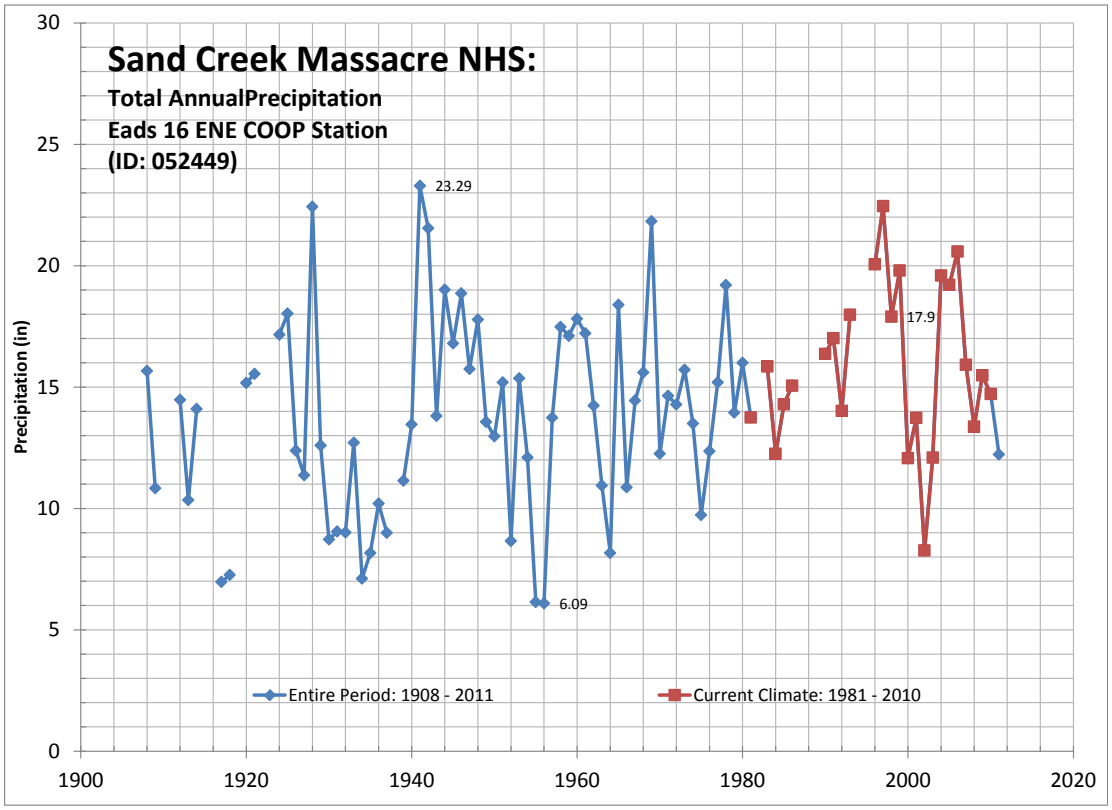
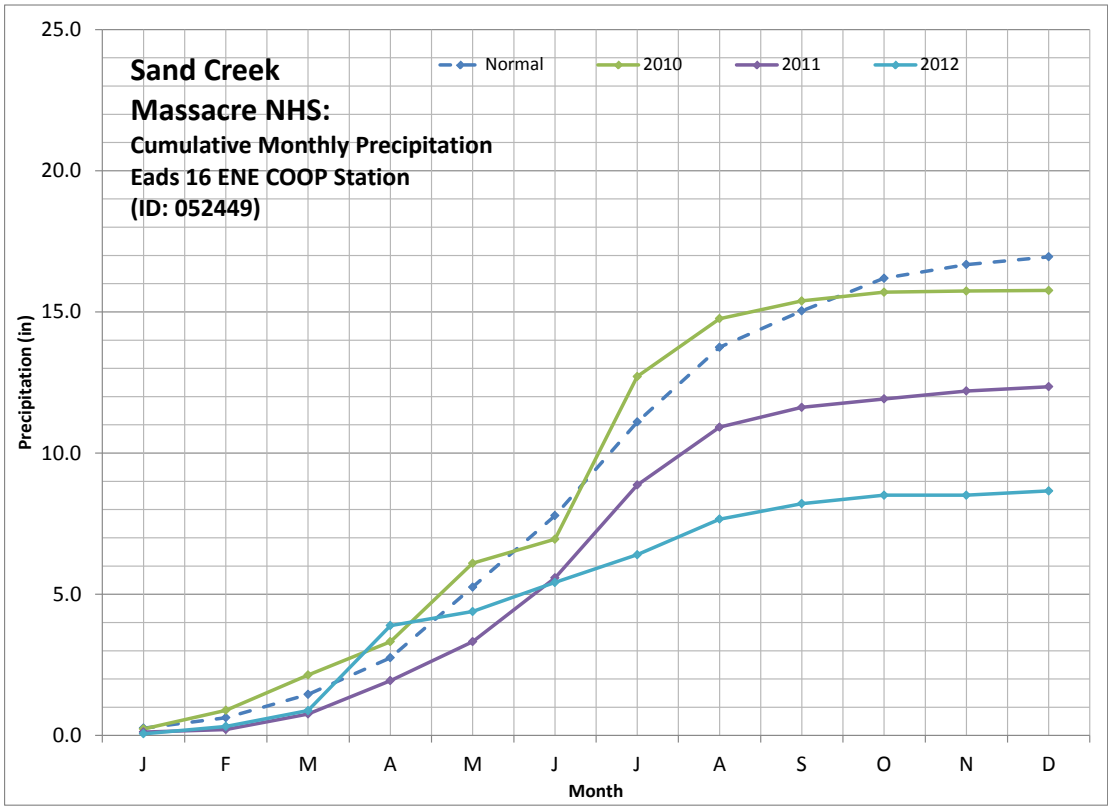


Figure 4.9-2. Fuel reduction treatments since 2009 at Sand Creek Massacre NHS.



Graph 4.9-4. Annual precipitation from 1880 to 2012 at Sand Creek Massacre NHS.



Graph 4.9-5. Cumulative monthly precipitation for 2009 to 2012 (including normal levels) at Sand Creek Massacre NHS.

4.10. Washita Battlefield National Historic Site

4.10.1. 2012 Sampling

A total of four fire and nine long-term monitoring transects were established at Washita Battlefield National Historic Site (WABA; Figure 4.10-1). The plant communities monitored at Washita Battlefield NHS are: upland grasslands consisting of sand bluestem-giant sandreed herbaceous vegetation, big bluestem-Indiangrass herbaceous vegetation, little bluestem-sideoats grama herbaceous vegetation, blue grama-sideoats grama herbaceous vegetation, western wheatgrass herbaceous alliance, cheatgrass semi-natural herbaceous vegetation, Johnsongrass herbaceous vegetation, and Bermudagrass vegetation; and restoration grasslands consisting of reclaimed agricultural fields undergoing active prairie restoration (Cogan 2007b). In 2012, twelve transects were monitored in early June and September. All 2012 transects were included in this analysis.

4.10.2. Results and discussion

These early-monitoring results provide a baseline to measure future trends and should not be viewed as trends themselves. We are beginning to examine certain components of biotic integrity as applied to vegetation communities. Part of our consideration, the indicators chosen are robust to the sometimes significiant year to year variation in seasonal or annual rainfall or disturbance such as herbivory. These indicators can vary significantly from year to year in response to these environmental factors yet remain within the range of natural variability. The monitoring conducted over the past three

Table 4.10-1. Plant community and sampling dates for each transect at Washita Battlefield NHS, 2010-2012.

			Date visited		
Group	Transect	Plant community	2010	2011	2012
Restoration	DIST-01	Bromus tectorum Semi-Natural Herbaceous	6/26	7/1	6/8
	RESTE-LT01	Andropogon gerardii - Sorghastrum nutans Herbaceous	6/24	7/2	9/3
	RESTE-LT02	Andropogon gerardii - Sorghastrum nutans Herbaceous	6/24	7/2	6/10
	RESTW-LT01	Andropogon gerardii - Sorghastrum nutans Herbaceous	6/25	6/30	6/9
	RESTW-LT02	Iva annua - (Xanthium strumarium) Temporarily Flooded	6/25	7/1	6/8
	WABA-04	Andropogon gerardii - Sorghastrum nutans Herbaceous	NS	NS	9/4
	WABA-06	Andropogon gerardii - Sorghastrum nutans Herbaceous	NS	NS	9/3
Upland	UPLAND-F03	Schizachyrium scoparium - Bouteloua curtipendula Herbaceous	6/26	NS	NS
	UPLAND-LT01	Bromus tectorum Semi-Natural Herbaceous	6/24	6/30	6/7
	UPLAND-LT02	Andropogon hallii - Calamovilfa gigantea Herbaceous	6/27	7/3	6/9
	UPLAND-LT03	Bouteloua gracilis - Bouteloua curtipendula Herbaceous	6/27	7/2	6/9
	UPLAND-LT04	Schizachyrium scoparium - Bouteloua curtipendula Herbaceous	6/25	6/30	6/9
	WABA-03	Siberian Elm Woodland	NS	NS	9/4

NS = not sampled

years will serve as a baseline to determine trends in the coming years.

Appendix J presents the detailed monitoring results for each transect monitored within the study area. This data shows the annual variation of species within a given area, as well as a 3-year comparison of frequency and species cover for each transect. The transects have been grouped according to similarity of gross plant communities. Exotic species are highlighted in pink.

Table 4.10-2 presents the cumulative cover value of the ground strata for each transect monitored in 2012. When recorded correctly, the values for each transect will add up to 100%. SOILOPEN is the measure of bare soil exposed to the sky and the potential for wind and/or water erosion. SOILUNDER is the measure of bare soil beneath plant cover, which provides some protection from potential erosion. LITTER is another important measure, as some litter is to be desired while excessive litter may negatively impact grassland health. CRUST refers to biotic soil crust, an important and delicate component in semi- and arid grasslands.

Biotic Integrity

One of the major threats to grasslands and other plant communities is invasive species. Invasive species have been directly linked to the replacement of dominant native species (Tilman 1999), the loss of rare species (King 1985), changes in ecosystem structure, alteration of nutrient cycles and soil chemistry (Ehrenfeld 2003), shifts in community productivity (Vitousek 1990), and changes in water availability (D'Antonio and Mahall 1991). The proportion of annual, biennial and perennial species provides an indication of the stability of the site, and it is generally expected that the proportion of annual species at a given site would be higher immediately following a disturbance, but would shift toward an increased proportion of perennials as time passes since a disturbance.

Washita Battlefield NHS has consistently suffered from a persistent low-level invasion of a suite of exotic grasses and forbs. Unique weather conditions leading up to the 2012 growing season resulted in a mass explosion of these exotic populations that overwhelmed all plant communities. The most dramatic increases occurred with two grasses, Japanese brome (*Bromus japonicus*) and cheatgrass (*Bromus tectorum*), both early season annuals that produced a smothering amount of biomass in some areas. A number of strategies have been developed to recover from this invasion, but it will likely be several years before the WABA grasslands are on a positive trajectory.

All plant communities are stressed because of the drought, showing a decline in cover for all native perennial grasses and forbs, while exotic annuals - and to a lesser degree,

Table 4.10-2. Percentage of substrate cover for each long-term monitoring transect sampled, Washita Battlefield NHP, 2012

Cover	Transect									
	RESTE-LT02	RESTW-LT01	RESTW-LT02	UPLAND-LT01	UPLAND-LT02	UPLAND-LT03	UPLAND-LT04	WABA-03	WABA-04	WABA-06
SOILOPEN	2.25	1.2	0.6	4.4	45.8	0.8	2.2	1.75	0.4	4.6
SOILUNDER	3	2.8	0.6	6.8	13.2	1.6	1.2	3	1	11.4
LITTER	94.75	96	97.2	88.8	34.8	97.4	95.6	95.25	98.6	82.4
WOOD	–	–	1.6	–	–	0.2	1	–	–	–
ROCKLG	–	–	–	–	–	–	–	–	–	–
ROCKSM	–	–	–	–	2	–	–	–	–	–
LICHEN	–	–	–	–	–	–	–	–	–	–
MOSS	–	–	–	–	–	–	–	–	–	–
CRUST	–	–	–	–	4.2	–	–	–	–	1.6

Table 4.10-3. The number and percentage of native and exotic species of each life form found on Washita Battlefield NHS during the 2010-2012 grassland monitoring sampling.

Lifeform	Native	Exotic	Total	% Native
Forb	53	11	64	82.81
Graminoid	25	5	30	83.33
Subshrub	1	0	1	100.00
Vine	3	0	3	100.00
Tree	4	1	5	80.00

perennials - are increasing (Graphs 4.10-1, -2 and -3). The Upland Community appears to be more impacted by exotics than the Restoration Community (primarily the bottomland area of the park) – where native perennial grasses were robust in 2010, they are now being challenged for dominance by exotic annual grasses (*Bromus species*). Both plant communities were often plowed prior to park establishment and the Upland Community is still impacted by historic terracing. A raised abandoned railroad bed still separates the two communities. It is unknown which, if any, of these historic disturbances is a factor in the distribution difference of the exotics.

It has been observed throughout the short span of monitoring that the forb component of the Restoration Community has less cover and fewer species then the Upland Community. Past seeding efforts in this community have favored grasses over forbs and the robust native perennial bunchgrasses have left little space for forb establishment. Forb cover in this community remained stable during this period, but perennials are being replaced with annuals.

As stated previously, this data should serve as baseline data for determining future trend – not as trends themselves.

NPS

A total of 7 fire and 9 long-term monitoring transects were established at Washita Battlefield NHS.

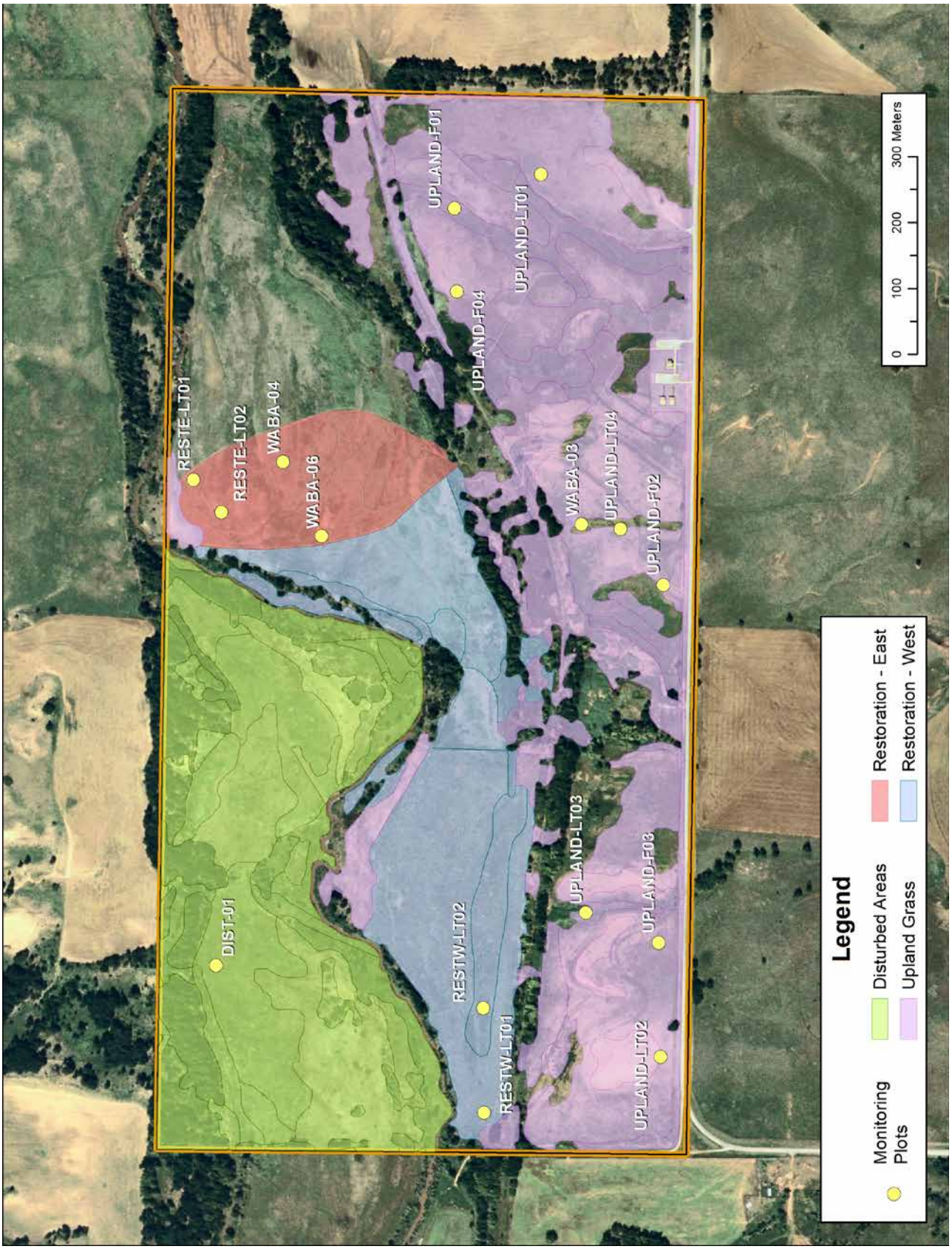
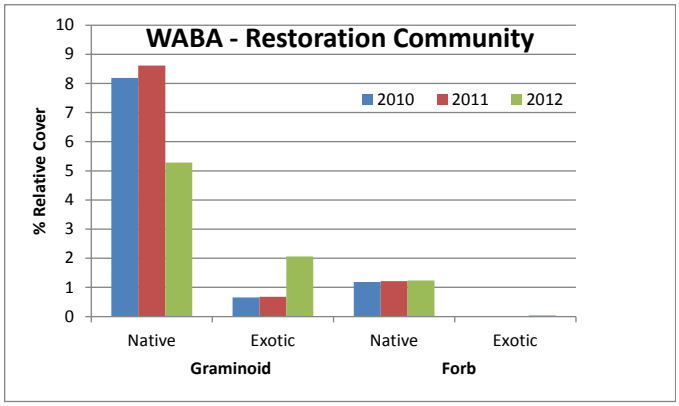
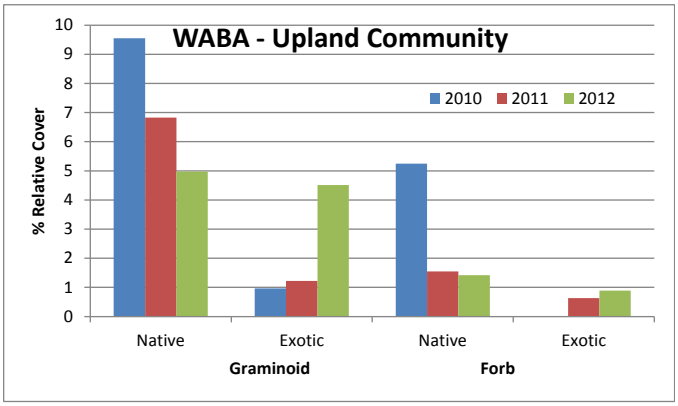
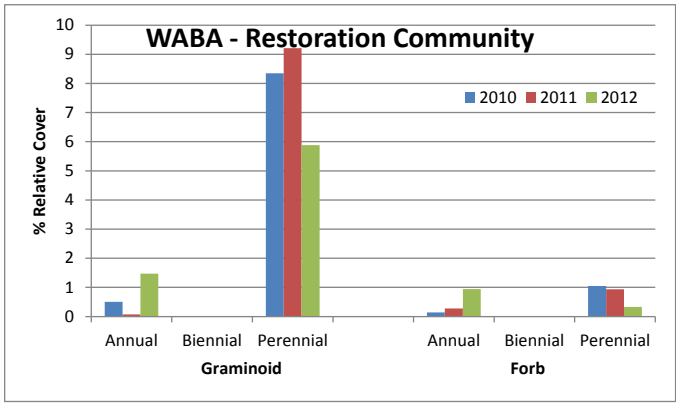


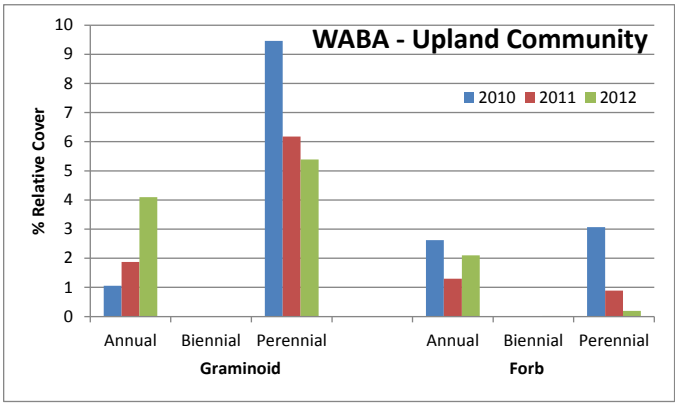
Figure 4.10-1. Monitoring transects at Washita Battlefield NHS.



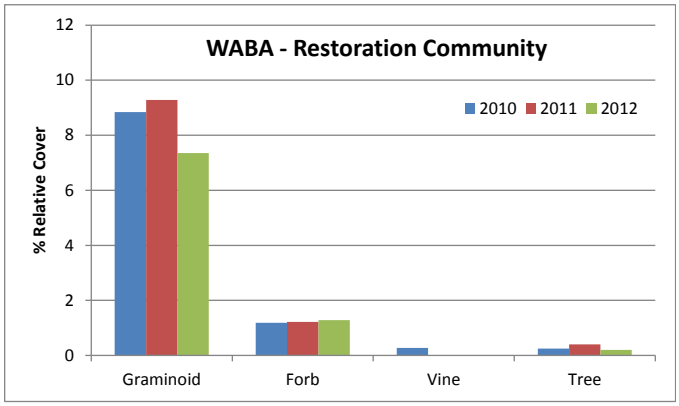


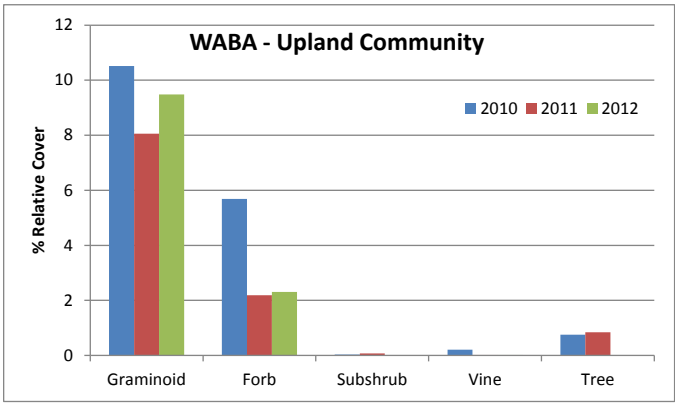
Graph 4.10-1. Percent of relative cover of annual, biennial, and perennial grasses and forbs for each plant community over a 3-year sample period at Sand Creek Massacre NM by plant community. Note the change of scale in the Upland Community chart.





Graph 4.10-2. Percent of relative cover of annual, biennial, and perennial grasses and forbs for each plant community over a 3-year sample period at Sand Creek Massacre NM by plant community. Note the change of scale in the Upland Community chart.





Graph 4.10-3. Percent of relative cover of annual, biennial, and perennial grasses and forbs for each plant community over a 3-year sample period at Sand Creek Massacre NM by plant community. Note the change of scale in the Upland Community chart.

4.10.3. Prescribed fire treatments or wildfire occurrence

Prescribed fire has been a management tool over the past eight years at WABA (Figure 4.10-2), with the majority of the park having been burned between 2003 to 2007. Since that time, environmental conditions have not been favorable for additional burning. No wildland fires have been reported in recent history.

4.10.4. Fire effects

Fire effects monitoring is an integral part of the Grassland Monitoring Protocol (Folts-Zettner et al. in review) and current results from monitoring within the scope of this long-term project are reported in Appendix J. As monitoring progresses, any noted effects of burning will be presented in this section.

4.10.5. Known treatments for exotics

The treatment of exotic plant species on grasslands in the southern plains may have a short-term effect on long-term monitoring transects. In order to inform monitoring results, communications have been developed with the Southern Plains/Chihuahuan Desert Exotic Plant Management Team to map annual treatment areas. Pertinent information will be presented in this section when treatments are known.

The EPMT has been very active at WABA. Past years have seen saltcedar (Tamarisk species) removal throughout the riparian area, treatment of Siberian elm and control of bromes. Johnsongrass (*Sorghum halepense*) and sweetclover (*Melilotus species*). 2012 efforts included additional treatment of saltcedar and Siberian elm (*Ulmus pumila*), and herbiciding of cheatgrass, prickly Russian thistle (*Salsola tragus*), kochia (*Kochia scoparia*) and Johnsongrass. A treatment map (Figure 4.10-3) has been developed to inform the SOPN of potential impacts to permanent transects.

4.10.6. Precipitation Data

Charts reflecting both historic and current precipitation data have been developed. The long-term data is from the Sayer National Weather Service COOP Climate Station (Graphs 4.10-4) and the Short-term data is from the Cheyenne Remote Automated Weather Station (RAWS) (Graph 4.10-5).

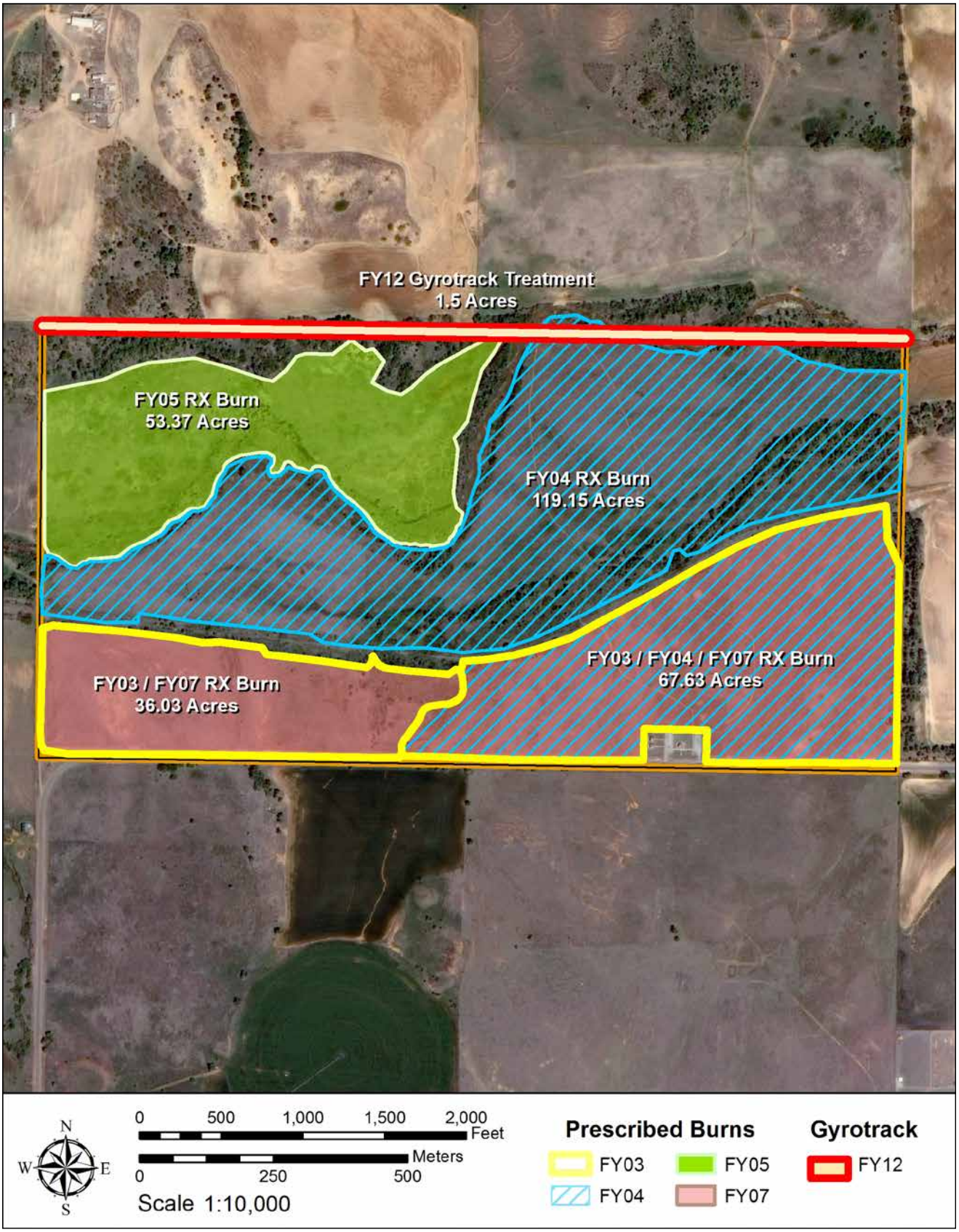


Figure 4.10-2. Prescribed treatment or wildland fires since 2003, Washita Battlefield NHS.

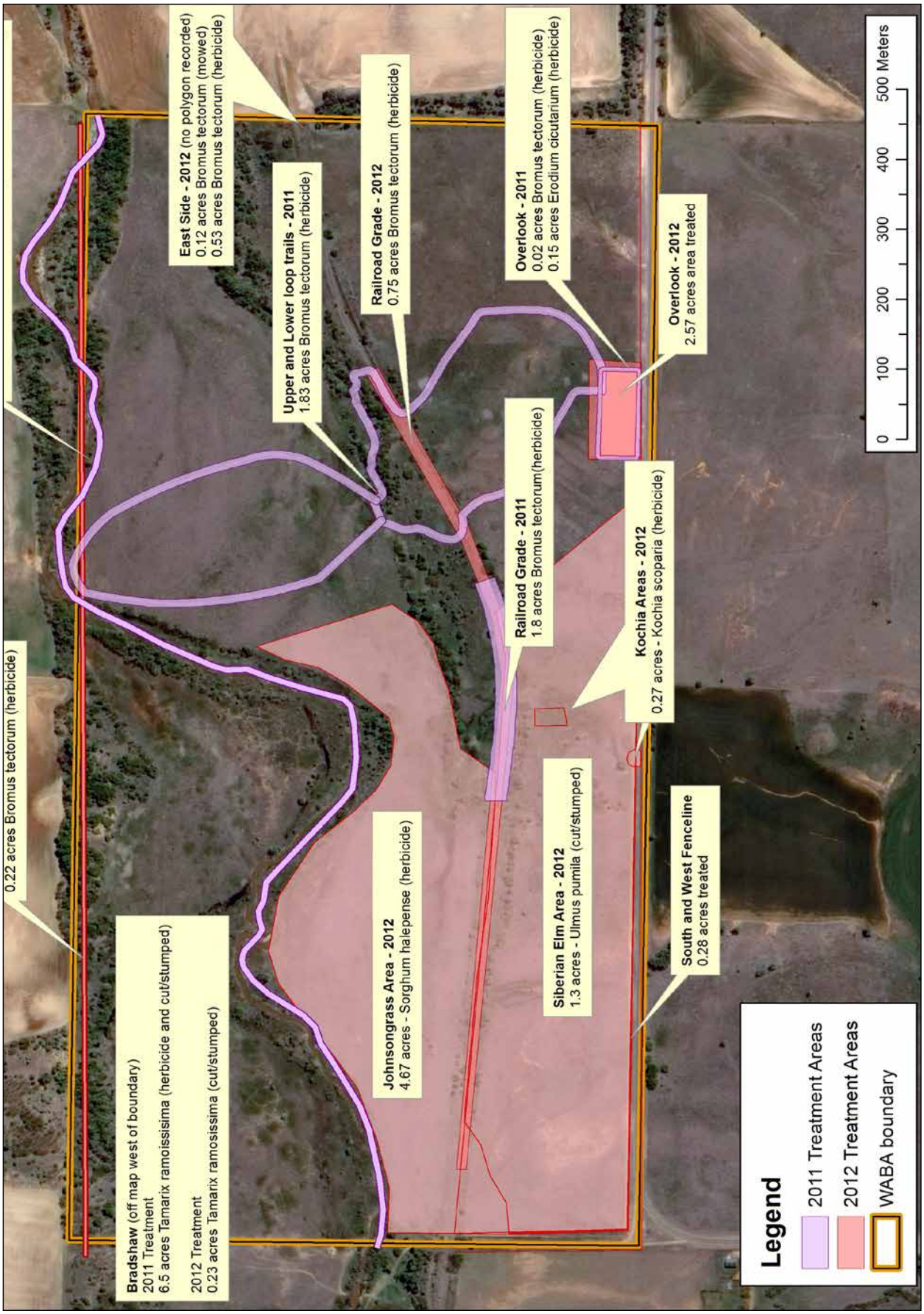
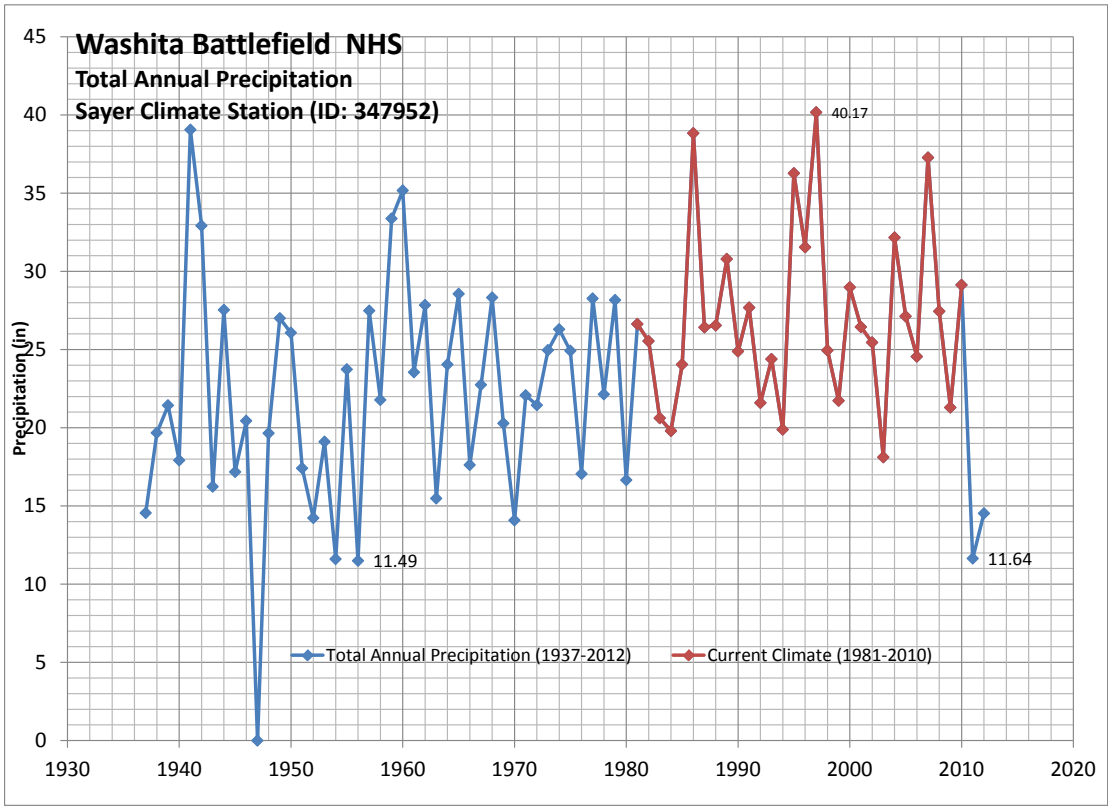
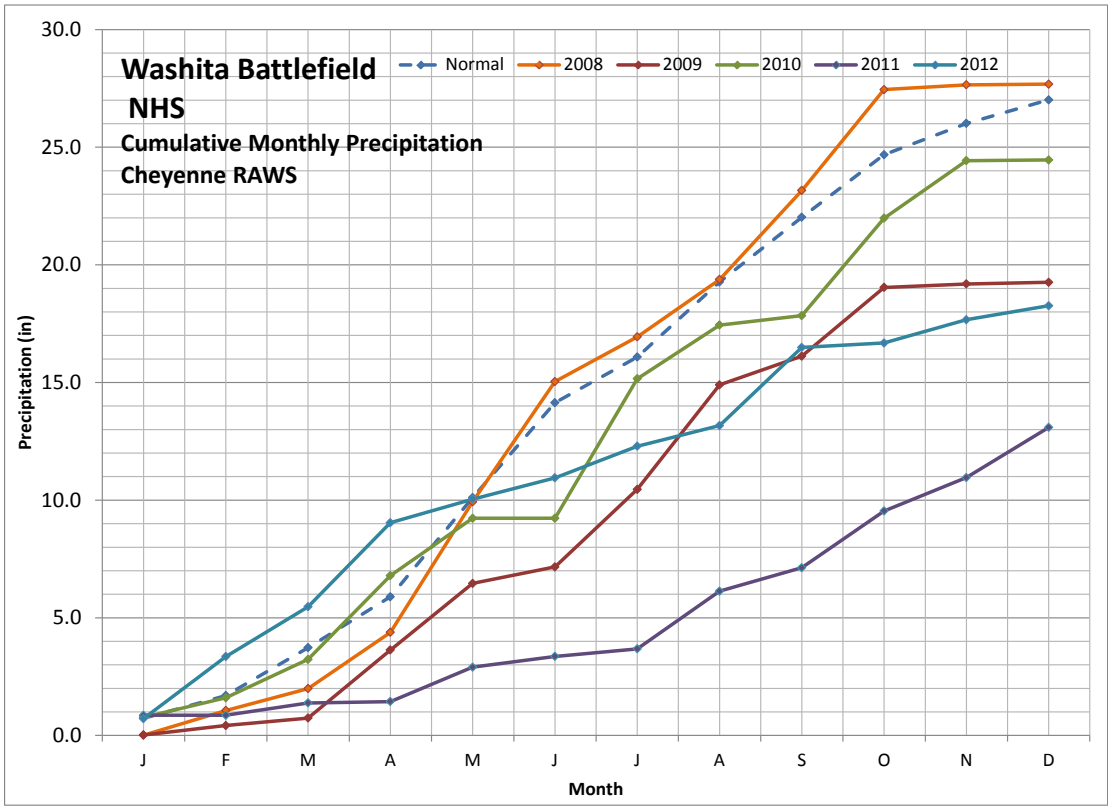


Figure 4.10-3 Exotic plant management team treatment areas at Washita Battlefield NHS.



Graph 4.10-4. Annual precipitation from 1880 to 2012 at Washita Battlefield NHS.



Graph 4.10-5. Cumulative monthly precipitation for 2009 to 2012 (including normal levels) at Washita Battlefield NHS.

Chapter 5: Discussion

We have now completed three years of data collection on this long-term monitoring project. With so little data at hand no inferences can yet be made to trends or long-term drought effects. A competitive advantage was observed in several common exotic species that may have an effect should the extreme drought continue for several years. An increase in annual exotics is occurring in most parks of the Southern Plains, although the extent of this increase has varied from little to extreme, depending on local conditions and existing seed bank. The relative cover of perennial grasses and forbs has fallen considerably, while exposed soil has increased.

Of particular importance for the next year is to set in place reporting procedures for the parks regarding both fire and exotic treatments. The type and extent of treatment in a given area can affect monitoring plots and needs to be tracked to correctly understand and interpret monitoring data. Any additional historic information that parks may have regarding treatments should be communicated to the SOPN for inclusion in the GIS base data.

Chapter 6: Literature Cited

Axelrod, D.I. 1985. Rise of the Grassland Biome, Central North America. Botanical Review 51: 163-202.

Anderson, R.C. 1990. The Historic Role of Fire in the NOrth American Grassland. Pages 8-18 in S. L. Colilins and L. L. Wallace, editors. Fire in North Amercan Tallgrass Praries. University of Oklahoma Press, Norman, OK.

Cogan, D. 2007a. Lyndon B. Johnson National Historic Park Vegetation Classification and Mapping Project Natural Resource Report. A report for the Southern Plains Network. National Park Service, Johnson City, Texas.

Cogan, D. 2007b. Washita Battlefield National Historic Site Classification and Mapping Project Natural Resource Report. A report for the Southern Plains Network. National Park Service, Johnson City, Texas.

Cogan, D., L. Walker, H. Loring, S. Jog and J. Delisle. 2007. Fort Larned National Historic Site Vegetation Classification and Mapping Project Natural Resource Report. A report for the Southern Plains Network. National Park Service, Johnson City, Texas.

D'Antonio, C.M. and B. E. Mahall. 1991. Root profiles and competition between the invasive, Exotic perennial, Carpobrotus edulis, and two native shrub species in California coastal scrub. American Journal of Botany 78(7): 885-894. 1991.

Ehrenfeld, J.G. 2003. Effects of exotic plant invasions on soil nutrient cycling processes. Ecosystems (2003) 6: 503-523

Fenton, K., J.R. Bell and D. Wegner. 2007. USGS-NPS Vegetation Mapping Program: Lake Meredith National Recreation Area, Alibates Flint Quarries National Monument, Texas. U.S. Bureau of Reclamation Technical Services Center. Denver, CO.

Folts-Zettner, T., K. Cherwin, R. Bennetts and R. Gatewood. 2007. Grassland Monitoring Protocol and Standard Operating Procedures for the Southern Plains I&M Network and Fire Group. Version 1.00. Natural Resource Report NPS/SOPN/NRTR-2007?00X. National Park Service, Fort Collins, CO.

Folts-Zettner T. 2009. Exotic plant monitoring in the Southern Plains Network. Natural Resource Report. NPS/SOPN/NRR—2009/099. National Park Service. Las Vegas, NM. Published Report-661584.

Folts-Zettner T and Sosinski H. 2011. Exotic plant monitoring in the Southern Plains Network: project report 2011. Natural Resource Technical Report. NPS/SOPN/NRTR—2012/538. National Park Service. Fort Collins, Colorado. Published Report-2182473.

Folts-Zettner T and Sosinski H. 2012. Exotic plant monitoring in the Southern Plains Network: project report 2012. Natural Resource Report. NPS/SOPN/NRTR—2012/655. National Park Service. Fort Collins, Colorado. Published Report-2192064.

Hoagland, B.W. and F.L. Johnson. 1999. Prairie restoration recommendations for the Guy Sandy area, CHIC, Murray county, Oklahoma. Oklahoma Biological Survey: Norman, OK. Muldavin, E., Y. Chauvin, A. Browder and T. Neville. 2009. A vegetation survey and map of Fort Union National Monument Park, New Mexico. Natural Heritage New Mexico. Albuquerque, NM. (Under review).

King, W. B. 1985. Island birds: Will the future repeat the past? Pages 3–15 in P. J. Moors, ed., Conservation of Island Birds. International Council for Bird

Preservation. Cambridge: Cambridge University Press

Muldavin E and Others. 2012. A vegetation classification and map: Pecos National Historical Park. Natural Resource Technical Report. NPS/SOPN/NRTR–2012/601. National Park Service. Fort Collins, Colorado. Published Report-2187389.

Neid, S., J.E. Stevens, K. Forest and M. Fink. 2007. Sand Creek Massacre National Historic Site: Vegetation Classification and Mapping. Natural Resource Technical Report NPS/SOPN/NRTR-2007/050. National Park Service, Fort Collins, CO.

Pellant, M., P. Shaver, D.A. Pyke, and J.E. Herrick. 2005. Interpreting indicators of rangeland health, version 4. Technical Reference 1734- 6. U.S. Department of the Interior, Bureau of Land Management, National Science and Technology Center, Denver, CO. BLM/ WO/ST-00/001+1734/REV05. 122 pp.

Science 277: 1300-1302.USDI National Park Service. 2003. Fire Monitoring Handbook. Boise (ID): Fire Management Program Center, National Interagency Fire Center. 274p

Southern Region Climate Center. 2012. CLIMOD data website. http://climod.srcc.lsu.edu/ (accessed 15 January 2013)

Stevens, J.E., K. Forrest, S. Neid and M. Fink. 2007. Bent's Old Fort National Historic Site: Vegetation Classification and Mapping. National Resource Technical Report NPS/SOPN/NRTR-2007/049. National Park Service, Fort Collins, Colorado.

Tilman, D., J. Knops, D. Wedin, P. Reich, M. Ritchie, and E. Sieman. 1997. The influence of functional diversity and composition on ecosystem processes.

Tilman, D. 1999. The ecological consequences of changes in biodiversity: a search for general principles. The Robert H. MacArthur Award Lecture. Ecology 80:1455-1474.

Vitousek, P.M. 1990. Biological invasions and ecosystem processes: towards an integration of population biology and ecosystem studies. Oikos 57: 7-13.

Western Region Climate Center. 2012. Cooperative Climatological Data Summaries website. http://www.wrcc.dri.edu/climatedata/climsum/ (accessed 15 January 2013)

Appendix A: Bent's Old Fort NHS Results Tables

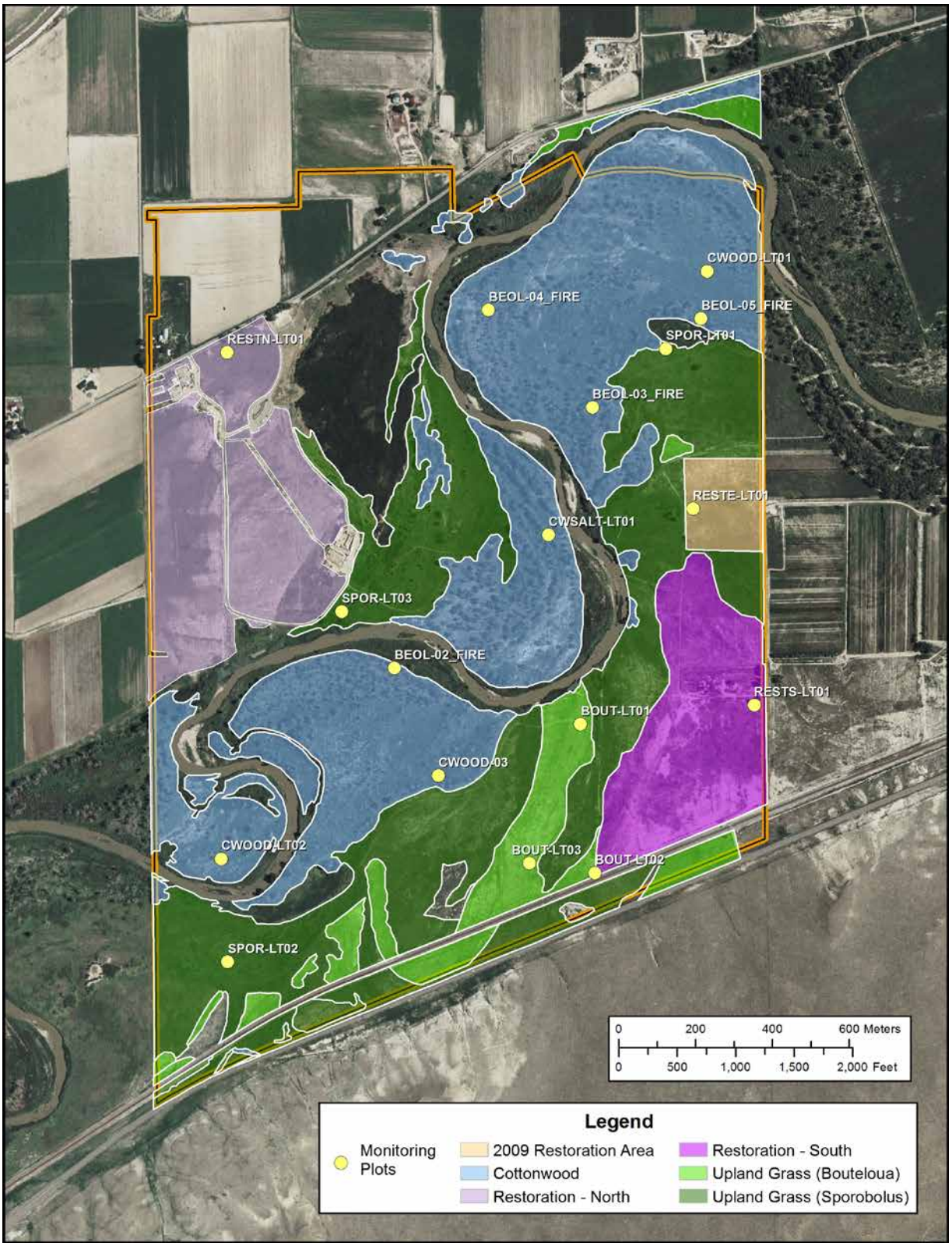


Figure A-1. Monitoring transects visited at Bent's Old Fort NHS in 2012.

Table A-1. Three year cottonwood community comparison of frequency and cover, by plot at Bent's Old Fort NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	CWOOD-LT01						CWOOD-LT02						CWOOD-03						BEOL-05						CWSALT-LT01					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																														
ARIPUR								1			5																			
DISSPI	4	5	4	98.5	103.5	27.5	2	3	2	1	10.5	3.5	2	4	4	13	76	83		4			46		5	5	5	95	25	13
ELYCAN							1			0															2	4		5.5	27	
ELYELY															1			0.5									1			1
MUHASP							1	1		5	15																			
PANOBT							1	3	1	7	17.5	0.5													5			8		
PASSMI								1			5		5	2	2	43.5	17.5	4							5	2	5	52	8	17.5
PLEJAM																									1			0.5		
SORHAL																										2			1.5	
SPOAIR							4	1	4	50	1	32		1			3									4	3		10	11.5
SPOCRY							1	3	1	7	11	5		1			0.5													
FORB																														
AMBPSI							4	2		30	5.5																			
APOCAN							2			0.5															1		2	3		1
ASCSPE																										1			3	
ASCSUB																				2			1		2	1	1	0.5	1	0.5
ASTBIS							1	1	2	70	10	4																		
CHEBER	1			0.5			3	4	3	4	21	2	1			10											3			2
CONARV								1	1		0.5	0.5								2			5.5							
CONCAN	2	2		7.5	4		1			3															1			0.5		
CUCFOE													1			0														
DESSOP			3			1.5																								
EUPDEN							1			0.5																				
GLYLEP							4	5	5	36	83	21.5													5	5	3	43	39	7
HELANN	1		1	*		7	3	1	1	4.5	0.5	0.5	2		1	3.5		0.5		3			2.5		1			3		
HELPET																									4	1		4	3	
KOCSCO	5	4	9	97	98	176.5	3	2	5	52	6	11.5	5	4	7	153.5	36	208.5		4			75.5		2	1	3	3	20	14
LACSER	1		1	10		0.5	1		1	*		0.5													3		3	1		2
LILYSSP	1	1		0.5	3																									

* = present but no value recorded. Pink highlight denotes an exotic species

Table A-1. Three year cottonwood community comparison of frequency and cover, by plot at Bent's Old Fort NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (continued)

Species	CWOOD-LT01						CWOOD-LT02						CWOOD-03						BEOL-05						CWSALT-LT01					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
MELALB																									1			0.5		
MENNUD							1			0.5																				
MIRNYC							1			0.5																				
PHYVIR							2	1		1	1																			
RATTAG							4	4	4	46	38	19																		
RUMCRI							1	1		1	0.5																			
SALTRA			1			0.5	1		4	5		2									3			1.5			1			1
WOODY																														
BACSAL							1	1	1	10	10	13																		
SALEXI																									2	2	4	38	63	7.5

* = present but no value recorded. Pink highlight denotes an exotic species

Table A-2. Three year blue grama and dropseed community comparison of frequency and cover, by plot at Bent's Old Fort NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	BOUT-LT01						BOUT-LT02						BOUT-LT03						SPOR-LT01						SPOR-LT02						SPOR-LT03					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																																				
ACHHYM													1			0.5																				
ARIPUR							2	2	2	32	17	11	1	1	2	7	7	1																		
BOUGRA	5	5	7	110	95	80			2			1	2	2	3	8	8	4.5	2	3	2	35	47	34												
DISSPI							1	4	4	5	19	2.5	3	3	3	3.5	26	6	4	4	5	93	86	51.5	5	5	5	275	215	290	5	5	5	115	167	127
ELYCAN	1			0.5																					1			1								
ELYELY	1	1		3	1		1	1		0.5	0.5		5		1	5.5		0.5																		
MUHASP																															1			0.5		
PANMIL																					1			0.5												
PANOBT																			3	3		11	10.5		4	1	1	5	3	0.5						
PASSMI																			3	2	1	20	20.5	3	3	4	2	7.5	35	5.5	5	5	5	145	41	14
PLEJAM			2			23																														
SCHPAN							1		1	1		1																								
SPOAIR																			3	3	4	80	65	61		3	2		18.5	1	1	1	1	1	0.5	0.5
SPOCRY	3	3		13	4		1	2		0.5	1.5		5	5	6	38	33	17.5																		
FORB																																				
ASCSUB																			3	2		4	1													
ASTBIS																				1			0.5													
ASTMIS2																			1			3														
CHAGLY	2	1		1	1		2	2		1.5	5.5			1			0.5		2			10														
CHAPRO	3			1										2			3.5																			
CHEBER																			1	1	1	1	0.5	1	3	1	4	1.5	1	2.5	1	1	1	20	1	0.5
CONARV							4	3	3	11.5	23	2.5													3	3	3	35.5	18.5	8.5	1	1	1	0	10	0.5
CONCAN	1			0															2			3														
CROTEX													2			0																				
DESSOP															2			1			1			0.5			1			0.5						
ERILON							1			0																										
EUPDEN													1			0.5																				
GAUMOL														1			0.5																			
GRISQU							1			1				1			0.5																			

* = present but no value recorded. Pink highlight denotes an exotic species

Table A-2. Three year blue grama and dropseed community comparison of frequency and cover, by plot at Bent's Old Fort NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (continued)

Species	BOUT-LT01						BOUT-LT02						BOUT-LT03						SPOR-LT01						SPOR-LT02						SPOR-LT03					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
HELANN	4		2	20.5		1.5	2			7			1		3	5		1.5	2		1	13		0.5	5		5	123		4.5	1			*		
HELPET	4			11.5									2			17																2			7.5	
IVAAXI																																	1			1
KOCSCO			2			1	5	3	4	20.5	4.5	2.5	2		7	1		4			2			1	1	1	3	1	3	1.5	2		2	1		3.5
LACSER	2			1															2		1	0.5		0.5	2			1					2			1
LAPOCC			2			1																														
LINARI	3			1.5																																
LYGJUN	1	1	1	0.5	1	0.5																														
MACPIN			1			0.5	2	5	5	6	25	3	1			3																				
MACTAN	2			1			5			23			3			8.5																				
MELALB													1			0																				
MENNUD	2			3.5																																
MIRNYC							1			0																										
PHYVIR													1			0.5			1			0.5			2			3.5								
RAYANN													3			38.5																				
RUMCRI							1			0									3			4.5														
SALTRA	2		5	0.5		3.5	4	1	5	2	3	27.5	4		8	1.5		18.5	1	1	2	0.5	1	1			2			1						
SOLCAR																			2			0.5									1			0		
SPHCOC	1	1	1	7	7	1	4	4	4	21	28	2.5	3	3		6.5	4.5																			
SYMERI									1			0.5									1			0.5	2		1	0.5		0.5						
SYMFAL2																															1	1		1	3	
TETLIN								1			3		1			0																				
TRADUB																			1			1														
WOODY																																				
ARTFIL	4	5	5	52	54.5	87	2	2	2	16	33	38	4	4	4	43	82	44																		

* = present but no value recorded. Pink highlight denotes an exotic species

Table A-3. Three year restoration community comparison of frequency and cover, by plot at Bent's Old Fort NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	RESTE-LT01						RESTN-LT01						RESTS-LT01					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																		
ARIPUR							3	2		11	1.5							
BOUCUR							5	5		20.5	25							
BOUGRA								2	4		6	11.5						
DISSPI	2		1	20.5		0.5	1	3		1	14							
MUHASP								1			3							
PANMIL													2			1		
PANVIR							1	1		0	3							
PASSMI							5	5	5	48	63	74						
PLEJAM							4	4	8	54	19	23.5						
SPOAIR							2	1		11	1							
SPOCRY							1			3								
FORB																		
AMBPSI	1			0														
ASCSUB	1	5	1	0.5	5.5	*		1			1			2	2		6	1
ASTBIS							3	2		1	3.5		3	4	3	1.5	11	1.5
CHAGLY	3	2		6.5	3.5													
CHAPRO	4	3		6.5	2								5	3		6.5	2	
CONARV	5	5	3	5.5	70	1	5	5	5	14.5	21.5	3.5	5	5	4	36	70	2
CONCAN	1	1		*	7													
GAUCOC	1			0														
HELANN	3		3	29		2							3		3	2		2.5
IVAAXI							1			0.5								
KOCSCO	5	2	5	41	1	51	2			1			5	4	5	69	13.5	7.5
OENVIL	2			1.5														
PHYVIR													1	1		*	1	
RATCOL															1			0.5
RAYANN	1			0														
RUMCRI	1			3														
SALTRA	4		5	9		48							1		5	0.5		7
SPHCOC													5	4	5	10.5	12	4
SYMERI			1			1								1	5		*	9
WOODY																		
ARTFIL													5			21.5		
POPALB									1			0.5						

* = present but no value recorded. Pink highlight denotes an exotic species

Appendix B: Capulin Volcano NM Results Tables

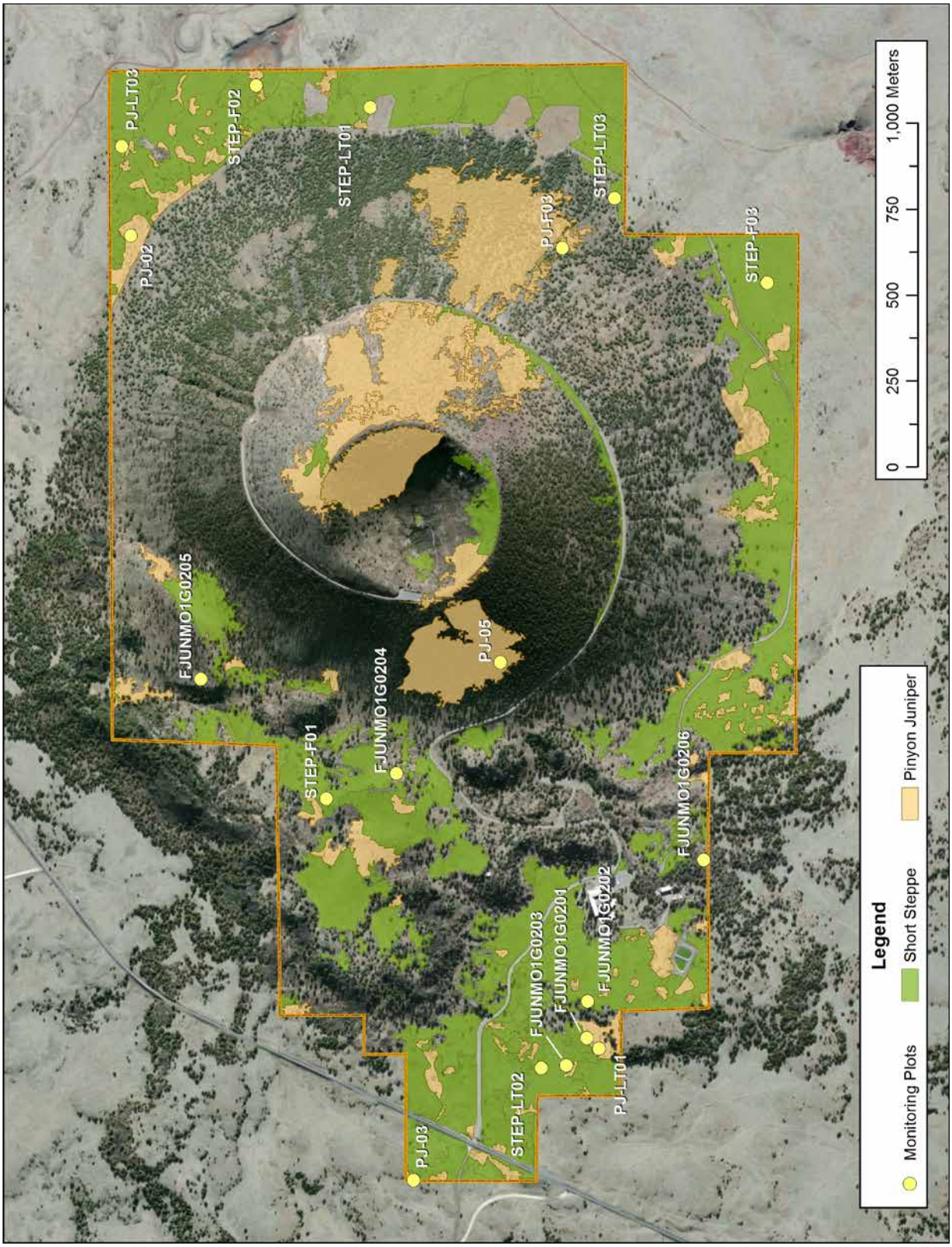


Figure B-1. Monitoring transects visited at Capulin Volcano NM in 2012.

Table B-1. Three year pinyon-juniper community comparison of frequency and cover, by plot at Capulin Volcano NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	PJ-LT01						PJ-03						PJ-LT03						PJ-204-FJUMO1G						PJ-205-FJUMO1G						PJ-206-FJUMO1G					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																																				
ANDGER	5	4		55	14		3	3		19	7		3	4		8	14																			
ARIPUR	3	4		40	8		3	1		4	1																						3			2
BOUCUR	4	5	2	20	19	1.5	4	3	3	15.5	15	2	4	3	3	12	16	6			2			5.5									1			0.5
BOUGRA	5	3	5	30	25	13	5	3	5	54	21	38	5		5	21		25			4			17			3			11.5			2			13.5
BROJAP			1			0.5									1			1			1			3			2			13.5						
BROPOR																											1			1						
BROTEC																											1			0.5						
BUCDAC			2			1.5			5			71		1	1		3	0.5															2			7.5
CARINO																					3			5												
CARSSP							1			3			2	2		5.5	4																			
ELYELY	3	3		5	5		4	1	1	21	25	0.5	5	3	3	22	2	2									1			0.5					
FESARI													3		1	1.5		0.5			3			8.5												
LYCSET	3			35			2		2	35		7.5			1			0.5			1			1									2			3.5
MUHMON	4	4	3	17	11.5	9	2	2	1	3	1.5	1			1			0.5			3			4.5			3			9			1			0.5
MUHTOR							1			*																										
MUHWRI			3			4.5			1			1			1			0.5									3			11			3			6
PASSMI	3	3	2	6.5	1.5	5.5	3	2	1	4	1.5	0.5	10	5	4	10	5.5	5			1			1			1			1			2			1
POAFEN	2	2	1	1	2	1							1		2	3		1.5															1			0.5
SCHSCO		2	4		4	14	2	4	5	6	26	19.5	5	5	5	50	38	37			3			9									3			2
SPOCRY							1			3			1	1	1	0.5	1	0.5															1			1
FORB																																				
ACHMIL														1			0.5																			
ALLCER							1	2		0.5	1		1			0.5																				
ARTCAR			3			2			4			19.5			3			3			1			0.5									1			0.5
ARTDRA								1			0.5																									
ARTFRI	4	3	2	16.5	6.5	1	5	5	3	30	13	4.5	5	5	4	30.5	10.5	11.5			4			2.5			5			15						
ARTLUD													2	1		3	0.5				3			1.5			1			0.5						
CASINT							1			*				1			1																			
CHAERI															2			1.5																		

* = present but no value recorded. Pink highlight denotes an exotic species

Table B-1. Three year pinyon-juniper community comparison of frequency and cover, by plot at Capulin Volcano NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (continued)

Species	PJ-LT01						PJ-03						PJ-LT03						PJ-204-FJUMO1G						PJ-205-FJUMO1G						PJ-206-FJUMO1G					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
CHASER2	1	1		0	0.5																															
CHELEP							1			*			3		2	1.5		1.5			1			0.5												
CHEPRA	5		3	3		8.5	2			*					1			0.5			2			1			1			0.5						
CIRUND	3	1		1	0.5		1			*																										
ERIDIV															1			0.5																		
ERIFLA													3			1.5																				
ERIJAM							1	1	3	3	1	1	1	1		15	1				1			0.5												
FRBLNG			1			0.5																					1			0.5						
GAUCOC	2	3	1	0.5	1.5	*	1	1	1	0.5	1	*			1			1																		
GUTSAR							4	1	2	4	0.5	1.5															1		0.5							
HELANN	2		1	7		0.5	3			1.5			4		3	4		1.5			2			1												
HELMUL													2			1.5																				
HETVIL	1			*			5	5	4	27	17	9	2	2	2	15	6	1.5																		
KOCSCO			1			0.5			1			1																								
LACSER							1			3																										
LAPOCC													1			0.5											3			6.5						
LIAPUN	1		1	1		0.5	3			5																										
LITMUL	2		2	1.5		1.5							1			*					1			0.5												
LUPARG	2	2	1	13	1	0.5	3	1	2	6	3	1	1			*																				
MACPIN							1	1		0	0.5																						1			0.5
MENMUL														1			0.5																			
MENNUD							1			0.5																										
ORTLUT	1	1		*	0.5																															
PACNEO	1			*			2			1				1			7																			
PENANG													1		2	1		5.5									3			1.5						
POLDOD	1			0.5																																
PSOTEN							1	1	3	5	0.5	2																								
RATTAG																																	1			0.5
SALTRA			2			1.5							2	1	5	1	1	3			4			17												
SOLCAN	2			*																																
SOLMOL																											1			3						

* = present but no value recorded. Pink highlight denotes an exotic species

Table B-1. Three year pinyon-juniper community comparison of frequency and cover, by plot at Capulin Volcano NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (continued)

Species	PJ-LT01						PJ-03						PJ-LT03						PJ-204-FJUMO1G						PJ-205-FJUMO1G						PJ-206-FJUMO1G					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
SPHCOC			1			1	1		1	*		0.5									1			0.5									1			0.5
THEMEG							3		2	6		3.5																								
TRADUB							3			1					2			1			2			1			1			0.5						
VICAME	3			2			3			1.5																										
WOODY																																				
CERMON																											5			40						
ECHVIR							1		2	*		1.5									1			0.5												
JUNSCO	1	1	1	60	30	80																											3			40.5
OPUPHA																					1			0.5												
OPUPOL													1			*											1			3						
QUEGAM																											2			20						
RHUTRI							1			*																	2			6						
YUCGLA		1			1			1			0.5		5	2	3	27.5	25	25.5																		

* = present but no value recorded. Pink highlight denotes an exotic species

Table B-2. Three year shortgrass steppe community comparison of frequency and cover, by plot at Capulin Volcano NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	STEP-LT01						STEP-LT02						STEP-LT03						STEP-202-FJUMO1G						STEP-203-FJUMO1G					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																														
ACHROB																					1			1						
ANDGER	5	5		43	24		1	1		15	7		1	3		0.5	4.5													
ARIPUR	1	2	1	7	15	1	3	1	1	2	5	1	2	3	1	4	6.5	*			3			3						
BOUCUR	4	1	4	18.5	1	11	4	2	2	30.5	7.5	1.5	2	2		0.5	2										1			0.5
BOUGRA	5	1	2	25.5	5	15	5	4	5	19.5	18	29.5									4			18.5			3			30
BROINE															1			0.5												
BROJAP									1			0.5									1			0.5			2			1.5
BROPOR	2			0.5									3			16														
BUCDAC		1			0.5																3			8.5			1			5
ELYELY	5	2		18	2		5	1		24.5	3		2	2	1	10	8	0.5			1			0.5						
LYCSET							3		2	41		8									3			15.5			1			1
MUHMON							5	3	5	19	11	35			1			0.5			3			2			4			21.5
MUHWRI																					2			3.5			1			0.5
PASSMI		2	2		1	1.5	4	4	5	28	3	12.5		2	1		3.5	*			4			3			5			11.5
POAFEN							1			*											3			1.5			1			0.5
SCHSCO	4	2	5	35	55	82	1	2	3	0.5	20	12	1		1	*		3			2			18			2			3.5
SPOCRY			1			3																								
FORB																														
AMAHYB	1	1		1	0.5								2			2														
ARGHIS	1	1		1	0.5									1			1													
ARTCAR			5			10.5			4			7									3			2			4			6
ARTDRA		1			1		1	2		*	1																			
ARTFRI	5	5	3	45	30	1.5	5	5	4	55.5	28.5	10	2			*					1			0.5			2			3.5
CHAFEN	1			0.5																										
CHASER2													2	1		*	0.5													
CHEFRE															2			1												
CHEHIA																											1			0.5
CHEPRA			2			1.5	2		2	1		1									2			1			2			1.5
CIRUND							3	1	1	1.5	0.5	0.5															1			0.5

Notes: * = present but no value recorded. Pink highlight denotes an exotic species

Table B-2. Three year pinyon-juniper community comparison of frequency and cover, by plot at Capulin Volcano NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (continued)

Species	STEP-LT01						STEP-LT02						STEP-LT03						STEP-202-FJUMO1G						STEP-203-FJUMO1G					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
ERIDIV									1			0.5																		
EUPDAV	2			1									2			1														
FRBLNG									1			0.5																		
GAUCOC							1	2	1	0.5	1.5	0.5									1			0.5			1			0.5
GUTSAR							3		3	3.5		2									1			0.5			3			2
HELANN	3	2		45	1		4		1	11.5		0.5	4			22											1			0.5
HELMUL	2	1		3	0.5																									
HETVIL	2	1	1	7	0.5	1	3	1	1	0.5	3	0.5			2			1			3			2			4			2
LACSER	1			0.5			2	1		5.5	0.5		2			1.5														
LAPOCC	1		1	0.5		0.5							1			*														
LIAPUN							3		3	2		1.5																		
LITMUL									1			0.5																		
LUPARG							1			1																				
MARVUL													1			1														
MELALB													1			*														
MENNUD	2	1		3	0.5								1			10														
MIRLIN							2			1.5																				
OENCAE																					1			0.5						
PACNEO	1	1		0.5	0.5		1			*																				
PECANG													2	1		15	1													
PENANG	1			3																										
PENSSP			1			0.5																								
PHAHET													2			10														
PHYSUB	1			0.5									3			12														
PINSSP														1			1													
POLDOD	3			1.5																										
RATCOL							1			*																				
RATTAG	1	1	1	0.5	0.5	0.5	1			*																				
ROSWOO															1			0.5												
SALTRA	1	1	2	3	3	16			1			0.5	4	2	5	13.5	14	11.5			1			0.5			3			11
SENFLA	1			0.5																										

Notes: * = present but no value recorded. Pink highlight denotes an exotic species

Table B-2. Three year pinyon-juniper community comparison of frequency and cover, by plot at Capulin Volcano NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (continued)

Species	STEP-LT01						STEP-LT02						STEP-LT03						STEP-202-FJUMO1G						STEP-203-FJUMO1G					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
SOLCAN							3			1.5																				
SOLVEL																											1			0.5
SPHCOC							3	3	3	4	2.5	1.5									2			1			3			2
STEMIN							1	1	3	3	0.5	2																		
THEMEG	5		2	4.5		1	4	1		2.5	0.5																			
TRADUB	1			0.5			2			1			1			0.5					2			1			1			0.5
VERENC													1			0.5														
VERTHA	1			*			2		1	1.5		0.5									1			3						
VICAME							4			2																				
WOODY																														
ECHVIR			1			0.5	1	1	1	1	3	1									1			0.5			2			1
JUNMON																					1			65						
OPUPHA																					1			1						
PINSSP																														
QUEGAM													2	2	2	130	135	155			1			0.5						
RHUTRI													2	3	2	90	21.5	22			1			0.5						
YUCGLA	3	4	4	8.5	11.5	9.5		1			0.5		3	1	2	32	25	26												

Notes: * = present but no value recorded. Pink highlight denotes an exotic species

Appendix C: Chickasaw NRA Results Tables

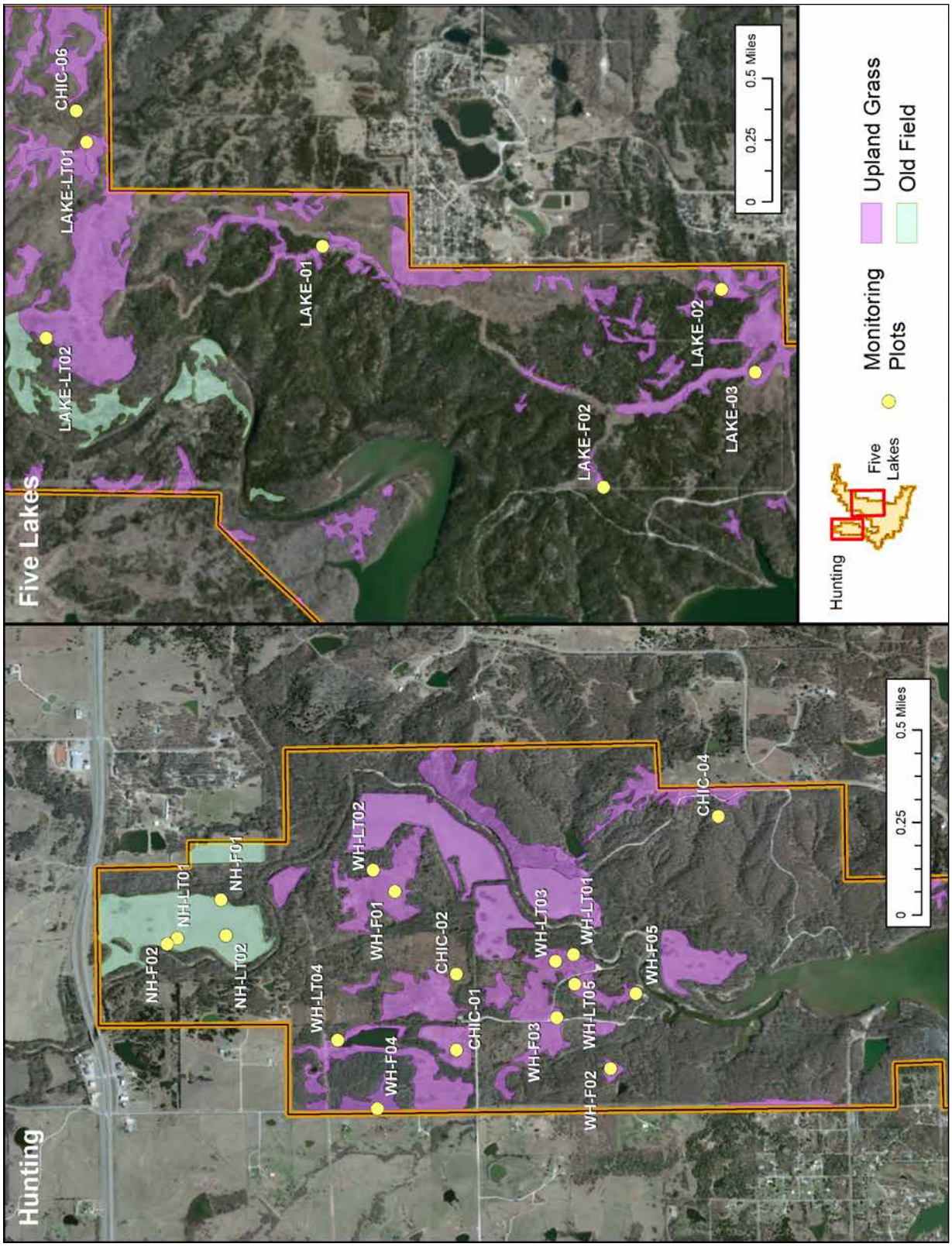


Figure C-1. Monitoring transects visted at Chickasaw NRA in 2012.

Table C-1. Three-year upland grass community comparison of frequency and cover, by plot at Chickasaw NRA. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	LAKE-LT01						LAKE-LT02						LAKE-03						LAKE-01						LAKE-02						LAKE-F02					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																																				
ANDGER															2			1		5			108.5			3	1		22	0.5						
ANDGLO														1			10																			
ANDVIR													4	4		6.5	21.5																			
ARIPUR	4	4	1	54	10	1	3	1	3	8.5	3	7	1	2		1	3.5																			
BOTISC	1	1		20	15																															
BOTLAG		1			0.5																2			1.5							1			8		
BOUCUR	1	1		0.5	1		2	2	3	2.5	5.5	8									1			1												
BOUHIR	1			5			3	2	1	2	7	0.5							1			0.5														
BROJAP			2			1									2			5.5									1			0.5						
CARALB																										2			1							
CARSSP	2	1		5.5	0.5		1	2		1	1.5		4	4		12.5	3			1	2		1	1	1		5	0.5		3.1	4		6			
CARSSP1													3			8																				
CARSSP2													3			7															2		0.5			
CYNDAC	1	1		1	3																															
DICACU	2	2	3	1.5	13.5	4.5							5	5	5	85.5	50.5	10									2			1.5	4		26.5			
DICCLA							2		1	3.5		0.5								1			7			3			1.5		2		3			
DICLIN																											1			0.5						
ELYCAN																			4			12			4			15.5			2		3.5			
ELYELY																										2			1							
ELYVIR																											2			8						
ERACAP															2			7.5													1		0.5			
ERAINT			3			8.5																														
ERASPE																									2			1								
JUNMAR															3			1.5																		
JUNTEN														2			1																			
LEPPAN																															1		45			
MUHSYL		2	2		1	6																														
NASLEU		1			0.5		2			10.5											1			0.5							2		0.5			
PANCAP																											1			0.5						

* = present but no value recorded. Pink highlight denotes an exotic species

Table C-1. Three-year upland grass community comparison of frequency and cover, by plot at Chickasaw NRA. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	LAKE-LT01						LAKE-LT02						LAKE-03						LAKE-01						LAKE-02						LAKE-F02					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
PANVIR	2		1	4		0.5	3	2	1	14	6	0.5	4	1	1	12	5	0.5									1			0.5						
POAARA																			1			0.5														
SCHSCO	3	3	2	61.5	25	6	5	5	3	53.5	83.5	6.5			1			1	5		4	38.5		31	4		1	37		20	2		1			
SORHAL	2	1		2	0.5														3			1.5			5		1	38		1						
SORNUT	1	2		0.5	16		3			1				1	1		3	0.5		3	3		7	15		2	2		5.5	1	3		2			
SPHOBT																											1			0.5						
SPOCOM									5			14.5																								
SPOCRY	1			3																																
TRIMUT																															1		3			
VULOCT																											1			0.5						
FORB																																				
ACAANG	1	4	1	0.5	2	0.5	2	1		1	0.5		2	2		1	1			1	1		0.5	0.5		2	1		1	0.5						
ACHMIL																										1	2		0.5	1.5						
AMBART	1			3																																
AMBPSI	5	4	3	10	7	4.5	4	4	1	7.5	13.5	0.5	4	4	2	13	5	1		1	1		0.5	1	3	1	3	5.5	10	4	1		0.5			
AMPDRA			3			2																														
ANTPAR1																											1			0.5						
ARTCAR			1			1																														
ARTLUD																										1	1		0.5	3						
ASCASP	3			0.5																																
ASCVIR2													2	1	1	0.5	0.5	0.5								2			3.5						
ASTPRA																					1			0.5		2	3		3.5	1.5	1		1			
BAPAUS							2	2		13	7																				1		0.5			
CALBER																											1			0.5						
CALINV							1			0.5																										
CALSER							2	3		4	7																									
CENAME			1			0.5																														
CHAFAS															1			0.5									1			0.5						
CHAMAC							2			0.5																	1			0.5						
CHAMIS	1	3		0.5	6		1			0.5																										
CHEBER																									1			0.5								

* = present but no value recorded. Pink highlight denotes an exotic species

Table C-1. Three-year upland grass community comparison of frequency and cover, by plot at Chickasaw NRA. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	LAKE-LT01						LAKE-LT02						LAKE-03						LAKE-01						LAKE-02						LAKE-F02					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
CHESIM																															1			0.5		
CHRPIL							1			0.5																										
CIRALT													3		3	0.5		10.5																		
CIRUND	2	2	2	28	40	4									3			2.5			1			0.5												
CLIMAR							1			0.5																					1			1		
COCCAR																											1			1						
CONCAN													3	2	2	1.5	1	1.5			2			1			5			3	1			0.5		
CORTIN	2			16			1			0.5																										
CORVAR																					3			4												
CROMON	3	1	4	1	0.5	4.5	3	1	4	1	0.5	9.5	2	3	1	1	2	0.5			4			2	2		2	1		1	5			17.5		
DALAUR																					2			1												
DALENN	1	3	1	3	4	0.5	4	3		1.5	1.5		1			1				1			0.5								3			5.5		
DALPUR	2	1		0.5	0.5															1			0.5								1			0.5		
DESILL1	2	3		1	4.5									1	1		3	1									2			1						
DESPAN								2			1																									
ERIANN1	1			0.5																																
ERILON							3	3		0.5	2		1			0.5																				
ERISTR																					1			0.5			3			1.5						
ERYLEA		2	5		1	8			3			10.5																								
EUPBIC								1			0.5																									
EUPDEN																											2			1	2			0.5		
EVONUT									3			2																								
FRBLNG															2			1																		
GAIPUL	5		2	16		1.5																														
GALSSP																									3			8.5								
GLABIP	1			0.5																	1			0.5												
GRIPAP	4		1	1		0.5	1	2	1	0.5	1.5	0.5																								
HEDNIG																															1			0.5		
HELHIR							1			0.5																										
HELTEN									2			1																								
HETVIL													1		1	0.5		0.5													2			0.5		

* = present but no value recorded. Pink highlight denotes an exotic species

Table C-1. Three-year upland grass community comparison of frequency and cover, by plot at Chickasaw NRA. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	LAKE-LT01						LAKE-LT02						LAKE-03						LAKE-01						LAKE-02						LAKE-F02					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
HYBVER	3			5			2			1																					2			1		
INDMIN							1			0.5																					1			0.5		
KRALAN																			2			1			1			0.5								
LACSER								1	2		0.5	1								1			0.5			2			3.5							
LATHIR													1			0.5																				
LESCUN													2	2		1	3.5								2			13.5								
LESPRO													2	3	1	1	2	0.5				4	2		3	1										
LESVIR																						1	2		0.5	1										
LINMED																															1			0.5		
LINPRA	1			3																																
MEDLUP	2			1.5																																
MELALB													2			18																				
MELOFF														1			5																			
MINMIC	2			0.5																																
MOLVER													2			0.5															1			0.5		
MONCIT													1	3	2	13	4.5	3.5																		
MONFIS													2			3.5			1			0.5														
NUTTEX																															2			0.5		
OXASTR														1	4		0.5	2								4			6.5		4			1.5		
PACOBO																															1			1		
PENCOB	1			0.5			1			0.5																										
PENOKL							1			0.5																										
PLAPAT									2			1.5									1			0.5												
PLARHO																					3			6			4			2.5						
PLAVIR																											6			4						
POLNUT	1		1	0.5		0.5			4			2.5																								
PSOTEN																					2			1												
RANARB																															1			0.5		
RUDHIR													1			1																				
SALTRA			1			0.5																2			1											
SIDABU	2			3.5			1			0.5																										

* = present but no value recorded. Pink highlight denotes an exotic species

Table 4.3-2. Three-year upland grass community comparison of frequency and cover, by plot at Chickasaw NRA. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	LAKE-LT01						LAKE-LT02						LAKE-03						LAKE-01						LAKE-02						LAKE-F02					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
SOLCAN																			3			1.5			3			3.5								
SOLCAR			1			0.5																														
SOLELA	2			1																																
SOLULM																										1			0.5							
SONASP							2			1.5																										
SPEINE																				1			0.5													
STRLEI														1			0.5		2			2														
SYMERI			1			0.5			1			0.5																								
SYMORB							1			5																					2			1.5		
SYMPRA													1	3	3	0.5	12.5	8		1			0.5			1	2		*	1						
TETLIN																											1			0.5						
TEUCAN														2			50																			
TORARV	3			1									4	5	5	9	32	38																		
TRARAM		1			1			1			0.5																									
TRIDUB																															1			0.5		
TRIPER							1			0.5			4			1.5																				
VERBAL													4	2	3	25.5	7.5	2																		
VERBRA1																											1			3						
WOODY																																				
ACENEG														2			21																			
BROPAP																									1	1		3	5							
CERCAN							3		1	3		0.5	2	1	1	45	85	35													2			1.5		
CORDRU							1		1	3		0.5																								
ESCVIV		1			1																															
FRAAME																										1			1							
FRACAR																															1			1		
FRAPEN													1	1	4	7	48	9									1			7						
FRAXSSP								1			3			3	3		9	73													4			80.5		
JUNVIR							2	1	1	0.5	1	1															1			1	2			1.5		
OPUENG		3	3		2	5		1			3														2			3.5								
OPUMAC	4			2.5			1			0.5																										

* = present but no value recorded. Pink highlight denotes an exotic species

Table C-1. Three-year upland grass community comparison of frequency and cover, by plot at Chickasaw NRA. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	LAKE-LT01						LAKE-LT02						LAKE-03						LAKE-01					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
PARQUI																								
PRUANG															1			3						
PRUSER							1			0.5														
PRUVIR																								
QUEMAR																								
QUESHU							2			70					1			1						
QUESTE													1	1		2	3							
RHUCOP													3	3	3	55	95.5	38						
RHUGLA														2	1		16	1						
RHUTRI			1			0.5																		
SMIBON		1	1		3	1							3	4	4	25	76	15.5		2			1	
SMIHER	1			5									2	2		15	26							
TOXRAD														1			0.5							
ULMALA	1			0.5			3	3	2	75.5	11	1.5	5	3	4	7	9	4.5						
ULMAME																								
VITSSP																								

Species	LAKE-02						LAKE-F02					
	Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
PARQUI		1			0.5							
PRUANG												
PRUSER			1			1						
PRUVIR		1			3							
QUEMAR	4	3	1	29	31	10						
QUESHU							4			9		
QUESTE			2			28	1			8		
RHUCOP	4	2		33.5	1.5							
RHUGLA			1			0.5						
RHUTRI		1			3							
SMIBON	4	4	3	5	4.5	5	3			1.5		
SMIHER							2			10.5		
TOXRAD												
ULMALA	4	2	5	21	6	23	4			50		
ULMAME		2			6							
VITSSP							2			1		

* = present but no value recorded. Pink highlight denotes an exotic species

Table C-2. Three year upland grass community comparison of frequency and cover, by plot at Chickasaw NRA. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	WH-01						WH-LT01						WH-LT02						WH-LT03						WH-LT05					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																														
ANDGLO															1			3			2			1			1			3
ARIPUR		1			1															1			0.5							
BOTISC			3			18.5								2	5		7.5	6			1			0.5			2			6
BOTLAG														2			1													
BOUCUR		1			0.5																				1			3		
BOUHIR														1			0.5													
BROCAT		1			0.5																									
BROJAP	1		3	7		6.5													1	2	5		1.5	79			2			3.5
BROTEC																				2			8							
CARALB																					1			0.5						
CARCEP			3			8																					2			3.5
CARGRA2									1			0.5									1			0.5			2			1
CARSSP	3	4		8.5	2.5		3	2		21	1.5			4	2		8	1	4	3	1	3.5	4	0.5	1	4		0.5	7.5	
CARSSP2																									1			0.5		
DICACU			5			11.5	5	2	4	3.5	3.5	2		5	4		7	2	2	5	3	3.5	59	1.5		1	5		1	3.5
DICBOS			1			0.5																								
DICCLA																			3			21			5	3		14.5	6	
DICLAX	5	4		33	33																									
ELYCAN	3			2			2	2		0.5	4								1			0.5								
ELYVIR			1			1		1	3		5	1.5			1			0.5			1			0.5						
ERACAP															3			1.5							4		4	14		26
GRSSLNG															1			0.5												
JUNMAR															1			0.5			1			0.5						
NASLEU			3			1.5																								
PANCAP			2			3																								
PANVIR																			2		1	2		0.5	2	2		4	3.5	
PASLAE	1			3																										
SCHSCO	5	5	1	60.5	85	0.5	4	4	7	93	128	91		4	4		148	22.5	5	3	2	73.5	33	7.5	5	5	5	61	125	31
SETPAR		1			0.5																									

* = present but no value recorded. Pink highlight denotes an exotic species

Table C-2. Three year upland grass community comparison of frequency and cover, by plot at Chickasaw NRA. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	WH-01						WH-LT01						WH-LT02						WH-LT03						WH-LT05					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
SORHAL	1		1	10		0.5													1	3	1	10	25.5	0.5						
SORNUT	4	2	4	36	4	21	4	3	4	28	15	5		5	3		12.5	4.5	5	2	1	4.5	3.5	0.5	5	3	5	10.5	9	10
SPHOBT																									1			3		
VULOCT																					1			0.5			2			1.5
FORB																														
ACAANG			3			4								1	1		0.5	0.5							2	1		0.5	0.5	
ACHMIL	4	3	4	4	1.5	3	4			2				2	4		3.5	2.5	4	1	2	1	7	1.5	3	1	2	1	1	5.5
AMBART																					1			3			1			3
AMBPSI	3	4	5	10.5	78	73.5	1			0.5				5	5		24.5	32	4	1		26.5	1		5	4	2	14	6	1
AMMPOP	3			1																										
ANTPAR1															5			5.5									1			0.5
APOCAN								2			3.5																			
ARNPLA	2			1																										
ARTCAR	4	5	4	25.5	34.5	12	3	3	3	5	2	1.5			1			0.5	4	4	3	22.5	24	6.5			1			5
ASCVIR1																											1			1
ASCVIR2		2	2		5.5	3.5		1	1		1	0.5			1			0.5	1		1	0.5		0.5			1			0.5
ASTPRA	4		4	17		12.5									1			0.5	4	1		2	65		4	5	3	60.5	27.5	13.5
BAPALB															1			1												
BAPAUS			4			78									1			1												
BAPSPH	5	5		95	88									2			7.5													
CALINV							1	1		0.5	0.5								2			0.5								
CHAFAS								1			0.5				1			0.5		1			0.5							
CHALAT2	1			1																										
CHANIC																											2			1
CHRPIL							1			3															3			2		
CIRALT									2			1									1			0.5						
CIRUND															1			0.5												
COCCAR							1	3	2	1	1.5	3.5							4	3	4	18.5	5	17.5						
CONCAN		3			2.5									3	1		2	0.5		1			0.5				2			1.5
CROMON														1	1		0.5	0.5								1			0.5	
CUSCUTA																			2			7								

* = present but no value recorded. Pink highlight denotes an exotic species

Table C-2. Three year upland grass community comparison of frequency and cover, by plot at Chickasaw NRA. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	WH-01						WH-LT01						WH-LT02						WH-LT03						WH-LT05					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
DALENN																			1			1								
DAUPUS									1			0.5			1			0.5												
DESILL1	4	2	1	8	1	0.5	3			1					1			0.5	2			1.5			3			1.5		
DESPAN																			1			0.5								
DESSES													2		1	4		1	2		2	1		1						
ERIANN1	1			0.5				1			0.5		1			0.5									2	1		1.5	1	
ERIANN2															3			1.5												
ERISTR	3		5	4.5		5.5	2			1					4			2									5			30
EUPBIC		1	2		0.5	1																								
FRBLNG															1			0.5												
GAMPUR															1			0.5									4			2
GAUSIN															1			0.5												
GERCAR																					2			1			2			1
GEUCAN																				1			0.5							
GRIPAP															1			0.5			1			0.5						
HELHIR															1			0.5							1			1		
HIELON									1			0.5			1			0.5												
INDMIN															1			0.5												
LACSER									3			1.5									1			0.5						
LATHIR																					1			0.5						
LESCUN							3	5	5	16.5	26.5	1.5		2			5.5		5	4	3	147.5	73	1.5	5	5	4	34	54	36.5
LESPRO							4	2		6	1			1	2		7	1	5	1	2	78.5	0.5	1.5						
LESVIO								2	3		8	1.5			1			0.5												
LESVIR							1		3	0.5		1.5			1			0.5			3			4			2			1.5
LIAMUC							1	1	1	1	1	0.5		2	2		4	3.5												
LINSUL															4			4.5												
MOLVER							1			0.5																				
MONCIT															1			0.5									1			0.5
OXASTR			3			1.5		1			0.5				3			1.5	1			0.5					4			3.5
PLAPAT									1			1			3			1.5												
PLARHO			3			1.5			1			0.5									1			0.5						

* = present but no value recorded. Pink highlight denotes an exotic species

Table C-2. Three year upland grass community comparison of frequency and cover, by plot at Chickasaw NRA. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	WH-01						WH-LT01						WH-LT02						WH-LT03						WH-LT05					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
PLAVIR			2			1			1			0.5			3			1.5									3			16
POLNUT			2			1			1			0.5			3			2.5	3		1	17		0.5	5		4	5		4.5
PSEOBT			1			0.5									5			2.5												
PYRCAR															1			0.5												
RANARB							1			0.5																				
RATCOL																									1			0.5		
RUBFLA	1		1	1		0.5	1	1		4	17			1	1		3	0.5							2	2		40.5	4	
RUBTRI																				3			96				1			20
RUDHIR							2		1	0.5		0.5			3			2.5	4		2	2		1	2		2	0.5		1
RUMALT																			1			0.5								
SABCAM	4		4	5.5		2.5									3			19												
SESHER								1			0.5																			
SILANT																					1			0.5						
SOLCAN			1			0.5																					1			0.5
SOLELA							1			0.5																				
SOLGIG																									1		2	1		1.5
SOLMIS																									4	4	1	26.5	44	3
SOLNEM														2			1													
SOLPTY								1			0.5									1			3							
SPEINE									4			2																		
STRLEI								3			55.5			1			1			2			51			1			3	
SYMERI		5			8.5			2			1			5			3													
SYMORB	3	4	3	25	6.5	11.5	1	1		5	13			1	1		3	10	1	1		0.5	7		2	1	2	25	13	8
SYMPRA	2		4	8		15	1		1	0.5		0.5			4			2.5	1	2	3	1	1	2	4	1	5	11.5	0.5	7
TORARV							1			0.5																	1			0.5
TRIPER			1			0.5			3			1.5									1			0.5			3			1
VALRAD															1			0.5												
VICLUD							1		1	0.5		0.5																		
WOODY																														
CELLAE	1			1																	2			5.5						
CELSSP	1	1	2	8	7	11	2	2	3	20	45	66			1			0.5												

* = present but no value recorded. Pink highlight denotes an exotic species

Table C-2. Three year upland grass community comparison of frequency and cover, by plot at Chickasaw NRA. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	WH-01						WH-LT01						WH-LT02						WH-LT03						WH-LT05					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
CORDRU																				1			5							
DIOVIR2							1	1		15	5																1			0.5
JUNVIR							1			0.5																				
MORRUB							1			15																				
MORUS							1	1	1	8	3	0.5																		
PARQUI								1	1		15	1																		
PRUANG								1			15										2			2	2	1	1	3	3	0.5
QUEMUH								1			1																			
QUESTE								2			90																			
RHUCOP							5	1	1	60	13	10							2	4	4	50.5	188	3	2	1	1	40	45	35
RHUTRI	3	1	4	1	1	2	3	3	3	17	62	27								1			0.5							
SMIBON	1			5			3			13									1	4		0.5	155							
TOXRAD							5	4	4	56.5	73	30.5		4	2		8.5	1	1	2	1	0.5	25	0.5						
ULMALA																			1	1	2	2	0.5	35.5	3	3	3	21	22	36.5
VITVUL																				1			7							

* = present but no value recorded. Pink highlight denotes an exotic species

Table C-3. Three year upland grass community comparison of frequency and cover, by plot at Chickasaw NRA. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	WH-F03						CHIC-01						NH-LT01						NH-LT02					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																								
ANDGER									2			7.5												
ARIPUR	3			8.5										1			0.5							
BOUHIR																			2			0.5		
BROJAP														2	5		1.5	47.5	4	2	5	4	13	97.5
BROTEC																			1			0.5		
BUCDAC									2			3.5												
CARCEP									1			10												
CARSSP	4			17.5										2			1		2	5	4	1.5	12	2
DICACU	2			3					4			3												
DICCLA	2			1.5																				
DICLAX													5	5	4	63.5	217	16	4	3	3	4.5	32.5	1.5
ERACAP													1			0.5			5			51.5		
HORJUB																					4			10.5
JUNMAR									1			0.5												
LOLPER															4			2.5	3		5	20		91
RHYGLO									4			2												
SCHSCO	5			78					5			50.5								2			1	
SORHAL														3	2		14.5	34	2	5	5	3.5	76	31
SORNUT	4			20					5			41.5								1			0.5	
FORB																								
ACAANG									1			0.5												
ACHMIL	1			0.5					1			0.5	5	2		1.5	3.5		4	4	3	9	10	1
AMBPSI	3			1.5					3			2												
ANTPAR1									3			1.5			1			0.5						
ARESER																			1			0.5		
ARTCAR	1			10																				
ASCVIR																			2			0.5		
ASCVIR2									1			1												
ASTPRA	1			0.5					1			0.5												

* = present but no value recorded. Pink highlight denotes an exotic species

Table C-3. Three year upland grass community comparison of frequency and cover, by plot at Chickasaw NRA. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	WH-F03						CHIC-01						NH-LT01						NH-LT02					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
CHAMIS																			1			0.5		
CHANUT																			1			0.5		
CHEGLA	1			0.5																				
CHRPIL																			2		3	1		1.5
CIRALT																				1			3	
CIRUND																			1			0.5		
CONCAN													3	1		1	5		5			6.5		
CROMON																			1	1		5	0.5	
DALMUL	2			1																				
DALPUR									1			0.5												
DESILL	5			81																				
DIAARM																			4	1	1	10	0.5	0.5
ERIANN1														1			10		4	1		6	1	
ERILON	1			3																				
ERISTR									3			4.5												
EROCIC																			1			3		
EUPBIC																				1			0.5	
EUSEXA	2			5																				
FRBLNG									2			1												
GAIPUL														1	2		0.5	0.9						
HEDDRU																			2			1		
HEDNIG	1			0.5																				
HELHIR									4			49.5												
HELMAX	1			0.5																				
LACFLO																					1			0.5
LATHIR																			4	1	3	14	5	1.5
LEPVIR													4			2.5								
LESCUN	1			0.5																				
LESPRO	2			3.5					1			7												
LIAMUC	3			8.5					4			2.5												
LINMED																			2			1		

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Table C-3. Three year upland grass community comparison of frequency and cover, by plot at Chickasaw NRA. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	WH-F03						CHIC-01						NH-LT01						NH-LT02					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
LINSUL									3			1.5												
MENOLI													1			0.5								
MIMNUT	1			0.5																				
MONCIT	1			0.5																				
NEPLUT									3			18												
OXASTR									2			1	5			2.5			5	1		23.5	0.5	
PLAPAT													3	3	3	2	1.5	2	1			0.5		
PLAVIR									6			5.5												
POLCON																					1			0.5
PSEOBT									2			1												
RUBFLA	4			5.5																				
RUBTRI	1			0.5																				
RUDHIR													3	1		23.5	3		1	3		3	2	
RUMALT	1			0.5									1			0.5			3			4		
RUMCRI																				3			2.5	
SABCAM									5			11.5												
SOLCAN									3			1.5												
SOLDIM														2	4		8	3		1	1		1	0.5
SOLELA																			1			0.5		
SOLMIS																			2			1		
SOLPTY	2			0.5																				
SYMERI														5			14			5			12	
SYMPRA	1			3					5			13	2		5	3.5		2.5	3		2	1		1
TETLIN																			1			0.5		
TORARV																			1	1		5	0.5	
TRADUB															1			0.5						
TRIARV															2			1						
TRIDUB													4		5	9		72	5		1	47.5		0.5
TRIHYB													5	5	5	305	24	70	3	5	3	135	72.5	4
TRIPER									1			0.5												
VICLUD													1		2	3		1	3			1		

* = present but no value recorded. Pink highlight denotes an exotic species

Table C-3. Three year upland grass community comparison of frequency and cover, by plot at Chickasaw NRA. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	WH-F03						CHIC-01						NH-LT01						NH-LT02					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
VICSAT															2			1			1			0.5
WOODY																								
DIOVIR2	3			12																				
RHUCOP	2			28					2			4												
RHUGLA	3			40					3			4												
SMIBON	2			5.5																				
ULMALA	4			14					1			0.5												

* = present but no value recorded. Pink highlight denotes an exotic species

Appendix D: Fort Larned NHS Results Tables

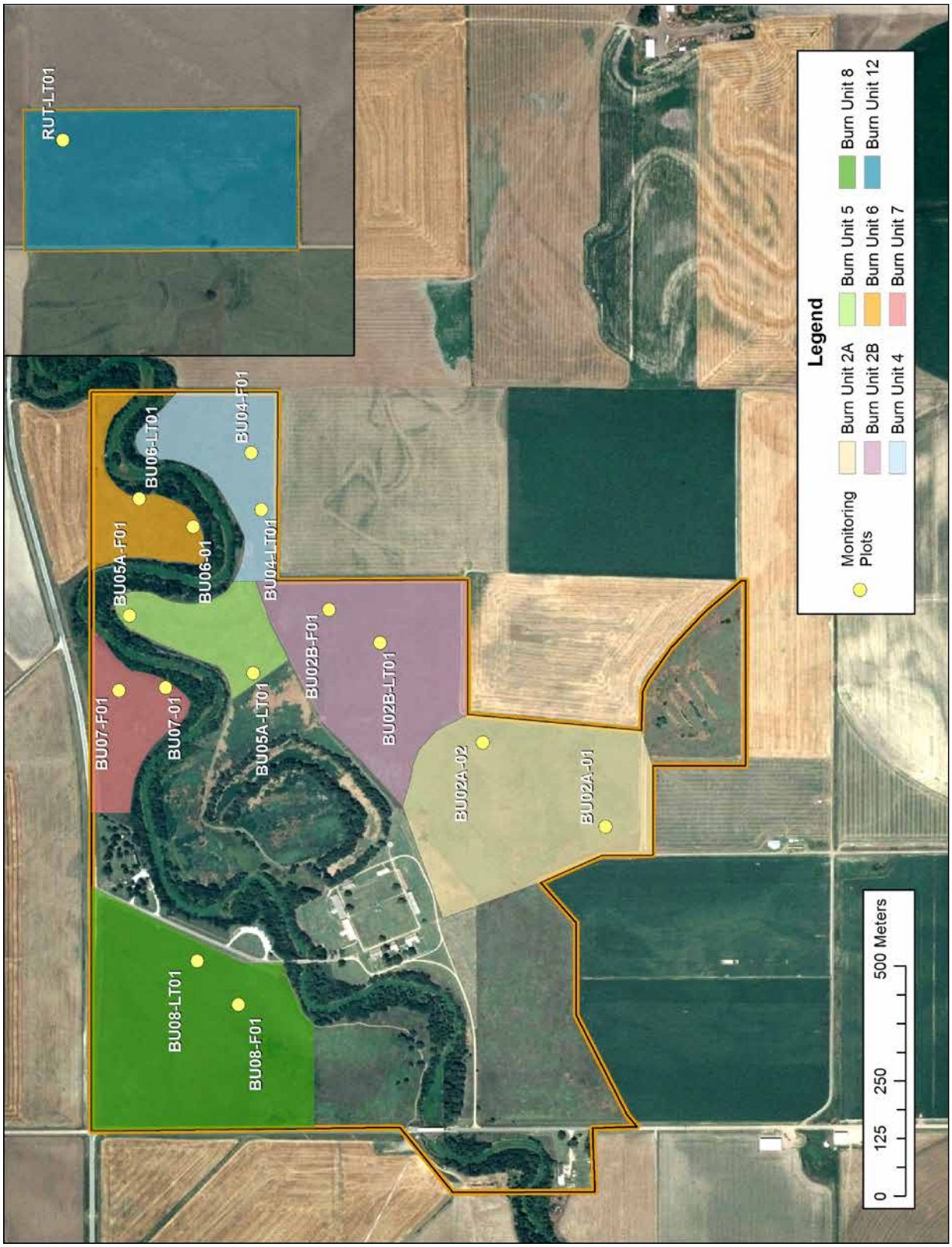

Figure D-1. Monitoring transects visited at Fort Larned NHS in 2012.

Table D-1. Three year restored prairie community comparison of frequency and cover, by plot at Fort Larned NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	BU02A-LT01						BU02A-F02						BU02B-LT01						BU04-LT01						BU04-F01					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																														
ANDGER							1		4	0.5		5.5													3			1		
ARIPUR																					2			1						
BOUCUR	5	4	3	78	97	4	5			71									4			43			2			10		
BROINE		1			1								5	5	5	260	76	111	5	5	5	260	222	235	5		5	255		235
ELYVIR			1			0.5																								
PANVIR	5	5	6	51.5	81	25.5	5		5	150		140		1	1		0.5	0.5	5	4	3	43.5	11.5	6.5	4		4	33		9
PASSMI																									1			3		
SCHSCO	3	5	6	20	45	21	3		2	0.5		3.5																		
SORNUT	4	4	3	16.5	53.5	6.5	2		5	1		5.5													5			36.5		
FORB																														
AMAPAL			1			0.5																								
AMBPSI	2	2	2	40	11	32																								
ASTMOL																											1			0.5
CALINV																			1			0.5					1			0.5
CEPOCC																			1			0.5								
CHEALB	1	2	2	15	11	4	2		1	1		1		1			1													
CHESIM									1			3																		
CIRUND	1	1	1	0.5	1	0.5	2		2	25		1.5																		
CONARV	3	1	1	5.5	3	0.5	3		3	21		2	4	4	4	24	26.5	13.5	1	1	1	0.5	1	0.5	3		2	3.5		1
CONCAN	3	1	2	0.5	3	1.5			4			2.5													2			3		
DALPUR																									1			0.5		
DESPIN	2			0.5			3			1																				
EUPDEN							2			1.5																				
FRBLNG	1			0.5																										
GAUVIL	1	1		1	3																									
HELANN									4			5.5																		
HELPET	3	5	5	91	43.5	39.5	3		1	1.5		0.5																		
KOCSCO							3		1	7.5		0.5																		

* = present but no value recorded. Pink highlight denotes an exotic species

Table D-1. Three year restored prairie community comparison of frequency and cover, by plot at Fort Larned NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued.)

Species	BU02A-LT01						BU02A-F02						BU02B-LT01						BU04-LT01						BU04-F01					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
MELOFF	3	2	3	45.5	1.5	4.5	4		1	1		0.5							4			61			2			1		
PHYLON							3		4	2		2			1			0.5			1			0.5						
RATTAG									1			0.5																		
SILANT																			2			0.5								
SOLCAN	4			1.5																										
SPHCOC																			1	1	1	3	1	3	3		3	1		1.5
SYMERI	1	1	2	0.5	10	5.5																								
SYMORB									1			0.5																		
TRADUB							1			0.5																				

* = present but no value recorded. Pink highlight denotes an exotic species

Table D-2. Three-year restored prairie community comparison of frequency and cover, by plot at Fort Larned NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	BU05-LT01						BU06-LT01						BU07-LT01						BU07-F01					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																								
BOUCUR	5	2	5	3.5	6	5.5	5	1	4	14.5	30	14	4	2	3	1.5	6	16	1			5		
BROINE	5	5	5	355	155	160	5	5	5	155	175	207	5	5	5	165	162	165	5			230		
PANVIR		4	2		2.5	1	4	3		26	7			1	1		0.5	0.5	2			1.5		
PASSMI		1			0.5								1			0.5								
SCHSCO	3	2	3	1	6	2	4	1	2	5.5	0.5	1	3	3	4	15.5	36	9.5						
SORNUT	2			1			5	1	2	34	3	1	4	3	2	46	27	1						
SPOCRY									1			0.5												
FORB																								
CHEALB		1			0.5			2			3.5													
CONARV							2	1	1	3.5	7	3	4	4	4	58	18	3	3			14.5		
DESILL1	1			0.5			2			1														
HELMAX							1			8														
PHYLON			1			0.5	1		1	1		0.5							1			0.5		
SOLCAN							3		1	1		1												

* = present but no value recorded. Pink highlight denotes an exotic species

Table D-3. Three-year restored prairie community comparison of frequency and cover, by plot at Fort Larned NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	BU08-LT01						BU08-F01						RUTS-LT01					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																		
ANDGER	5	2	5	46	3.5	12	1		1	5		0.5						
BOTLAG	2			5														
BOUCUR	5	1	1	49	0.5	0.5	1		3	20		1.5	2	2		23	35.5	
BROINE	5	5	5	138	75	44	5		5	210		48						
BROJAP													3			1		
BUCDAC									1			0.5						
CARGRA1													5	5		121	63	
PANVIR		3			3													
PASSMI	2			6			1			0.5			5	4	2	23	2.1	1
POAPRA													3	2	3	10.5	1	2
SCHSCO		5	5		76	3	1		1	3		1						
SETPUM															4			3
SORNUT	5	5	5	40.5	29	4	1		1	0.5		0.5						
FORB																		
AMBPSI													4	3		96	8.5	
ASCPUM													1		1	0.5		0.5
ASCSYR													2			1		
ASTMOL		1	1		5	0.5												
CALINV													2	1	1	10	0.5	0.5
CHAMAC															4			2.5
CHASER									4			2			1			0.5
CHEDES														1	1		0.5	1
CIRUND															1			0.5
CONARV													5	5	5	80.5	25	7
CONCAN									2			1						
CONRAM													2		4	6		2
EUPMAR															5			8.5
FRBLNG															1			0.5
GALAPA													2			1		
KOCSCO									2			1	3	3	5	13.5	21.5	3
LEPDEN													3			1.5		
LIAPUN							1			0.5								
MELOFF	5	2	3	17.5	16	1.5	2		1	0.5		0.5						
OXASTR													3	2	5	15	1.5	55
PHYHET													1		3	0.5		1.5
PHYLON							1		1	0.5		0.5	2		5	8		2.5
SALKAL															2			1.5
SILANT													3			1.5		
SONASP													2			3.5		
SPHCOC							1			0.5								
TRADUB									1			0.5						
TRIPER													1			1		

* = present but no value recorded. Pink highlight denotes an exotic species

Appendix E: Fort Union NM Results Tables

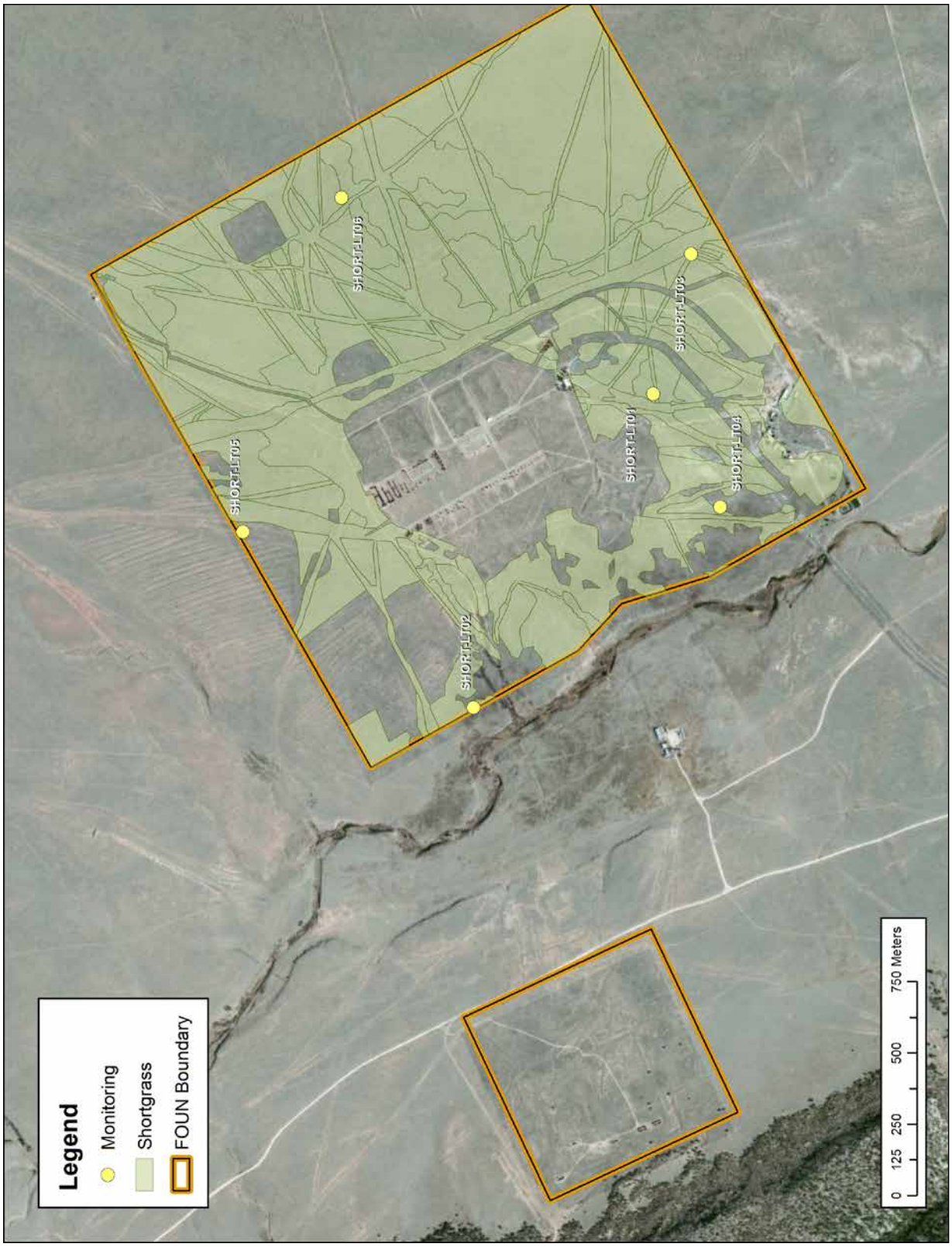

Figure E-1. Monitoring transects visited at Fort Union NM in 2012.

Table E-1. Three year shortgrass steppe community comparison of frequency and cover, by plot at Fort Union NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	SHORT-LT01						SHORT-LT02						SHORT-LT03						SHORT-LT04						SHORT-LT05						SHORT-LT06					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																																				
ACHROB							1			1																										
ARIDIV															1			0.5									2			5.5						
ARIPUR	3	2		21	*								4	1		41.5	*		4			16			2			3.5								
BOUCUR													1	1		0.5	*																			
BOUGRA	5	5	5	190	50.5	205	5	4	5	114	45.5	82.5	5	1	5	143	*	51	1	5	1	103	3	1	5	3	5	235	160	157	5	5	5	125	180	58
BUCDAC	1	4		8	1								2	1		26	*								2	2		13	40		2	3		4	95	
CYPFEN							1			0.5															2			6								
DISSPI																											1			0.5						
ELYELY	2			1			4		1	8		0.5		1	1		0.5	10	1			3			5			2								
ELYTRA									1			3																								
LYCPHL													2		3	13		4.5	2			5.5			2		1	4		5						
MUHTOR													2		1	1.5		1	2	2		16	22													
PASSMI	2		1	1		0.5	3	2	4	26	1.5	7.5							4			17			2		3	5.5		2		1			10
SPOAIR															1			5			2			13												
SPOCRY			1			3							2		1	3		0.5	3	1		6	0.5		2			5			1	2	4	13	3.5	11.5
FORB																																				
ALLCER																									1			0.5								
AMBCON	5	1	3	31.5	0.5	17	5	5	5	68.5	28.5	118	5	3	5	22	13	21.5	5	3	3	35	14.5	14.5	3		1	9		0.5	5	1	4	91	0.5	37
ARTCAR							3	2	1	8	1	0.5	2		3	8		4			1			0.5	1	1		0.5	0.5							
ARTFRI	3	1		4	0.5		2	2		1	1.5		2	1		1	0.5		3			6			1			5								
ARTLUD							2	1	1	9	0.5	5								2			1.5													
ASCINV																			1			0.5														
CHACOR			1			0.5			1			3																								
CHAERI																									1	1		0.5	0.5							
CHASER							4			2																										
CHASER1								1			0.5																									
CHASER2	1		2	1		1			1			0.5			1			0.5							3		3	3.5		4			4			3
CHEALB									1			0.5																								
CHEINC							1			1																										

* = present but no value recorded. Pink highlight denotes an exotic species

Table E-1. Three year shortgrass steppe community comparison of frequency and cover, by plot at Fort Union NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	SHORT-LT01						SHORT-LT02						SHORT-LT03						SHORT-LT04						SHORT-LT05						SHORT-LT06					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
CHELEP	2	4		2		2.5	4		3	3.5		6			4			2.5			3			1.5	2			1								
CHEPRA									3			4									1			0.5											
CIRUND													1	1	1	1	3	0.5	3			1.5				1	1		0.5	0.5						
CONARV																				3	3		23	25												
DALCAN																			1			1														
DYSPAP							1			0.5																	1			0.5						
ENGPER	1		1	0.5		0.5	2	2	2	0.5	3.5	1.5	2		1	1		0.5	1			1					1			0.5						
ERIANN2	1			0.5																																
ERICAN																											1			0.5						
ERIJAM			1			0.5																					1			0.5						
EUPDAV			2			1	3		5	18.5		3	1		1	0.5		0.5	1			1														
FRBLNG			1			0.5									1			0.5			1			0.5												
GAUCOC													1			0.5			2			0.5														
GLABIP															1			0.5																		
GRISQU															2			1																		
GUTSAR	2			1			2	2	2	4	8	6	5	4	1	24.5	5	0.5	3			1.5				1	1		0.5	3					
HELANN									2			6																								
HETVIL														2			4									1			0.5						
KOCSCO			1			7														5	5		39	225							1	1		0.5	1	
LEPDEN																				1			0.5													
LIAPUN														2			6																			
LINLEW							4	2	1	5.5	3.5	1			2			1																		
LYGJUN																			1			1														
MACPIN													2		1	0.5		0.5																		
MELOFF									1			0.5																								
MENMUL							1		1	1		0.5								1			3				1			0.5						
MIRLIN			1			0.5			1			1	2		1	0.5		0.5	1			1			1			0.5								
PHYHED													2		1	4		3																		
PLAPAT														1			1								1			0.5								
POROLE			1			0.5	1			0.5																							3			1.5
PSOTEN	2	1	1	1.5	1	0.5	1	1	1	3	1	1		2			16		2			13					1			1						

* = present but no value recorded. Pink highlight denotes an exotic species

Table E-1. Three year shortgrass steppe community comparison of frequency and cover, by plot at Fort Union NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	SHORT-LT01						SHORT-LT02						SHORT-LT03						SHORT-LT04						SHORT-LT05						SHORT-LT06					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
RATTAG							1		3	1		2.5	1	1		0.5	0.5		1			0.5					1			0.5	1			0.5		
ROSWOO							2	2	2	6	2	1.5																								
SALTRA			2			1.5	3	1	3	0.5	0.5	2	4	1	4	3.5	0.5	6.5	2	4	4	1	16	15								1			1	
SENSPA																									3			0.5								
SOLMOL							1			3																										
SPHCOC	4		1	4		0.5	4	4	4	14	11.5	9.5	5	4	5	25	5	15	5	1		5	1		2	2	3	4	1	4.5	4	1	4	25.5	3	11
SYMFAL2																											1			0.5						
SYMLAN																			1			10														
TALPAR									4			11.5									1			1												
THEMEG							3	1	2	1	0.5	4		3	2		4.5	1	4			0.5			1		1	1		0.5						
ZINGRA	1		1	8		7													3			1.5														
WOODY																																				
ECHVIR	2	2	3	0.5	4	1.5							1		1	1		0.5							4	2	2	3	1.5	7.5		2			2	
OPUPOL																									1			0.5								

* = present but no value recorded. Pink highlight denotes an exotic species

Appendix F: Lake Meredith NRA and Alibates Flint Quarries NM Results Tables

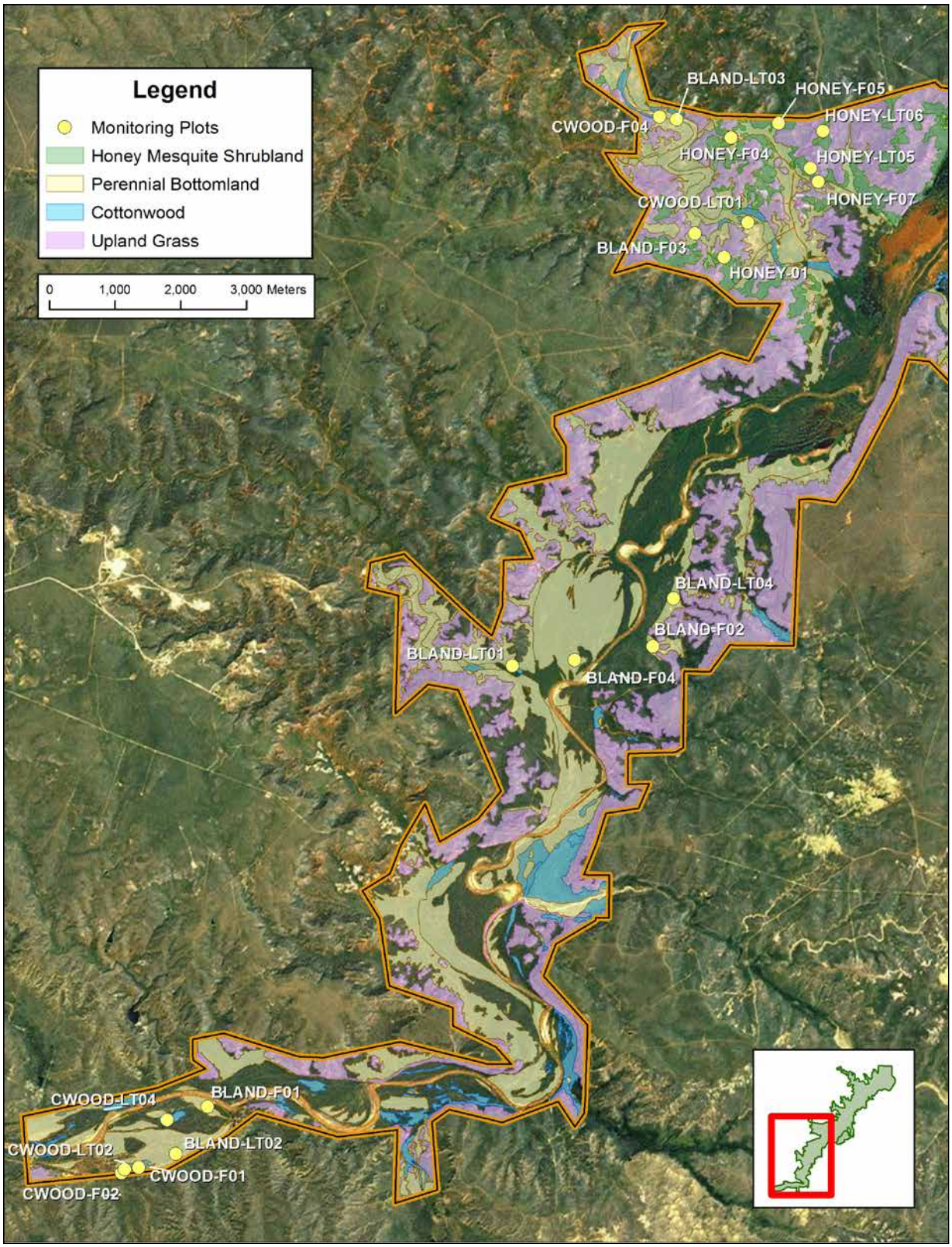

Figure F-1. Lower monitoring plots visited at Lake Meredith NRA and Alibates Flint Quarries NM in 2012.

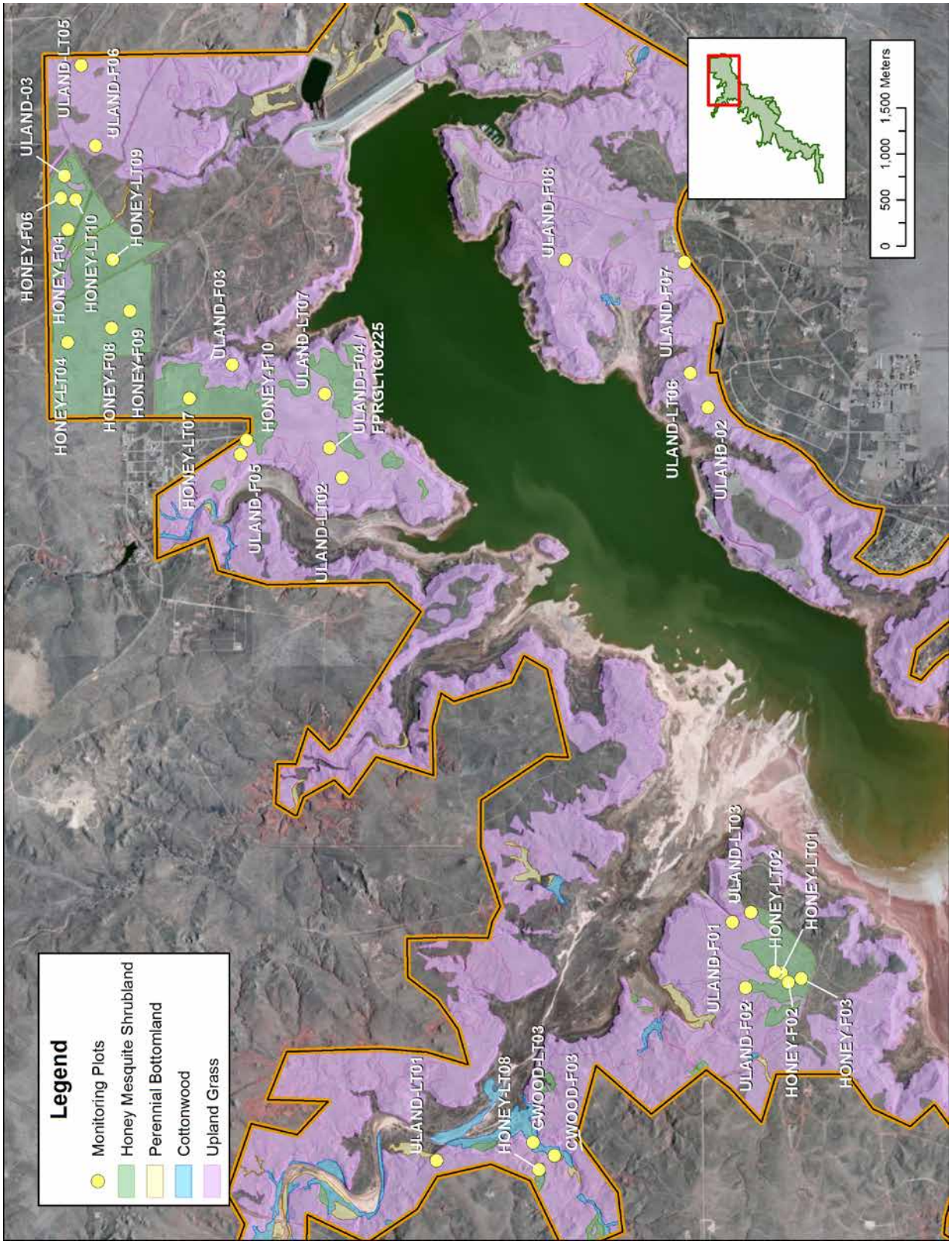

Figure F-2. Upper monitoring plots visited at Lake Meredith NRA and Alibates Flint Quarries NM in 2012.

Table F-1. Three-year bottomland grass community comparison of frequency and cover, by plot at Lake Meredith NRA / Alibates Flint Quarries NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	BLAND-LT01						BLAND-LT02						BLAND-LT03						BLAND-LT04					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																								
ANDGER															1			3			1			3
ANDHAL							2			1.5				1	1		3	0.5						
BOTLAG							1	2		0.5	8													
BOUCUR							5			39.5			5	5	5	47	125	35			5			15
BOUGRA																					2			2
BROJAP															3			1.5						
BUCDAC															1			0.5			2			7.5
DISSPI							2	3		1	18.5				1			0.5	5			15.5		
ELYCAN													2	1	1	2	5	0.5						
EQULAE							4	5		1.5	14										5			4
ERABAR															2			3.5						
MONSQU															3			4						
PANHAL							1			3														
PANOBT	4			2															5			39.5		
PANVIR														2	1		1.5	1			4			11
PASSMI		2	8		15.5	99.5									3			34			1			0.5
SCHSCO													3	1	4	24	3	4.5						
SORNUT							5			18				1			5				1			1
SPOAIR													5	2	2	34	4	5.5						
SPOCRY	4		2	4.5		1	1			5					1			0.5	2			7		
FORB																								
AMBPSI							5	5		10.5	5.5		1		2	1		1.5			5			8.5
ASCENG															2			1						
ASCSUB								1			0.5													
ASTNUT															1			0.5						
CENLON															1			1						
CHAMAC															2			1.5						
CHEALB		1			5																			
CIRUND																					1			1

* = present but no value recorded. Pink highlight denotes an exotic species

Table F-1. Three-year bottomland grass community comparison of frequency and cover, by plot at Lake Meredith NRA / Alibates Flint Quarries NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	BLAND-LT01						BLAND-LT02						BLAND-LT03						BLAND-LT04					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
CROGLA																			1			0.5		
DALCAN																					1			1
DESILL1							2	2		0.5	6										2			4
DESPIN			1			0.5																		
EUPDAV			1			0.5																		
FRBLNG			2			1									1			0.5						
GAUCOC								1			0.5										3			1.5
GAUVIL														1			0.5							
GLYLEP																					1			1
GRIPAP							2	1		1	3													
GUTSAR								1			0.5													
HELANN															3			2.5						
IVAXAN															1			0.5						
KOCSCO	1	1	6	3	3	31.5	1	2		0.5	1.5		3			6			1			3		
KRALAN															2			1.5						
LAPOCC			2			1																		
LEPDEN																					1			0.5
LIAPUN																					1			0.5
MACPIN							4	1		2.5	3										1			1
MELALB								4			15.5													
MELLEU																			1			7		
SALTRA		1	6		3	8.5	3			2					1			1	1		5	13		10.5
SOLELA		4	5		40	5.5																		
SOLROS			1			0.5																		
SYMERI														2	2		1	1						
THEMEG							2	2		4	7.5		2	1		0.5	0.5				2			3.5
TIDLAN															2			1						
WOODY																								
CELLAE	1	1	1	17	0.5	90																		

* = present but no value recorded. Pink highlight denotes an exotic species

Table F-2. Three-year cottonwood grass community comparison of frequency and cover, by plot at Lake Meredith NRA / Alibates Flint Quarries NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	CWOOD-LT01						CWOOD-LT02						CWOOD-LT04					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																		
ANDGER	2	4	1	35	21.5	0.5	5	5	1	25	18.5	0.5	5	2	5	39	10	12.5
ARIPUR	3			16														
BOTLAG			1			0.5	3	1	4	10	0.5	5						
BOUCUR		2			4		5	4	6	33	33	29		1	2		3	4
DISSPI	2	2	1	14	3.5	13	1	2		0.5	15			3			18	
ELYCAN		3	1		25.5	0.5			1			0.5						
EQULAE													2	5	5	1	24	9
ERASPE															2			1
HESCOM			1			5												
MUHASP															1			5
PANHAL							4	1		2	5							
PANVIR		3			9				3			1.5			4			15
PASSMI		1	5		3	23.5		1	1		1	5						
SCHSCO		1			0.5		4	1	4	18.5	15	14	3	4	2	14	31	8
SORHAL	4	3	3	47	10.5	16.5												
SORNUT		1	5		3	6	5		1	35.5		0.5	5	1	1	11	3	0.5
SPOAIR															5			8
SPOCRY														2			3.5	
FORB																		
AMBPSI							1	3	2	3	6.5	8	5	4	4	8	5.5	9.5
ASCSUB								1			0.5							
ASTMIS1		2	2		1	1.5		3	2		11.5	2						
CHAMIS															3			1.5
CIRUND								1			1				4			2.5
CONCAN								2			10							
FRBLNG			2			1												
GAUCOC									1			1		1			1	
GAUVIL								1			0.5							
GLYLEP														1	1		3	0.5
GUTSAR														2			2	
HEDNIG														2			1.5	
HELANN			2			0.5												
LIAPUN								1			0.5							
MELALB														3			45.5	
OENJAM															1			0.5
SALTRA	1			3			4			13.5			3		1	9		1
STRLEI															1			0.5
SYMERI		1	1		0.5	1		2	4		4	8		1	5		0.5	8.5
WOODY																		
CELOCC	2	3	3	4	2.5	2												
OPUPHA															1			3
POPDEL								1			1							

* = present but no value recorded. Pink highlight denotes an exotic species

Table F-3a. Three-year honey mesquite community comparison (part 1) of frequency and cover, by plot at Lake Meredith NRA / Alibates Flint Quarries NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	HONEY-LT02						HONEY-01						HONEY-LT06						HONEY-LT07						HONEY-LT09					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																														
ARIPUR	5	2	1	8.5	*	1								1	3		5	2							4			3		
BOUCUR							3	4	4	22.5	24	27	1	5	4	0.5	26	32.5	2			13			4	1		21	*	
BOUGRA	4	2	5	40	*	21.5			1			0.5		1	2		1	6	5	3	5	128	15	14.5			3			1.5
BOUHIR																			2	1		5	*							
BUCDAC	5		3	47		2.5													1			0.5			3		1	4		0.5
DICACU			3			4.5																								
DIGCOG									2			1																		
ELYELY									1			0.5													1			0.5		
ERASES																			1			1								
HESCOM																									1			3		
PANHAL	3			4					2			1													1			3		
PANOBT							3	1	1	1.5	5	20																		
SPOCRY	5	2	6	20.5	*	11.5	4	4	3	5	13.5	4.5			2			1.5	4	1	1	18	*	1	3	1	3	4.5	0.5	2
TRIALB									1			0.5			2			1												
FORB																														
AMBPSI		2			0.5		5			16.5									1	1		1	0.5		3			1		
AMPDRA																			1		1	3		0.5						
ARTLUD		1			*																									
ASCSUB													1	1		0.5	0.5													
ASTMIS1									1			0.5															3			1
CALINV															1			0.5												
CENAME			3			4.5			1			0.5			4			2.5												
CHAERI	5		4	11.5		3								1	4		0.5	3			3			1.5	4		5	83		2
CHALAT1	2			3			1	2	2	0.5	3.5	3.5	1	3	5	0.5	6	3	1			0.5			3		5	1		0.5
CHAPRO																				1			1							
CHEALB																					1			0.5						
CHELEP													1			3					5			3						
CHEPRA									2			1													5		5	7.5		9
CONRAM								1			5																			

* = present but no value recorded. Pink highlight denotes an exotic species

Table F-3a. Three-year honey mesquite community comparison (part 1) of frequency and cover, by plot at Lake Meredith NRA / Alibates Flint Quarries NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	HONEY-LT02						HONEY-01						HONEY-LT06						HONEY-LT07						HONEY-LT09					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
CROGLA									1			3																		
CROMON							1	1		3	0.5																			
CROTEX	3		2	1.5		1		1	4		0.5	6.5									3			2.5						
DALNAN									1			0.5																		
DESILL1																				1			1							
ERILON													3	2	3	4	4	2							1		1	0.5		*
FRBLNG			1			0.5																								
GAUCOC																											1			0.5
GRIPAP	2			1																										
GUTSAR	1	1	2	20	15	10	1			5			5	4	3	68	50	2.5												
HEDNIG														2			0.5													
HELANN			1			0.5			3			2.5			1			0.5												
HELPET																					4			3						
KOCSCO	2			1									2			1			2			1								
KRALAN													3	1	5	3.5	0.5	3												
LAPOCC			2			1									1			0.5			3			1.5			5			2.5
LEPDEN														1	2		*	1									1			0.5
LEPVIR																					1			0.5						
LIAPUN									1			0.5			1			0.5												
LYGJUN	2			1																										
MACPIN									1			0.5							1	2		13	5		4	2	1	10.5	0.5	0.5
MELLEU																									1			0.5		
MENDEC									3			1.5			2			1												
MIMNUT																									1		1	0.5		0.5
PLAPAT														1			3									1	1		3	*
SALTRA	4		7	4.5		16.5	2	1	2	6	5	1.5			4			9.5	5	2	5	95	8	29	5		3	40		1
SOLELA			4			6		3	5		2.5	6		1			1		5		3	2.5		1.5						
SOLROS			2			1															1			0.5			2			1
SPHCOC	4	2	2	8	6	2													3		3	6		6	5		3	9.5		2
TETSCA													1	2	4	1	1.5	2												
THEMEG													1			0.5									1			0.5		

* = present but no value recorded. Pink highlight denotes an exotic species

Table F-3a. Three-year honey mesquite community comparison (part 1) of frequency and cover, by plot at Lake Meredith NRA / Alibates Flint Quarries NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	HONEY-LT02						HONEY-01						HONEY-LT06						HONEY-LT07						HONEY-LT09					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
TRARAM														4	5		3	6												
WOODY																														
ECHREI													1		2	0.5		1												
MIMBOR														2	2		50	65	1		1	0.5		0.5	1		2	3		0.5
OPULEP	1		1	5		1																								
OPUPHA			1			7								1			15													
OPUPOL	2	2	1	13	15	1	1	1	1	1	3	1	2	2	3	15.5	1.5	11												
PROGLA	1	1		30	25		1	1	1	38	17	27							4	2	2	25	40	17	5	5	2	71	78	20
YUCGLA	4	3	3	31	30	26	4	3	2	10	18	3.5	2	3	2	13	33	8	2		1	1		1	1	1	1	1	3	1

* = present but no value recorded. Pink highlight denotes an exotic species

Table F-3b. Three-year honey mesquite community comparison (part 2) of frequency and cover, by plot at Lake Meredith NRA / Alibates Flint Quarries NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	HONEY-LT10						HONEY-F01						HONEY-F06						HONEY-F08						HONEY-F09					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																														
ARIPUR	4		1	1		0.5	5		2	19		1	3			4					1			0.5						
BOUCUR	2	1	1	7	*	1	4			17											1			0.5						
BOUGRA	4	1	2	91	*	1	5		5	99		3.5	5	4	6	58.5	18	9			5			88.5			5			42.5
BOUHIR	1	1		0.5	*								1			0.5									4			5		
BUCDAC	3	1		21	*		3			1			5	5	3	110	63	2			3			2.5	3		4	4.5		2
LOLARU																					2			2						
MUHTOR																					1			1						
PANHAL																											2			1
PANOBT													1	2		8	4													
SPOCRY	5		4	22		2.5	5		2	40.5		1	5	5	5	21	14	5									3			2
FORB																														
AMBPSI	2		1	1		0.5	4		2	4.5		1	3		1	1		0.5												
ASTMIS1									2			1			2			1												
CHAERI							5		2	43		1	1	1	1	8	17	0.5			4			2	4		2	5		1
CHAGLY									1			0.5																		
CHALAT							4		4	4		2									1			0.5						
CHELEP																					2			1.5			1			0.5
CHEPAL							5			15																				
CHEPRA	5		5	20.5		60			5			32.5	5		4	7.5		85												
CIRUND	2			0.5			1			5																				
CROGLA							5			1											1			0.5						
CROTEX			2			1			4			2	3		4	2		2												
CUSCUTA													1			3														
DESPIN															3			2												
DESSES																									2			3.5		
ERILON			1			0.5			1			0.5	1	1	1	0.5	0.5	1												
EUPHEX									2			1																		
GAUCOC							4			1					1			0.5												
GAUVIL																														

* = present but no value recorded. Pink highlight denotes an exotic species

Table F-3b. Three-year honey mesquite community comparison (part 2) of frequency and cover, by plot at Lake Meredith NRA / Alibates Flint Quarries NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	HONEY-LT10						HONEY-F01						HONEY-F06						HONEY-F08						HONEY-F09					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
HELCON							1			0.5																				
HETSTE	2			1			4			3			1			0.5														
HOFGLA																									1			0.5		
KOCSCO			1			0.5								2	1		1	0.5												
KRALAN	1	1	1	3	0.5	0.5	4		2	0.5		1.5	3	1	4	9	3	2		4			14			1			10	
LACSER			1			0.5																								
LAPOCC			1			0.5	3		3	0.5		1.5		2			1							1			3		
LEPDEN			1			0.5	3		1	0.5		0.5																		
MACPIN	2	1	1	8.5	1	0.5	1		2	1		1	4	1	1	2.5	0.5	0.5												
MIMNUT			1			0.5							2	1		0.5	0.5													
MIMRUP																				1			0.5			1			0.5	
PLAPAT			1			0.5	5		2	1.5		1			1			0.5												
RATCOL																										1			0.5	
SALTRA	5	1	5	114	0.5	3	5		5	28.5		2.5	5	3	4	24	4	3		3			1		4	1		2	1	
SILLAC			1			0.5																								
SOLELA															1			0.5		1			0.5		2	4		0.5	2	
SOLROS			2			1			2			1			1			0.5								3			8.5	
SPHCOC																				3			2		5	4		6	7	
STISYL							3			0.5																				
THEMEG	1			9									1			0.5														
ZINGRA			1			0.5														1			0.5			1			0.5	
WOODY																														
ARTFIL							2		1	0.5		0.5																		
OPUPOL																				1			0.5							
PROGLA	4	4	2	43	58	16	2		2	45		3.5													2	2		20	4	
YUCGLA	1	2	1	0.5	7	0.5	4		4	12.5		2	1	1	1	5	15	15												

* = present but no value recorded. Pink highlight denotes an exotic species

Table F-4a. Three-year upland grass community comparison (part 1) of frequency and cover, by plot at Lake Meredith NRA / Alibates Flint Quarries NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	ULAND-02						ULAND-LT02						ULAND-LT03						ULAND-LT05					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																								
ANDHAL																			2			8		
ARIPUR	5	5	4	26	20	21								1			*		1	1	2	15	*	15
BOUCUR	5	4	5	22	31	10.5							2		1	31		0.5	3	2	3	23	*	16
BOUGRA	2	5	4	6	24.5	14	5	3	5	81	0.5	24.5	3	1	3	19	*	20	1			3		
BOUHIR																			2		2	5		1.5
BROJAP															1			7						
BUCDAC	1			8											1			0.5						
DICACU									1			0.5												
ELYELY							3	1	2	8	*	1												
ERIPIL			1			0.5																		
LOLARU															3			11.5						
MUHASP																					1			0.5
MUHTOR			2			3.5									1			0.5						
PANOBT													4	1	3	44	*	42						
SCHSCO	3	3	1	3	2.5	3													1	1	1	15	*	1
SPOAIR														1			*							
SPOCOR																					1			0.5
SPOCRY			4			2.5	4	2	3	38	*	4		1	4		0.5	5	5	2	4	21.5	*	15
FORB																								
ALLDRU															1			0.5						
AMBPSI	1			0.5									2	2		1	1.5		4	1	1	19.5	0.5	0.5
ARTLUD							4			2				1			0.5							
ASCSUB													2			1								
ASTMOL															1			0.5						
CENAME															2			1						
CHAERI	5		4	9		3			2			2	5	2	3	7.5	3.5	2						
CHAGLY															2			1						
CHALAT			3			1.5	2			1			3	1	1	1	3	0.5						
CHAMIS																			4			6.5		

* = present but no value recorded. Pink highlight denotes an exotic species

Table F-4a. Three-year upland grass community comparison (part 1) of frequency and cover, by plot at Lake Meredith NRA / Alibates Flint Quarries NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	ULAND-02						ULAND-LT02						ULAND-LT03						ULAND-LT05					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
CHEBER																					3			6.5
CHEGLA																				1			0.5	
CHELEP									9			33			1			0.5						
CHEPRA																			2	1		0.5	1	
COMERE																			3			1		
CROGLA																			2			0.5		
CROTEX	1	1	2	0.5	0.5	1.4							4	2		4.5	1							
DALENN													1			0.5								
ERIANN1																			1			0.5		
ERIANN2													3			3.5								
ERILON	2	1	2	3	1	1													1			0.5		
EUPDAV																					1			0.5
EUPHEX																					2			1
EVONUT																					1			0.5
GRIPAP							2			0.5			3			1								
GUTSAR													2	3	2	6	15	4	2	1	1	4	1	0.5
HELANN															2			1						
HELCIL									1			1												
KOCSCO	1			0.5			1		2	0.5		1.5												
KRALAN															1			0.5		2	1		3.5	0.5
LAPOCC									5			3			3			1.5						
LEPDEN								1			*									2	2		*	1
LIAPUN			1			0.5																		
LINRIG																			2	1		13	0.5	
LYGJUN													1			0.5								
MACPIN	1	1	2	0.5	0.5	1	1	1		40	*								2	2	2	1.5	3.5	1
MELLEU	4		1	14		0.5																		
OENPAL			1			0.5																		
PARJAM																			4		1	20		0.5
PEDDIG																			4			7		
PENALB																					1			0.5

* = present but no value recorded. Pink highlight denotes an exotic species

Table F-4a. Three-year upland grass community comparison (part 1) of frequency and cover, by plot at Lake Meredith NRA / Alibates Flint Quarries NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	ULAND-02						ULAND-LT02						ULAND-LT03						ULAND-LT05					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
PENAMB																					4			8.5
PENBAR																				5			18	
PENFEN															1			0.5						
PLAPAT															1			0.5						
PLARHO							2			1														
SALTRA			6			8.5	5		5	48.5		11	4		4	7		11.5	1		2	0.5		6
SCURES																			2			13.5		
SOLELA		1	3		3	2.5	5	2	3	11.5	*	1.5		1	5		1	8						
SPHCOC		1	1		1	0.5	4	1	1	11.5	17	3	4	4	4	7	8	5.5						
TETSCA	3		3	26		6.5																		
THEMEG	1	1	1	0.5	*	0.5														1	1		1	0.5
TRADUB															1			0.5						
VERBRA1		1			3																			
ZINGRA			2			1.5																		
WOODY																								
ARTFIL	2			0.5															2	3	3	11	18	8.5
OPUPHA																					1			0.5
OPUPOL															1			1						
PROGLA													1	1	1	7	7	3						
YUCGLA	3	4	4	60	88	58	1			1			3	4	3	34	26	25	3	4	2	56	98	32

* = present but no value recorded. Pink highlight denotes an exotic species

Table F-4b. Three-year upland grass community comparison (part 2) of frequency and cover, by plot at Lake Meredith NRA / Alibates Flint Quarries NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	ULAND-02						ULAND-LT02						ULAND-LT03						ULAND-LT05					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																								
ARIPUR		2	4		5	38		2			1		3		2	8		8						
BOUCUR		5	2		13	1							1	4	1	25	5.5	1						
BOUGRA		3	3		4.5	13.5		5	5		12.5	10.5	1		1	3		1			5			125
BUCDAC													1		1	20		0.5						
DISSPI													1			3								
ERIPIL			1			1																		
MUHTOR																					1			3
PANOBT		2			2								5		7	75		41						
SCHSCO								1	1		*	0.5		5			12.5							
SORHAL													1			1								
SPOCRY		1	4		*	5.5		1			*				5			5.5						
FORB																								
ALLDRU																					1			0.5
AMBPSI													3	2	1	16	1	0.5						
AMPDRA									1			0.5												
ASTMOL		1			0.5																			
BRASSP															1			0.5						
CHAERI			2			1									1			0.5						
CHAFEN																					1			0.5
CHALAT			1			0.5							1			1								
CHAMAC									1			0.5												
CHAPRO		2			1.5																			
CHASOR									2			1.5												
CHELEP															5			31						
CHEPRA													5			12								
CIRUND									1			0.5												
COMERE													1			3								
CROMON													4			1								
CROTEX													2		1	1		0.5			2			1

* = present but no value recorded. Pink highlight denotes an exotic species

Table F-4b. Three-year upland grass community comparison (part 2) of frequency and cover, by plot at Lake Meredith NRA / Alibates Flint Quarries NM. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	ULAND-02						ULAND-LT02						ULAND-LT03						ULAND-LT05					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
DALFOR		4	4		20.5	10																		
ERILON		2	3		2	1.5																		
ERIMOD			2			1																		
FRBLNG									1			0.5									2			1
GAUCOC														1			0.5							
GUTSAR			1			5								1			1				1			7
HELANN			1			0.5															2			1
HETSTE		1	1		0.5	0.5																		
KOCSCO														3			1.5							
KRALAN		2	2		1	1			2			1												
LESGOR																					1			0.5
LIAPUN		1			0.5																			
MACPIN		1	1		1	0.5							2	1		21	1				1			0.5
MELLEU			1			5																		
MENDEC									1			3												
MENMUL																					1			0.5
PLAPAT																					4			2
POLCON			3			2.5																		
SALTRA			5			13		1	5		0.5	6	5	2	3	22.5	5.5	5			5			15
SOLELA																					4			2
SOLROS									3			6.5												
SPHCOC									1			0.5		2	1		1	0.5			2			1
TETSCA		1			1																			
THEMEG			1			0.5																		
WOODY																								
ARTFIL													4	4	4	57	45	18						
MIMBOR		2	2		35	35																		
OPUPHA																					3			25.5
PROGLA													2	1	1	8	20	1						
YUCGLA								3	3		17	8.5		3			4.5							

* = present but no value recorded. Pink highlight denotes an exotic species

Appendix G: Lyndon B. Johnson NHP Results Tables

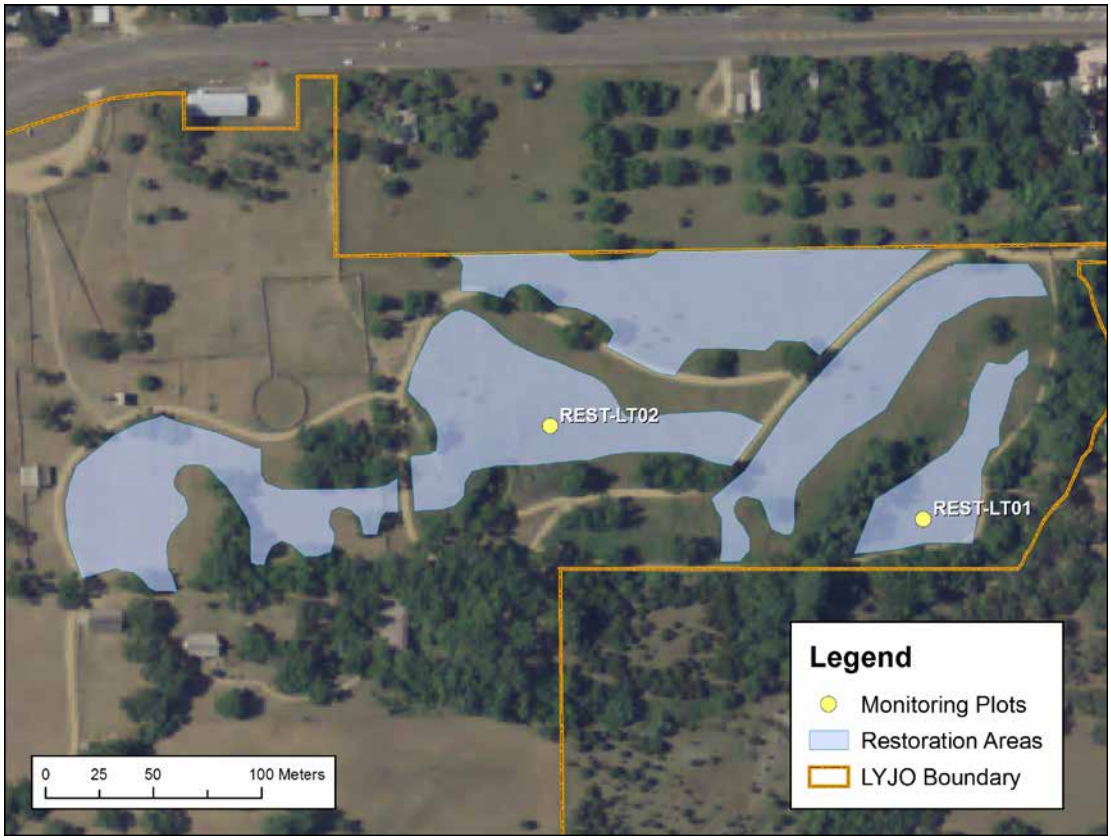

Figure G-1. Monitoring transects at Lyndon B. Johnson NHP in 2012.

Table G-1. Three-year restoration grass community comparison of frequency and cover, by plot at Lyndon B. Johnson NHP. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	BU08-LT01						BU08-F01					
	Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS												
ARIPUR		4	5		26.5	9	2	1	2	8	1	22
BOTISC	3	1	2	9	1	10	4	1	2	73	17	75
BOTLAG							2	1	1	5	0.5	1
BOUCUR	5	4	2	93	19	8	3	1		6	0.5	
BROJAP									3			9
CARPLA	1	2	1	0.5	1	1	2	4	2	4	7.5	8
CYNDAC							1			1		
DICOLI	3	4		4	2.5							
DIGCOG	2			3.5			1			1		
DISSPI								1	1		10	10
ELYCAN	1			0.5								
ELYVIR		2			1.5			1	2		1	4
ERAINT	4			13.5								
GRSSLNG			1			3						
LEPPAN								1			3	
NASLEU			1			7	1	2	1	1	1.5	7
PANVIR								1	2		3	5.5
PASDIL									1			1
SCHSCO		4	4		10	7.5	3	4	3	71	99	115
SORHAL							2	1	1	50	3	20
SORNUT	1	1		15	15			1	1		7	0.5
FORB												
AGAHET	5		5	31		12	4			7		
AMBART			2			2			1			0.5
AMBPSI		3			1.5		2	2		8	14	
ASCOEN												
CALINV	1	4		0.5	2							
CENTEX									2			6
CHANUT	3			0.5			2			0.5		
CHATAI							1			0.5		
CIRTEX	1		3	0.5		4.5	1	1	4	0.5	0.5	64
COCCAR		1	2		0.5	2		1	1		0.5	0.5
CONCAN	2			0.5								
CORWRI2			4			5			2			5.5
CROMON	5		5	128		74	5		3	26		6
DESILL1	4	2	3	26	3.5	6.5						
DESPAN								1			0.5	
DICCAR	3		1	9		5						
ENGPER		4	4		2	3			1			1
EUPDEN	2			1								

* = present but no value recorded. Pink highlight denotes an exotic species

Table G-1. Three-year restoration grass community comparison of frequency and cover, by plot at Lyndon B. Johnson NHP. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	BU08-LT01						BU08-F01					
	Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
EUPMAR	2			0.5			2		1	0.5		0.5
GAIPUL		4	4		12	125		3	5		1.5	94
GAUCOC		1			0.5							
GAUDRU	1			8								
GAUSUF								1	2		0.5	1.5
GERCAR									1			3
GLABIP	3	1	5	4.5	3	8.5			3			2
GRINUD	2	2	3	6	4	8.5						
HEDACI									3			4.5
HEDNIG	4	5	5	12.5	5	3.5		1	4		0.5	2.5
HYBVER	3	1	1	1.5	3	1		2			1	
IPORUB	1	2	1	0.5	1	0.5	1			0.5		
IVAANG	5	5	5	120	34.5	108	3		2	38		5.5
LEPVIR									2			10.5
LINBER		1			0.5			1			0.5	
LINRIG			2			1						
MONCIT			5			8		1	4		0.5	8
OXASTR	1	1		0.5	0.5				1			0.5
PHYCIN			2			1		1	1		0.5	0.5
PLARHO			5			44			3			1.5
RATCOL	1	4	4	3	9.5	13.5	2	5	5	33	23.5	49
RUBABO	5		1	15		7	1		1	7		7
RUBTRI		3			4			1			3	
RUDHIR		2	3		1	2		1			0.5	
SALCOC							1	1		25	0.5	
SCUDRU		2	4		1	8	2		2	1.5		33
SIDABU		1			0.5		1	1		1	0.5	
SONASP									1			0.5
SYMERI	2	1	4	1	0.5	5.5	4	2	3	3.5	1	2
SYMPRA		1			0.5							
TORARV									1			0.5
TRABRE	3			1			1	1		1	0.5	
TRARAM			1			1		1	2		0.5	5.5
VERHAL								1			0.5	
WOODY												
CELLAE									1			0.5
JUNASH									1			0.5
OPULEP		1			0.5							
QUEFUS								1	1		20	1
RHUCOP	1			3								
SMIBON	1	1		0.5	1		1	1	1	3	0.5	3
TOXRAD								1	1		0.5	1
VITMUS							2	1	2	30.5	1	21

* = present but no value recorded. Pink highlight denotes an exotic species

Appendix H: Pecos NHP Results Tables

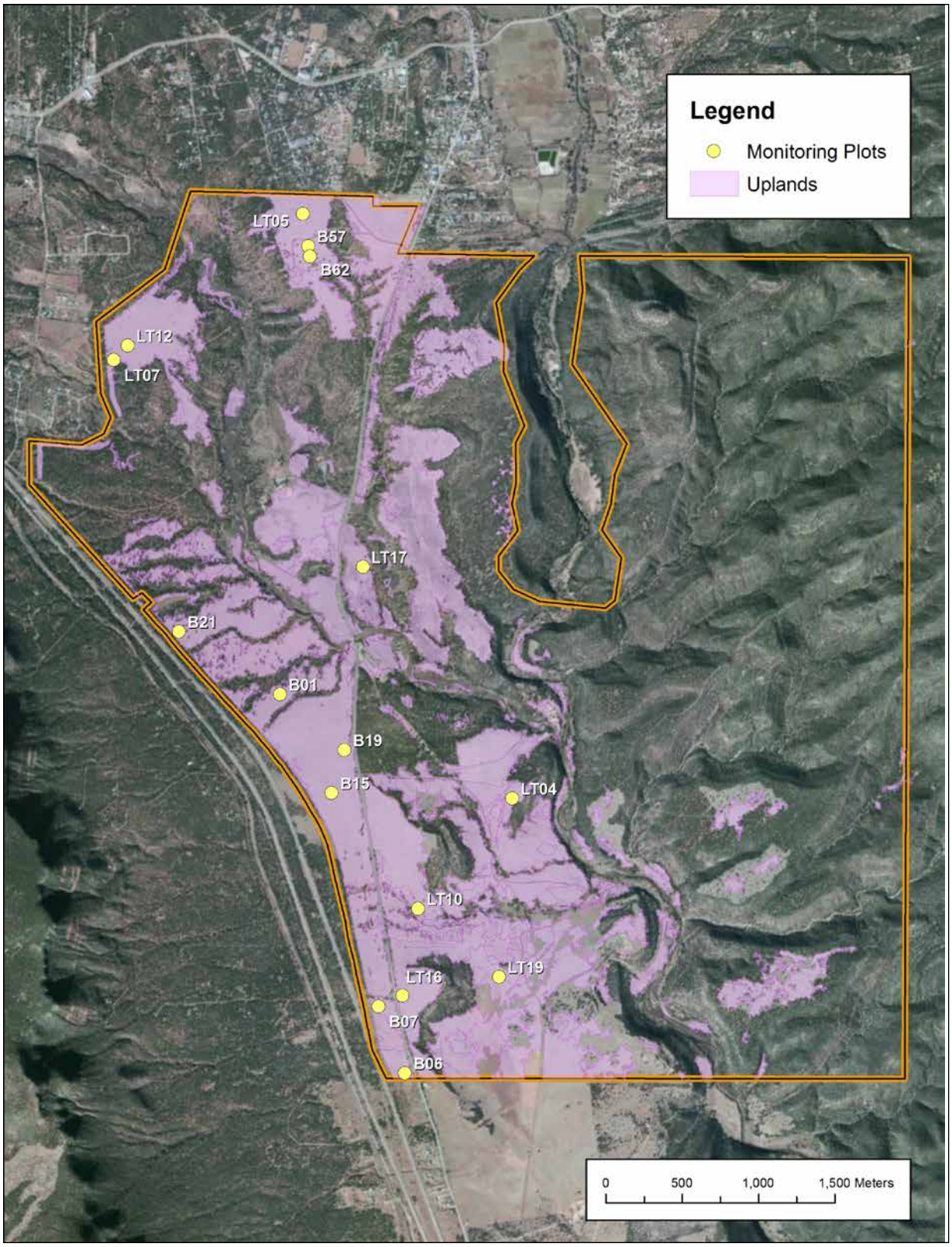

Figure H-1. Monitoring transects visited at Pecos NHP in 2012.

Table H-1. Three-year upland grass community comparison of frequency and cover, by plot at Pecos NHP. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	LT04						LT05						LT07						LT10					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																								
ARIPUR	2	5	4	10	21.5	21.5							4	3	3	13.5	28	23	1		1	3		1
BOUCUR	4	4	4	21.5	23	8							4	3	4	32	9	24.5	5		2	14		3.5
BOUGRA	4	3	3	23	21	11	5	3	5	28.5	8	35.5	5	4	5	86	21	14.5	5		6	73		21.5
BOUHIR															5			17						
BUCDAC																					1			0.5
CYPFEN									1			1												
ELYELY	4	2	3	7.5	6	1.5	5	4	4	48.5	12	5.5	5	1	4	33.5	5	4.5	5		5	15		4
LYCSET	1		1	1		0.5	3			6			3		4	10		3	3			3		
MUHMON		1			0.5																			
MUHTOR							3	1	3	6	0.5	6.5							3		3	11		2
MUHWRI							4		1	0.5		0.5												
PASSMI		1			3			2	2		4	3.5			3			1.5						
POABIG							1			0.5														
SCHPAN									1			0.5												
SPOCRY	3	1	1	4	3	0.5			1			0.5			1			0.5			1			1
FORB																								
ARTFRI		1			3		2			3														
ASCSUB													1	2	1	3	3.5	3						
ASTMIS1		2			2			1	2		3	1		1			0.5							
ASTMOL							1			3														
BRASSP																					2			1
CASINT								1			0.5										1			0.5
CHAALB		1			1														1			0.5		
CHAERI			2			1							2	1	3	2	0.5	2	3		2	1.5		1.5
CHAFEN	4	4	3	2	5	1.5			1			0.5	5	4	4	16	9.5	2	5			2		
CHEINC									1			0.5												
CHEPAL													1	1	1	1	3	0.5	2		1	0.5		0.5
CIRNEO								1	1		3	0.5	3	4	3	13	16	5	2		2	1.5		1.5

* = present but no value recorded. Pink highlight denotes an exotic species

TTable H-1. Three-year upland grass community comparison of frequency and cover, by plot at Pecos NHP. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	LT04						LT05						LT07						LT10					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
CORWRI1	4	1		87	0.5			1			3													
CRYCIN		2			11		1			0.5														
DALAUR													1			1								
DALCAN			1			0.5	1			1														
DALJAM																			2			5.5		
DESCOO		1	1		3	0.5																		
ERIALA									2			1			5			11						
ERIANN2							1	1		5	1		4			15.5			1			1		
ERICAN																			1			0.5		
ERIDIV							3	1		1	1				1			0.5						
ERIFLA							2			1.5			3		2	8		1						
ERIJAM	2	2	1	3	10.5	0.5	2		3	25		13.5							4		2	8		2
GAIPIN																			1			5		
GAUCOC	1	3		0.5	2.5			2			6		1	2	1	0.5	10	0.5	1			0.5		
GUTSAR	5	2	5	34	3.5	12.5	4	1	1	20	1	3	3	1		1	1							
HACBES		2			1																			
HELPET							1			1														
HETVIL							1		1	25		7	3	3	2	4.5	4.5	1	3			3		
HYMFIL	2			0.5									1		1	0.5		0.5						
HYMRIC	2	2	4	5	1.5	3.5		1	2		13	1.5	4	1	2	6.5	3	13			1			0.5
KOCSCO																					1			0.5
LACSER							4		1	9.5		0.5	2			3.5			2			1		
LACTAT															1			0.5						
LAPOCC									1			0.5			1			0.5	1		2	0.5		1
LILSPP													2			1								
LINPUB		1			0.5		1			0.5														
LITMUL														1			0.5							
MACPIN													3	1	3	16	5	4.5	2		2	5		1
MELLEU	1			5																				
MENSCA	1	1	3	30	7	4.5	3	2	4	8	25	14							5		5	61		30.5
MIMRUP	2	1		6	1																			

* = present but no value recorded. Pink highlight denotes an exotic species

Table H-1. Three-year upland grass community comparison of frequency and cover, by plot at Pecos NHP. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	LT04						LT05						LT07						LT10					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
MIRLIN														1	1		0.5	0.5						
OENCOR			1			0.5																		
PENJAM			4			2			3			1.5	1		2	0.5	0.5							
PENSSP													1			1								
PHLNAN													1			1								
PHLTRI															3			1.5						
PHYHED	1			0.5																				
PHYREC																			1			0.5		
PHYSUB							2		1	1		0.5												
PICOPP									3			2.5												
PLAPAT														1			1							
POROLE							1		1	0.5		0.5							1			0.5		
PSOTEN	1	3	1	3	9	0.5	2		1	0.5		0.5							1		1	0.5		1
RATTAG								1	1		0.5	0.5												
SALTRA		1	1		5	1													2			1.5		
SENFLA		2			10																			
SENSPA																					1			0.5
SPHCOC	1	1	1	3	3	1																		
SPHFEN							2	2	1	1	8	3												
TALPAR															2			1						
TETARG	5	1	5	34	5	10							1	2	1	3	14	1	2		2	7.5		6
THEMEG	2	2	1	1.5	1.5	0.5	2	1	2	4	0.5	3.5							4			4		
TRADUB							1		1	0.5		0.5	3	1	1	1.5	0.5	0.5	1		1	0.5		0.5
VERBRA1			1			0.5	2	1	3	1	3	1.5			1			0.5	3		1	0.5	0.5	
VERTHA									1			7												
WOODY																								
ARTFIL									1			3												
ECHVIR													2		3	1		2						
ERINAU	2	1	2	20	0.5	3.5													3			4		
FRAXSSP								1			1													
JUNMON	1	1	1	15	7	3	1	1	1	10	13	7		1			0.5							

* = present but no value recorded. Pink highlight denotes an exotic species

Table H-1. Three-year upland grass community comparison of frequency and cover, by plot at Pecos NHP. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	LT04						LT05						LT07						LT10					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
OPUPHA			1			0.5			1			0.5									1			1
OPUPOL	1	1		0.5	0.5														2			1		
PINEDU													1	1	1	0.5	1	3						
PINPON	2			0.4																				
YUCGLA		1			0.5																			

* = present but no value recorded. Pink highlight denotes an exotic species

Table H-2. Three-year upland grass community comparison of frequency and cover, by plot at Pecos NHP. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	LT12						LT16						LT17						LT19					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																								
ARIPUR	1		1	5		1																		
BOUCUR	2	1	3	18	5	4		1			3		5	4	5	66	12	33						
BOUGRA	5	3	4	109	7.5	7	5	5	6	70	93	39	5	4	4	55	18.5	9.5	5	5	5	150	125	55
BOUHIR									2			8												
BROINE									1			0.5												
BUCDAC	2			18															1			3		
ELYELY	5		2	16.5		1	4	3	5	33.5	4	19.5	4	3	4	9	2	6.5	2			1		
LYCSET	4			6			5			5			4			15								
MUHTOR			1			3							1	1	1	0.5	0.5	0.5						
PANCAP	1			0.5																				
PASSMI		1	1		*	3													1	1	1	20	0.5	3
PLEJAM							1			0.5														
POAFEN							3		2	4.5		2												
SPOCRY			1			0.5	3			1														
FORB																								
ARTCAR			1			1																		
ARTFRI	1	1		0.5	0.5																			
ASCSUB			1			0.5																		
ASTHUM														1			0.5							
ASTMIS1	1	1		1	0.5		1	1	1	0.5	3	0.5	5	1	1	0.5	0.5	0.5						
ASTMOL		1			0.5																			
BRASSP									1			1												
CHAALB																			1			0.5		
CHAERI							2			1.5			2	3		1	8.5							
CHAFEN	4	2	1	5.5	1.5	0.5							5	4	4	8	8	2	2			0.5		
CHEHIA																			4			1		
CHEPAL							2		1	4		0.5	1		1	0.5	0.5							
CHEWAT							2			3														
CIRNEO	2	1	1	0.5	3	0.5																		

* = present but no value recorded. Pink highlight denotes an exotic species

Table H-2. Three-year upland grass community comparison of frequency and cover, by plot at Pecos NHP. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	LT12						LT16						LT17						LT19					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
CONCAN							1	1		0.5	0.5													
CORWRI1													3			23.5								
CRYCIN							3	1		4	3													
DALCAN	1		1	0.5		0.5							4	4	4	30	5.5	4.5						
ERIALA			3			1.5									1			0.5						
ERIANN2	4			5			1			0.5			1			0.5								
ERICAN		1			5								3	3	3	5	2.5	1.5						
ERIDIV	1	2	1	0.5	0.5	0.5	2			3									5			10		
ERIFLA	5		3	43		2	4		1	62.5		1												
ERIJAM	2	2	2	1.5	3.5	4							4	4	4	46	16	7						
FRBLNG			1			0.5																		
GAUCOC								2	1		15	0.5	1	2	2	3	2	1	1			0.5		
GUTSAR	1	2	1	3	7.5	3	5	4	4	26.5	34	13.5	5	3	5	2.5	6.5	7.5	3	1		0.5	0.5	
HACBES																				1			3	
HELPET													1	1		3	0.5							
HETVIL	1	1	1	5	1	1	1			0.5			4		4	18.5		4.5						
HYMFIL	1			0.5									2		1	0.5		0.5						
HYMRIC	2		2	3.5		1.5		1	1		3	0.5							4			1.5		
LAPOCC									1			0.5												
LILSPP	1			1																				
MACPIN	3	2	1	1.5	3.5	0.5	2	3	2	20	23	1	1	1	1	3	3	1	1			0.5		
MELLEU								1			5				2			1.5						
MELOFF		1			0.5																			
MENSCA	2	1	2	4	0.5	1	3	1	4	8.5	10	5.5	3		1	4		1						
MIRLIN	1	2	2	0.5	1.5	1							1	1	1	0.5	3	0.5						
PENJAM	2		2	1.5		1							3		4	1.5		2						
PHLNAN	3			3.5									2			21								
PHLTRI			2			1																		
PHYHED							1			0.5														
PHYSUB									1			0.5	1	1		0.5	0.5							
PLAPAT			1			0.5	3			4									3			1		

* = present but no value recorded. Pink highlight denotes an exotic species

Table H-2. Three-year upland grass community comparison of frequency and cover, by plot at Pecos NHP. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	LT12						LT16						LT17						LT19					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
POROLE			1			0.5			1			0.5							4			3.5		
PSOTEN	1			0.5																				
RATTAG							2			7.5				1			1							
SALCOL			1			0.5																		
SALTRA			1			0.5			1			0.5			2			1						
SENFLA								1			5													
SPHCOC								1			0.5													
SPHFEN	1	1	1	10	3	1									1			0.5						
TALPAR			1			0.5													5	2		3.5	1	
TETARG	1	2	1	0.5	3.5	1	3	1		1.5	0.5		2	4		6	16							
THEMEG		1			1								4	3	2	1.5	2	1						
TRADUB	1	1		0.5	1		5		2	4.5		1.5	3	1	2	2	0.5	1						
VERBRA1	2			1.5									1			0.5								
WOODY																								
ECHVIR							1		2	0.5		1												
ERINAU	1			7			2		1	4		3												
ESCVIV			2			1			1			0.5			1			0.5			1			0.5
OPUPHA																			1	1	1	0.5	0.5	0.5
OPUPOL													1	1	1	1	3	1						

* = present but no value recorded. Pink highlight denotes an exotic species

Appendix I: Sand Creek Massacre NHS Results Tables

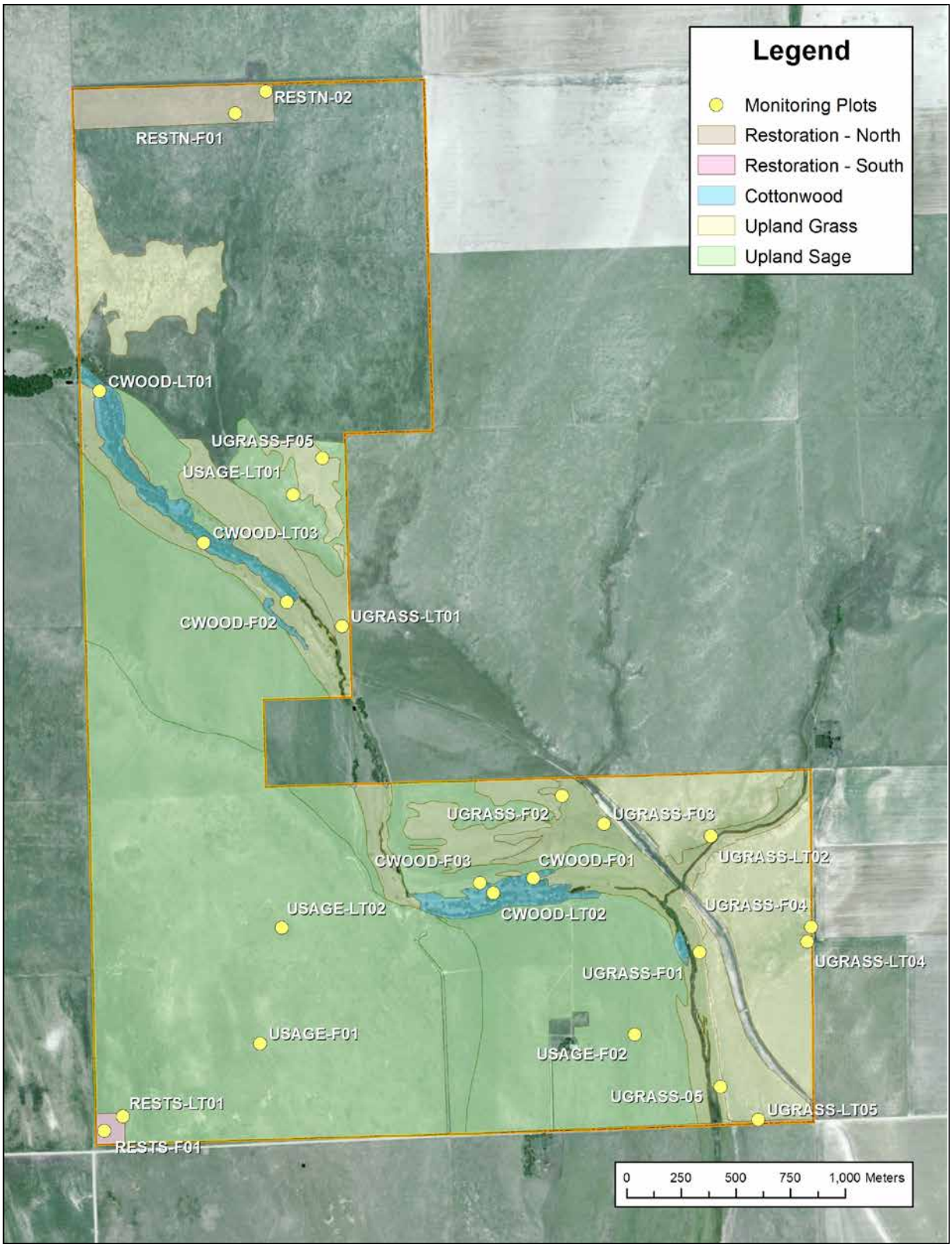

Figure I-1. Monitoring transects visited at Sand Creek Massacre NHS in 2012.

Table I-1. Three-year cottonwood community comparison of frequency and cover, by plot at Sand Creek Massacre NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	RESTE-LT01						RESTN-LT01						RESTS-LT01					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																		
BOUCUR									2			1						
BOUGRA									1			0.5						
BUCDAC							2	2	3	28	14	16						
CARSSP													1			1		
DISSPI	3	4	3	0.5	48	2.5		2	1		13	15	5	3	2	19	6.5	1
ELYCAN	2			2					3			2.5	3	1		13	10	
ELYELY							5			11								
ELYVIR															3			4.5
PANCAP													1			0.5		
PANVIR							3	3		13	30		4	4	3	26	55	2.5
PASSMI	4	4	5	160.5	95.5	78.5	5	5	5	28.5	42	20.5	3	4	4	4	20	13.5
POAPRA			2			7.5												
SCHAME													1	1	1	30	20	1
SPOAIR								1	2		3	6	1	2	5	5	8	40.5
SPOCRY							2	1	2	17	10	1.5		1			3	
VULOCT															2			1
FORB																		
AMBPSI							4	3	3	6.5	11.5	1.5	5	4	5	37	14	2.5
ARTDRA															1			0.5
ASCSPE	3	2	1	4	6	0.5	2	1		1	0.5				1			0.5
ASCSUB	4	3	4	3	4.5	3		3	3		2	1.5	4	4	3	5	14	4.5
ASCVIR2														1			1	
ASTBOD							1	2	1	0.5	1.5	1	2		2	3		1
CALINV							3	1		0.5	0.5							
CHASER1	1			1			1	1		0.5	0.5		3	1		1.5	1	
CHEALB	1		3	0.5		4												
CHEWAT														2			1	
CIRUND							2	2	2	3	6	1	2	1	1	3.5	7	1
DALEA							1			0.5								
DYSPAP	1			0.5														
ERIANN2	1		1	0.5		0.5												
FRBLNG									1			0.5						
GAUCOC									2			1						
GLYLEP													1	2	1	15	10	1
GRIPAP							1	2		0.5	4							
HELANN	2		0.5										1			0.5		
KOCSCO	2			1				1	1		0.5	0.5			1			0.5
LACSER							1			0.5								
MELOFF	2	1	1	1.5	0.5	0.5	1			0.5								

** = present but no value recorded. Pink highlight denotes an exotic species*

Table I-1. Three-year cottonwood community comparison of frequency and cover, by plot at Sand Creek Massacre NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	RESTE-LT01						RESTN-LT01						RESTS-LT01					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
PACNEO							1			0.5								
PHYLAN								1			3							
PHYLON	2			1			1			0.5			3			1		
PSOTEN															1			0.5
RATCOL								1			5		1	1		0.5	5	
SALTRA			3			1.5			1			0.5			1			0.5
SOLGIG									1			0.5						
SYMERI							2			1.5			1		1	0.5		0.5
WOODY																		
POPDEL	present but not measured						present but not measured						present but not measured					

** = present but no value recorded. Pink highlight denotes an exotic species*

Table I-2. Three--year restoration and upland sage community comparison of frequency and cover, by plot at Sand Creek Massacre NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	RESTN-02						RESTS-LT01						USAGE-LT01						USAGE-LT02					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																								
ARIPUR		2	1		1.5	0.5	3	3	3	2	44	6.5							2	3	3	3.5	13	3
BOUCUR		4	5		170	129	2	2	4	25	8	26	4	5	5	140	180	97	2	5	1	7	9	0.5
BOUGRA							4	3	4	55	26.5	42.5	6	3	5	56	11	28.5	3		5	47		40
BUCDAC		1	1		7	10							5		4	15.5		2.5	1	2		3	18	
CARSSP							1			1														
ELYELY		1	1		3	1		2	3		2	2	1			1					1			1
PASSMI														1			0.5							
SCHPAN																				1			3	
SPOCRY		5	2		30.5	1.5	3	5	4	40	29	48							5	5	5	27.5	107	20
FORB																								
AMBPSI							5	4		4.5	2.5								5	2	1	5	6	0.5
ARTLUD																					1			0.5
ASTLON													5	1		32.5	0.5							
CALINV																			2	2		0.5	2	
CHAMIS								2			6													
CHEALB		1			1				3			4									5			5.5
CHESIM																					1			0.5
CIRUND																			1	2	1	0.5	1.5	0.5
CONCAN		3			20.5		5	1		45.5	0.5		1			0.5			5	1		11	0.5	
CROTEX								1			1									1			0.5	
DALCAN									1			0.5		5			6.5							
DYSPAP							2			1														
ERIANN2							3			7									5			21.5		
ERIBEL							4			7.5														
EVONUT							1	1		1	5													
GRIPAP							3	1		6	0.5								3			31		
HELPET							2	1		1	0.5													
IVAAXI																				1			0.5	

* = present but no value recorded. Pink highlight denotes an exotic species

Table I-2. Three--year estoration and upland sage community comparison of frequency and cover, by plot at Sand Creek Massacre NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	RESTN-02						RESTS-LT01						USAGE-LT01						USAGE-LT02					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
KOCSCO		2	3		2	2		1	1		0.5	4							1		1	7		0.5
LAPOCC									1			0.5												
LITINC													1			0.5								
LYGJUN		1	1		0.5	0.5	1	1		0.5	1				3			1.5						
MACPIN		1			0.5		1	1	2	0.5	0.5	6	1	1	1	0.5	1	0.5	1			0.5		
MENNUD								1			0.5													
PEDDIG																			1			0.5		
PENALB															2			1						
PSOTEN							3			4					1			0.5						
QUILOB																			3			0.5		
SALTRA			3			1.5			3			2.5							2		4	3.5		2.5
SPHCOC		1	1		1	1	3	3	3	11	9	8								1			0.5	
SYMERI			2			1.5													1			0.5		
VERBRA1																			2			1		
WOODY																								
ARTFIL							5	5	6	48	50	38							4	4	4	128.5	100.5	46
ESCVIV							2			1			1			0.5								
OPUFRA													1	1	1	0.5	0.5	0.5						
OPUPOL		1	1		1	1									1			0.5	2		1	0.5		1
YUCGLA							1	1		0.5	0.5													

* = present but no value recorded. Pink highlight denotes an exotic species

Table I-3. Three-year upland grass community community comparison of frequency and cover, by plot at Sand Creek Massacre NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	UGRASS-LT01						UGRASS-LT02						UGRASS-LT04						UGRASS-LT05						UGRASS-05					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																														
ARIPUR		1			0.5		1	4		1	7		4	4	3	55.5	106	81	4	4	5	22.5	70	80	3	3	3	6.5	19	10.5
BOUCUR		1			0.5		1	1	1	3	7	15									1			1	2	2	3	5	17	11.5
BOUGRA	5	3	5	230	76	80			2			1							2	2	4	1.5	14	7.5	4		4	48		61
BUCDAC	3	3	1	8.5	13	3														1	2		1	1.5	2	2	2	14	6	1.5
DISSPI	2	3	1	1.5	31	1	4	4	5	125	105.5	79															3			16
ELYELY			1			0.5	1	1		0.5	10				1			0.5	1	1		0.5	0.5		1	1		3	3	
PANVIR		2			18			2			35														3	5		11.5	10	
PASSMI							5	5	1	53	173	27	5	5	5	101.5	71.5	174	2	2	2	47	8	6	1	1	1	35	25	5
SCHPAN							2			1.5									1	3	1	0.5	13	0.5						
SPOAIR	2	5	2	18	82	22	2	4	3	105	11.5	81	1		1	3		10									1			10
SPOCRY	4	4	3	2	19	4.5			4			2.5													2	4	1	10.5	59	0.5
FORB																														
AMBPSI																									1			0.5		
ARTFRI		1			3																									
ASCASP																									1			0.5		
ASCLAT																									1			0.5		
ASCSPE							1	1		1	3		1			0.5														
ASCSUB																			1			0.5								
ASTCRA													4	1		5	1													
CALBUS													1		2	0.5		1												
CALINV	1			0.5									4	4	2	14	9	1												
CIRUND	1	1		0.5	0.5								3	1	1	1	3	1												
CONARV													5	5	4	78	25	2												
CONCAN	3	1		21.5	0.5		1			0.5			2	4		6	17													
DALCAN																									2	1	1	17	7	0.5
ERIANN2	1			0.5																										
ERYCAP																					2			2						
EUPMAR													3	1		1	3									1			1	
EVONUT																				2			1.5							

* = present but no value recorded. Pink highlight denotes an exotic species

Table I-3. Three-year upland grass community community comparison of frequency and cover, by plot at Sand Creek Massacre NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	UGRASS-LT01						UGRASS-LT02						UGRASS-LT04						UGRASS-LT05						UGRASS-05					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GAUCOC													2		5	6		3.5												
GRIPAP																			1	2		0.5	13		1			0.5		
HELANN	2			0.5																										
HETVIL													2			7.5														
IVAAXI																			2	1	2	25	25	1						
KOCSCO	2	1	2	1	0.5	1	4	1	1	60.5	5	1	3		2	6		1.5	3	1	4	42	3	5.5			2			1
LAPOCC			1			0.5															2			1						
LYGJUN	2	2	3	3.5	1.5	1.5	3	1	3	1.5	0.5	1.5	1			0.5			1			0.5								
MACPIN														1			0.5		2		2	5.5		1	3		1	0.5		0.5
MELALB							1			7																				
PHYCIN	1			0.5																										
PHYLAN																			3			60								
PHYLON													1			0.5									1			0.5		
PSOTEN													3			5														
RATCOL	1			0.5			1			0.5			2		1	0.5		0.5							1			0.5		
RATTAG																					1			0.5						
SALTRA	2	2	4	3.5	1	2.5			1			0.5	2	2		1	2		2		4	1.5		2.5	5	2		9.5	8	
SPHCOC	1	1	1	1	3	0.5	2	1	1	0.5	1	0.5	5	5	5	41	18.5	6	5	3		78	25		1		2	0.5		1
SYMERI													5	1		27	1								2	1	1	7.5	15	10
VERBRA1													3			1														
WOODY																														
ARTFIL	3	2		3	8																				4	4	3	15.5	9	6
ERINAU																											3			2
OPUPOL																										1			0.5	
YUCGLA	1		1	0.5		10																								

* = present but no value recorded. Pink highlight denotes an exotic species

Appendix J: Washita Battlefield NHS Results Tables

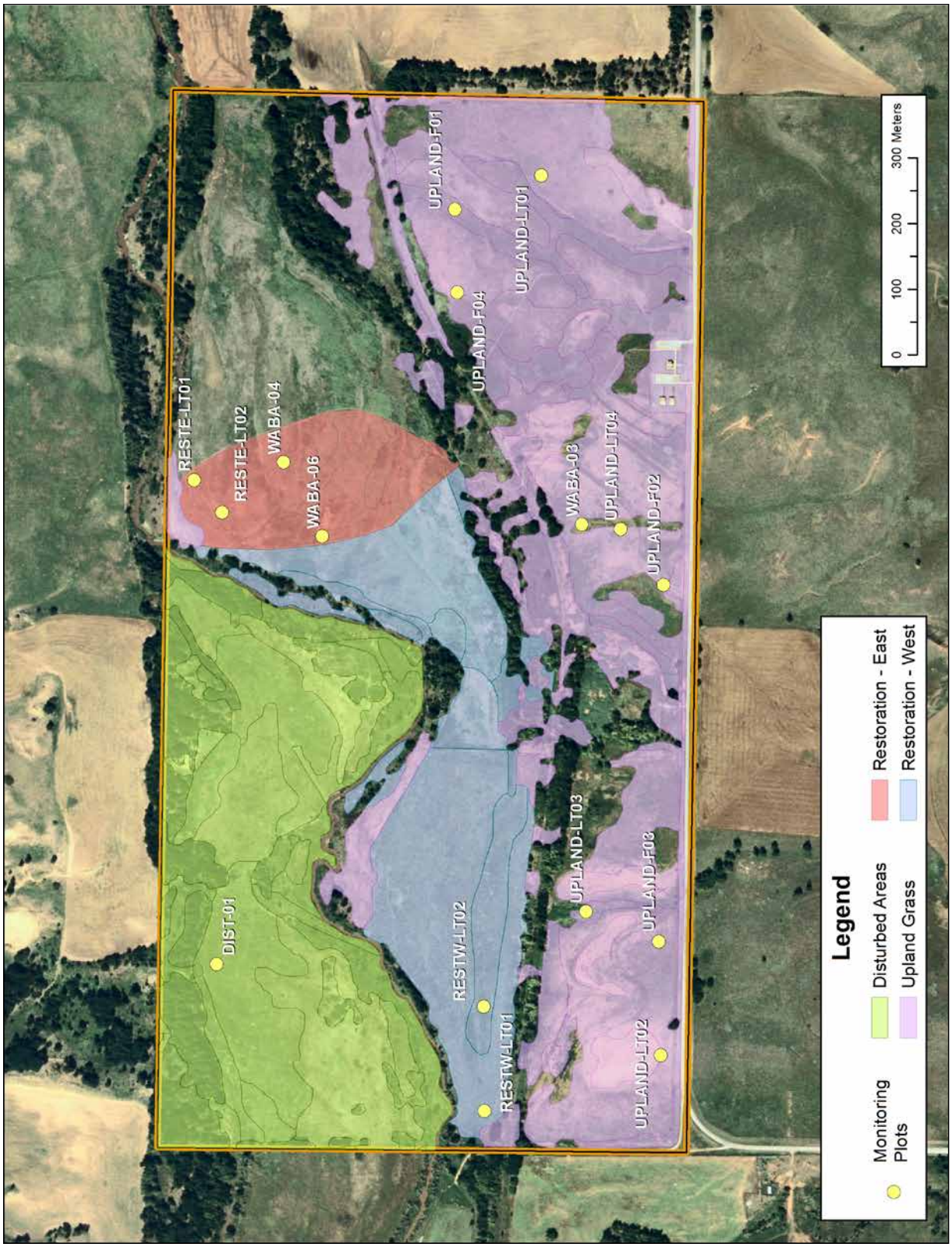

Figure J-1. Monitoring transects visited at Washita Battlefield NHS in 2012

Table J-1. Three-year upland grass community community comparison of frequency and cover, by plot at Washita Battlefield NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	UPLAND-LT01						UPLAND-LT02						UPLAND-LT03						UPLAND-LT04						WABA-03					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																														
ANDGER																					1			3			4			18
ANDHAL							4	1		6	3								1			0.5								
ARIPUR	1	2	1	30	55	10														5			28.5							
BOTISC																					1			10			3			4
BOTLAG																					1			0.5			1			7
BOUCUR							5	4	6	28	17.5	46	1			5			4	5	5	60	103	8.5			4			20
BROJAP	1	5	5	0.5	53	101							1	2	5	0.5	27	172	2	1	4	0.5	3	54			4			2.5
BUCDAC																											2			4
CARGRA1													3		1	77		1												
CARSSP	2			3										2	3		1	1.1	1			0.5								
CYNDAC			4			26.5								1	1		1	0.5												
CYPODO																					1			0.5						
DISSPI		3			21															1			1							
ELYCAN													3			10.5														
ELYVIR															1			0.5												
GRSSLNG															1			0.5												
LEPFUS			1			0.5													3			11								
PANVIR																			1	2		7	1				5			11
PASSMI																			2		2	3.5		1.5						
SCHSCO	5	3	5	69	78	22.5	5	5	10	97	95	112.5	1		2	3		1.5	4	5	9	81	150	93			6			28
SETPAR									3			1.5																		
SORHAL													2	2	2	25	1.5	1												
SORNUT							3	2	2	4	3.5	4		1			1		3	1	1	10.5	0.5	10			5			23.5
SPOCRY	5	4	1	85	3	0.5		1	1		0.5	0.5	2			25														
FORB																														
AMBART																			2	1	4	8	1	5						
AMBPSI	4	4	4	26.5	14	3														2			1.5				5			22.5
AMBTRI													2			3.5														
ARTLUD	2	1		1.5	3														1			3								

* = present but no value recorded. Pink highlight denotes an exotic species

Table J-1. Three-year upland grass community community comparison of frequency and cover, by plot at Washita Battlefield NHSFrequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	UPLAND-LT01						UPLAND-LT02						UPLAND-LT03						UPLAND-LT04						WABA-03					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
ASTPLA							5			8																				
CHAGLY	3			1																										
CHEDES													3			130														
CHEPRA																					1			0.5						
CIRALT																					2			1						
COCCAR	5			6			2			1									4			4								
CONARV													1	1		1	0.5													
CONCAN																					2			1.5			1			0.5
CROGLA			2			1																								
CUCFOE	2	1		3.5	0.5														2	1		1	1							
DALAUR							5			19																				
DALENN								5	4		31.5	5.5																		
DESILL1									1			0.5	1	2	1	13	3.5	0.5												
DESSOP																					1			0.5						
ERIANN1							2			1																				
ERIANN2	1		3	0.5		1.5			2			1															1			0.5
ERIBEL		1			0.5																									
EUPDEN													1			0.5														
EUPMAR																					1			0.5						
GAIPUL	2	1	2	15	3	4																								
GAUMOL															1			0.5												
GAUVIL																					1			0.5						
GRIPAP	3			1.5																	2			1						
HELANN													3	1	2	8.5	0.5	3.5									1			0.5
HELPET			1			0.5															1			0.5						
HETCAN																					1			1						
IVAANN																			2			0.5								
KOCSCO													3	2	1	29	48	75												
LACSER														1			0.5				1			0.5						
MACPIN																			1			10								
MEDMIN							5	2		3.5	1		1			3														

* = present but no value recorded. Pink highlight denotes an exotic species

Table J-1. Three-year upland grass community community comparison of frequency and cover, by plot at Washita Battlefield NHSFrequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	UPLAND-LT01						UPLAND-LT02						UPLAND-LT03						UPLAND-LT04						WABA-03					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
MELOFF									5			2.5									2			1						
OENELA																					2			1						
PHYCIN													2			4														
PHYLON													2		1	0.5		0.5												
PLAPAT		1	2		0.5	1																								
SALTRA	3	1		1	0.5															2	3		13	8.5						
SOLCAN	4			3.5																										
SOLELA	1	2	1	5	1.5	1							4	4	4	11.5	9.5	2									1			1
SONASP													1			0.5														
STRLEI	3		2	0.5		1															1			0.5						
SYMSSP																				2			8							
WOODY																														
FRAXSSP													1			25														
OPUMAC	1	1	1	3	7	1																								
RHUCOP														1			13													
SAPSAP															1			1												
ULMPUM								1			3				1			0.5	2	2	1	5	10.5	3			4			4.5

* = present but no value recorded. Pink highlight denotes an exotic species

Table J-2a. Three-year restoration grass community (part 1) comparison of frequency and cover, by plot at Washita Battlefield NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	RESTE-LT01						RESTE-LT02						WABA-04						WABA-06					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																								
ANDGER			6			15			1			0.5			3			4.5			3			5
ANDHAL	3	1		3	1		5	4	3	33.5	33	2												
ARIPUR							2			0.5														
BOUCUR	5	4	4	75	11	7.5	3	4	2	12	35	4			2			11			4			26
BROJAP									1			7			5			25			5			44
DICOLI																					1			0.5
ERASPE	3			4			1			0.5											1			0.5
PANVIR	5	5	6	34	60	43	4	4	6	21	14	39			7			40			3			4.5
PASSMI							1		1	3		1												
POAFEN			1			0.5																		
SCHSCO	5	5	10	110	150	52	5	5	10	70	155	48.5			9			48			5			25
SORHAL	1			5																				
SORNUT	5	4	3	54	42.5	4.5	5	3	2	20	8	14.5			4			3			2			10.5
SPOCRY			1			0.5																		
VULOCT																					2			8
FORB																								
AMBTRI																					1			5
CHASTI																					2			1
CHEALB																					1			0.5
CIRUND	1			0.5																				
COCCAR	3			2			5			2.5														
CONCAN			4			5			5			2			4			2.5						
CROMON									1			0.5												
CROTEX							1			1														
DESILL1	5	5	3	67.5	67	4	5	4	3	29.5	18.5	1			4			9.5			1			0.5
ERIANN2	2		2	0.5		4	2		3	0.5		4												
GAUMOL									2			1									1			1
GRIPAP			1			1			2			1			4			2.5			1			1
HELANN			4			9.5			4			1			4			4.5			2			3.5

* = present but no value recorded. Pink highlight denotes an exotic species

Table J-2a. Three-year restoration grass community (part 1) comparison of frequency and cover, by plot at Washita Battlefield NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	RESTE-LT01						RESTE-LT02						WABA-04						WABA-06					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
HELPET		1			3																			
LACSER																					1			0.5
OENELA							1		1	0.5		0.5												
PLAPAT	1	1	1	0.5	0.5	0.5	2	1	2	1	1	3.5									2			1.5
SOLELA		1			1										1			3			2			8
SOLNEM															2			2						
SOLROS			1			3															3			6.5
SONASP							1			0.5														
TRADUB															1			0.5						
TRIHOL									1			0.5												
WOODY																								
ULMPUM	4	4	2	1.5	3	1																		

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Table J-2b. Three-year restoration grass community (part 2) comparison of frequency and cover, by plot at Washita Battlefield NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values.

Species	RESTW-LT01						RESTW-LT02						DIST-01					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
GRASS																		
ANDGER			1			3			2			3.5			9			65
BOTISC			1			1			1			40						
BOTLAG	3	1	1	2	1	1	4	5	1	8	23.5	0.5		2			2	
BOUCUR	4	2	6	108	15	21	3	2	2	6.5	18	1.5						
BROJAP	2	3	5	1	1.5	22	5	2	5	1	6	40.5		4	5		37	79
BROTEC									1			0.5						
CALGIG			3			23.5												
CYNDAC									2			2						
CYPODO													5	3		53	67.5	
DISSPI		2			1													
ELYCAN													2			1		
LEPFUS	3			10			5			38			2			1		
PANVIR	4	4		8.5	50		3	4		25	53.5		1	3		30	4.5	
PASSMI									1			0.5						
SCHSCO	5	5	8	100	88	43	4	4	1	8.5	55	1	3	3	2	16.5	46.5	1
SORHAL	1	2	3	0.5	15	13.5	5	2	3	58	45	11			2			1
SORNUT	4	4	2	12	26	8	5	2	4	51.5	20	3						
SPOCRY	1	1		0.5	0.5													
FORB																		
AMBPSI	1	2	1	3	10.5	17							5	5	5	14.54	40	68
ARTLUD	2			0.5									3	2	2	40.5	20	0.5
CIRUND									1			0.5						
COCCAR	4			2.5			5			19			4			1		
COMERE			1			0.5												
CONCAN			3			1.5			3			1.5						
CUCFOE	1			1			1			0.5								
DESILL1	2	2	1	4	3.5	0.5	3	2	2	2.5	1.5	2	5	3	4	150	2	2
ERIANN2			3			1.5							1			0.5		
FRBLNG			1			0.5												
GAUMOL													2	2	5	3	1	3
GRIPAP			1			0.5												
HELLON														1			0.5	
HELPET														2	1		3.5	1
HELSSP			1			0.5												
IVAANN							1	1		5	13							
LACSER									1			0.5						
LINRIG	2			1														
MACPIN													2			1		
PHYLON													1			0.5		
SALKAL			1			0.5			2			1.5			1			1

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Table J-2b. Three-year restoration grass community (part 2) comparison of frequency and cover, by plot at Washita Battlefield NHS. Frequency is the number of 2x1 plots where present. Cover is a sum of individual plot cover values. (Continued)

Species	RESTW-LT01						RESTW-LT02						DIST-01					
	Frequency			Cover Sum			Frequency			Cover Sum			Frequency			Cover Sum		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
SOLDIM													3	3	2	5.5	9	3.5
SOLELA															1			0.5
SOLPET													1	1		7	0.5	
STRLEI									1			0.5	2			1		
SYMPRA		2	2		1.5	1		1			0.5							
TEUCAN													1			3		
TRADUB			1			0.5												
TRIHOL							1			1								
WOODY																		
PRUANG													3	2	2	40.5	55.5	65.5
ULMPUM	4	2	1	2	5.5	5	5	4	5	21.5	31.5	14.5	5	3	3	4	2.5	1.5

* = present but no value recorded. Pink highlight denotes an exotic species

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NPS XXX/XXXXXX, March 2013

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