A GRASSLAND CONSERVATION PLAN FOR PRAIRIE GROUSE

North American Grouse Partnership

Compiled by

William L. Vodehnal and Jonathan B. Haufler


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EXECUTIVE SUMMARY

Prairie grouse, including all species of prairie-chicken and the sharp-tailed grouse, have declined precipitously and steadily from historical levels throughout the Great Plains of North America. While many factors have contributed to these declines, the loss and fragmentation of expansive prairies to farming, and the reduction of habitat quality within remaining prairie fragments are known to be the primary causes. The social, political and economic drivers that have facilitated this loss of native grasslands throughout the United States and Canada generally fall beyond the jurisdiction of individual local, regional, state, and provincial wildlife management authorities. As a result, many grassland-dependent species requiring high-quality native grasslands are now threatened, endangered, or species of concern. Grasslands have been identified as some of the most endangered ecosystems in North America, so it is not surprising that many associated species are of concern for their level of decline.

This Grassland Conservation Plan for Prairie Grouse, coordinated by the North American Grouse Partnership, represents the collective efforts and expertise of numerous grassland and prairie grouse experts in developing habitat prioritizations that are needed to sustain grouse and other grassland species into the future. The Plan provides a framework for managing, enhancing and restoring grassland ecosystems to meet the needs of three prairie grouse species; greater prairie chicken (*Tympanuchus cupido*), lesser prairie-chicken (*T. pallidicinctus*), and plains sharp-tailed grouse (*T. phasianellus jamesi*). While prairie grouse are deserving of conservation efforts on their own right, they also serve as flagship species for broader conservation of prairies.

As a group, prairie grouse are resident species requiring relatively large home ranges to sustain their populations. For example, an estimate of the need for a sustainable population of 10,000 prairie grouse spread across 500 spring display grounds would require up to 225,000 acres of nearly contiguous native grassland. By providing for the needs of these species, many other grassland species may be adequately conserved as well. This plan and its implementation are urgently needed if we desire to maintain both prairie grouse and many other grassland species.

This Plan uses an ecosystem diversity approach to grassland conservation, primarily based upon the Natural Resources Conservation Service's extensively-mapped ecological site descriptions within Major Land Resource Areas (MLRAs). Prairie grouse, along with other flora and fauna, evolved in response to the historical ecological diversity of the Great Plains. These systems were formed by fire, grazing, and climate influences within each ecological site, ultimately creating a diversity of adapted plant and animal species. Over time, and with increasing settlement, human actions on these ecological sites and processes caused changes in compositions, structures and functions of most grassland ecosystems. This plan proposes to identify, maintain, and restore representation of the ecosystem diversity that comprised our native prairies.

To determine the desired amounts of ecosystem diversity for prairie grouse, certain fire, grazing, climate, and other science-based factors were evaluated in relation to the ecological site descriptions for MLRAs in the U.S. and equivalent soil correlation areas (SCA) in Canada. Ecological sites were mapped using existing soil maps for approximately 550 million acres of the Great Plains of the U.S. and Canada. Historical ecosystems were described and relative amounts of specific ecosystems quantified. Current conditions were compared with conditions that occurred across specific ecological sites prior to European settlement. Using this as a foundation, teams of biologists knowledgeable of current prairie grouse population abundance and distribution throughout the states and provinces provided acreage goals for ecosystem diversity, identified priority areas for grassland conservation for each species, and described the primary threats to the species within each Bird Conservation Region (BCR).

Ecosystem diversity acreage goals were derived using current distribution of each species in various states and provinces based on spring breeding ground surveys and display ground density. Based on population abundance, acreage goals fell within categories of 10%, 15%, and 20% representation for each ecological site of an MLRA or SCA. Twenty percent representation was used for areas supporting high spring population densities with a focus of sustaining or increasing habitat quantity and quality. Ten percent representation was used for MLRAs or SCAs exhibiting low populations and also focused on connecting populations that may be isolated. This Plan identifies throughout the 10 BCRs within the Great Plains approximately 65 million acres that should be maintained or restore to accommodate conservation efforts for prairie grouse. This represents a minimum value as biologists also identified additional acres that may be necessary to sustain some isolated but essential populations in highly altered landscapes.

A critical component of this effort is to advance restoration and conservation actions to obtain these acreage goals within each BCR. Funding and other resources must be identified and committed to the goals of this plan. State and federal agencies, private organizations, and diverse partnerships will be essential to successful implementation. Vehicles for delivering funds and actions will likely include established entities such as the Joint Ventures and the collaborative efforts of agencies and organizations working across jurisdictional boundaries to affect large landscapes for prairie grouse and other grassland species.

The singular mission of the North American Grouse Partnership has been to promote the conservation of grouse and the habitats necessary for their survival and reproduction. Inherent to this mission is to ensure that future generations have the opportunity to experience the magnificence of these hallmark game birds, either through the exhilaration of birds exploding underfoot during a hunt, or by watching the sun rise over a lek of males dancing, booming and cackling to greet a new spring. To achieve this mission requires science-based planning, comprehensive coordination, and an unflinching dedication to long term success. With this Plan, we take the first step toward that future.

ACKNOWLEDGEMENTS

William Vodehnal coordinated the preparation of this plan. The Ecosystem Management Research Institute, particularly Jon Haufler, Carolyn Mehl, Amy Ganguli, and Scott Yeats, completed the ecosystem diversity assessment and final editing, layout, and production of the plan. Collaborative writing teams were involved in the preparation of the plan, especially for the BCR write-ups. Numerous state, provincial, and organization biologists from the US and Canada provided input to the plan. The Resident Game Bird Working Group and Bird Conservation Committee of the Association of Fish and Wildlife Agencies encouraged the preparation of this project. Landscape level descriptions were provided through ecological site descriptions and range site descriptions from the Natural Resources Conservation Service and through soil correlation areas from Agriculture and Agri-Food Canada.

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INTRODUCTION

Twelve species of grouse occur in North America across forest, prairie, shrub, and mountain ecosystems. They are charismatic species of particular interest for their recreational value and aesthetics. Most of these species require large and often complex habitat, making them good indicators of ecosystem integrity at landscape scales. For these reasons, North American grouse are excellent flagship species for conservation planning. In recognition of this, the North American Grouse Partnership (NAGP) has developed a North American Grouse Management Strategy (NAGMS) that is designed to highlight these 12 species and to generate support and cooperation for their management. A number of the 12 species, such as greater sage-grouse (*Centrocercus urophasianus*) and ruffed grouse (*Bonasa umbellus*), are already the focus of comprehensive conservation planning efforts. Others, such as several species of prairie grouse, have not received such focused attention.

This project has developed a grassland conservation plan for three species of prairie grouse: sharp-tailed grouse (*Tympanuchus phasianellus*), greater prairie-chicken (*T. cupido*), and the lesser prairie-chicken (*T. pallidicinctus*). The Attwater's prairie-chicken (*T. c. attwateri*) has already been the focus of specific conservation planning within its limited distribution, and will not be incorporated into this plan.

One of the challenges for most conservation efforts is to develop plans that meet the needs and objectives of cooperating state, provincial, and federal agencies, but that can be understood and supported by private landowners. This challenge is particularly true for prairie grouse, where a vast majority of their existing or potential habitat is in private ownership. A conservation strategy for prairie grouse should help coordinate and augment the individual efforts of state, provincial, and federal agencies. In doing so, it should provide direction and actions that can be understood and supported by private landowners.

This plan uses an ecosystem approach to address habitat needs of prairie grouse within the Great Plains of the U.S. and Canada, concentrating on grassland conservation and restoration that will provide habitat conditions for sharp-tailed grouse, greater prairie-chickens, and lesser prairie-chickens. It also addresses more specific threats and conservation actions for each species, including conservation needs of these species. Since sharp-tailed grouse and greater prairie-chicken occur outside of the Great Plains as well, specific recommendations for habitat conservation are included as they are not addressed by the ecosystem approach for the Great Plains. For all species, existing data were compiled and new analyses and interpretations were conducted that address grassland conservation and the needs of prairie grouse.

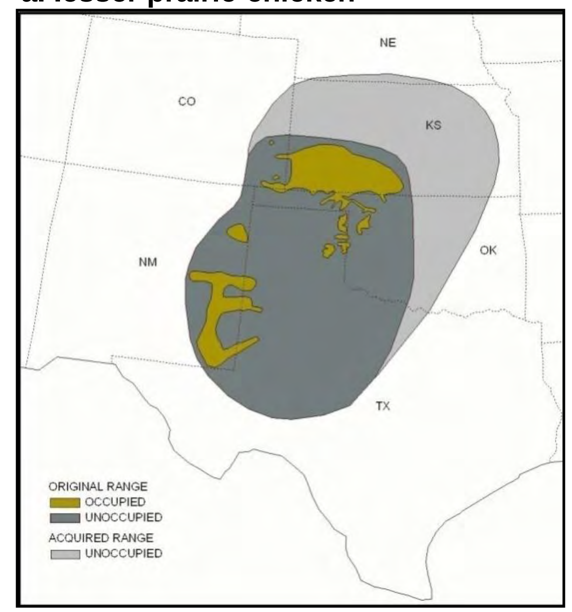
The goal of this plan is to provide a framework for managing, conserving, enhancing, and restoring grassland ecosystems within the Great Plains, and prairie grouse habitat in other areas, for greater and lesser prairie-chickens, and sharp-tailed grouse to support viable populations and desired numbers of these species.

BACKGROUND

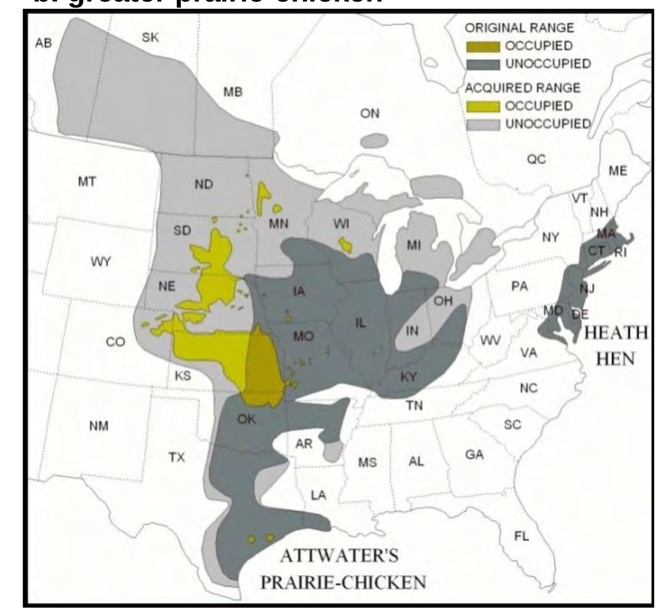
Prairies have undergone significant changes from their historical conditions. Substantial areas have been converted to agricultural uses as well as developed for residential, industrial, and commercial uses. These changes have often resulted in a loss of functional habitat for prairie grouse and other native species. Other areas, still maintained as grasslands, have also undergone significant change. In most areas, historical disturbance regimes have been altered, and resulting plant communities have different compositions, structures, and processes than occurred historically. The net effects of these impacts have been a substantial decline in prairie ecosystems, leading them to be identified as among America's most endangered ecosystems (Noss et al. 1995, Samson and Knopf 1996).

Changes in prairie ecosystems have resulted in losses and shifts in prairie grouse distributions. Schroeder et al. (2004) developed maps of these species, displayed in Figure 1 (a,b,c; adapted from NAGMS). Maintaining and enhancing prairie grouse populations is an important management need that will also provide benefits to many other prairie dependent species.

a. lesser prairie-chicken



b. greater prairie-chicken



c. sharp-tailed grouse

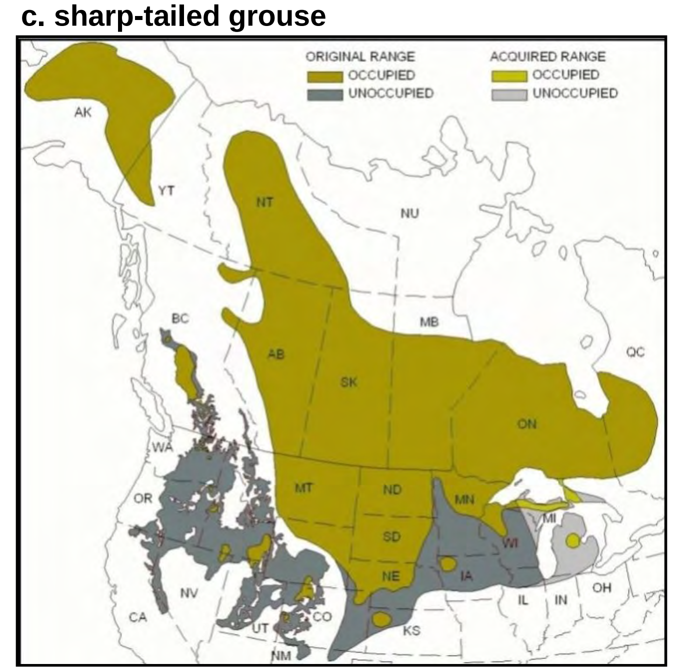


Figure 1. (a,b,c). Maps of historical and existing ranges of (a) lesser prairie-chicken, (b) greater prairie-chicken, and (c) sharp-tailed grouse in the United States and Canada. Produced by M. Schroeder, North American Grouse Management Strategy.

Spatial Needs of Prairie Grouse to Sustain Viable Populations

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Historically, the grasslands of North America covered almost half of the continent before European settlement of the Great Plains, making it one of the largest biomes in North America. At one time, these grasslands sustained millions of prairie grouse. The current status of greater and lesser prairie-chickens, Columbian sharp-tailed grouse (*T. p. columbianus*), and to a lesser extent, other sharp-tailed grouse, have reached the point where many populations of these species are now threatened, having become ecologically and genetically isolated from the rest of their range (Halfmann 2002, Johnson et al. 2003, 2004, Toepfer 2003).

Today, less than a half million greater prairie-chickens exist with three quarters occurring in only three of 17 states (Kansas, Nebraska, and South Dakota) within their historical range (Westemeier and Gough 1999). The heath hen (*T. c. cupido*), the eastern subspecies, is extinct and the Attwater's prairie-chicken, the southern subspecies, is considered the most endangered bird in North America with most of the birds existing in breeding facilities in Texas. Only two small isolated remnant greater prairie-chicken populations remain east of the Mississippi, one in southern Illinois and the second in central Wisconsin. The loss of suitable grassland habitat, primarily to farming and woody encroachment or plantings has resulted in the extirpation of the species throughout much of its range. The greater prairie-chicken is currently considered a species of concern by the U.S. Fish and Wildlife Service (USFWS). However, based on its isolation, small disconnected range, rapid range contraction, genetic viability, and limited amount of grassland habitat, it may eventually warrant federal protection if trends continue.

The range of the lesser prairie-chicken, like the greater, has contracted by an estimated 90% (Crawford 1980). Habitat losses through conversion of native prairie to production agriculture (Crawford and Bolen 1976a), poor grazing management practices (Jackson and DeArment 1963, Riley et al. 1992), habitat fragmentation from oil and gas development (Hunt 2004), and prolonged drought throughout their range (Giesen 1998) are contributing factors leading to the decline and further isolation of populations of the lesser prairie-chicken. In response to declining abundance and distribution of this species, a petition was submitted to the USFWS in 1995 to list the lesser prairie-chicken as threatened. The Service's finding on the petition was "warranted but precluded," indicating the USFWS felt the species warranted protection but was precluded from listing by higher priority species. (Federal Register 63:110, 31400-31406).

Of all the prairie grouse, the six subspecies of sharp-tailed grouse have the largest distribution (Miller and Graul 1980). However, portions of their habitat, like the prairie-chicken, have become fragmented and subpopulations have become isolated by natural succession and intensive agricultural activities. The plains sharp-tailed grouse (*T. p. jamesi*) occupies the majority of its historical range (Miller and Graul 1980). The Columbian sharp-tailed grouse has experienced the greatest declines in numbers and range (Miller and Graul 1980) with the largest populations occurring in Canada. In the U.S., the status of the Columbian sharp-tail is one of small, widely scattered, isolated populations and it is being considered for listing as a federal protected species. The eastern subspecies, or prairie sharp-tailed grouse (*T. p. campestris*), also has its largest populations in Canada but in the southern portion of their range in Michigan, Wisconsin and Minnesota they exist as small, isolated populations. Little is known about the ecology, status and populations of the three northern subspecies of sharp-tail grouse (Miller and Graul 1980).

Continued habitat loss and fragmentation may result in small, isolated prairie grouse populations at risk of losing genetic variation. Genetic diversity is necessary for a population to respond to environmental change, thus a loss of genetic variation may jeopardize the persistence of fragmented populations (Shaffer 1981). Populations, such as the greater prairie-chicken, that have undergone large decreases in population size are likely to lose genetic variation (Nei et al. 1975, Maruyama and Fuerst 1985), resulting in the need for intensive management actions such as translocations from larger populations (e.g., Wisconsin and Illinois) to increase genetic diversity to maintain these populations.

Prairie grouse are species with relatively large home ranges and their populations require vast acreages of grassland/prairie to sustain populations. The quality of available habitat within the Great Plains ecosystem contributes to the effectiveness of many of the other factors regulating prairie grouse populations. Managing for quality habitats, while maintaining and restoring habitat quantity, are likely the two most important factors for long-term sustainability of prairie grouse populations. Prairie grouse, unlike many grassland birds, are year-round residents of the prairie and their presence indicates quality grasslands, thus making them flagship species for other grassland wildlife. The first step in the development of any prairie grouse management plan is to assess how many prairie-chickens and sharp-tailed grouse are needed to sustain secure, viable populations. These numbers will ultimately determine how much grassland habitat we will need to maintain and/or reestablish across the range of prairie grouse.

Recent genetic research with greater prairie-chickens has given us a better understanding of the number of greater prairie-chickens necessary to sustain viable populations. However, setting minimum numbers to sustain genetically viable populations does not take into account annual catastrophic events that often affect populations. Total local annual recruitment failures have been documented in several greater prairie-chicken populations (Toepfer 2007). Optimal management security, genetic and catastrophic, for greater prairie-chicken will only be achieved with populations 2-3 times the genetically calculated minimum number. Therefore, in order to maintain a genetically healthy minimum population size of 2,500 birds of isolated greater prairie-chicken population (Walk 2004) requires a "minimum" breeding population of 1,250 cocks or 125 display grounds with 10 cocks per ground. However, 10,000 individuals or 500 booming grounds would be needed to withstand 2 years of reproductive failure at 50% annual survival. A prairie grouse population of 500 display grounds would require about 450 acres per ground (Toepfer 2003) or 225,000 acres (350 square miles) of biologically interconnected grassland reserves to sustain genetic diversity in an isolated population. Morrow et al. (2004) indicated that there are currently 70,000 acres of coastal grassland available for Attwater's prairie-chicken reestablishment and that the long-term recovery habitat goal for Attwater's prairie-chicken in Texas is the management of 300,000 acres of costal prairie (Mike Morrow, personal communication).

Habitat components necessary to fulfill lesser prairie-chicken life history needs include nesting habitat, brood-rearing and summer habitat, and autumn/winter habitat. The average home range of an individual bird is about four square miles (Bidwell et al. 2003). However, the collective home range of all birds that attend a particular lek site is approximately 19 square miles (>12,000 acres) (Bidwell et al. 2003). Although the minimum habitat patch size to support lesser prairie-chickens is not clear, several studies have speculated that approximately 1,200 – 25,000 acres of contiguous native rangelands may be necessary to sustain a viable lesser prairie-chicken population (Davison 1940, Crawford and Bolen 1976a, Taylor and Guthery 1980b, Woodward et al. 2001, Bidwell et al.

2003). Applegate and Riley (1998) recommended clusters of 6-10 or more leks, each with a minimum of six males, separated from one another by a distance of 1.2 miles or less to ensure viable lesser prairie-chicken populations. A number of studies have reported inter-lek distances of a mile or less (Jamison et al. 2002a). At this density, a complex of 6-10 lek sites could fall within a habitat patch size of roughly four square miles. If each lek in the cluster was surrounded by a two-mile radius area (i.e., the minimum breeding season patch size around a lek), the entire lek and core habitat complex might occupy up to 32 square miles (~21,000 acres), with a wider perimeter of habitat for autumn and winter foraging and escape cover. This is more or less consistent with the 25,000-acre estimate of Bidwell et al. (2003). Many such populations with genetic interchange would be required to maintain genetic viability of the species.

The distribution of display grounds and distance between them provides another approach to assess the area necessary to sustain a viable prairie grouse population. The mean distance between greater prairie-chicken booming grounds in Minnesota and Wisconsin is about 1.2 miles. This distance creates an exclusive area per booming ground of 1.1 square miles. This would mean that 10,000 birds (e.g., 500 booming grounds) would cover an area of 550 square miles or 350,000 acres in order to support viable greater prairie-chicken populations. Hamerstrom et al. (1957) indicated that greater prairie-chicken populations occurred on a sustainable basis in areas with a minimum of 33% relatively undisturbed grassland. This would require about 115,500 acres (180 square miles) of permanent grass habitat within this area to maintain a viable isolated prairie-chicken population.

The basic concepts of population size should apply in similar fashion to other prairie grouse species. The size of an area and amount of habitat for lesser prairie-chickens would likely be similar to that estimated for greater prairie-chickens but could be calculated based on the number of males per lek and for sharptails the distance between dancing grounds and the formula from Franklin and Frankham (1998) and adapted by Walk (2004). Sharp-tailed grouse dancing grounds are generally farther apart than booming grounds and would likely require areas at least as large if not larger than those necessary to sustain a viable isolated prairie-chicken population.

Maintaining large contiguous blocks of the permanent grassland habitat necessary to sustain viable prairie grouse populations will be a challenge because of the current land use patterns and checker boarding of private landownership. Landscapes in which more than 37% of native rangeland has been lost may be incapable of supporting lesser prairie-chickens, and populations have declined in areas with only 20% rangeland conversion (Crawford and Bolen 1976a).

Prairie grouse adapted to the diversity of ecological communities that historically occurred within the various ecoregions they occupied. The ecosystem diversity approach evaluates prairie grouse habitat relative to what occurred historically at a specific site or location. Understanding the types, distribution and dynamics of these ecosystems is fundamental to managing or restoring prairie grouse habitat across the Great Plains. The ecosystem diversity approach is directed at maintaining or restoring functional prairie ecosystems that represent the full array of grass and shrub ecosystems that occurred within the Great Plains. Prairie grouse will serve as flagship species to demonstrate the need for maintenance and restoration of grassland ecosystems as well as to evaluate proposed amounts and distributions of these ecosystems. More specifically, this approach will be applied across the historical and current distribution of the prairie grouse.

Lands enrolled in the Conservation Reserve Program (CRP) might provide an important management opportunity for increasing and improving prairie grouse habitat. Lesser prairie-chickens have expanded their range in response to multiple-species native grass CRP stands in the central plains, particularly in west-central Kansas (Rodgers 2005, Rodgers and Hoffman 2005). In Minnesota, approximately 170,000 acres of grassland habitat established through the CRP were added to the greater prairie-chicken range. These grassland acres have resulted in an increase from about 500 males in 1985 to 3,200 in 2003. Similar increases in greater prairie-chicken numbers and distribution have also been associated with the addition of hundreds of thousands of acres of CRP grasslands in Kansas, South and North Dakota, Nebraska and Colorado. Therefore, CRP grasslands should be strategically placed to maintain, reconnect and increase prairie grouse populations to ensure the genetic viability of the three species of prairie grouse as a whole.

The history of the prairie grouse in North America is one of dramatic expansion with early agricultural activities creating open space and additional food sources, followed by contraction as farming intensified converting grassland to cropland. If the prairie grouse are to have a future as viable species in North America, range contraction, habitat fragmentation and subpopulation isolation needs to cease and expansion occur. The current state of the Columbian sharp-tail, Attwater's and the greater prairie-chicken in Illinois, Wisconsin and Missouri are classic case studies of what can and will likely happen to other prairie grouse populations if trends are not reversed. We must develop and implement plans to not only maintain and improve existing permanent grassland habitat but expand grassland habitat, and reestablish connectivity to provide prairie grouse populations with security from catastrophic events and loss of genetic diversity.

The long-term conservation of prairie grouse requires the integration and implementation of conservation efforts at local, state, provincial, and range-wide levels. It is through implementing actions at the state and local level that projects and other actions of most immediate benefit to prairie grouse will grow. The Grassland Conservation Plan for Prairie Grouse identifies threats, issues, and strategies to consider in prairie grouse management and provides a comprehensive framework that facilitates the development and implementation of local, state, provincial, and range-wide plans.

APPROACH

Ecosystem Diversity

Prairie grouse adapted to the diversity of ecological communities that historically occurred within the various ecoregions they occupied. The approach used in this plan evaluates prairie grouse habitat relative to the ecosystem diversity that occurred historically within an area or landscape. There is strong scientific foundation for using a historical reference for defining ecosystem diversity. Prairie grouse, along with all of the other prairie flora and fauna evolved with and adapted to the historical ecosystem diversity of the Great Plains and other areas. Providing representation of this ecosystem diversity is perhaps one of the only effective ways of providing for the habitat needs of not only prairie grouse, but also for other prairie-dependent species, many of which we know little about. In this way, prairie grouse can serve as flagship species for conservation of prairies and their diverse flora and fauna.

Historical ecosystem diversity was formed and maintained by two primary factors; different ecological sites (abiotic factors) that allowed different plant and animal species to occur at that site and disturbances that influenced the composition and structure of the plant community and resulting prairie grouse habitat. Understanding the types, distribution and dynamics of these ecosystems is fundamental to managing or restoring ecosystem diversity for prairie grouse habitat across the Great Plains.

Ecosystems and prairie grouse habitats have and continue to be directly altered by human actions. Although Native Americans interacted and influenced ecosystems for thousands of years, these influences are incorporated in a historical reference. It is the extent of human influence over the last 150 years that is of greatest conservation concern. Ecosystem conversion to agriculture, urban, and suburban uses are the most obvious impacts. However, there are also less obvious, yet in some instances more pervasive, human-induced changes at the ecosystem level as well. We have only recently begun to understand the implications of a century of European alterations to and interruptions of historical disturbance regimes in the Great Plains. Recent studies have shown that the suppression or cessation of historical disturbance has gradually changed ecosystem processes and ultimately the composition, structure, and function of many ecosystems. These changes have also impacted the distribution and quality of habitat for many prairie grouse species. Therefore, important reference information for the identification of ecosystems or habitats in need of conservation includes a description and assessment of historical conditions as influenced by historical disturbance regimes. This information can then be used to compare historical conditions to current land use patterns to identify critical remaining areas of intact or "natural" ecosystems and highlight areas with greatest restoration potential. This approach will also provide important information on site specific dominant species compositions, for implementing restoration or enhancement efforts.

The ecosystem diversity approach we are using is directed at maintaining or restoring functional prairie ecosystems that represent the full array of grass and shrub ecosystems that occurred within the Great Plains in the U.S. and Canada. The three species of grouse will serve as flagship species to demonstrate the need for maintenance and restoration of grassland ecosystems as well as to evaluate proposed amounts and distributions of these ecosystems. This approach is applied to the Great Plains of the U.S. and Canada. Conservation of greater prairie-chickens and sharp-tailed grouse populations occurring outside of this Great Plains ecosystem-focus area is also important and included in this plan, but does not use the historical ecosystem representation approach.

Historical Reference

A primary objective of this plan is to identify and characterize grassland ecosystem diversity across the Great Plains based on a historical reference. This reference is built on an understanding of the role of historical disturbances and their influences on plant community compositions across the various soils, precipitation zones, and other factors that defined the abiotic environment. This combination of disturbance and sites determined the specific plant communities that occurred at a site over time in response to the disturbances and successional processes. In this approach, an historical ecosystem is defined as one of a number of specific plant communities and their associated fauna that occurred as a result of the effects of the interaction of disturbances and the abiotic environment at a specific location. Using this approach requires an ecological classification of site conditions to define the abiotic environments of the Great Plains as well as an understanding of the primary historical disturbances that produced specific ecosystems across these sites. An ecological classification used for distinguishing among sites allows for mapping of the differences in abiotic conditions that influence the types of plant communities that each type of site could support. Specific disturbances then determined the plant community present at any given point in time. This combination of ecological sites and disturbance processes allows for the identification of the full range of successional conditions or ecological states that were possible within defined landscapes. For this reason, it is important to combine an ecological site classification with a classification of successional stages or states resulting from historical disturbance. To accomplish this, a conservation planning tool termed an Ecosystem Diversity Matrix (EDM) that provides the framework for combining ecological classification with a classification of successional stages and/or alternative states has been used. The EDM can be linked to a GIS and used to quantitatively evaluate the historical ecosystem diversity relative to existing conditions.

For the purposes of this plan, we define historical reference as the ecosystem conditions that resulted from natural (i.e., fire, grazing, etc.) and human-influenced (i.e., Native American) disturbances that created the dynamic conditions that species were and are dependent upon. Historical disturbance regimes are the patterns of frequency and intensity that can be quantified using ecological evidence. For example, fire regimes are frequently described relative to frequency of occurrence and relative intensity. Another term frequently used in relation to historical conditions is the historical range of variability. Historical range of variability is an important concept because it emphasizes that many ecosystems varied in amounts, compositions, and structures due to variations in climate and disturbance events.

Historical reference is usually confined to a period less than 1,000 years prior to European settlement, as these reflect the habitat conditions most relevant to the species that are present today and for which information may be available. In some areas of the country quantifying historical reference may be a difficult task due to a lack of ecological information to help describe historical conditions. Depending on the ecoregion being evaluated in the Great Plains, historical information may or may not be available to help reconstruct the full range of historical conditions. Where information is less available it may be necessary to extrapolate from nearby areas or make assumptions based on the best available information or experience with similar systems.

It should be emphasized that ecosystems were not static during any defined reference period. Species distributions were changing, human activities were changing, and species themselves were adjusting to these changes through behavioral and genetic alterations. However, providing an understanding of the ecosystem diversity that occurred during an identified timeframe prior to European settlement provides critical reference information for defining a baseline of what should be considered "natural" for an area.

Three primary historical disturbance regimes were identified for upland grassland ecosystem diversity across the Great Plains. They are discussed relative to their influence on ecosystem diversity and landscape patterns. These three disturbance types include climate, fire, and grazing. The normal Great Plains climatic pattern is cyclical between wet and dry periods that can cause changes in plant species composition and structure. Fire was a relatively common disturbance event prior to European settlement and as a result, most ecosystems exhibit a number of characteristics and strategies that are well suited to a fire prone landscape. Grazing, particularly by bison (*Bos bison*), also contributed to shaping the grassland ecosystem diversity of the Great Plains.

A framework for addressing ecosystem diversity for grass and shrub ecosystems across the Great Plains of the U.S. and Canada was developed by the Ecosystem Management Research Institute. This framework identified specific ecosystems (plant communities as temporal states or stages occurring on specific ecological sites defined by soils and other abiotic factors) that in total included a classification of all ecosystems that commonly occurred historically within each Major Land Resource Area (MLRA) or Soil Correlation Areas (SCA) in Canada (Figure 2). A brief description of the major historical disturbance regimes within each MLRA was provided, and showed using Ecosystem Diversity Matrices the different dominant plant communities for each definable ecosystem. Analysis of soils maps quantified the amounts of each ecological site within each MLRA or SCA. Additional mapping analysis determined amounts of each ecological site that have been converted to rowcrops, urban development, exurbia, or other human uses. The description of historical ecosystem diversity and associated mapping of ecological sites and existing conditions is presented in Appendix A. Information on the existing conditions of plant communities does not exist on a consistent basis for the untilled grasslands across the Great Plains, information that we think is critical for grassland conservation. Without this information, we cannot quantify the existing levels of representation of historically occurring ecosystems, although numerous studies in various locations suggest that current conditions are significantly different than the full ecosystem diversity that occurred historically. This is a primary reason why prairie grouse, as well as, other grassland species are of significant concern today. Correcting the cumulative effects of habitat change in grassland ecosystems may best be approached by providing representation of all ecosystems within a planning area (e.g., MLRA) that occurred within each MLRA historically.

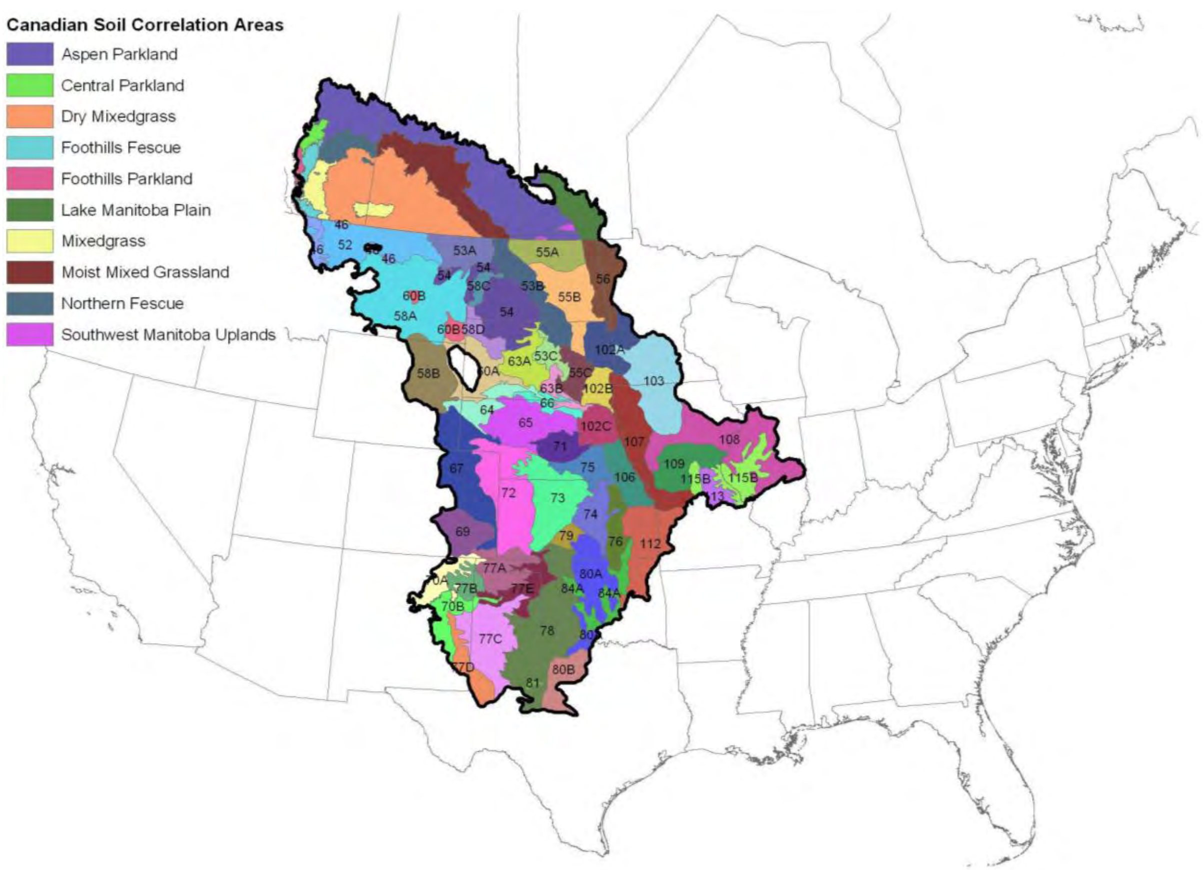

Figure 2. Map of Major Land Resource Areas (MLRA) in the Great Plains of the United States and Soil Correlation Areas (SCA) of the Great Plains in Canada. Numbers for each MLRA are its identification number.

Ecosystem Representation

Using the described classification system and accompanying analyses, the ecosystem diversity approach functions to identify conservation objectives for ecosystem diversity. A goal is not to return landscapes to historical conditions, but to use the historical reference to help set specific objectives for amounts of different plant communities at the landscape level, and the desired compositions and processes for plant communities at the ecosystem level. The appropriate levels of ecosystem representation can be informed by the historical reference, but because the goal is not a return to historical conditions across the landscape, the desired amounts and distributions of desired ecosystem conditions must be evaluated with additional criteria. This is where prairie grouse, as flagship species, can help to set these desired amounts and distributions.

The plan focuses on providing sufficient amounts of functionally similar ecosystems to those that were present historically to provide for the habitat needs to maintain viable populations and desired population sizes of native species. Ecosystem representation based on the historical reference identifies an estimate of the threshold level to "represent" each ecological community that occurred under historical disturbance regimes.

In this prairie grouse plan, an initial goal for ecosystem representation is maintaining more than or restoring at least 10, 15, or 20% of the historical conditions for all ecosystems in each of the 46 MLRA's in the United States and 9 SCA's in Canada. The value of 10, 15, or 20% is dependent on the status of the existing prairie grouse populations, with higher levels of ecosystem representation occurring in areas with higher existing grouse populations and lower representation in areas with lower grouse populations (Figure 3). The minimum 10% level of representation has often been used as a conservation goal under various national and international programs. The assumption here is to put the greatest focus on those areas that still have grouse populations as indicators of where functional grassland ecosystems may still occur, and to maintain the quality of these areas. The assumption used in developing these varying levels of representation across MLRA's and SCA's was that with limited resources available it would be more cost effective for prairie grouse conservation to target higher levels of representation where prairie grouse populations are still viable and to target lower levels of representation in areas where grouse populations are lower and where fewer cost effective options may exist for ecosystem restoration. These goals can be revised through finer scale analyses or when more resources become available, and are not suggested to override any local efforts at grouse conservation that may set higher levels in specific locations where good restoration potential exists.

Although 10, 15, or 20% is identified as a minimum level of representation, it should be emphasized that maintaining levels greater than this amount is preferred. Where current existing levels of representation occur, the specification of representation levels ≤ 20% in no way justifies or should be construed to justify additional habitat conversion in those areas. The 10% figure has often been used as a conservation goal under various national and international programs. The initial goal of 10, 15 or 20% ecosystem representation, depending on prairie grouse population status, will require on-going evaluation and monitoring to determine its effectiveness in conserving prairie grouse populations and ecosystem diversity. In addition, although this strategy makes recommendations on ecosystem representation goals in each MLRA, information on both historical amounts and existing amounts of historical ecosystems is not currently available for most MLRA's or SCA's. As better information is obtained on the historical amounts of ecosystems and the status of existing conditions, ecosystem representation goals and their prioritization for restoration can be revised and updated to reflect this improved knowledge.

Application of the Representation Goals

The goals for representation were calculated across the entire Great Plains using the methods described above. Grouse biologists within each Bird Conservation Region (BCR) used these numbers as a starting point to make finer scale recommendations for each of their respective BCR. Specifically, they identified the highest priority ecological sites for maintenance or restoration for grouse conservation within their BCR, the highest priority areas for concentrating prairie maintenance or restoration within the BCR, and other specific recommendations for sizes, distributions, or other considerations for conservation actions. Table 1 lists the total acres of representation goals for each BCR. The specific listings of goals for each ecological site are presented in the following sections that describe each BCR.

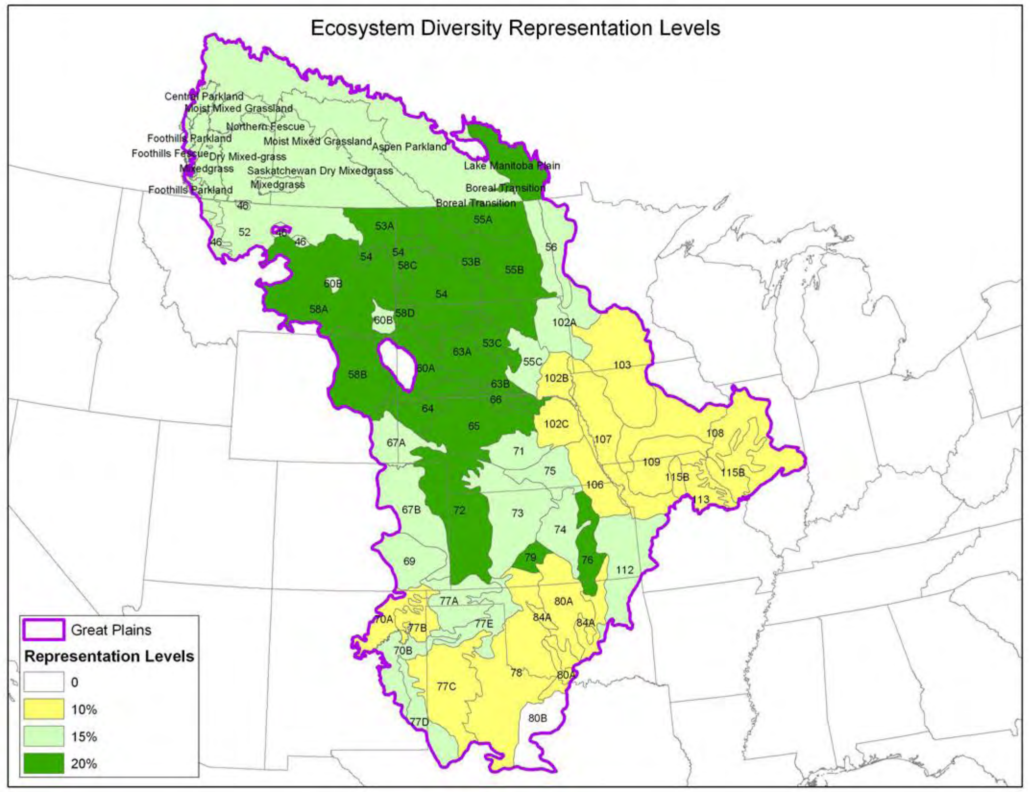

Figure 3. Recommended levels of historical ecosystem representation for Major Land Resource Areas in the United States and Soil Correlation Areas in Canada based on current population status of prairie grouse.

Table 1. Bird Conservation Region acreage goals for grassland conservation for prairie grouse based on ecosystem diversity representation in the Great Plains.

Bird Conservation Region	Number	Acres
Prairie Pothole	11	23,680,328
Badlands and Prairies	17	13,436,515
Shortgrass Prairie	18	11,976,269
Central Mixed-Grass Prairie	19	11,217,531
Eastern Tallgrass Prairie	22	2,881,277
Prairie Hardwood Transition	23	N/A
Boreal Hardwood Transition	12	N/A
Northern Rockies	10	473,407
Southern Rockies/Colorado Plateau	16	905,200
Oaks and Prairies	21	680,428
Total		**65,250,955**

To achieve the representation goal of 65,250,955 acres across the Great Plains of the U.S. and Canada significant conservation actions and funding are needed. This plan identifies a number of these specific needs within each BCR, as well as general strategies and actions that will be needed to achieve this goal. This plan proposes to accomplish this task over time. The Great Plains of the U.S. and Canada were not degraded to their current status quickly, and their restoration will likewise not occur quickly. However, with the significant risks that exist to the integrity of these ecosystems and to prairie grouse that depend on these ecosystems, conservation actions should begin immediately to reverse the downward trends and losses that have and continue to occur.

Benefits to Other High-Priority Landbirds

Terrell D. Rich
National Coordinator, Partners in Flight

Maintaining or restoring functional prairie ecosystems that represent the full array of grass and shrub ecosystems that occurred within the Great Plains will have benefits for a number of other high-priority grassland species. This should be particularly true for landbirds identified by Partners in Flight (Rich et al. 2004) because the habitat requirements of a suite of breeding and wintering avian species overlap greatly with those of prairie grouse. In addition, the spatial requirements of prairie grouse are much greater than those of many other bird species. It is thus reasonable to hypothesize that these prairie grouse will function as flagship species for other birds of concern and other grassland wildlife.

Fifteen species of landbirds that breed primarily in grassland habitats – including the 3 species of prairie grouse covered in this Plan – have been identified as Species of Continental Importance in the U.S. and Canada (Table G-1) by Partners in Flight (Rich et al. 2004). These include species that breed primarily within the geographic area covered by this plan as well as those that breed elsewhere but winter in the planning area [(e.g. Lapland Longspur (*Calcarius lapponicus*)]. Details concerning status, numbers, occurrence and population objectives of these high-priority species (except prairie grouse) for each BCR are included within Table G-1. Habitat needs, population objectives, and recommendations for some or all of these species can be found in Bird Conservation Plans and Best Management Practices references located on the Partners in Flight web site (www.PartnersInFlight.org).

We hope that by presenting these species and additional details on the objectives for their conservation that all the partners involved in prairie ecosystem conservation will be able to make the best choices as we implement this Plan. We appreciate that all species differ somewhat in their specific habitat requirements and that tradeoffs are almost always involved in partnership enterprises. But we are also convinced that our time, money, and other resources will be most effectively and efficiently used if we move ahead together.

BIRD CONSERVATION REGION 11
PRAIRIE POTHOLE

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Jerry D. Kobriger
North Dakota Game and Fish Department
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Saskatchewan Environment
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South Dakota Game, Fish and Parks
Rick Northrup
Montana Fish, Wildlife and Parks
Bill Penning
Minnesota Department of Natural Resources

Description

The Prairie Pothole region (BCR 11) is a glaciated area of mixed-grass prairie in the west and tall grass prairie in the east (Figure 4). Stream drainage is weakly developed in much of the area with much run-off collecting in numerous closed depressions and small lakes. Drainage was greatly affected by glaciations and most waterways carried water from melting glaciers. Most of the area is undulating plain but some nearly level glacial lake basins remain.

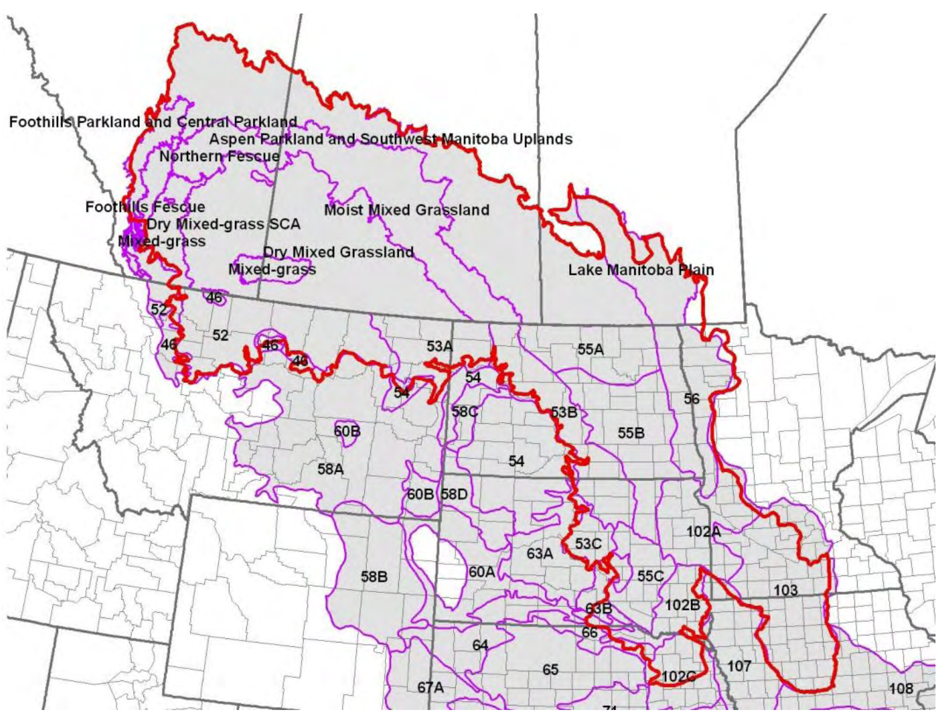

Figure 4. States, provinces, counties, Major Land Resource Areas, and Soil Correlation Areas within BCR 11.

History of Prairie Grouse in BCR 11

Historically, prairie grouse were commonplace on these prairies prior to exploration and settlement. Lewis and Clark made many references to prairie grouse in their journals during 1804-05. They reported great numbers of sharp-tailed grouse in South Dakota and North Dakota, but noted prairie-chickens only as far north as southeastern South Dakota. The Great Plains were influenced by grazing herds of bison and an approximate 8-year fire interval. As settlers moved into the Great Plains, prairie grouse, particularly greater prairie-chickens, thrived for a period of years due to initially improved grassland habitat resulting from the demise of the bison herds. Interspersion of grain crops by early settlers provided a year-around bountiful nutritious food source. For a brief period (late 1800's and early 1900's), the greater prairie-chicken expanded its range to include most of North Dakota, northeastern Montana, all of Minnesota (except for the Boreal forest), and the Canadian provinces.

As domestic livestock and agricultural cultivation replaced bison, the amount of habitable grassland decreased. Settlers became more populous, converted more grassland to crops, and vast acres of grassland disappeared. So did the prairie-chicken. In BCR 11, greater prairie-chickens survived only in Minnesota, South Dakota, Nebraska, and the southeastern corner of North Dakota. Sharp-tailed grouse dropped in numbers but there are no definitive records for the sharp-tail population fluctuation. The Soil Bank program in the 1950's and 1960's sustained and improved prairie grouse numbers for a time in the U.S. but as that program phased out, greater prairie-chickens nearly disappeared from BCR 11 though sharp-tailed grouse remained in good numbers. More recently, CRP in the U.S. has provided the grassland habitat to restore both species. Canadian producers strive to maintain grassland pastures in a state that provides maximum beef production. Although trends are towards long-term conservation-minded grazing of grasslands, most grazing practices that provide maximum sustainable beef production result in grasslands that are either grazed too uniformly, or too heavily for maximizing production of sharp-tailed grouse. There currently is a lack of meaningful incentive programs in Prairie Canada for maintenance of wildlife-oriented habitat. Incentives that provide land owners financial compensation for maintenance and production of ecological goods and services are needed to maximize potential for maintaining grasslands in conditions optimal for prairie grouse production as opposed to cattle production. Incentives to land managers (e.g., CRP) may also be required to maintain grassland acres if economic forces should result in devalued profit margins related to beef production. Any significant market forces that make cultivation more lucrative or more feasible than grazing by beef cattle will be detrimental to grouse production.

Sharp-tailed grouse have increased in density, and greater prairie-chickens, aided by a trap and transplant program, have been restored in two areas of BCR 11 within MLRA 56 and permitted hunting seasons now occur in North Dakota and Minnesota. Annual open seasons occur in South Dakota and Nebraska for both species.

Sharp-tailed grouse are much more widespread and occur throughout most of the BCR except for the southeast portion (Iowa, parts of Minnesota, South Dakota and Nebraska, or about 15% of the BCR). Throughout the rest of the BCR, sharp-tailed grouse are common and there are few if any populations that are isolated; connectivity is not considered a problem. On the other hand, some greater prairie-chicken populations in the BCR are isolated. North Dakota and Minnesota each have two isolated populations. Populations in South Dakota and Nebraska may be connected to larger more secure populations in both those states. The top priority for greater prairie-chickens in BCR 11 is to maintain the habitat acres now on the ground and to provide additional acres to provide connectivity and maintain both demographic support and genetic diversity between and among existing populations in those states with prairie-chickens. Currently there are no prairie-chickens in the Canadian portion of BCR 11.

Ecosystem Diversity Assessment

As indicated in the ecosystem diversity section of the main plan and Appendix A, grassland diversity within BCR 11 has changed considerably due to influences of European settlement. Fires have been reduced or eliminated as disturbances in most areas. The grazing patterns of bison have been eliminated. Existing grazing patterns have created fairly uniform conditions across remaining grasslands. Substantial acres have been converted to crops, urban, and exurban development. Numerous species of exotic plants have invaded. All of these have caused dramatic changes to the ecosystem diversity that once existed.

Acreage goals for the Prairie Pothole BCR 11 (Table 2) were generated utilizing ecological site descriptions from the following MLRA's in the United States to address ecosystem diversity for grass and shrub ecosystems: Northern Rocky Mountain Foothills (MLRA 46), Brown Glaciated Plain (MLRA 52), Northern Dark Brown Glaciated Plains (MLRA 53A), Central Dark Brown Glaciated Plains (MLRA 53B), Southern Dark Brown Glaciated Plains (MLRA 53C), Southern Black Glaciated Plains (MLRA 55C), Southern Rolling Pierre Shale Plains (MLRA 63B), Northern Black Glaciated Plains (MLRA 55A), Central Black Glaciated Plains (MLRA 55B), Red River Valley of the North (MLRA 56), Dakota-Nebraska Tableland (MLRA 66), Rolling Till Prairie (MLRA 102A), Till Plains (MLRA 102B), and Loess Upland (MLRA 102C). The Soil Correlation Areas in Canada used for acreage projections were Dry Mixed-Grass, Mixed-Grass, Foothills Fescue, Foothills Parkland and Central Parkland, Northern Fescue, Aspen Parkland and Southwest Manitoba Uplands, Moist Mixed-Grass Ecoregion, Dry Mixed Grassland Ecoregion, and Lake Manitoba Plain Ecoregion.

A total of 10,611,089 acres have been projected as an ecosystem representation goal within the United States and at least 13,069,239 acres projected within the Canada portion of BCR 11 with a total acreage goal for BCR 11 of 23,680,328 acres. These are targeted for grassland maintenance, securement, enhancement, or restoration based on ecological site descriptions, prairie grouse population abundance and distribution, representation levels of ecosystem diversity, and historical disturbance regimes. Refer to Appendix C for the appropriate Ecosystem Diversity Matrix to determine targeted conservation acres for specific region for prairie grouse conservation. These targets could be adjusted with more detailed analyses of historical conditions conducted within each MLRA, but they provide a working framework for strategic planning.

In Canada, there is no land cover classification described as MLRA's. BCR 11 corresponds to the Prairie Ecozone of the National Ecological Land Classification System. The Prairie Ecozone is subdivided into ecoregions primarily based on soils zones. Ecoregions are further subdivided into ecodistricts (landscape areas in Saskatchewan) based on distinctive assemblages of landform, relief, surficial geological material, soil, water bodies, vegetation and land uses (Acton et al. 1998). The prairie ecoregions contain important grasslands for sharp-tailed grouse but they are not the only habitat types of value. Tree (aspen [*Populus tremuloides*]), shrub, and wetland habitat communities are also key components of prairie grouse habitat in Canada. Priority ecoregions for sharp-tailed grouse in Saskatchewan include the Aspen Parkland Ecoregion (about 0.7 million acres), Moist Mixed Grassland Ecoregion (about 2.2 million acres) and the Dry Mixed Grassland Ecoregion (5.4 million acres) including 21 wildlife management zones (Figure 5). These grassland acres total almost 24% of the priority area and therefore habitat program emphasis should be on retention and better management of existing grasslands as opposed to conversion of cultivated areas to grassland. However, conversion of marginal cropland should also be encouraged. In Alberta, grassland conservation and securement efforts should focus on the 28 wildlife management units in the Alberta portion of BCR 11 that contain both grasslands and high sharp-tailed grouse abundance (11,793,325 acres) along with enhancement of grazing management practices to provide optimal grassland habitat conditions for sharp-tailed grouse on 3.2 million acres.

Table 2. Acreage targets for ecosystem diversity conservation from MLRA's within the U.S. and Canada portion of Prairie Pothole BCR 11.

Land Cover Classification	Acres	Representation (%)	Appendix Matrix
United States			
MLRA 46	152,320	15	C-1
MLRA 52	2,023,287	15	C-2
MLRA 53A	1,322,693	20	C-3
MLRA 53B	1,581,616	20	C-4
MLRA 53C, MLRA 55C, MLRA 63B	1,557,807	20	C-5
MLRA 55A, MLRA 55B, MLRA 56	2,964,880	20	C-6
MLRA 102B, MLRA 102C	1,008,486	10	C-7
USA Total	**10,611,089**		
Canada			
Dry Mixed-Grass SCA	1,547,134	15	C-8
Mixed-Grass SCA	800,426	15	C-9
Foothills Fescue SCA	480,000	15	C-10
Foothills Parkland & Central Parkland SCA	334,582	15	C-11
Northern Fescue SCA	623,963	15	C-12
Aspen Parkland & Southwest Manitoba Uplands	3,851,330	15	C-13
Moist Mixed-Grass Ecoregion	3,937,846	15	C-14
Dry Mixed Grassland Ecoregion	7,973,089	15	C-15
Lake Manitoba Plain Ecoregion	1,155,130	20	C-16
Canada Total	**13,069,239**		
BCR Total	**23,680,328**		

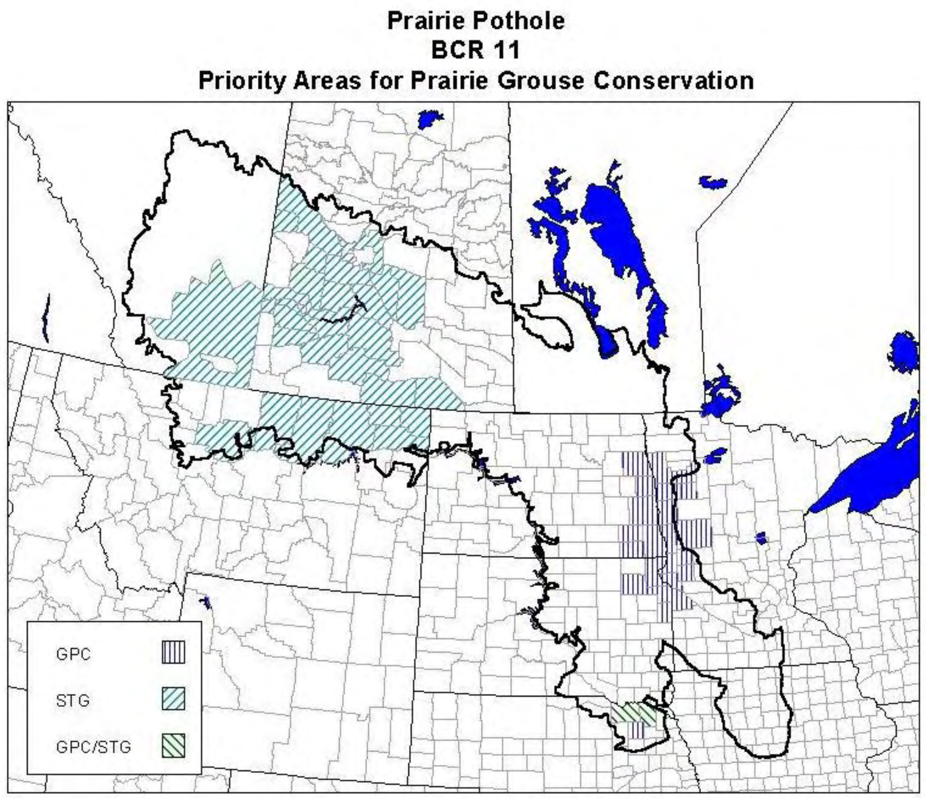

Figure 5. Priority areas within prairie pothole region (BCR 11).

Priority areas within BCR 11 identified for grassland conservation and restoration have been identified to sustain or enhance greater prairie-chickens and plains sharp-tailed grouse populations within the BCR include areas within the Northern Black Glaciated Plains (MLRA 55A), Central Black Glaciated Plains (MLRA 55B), and Red River Valley of the North (MLRA 56). Disturbed land cover is currently approximately 69% in these 3 MLRAs and will require conversion of cropland acres to grasslands to create needed grassland complexes in 3 states. A goal of maintaining 7,000,000 core grassland areas comprised of 700,000 acres in continuous grass and an additional 145,000 acres of grass within the surrounding core area is an immediate objective. In addition, core areas should be connected by linkage zones that contain not less than 10,000 acres of grassland within each township.

While a diversity of grass communities across the various ecological sites representing a range of historical grazing conditions should be provided, a primary restoration focus should be on light grazing communities especially for grasslands occurring on loamy, clayey, and sand ecological sites. Of particular importance for greater prairie-chickens are the following counties in North Dakota: Grand Forks, Traill, Cass, Richland, Ransom, and Sargent. Connecting the North Dakota population to populations in Minnesota and South Dakota is crucial for long term sustainability of the species. Minnesota counties containing greater prairie-chickens in low abundance and/or are important to connecting the populations to North Dakota are Polk, Red Lake, Norman, Mahnomen[1], Clay, Otter Tail[1], Wilkin, Grant[1,2], Traverse[2], Stevens[2], Big Stone[1,2], and Lac Qui Parle[1] and Swift[1] ([1]These counties are outside of or mostly outside of BCR 11 but fit best in the context of BCR 11 as they add significantly to the core of Minnesota's prairie grouse populations. [2]These counties currently have few prairie-chickens but are important for future north-south and Minnesota-Dakota connectivity.). South Dakota counties important to connectivity include Roberts, Grant, Deuel, and Day. Nebraska counties of priority for grassland conservation efforts include Knox and Cedar counties for greater prairie-chickens and sharp-tailed grouse and Pierce County for greater prairie-chickens only. Figure 5 displays the U.S. counties and Canada land areas of greatest conservation priority for prairie grouse in BCR 11. Important counties in Montana for sharp-tailed grouse would include Sheridan, Roosevelt, Daniels, Valley, Phillips, Blaine and Choteau. Much of the focus area in Alberta includes the 28 wildlife management units occurring in the southeastern portion of the province.

Most of the states within BCR 11 have other federal and state programs (e.g., Environmental Quality Incentive Program, Wetland Reserve Program, Continuous Conservation Reserve Program, Conservation Reserve Enhancement Program, Reinvest in Minnesota) that also provide important grassland acres for prairie grouse. In addition, the value of state and federally-owned grassland acres cannot be underestimated. These acres, though more secure, still need to be maintained. States within BCR 11 continue to highly value CRP acres, knowing this federal program can be changed or eliminated at any time. However, we also recognize the value and need of other state and federal programs and lands for prairie grouse. Any loss of grassland habitat from any of these programs or lands would be a net loss for prairie grouse populations.

Conservation Reserve Program Priorities

Greater prairie-chicken populations have occurred or increased in North Dakota and Minnesota counties largely due to trap and transfer efforts between states and establishment of large grassland landscapes through the CRP. CRP provides for the short-term reestablishment of grasslands from croplands. Maximum benefits to prairie grouse and other grasslands species will be achieved where CRP plantings are designed to restore the native light grazing plant communities that historically occurred on a specific ecological site. These CRP acres can then contribute directly to the ecosystem diversity goals identified above. Due to the limited duration of CRP programs, a goal should be to provide for the long-term maintenance of these acres in a restored grassland condition.

There is no CRP in Prairie Canada, nor are there any meaningful large scale programs that provide incentives for landowners to retain habitat conditions conducive to wildlife production. Although grasslands are maintained for livestock production, incentives may be required to encourage land managers to maintain ecological processes that optimize grassland grouse production within agricultural landscapes. Presently, wildlife department s in all three Prairie Provinces have few dollars for habitat development programs or incentives for private lands. Some habitat retention and reestablishment that benefits sharp-tailed grouse does occur under the North American Waterfowl Management Plan. However, Canada requires additional programs, probably as part of an agricultural program. These could include marginal cropland retirement with conversion to grassland or ecological goods and services initiatives, to provide large scale habitats conducive to sharp-tailed grouse.

Table 3 summarizes specific state priority areas by county, geographic area (Canadian areas), current CRP acres, and needed CRP acres, while Table 4 summarizes similar information for the Canadian provinces to meet this additional challenge to increase grassland acres for maintaining and connecting various greater prairie-chicken populations and also increasing sharp-tailed grouse numbers in the prairie pothole region.

Table 3. Conservation Reserve Program goals to maintain prairie grouse within the states of BCR 11.

State	Species	MLRA	County	Acres	Existing Acres	Future Needs
ND	greater prairie-chicken	56	Cass	1,120,000	34,007	87,122
	"	56	Grand Forks	920,320	100,000	108,531
	"	55B	Ransom	552,320	82,675	82,675
	"	56	Richland	933,760	35,448	56,574
	"	55B	Sargent	552,320	41,631	64,374
	"	56	Traill	551,040	12,844	52,274
	sharp-tailed grouse	56	Pembina	719,360	35,841	35,841
	"	56	Walsh	825,600	115,949	115,949
	TOTALS			**6,174,720**	**458,395**	**603,340**
SD	prairie grouse	102A	Day	200,000	96,800	96,800
	"	102A	Deuel	180,000	46,000	46,000
	"	102A	Grant	200,000	32,100	32,100
	"	102A	Roberts	300,000	70,800	70,800
	TOTALS			**880,000**	**245,700**	**245,700**
MT	sharp-tailed grouse	52	Blaine	2,711,223	164,000	164,000
	"	52	Chouteau	2,555,461	279,000	279,000
	"	53A	Daniels	912,999	147,000	147,000
	"	52	Phillips	3,333,245	12,000	12,000
	"	52	Valley	3,237,438	208,000	208,000
	"	53A	Sheridan	1,091,637	159,000	159,000
	"	53A	Roosevelt	1,515,396	178,000	178,000
	TOTALS			**15,357,399**	**1,147,000**	**1,147,000**
MN	sharp-tailed grouse	56	Kittson	706,925	100,754	100,754
	"	56	Marshall	1,161,043	197,725	197,725
	"	56	Pennington	395,629	75,404	75,404
	GPC/STG	56	Red Lake	277,184	47,087	47,087
		56	Polk	1,279,437	145,273	145,273
	greater prairie-chicken	56	Norman	561,574	51,797	51,797
	"	56	Clay	674,342	40,714	40,714
	"	56	Wilkin	481,178	11,605	11,605
	"	56	Traverse	375,277	2,652	2,652
	"	56	Big Stone	338,272	6,290	6,290
	TOTALS			**6,250,861**	**679,301**	**679,301**

Table 4. Grassland acre goals to maintain prairie grouse within the provinces of BCR 11.

Province/ Species	Location	Existing Acres[1]	Priority Acres	Future Needs
Manitoba/sharp-tailed grouse				
	Aspen Parkland & SW MB Uplands	2,167,000[3]	2,167,000	2,167,000
	Lake Manitoba Plain	1,812,000[3]	1,812,000	1,812,000
	TOTALS	**3,979,000**	**3,979,000**	**3,979,000**
Saskatchewan/sharp-tailed grouse				
	Aspen Parkland	2,636,283[2]	691,492	691,492
	Moist Mixed Grassland	2,613,856	2,267,311	2,267,311
	Dry Mixed Grassland	6,706,636	5,400,766	5,400,766
	TOTALS	**12,835,869**	**8,359,569**	**8,359,569**
Alberta/sharp-tailed grouse				
	SE Alberta	13,906,162	11,396,363	11,396,363
	TOTALS	**13,906,162**	**11,396,363**	**11,396,363**

[1]There is no CRP in Canada. Existing acres are total acres within a soil correlation. They are privately owned, provincial, or federal land which are still in grassland cover, but are managed primarily for beef production.

[2]Hammermeister et al. 2001.

[3]This represents range and grassland and agricultural forage of which forage represents less than 17%.

Additional Threats Specific to BCR 11

Grassland Conversion

Grassland conversion will always be an issue of concern for BCR 11. Changes in farm programs will always affect grassland acres. The value of land, farm loans, commodity prices, and improvements in farming technology will influence how much grassland will be converted to production land. At present, CRP has delivered in increasing the number of grassland acres on the landscape. But changes are on the horizon in terms of acres to fuel ethanol production industry. This potential move to intensive agriculture can have secondary effects on the ability of CRP to maintain grassland acres. It is also noted in Alberta that any expansion of irrigation systems could result in enhanced arability and increased potential for cultivation current grasslands. New conservation programs designed to retain and restore grassland acres will need to include incentives for producers to maintain grassland acres, expand grassland/conservation easements or long term leases, promote sustainable uses of native grasslands, and collaborate efforts within the conservation community.

Infrastructure development such as road expansion or improvement and urbanization are further examples of grassland conversion causing dissection and fragmentation of habitats for prairie grouse.

Energy Development

Mineral exploration and development, and wind towers are planned for several areas within BCR 11. This includes oil, gas, coal-bed methane, coal, and wind. Effects on prairie grouse populations will occur due to mines, wells, power lines, towers, etc. but probably a greater impact will be the support facilities such as roads, more power lines, pipe lines, air, water and noise pollution, invasive species, gathering stations and constant heavy traffic. Alberta faces similar problems with further intensification of oil/gas extraction, additional processing facilities, expanding coal-bed methane extraction, increasing electricity-generating wind farms, and enhanced transportation/utility infrastructure to support industrial developments on the landscape all of which can contribute to habitat loss or fragmentation and degradation of habitat quality.

Land Management (Grazing)

Prairie grouse evolved with grazing and can continue to co-exist with grazing. BCR 11 mostly contains grasslands which are grazed by domestic livestock. Closely monitored livestock grazing, with timely adjustments to duration and intensity, may provide a more vigorous grassland community, and will maintain residual cover used by prairie grouse for nesting and brooding. However, drought and over-utilization of pastures can lead to a lack of residual cover that is critical for nesting and brood survival. Appropriate timing of grazing and scheduled deferment or rest are necessary for maintaining intact native plant communities. Managing grazing in a manner that supports native vegetation health and vigor will assure sustainable grass, forb and shrub habitats that are valuable to prairie grouse populations. There needs to be cooperation between federal, state, and local agencies involved with grassland management so that grazing systems can be established to provide cover and intact plant communities needed by prairie grouse for reproduction and survival.

Invasive Species

Invasive, non-native plants can cause considerable negative impacts to grasslands and to prairie grouse. Some invasive plants have already spread into some grassland areas and it will take a multi-group effort to bring them under control. Preventing the occurrence of invasive plants is the most effective measure for maintaining productive prairie grouse habitats. Tree and shrub invasion into grassland habitat can also be detrimental especially in areas where prairie-chickens occur. Every land-use agency needs to work cooperatively to be effective at promoting measures that prevent invasive plants from establishing in native habitats.

BIRD CONSERVATION REGION 17
BADLANDS AND PRAIRIES

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South Dakota Game, Fish, and Parks
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Montana Fish, Wildlife and Parks

Description

A portion of Montana, Wyoming, North Dakota, and South Dakota encompass BCR 17 (Figure 6), and is approximately 68 million acres of rolling topography, with many large tracts of contiguous grassland or shrub-grassland habitat. Ranching and farming make up the bulk of land use activities, with rangeland acres for livestock grazing surpassing cropland acres. Since 1986, many cropland acres have been seeded back to grassland habitat through CRP. Climatic conditions are of extreme nature, with dry hot summers and cold winters, with most annual precipitation occurring during the growing season. On an annual basis, precipitation is the main factor dictating habitat conditions in BCR 17.

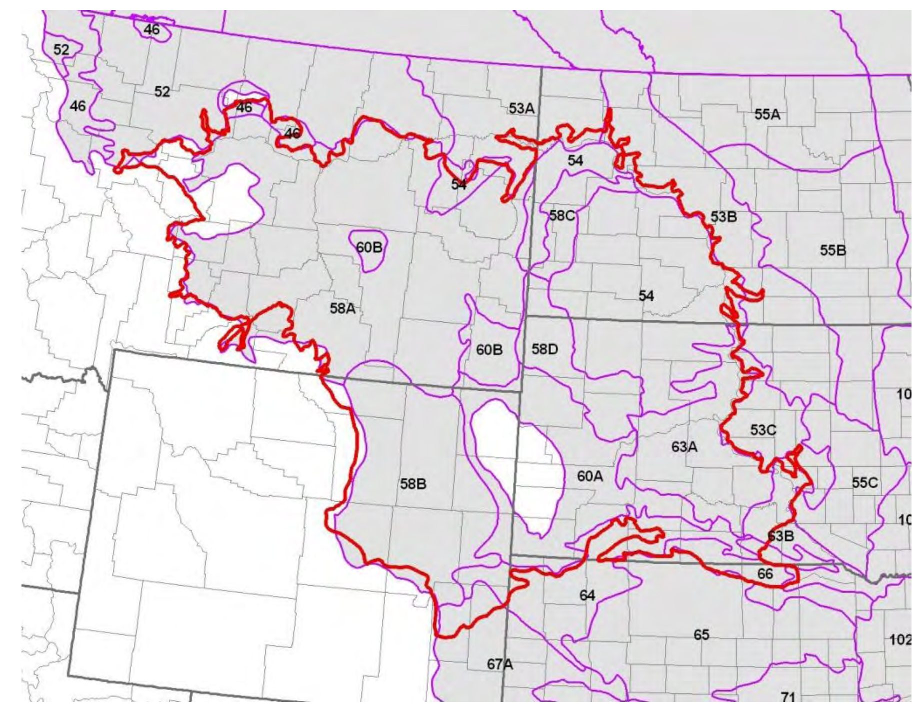

Figure 6. States, counties, and Major Land Resource Areas within BCR 17.

History of Prairie Grouse

Historically, sharp-tailed grouse have inhabited much of BCR 17, with fluctuations in numbers related directly to landscape changes resulting from bison grazing, frequency of fires, climatic changes, settlement, and the landscape changes associated with settlement (e.g., removal of bison, introduction of livestock grazing, and the conversion of prairie to agricultural land). During these events, sharp-tailed grouse numbers have gone up and down, at times extremely low, however rebounding when national conservation programs were implemented. Grazing legislation, such as the Taylor Grazing Act of 1934, helped establish parameters for livestock grazing on public lands, whereas private lands programs such as the Soil Bank program of the late 1950's to early 1960's, and most recently CRP, have helped create more grassland resulting in increased local grouse populations and even expansion in some areas.

As settlers began planting small grains and bison herds disappeared, the greater prairie-chicken range began to expand farther north and west, eventually reaching the Canadian prairies. Continued landscape changes including the increase of cattle grazing and expansion of agricultural land caused prairie-chicken numbers to decline and their range to retreat. Areas currently supporting prairie-chickens consist of either mixed grass prairie with suitable grassland habitat intermixed with small grain or remnant tall grass prairie areas that have enough grassland habitat suitable to sustain small, and often isolated, populations. Suitable tall grass prairie areas exist mainly on land administered for wildlife habitat by both state and federal agencies, as well as privately-owned grassland habitats established through conservation programs such as CRP. Currently, greater prairie-chickens are restricted to central and south-central South Dakota in BCR 17.

The plains sharp-tailed grouse is the most abundant and widespread prairie grouse species and can be found in virtually every county of Montana, Wyoming, North Dakota, and South Dakota within the BCR boundary. Although widely distributed, sharp-tail numbers vary and are dependent upon the amount of grassland habitat and existing management, as well as short term climatic conditions.

Ecosystem Diversity Assessment

As indicated in the ecosystem diversity section of the main plan as well as Appendix A, grassland diversity within BCR 17 has changed considerably due to influences of European settlement. Fires have been reduced or eliminated in most areas. The grazing patterns of bison have been eliminated. Existing grazing patterns have created fairly uniform conditions across remaining grasslands. Substantial acres have been converted to crops, urban, and exurban development. Numerous exotic plant species have invaded. All of these have caused dramatic changes to the ecosystem diversity that once existed.

Acreage goals for the Prairie Pothole BCR 17 were generated utilizing ecological site descriptions from the following MLRA's in the United States to address ecosystem diversity for grass and shrub ecosystems: Northern Rocky Mountain Foothills (MLRA 46), Southern Dark Brown Glaciated Plains (MLRA 53C), Rolling Soft Shale Plains (MLRA 54), Southern Black Glaciated Plains (MLRA 55C), Northern Rolling High Plains (MLRA 58A), Northern Rolling High Plains (MLRA 58B), Northern Rolling High Plains, Northeastern Part (MLRA 58C), Northern Rolling High Plains, Eastern Part (MLRA 58D), Pierre Shale Plains and Badlands (MLRA 60A), Pierre Shale Plains, Northern Part (MLRA 60B), Northern Rolling Pierre Shale Plains (MLRA 63A), Southern Rolling Pierre Shale Plains (MLRA 63B), and Mixed Sandy and Silty Tableland (MLRA 64).

A total of 13,436,515 acres have been projected as an ecosystem representation goal for BCR 17 (Table 5). These are targeted for grassland restoration based on ecological site descriptions, prairie grouse population abundance and distribution, representation levels of ecosystem diversity, and historical disturbance regimes. Refer to Appendix C for the appropriate Ecosystem Diversity Matrix to determine targeted conservation acres for specific region for prairie grouse conservation. These targets could be adjusted with more detailed analyses of historical conditions conducted within each MLRA, but they provide a working framework for strategic planning.

Table 5. Acreage targets for ecosystem diversity conservation from MLRA's within the Badlands and Prairies BCR 17.

Land Cover Classification	Acres	Representation (%)	Appendix Matrix
MLRA 46	53,700	15	C-17
MLRA 53C, 55C, 63B	227,106	20	C-18
MLRA 54, 58C	3,075,764	20	C-19
MLRA 58A, 60B	5,039,160	20	C-20
MLRA 58B	1,546,184	20	C-21
MLRA 58D, 60A	1,849,824	20	C-22
MLRA 63A	1,195,917	20	C-23
MLRA 64	448,860	20	C-24
Total	**13,436,515**		

Priority Areas

BCR 17 lies within the heart of the sharp-tailed grouse range, making the entire BCR important to sustaining prairie grouse populations. In response, a priority area was determined within each state, focusing on counties functioning as core areas and those most likely affected by land-use changes (e.g., grazing, conversion to cropland, CRP). In the case of South Dakota, the priority area was selected on the same criteria, but also due to a significant overlap of sharp-tailed grouse and the stronghold of the state's greater prairie-chicken population.

Due to topography, soil, and average precipitation, it is likely that a high proportion of the BCR will remain in rangeland, thus grassland and grazing management remains at the top of priority practices. However, in areas where agricultural land is expanding, grassland conservation and establishment will be critical. The combination of practices such as CRP acres, grassland easements, and intensive grazing management will provide the necessary grassland habitat needed for sustaining healthy prairie grouse populations. Using these practices, a core area goal of 1.6 million acres in Montana, 730,000 acres in North Dakota, 500,000 acres in South Dakota, and 363,000 acres in Wyoming would be ideal.

Focus counties in Montana include Richland, Wibaux, Dawson, Prairie, Custer, McCone, Fergus, Petroleum, and Yellowstone, all falling within the northern part of the Northern Rolling High Plains (MLRA 58A). North Dakota counties of interest lie within the eastern part of the Northern Rolling High Plains (MLRA 58D) and are Adams, Bowman, Hettinger, and Stark. South Dakota's priority counties include Haakon, Jones, Lyman, and Stanley, situated in the Northern Rolling Pierre Shale Plains (MLRA 63A). Four of Wyoming's priority counties (Weston, Crook, Sheridan, and Johnson) lie within the southern part of the Northern Rolling High Plains (MLRA 58B) and two counties (Platte and Goshen) are located in the Mixed Sandy and Silty Tableland ecosystem (MLRA 64). Figure 7 illustrates the counties of greatest conservation priority for prairie grouse in BCR 17.

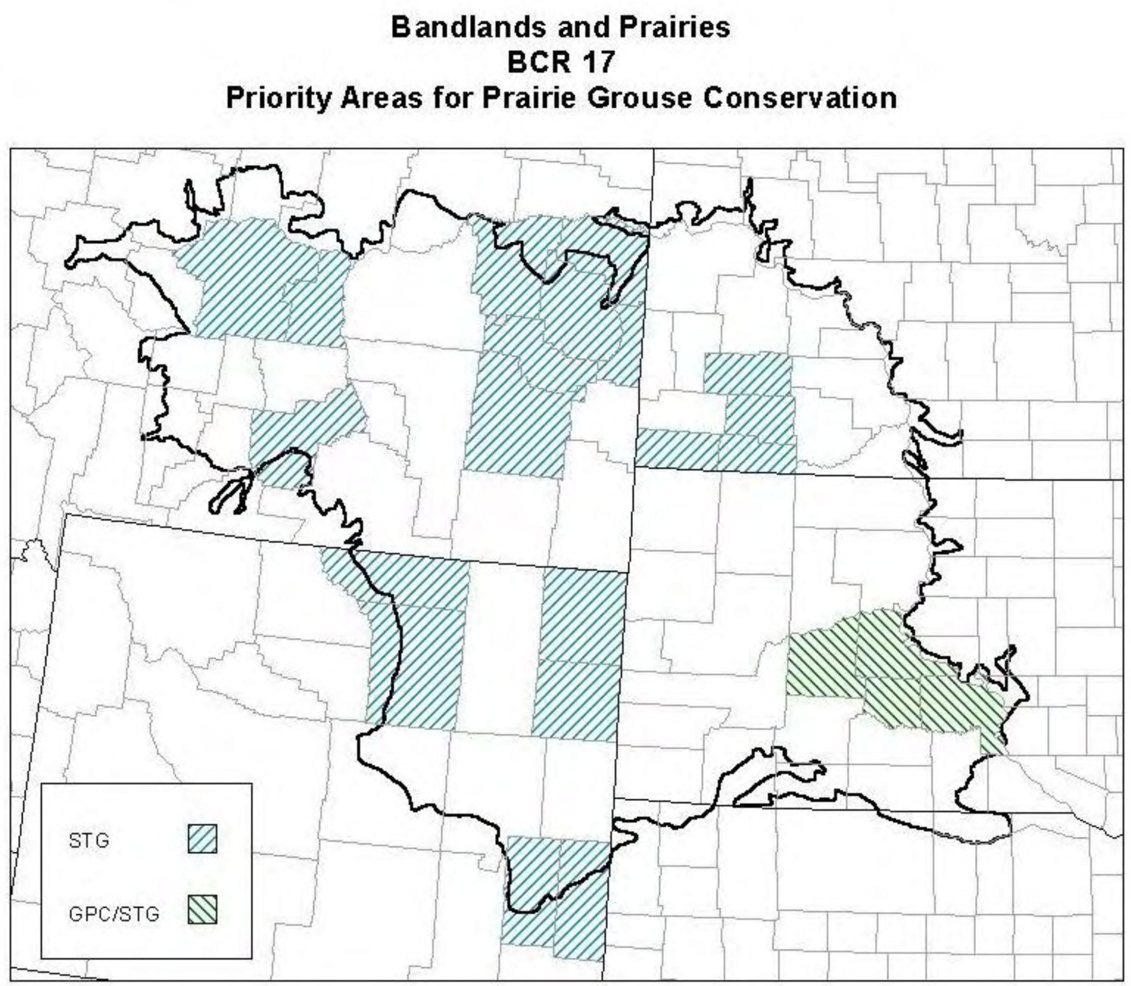

Figure 7. Priority areas within the badlands and prairies region (BCR 17).

Habitat Opportunities

Grassland habitat issues are addressed in each state, some with national programs, others designed, funded, and implemented at a state level. State grassland programs vary in degree and level of acceptability but are an important component in grassland habitat management. Each state has program funds, largely derived from hunter license dollars that support habitat conservation or enhancement on private lands and/or land acquisition. Fee title purchases provide secure habitat and recreational opportunities, while state cost-share assistance to private landowners support wildlife habitat and landowner objectives, and in some cases hunting opportunities. Conservation easements administered by state agencies, conservation organizations, or the USFWS provide financial incentives for long-term protection from habitat conversion.

National Farm Bill programs are the most widely known and used because of funding levels and availability. Grassland can be managed and secured through programs such as the Grassland Reserves Program (GRP) and the Environmental Quality Incentives Program (EQIP), however the most popular grassland program utilized across the BCR is CRP, where existing cropland is restored to grassland habitat.

Conservation Reserve Program Priorities

Greater prairie-chicken populations have remained stable, or slightly increased, in South Dakota where large blocks of CRP plantings have provided habitat mimicking tall grass prairie characteristics. Maximum benefits to prairie grouse and other grassland species will occur where CRP grasslands support a diversity of plants reflective of native habitats. Ultimately, if these areas are managed with sustainable grazing in a manner that supports native grassland characteristics, these former croplands would contribute directly to ecosystem diversity goals. Table 6 reports priority county information with respect to currently-enrolled CRP and future recommended CRP acreages intended for retaining and increasing prairie grouse populations.

Table 6. Goals to maintain prairie grouse within the counties of BCR 17.

State	Species	MLRA	County	Acres	Existing Acres	Future Needs
SD	**greater prairie-chicken and sharp-tailed grouse**					
		63A	Haakon	1,160,391	43,304	34,429
		63A	Jones	621,209	16,743	6,658
		63A	Lyman	1,049,653	90,756	22,577
		63A	Stanley	923,760	48,143	14,291
SD	**sharp-tailed grouse**					
		58D	Adams	632,786	70,114	Retain
		58D	Bowman	746,938	63,137	Retain
		58D	Hettinger	725,631	114,566	52,000
		58D	Stark	857,841	89,140	Retain
WY	**sharp-tailed grouse**					
		58B	Weston	1,500,000	1,000	1,000
		58B	Crook	1,800,000	2,200	2,500
		58B	Sheridan	1,600,000	750	1,000
		58B	Johnson	2,600,000	350	500
		64	Platte	1,300,000	58,000	60,000
		64	Goshen	1,400,000	85,000	85,000
MT	**sharp-tailed grouse**					
		58A	Richland	1,344,531	115,000	Retain
		58A	Wibaux	568,973	37,000	Retain
		58A	Dawson	1,523,392	92,000	Retain
		58A	Prairie	1,113,875	41,000	Retain
		58A	Custer	2,425,146	16,000	Retain
		58A	McCone	1,715,104	141,000	Retain
		58A	Fergus	2,780,947	74,000	Retain
		58A	Petroleum	1,070,054	12,000	Retain
		58A	Yellowstone	1,693,926	58,000	Retain
			Totals	**31,154,157**	**1,269,203**	**279,955**
			Primary Focus Area Goals	**1,549,158**		

Additional Threats Specific to BCR 17

Grassland Conversion

Grassland conversion continues to be a major issue of concern for BCR 17. Current farm programs, approaches to land valuation and farm loans, and improvements and shifts in farming technology, including development of alternative fuels such as ethanol, have compelled producers to convert grassland to production land. Incentive-based conservation programs and efforts to retain and restore grasslands should include continuing and expanding grassland/conservation easements or long term leases, promoting economically-sustainable uses of native grassland, and establishing collaborative efforts throughout the conservation community.

Energy Development

The demand for energy and fuel sources is at an all time high in the U.S., and potential sources of energy are located within the BCR. Exploration and development of energy from oil, gas (e.g., coal bed methane), and wind continues with increasing momentum, elevating the need for the conservation community be proactive in helping minimize adverse effects. It is imperative that critical habitat areas, especially leks and other seasonal habitats, be identified and conserved. To minimize the impact on native grassland habitat, alternative sites for energy production (e.g., wind turbines) should be located on cropland areas where possible. Continued education and communication between state and federal agencies, conservation organizations, and the public will be imperative as energy issues continue to grow.

Land Management (Grazing)

Because much of BCR 17 remains in grassland, it's not surprising that grazing is the most common land use practice. Historic and current mismanagement, resulting in degraded grassland habitats, occurs across the BCR. Livestock grazing has both short and long term effects on native vegetation. Grazing removes a portion of annual herbaceous vegetative growth and reduces residual cover. Prairie grouse are adapted to grazing by large herbivores but directly benefit from residual cover for nesting, rearing broods, and hiding. Grazing that is managed to maintain residual cover will benefit prairie grouse production and survival.

Grazing can also impact vegetation communities over a longer period of time. Generally, managing grazing timing and rest in a manner that supports native vegetation health and reproduction will assure sustainable and intact grass and shrub habitats. This should be an integral goal of every grazing management system. Federal, state, and local agency efforts and programs that emphasize sound grazing practices and grassland conservation through grazing management need to be expanded. Responses by prairie grouse to different grazing management systems are not well understood. Efforts to improve grazing management should also include tackling this basic research question, as well as follow-up dissemination of information describing grazing practices that benefit wildlife and livestock.

Invasive Species

Invasive, non-native plants have the potential in some areas to cause considerable negative impact to habitat effectiveness. Direct impacts caused from competition with native shrubs, grasses, and/or forbs are important for food and cover. The impact of invasive plants is an issue that extends beyond wildlife habitat. Private individuals along with local, state, and federal governments have actively pursued measures to control and isolate noxious plants and prevent their spread. Within the realm of invasive plants, preventing their occurrence is the most effective measure for maintaining productive prairie grouse habitats. This can be in the form of both maintaining healthy native rangelands to inhibit growth of invaders as well as controlling the spread of invasive plant seeds. Prevention needs to be integrated with regular surveillance for and immediate control of isolated patches when they occur. Agency or citizen-led partnerships in rural settings can be very effective at promoting measures that prevent invasive plants in native habitats.

BIRD CONSERVATION REGION 18 SHORTGRASS PRAIRIE

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Description

The Shortgrass Prairie lies in the rain shadow of the Rocky Mountains, where arid conditions greatly limits the vegetative composition and structure (Figure 8). Some of North America's highest priority bird species breed in this area, including the mountain plover (*Charadrius montanus*), McCown's longspur (*Calcarius mccownii*), long-billed curlew (*Numenius americanus*), ferruginous hawk (*Buteo regalis*), burrowing owl (*Athene cunicularia*), and three species of prairie grouse (the lesser prairie-chicken, greater prairie-chicken, and the plains sharp-tailed grouse). Reasons for the precarious status of these avifauna are poorly understood, but might be attributed to the reduction in the diversity of grazing pressure as bison have largely been replaced by domestic livestock. For migrants, it is possible that conditions on wintering grounds could also be having a negative impact on grassland obligate species.

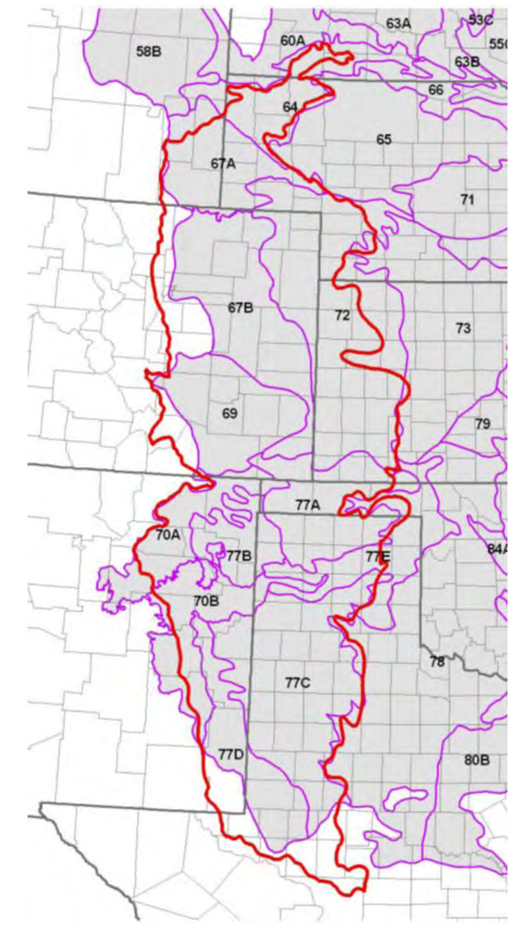

Figure 8. States, counties, and Major Land Resource Areas within BCR 18.

Numerous rivers, such as the Platte, drain out of the Rockies through this region toward the Mississippi Valley. These formerly created broad, braided, and treeless wetlands heavily used by migrating waterfowl, shorebirds, and cranes. Hydrological simplification has resulted in invasion of trees and shrubs that support breeding eastern riparian birds, but otherwise greatly reduce the value of the areas as wetlands. The Playa Lakes area in the southern portion of this region consist of numerous shallow wetlands that support many wintering ducks, migrant shorebirds, and other important breeding species such as the snowy plover.

Much of BCR 18 is predominately used for ranching. However, substantial amounts of the landscape have been converted from native shortgrass, sand sagebrush (*Artemisia filifolia*) and other prairie grassland habitats into intensively farmed agricultural lands. Both irrigated and non-irrigated crops are grown throughout BCR 18, including cotton (*Gossypium* spp.) corn (*Zea mays*), wheat (*Triticum* spp.), and other small grain crops, sunflowers (*Helianthus* spp.), and peanuts (*Arachis* spp.). The development of CRP has substantially enhanced prairie grouse habitat in recent years, and the expansion of this program in targeted areas has the potential to provide essential habitat to the three prairie grouse species within BCR 18.

History of Prairie Grouse

The lesser prairie-chicken is endemic to the shinnery oak (*Quercus harvardii*), sand sagebrush, and mixed-grass dominated rangelands of the southern Great Plains in Colorado, Kansas, Oklahoma, New Mexico, and Texas. At one point in time, the lesser prairie-chicken was hunted throughout all 5 states within its range; currently it is hunted only in Kansas and Texas. Priority areas within BCR 18 to target for habitat improvements to enhance lesser prairie-chicken populations include: Finney, Hamilton, Kearny, Morton, and Stevens counties in Kansas; Union, Harding, Quay, Curry, Roosevelt, and portions of DeBaca, Chaves, and Lea counties in New Mexico; Deaf Smith, Parmer, Bailey, Lamb, Cochran, Hockley, Yoakum, Terry, Gaines, and Andrews counties in Texas; Cimarron, Texas, and Beaver counties in Oklahoma; and Baca, Prowers, Bent, Cheyenne, and Kiowa counties in Colorado.

The greater prairie-chicken inhabits mixed-grass and sand sagebrush habitats and may also occupy agricultural fields during some times of the year. Within BCR 18 the greater prairie-chicken occupies northeast Colorado, northern Kansas, and southwestern Nebraska. Limited hunting opportunities exist in all three states. Priority areas within BCR 18 to target for habitat improvements to enhance greater prairie-chicken populations include: Yuma, Philips, Sedgwick, Logan, Washington counties in Colorado; Cheyenne County in Kansas; and Dundy, Chase, Lincoln, Keith, and Garden counties in Nebraska.

Plains sharp-tailed grouse are found in steppe, grassland, and mixed-grass habitats, and to varying degrees, demonstrate some use of agricultural areas. Plains sharp-tailed grouse populations occurring within BCR 18 are limited to northeast Colorado, southeast Wyoming, and southwest Nebraska. They are not hunted in Colorado, and have limited hunting in Wyoming and western Nebraska. Priority areas within BCR 18 to target for habitat improvements to enhance plains sharp-tailed grouse populations include: Weld, Logan, and Sedgwick Counties in Colorado; Laramie County in Wyoming; and Sioux, Dawes, Sheridan, Box Butte, Scotts Bluff, Morrill, Garden, Banner, Kimball, Cheyenne, Deuel, Keith, and Lincoln counties in Nebraska.

Ecosystem Diversity Assessment

As indicated in the ecosystem diversity section of the main plan, as well as Appendix A, grassland diversity within BCR 18 has changed considerably due to influences of European settlement. Natural fire regimes have been reduced or eliminated as disturbances in most areas, resulting in woody encroachment. The grazing patterns of bison have been eliminated and replaced by domestic livestock. Existing grazing patterns have created fairly uniform conditions across remaining grasslands. Substantial acres of native rangelands have been converted to crops, urban, and energy development. All of these factors have caused dramatic changes to the ecosystem diversity that once existed.

Acreage goals for BCR 18 were generated utilizing ecological site descriptions from the following MLRA's in the United States to address ecosystem diversity for grass and shrub ecosystems: Mixed Sandy and Silty Table Land (MRLA 64), Central High Plains, Northern Part (MLRA 67A), Central High Plains, Southern Part (MLRA 67B), Upper Arkansas Valley Rolling Plains (MLRA 69), Canadian River Plains and Valleys (MLRA 70A), Upper Pecos River Valleys (MLRA 70B), Central High Tableland (MLRA 72), Southern High Plains, Northern Part (MLRA 77A) and Southern High Plains, Breaks (MLRA 77E), Southern High Plains, Northwest Part (MLRA 77B), Southern High Plains, Southern Part (MLRA 77C) and Southern High Plains, Southwest Part (MLRA 77D)

A total of 11,976,269 acres have been projected as an ecosystem representation goal within BCR 18. These are targeted for grassland restoration based on ecological site descriptions, prairie grouse population abundance and distribution, representation levels of ecosystem diversity, and historical disturbance regimes (Table 7).

Table 7. Acreage targets for ecosystem diversity conservation from MLRA's within the Shortgrass Prairie BCR 18.

Land Cover Classification	Acres	Representation (%)	Appendix Matrix
MLRA 64	603,538	20	C-25
MLRA 67A	868,303	15	C-26
MLRA 67B	1,516,928	15	C-27
MLRA 69	835,562	15	C-28
MLRA 70A	301,916	10	C-29
MLRA 70B	620,037	15	C-30
MLRA 72	2,816,828	20	C-31
MLRA 77A, 77E	1,338,137	15	C-32
MLRA 77B	334,319	10	C-33
MLRA 77C, 77D	2,740,701	15	C-34
Total	**11,976,269**		

The quality of available habitat within BCR 18 contributes to the effectiveness of many of the other factors regulating prairie grouse populations. Drought, disease, predation, hunting, and disturbances are less likely to affect populations when habitat quality is high and both the individual birds and the population are quick to recover. Population impacts from unfavorable weather conditions may be somewhat ameliorated by having high quality habitats. Managing for quality habitats, while maintaining and restoring habitat quantity, are likely the two most important factors for long-term sustainability of prairie grouse populations.

Priority areas within BCR 18, where grassland conservation and restoration have been identified to sustain or enhance prairie grouse populations within the BCR, include areas within MLRAs 69, 67B, and 72 (Colorado); 72, 77A (Kansas), MLRAs 77C, D and 70B (Texas and New Mexico), and MLRA 77A (Oklahoma). Disturbed land cover is currently about 41.5% of total acreage (approximately 27.3M acres of 65.9M acres) in these 7 MLRAs and will require conversion of cropland acres (i.e., disturbed acres) to grasslands to create desired grassland complexes in 7 states. More specifically, disturbed land cover is currently an estimated 44% of total acreage (approximately 9.4M acres of 21.3M acres) within 10 miles of lesser prairie-chicken occupied range in the 6 MLRAs that have lesser prairie-chickens. There are currently an estimated 7.7M acres of grass cover type within 10 miles of lesser prairie-chicken occupied range, and 26.6M acres in the 7 priority MLRAs in BCR 18. For all priority areas of BCR 18, and considering the needs of all prairie grouse that occur in BCR 18, a goal of 35M acres of core grassland areas comprised of 30M acres in continuous grass and an additional 5M acres of grass within surrounding area is an immediate objective.

For the lesser prairie-chicken, grasslands should be managed to protect and maintain existing tracts of native mixed-grass, shinnery oak, or sand sagebrush prairies. Conservation programs and efforts to retain and restore grassland acres should include reestablishing grassland and/or shrublands within lesser prairie-chicken range. These areas must be large and close enough to other patches (≤ 19 mi) to support viable lesser prairie-chicken populations. However, smaller tracts (≥ 1,200 and ≤ 4,900 ac) but with high connectivity (≤ 6 mi spacing) also should be included in such efforts.

For the greater prairie-chicken, current habitat is characterized by mid- and tall-grass, and sand sagebrush prairie, sometimes mixed with cropland. Restoration of grasslands into large, contiguous areas with minimal fragmentation will benefit the species. Considering the high fidelity to breeding sites (leks), conservation efforts should be targeted around known lek or nesting sites.

For the plains sharp-tailed grouse, general habitat needs are similar to those of the greater prairie-chicken. Reliance on grassland and mixed shrub habitats are characteristic of this species. Some populations also depend on croplands to varying degrees.

While a diversity of grass communities across the various ecological sites and representing a range of historical grazing conditions should be provided, a primary restoration focus should be on light grazing communities especially occurring on Sandy, Sands, Choppy Sands, Sandhills, Loamy, and the Sandy Plains ecological sites. Of particular importance for prairie grouse are the following counties: Finney, Hamilton, Kearny, Morton, Cheyenne, and Stevens in Kansas; Union, Harding, Quay, Curry, Roosevelt, DeBaca, Chaves, and Lea, counties in New Mexico; Cochran, Hockley, Yoakum, Terry, Bailey, Lamb, Deaf Smith, Parmer, Andrews, Gaines and Gray counties in Texas; Beaver, Harper, Texas, Ellis, and Woodward counties in Oklahoma; Baca, Prowers, Cheyenne, Kiowa (LPCH) Yuma, Philips, Sedgwick, Logan, Washington counties (GPC) and Weld, Logan, and Sedgwick counties (PSTG) in Colorado; Beaver, Texas, and Cimarron in Oklahoma; Laramie County in Wyoming; and Dundy, Chase, and Lincoln counties (GPC) and Sioux, Banner, Box Butte, and Sheridan counties (PSTG) in Nebraska (Figure 9).

Conservation Reserve Program Priorities

Lands enrolled in CRP provide an important management opportunity for increasing and improving prairie grouse habitat. Lesser prairie-chickens have expanded their range in response to multiple-species native grass CRP stands in the central plains, particularly in west-central Kansas (Rodgers 2005, Rodgers and Hoffman 2005). CRP grasslands in Kansas comprise 13% of the total area of 15 core counties in southwestern counties enrolled in CRP (http://www.fsa.usda.gov/crpstorpt/r1sumsn/ks.htm) and in some cases provide the only available grassland habitat.

CRP grasslands comprise a similar portion of lesser prairie-chicken range in Colorado; i.e., 17% of the total area of Baca, Kiowa, and Prowers counties is enrolled in CRP (http://www.fsa.usda.gov/crpstorpt/r1sumsn/co.htm). Much of the early CRP-enrolled acreage in southeast Colorado was planted to mixtures containing sideoats grama (*Bouteloua curtipendula*) which became dominant, stunted, and sodded in. The result was extremely low quality habitat. Sideoats-dominated stands provide insufficient cover and lack both the diversity and abundance of native grass and forb species when compared to native habitat (Sullivan et al. 2000, Fields 2004). Although historic evidence suggested that birds in Colorado occasionally used CRP as roosting cover (Giesen 2000), recent survey efforts have found lesser prairie-chickens using CRP as lekking and roosting sites and have been directly correlated with increasing lesser prairie-chicken populations in Prowers County.

Shortgrass Prairie
BCR 18
Priority Areas for Prairie Grouse Conservation

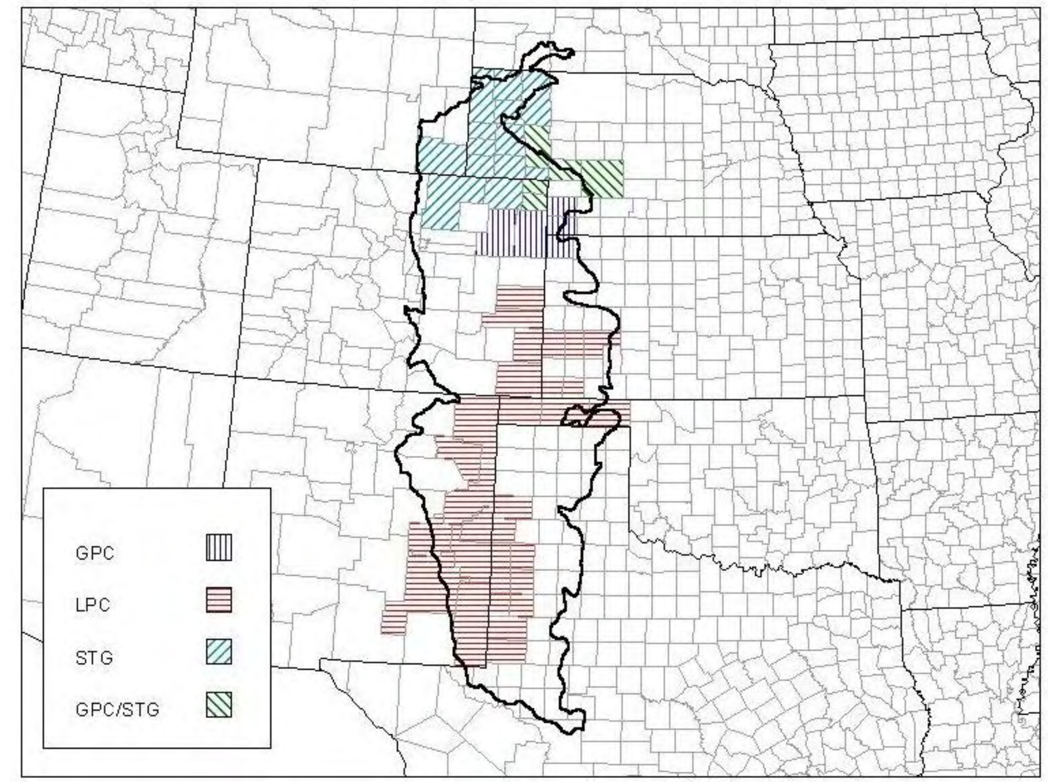

Figure 9. Counties of greatest conservation priority for prairie grouse in BCR 18.

In New Mexico, conversion of cropland to CRP grasslands was believed to have been detrimental to lesser prairie-chicken populations by decreasing winter food resources (Bailey and Williams 2000); however about 70-80% of the original CRP seedings in eastern New Mexico consisted of dense, single-species stands of weeping lovegrass (*Eragrotis curvula*) or Caucasian bluestem (*Bothriochloa bladhii*). Lesser prairie-chicken populations have generally not increased in response to the monocultures noted, but have increased slightly in range and population in an area outside what Ligon (1927) described as suitable lesser prairie-chicken range in northern Curry County where mixed stands that included sand dropseed (*Sporobolus cryptandrus*), sideoats grama, and blue grama (*B. gracilis*) are more prevalent (D. M. Davis, NMDGF, unpublished data).

CRP grasslands in Texas were established as monocultures of exotic warm season species such as weeping lovegrass, old world bluestem (*B. bladhii*), King Ranch bluestem (*B. ischaemum*), or klinegrass (*Panicum coloratum*) that provide little brood-rearing or winter cover. Establishment of CRP grasslands in the Texas Panhandle has not been detrimental to lesser prairie-chickens even though the vegetative structure in those fields does not generally appear to provide suitable habitat for the species (Sullivan et al. 2000). Lesser prairie-chickens are known to use CRP in Texas throughout the year, although this use is limited and observations have been relatively infrequent and sporadic. In recent years, those CRP fields that were either planted to native species or now have a native component (through succession or mid-contract management) have been reported as used more than those that are still in an exotic cover type.

Plains sharp-tailed grouse have responded favorably to CRP in the Nebraska Panhandle, particularly in Banner and Kimball counties, where CRP makes up 15% of their collective landscapes. Enrollments have been smaller and responses more localized in other Panhandle counties. In southwest Nebraska, greater prairie-chickens have also shown a positive response in counties such as Perkins.

Maximum benefits to prairie grouse and other grassland species will be achieved where CRP plantings are designed to restore the native light grazing plant communities that historically occurred on a specific ecological site. These CRP acres can then contribute directly to the ecosystem diversity goals identified below. Due to the limited duration of CRP programs, a goal should be to provide for the long term maintenance of these acres in a restored grassland condition. In addition, Table 8 summarizes currently enrolled CRP acreage for maintaining and connecting prairie grouse populations in BCR 18.

In addition to the CRP conservation priorities for prairie grouse identified in this Plan, the Playa Lakes Joint Venture (PLJV) has been a partner in BCR-level planning within the five states with occupied lesser prairie-chicken habitat. PLJV used a process based on principles of *Strategic Habitat Conservation* (USFWS and USGS 2006) to develop habitat management recommendations in this plan. In general, PLJV developed: 1) bird abundance targets that are stepped-down from continental objectives in the bird initiatives, and 2) habitat objectives that are linked biologically to the abundance targets. More specifically, they used the following model to estimate current carrying capacity of each habitat for each priority bird species (of which lesser prairie-chickens are one):

Number of birds = acres of habitat * habitat availability factor * habitat suitability factor * large block factor * bird density

The estimated number of birds supported in each habitat is summed, and compared to the bird abundance target. This process quantifies the importance of each habitat to each species. It also quantifies current carry capacity relative to desired carrying capacity, which allows crafting specific habitat acreage recommendations to bring a species to desired levels. Habitat recommendations herein are only as good as the model inputs used to develop them. Recommendations are based on current models and current land cover data. All partners in this process expect that recommendations will change as data become better. Most current recommendations will always be available at www.pljv.org.

Colorado

Colorado lesser prairie-chicken habitats are at the fringe of lesser prairie-chicken range, and current habitat conditions are insufficient to support a growing population of this species. Colorado is committed to engaging in conservation practices to benefit this species, and conservation goals are meant to be realistic and achievable. Population goals in Colorado are to increase current numbers of lesser prairie-chickens by 25% over the next 20 years. These goals are meant to be achieved by targeting habitat improvements in existing CRP, influencing CRP re-enrollment, and working with other partners and private landowners to enhance existing habitat.

Table 8. Currently enrolled CRP acres to maintain prairie grouse in BCR 18.

Species	MLRA	State	County	Existing Acres[1]
lesser prairie-chicken	67B, 77A	CO	Baca	263,047
	67B	CO	Cheyenne	144,374
	67B, 69	CO	Kiowa	214,338
	69	CO	Prowers	173,786
	72	KS	Finney	84,731
	72	KS	Hamilton	136,154
	72	KS	Kearny	70,512
	72, 77A	KS	Morton	95,718
	77A	KS	Stevens	70,288
	77C	NM	Curry	208,474
	77C&D	NM	Roosevelt	169,734
	70B	NM	DeBaca	1,931
	77B	NM	Harding	18,679
	77D	NM	Lea	38,051
	70B	NM	Quay	115,526
	70A, 77B	NM	Union	24,980
	77A&E	OK	Beaver	134,378
	77A	OK	Texas	213,221
	77A	OK	Cimarron	158,511
	77C	TX	Bailey	131,723
	77C	TX	Deaf Smith	182,537
	77C&E	TX	Gray	43,480
	77C	TX	Lamb	137,713
	77C	TX	Cochran	99,385
	77C	TX	Yoakum	75,661
	77C&D	TX	Gaines	192,634
	77C	TX	Terry	117,103
	77C	TX	Hockley	115,494
greater prairie-chicken	72	CO	Yuma	121,767
	72	CO	Philips	46,721
	67B, 72	CO	Washington	223,854
	72	KS	Cheyenne	51,842
greater prairie-chicken/ sharp-tailed grouse	67B, 72	CO	Logan	138,443
	72	CO	Sedgwick	15,369
	67B	CO	Morgan	96,024
sharp-tailed grouse	67B	CO	Weld	252,926
	67A	WY	Laramie	94,329
	67A	NE	Banner	58,130
	67A, 72	NE	Cheyenne	68,905
	72	NE	Deuel	17,179
	67A	NE	Kimball	104,807
Totals				**4,722,459**

[1]Acres based on active contracts for all program years (1986-2008) as of 3-30-2007 (http://content.fsa.usda.gov/crpstorpt/r1sumyr/r1sumyr.htm).

Specific to CRP acreage, enhancing 50% of the existing low-quality lesser prairie-chicken CRP habitat in, or near, currently occupied lesser prairie-chicken habitat in Colorado to a more appropriate grass stand is the primary goal. Additionally, working with the Comanche National Grasslands to restore the core historical population will be a major goal. This will be accomplished through diversifying the seed mixes used for future plantings, converting current monoculture CRP through an extensive series of practices to ensure reseeding success, interseeding forbs into existing CRP, and other appropriate practices. Additional partnership opportunities that target habitat improvement/enhancement will be explored with various agencies, non-governmental groups (NGOs) and private landowners. Specifically, relationships with local Farm Service Agency (FSA) and USDA/USFS offices will be fostered to help achieve these goals.

Recovery plans were written for greater prairie-chicken (1990) and plains sharp-tailed grouse (1992) in Colorado. These plans are out of date and efforts to have them updated will begin in the coming year. Both plans describe the need to manipulate, enhance, acquire, and create habitat throughout the species' ranges. This will be considered in the plan rewrites. This will be accomplished through collaboration with private landowners, NGOs, and appropriate state and federal agencies. Translocations of plains sharp-tailed grouse have occurred over the past 3 years, into Weld County and are our primary management tool. Monitoring also occurs on an annual basis. Practices to enhance habitat will follow the model described above for the lesser prairie-chicken, in that occupied habitats will be the priority areas where practices will be put in place to enhance habitat.

New Mexico

Based on the most recent (July 2007) PLJV modeling efforts, recommendations to improve CRP for lesser prairie-chickens include the following:

1) Establish a goal to increase the lesser prairie-chicken population by 150% over the next 30 years (D. M. Davis, personal communication);
2) Increase sand sagebrush acres by 53,195 which contribute to large blocks of habitat through the judicious placement of CRP fields (see large block lesser prairie-chicken model below). Currently the PLJV estimates that 5,851 acres of sand sagebrush contributes to large blocks of habitat;
3) Increase the amount of shinnery oak, contributing to large blocks of habitat by 486,302 acres. Currently the PLJV estimates that 263,297 acres contribute to large blocks.
4) Increase CRP acreage contributing to large blocks of habitat by 309,675 acres;
5) Convert CRP in native grass mixtures from a current PLJV-estimated 57,883 acres to 241,533 acres.

The current PLJV lesser prairie-chicken model requires areas with native mixed grasses and at least 1,000 acres of shinnery oak within a 5,000 acre block that also contains no more than: 1) 2,000 acres of cropland or CRP; 2) 50 acres of roads (and no 4-lane roads); and 3) 50 acres of woodland types. The current model has a good fit with the known distribution of lesser prairie-chicken in New Mexico, though it does not completely capture all areas. The PLJV can recommend locations that may benefit from an increase in CRP within or near lesser prairie-chicken range. Efforts to increase populations of this bird should focus on increasing the amount of sand sagebrush that can support lesser prairie-chicken through focused placement of CRP, and research to assess how CRP may become more valuable to the bird in New Mexico, as CRP has been demonstrated to be in Kansas. The PLJV will work in concert with New Mexico partners to further refine the lesser prairie-chicken model for the state.

Texas

There are approximately 2.2M acres of CRP (and approximately 5.8M acres of cropland) in the BCR 18 portion of Texas (TPWD, unpublished data). More specifically, there are approximately 1.5M acres of CRP within 10 miles of estimated occupied lesser prairie-chicken range in Texas portion of BCR 18. Counties with more than150,000 acres of CRP include Bailey, Deaf Smith, Lamb, Gaines, Terry, and Hockley counties. Counties with more than 100,000 acres of CRP include the above list plus Lipscomb, Cochran, Yoakum, and Castro counties.

Use of CRP by lesser prairie-chickens has been documented in Texas, and although range expansion has yet to be documented, a newly discovered population has been reported from Deaf Smith County, and those birds appear to use CRP vegetation types. Improvements to, and management of, the millions of CRP acres in Texas via reseeding to natives or implementation of other conservation practices is expected to improve the suitability of CRP for lesser prairie-chickens and perhaps provide the movement and dispersal corridors necessary for properly functioning metapopulation dynamics of the species.

Based on the recent (July 2007) PLJV modeling efforts, recommendations to improve CRP for lesser prairie-chickens include the following:

1) Increase the amount of CRP within or near lesser prairie-chicken range in BCR 18 by 35,709 acres and that these acres contributes to large blocks of habitat (see large block lesser prairie-chicken model below). Ensure that all these CRP acres are in native grasses;
2) Convert or maintain at least 120,856 acres of CRP acreage within lesser prairie-chicken range in native grasses found in sand sage prairie, interseeded with forbs and legumes;
3) Ensure that 103,500 acres of shinnery oak habitat contributes to large blocks of habitat;
4) Ensure that 2,080 acres of mixed grass contributes to large blocks of habitat.

PLJV assumes that adding the acres of CRP near existing areas of shinnery oak will be able to appropriately expand large blocks of habitat to allow for chickens to achieve goal although it is still unclear (because of current land use and land cover data) whether this configuration is possible. Nevertheless, there are a variety of methods to bring this bird to current goal, and this is only one suggestion.

The current Texas PLJV lesser prairie-chicken model requires areas with native mixed grasses and at least 1,000 acres of shinnery oak or sand sagebrush within a 5,000-acre block that also contains no more than: 1) 2,000 acres of cropland or CRP; 2) 50 acres of roads (ranch or paved), and no 4-lane roads); 3) 50 acres of woodland types; and 4) 150 acres of mesquite. The current model has a poor to moderate fit with the known distribution of lesser prairie-chicken in Texas, primarily because the best available land cover data are poor. Texas Parks and Wildlife is working on creating land cover maps and layers in lesser prairie-chicken areas that should greatly improve the ability of the model to predict lesser prairie-chicken occurrence as well as provide areas where focused efforts to target CRP acres to create large blocks of habitat would be most effective. As this becomes available the PLJV will redo its models and provide better information for the targeting of CRP. Additionally, research to assess how CRP may become more valuable to the bird in Texas, as CRP has been demonstrated to be in Kansas, can affect recommended mixtures and management for CRP. Native CRP in Kansas has been demonstrated to improve conditions for lesser prairie-chicken. As more native CRP is placed on the ground, the model above can change so that there needs to be at least 2,000 acres of shinnery and/or native CRP. Thus the addition of native CRP to the landscape can "create" new large blocks of habitat for the prairie-chicken. The PLJV will work in concert with Texas Parks and Wildlife and other partners to further refine the lesser prairie-chicken model for the state as new GIS or research data become available.

Oklahoma

Based on the recent (July 2007) PLJV modeling efforts, recommendations to improve CRP for lesser prairie-chickens include the following:

1) Convert 204,304 acres of CRP from non-native grass mixes to native grass-mixes. Currently PLJV estimates that there are 51,075 acres of native grass-mix CRP in the area;
2) Reconfigure 192,556 acres of CRP so that it contributes to large blocks of habitat (see lesser prairie-chicken model below). Currently the PLJV estimates that 27,070 acres contribute to large blocks of habitat for lesser prairie-chickens;
3) Reconfigure 22,659 acres of sand sagebrush so that it contributes to large blocks of habitat, providing 353 birds. Currently the PLJV estimates that 52,038 acres do so.

These are not the only methods for achieving lesser prairie-chicken population goals in Oklahoma, but sand sagebrush and CRP are very important to the species in this area. Interseeding native-grass mix CRP with forbs and/or alfalfa (*Medicago* spp.) may well increase the densities of lesser prairie-chickens thereby reducing the need for the reseeding of CRP. However, it is unknown to what extent densities change when this manipulation is implemented. Regardless, researchers in Kansas have noted increases in lesser prairie-chicken activity when those fields have been modified as above.

The current Oklahoma PLJV lesser prairie-chicken model requires areas with native mixed grasses and at least 1,000 acres of sand sagebrush within a 5,000 acre block that also contains no more than: 1) 3,000 acres of cropland or CRP; 2) 50 acres of roads (and no 4-lane roads); and 3) 50 acres of woodland types. The current model has a moderately good fit with the known distribution of lesser prairie-chicken in Oklahoma, though it has tended to overemphasize some areas. The PLJV can recommend locations that may benefit from an increase in CRP within or near lesser prairie-chicken range. Efforts to increase populations of this bird should focus on increasing the amount of sand sage that can support lesser prairie-chicken through focused placement of CRP, and research to assess how CRP may become more valuable to the bird in Oklahoma, as CRP has been demonstrated to be in Kansas. The PLJV will work in concert with Okalahom and other partners to further refine the lesser prairie-chicken model for the state.

Kansas

There are currently about 546,000 acres of native-grass CRP stands within the BCR 18 prairie grouse range in Kansas. This acreage should be retained or increased by up to 200,000 acres. To the degree possible, new CRP should be clustered in areas close to native rangelands (< 2 miles) such that a minimum 40% of the landscape mosaic within township-sized areas is composed of grasslands and/or shrublands. All new CRP seedings should contain a significant component of native forbs (non-native alfalfa is also desirable) and existing stands without a significant forb component should be interseeded with forbs. Kansas should protect and retain all remaining sand sagebrush and mixed-grass prairies and increase habitat quality within these prairies wherever possible though improved management. Every opportunity to recreate grasslands that resemble sand sagebrush prairie and/or mixed-grass prairie should be seized.

Wyoming

Maintain the existing 70,000 acres that are enrolled into CRP, while at the same time improve or enhance 15% of the existing CRP acreage to improve grass stand health and vigor by interseeding native grasses and forbs, and implementing mechanical/chemical practices to remove undesirable cool season grass species.

Nebraska

Prairie grouse currently occur in every county within BCR 18. For long-term population persistence, maintaining high quality native habitats within the core grouse range is the highest priority, followed by improving quality and quantity of grassland for more peripheral populations.

For greater prairie-chickens, counties such as Dundy, Chase, and Lincoln offer sufficient acres of grassland to support healthy core populations, so conservation should emphasize maintaining native (particularly sand sage) prairies with vegetation structures and species diversity necessary to support grouse life history needs.

Core populations of sharp-tailed grouse, abundant grasslands, and favorable soils exist in counties such as Sioux, Box Butte, and Sheridan. Management in these and similar counties should focus on promoting range management practices that provide key habitat components. Populations in Kimball and Banner counties are much more reliant on CRP habitats, so maintaining enrollments (currently over 160,000 acres) and providing proper structure and diversity should be key activities. Cheyenne and Deuel counties have the lowest percentage of grassland in the Panhandle; conservation efforts there should emphasize improving range conditions and increasing high-quality, large-block CRP enrollments.

Additional Threats to BCR 18:

The southern Great Plains have changed dramatically since settlement by Europeans. The dominant factors that have influenced prairie grouse habitats across shinnery oak, sand sagebrush, and mixed-grass prairie communities within BCR 18 are energy development, habitat fragmentation and resulting population isolation, the political uncertainty of important USDA programs such as CRP, altered fire regimes and associated woody encroachment, and conversion of native grassland habitats into agricultural production. The potential threats to prairie grouse are presented below as separate entities but emphasize the cumulative effects of these stressors on ecological processes affecting prairie grouse habitats and their combined influence on upland grassland ecosystem diversity across BCR 18.

Energy Development

Energy exploration and development occur on public and private surface lands throughout the range of prairie grouse within BCR 18. Although the effects of oil and gas developments on prairie grouse are poorly understood, recent studies have suggested that development of oil and gas resources negatively impacts prairie grouse, particularly during the breeding season (Lyon and Anderson 2003, Pitman et al. 2005). Prairie grouse require large contiguous tracts of prairie ecosystems to fulfill their life history requirements. The cumulative impacts of roads and increased traffic, well pads, pipelines, overhead transmission lines, compressor stations, and production facilities not only result in direct habitat loss but fragment remaining suitable habitat deterring use by prairie grouse (Pitman et al. 2005). Nesting prairie grouse avoid areas near roads, power lines, and other man-made infrastructures (Pitman et al. 2005). Crawford and Bolen (1976b) noted that lesser prairie-chicken leks adjacent to heavily traveled roads were abandoned at a higher rate than those found further from anthropogenic disturbance. The effect of daily vehicular traffic associated with maintenance of oil and gas operations along these road networks can also impact breeding activities and may further decrease the availability of habitat (Braun et al. 2002). Collisions with overhead transmission lines cause direct mortality to prairie grouse and may further limit prairie grouse populations (Bidwell et al. 2003). Construction of transmission lines also provides perches for various raptor species, which could potentially increase the mortality rate of prairie grouse (Bidwell et al. 2003). Noise associated with pumping and oil field activities may impact breeding activities if mating display vocalizations are disrupted by background sounds. Further, sage-grouse lek attendance was lower on breeding grounds located in close proximity to active mineral resource developments compared to less disturbed lek sites (Braun et al. 2002). Braun (1986) speculated if noises associated with pumping and oil field activity deter recruitment of yearling sage-grouse males to breeding grounds, leks may become extinct.

Studies to assess whether noise from oil and gas exploration may have played a role in the abandonment of a number of historically active lesser prairie-chicken lek sites in southeast New Mexico show that abandoned lek sites were exposed to higher ambient sound levels than active sites (Hunt 2004). The same study also reported a significantly higher number of operating wells within one mile of abandoned lek sites. Whether this pattern of lek abandonment reflects sensitivity to noise or some other form of disturbance associated with intensive oil and gas development, or is a response to factors not associated with drilling, remains unknown. However, all of these studies emphasize the importance of taking behavioral avoidance into consideration when assessing development impacts on prairie grouse habitat.

Presently, little is known on how wind power developments affect prairie grouse and/or prairie grouse habitats. Areas within the range of greater and lesser prairie-chickens and sharp-tailed grouse are currently being monitored for suitability as wind energy sites throughout their ranges. These developments include the towers and turbines that harness the energy, as well as access roads, and transmission line connections to substations or other existing power grids. Physical disturbance affected by the construction of turbines, turbine noise, and physical movement of turbines during operation have the potential to disturb nesting prairie grouse (Robel et al. 2004). However, behavioral avoidance of these facilities by prairie grouse has the potential to greatly broaden the negative impacts of the project area. The effects of habitat fragmentation may indirectly affect local prairie grouse populations by decreasing the area of habitat available for nesting and brood-rearing (Pitman et al. 2005). The behavioral response of the greater prairie-chicken is likely to be similar to that of the lesser prairie-chicken and it has been predicted that nesting and brood-rearing hens of both species will avoid large wind turbines by at least a one-mile radius (Robel et al. 2004). Fragmentation and changes in habitat structure may increase the amount of edge, which serve as lanes for terrestrial predators (Kuehl and Clark 2002), and are consequently avoided by nesting prairie grouse (Robel 2002a, Pitman et al. 2005). In addition to the effects of habitat fragmentation, prairie grouse avoidance of vertical structures (Anderson 1969, Manes et al. 2004) and human disturbance activities may further impact prairie grouse movements and habitat use (Robel 2002a, b). Therefore, this type of land use change has a variety of potential impacts to prairie grouse.

Habitat Fragmentation

Habitat fragmentation occurs when large areas of habitat are broken up into smaller, isolated patches of habitat. Because suitable habitat for prairie grouse has been lost due to conversion to agriculture and modified through grazing practices and other factors, much of the remaining suitable habitat is fragmented (Crawford 1980, Braun et al. 1994). Fragmentation may threaten local prairie grouse populations through several means: habitat juxtaposition and remaining patches of rangeland may be smaller than necessary to support populations (Samson 1980); necessary habitat heterogeneity may be lost; habitat between patches may accommodate high densities of predators; and ability to move and/or disperse among suitable patches of habitat may decrease (Wilcove et al. 1986, Knopf 1996).

Direct conversion of rangeland to some other land use is the most extreme of a number of developments that may result in fragmentation of prairie grouse habitat. Other sources of impact on the structure and continuity of grassland habitats include infrastructure associated with resource extraction, roads, power lines, fences, buildings, and tree plantings or windbreaks. As a group, prairie grouse may be particularly sensitive to habitat fragmentation due to their limited dispersal distances and landscape scale habitat requirements (Braun et al. 1994). Recent lesser prairie-chicken declines in the southern portion of its range in New Mexico, although probably at least in part drought-related, have led to concern over the effects of fragmentation caused by oil exploration and drilling. While it is often difficult to assign cause-and-effect linkages between specific sources of fragmentation and eventual population responses, recent studies have found lesser prairie-chicken population declines in Oklahoma and New Mexico to be associated with several measures of overall habitat fragmentation, including patch size, edge density, and total rate of landscape change (Woodward et al. 2001, Fuhlendorf et al. 2002).

Fences and power lines may also be a significant cause of direct mortality by collision (Bidwell et al. 2003). Historical settlement patterns in Oklahoma were characterized by ownership tracts divided into approximately 158 acre parcels; whereas, New Mexico retained larger (>600 ac), more contiguous patches of rangeland (Samson and Knopf 1994). A recent study found the increased extent of fencing in Oklahoma was associated with higher mortality of female lesser prairie-chickens and 4 of every 10 lesser prairie-chicken deaths was attributed to collisions with a fence, powerline, or vehicle (Patten et al. 2005). Ligon (1951) expressed concern that spread of these features in eastern New Mexico might severely limit lesser prairie-chicken populations, however, the full extent of collision mortality is not known and is difficult to measure.

Impacts of fragmentation are cumulative, and are often mediated by behavioral responses to whatever change is occurring on the land. A growing body of evidence suggests that prairie grouse actively avoid areas of human activity, noise, and proximity to vertical structures that may provide hunting perches for raptors, particularly during nesting (Robel et al. 2004). Data from several studies indicate that prairie grouse may avoid or nest at reduced rates in areas near roads, power lines, compressor stations, and inhabited dwellings (Braun et al. 2002, Lyon and Anderson 2003, Pitman 2003, Robel et al. 2004). Recent studies in Kansas showed that lesser prairie-chickens seldom nest or raise their broods within approximately 580 feet of oil or gas wellheads, 1,200 feet from electrical transmission lines, 2,600 feet of improved roads, and 4,000 feet from buildings (Robel et al. 2004, Pitman et al. 2005). The authors calculated that nesting avoidance at these distances would effectively eliminate a large percentage of available nesting habitat over a three-county area in southwestern Kansas. Thus, the presence of these features may result in lesser prairie-chicken abandonment of areas containing a high percentage of otherwise suitable habitat, effectively increasing the impact of these features far beyond their physical footprint.

Continued habitat loss and fragmentation may result in small, isolated prairie grouse populations at risk of losing genetic variation. Genetic diversity is necessary for a population to respond to environmental change, thus a loss of genetic variation may jeopardize the persistence of fragmented populations (Shaffer 1981). Populations that have undergone large decreases in population size are likely to lose genetic variation (Nei et al. 1975, Maruyama and Fuerst 1985). The level of fragmentation may influence demographic processes such as dispersal and, consequently, genetic interchange (Bellinger et al. 2003, Johnson et al. 2003, Bouzat and Johnson 2004, Johnson et al. 2004). Resistance to disease and the ability of populations to respond to environmental perturbations may also decrease with the loss of genetic variation (Lacy 1997). Thus, loss of genetic variation may negatively impact the long-term viability of prairie grouse populations across their range

Changing Land Uses

Change in land use refers to a change from wildlife habitat to another land use that represents a long-term or permanent change. Many authors cite conversion of native grasslands to areas of cultivation as an important factor in the decline of prairie grouse (Copelin 1963, Jackson and DeArment 1963, Crawford and Bolen 1976a, Crawford 1980, Taylor and Guthery 1980a, Braun et al. 1994). Landscapes in which more than 37% of native rangeland has been lost may be incapable of supporting lesser prairie-chickens, and populations have declined in areas with only 20% (Crawford and Bolen 1976a). In Kansas, lesser prairie-chickens avoided nesting within 300-400 yards of fields with center-pivot irrigation, effectively increasing the impact footprint of agricultural lands (Robel et al. 2004). Irrigated cropland has eliminated or fragmented a significant amount of sand sagebrush prairie within the range of the lesser prairie-chickens in Kansas (Jensen et al. 2000). However, since 1981 water conservation measures have limited the increase in center-pivot irrigation (Robb and Schroeder 2005b). Irrigation drawing on the Ogallala aquifer has resulted in extensive conversion of lesser prairie-chicken rangelands to croplands in Texas and Oklahoma, but this has not been considered a major factor in New Mexico (Leslie et al. 1999). In recent years, however, areas of lesser prairie-chicken habitat in Curry and Roosevelt counties have been converted to grow crops or forage for a rapidly growing dairy industry in eastern New Mexico (Melcher 2006).

Tree plantings, windbreaks, and woody encroachment by eastern red cedar (*Juniperus. virginiana*) and Osage orange (*Maclura pomifera*) further fragment remaining grasslands and create abrupt boundaries that can intensify edge effects. Additionally, the suppression of ecological processes (e.g., fire) has allowed an increase in woody encroachment into grassland habitats (Bidwell et al. 2003). Studies indicate grassland birds are sensitive to small increases (1-2%) in the amount of tree cover within landscapes and woody vegetation had a deleterious effect on prairie grouse occurrence, density, and/or nesting success (Berger and Baydack 1992, McKee et al. 1998, Merrill et al. 1999, Hanowski et al. 2000, Niemuth 2000, Fuhlendorf et al. 2002).

The development of the biofuels industry is being driven by diminishing supplies of fossil fuels, political instability in major fossil-fuel exporting countries, and by serious negative environmental consequences (e.g., global warming) associated with fossil fuel production and consumption. This development has the potential to produce both negative and positive effects on prairie grouse populations. Production of biofuels, particularly ethanol, could spur additional conversion of grassland to cropland throughout BCR 18 as grain prices rise in response to the additional demand created by this relatively new industry. Although cellulosic ethanol production could possibly result in some croplands being converted to biomass-producing grassland, there also exists a real possibility that the habitat quality of existing grasslands, especially CRP grasslands, could be compromised if management and harvest of these grasslands does not adequately consider prairie grouse needs and the needs of other wildlife.

BIRD CONSERVATION REGION 19
CENTRAL MIXED-GRASS PRAIRIE

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Description

The Central Mixed-Grass Prairie extends from the vast Nebraska Sandhills region in the north to the Central Rolling Red Plains of Texas in the south (Figure 10). This is a region with a significant east–west precipitation gradient with a resultant ecological transition between the semi-arid shortgrass prairies on the west to the comparatively moist tallgrass prairie region (now better known as the corn belt) on the east. While the prairies of the Nebraska Sandhills remain relatively intact, extensive areas in the remainder of this BCR have been converted to cropland. Soils vary widely, ranging from deep sands to-fine-textured Permian clays. Topographic features are also quite variable. These include, among others, the huge vegetated dunes of the Nebraska Sandhills, dendritic drainage patterns and limestone bedrock formations in the Smoky Hills of Kansas, rolling terrain and canyons in the Rolling Red Plains, as well as gently rolling to level regions in all four states.

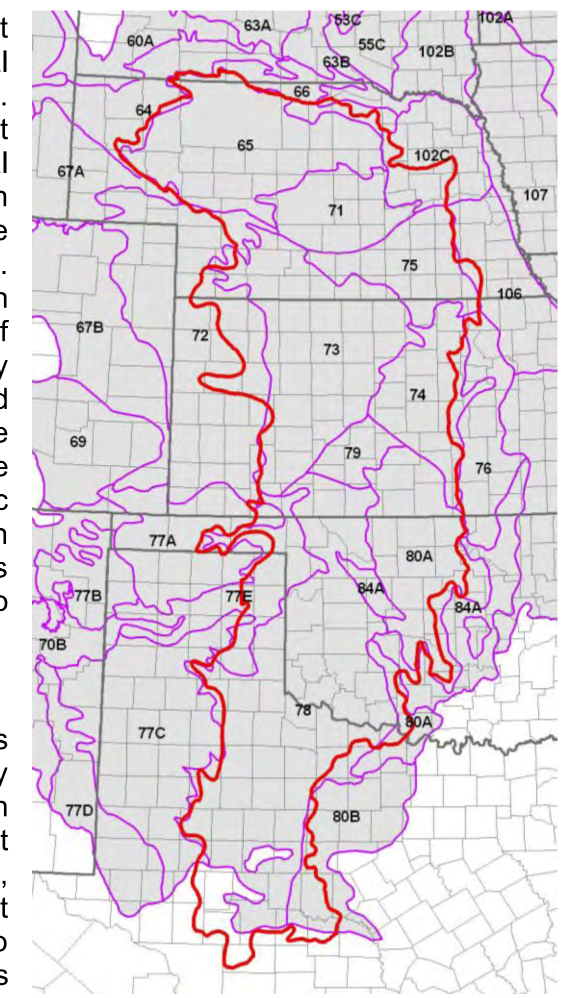

Figure 10. States, counties, and Major Land Resource Areas within BCR 19.

History of Prairie Grouse

The central mixed-grass prairies harbor three species of prairie grouse and the ranges of all three historically overlapped in the western Kansas and eastern Colorado. Sharp-tailed grouse were the predominant prairie grouse in northwestern portions of the region, greater prairie-chickens were most common in the east — from Nebraska through Kansas, Oklahoma, and into northeastern Texas — and lesser prairie-chickens were found in the southern sections of BCR 19 from western Kansas south into Texas. The habitats of all three of these species were influenced by fire and the grazing of the great bison herds, the interaction of which created a shifting pattern of heavily grazed and lightly-grazed areas that satisfied their various life requirements. This shifting habitat pattern and the wide variety of land forms and soil types present assured that prairie-grouse distributions were widespread, but unevenly across the landscapes of BCR 19.

Historic accounts suggest that populations of prairie grouse initially increased with the introduction of agriculture in what is now BCR 19, presumably due to the added food resources made available in the form of cultivated grains. This increase was short-lived, however, as the continued conversion of grassland to cropland far exceeded levels tolerated by prairie grouse. With the exception of the Nebraska Sandhills, agricultural conversion eventually eliminated 60–90% of the original grasslands within BCR19, depending upon location. Prairie grouse populations reached their lowest points during the 1930's when cropland conversion and severe drought combined to create intolerable conditions, particularly in the southern half of what is now BCR 19. Over the following 2–3 decades, prairie grouse numbers in the region gradually increased as some croplands were restored to grasslands and small improvements in grassland management practices through the mid-20th century. By the 1960's, extensive tapping of the Ogallala aquifer by new center-pivot technology resulted in much new conversion of remaining grasslands to irrigated croplands. This land use and the resumed breaking of grasslands for dryland agriculture again resulted in downward trends for prairie grouse populations in BCR 19. Additional losses of habitat resulted from continued poor grazing management in many areas and the encroachment of trees due to fire suppression on some remaining grasslands.

Since historic times, the range of sharp-tailed grouse has declined by an estimated 50–60%, the range of greater prairie-chickens has decreased about 60–70%, and the range of lesser prairie-chickens has diminished approximately 80–90% within BCR 19. Populations of lesser prairie-chickens are particularly fragmented, leaving them vulnerable in some areas to reduced productivity as a result of genetic isolation. Over the past 3 decades within BCR 19, sharp-tailed grouse have been stable to slightly declining and greater prairie-chicken populations have been stable to slightly increasing in Nebraska. Greater and lesser prairie-chickens have been stable to modestly increasing in Kansas, and lesser prairie-chickens have continued to decline in Oklahoma and Texas. Modest but significant increases in lesser prairie-chicken range in Kansas, and in the greater prairie-chicken range in parts of Kansas and Nebraska have been attributed to CRP. Lesser prairie-chicken populations in Oklahoma are declining and are stable to declining in the Texas portion of BCR 19. Lesser prairie-chickens in Oklahoma and Texas did not significantly respond to the CRP due to the widespread use of exotic monocultures in CRP stands in these states.

Ecosystem Diversity Assessment

Grassland diversity within BCR 19 has changed considerably since European settlement. South of the Nebraska Sandhills, much of the previously existing grassland has been converted to cropland. Where grasslands remain, the influence of fire has been drastically reduced and the historic grazing patterns of bison have been eliminated. Grazing patterns created by domestic livestock are somewhat variable among pastures as a result of differing stocking rates and grazing systems, but the annual variability in grazing intensity that existed with the bison herds no longer occurs. Exotic species have invaded many ecological sites, particularly including cheatgrass (*Bromous tectorum*) on fine-soil sites. Invasive trees, especially eastern red cedar (*Juniperus virginiana*) and mesquite (*Prosopsis glandulosa*), threaten the ecological integrity of many areas.

Acreage goals to address ecosystem diversity for the Central Mixed-Grass Prairie were generated using ecological site descriptions from the following MLRA's: Nebraska Sandhills (65), Dakota-Nebraska Eroded Tableland (66), Central Nebraska Loess Hills (71), Central High Tableland (72), Rolling Plains and Breaks (73), Central Kansas Sandstone (74), Central Loess Plains (75), Southern High Plains – Northern Part F(77A), Southern High Plains – Breaks (77E), Central Rolling Red Plains (78), Great Bend Sand Plains (79), Central Rolling Red Prairies (80A), North Cross Timbers (84A), and the Texas North-Central Prairies (80B).

A total of 11,217,531acres have been projected as a basic ecosystem restoration goal for BCR 19 (Table 9). This was done by comparing prairie grouse distribution and abundance with ecological site descriptions and historical disturbance regimes. In addition, priority ecological site classes were selected based on their relative potential to continue to sustain prairie grouse and/or their potential to be restored as prairie grouse habitats. With the exceptions of MLRA's 73 and 74, all the priority ecological sites in BCR 19 were dominated by sandy soils. Limy and Loamy sites were considered priority ecological sites in MLRA's 73 and 74 (Table 18).

Table 9. Basic grassland restoration targets and priority ecological site classes within Major Land Resource Areas (MLRA's) in the Central Mixed-Grass Prairie Bird Conservation Region 19 (BCR 19).

MLRA's	Representation (%)	Target (acres)	Priority Ecological Site Classes	Matrix Table
65,66	20	2,538,300	Sands, Loamy, Choppy Sands, Sandy	C-35
71,75	15	1,241,079	Sands/Sandy, Limy, Loamy, Clayey	C-36
72	20	713,474	Choppy Sands, Sands, Sandy, Limy, Loamy	C-37
73	15	1,972,894	Limy, Shallow Limy, Sands, Sandy, Loamy	C-38
74	15	740,449	Loamy, Limy, Clayey, Sandy, Choppy Sands	C-39
77A,77E	15	610,512	Sands, Sandy, Choppy Sands, Loamy, Clayey	C-40
78	10	2,232,599	Sandy, Sands/Choppy Sands, Loamy, Clayey	C-41
79,80A,84A	15	1,168,224	Choppy Sands, Sands, Sandy, Limy, Loamy	C-42
80B	0	0		C-43
	TOTAL ACRES	**11,217,531**		

*Priority ecological sites for grassland restoration are listed in descending order of importance.

In addition to the base grassland restoration targets noted above, highest-priority ecological sites (Table 10) and counties (Table11; Figure 11) have been selected based on their potential to enhance prairie grouse populations.

Kansas

In the Rolling Plains and Breaks (MLRA 73), targeted grassland conservation in Osborne and Russell counties on limy and shallow limy soils would benefit greater prairie-chickens, particularly in the form of removing/controlling invasive trees. Also within MLRA 73, improved rangeland and CRP stand management on limy and shallow limy soils in Hodgeman and Ness counties could significantly benefit lesser prairie-chickens. On loamy and limy soils in MLRA 74 (Ellsworth, Lincoln counties) grassland conservation focused on removing/controlling invasive trees would substantially benefit greater prairie-chickens. Removing/controlling invasive trees would also benefit lesser prairie-chickens in MLRA 78 (Clark, Comanche, Kiowa counties), particularly on various sandy ecological sites. Restoration of grasslands from irrigated agriculture where groundwater supplies are being depleted has great potential to benefit lesser prairie-chickens in MLRA 79 (Edwards, Kiowa counties) on various sandy sites.

Table 10. Preferred grassland restoration targets for high-priority ecological site classes within selected Resource Areas (MLRA's) in the Central Mixed-Grass Prairie Bird Conservation Region 19 (BCR 19).Major Land

MLRA's	Highest Priority Ecological Site Classes	Preferred Priority Ecological Site Representation	
		(%)	(acres)
71,75	Sands/Sandy	40	325,000
71,75	Limy	30	262,000
73	Limy	25	920,000
73	Shallow Limy	25	51,000
74	Loamy	30	600,000
74	Limy	30	106,000
77E	Sands	40	110,000
77E	Sandy	35	248,000
78	Sandy	30	1,365,000
78	Sands/Choppy Sands	30	287,000
79	Choppy Sands	40	34,000
79	Sands	40	178,000

Nebraska
In the Central Nebraska Loess Hills (MLRA 71), prairie grouse would benefit from planned grazing and burning systems that reduce the prevalence of exotic cool-season grasses and eastern red cedar in existing grasslands. In particular, Custer, Dawson, and Sherman counties should be targeted. Planned grazing and burning would also provide significant benefits to prairie-chickens in the Central Loess Plains (MLRA 75), particularly in Jefferson, Nuckolls, and Thayer counties. Also in MLRA 75, additional CRP stands in Clay, Fillmore, and Kearney counties would significantly benefit prairie-chickens that have responded to existing CRP stands.

Oklahoma
Within the Southern High Plains Breaks (MLRA 77E) and the Central Rolling Red Plains (MLRA 78), grassland conservation focused primarily on sandy soils in Beaver, Ellis, Harper, Roger Mills, Woods, and Woodward counties would substantially benefit lesser prairie-chickens. The highest priority conservation practice for this area should be removal and control of invasive trees (especially eastern red cedar) from grasslands. In those counties with significant shinnery oak shrublands, reduction in stature of the shinnery oak and oak motts through increased application of prescribed fire and/or herbicides is a pressing need. Conversion or replacement of existing Old World bluestem-dominated CRP stands with native-grass mixtures that include forbs would also significantly benefit lesser prairie-chickens in this area.

Table 11. Estimates of native rangeland and Conservation Reserve Program (CRP) grassland by state with priority areas to be targeted for grassland conservation within Bird Conservation Region 19 (BCR 19).

State	Rangeland (acres)	CRP (acres)	MLRA	Counties
Kansas	8,653,000	1,717,000	73	Hodgeman, Ness, Osborne, Russell
			74	Ellsworth, Lincoln
			78	Clark, Comanche, Kiowa
			79	Edwards, Kiowa
Nebraska	16,500,000	431,000	71	Custer, Dawson, Sherman
			75	Clay, Fillmore, Jefferson, Kearny, Nuckolls, Thayer
Oklahoma	9,300,000	840,000	77E	Beaver, Ellis, Harper, Roger Mills, Woodward
			78	Woods, Woodward
Texas	13,466,000	945,000	77E	Donley, Gray, Hemphill, Lipscomb
			78	Collingsworth, Wheeler

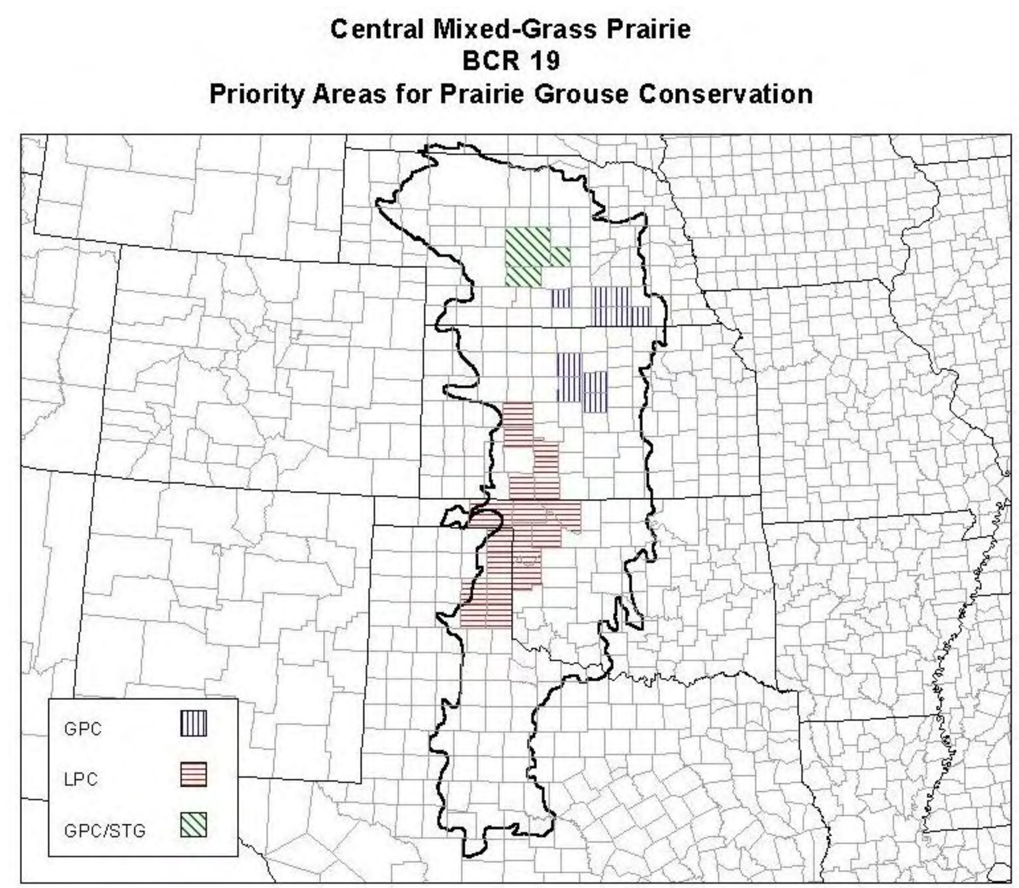

Figure 11. Counties of greatest conservation priority for prairie grouse in BCR 19.

Texas

Within the Southern High Plains Breaks (MLRA 77E) and the Central Rolling Red Plains (MLRA 78), grassland conservation focused primarily on sandy soils in Collingsworth, Donley, Gray, Hemphill, Lipscomb, and Wheeler counties would substantially benefit lesser prairie-chickens. The highest priority conservation practice for this area should be removal and control of invasive trees (eastern red cedar and mesquite) from grasslands. In those counties with significant shinnery oak shrublands, reduction in stature of the shinnery oak and oak motts through increased application of prescribed fire and/or herbicides is a pressing need. Conversion or replacement of existing Old World bluestem-dominated CRP stands with native-grass mixtures that include forbs would also significantly benefit lesser prairie-chickens in this area.

Threats to Prairie Grouse within BCR 19

Some threats to prairie grouse are ubiquitous throughout BCR 19. These include continued conversion of grasslands to croplands, fire suppression, improper grazing management, invasive exotic species, and human developments. These may be interrelated as is exemplified by the propensity for invasive species to degrade native grasslands once improper grazing and/or fire suppression occurs. Invasion of native grasslands by trees is probably the most serious form of this type of habitat degradation. Industrial-scale wind power development also threatens many grasslands throughout the region. Production of biofuels, particularly ethanol, could spur additional conversion of grassland to cropland throughout the BCR as grain prices rise in response to the additional demand created by this relatively new industry. Although cellulosic ethanol production could possibly result in some croplands being converted to biomass-producing grassland, there also exists a real possibility that the habitat quality of existing grasslands, especially CRP stands, could be compromised if management and harvest of these grasslands does not adequately consider prairie grouse needs and the needs of other wildlife.

Oil and gas development, particularly at high location densities, currently appears to pose the greatest threat in the southern third of BCR 19 where lesser prairie-chicken populations are present, but less-dense fossil fuel operations have the potential to diminish habitat quality at other sites in the BCR. Also in southern sections of BCR 19, genetic isolation of some populations of lesser prairie-chickens could diminish their potential productivity over time.

Threat Mitigation

No single program or effort can adequately counter-balance all the potential threats to prairie grouse in BCR 19. Generally, federal, state, and local programs should: 1) discourage conversion of grassland to cropland, 2) provide incentives for proper management of existing native grasslands, 3) prevent further tree invasion of remaining un-invaded prairies, 4) aggressively restore existing tree-invaded grasslands using combinations of mechanical, chemical, and prescribed burning treatments, 5) strengthen CRP, particularly including the conversion or replacement of Old World Bluestem stands with native mixtures, 6) focus programs on maintaining and creating large blocks or mosaics of grasslands of sufficient size and density to meet the needs of prairie grouse, 7) moderate energy development with a regulatory process that does not discount the needs of grassland wildlife, and 8) include strong education and monitoring programs which augment all of the above.

BIRD CONSERVATION REGION 22
EASTERN TALLGRASS PRAIRIE

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Description

The Eastern Tallgrass Prairie is the center of the greater prairie-chicken's historic range (Figure 12). At present, land use in the flat to gently rolling 'Corn Belt' is dominated by row crop agriculture, and is less than 5% native tallgrass prairie. Significant remnant patches of prairie remain in the western portions of the BCR. CRP, pasture, other agricultural grasslands, and conservation areas are important surrogate habitats for prairie wildlife in the region.

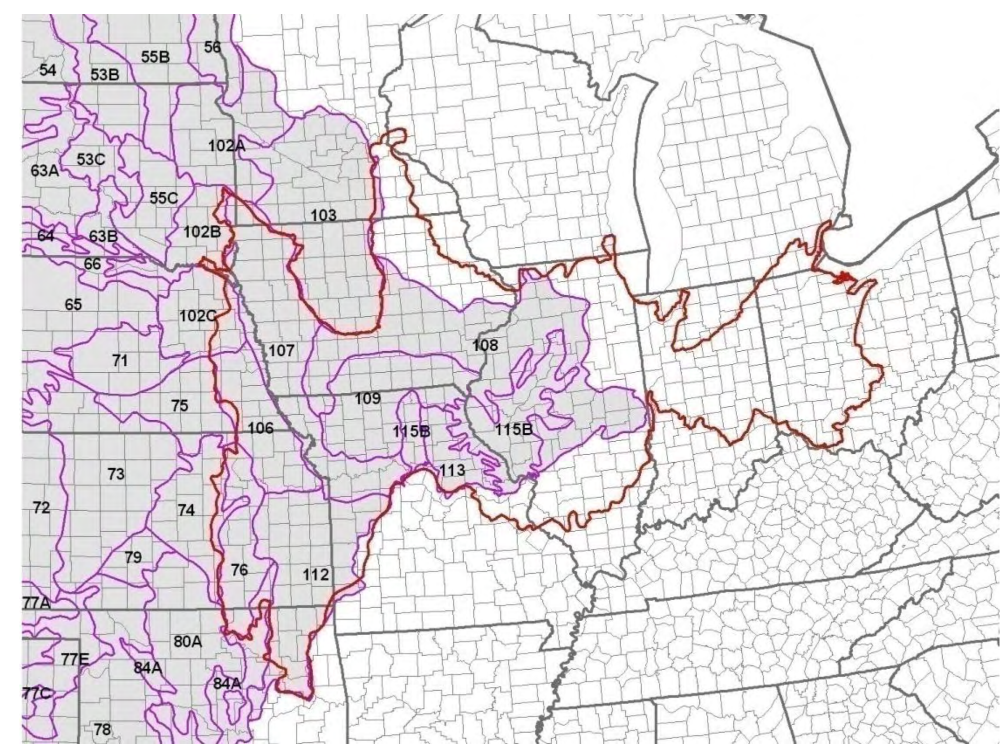

Figure 12. States, counties and Major Land Resource Areas within BCR 22.

History & Status of Prairie-Chickens

Greater prairie-chickens were historically abundant throughout the BCR, but have been extirpated from most areas. Small, isolated, endangered populations persist in south-central Illinois (200 birds), south-central Iowa (50 birds), and north-central and western Missouri (500 birds). The Flint Hills of east-central Kansas, on the western edge of BCR 22, remains a stronghold for the species, but even here prairie-chicken abundance has declined by about 30% over the past 20 years. Populations in eastern Nebraska have been stable or increasing, although prairie-chickens remain absent from a large portion of their historic range.

Loss of tallgrass prairie and suitable agricultural grasslands to intensive rowcrop production and development are overwhelmingly responsible for decimation of prairie-chicken populations in the BCR. Areas of native tallgrass prairie capable of supporting prairie-chickens remain only in eastern Kansas, southeastern Nebraska, and a few areas in Missouri. Prairie-chickens in Missouri, Iowa, and Illinois are highly dependent on grasslands managed specifically for the species. CRP grasslands, restored native warm-season grasses, and introduced cool-season grasses – when managed to provide appropriate vegetation structure– have proven effective substitutes for native prairie in conserving greater prairie-chickens.

Remaining prairies and CRP grasslands remain vulnerable to conversion in the BCR. Encroachment of woody vegetation is problematic throughout the BCR, as are invasive herbaceous plants [tall fescue (*Schedonorus phoenix*) and *Serecia lespedeza* are noteworthy]. Annual burning of large areas in the Flint Hills, eliminating suitable nesting cover, is likely a major contributor to prairie-chicken declines in that region. Especially among the eastern outpost populations, lack of connectivity has created demographic constraints, loss of genetic diversity and inbreeding depression among profoundly isolated populations. Infrastructure (roads, transmission lines, confined animal feeding operations and wind energy development) and exurban development are emerging factors that may further limit open landscapes suitable for greater prairie-chickens.

Ecosystem Diversity Assessment

Ecosystem diversity representation objectives, based upon using ecological site descriptions, were established for MLRAs in the western portion of the BCR (MLRA 76 Bluestem Hills, MLRA 106 Nebraska & Kansas Loess-Drift Hills, MLRA 112 Cherokee Prairie, and MLRA 74 Central Kansas Sandstone Hills; Table 12). The diversity of native prairies in these areas has been significantly altered by changes in natural disturbance regimes (fire, grazing), non-native invasive species, and other abuses. The ecosystem diversity representation approach is poorly-suited to the highly-altered regions of the BCR where less than 1% of tallgrass prairie remains, and remnant greater prairie-chicken populations are small and isolated. For these areas, Missouri, Iowa and Illinois have habitat objectives for specific areas that will establish connectivity and maintain viable greater prairie-chicken populations across the BCR (Tables 12, 13).

A total of 2,881,277 acres will achieve ecosystem diversity representation objectives in MLRAs in the western portions of BCR 22. Additionally, 75,000 acres in MLRAs 109 and 113 will ensure long-term viability of greater prairie-chicken populations in central and eastern portions of the BCR (Table 12). These are targeted for grassland restoration based on ecological site descriptions, representation levels of ecosystem diversity, and historical disturbance regimes. Refer to Appendix C for the appropriate Ecosystem Diversity Matrix to determine targeted conservation acres for specific region for prairie grouse conservation. These targets could be adjusted with more detailed analyses of historical conditions conducted within each MLRA, but they provide a working framework for strategic planning. Across BCR 22, all or portions of several counties in each state are high-priorities for grassland restoration, based on the current and historic abundance and distribution of prairie-chickens, and contemporary land uses (Table 13).

Table 12. Acreage targets for ecosystem diversity conservation from MLRA's within the Eastern Tallgrass Prairie BCR 22.

Land Cover Classification	Acres	Representation (%)	Appendix Matrix
MLRA 76	890,759	20	C-44
MLRA 106, 112	1,873,271	15	C-45
MLRA 74	117,247	15	C-46
MLRA 113-Illinois	35,000	N/A	N/A
MLRA 109-Iowa	32,000	N/A	N/A
MLRA 109-Missouri	8,000	N/A	N/A
Total	**2,956,277**		

Table 13. Counties within BCR 22 to be targeted for grassland conservation for greater prairie-chickens; not all portions of all counties are high-priorities.

State	MLRA	Counties with Priority Areas
Illinois	113	Clay, Clinton, Effingham, Fayette, Jasper, Marion, Perry, Richland, Washington
Iowa	109	Adair, Adams, Decatur, Ringgold, Union, Wayne
Kansas	76	Butler, Chase, Cowley, Elk, Geary, Greenwood, Lyon, Marion, Morris, Pottawatomie, Riley, Wabaunsee
	106	Jackson, Marshall, Nemaha
	112	Anderson, Coffey, Osage, Woodson
Nebraska	106	Gage, Johnson, Lancaster, Nemaha, Otoe, Pawnee, Richardson
Missouri	109	Adair, Harrison, Sullivan
	112	Barton, Benton, Cedar, Dade, Jasper, Lawrence, Pettis, St. Clair, Vernon

MLRA 76 Bluestem Hills - 20% representation

Also known as the Flint Hills region extending from northern Oklahoma across east-central Kansas, much of this area is native prairie that could support significantly more greater prairie-chickens with restoration and improved management. Key actions include moderating the annual fire regime; improved grazing practices; removing red cedar, Osage orange, honey locust (*Gleditsia triacanthos*) and other woody encroachment to re-establish open space; controlling *Serecia lespedeza*, and protecting open space from infrastructure and exurban development.

MLRA 106 Nebraska & Kansas Loess-Drift Hills and MLRA 112 Cherokee Prairie – 15% representation

This region encompasses southeastern Nebraska, eastern Kansas, and western Missouri, with a modest amount of remnant prairie and more extensive pasture and CRP grasslands. CRP acreage is particularly important in southeast Nebraska, where this habitat appears critical for maintaining the region's moderate to high greater prairie-chicken densities. Key actions will include securing and expanding the amount of grassland habitat available to scattered greater prairie-chicken populations, especially in areas that will re-establish connectivity; removing and controlling invasive woody vegetation; improving and maintaining grassland composition through control of tall fescue and other undesirable plants; and improved grazing practices.

MLRA 74 Central Kansas Sandstone Hills – 15% representation
Much of this MLRA lies within the Central Mixed-Grass Prairie (BCR 19). On loamy and limy soils in MLRA 74, grassland conservation focused on removing/controlling invasive trees would substantially benefit greater prairie-chickens.

Missouri
Six high-priority geographies are identified for focused grassland restoration and management; four of these geographies lie within MLRA 112, and two are within MLRA 109 (Figure 13). The Partners in Flight 'Grassland Bird Conservation Area' landscape model drives habitat goals in each of these geographies, with a minimum 2,000 acre core area, supported by at least 2,000 additional grassland acres in a 10,000+ acre landscape. Recovery objectives include establishing a total of nine PIF Model landscapes within these six geographies. Greater prairie-chicken recovery objectives include populations of no less than 200 birds in each area, and a statewide population of at least 3,000 birds. Key actions will include securing and expanding the amount of grassland habitat available to scattered greater prairie-chicken populations, especially in areas that will re-establish connectivity; removing and controlling invasive woody vegetation; improving and maintaining grassland composition through control of tall fescue and other undesirable plants; improved grazing practices; and translocations to provide immediate demographic relief and genetic diversity.

Iowa
Greater prairie-chickens exist on reconstructed prairie areas (state-owned), pastures, and CRP acres scattered in the Grand River Grassland Area within MLRA 109. Greater prairie-chicken recovery numbers of at least 2,000 birds and establishing connectivity with Missouri populations are goals. Key actions include tree removal, fescue pasture conversion, improving grazing practices, translocating birds to improve genetic viability, and acquiring more public ground.

Illinois
Greater prairie-chicken conservation is currently limited to portions of MLRA 113 Central Claypan, where populations persist in two grassland bird conservation areas (Figure 13). A total of five grassland bird conservation areas, each with at least 5,000 acres of secure grassland habitat, and linked by smaller satellite areas with at least 500 acres of grassland, are necessary for long-term viability and the recovery objective of 5,000 birds. Key actions will include expanding the amount of grassland habitat available, especially in areas that will re-establish connectivity; improving and maintaining grassland composition through control of tall fescue and other undesirable plants; and translocations to establish additional populations. Effectively using Farm Bill programs to establish suitable habitat in appropriate locations, either with new programs (e.g., State Acres for Wildlife Enhancement) or modifications of existing programs (e.g., CRP), will be essential for success.

Five- & Ten-Year Benchmarks With Cost Estimates

Nebraska
Within 5 years: 1) secure funding necessary to extend contracts on >50,000 acres of current CRP grasslands in Johnson, Pawnee, and western Gage counties for at least the next 10 years; this will cost an estimated $75/acre/year ($3.75 million per year, or $37.5 million over 10 years), 2) establish agreements with landowners to improve 20,000 acres of rangeland (preferred) or pasture in these counties through planned grazing, burning, and woody plant removal; this may cost between $0.5 and $3 million.

Within 10 years: 1) secure funding necessary to create or extend contracts on >100,000 acres of new or current CRP grasslands in Lancaster, Otoe, Nemaha, and Richardson counties for at least the next 10 years; this will cost an estimated $90/acre/year ($9 million per year, or $90 million over 10 years), 2) establish agreements with landowners to improve 40,000 acres of rangeland (preferred) or pasture in these counties through planned grazing, burning, and woody plant removal; this may cost between $1 and $6 million.

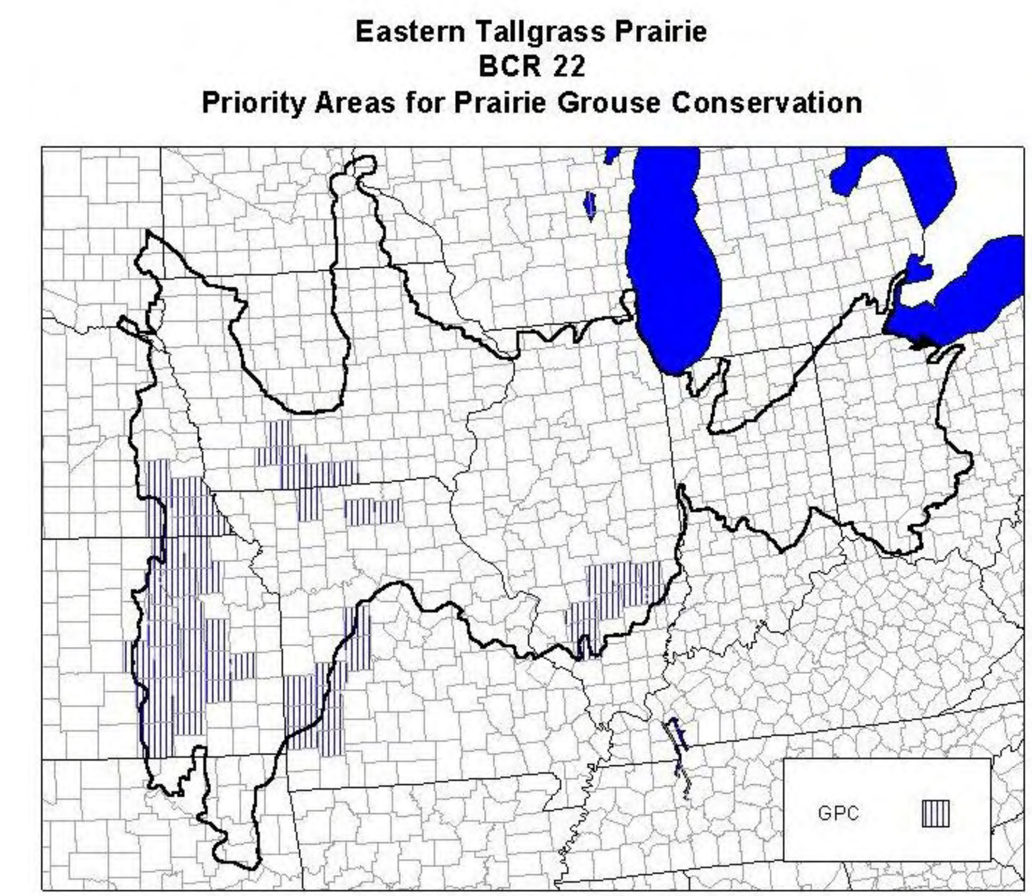

Figure 13. Counties of greatest conservation priority for prairie grouse in BCR 22

Kansas

Within 5 years: 1) establish 5 crews of 3-4 workers each to remove and control invasive trees on prairie areas in the eastern third of the state. These crews should be fully trained and equipped to conduct tree removal and controlled burning at minimal expense (25% landowner cost share) to the landowner or land manager; 2) discourage annual burning in the Flint Hills through educational efforts that promote rotational burning; 3) establishing patch burning / patch grazing demonstration pastures on at least 12 different ranches in the eastern third of the state; 4) establish conservation easements prohibiting non-ranching developments on at least 200,000 acres of tallgrass prairie in the eastern third of the state. Estimated cost (years 1-5) is $52 million.

Within 10 years: 1) continue funding of the 5 crews noted above and, if their previous work has proven insufficient to make necessary gains toward full reclamation of tree-invaded native prairies in the region, increase the number of established crews; 2) continue working toward more ecologically-sound rotational burning systems and expand patch burning/patch grazing to at least 100 ranches in the eastern third of the state; 3) continue establishing conservation easements that prohibit non-ranching development with a cumulative goal of 400,000 acres. Estimated cost (years 5-10) is $54 million.

Missouri

Within 5 years: 1) improve habitat on protected and private lands needed to establish Partners in Flight 'Grassland Bird Conservation Area' landscapes in four (two pairs of closely associated) priority geographies; 2) establish connectivity among remnant populations within closely associated (paired) priority geographies; 3) continue present levels of beneficial public grassland management and increase proactive efforts on private lands within the remaining four priority geographies; 4) translocate 500 birds to one priority geography and closely monitor dispersal and habitat preference among translocated and resident birds to inform future land protection and management objectives; 5) establish new partnerships and programs that provide legitimate program- and market-based incentives for landowners to adopt beneficial land management practices. Estimated cost (years 1-5) is $10.6 million.

Within 10 years: 1) evaluate the effectiveness of establishing Partners in Flight 'Grassland Bird Conservation Area' landscapes to recover isolated greater prairie-chicken populations in highly fragmented landscapes; 2) based on results of that evaluation, focus appropriate land treatment and translocation objectives in the remaining four priority landscapes. Estimated cost (years 5-10) is $15+ million.

Iowa

Within five years: 1) improve pastures through fescue conversion, improved grazing practices, and tree removal; 2) establish grazing management programs that are beneficial for greater prairie-chickens and private land owners; 3) establish connectivity with greater prairie-chicken populations of Missouri; 4) acquire public ground for grassland management and 5) stock additional birds to improve genetic viability. Estimated cost (years 1-5) is $16 million.

Within 10 years: evaluate the effectiveness of grassland habitat work and private land farm programs. Focus future work from the evaluation to continue grassland management work. Estimated cost (years 6-10) is $16 million.

Illinois

Within 5 years: 1) provide 5,000 acres of additional grassland habitat for the remnant greater prairie-chicken flocks (completing reserve design); 2) establish connectivity among the remnant flocks with at least 1,500 acres of grassland among at least 3 satellite locations; and 3) improve 1,000 acres of agricultural lands in project areas (e.g., fescue conversion, renovating linear woody vegetation, fallow and field border practices). Estimated cost (years 1-5) to achieve these objectives is $18.5 million.

Within 10 years: 1) Establish through translocations a third greater prairie-chicken population in a focus area if natural colonization has not occurred; 2) establish and enhance connectivity among all greater prairie-chicken populations with at least 5,000 acres of grassland among additional management landscapes and satellite areas; and 3) improve 5,000 acres of agricultural lands in project areas (e.g., fescue conversion, renovating linear woody vegetation, fallow and field border practices). Estimated cost (years 6-10) to achieve these objectives is $19.5 million.

BIRD CONSERVATION REGION 23
PRAIRIE HARDWOOD TRANSITION

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Minnesota Department of Natural Resources
Steve Merchant
Minnesota Department of Natural Resources
Scott Hull
Wisconsin Department of Natural Resources

Description

Prairies dominated this region in the west and south and beech (*Fagus* spp.)-maple (*Acer* spp.) forest in the north and east, separated by an oak savannah (Figure 14). There are still remnant populations of greater prairie-chicken and to a much lesser degree sharp-tailed grouse in grasslands and brushlands. Glaciation has resulted in numerous pothole-type wetlands and shallow lakes, and the Great Lakes support coastal estuaries and are the destinations of much river flowage.

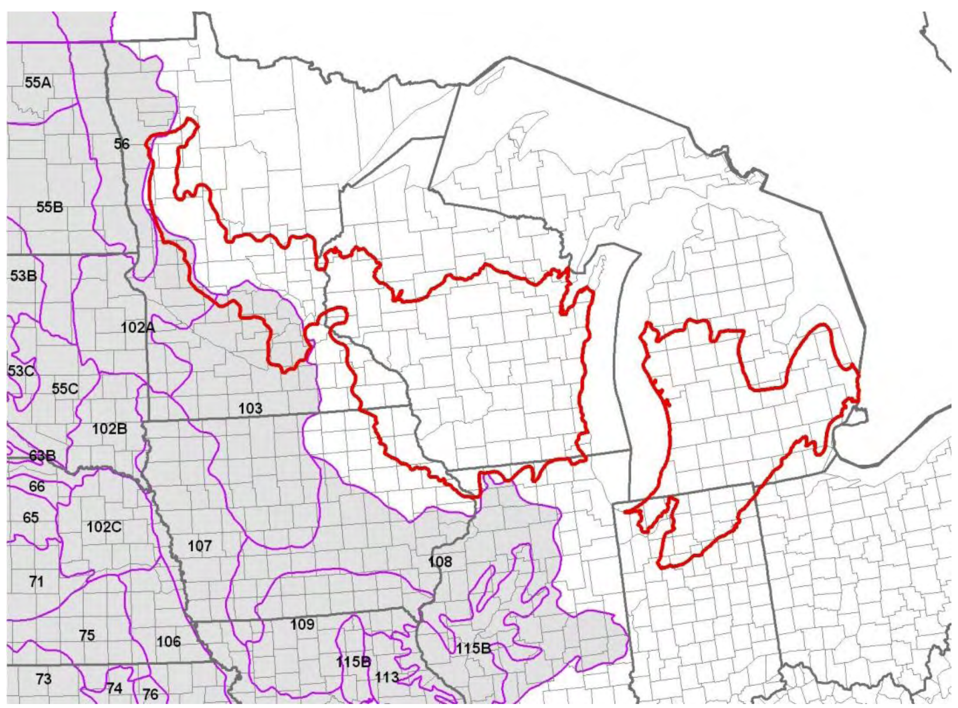

Figure 14. States, counties and Major Land Resource Areas within BCR 23.

History of Prairie Grouse:

There is some dispute as to the history of greater prairie-chickens in Minnesota prior to European settlement. Some claim that they were present only in the extreme southern portion of the state however that would leave a large area of grassland unoccupied by a grouse species, which does not make intuitive sense. It is likely that they occurred at low density and were semi-migrational at the northern portions of BCR 23 due to weather extremes. As the landscape was converted to small grain agriculture and forests were harvested then burned, greater prairie-chickens moved north and west and eventually occurred in great numbers through out BCR 23 by the 1880's. In fact, at the time of their maximum range expansion they were pushing into the margins of the boreal forest in the northeastern Minnesota. However as agriculture intensified and forest stands rejuvenated there was a steady decline in the chicken population with a resulting contraction in the range throughout the BCR until today there are few leks within the Minnesota portion of the BCR, other than those along the border with BCR 11 and one small isolated population in central Wisconsin (Figure 15). Greater prairie-chickens are a threatened species in Wisconsin. Wisconsin and Minnesota are currently working on a cooperative project to translocate prairie-chickens from western Minnesota to central Wisconsin to restore the genetic diversity of that population.

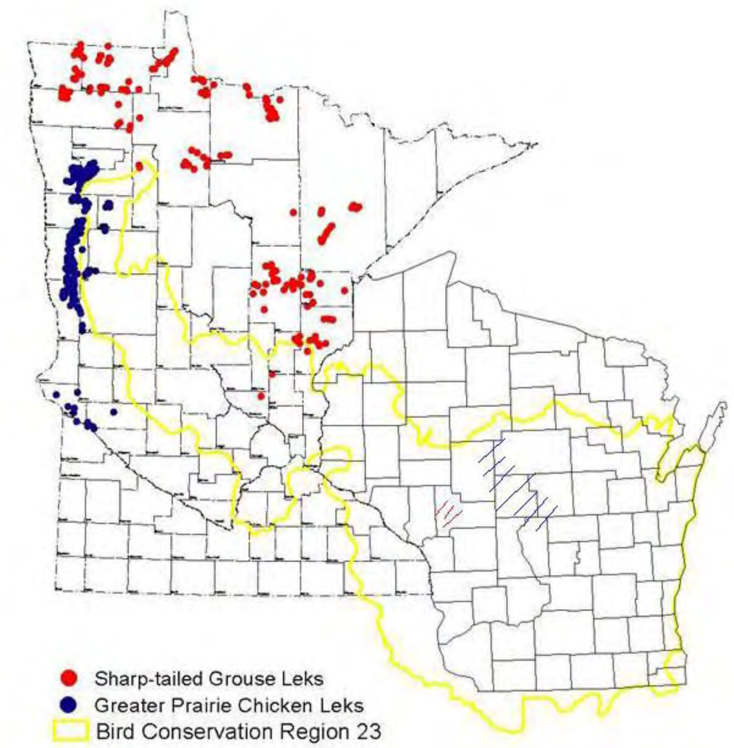

Figure 15. Prairie-chicken and sharp-tailed grouse range Minnesota and Wisconsin.

Prior to European settlement sharp-tailed grouse likely occurred throughout much of BCR 23 although their distribution was likely associated with major transient forest disturbance beyond core areas of prairies, savannas, and former glacial lake bed "bogs. Currently, there are a handful of known sharp-tailed grouse leks in the extreme northern portion of the BCR, again along the immediate border with BCR 11. In addition, sharp-tailed grouse populations occur in the Northwest Sands region of Wisconsin and extend northward into BCR 12. There is also a very small isolated population of sharp-tailed grouse in Jackson County, Wisconsin. In east central Minnesota, the population that was created much in the same way as the prairie-chicken population, via agricultural expansion and logging, has now receded to the former glacial lake beds immediately across the boundary into the Boreal Hardwood Transition BCR.

Habitat Assessment

NOTE: The MN portion of BCR 23 is roughly analogous to Minnesota's Eastern Broadleaf Forest Province, which we have used for much of the following analysis.

The Eastern Broadleaf Forest Province is a transition zone between the prairies to the west and the mixed coniferous-deciduous forest to the northeast. The province can be visualized as a belt that passes diagonally across Minnesota from the southeastern forests through the prairie-coniferous transitional zone to the Tallgrass Aspen Parklands in the northwest. The deciduous woods are a species-rich extension of the eastern United States deciduous forest, and numerous plant and animal species occur here at the very western edge of their range. Topography varies from level plains to the very steep blufflands that border the Mississippi River. Major landforms include lake plains, outwash plains, end moraines, ground moraines, and drumlin fields.

During Minnesota's last glacial period, the ice sheet sculpted portions of this geologically unique landscape but missed the "driftless" portion in southeastern Minnesota, northeastern Iowa, and southwestern Wisconsin. This area features caves, ravines, and sinkholes, and clear, spring-fed trout streams course through the steep and hilly countryside rich with plant and animal life. In the Twin Cities area, channels of preglacial rivers cut through rock formations, which later filled with glacial till. Once the till settled, the chains of lakes that now meander through the cities formed in the depressions.

Row crop agriculture is one of the major land uses in this province, approximately 50% of the province is in row crops while another 20% is in pasture. Many wetlands are scattered throughout this province, providing significant opportunities for wildlife recreation. This province is home to the majority of Minnesotans. The urban and suburban areas of the Twin Cities and other regional centers like St. Cloud and Rochester continue to expand, although not quite as rapidly as in the 1990s. The bulk of Minnesota's population lives in this BCR although only 5% of the total landscape is developed.

Grassland diversity within BCR 23 has changed considerably due to influences of European settlement. Fires have been reduced or eliminated as disturbances in most areas. Substantial acres have been converted to crops, urban, and exurban development. Numerous species of exotic plants have invaded. All of these have caused dramatic changes to the ecosystem diversity that once existed. Many open landscapes have succeeded from grassland or brushland to early to mid-successional woodland. Reforestation is occurring throughout much of BCR 23 as the forest industry is important to the economy of Minnesota and Wisconsin to the detriment of prairie grouse. Forests account for 12% of this province.

Threat Assessment unique to BCR 23

Development

BCR 23 is under significant land development threats from both urban/suburban development as well as recreational development. Some of the fastest growing counties in the nation are in BCR 23. Additionally the northern portions of BCR 23 are undergoing significant recreational development. This has resulted in parcelization, fire suppression, diminished ability to manage on a large parcel or landscape level and conversion of previously open landscapes such as pasture and agricultural lands into recreational properties. The recent economic slowdown has only marginally affected this.

Reforestation

Reforestation has been occurring throughout BCR 23 either naturally through forest succession, via fire suppression or through direct reforestation.

Genetic Isolation

Minnesota's BCR 23 greater prairie-chicken population is connected with the BCR 11 population and for the time being is not genetically threatened; although it is on the geographic margins and may become isolated over time. Wisconsin's Buena Vista population, however, has already shown signs of genetic isolation and degradation. In 2006, Minnesota and Wisconsin began a cooperative project to translocate up to 40 greater prairie-chickens per year from western Minnesota to Wisconsin to restore genetic diversity. Minnesota's sharp-tailed grouse seem not be genetically isolated; however, preliminary genetic studies in Wisconsin have found that Wisconsin's remaining populations of sharp-tailed grouse are becoming more and more isolated from one another. Additional genetic analysis is ongoing.

Grassland Habitat Loss and Fragmentation

Loss of grassland habitat and subsequent fragmentation continues to be an issue throughout BCR 23, especially for greater prairie-chickens. USDA conservation programs over the last 20-years have provided critical habitat for prairie-chickens, especially in Minnesota. Recent expansion of the ethanol industry and resulting increases in the amount of land in corn production could reverse the grassland habitat gains seen in the last 20 years (Table 14).

Table 14. Land use change in BCR 23 from the 1970's to the 1990's.

	Key Habitat	1970s % of subsection	1990s % of subsection
Anoka Sand Plain (1,199,711 acres).	Prairie	10.4	0
	Oak Savanna	53.8	0.7
	Grassland		17.6
	Non-forested wetland	12.7	4.5
	Shrubland	4.7	6.2
Hardwood Hills (3, 496,869 acres)	Prairie	6.5	0
	Oak Savanna/brush prairie	22.2	2.0
	Grassland		20.9
	Non-forested wetland	4.9	5.8
	Shrubland	5.5	3.1
Cental Sand Plains (WI) (2,187,100 acres)	Grassland	N/A	12
	Non-forested wetland	N/A	13
	Shrubland	N/A	1
Forest Transition (WI) (4,657,400 acres)	Grassland	N/A	14
	Non-forested wetland	N/A	6
	Shrubland	N/A	<1

Landscape Conservation Priorities

Minnesota

Eastern Broadleaf Forest Province in Minnesota is composed of seven subsections, and only two of these, the Anoka Sand Plain and the Hardwood Hills have recently been occupied by prairie grouse in Minnesota. The Anoka Sand plain is of minor conservation importance for prairie grouse, although it is an important subsection for other open landscape dependent species. Two sharp-tailed grouse leks have occurred here in the recent past, however both likely resulted from a failed translocation project at Sherburne National Wildlife Refuge.

A broad, flat, sandy lake plain dominates the majority of the Anoka Sand Plain area and forms the eastern and northern boundaries. Historically, the predominant vegetation was oak savanna and upland prairies surrounded by varied wetland complexes. This subsection stretches across the northern Twin Cities metropolitan area, including St. Cloud to the west and North Branch to the east, and has the second fastest-growing population in the state. Urban development and agriculture (primarily sod and vegetable crops), which occurs in about one-third of the subsection, has resulted in the loss of prairie and savanna and drainage of peatlands. The primary threats in this area are housing and recreational land development and associated parcelization, brushland succession, and invasive species.

There are currently 28 greater prairie-chicken leks in the extreme northwestern portion of the Hardwood Hills Subsection, while there are likely a few sharp-tailed grouse leks present also. Thus portions of this subsection are of conservation importance to prairie grouse. As mentioned previously, these birds are closely associated with the more extensive grasslands of BCR 11.

The Hardwood Hills Subsection runs through the heart of the Mississippi River flyway and central Minnesota. The Continental Divide splits this subsection; rivers to the north flow to Hudson Bay, and rivers to the south, to the Mississippi. The subsection contains numerous lakes, more than 400 greater than 160 acres and many smaller lakes. Wetlands, prairie potholes, and kettle lakes exist throughout the area. Before settlement by people of European descent, vegetation included maple-basswood (*Tilia americana*) forests interspersed with oak savanna, tallgrass prairie, and oak forest.

Currently much of this subsection is farmed. While many wetlands have been drained, many potholes remain and provide habitat for waterfowl and shorebirds. Important areas of forest and prairie exist throughout the subsection, but they are small and fragmented. About 15% of the subsection is forested. Other significant land uses are tourism and outdoor recreation, especially around lakes. Increased lakeshore development and wetland loss are conservation concerns in this subsection.

Wisconsin

Wisconsin's entire greater prairie-chicken population (about 68 leks) exists primarily in the Central Sand Plains and Forest Transition Ecological Landscapes. The Central Sand Plains is a vast sandy plain that was once the bed of glacial lake Wisconsin. Oak, aspen and pine (*Pinus* spp.) forests are the predominant cover types in this region. The Forest Transition Ecological Landscape is a mix of wet-mesic forests, grassland/wetland complexes and active agriculture. Priorities for greater prairie-chickens in Wisconsin are mostly within the Central Wisconsin Grassland Conservation Area (CWGCA). The CWGCA stretches in an “S” shape from southeastern Taylor County, through parts of Clark and Marathon Counties, between Stevens Point of Portage County and Wisconsin Rapids of Wood County, and south to northeastern Adams County. Within the CWGCA, the greater prairie-chicken is listed as a state threatened species and exists as a relatively small statewide population (<1,500) separated into four nearly isolated populations.

Wisconsin’s sharp-tailed grouse population primarily exists outside of BCR 23. However, there is a very small isolated population (<5 leks) in west-central Wisconsin that falls within the Central Sand Plains and Forest Transition Ecological Landscapes.

Five- and Ten-Year Benchmarks With Cost Estimates

Wisconsin

Within 5 years in the CWGCA: 1) Restore genetic diversity by translocating birds from Minnesota, 2) establish more permanent grassland habitat, up to 7,500 acres (15,000 within 10 years), primarily through acquisition and easements, and 3) establish up to 5,000 additional acres (10,000 within 10 years) of grassland habitat through Wisconsin’s CREP-grassland program and through other existing USDA Farm Bill conservation programs (CRP-SAFE, WRP, GRP).

Within 10 years in the CWGCA: 1) Continue land acquisition and easement programs, 2) continue Farm Bill conservation programs, 3) maintain a predominantly open, unforested, undeveloped landscape where agriculture is the dominant land use, and 4) collaborate with interested local governments and recreation providers, to provide limited, low-impact outdoor recreation opportunities compatible with grassland management. Estimated cost to protect up to 15,000 acres over the next years are estimated to be approximately $20,000,000 to $30,000,000 ($2 to $3 million/year). Management costs for the newly acquired land would be approximately $500,000 to $750,000 ($50,000-$75,000/year).

BCR 23 Summary

BCR 23 is not a top priority for prairie grouse conservation nationally however there are locally significant greater prairie-chicken and sharp-tailed grouse populations, particularly in Wisconsin. These populations face threats that most prairie grouse populations probably do not, such as genetic isolation and severely diminished habitat. There will be a significant amount of effort required to maintain and enhance these populations to keep them viable for the long term.

ADDITIONAL BIRD CONSERVATION REGION GOALS

The following BCRs have not been specifically described by biologists with respect to grassland conservation goals for specific prairie grouse species, but do have specific acreage goals concerning ecosystem diversity targets for each BCR. These BCRs are in the Great Plains ecoregion considered for this planning effort. The acreage goals and percent representation by Major Land and Resource Area for each BCR are presented in the following tables.

BIRD CONSERVATION REGION 12

BOREAL HARDWOOD TRANSITION

Garth Ball (Manitoba) and Al Stewart (Michigan)

There are no representation acres for BCR 12.

BIRD CONSERVATION REGION 10

NORTHERN ROCKIES

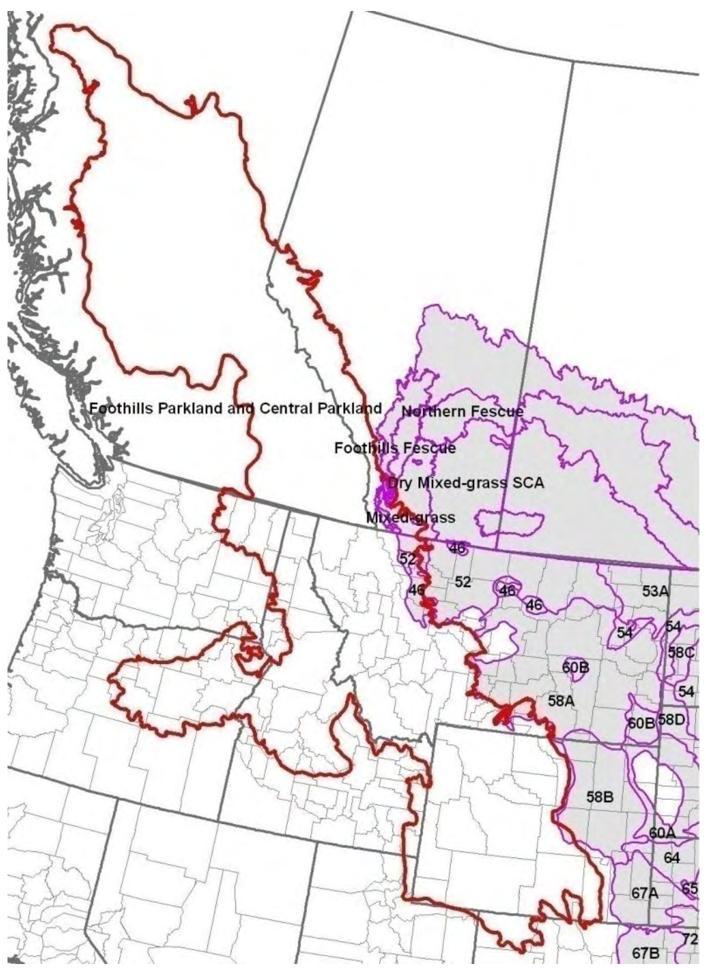

Figure 16. States, provinces, counties, Major Land Resource Areas, and Soil Correlation Areas within BCR 10.

Table 15. Acreage targets for ecosystem diversity conservation from MLRA's and within the U.S. and Canada portion of Northern Rockies BCR 10.

Land Cover Classification	Acres	% Representation	Appendix Matrix
United States			
MLRA 46	256,115	15	C-47
Canada			
Foothills Fescue	156,635	15	C-48
Park	60,657	15	C-49
Total	**473,407**		

BIRD CONSERVATION REGION 16

SOUTHERN ROCKIES/COLORADO PLATEAU

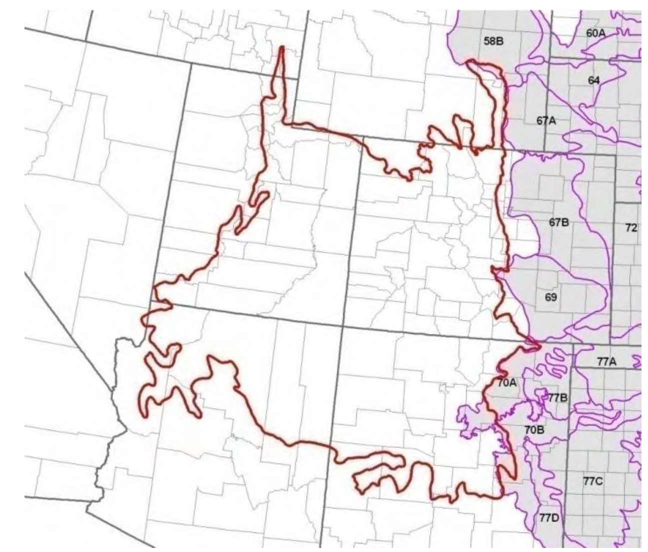

Figure 17- States, counties, and Major Land Resource Areas within BCR 16.

Table 16. Acreage targets for ecosystem diversity conservation from MLRA's within the Southern Rockies/Colorado Plateau BCR 16.

Land Cover Classification	Acres	Representation (%)	Appendix Matrix
MLRA 70A	84,611	10	C-50
MLRA 70B	820,589	15	C-51
Total	**905,200**		

BIRD CONSERVATION REGION 21
OAKS AND PRAIRIES

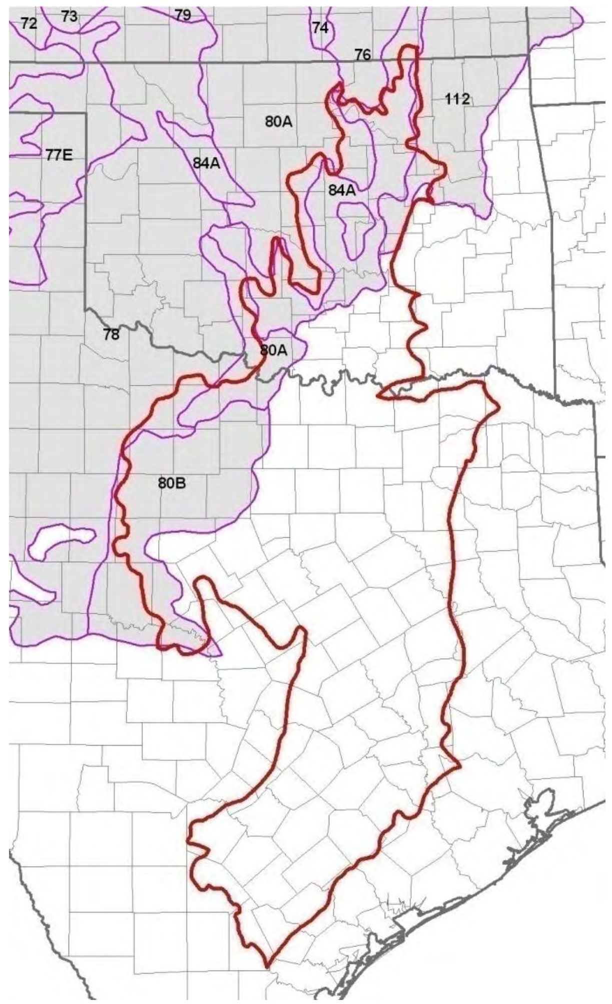

Figure 18. States, counties, and Major Land Resource Areas within BCR 21.

Table 17. Acreage targets for ecosystem diversity conservation from MLRA's within the Oaks and Prairies BCR 21.

Land Cover Classification	Acres	Representation (%)	Appendix Matrix
MLRA 79, 80A, 84A	680,428	15	C-52
MLRA 80B	*	0	C-53
Total	**680,428**		

* Prairie grouse did not historically occur in MLRA 80B.

IMPLEMENTATION STRATEGIES OF THE GRASSLAND CONSERVATION PLAN FOR PRAIRIE GROUSE

The purpose of this plan is to focus resources and actions from multiple entities on areas that are key to the recovery and conservation of habitats essential to prairie grouse and allied grassland species. The plan's basis, focusing at three scales (Bird Conservation Regions, States and Provinces, and MLRAs and Soil Correlation Areas) affords a landscape-level perspective for implementation strategies. Achieving success will require a concerted effort by federal, state and provincial agencies as well as private organizations to fully evaluate current habitat conditions, prioritize specific conservation actions, develop financial and information partnerships, secure implementation funding (in concert with NAGP and other partners), and monitor and evaluate the changing status of prairie grouse and other grassland species. The broad strategies provided below provide a framework for more specific strategies and actions that reflect priorities of the various geographies and species represented in the plan.

Strategy A: Develop necessary partnerships and coalitions for step-down planning and implementation.

Action step 1: Identify and coalesce partners within each state/province that are positioned to provide resources and expertise for conserving high-priority habitats; include federal land management and conservation agencies (USFWS, USFS, NRCS, USNPS, BLM); state wildlife, natural resources, and agriculture agencies; county and local conservation and land management agencies; and non-government organizations, especially those that directly influence large landscapes.

Action step 2: Develop and/or maintain an interagency/organization team for each prairie grouse species for preparing area-specific step-down implementation and action plans.

Action step 3: Develop and/or maintain involvement with All Bird Initiatives (ABI), Joint Ventures, Partners in Flight, and others; seek common goals, compatible funding strategies, and shared expertise and data bases.

Action step 4: Develop partnerships with agricultural organizations and other land-use stakeholders, in order to identify common goals and interests, and address potential conflicts and funding sources.

Action step 5: In cooperation with all partner and stakeholder entities, develop funding strategies for plan implementation.

Action step 6: Develop partnerships that will facilitate generation of comprehensive data layers that illustrate where grouse habitat projects are being planned or conducted in order to increase leveraging of resources and improve targeting of conservation initiatives (state natural heritage organizations, universities, etc.).

Strategy B: Secure funding for full implementation of the grasslands components of the North American Grouse Management Plan.

Action step 1: Fully fund the grassland components of the North American Grouse Management Plan; develop and implement a step-down action plan for generating state and federal support necessary to complete range-wide restoration and conservation of identified habitats for prairie grouse and allied grassland species (separate from Farm Bill program funds) on public and private lands; utilize state coalitions and a national steering group; ensure coordination of federal and state legislative communication; consult with other non-government organizations' staff in developing a funding platform and strategies; consult federal land management agencies regarding budget needs and associated support.

Action step 2: Cooperate with AFWA and the broader Farm Bill conservation coalition to develop strategies to focus Farm Bill funds, programs, and practices on habitat goals for prairie grouse and allied species; prioritize funding in programs, and implement practices to achieve stated objectives.

Action step 3: Develop strategies to focus other private lands programs on key habitat needs, including state and federal wildlife agency private lands programs and non-government organization programs.

Strategy C: Develop and implement monitoring programs and protocols to ensure that greater prairie-chicken, lesser prairie-chicken, and sharp-tailed grouse numbers and distribution, and associated trends, are fully described and understood across their North American ranges.

Action step 1: Synthesize current survey methodologies, and evaluate effectiveness, compatibility with other data sets, and scientific rigor.

Action step 2: Monitor population and distribution trends across state and provincial boundaries, using standardized protocols.

Action step 3: Evaluate the feasibility of the creation of a centralized database for lek location coordinates and use history; ensure that data management protocols respect confidentiality and data-ownership concerns.

Action step 4: Conduct continuous monitoring and evaluation of priority areas to accurately assess habitat conditions and population responses of prairie grouse and identified allied species.

Strategy D: Inventory and monitor current habitat conditions at finer scales to develop more accurate assessments of ecosystem diversity and prairie grouse habitat conditions.

Action step 1: Coordinate with current experts to determine best practices, needs for standardization, and methods to acquire better information on current ecosystem conditions, especially those that involve remote sensing and other uses of available technologies.

Action step 2: Measure and document quantities and distribution of current ecosystem conditions that meet desired ecosystem criteria.

Action step 3: Document, and prioritize for action, those areas where habitat is degraded, but still in a condition that facilitates recovery.

Action step 4: Document and prioritize areas that are in need of restoration and recovery for the purpose of abating habitat fragmentation and restoring genetic connectivity of populations.

Strategy E: Provide outreach, education, information transfer, and technical assistance to landowners and associated stakeholders.

Action step 1: Develop a formal network to provide information on best-practices, research, and other issues to all partners and stakeholders in conservation of prairie grouse and allied grassland species.

Action step 2: Provide information, education, and technical assistance on ecosystem conservation and restoration and prairie grouse conservation through various outreach mechanisms (popular and technical articles, brochures, videos, workshops, etc.).

Action step 3: Cooperate with partners who offer appropriate technical expertise in order to identify and prioritize research and monitoring needs; seek funding for implementation.

Action step 4: Provide workshops and other outreach for landowners and other stakeholders to promote concepts and actions for conserving landscape-level habitats for prairie grouse and allied species.

Action step 5: Develop specific actions to utilize existing communications and educational programs of NGOs and government agencies to promote conservation of large landscapes for prairie grouse and allied species; address funding needs in communications.

Strategy F: Foster research to address information gaps that impede landscape-level habitat management for prairie grouse and other grassland birds.

Action step 1: Create consensus among conservation partners that research projects for prairie grouse and associated species are critically needed; identify and prioritize immediate needs and direct to appropriate universities and other sources of expertise; identify and pursue necessary funding.

Action step 2: Identify top-priority gaps in expertise and information that presently impede landscape-level management of prairie grouse and other grassland species.

Action step 3: Develop and implement adaptive management frameworks for ecosystem restoration and prairie grouse management; consider trends in grouse populations, land-use, habitat conditions, climatological changes, weather patterns, and large-scale land conservation programs.

Action step 4: Foster and participate in regular and formal inter-agency/organization synthesis of research and monitoring results.

APPENDIX A. DESCRIPTION OF GRASSLAND DIVERSITY FOR THE GREAT PLAINS OF NORTH AMERICA.

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INTRODUCTION

The North American Great Plains is a floristically diverse, highly complex region that was historically influenced by a multitude of factors. These factors included fires that burned frequently across much of the Plains, grazing by large and abundant herbivores, especially bison (*Bos bison*), and varying weather patterns. These historical factors, coupled with the influences of Native Americans, shaped the plant and animal communities that evolved and adapted to occur in the Great Plains. Returning these historical conditions to large areas is seldom a feasible or desired management goal, but providing some level of representation of these conditions is often very feasible and desirable. Understanding the historical diversity and distributions of ecosystems across the Great Plains can provide a valuable reference for conservation planning.

Ecosystem diversity in an area is a function of 2 primary drivers. The first of these drivers is the influence of different ecological sites that support different communities of species because of differences in soils, climate, proximity to water tables, or a number of other abiotic factors. The second ecological driver is temporal or successional response to natural disturbances such as fire, grazing, or drought. An effective way of describing and mapping ecosystem diversity is to understand the role of each of these drivers, and to characterize how each driver affected both historical and current ecosystem diversity across the different ecological sites that occurred in an area. The primary goal of this ecosystem diversity assessment was to describe and map the full range of ecosystem conditions resulting from historical disturbance regimes across the North American Great Plains.

Objectives

The objective of this assessment was to classify, describe, and map the distribution of historically occurring ecosystem diversity of the North American Great Plains. Specifically, the objectives were to:

- Delineate appropriate landscapes across the North American Great Plains that would provide a framework for characterizing, and restoring historical ecosystem diversity,
- Develop grass and shrub ecosystem diversity descriptions for each delineated landscape,
- Provide descriptions of the dominant and indicator species for each specific plant community that occurred historically,
- Map the distribution of the ecological sites used in the description of ecosystem diversity, and
- Provide a coarse description of existing conditions that have resulted in major conversions of historical ecosystem diversity.

Background

Classification

To effectively characterize ecosystem diversity for conservation planning within a geographically large area, it is essential to identify appropriate classification systems that will facilitate biodiversity conservation efforts. The purpose of a classification system is to group like elements into units that can be defined and characterized. Although some classification systems are designed for a specific purpose, most attempt to provide a better description of the pattern of vegetation or ecosystems in an area.

In order to describe an historical reference for use in conservation planning, a classification system should have the ability to describe the complex of communities that occurred under historical disturbance regimes. In addition, this classification must delineate communities with sufficient detail to allow the full array of biological diversity at the ecosystem and species levels to be addressed, yet still provide a mechanism to quantify and evaluate the distribution of ecosystems at the landscape level. Although useful to many conservation efforts, classification systems like ecoregions (Figure 1) or Bird Conservation Regions (BCR) (Figure 2) are geographically too large to develop the level of detail required to adequately apply the ecosystem diversity strategy described here. While finer scale classification systems can be aggregated up to the level of the BCR or ecoregion, they must first be delineated and developed at a finer resolution.

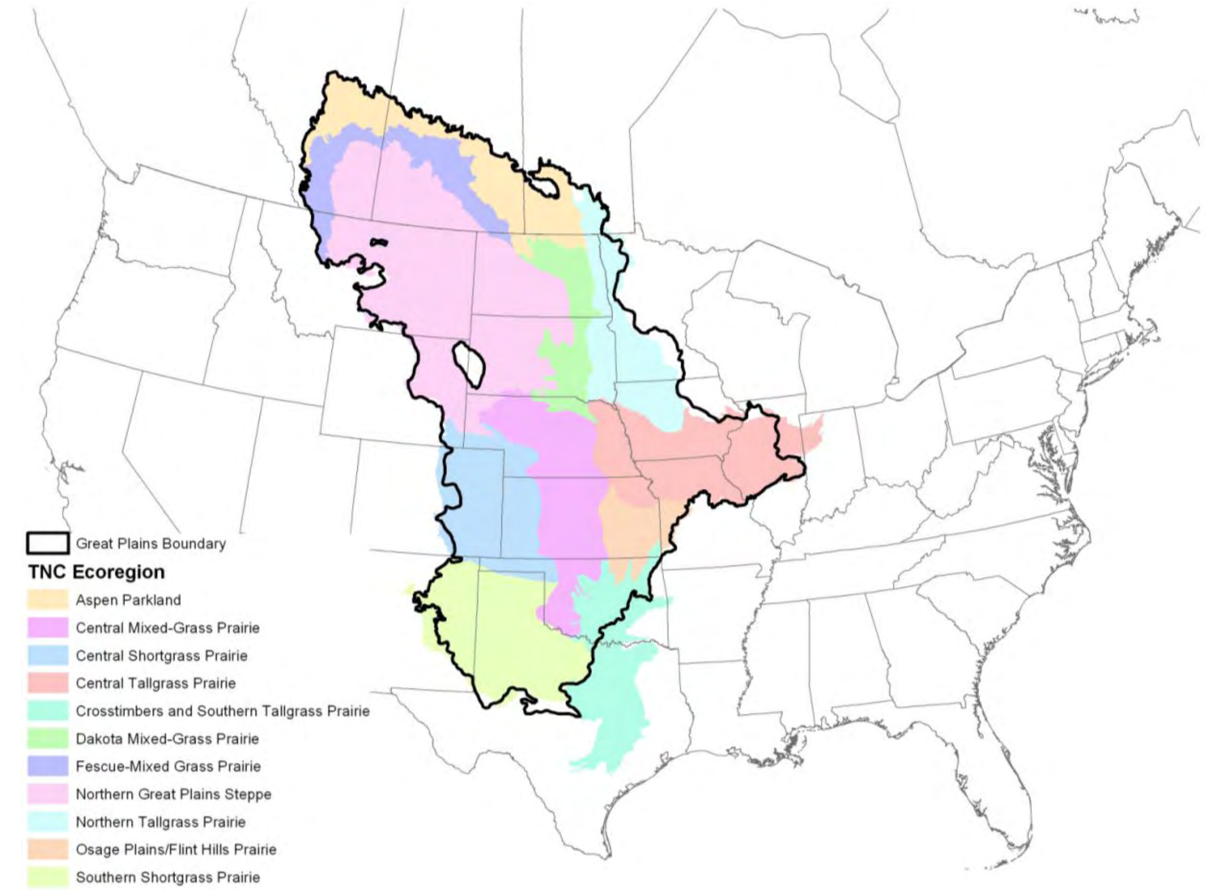

Figure A-1. The North American Great Plains Ecoregional delineations as designated by The Nature Conservancy shown in conjunction with the Great Plains boundary delineated for this project.

Understanding the role of historical disturbance and its influence on species composition, structure, and spatial arrangement requires an ecological classification of site conditions. This type of classification typically delineates the differences in abiotic conditions (e.g., climate, soils, aspect, elevation, moisture, etc.) that influence disturbance patterns and plant communities that can occur on that site. For grass and shrub ecosystems of the Great Plains, the Natural Resources Conservation Service's ecological sites and Canada's ecological range sites (USDA/NRCS 2003) provide a good example of ecological site classification. These classifications were selected as the most appropriate for classifying ecological sites for grass and shrub ecosystem diversity of the Great Plains.

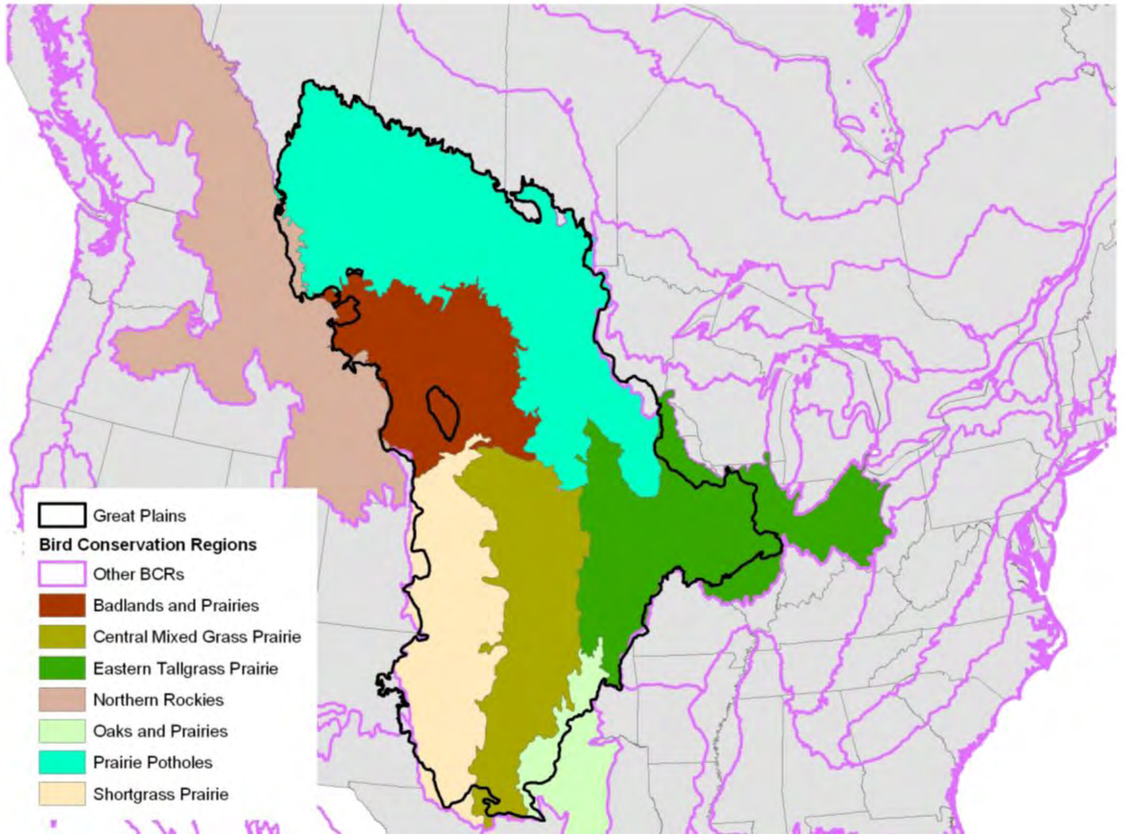

Figure A-2. Bird Conservation Regions within the Great Plains as designated by the North American Bird Conservation Initiative.

Although ecological site classifications provide valuable information on abiotic conditions, they do not identify the range of successional conditions possible on that site as a result of disturbance events and processes. This illustrates the need to combine an ecological site classification with a classification of successional stages and/or alternative states resulting from historical disturbance. A conservation planning tool that provides the framework to integrate ecological site classification with a classification of successional stages and/or alternative states is the Ecosystem Diversity Matrix (Haufler et al. 1996, Haufler 2000). An additional benefit of utilizing the Ecosystem Diversity Matrix is that it can be integrated with a geographic information system and used to quantify the coarse filter of ecosystem diversity relative to existing ecosystem conditions, thus extending its use for restoration efforts. The ecosystem diversity matrix and its specific application to this assessment are further described in a later section.

In this assessment we describe the ecosystem diversity that occurred historically across the Great Plains within 11 ecoregions (Figure 1) and parts or all of 6 BCR's (Figure 2). We focused our description of ecosystem diversity to these ecoregions in the Great Plains, and delineated the Great Plains boundary used in this assessment based on the boundaries of Major Land Resource Areas (MLRA's) in the United States and Soil Correlation Areas in Canada (SCA's) (Figure 3).

Historical Disturbance

Historical disturbances were a critical factor in the development and maintenance of Great Plains ecosystems. The historical reference that we are drawing upon is the ecosystem conditions that resulted from the effects of historical fire and grazing and their interactions. These created the dynamic ecosystem conditions that supported the biodiversity of the Great Plains. Historical disturbance regimes include the patterns of disturbance frequency and intensity that can be quantified using ecological evidence. Historical reference is confined here to a period less than 1000 years prior to European settlement as these conditions reflect the habitat conditions that are most relevant to the species that are present today.

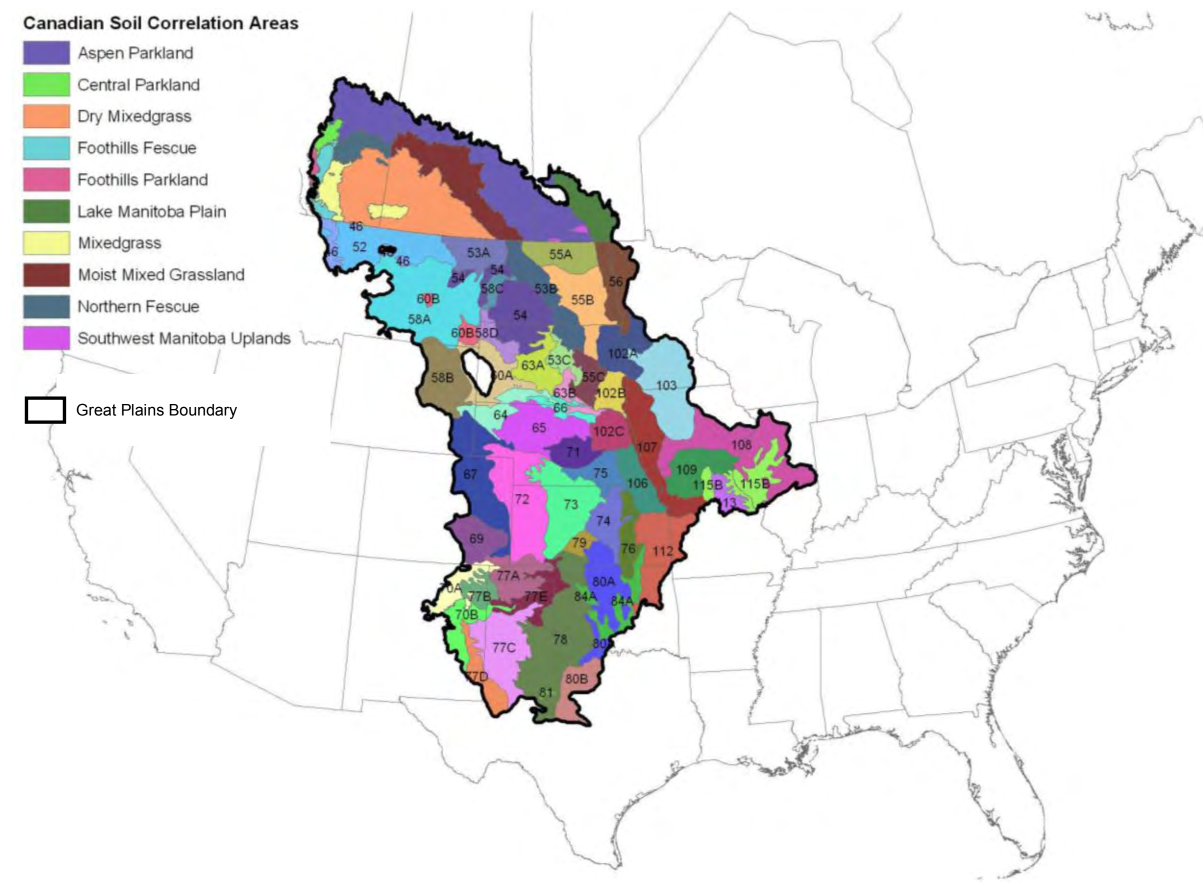

Figure A-3. Location of Great Plains Major Land Resource Areas in the United States and Soil Correlation Areas in Canada.

METHODS

Ecosystem Diversity Matrix

The ecosystem diversity matrix (EDM) (Haufler et al. 1996, Haufler 2000) is a coarse filter conservation planning tool that provides a framework for integrating ecological classification with a classification of plant community successional stages to describe historical ecosystem diversity. Within ecosystem diversity matrices factors known to drive ecosystem diversity such as abiotic ecosystem components and disturbance can be identified and described. In order to encompass the full range of ecosystems present in most North American landscapes it is necessary to develop separate ecosystem diversity matrices for grass/shrub systems, riparian/wetland systems, aquatic systems, and forested systems. For the purpose of this assessment, our primary focus is on grass and shrub ecosystems and thus we only developed ecosystem diversity matrices for grass and shrub ecosystems, however, we do identify riparian/wetland, aquatic, and forested systems in the maps we created for each MLRA or SCA.

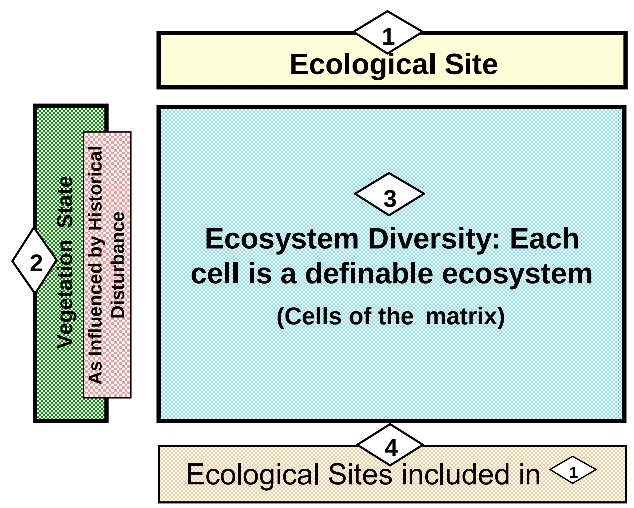

Figure A-4. Primary components of the ecosystem diversity matrix for Major Land Resource Areas within the North American Great Plains.

In a grass and shrub matrix, one axis identifies an appropriate classification of ecological sites that differ in abiotic factors. The other axis identifies the primary disturbance forces that altered and shaped the specific communities that historically occurred within each ecological site. The components of the ecosystem diversity matrix are identified by numbers in figure 4. For the purposes of this assessment, component 1 represents the ecological sites that occur within the United State's Major Land Resource Areas or the ecological range sites that occur within Canada's Soil Correlation Areas. Component 2 represents the vegetation successional states that existed in the presence of historical disturbance regimes such as fire and grazing, the two primary disturbances influencing the Great Plains ecological sites. The 3rd component represents the intersection of columns of component 1 and rows of component 2. Component 3, or the cells of the matrix, represents the specific ecosystems that occurred within each ecological site as a result of historical disturbance. All of the ecosystems represented comprise the ecosystem diversity within the designated MLRA or SCA. Finally, component 4 provides a summary of the ecological sites that were included in each of the identified ecological site groupings (i.e. component 1).

Each of the ecosystem classes (i.e., cells) defined in an ecosystem diversity matrix lists the potential dominant species or species that could be used as indicators that historically occurred on those sites as a result of the identified historical disturbance processes. Although few species are used to describe an ecosystem for the purpose of the ecosystem diversity matrix, each cell represents an ecosystem comprised of many species. Where ecological site or range site descriptions exist they can be used to more fully characterize plant species compositions and productivity. Furthermore, it is important to understand that not all of the species identified in an ecosystem class will be present on every site. Microclimate or different types of disturbance could influence the potential dominant species that actually occur within an ecosystem class. For a complete listing of the plant species used to describe historical ecosystem diversity in the Great Plains see Table 41 at the end of this appendix.

Development of Ecosystem Diversity Matrices

To create ecosystem diversity matrices for the portion of the Great Plains that fell within the United States we utilized the Natural Resources Conservation Service's ecological site classification system that uses soils as the basic mapping unit (USDA/NRCS 2003). In Canada, we utilized the ecological range site classification system, which also uses soils as the basic mapping unit, to describe ecosystem diversity within Alberta (Adams et al. 2003, 2004, 2005). Saskatchewan and Manitoba are in the process of developing ecological range site information, therefore, for the purposes of this assessment we used soils information from Saskatchewan and Manitoba to identify and map ecological sites and we extrapolated ecosystem diversity descriptions from adjacent areas. Within each Major Land Resource Area in the United States and Soil Correlation Area in Canada (Figure 2) we prepared an ecosystem diversity matrix to describe historical ecosystem diversity.

For the purposes of this assessment we grouped some MLRA's or SCA's because of similar ecosystem diversity. We also grouped ecological sites in some instances. Our reasons for grouping ecological sites included: 1) low representation within a given MLRA (i.e., a very low proportion of acres relative to the MLRA we were characterizing), 2) ecological site similarity, and 3) redundant ecological site designations across MLRA's. Ecological sites in a given MLRA that crosses state lines may have been named differently in the two states resulting in redundant ecological site designations or ecological site designations that differ because of unique naming conventions. For instance, the Nebraska's Choppy Sands ecological site designation is equivalent to Okalahoma's Dune ecological site designation, which are both analogous to Texas's Sandhills ecological site designation. NRCS designated some ecological sites as unclassified when those sites represented areas that are incapable of supporting vegetation (e.g., urban areas, gravel pits, dams, sanitary landfills, and rock outcrops). Ecological sites that had negligible acreages in a given MLRA (i.e. 0.5%) that could not be appropriately lumped with another ecological site grouping were also considered unclassified. Such sites were generally small inclusions of a type that was more abundant and included in a neighboring MLRA. If a rare but unique site was encountered within a MLRA, it was included in the matrix even though it had limited amounts. Some MLRA's had areas that could not be classified because data were unavailable by the NRCS for either soil maps or for descriptions of ecological sites.

We included fire and large herbivore grazing (i.e., bison) as the primary disturbance mechanisms that historically operated in grass and shrub ecosystems of the Great Plains. Although climate is an important factor in the development and maintenance of grass and shrub ecosystems of the Great Plains, we did not incorporate it into the ecosystem diversity matrices as a disturbance mechanism but we recognize climate as an important stochastic process. We predicted fire and grazing disturbance transitions for each ecological site using the best available information on ecosystem and plant species response. We characterized historical fire regimes for each MLRA by using information developed for the fire regime condition class Interagency Handbook Reference Conditions (Hann et al. 2003), as well as, supplemental literature. Bison grazing disturbance was divided into three levels of influence; light, moderate, and heavy grazing.

An advantage of using this ecosystem diversity strategy coupled with the NRCS ecological site and Canada's ecological range site information is that it is recognized, understood, and supported by the agriculture and ranching communities, two groups of landowners that perhaps offer the best potential for prairie ecosystem conservation planning. It presents conservation goals in terms they understand, describing desired plant compositions and structures for different sites in terms of the grasses, forbs, and shrubs with which they are familiar. Management practices relating to grazing and fire can be prescribed to produce desired ecosystem conditions for different sites. These are also treatments that the ranching community in particular understands. Use of an ecosystem diversity classification based on NRCS descriptions will also facilitate conservation processes that can directly link ecosystem restoration and maintenance objectives to conservation provisions of the Farm Bill. Through local committees that provide direction for EQIP or WHIP practices that qualify for funding, a process for supporting ecosystem restoration or enhancement could be developed for these programs within each state. An additional benefit of utilizing NRCS soils and ecological site information is that the USDA/NRCS has developed several different mechanisms for the acquisition of their compiled information free of charge (USDA/NRCS 2005-2006). For users that don't have access to a geographic information system or advanced computing power the USDA/NRCS has developed Web Soil Survey (http://websoilsurvey.nrcs.usda.gov), a user friendly web site database to acquire a wide array of information regarding soils and ecological sites. The current version of Web Soil Survey (version 1.1) can map and provide soils and ecological information for landscapes up to 10,000 acres in an easy to use, point and click user interface. Several of the Canadian Provinces are participating in the development of a Canadian Web Soil Survey, which has the potential of offering some of the same data acquisition benefits currently offered in the United States.

Characterizing Existing Conditions

To determine the existing conditions on ecological sites within United States MLRA's we used the GAP land cover classification. The GAP (Gap Analysis Program) used remote sensing information to classify existing land cover in three primary categories, culturally modified or developed cover, aquatic cover, and natural terrestrial cover (Lins and Kleckner 1996). Within these three primary categories we aggregated land cover classes into 6 categories disturbed, grassland, shrubland, forest land, riparian/wetland, and other. The disturbed category included agricultural lands, urban and other developed lands. The grassland, shrubland, forest land, and riparian/wetland categories included lands dominated by grasses, shrubs, trees, and riparian/wetland areas respectively. Lands categorized as other were generally rare and included rock outcrops, snow, cloud, or barren land classifications. Most of the United States was classified at a 90m resolution (i.e., 90m X 90m pixel or cell size), however, three states (North Dakota, Kansas, and Nebraska) classified their land cover at a 30m resolution. Because of computing limitations we reclassified images from these three states to a 100m resolution. In Canada SCA's we determined the existing conditions of ecological range sites using the Prairie Farm Rehabilitation Association's (PFRA) generalized land cover classification. Canada's land cover was classified at a 200m resolution.

Results

Northern Rocky Mountain Foothills (MLRA 46)

MLRA Description: MLRA 46 represents an area of 3,542,916 acres within Montana (Figure 5). Geographically this area falls within the Northern Rockies Bird Conservation Region and it is found within TNC's Fescue-Mixed Grass Prairie Ecoregion. The dominant landforms in this MLRA are plateaus, marine sediment uplifts, and glacial deposits. Mollisols (i.e., prairie soils) and Entisols (i.e., new soils) are the dominant soil orders in this MLRA. Elevation ranges from 1,100 to 2,400 meters above sea level. Average annual precipitation ranges from 30 to 50cm and the average frost free growing period ranges from 125 days.

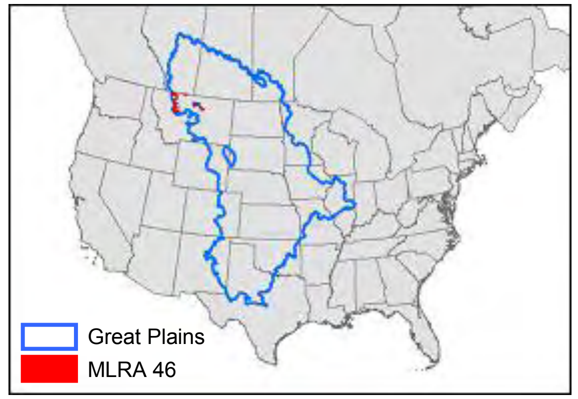

Figure A-5. Location of MLRA 46 within the Great Plains.

Historical Ecosystem Diversity: We used NRCS ecological site descriptions to describe historical ecosystem diversity in MLRA 46. The resulting grass and shrub ecosystem diversity matrix for MLRA 46 includes 12 ecological site groupings and is presented in Matrix 1. MLRA 46 is found in an area where the range in precipitation has an important influence on species distributions within the MLRA. Therefore, we followed the NRCS decision to split this MLRA into two precipitation zones, 25-36cm and 36-48cm of annual precipitation. Loamy ecological sites dominate within this MLRA, however, clayey ecological sites also make up a considerable portion of the grass shrub ecological sites. We used NRCS soils data to produce a map of the ecological sites within these MLRA's based on the EDM (see Figure 6). Soils information was available for 99.9% of this MLRA, which allowed us to classify ecological sites into appropriate groupings in all but 0.1% of this area.

The pre-settlement vegetation of this MLRA was dominated by grass/shrub ecosystems (approximately 87.0% of the total area). The remaining areas included riparian/wetland ecosystems (6.5%), aquatic ecosystems (0.1%), forest ecosystems (0.2%), and we were unable to classify 6.1% of this MLRA. Grass/shrub ecological sites within this MLRA were historically dominated by mostly cool season grass species. In areas of lower annual precipitation (i.e., 25-36cm) the species that responded as decreasers with increasing grazing pressure included green needlegrass, bluebunch wheatgrass, Indian ricegrass, alkali sacaton, and prairie sandreed. Species like western wheatgrass and Idaho fescue initially responded as increasers, however, they decreased as grazing pressure became more intense. Species that commonly increased as grazing became heavy included blue grama, prairie junegrass, needle and thread, threadleaf sedge, and saltgrass. The historical fire return interval in MLRA 46 was approximately 12 years (Barrett 1999), which played an important role in maintaining grass dominance in these ecosystems. Shrubs and trees were generally a minor component of grass/shrub ecosystems, however, areas of grass/shrub ecological sites that were protected from fire often experienced an increase in shrubby cinquefoil, creeping juniper, or broom snakeweed. In areas of higher annual precipitation (i.e., 36-48cm) the species that responded as decreasers with increasing grazing pressure included green needlegrass, plains muhly, bluebunch wheatgrass, Indian ricegrass, and Cusick's bluegrass. Species like rough fescue and Idaho fescue initially responded as increasers, however they decreased as grazing pressure became more intense. Species that commonly increased as grazing became heavy included Sandberg bluegrass, prairie junegrass, Parry's oatgrass, needle and thread, threadleaf sedge, poverty oatgrass, and western wheatgrass. The grass/shrub ecosystems in these areas of higher precipitation were also dominated by grasses, a result of the historical fire return interval. Ecological sites that were protected from fire often experienced increases in limber pine or shrubby cinquefoil.

Existing Conditions: Land ownership within MLRA 46 is currently 5.4% federal, 16.8% tribal, 7.8% state, and 70.1% private. Information regarding the current conditions of grass/shrub ecosystems within this MLRA, relative to the disturbance categories of the EDM, was not available for this MLRA. We conducted a coarse assessment of current conditions by assessing the state of ecological site groupings using GAP-GIS land cover classification (Table 1). See Figure 7 for the GAP map of current land uses by ecological site grouping within MLRA 46. Disturbed land cover currently occupies 17.4% of what we classified as historical grass/shrub ecosystems in MLRA 46 (Table 1). The eastern portion of MLRA 46 that fell into the 25 to 36cm. precipitation zone had higher amounts of disturbed land 24.1% when compared to the western portion of the MLRA 46 that fell into the 36 to 48cm precipitation zone had only 8.0% disturbed land. Within the 36 to 48cm precipitation zone, the most productive ecological sites (i.e., loamy, limy, and clayey) had higher levels of disturbed lands. We would also note that the Ecosystem Management Research Institute is currently assessing the existing conditions of grass/shrub ecosystems in this area through plant community sampling.

Table A-1. Land cover classification representing the existing conditions of grass/shrub ecological sites found within MLRA 46.

Ecological Site Grouping	Land Cover Classification					
	Disturbed	Grass	Shrub	Forest	Riparian/ Wetland	Other
	- - - - - - - - - - - -	- - - - - - - -	- - - - %	- - - - - - - -	- - - - - - - -	- - - - - - - -
25-36cm. precipitation						
Clayey	29.7	51.8	12.2	2.4	2.4	1.6
Claypan	6.8	58.1	29.7	0.6	1.8	3.0
Loamy	34.6	55.3	4.8	1.2	3.0	1.1
Limy	51.6	42.0	2.3	1.1	2.1	0.9
Sands/Sandy	11.7	79.5	3.9	0.9	3.5	0.5
Shallow	13.4	68.2	14.2	0.9	1.9	1.4
Saline Upland	20.7	56.1	7.2	4.0	10.0	2.0
36-48cm. precipitation						
Clayey	8.0	76.8	4.3	3.4	7.0	0.6
Loamy	12.2	67.0	6.3	7.2	6.5	0.7
Limy	2.4	86.8	5.3	3.2	1.5	0.7
Sands/Sandy	14.4	72.6	3.7	1.9	6.9	0.5
Shallow	3.0	62.3	3.8	23.9	5.1	1.9

Matrix A-1. Ecosystem diversity matrix for grass/shrub ecosystems within the Northern Rocky Mountain Foothills (MLRA 46).

ECOSYSTEM DIVERSITY MATRIX - Northern Rocky Mountain Foothills (MLRA 46)

GRASS/SHRUB ECOSYSTEMS

Disturbance Influenced Pathways	Ecological Site Grouping											
	Clayey 25-36cm. precip. Potential Dominant Species	Claypan 25-36cm. precip. Potential Dominant Species	Loamy 25-36cm. precip. Potential Dominant Species	Limy 25-36cm. precip. Potential Dominant Species	Sands/Sandy 25-36cm. precip. Potential Dominant Species	Shallow 25-36cm. precip. Potential Dominant Species	Saline Upland 25-36cm. precip. Potential Dominant Species	Clayey 36-48cm. precip. Potential Dominant Species	Loamy 36-48cm. precip. Potential Dominant Species	Limy 36-48cm. precip. Potential Dominant Species	Sands/Sandy 36-48cm. precip. Potential Dominant Species	Shallow 36-48cm. precip. Potential Dominant Species
Vegetative composition/structure primarily influenced by short-interval fire regimes (< 12 years)												
Light Grazing	bluebunch wheatgrass western wheatgrass thickspike wheatgrass green needlegrass	western wheatgrass thickspike wheatgrass bluebunch wheatgrass green needlegrass	bluebunch wheatgrass green needlegrass porcupinegrass western wheatgrass	bluebunch wheatgrass Idaho fescue needle and thread green needlegrass	bluebunch wheatgrass prairie sandreed needle and thread Indian ricegrass	bluebunch wheatgrass needle and thread prairie sandreed western wheatgrass	western wheatgrass alkali sacaton	bluebunch wheatgrass rough fescue Idaho fescue plains muhly	rough fescue bluebunch wheatgrass Idaho fescue green needlegrass	bluebunch wheatgrass rough fescue Idaho fescue green needlegrass	prairie sandreed rough fescue Indian ricegrass bluebunch wheatgrass	rough fescue bluebunch wheatgrass Idaho fescue Cusicks bluegrass
Moderate Grazing	western wheatgrass thickspike wheatgrass blue grama needle and thread	needle and thread blue grama Sandberg bluegrass prairie junegrass	western wheatgrass blue grama Sandberg bluegrass needle and thread	Idaho fescue needle and thread Sandberg bluegrass bluebunch wheatgrass	Idaho fescue needle and thread bluebunch wheatgrass	needle and thread blue grama western wheatgrass threadleaf sedge	Nuttall's alkali grass western wheatgrass alkali sacaton saltgrass	Idaho fescue bluebunch wheatgrass western wheatgrass Sandberg bluegrass	Idaho fescue western wheatgrass Parry's oatgrass rough fescue	Idaho fescue thickspike wheatgrass Sandberg bluegrass rough fescue	Idaho fescue needle and thread threadleaf sedge	Idaho fescue western wheatgrass Parry's oatgrass Sandberg bluegrass
Heavy Grazing	blue grama prairie junegrass Sandberg bluegrass threadleaf sedge	blue grama prairie junegrass needle and thread	blue grama Sandberg bluegrass prairie junegrass plains reedgrass	Sandberg bluegrass prairie junegrass threadleaf sedge needle and thread	needle and thread threadleaf sedge Idaho fescue	blue grama threadleaf sedge needle and thread Sandberg bluegrass	saltgrass Sandberg bluegrass blue grama	Sandberg bluegrass plains reedgrass prairie junegrass western wheatgrass	Parry's oatgrass western wheatgrass prairie junegrass	Sandberg bluegrass prairie junegrass poverty oatgrass plains reedgrass	needle and thread threadleaf sedge	Parry's oatgrass Sandberg bluegrass prairie junegrass
Vegetative composition/structure primarily influenced by long-interval fire regimes (> 12 years)												
Light Grazing	bluebunch wheatgrass western wheatgrass thickspike wheatgrass green needlegrass broom snakeweed	western wheatgrass thickspike wheatgrass bluebunch wheatgrass green needlegrass broom snakeweed	bluebunch wheatgrass green needlegrass porcupinegrass western wheatgrass creeping juniper	bluebunch wheatgrass Idaho fescue needle and thread green needlegrass creeping juniper	bluebunch wheatgrass prairie sandreed needle and thread Indian ricegrass shrubby cinquefoil	bluebunch wheatgrass needle and thread prairie sandreed western wheatgrass creeping juniper	western wheatgrass alkali sacaton broom snakeweed	bluebunch wheatgrass rough fescue Idaho fescue plains muhly shrubby cinquefoil	rough fescue bluebunch wheatgrass Idaho fescue green needlegrass limber pine	bluebunch wheatgrass rough fescue Idaho fescue green needlegrass limber pine	prairie sandreed rough fescue Indian ricegrass bluebunch wheatgrass shrubby cinquefoil	rough fescue bluebunch wheatgrass Idaho fescue Cusicks bluegrass limber pine
Moderate Grazing	western wheatgrass thickspike wheatgrass blue grama needle and thread broom snakeweed	needle and thread blue grama Sandberg bluegrass prairie junegrass broom snakeweed	western wheatgrass blue grama Sandberg bluegrass needle and thread creeping juniper	Idaho fescue needle and thread Sandberg bluegrass bluebunch wheatgrass creeping juniper	Idaho fescue needle and thread bluebunch wheatgrass shrubby cinquefoil	needle and thread blue grama western wheatgrass threadleaf sedge creeping juniper	Nuttall's alkali grass western wheatgrass alkali sacaton saltgrass broom snakeweed	Idaho fescue bluebunch wheatgrass western wheatgrass Sandberg bluegrass shrubby cinquefoil	Idaho fescue western wheatgrass Parry's oatgrass rough fescue limber pine	Idaho fescue thickspike wheatgrass Sandberg bluegrass rough fescue limber pine	Idaho fescue needle and thread threadleaf sedge shrubby cinquefoil	Idaho fescue western wheatgrass Parry's oatgrass Sandberg bluegrass limber pine
Heavy Grazing	blue grama prairie junegrass Sandberg bluegrass threadleaf sedge broom snakeweed	blue grama prairie junegrass needle and thread broom snakeweed	blue grama Sandberg bluegrass prairie junegrass plains reedgrass creeping juniper	Sandberg bluegrass prairie junegrass threadleaf sedge needle and thread creeping juniper	needle and thread threadleaf sedge Idaho fescue shrubby cinquefoil	blue grama threadleaf sedge needle and thread Sandberg bluegrass creeping juniper	saltgrass Sandberg bluegrass blue grama broom snakeweed	Sandberg bluegrass plains reedgrass prairie junegrass western wheatgrass shrubby cinquefoil	Parry's oatgrass western wheatgrass prairie junegrass limber pine	Sandberg bluegrass prairie junegrass poverty oatgrass plains reedgrass limber pine	needle and thread threadleaf sedge shrubby cinquefoil	Parry's oatgrass Sandberg bluegrass prairie junegrass limber pine
TOTAL ACRES IN EACH ECOLOGICAL SITE	**407,302**	**125,208**	**718,338**	**138,872**	**23,635**	**204,397**	**5,936**	**111,242**	**1,032,050**	**95,753**	**7,454**	**210,711**
	NRCS Range and/or Ecological Sites Included											
	Clayey Shallow Clay Clayey Steep	Claypan Dense Clay	Silty Silty Steep Silty Droughty	Silty Limy	Sands Sandy Sandy Steep	Shallow Shallow to Gravel Thin Hilly Gravel	Saline Upland	Clayey Shallow Clay Thin Clayey Clayey Steep	Silty Thin Silty Silty Steep	Silty Limy	Sands Sandy Thin Sandy	Shallow Shallow to Gravel Thin Breaks Silty Stony

KEY
precip. = average annual precipitation

Ecosystem Diversity Matrix concept described in: Haufler, J.B. et al. 2002. Performance measures for ecosystem management and ecological sustainability. The Wildlife Society Technical Review 02-1, 2002.

Ecological Site Classes derived from: Natural Resources Conservation Service, Ecological Site Descriptions. Available on the USDA/NRCS Ecological Site Information System website (http://esis.sc.egov.usda.gov/) or the USDA/NRCS Electronic Field Office Technical Guide website (http://www.nrcs.usda.gov/Technical/efotg/).

Fire Regime Information derived from: Barrett, S. W. 1999. Fire regimes on the pine butte swamp preserve, Montana. Unpublished Final Report on file at The Nature Conservancy's Pine Butte Swamp Preserve, Choteau, MT.

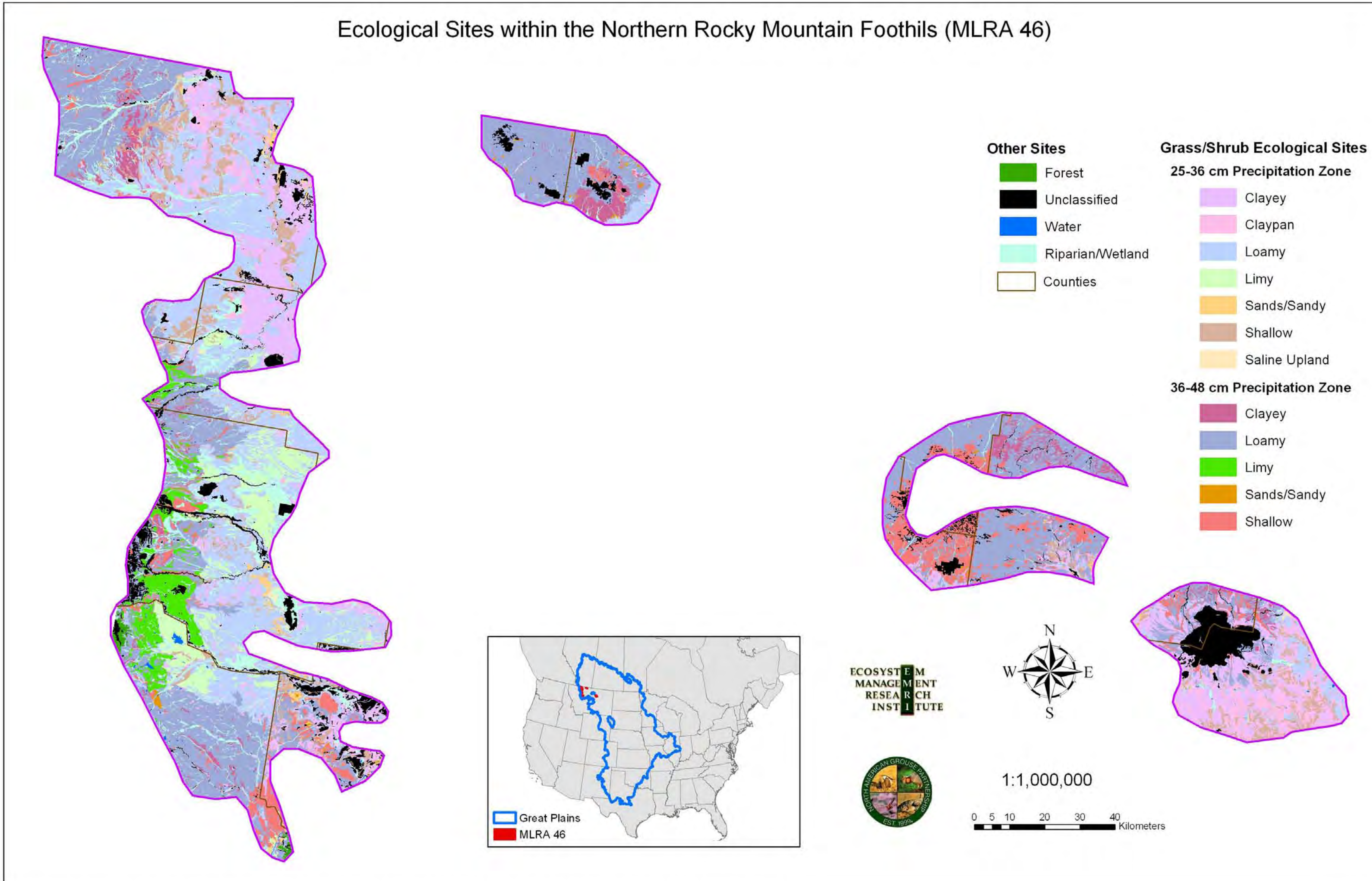

Figure A-6. Map of ecological site groupings within the Northern Rocky Mountain Foothills (MLRA 46) as derived from NRCS soils data.

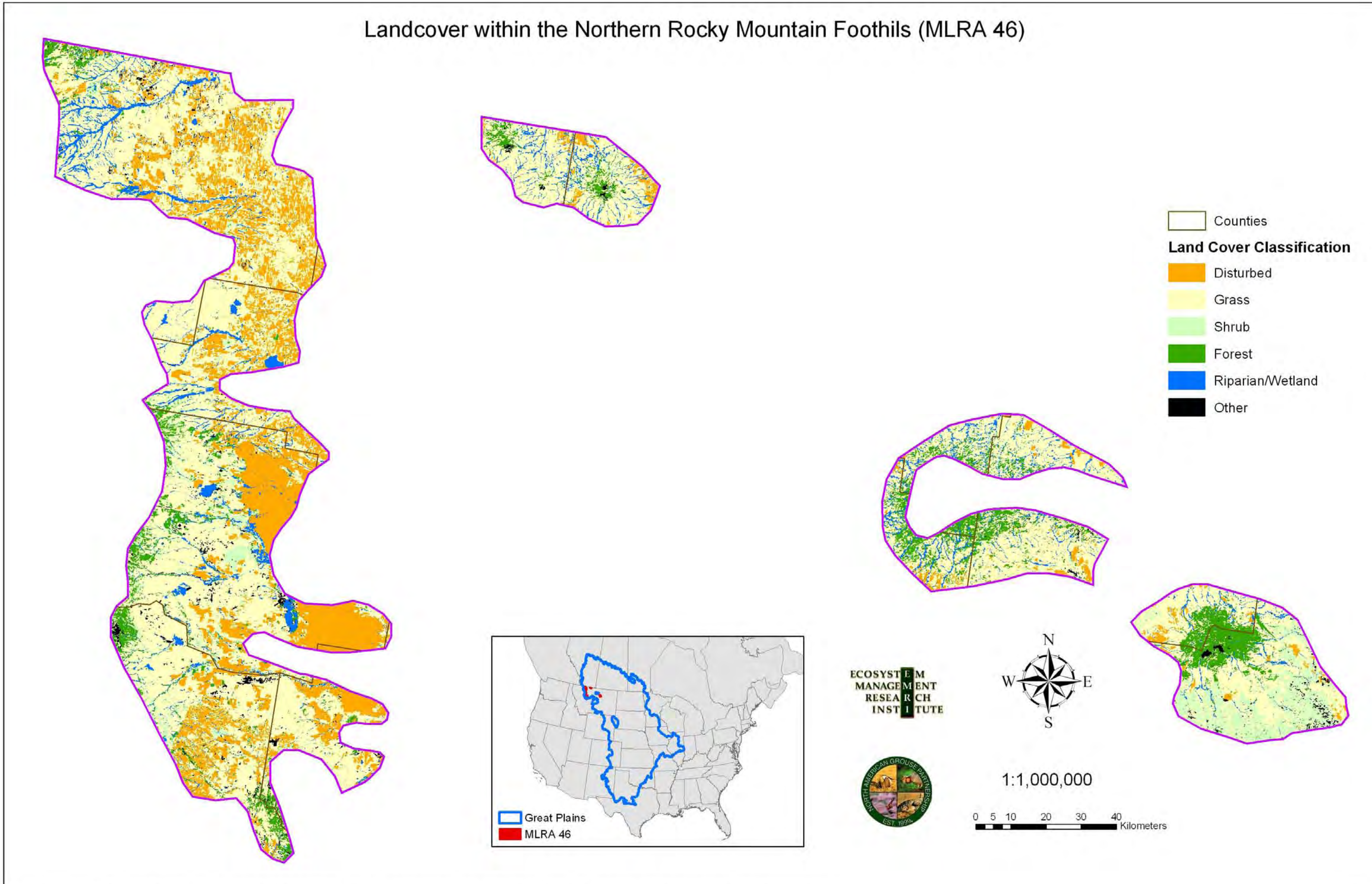

Figure A-7. Map of existing land cover within the Northern Rocky Mountain Foothills (MLRA 46) as derived from GAP land cover assessments.

Brown Glaciated Plain (MLRA 52)

MLRA Description: MLRA 52 represents an area of 14,508,955 acres within Montana (Figure 8). Geographically this area falls within the Prairie Pothole Bird Conservation Region and it is found within TNC's Northern Great Plains Steppe Ecoregion. The dominant landform in this MLRA is glacial till plains. Mollisols (i.e., prairie soils) are the dominant soil order in this MLRA, however, this area also has Alfisols i.e., (high nutrient soils) and Entisols (i.e., new soils). Elevation ranges from 600 to 1,400 meters above sea level. Average annual precipitation ranges from 25 to 43cm and the average frost free growing period is 140 days.

Figure A-8. Location of MLRA 52 within the Great Plains.

Historical Ecosystem Diversity: We used NRCS ecological site descriptions to describe historical ecosystem diversity in MLRA 52. The resulting grass and shrub ecosystem diversity matrix includes 10 ecological site groupings and is presented in Matrix 2. Loamy ecological sites dominate this MLRA, in fact, loamy ecological sites occupy approximately 68% of the grass/shrub ecological sites. We used NRCS soils data to produce a map of the ecological sites within this MLRA based on the EDM (see Figure 9). Soils information was available for 99.9% of this MLRA, which allowed us to classify ecological sites into appropriate groupings in all but 0.1% of this area.

The pre-settlement vegetation of this MLRA was dominated by grass/shrub ecosystems (approximately 93% of the total area). The remaining areas included riparian/wetland ecosystems (2.9%), aquatic ecosystems (0.3%), and we were unable to classify 3.7% of this MLRA. Grass/shrub ecological sites within this MLRA were historically dominated by mostly cool season grass species. As grazing pressure increased, the species that responded as decreasers included bluebunch wheatgrass, Indian ricegrass, prairie sandreed, green needlegrass, alkali sacaton, and porcupinegrass. Species like western wheatgrass and thickspike wheatgrass initially responded as increasers, however, they decreased as grazing pressure became more intense. Species that commonly increased as grazing became heavy included blue grama, needle and thread, prairie junegrass, plains reedgrass, saltgrass, threadleaf sedge, and Sandberg bluegrass. The historical fire return interval was approximately 11 years (Hann 2003a), which played an important role in maintaining grass dominance in these ecosystems. Shrubs and trees were generally a minor component of grass/shrub ecosystems, however areas of grass/shrub ecological sites that were protected from fire often experienced increases in creeping juniper, prairie sagewort, western snowberry, Rocky Mountain juniper, or broom snakeweed.

Existing Conditions: Land ownership within MLRA 52 is currently 13.0% federal, 8.1% tribal, 7.3% state, and 71.5% private. Information regarding the current conditions of grass/shrub ecosystems within this MLRA, relative to the disturbance categories of the EDM, is not available at this time. However, we were able to conduct a coarse assessment of current conditions by assessing the state of ecological site groupings using GAP-GIS land cover classification (Table 2). See Figure 10 for the GAP map of current land uses by ecological site grouping within MLRA 52. Disturbed land cover currently occupies 28.4% of what we classified as historical grass/shrub ecosystems in MLRA 52 (Table 2). Productive ecological sites (i.e., clayey, loamy, sands/sandy, and limy) had higher amounts of disturbed land as compared to less productive ecological sites, such as, shallow, shallow hilly, shallow clayey, and shallow to gravel.

Table A-2. Land cover classification representing the existing conditions of grass/shrub ecological sites found within MLRA 52.

Ecological Site Grouping	Land Cover Classification					
	Disturbed	Grass	Shrub	Forest	Riparian/ Wetland	Other
	%					
Clayey	59.7	26.7	4.5	1.8	5.9	1.3
Shallow Clayey	11.9	58.1	15.0	1.2	3.3	10.6
Claypan	20.0	54.8	17.6	0.7	3.7	3.2
Loamy	51.7	41.8	2.7	0.5	2.8	0.5
Limy	27.8	41.4	19.8	2.5	5.9	2.6
Sands/Sandy	46.1	43.0	2.5	1.3	4.6	2.5
Shallow	14.1	67.3	6.9	2.4	5.4	3.8
Shallow Hilly	11.5	69.7	11.5	0.6	4.4	2.3
Shallow to Gravel	20.4	67.1	2.9	1.5	7.6	0.4
Saline Upland	20.5	52.6	7.1	0.5	13.0	6.3

Matrix A-2. Ecosystem diversity matrix for grass/shrub ecosystems within the Brown Glaciated Plain (MLRA 52).

ECOSYSTEM DIVERSITY MATRIX - Brown Glaciated Plain (MLRA 52)

GRASS/SHRUB ECOSYSTEMS

Disturbance Influenced Pathways	Ecological Site Grouping: Clayey	Shallow Clayey	Claypan	Loamy	Limy	Sands/Sandy	Shallow	Shallow Hilly	Shallow to Gravel	Saline Upland
	Potential Dominant Species	Potential Dominant Species	Potential Dominant Species	Potential Dominant Species	Potential Dominant Species	Potential Dominant Species	Potential Dominant Species	Potential Dominant Species	Potential Dominant Species	Potential Dominant Species
Vegetative composition/structure primarily influenced by short-interval fire regimes (<11 years)										
Light Grazing	bluebunch wheatgrass green needlegrass western wheatgrass thickspike wheatgrass	green needlegrass western wheatgrass thickspike wheatgrass	bluebunch wheatgrass green needlegrass western wheatgrass alkali sacaton	bluebunch wheatgrass green needlegrass procupinegrass western wheatgrass	n/a	prairie sandreed needle and thread bluebunch wheatgrass Indian ricegrass	bluebunch wheatgrass prairie sandreed needle and thread western wheatgrass	n/a	bluebunch wheatgrass plains muhly needle and thread western wheatgrass	western wheatgrass alkali sacaton Nuttal's alkali grass
Moderate Grazing	western wheatgrass thickspike wheatgrass blue grama bluebunch wheatgrass	western wheatgrass thickspike wheatgrass blue grama	western wheatgrass thickspike wheatgrass blue grama needle and thread	western wheatgrass blue grama needle and thread bluebunch wheatgrass	n/a	needle and thread western wheatgrass thickspike wheatgrass prairie sandreed	needle and thread blue grama western wheatgrass threadleaf sedge	n/a	western wheatgrass needle and thread blue grama prairie junegrass	western wheatgrass Nuttal's alkali grass saltgrass blue grama
Heavy Grazing	blue grama prairie junegrass Sandberg bluegrass	blue grama prairie junegrass threadleaf sedge	blue grama needle and thread threadleaf sedge	blue grama needle and thread prairie junegrass Sandberg bluegrass	n/a	needle and thread blue grama plains reedgrass western wheatgrass	blue grama threadleaf sedge	n/a	blue grama prairie junegrass Sandberg bluegrass	blue grama Sandberg bluegrass saltgrass threadleaf sedge
Vegetative composition/structure primarily influenced by long-interval fire regimes (>11 years)										
Light Grazing	bluebunch wheatgrass green needlegrass western wheatgrass thickspike wheatgrass creeping juniper	green needlegrass western wheatgrass thickspike wheatgrass prairie sagewort	bluebunch wheatgrass green needlegrass western wheatgrass alkali sacaton prairie sagewort	bluebunch wheatgrass green needlegrass procupinegrass western wheatgrass western snowberry	n/a	prairie sandreed needle and thread bluebunch wheatgrass Indian ricegrass western snowberry	bluebunch wheatgrass prairie sandreed needle and thread western wheatgrass Rocky Mountain juniper	n/a	bluebunch wheatgrass plains muhly needle and thread western wheatgrass broom snakeweed	western wheatgrass alkali sacaton Nuttal's alkali grass prairie sagewort
Moderate Grazing	western wheatgrass thickspike wheatgrass blue grama bluebunch wheatgrass creeping juniper	western wheatgrass thickspike wheatgrass blue grama prairie sagewort	western wheatgrass thickspike wheatgrass blue grama needle and thread prairie sagewort	western wheatgrass blue grama needle and thread bluebunch wheatgrass western snowberry	n/a	needle and thread western wheatgrass thickspike wheatgrass prairie sandreed western snowberry	needle and thread blue grama western wheatgrass threadleaf sedge Rocky Mountain juniper	n/a	western wheatgrass needle and thread blue grama prairie junegrass broom snakeweed	western weatgrass Nuttalls alkali grass saltgrass blue grama prairie sagewort
Heavy Grazing	blue grama prairie junegrass Sandberg bluegrass creeping juniper	blue grama prairie junegrass threadleaf sedge prairie sagewort	blue grama needle and thread threadleaf sedge prairie sagewort	blue grama needle and thread prairie junegrass Sandberg bluegrass western snowberry	n/a	needle and thread blue grama plains reedgrass western wheatgrass western snowberry	blue grama threadleaf sedge Rocky Mountain juniper	n/a	blue grama prairie junegrass Sandberg bluegrass broom snakeweed	blue grama Sandberg bluegrass saltgrass threadleaf sedge prairie sagewort
TOTAL ACRES IN EACH ECOLOGICAL SITE	**1,458,283**	**626,314**	**828,904**	**9,100,904**	**22,953**	**509,598**	**315,703**	**445,879**	**81,754**	**98,287**
NRCS Range and/or Ecological Sites Included	Clayey	Shallow Clay Thin Clayey Clayey Steep	Claypan Dense Clay	Silty Silty Steep Thin Silty	Silty Limy	Sands Sandy Sandy Steep Thin Sandy Coarse Clay	Shallow	Thin Breaks Thin Hilly	Shallow to Gravel Gravel	Saline Upland

KEY
n/a - information is not available at this time

Ecosystem Diversity Matrix concept described in: Haufler, J.B. et al. 2002. Performance measures for ecosystem management and ecological sustainability. The Wildlife Society Technical Review 02-1, 2002.

Ecological Site Classes derived from: Natural Resources Conservation Service, Ecological Site Descriptions. Available on the USDA/NRCS Ecological Site Information System website (http://esis.sc.egov.usda.gov/) or the USDA/NRCS Electronic Field Office Technical Guide website (http://www.nrcs.usda.gov/Technical/efotg/).

Fire Regime Information derived from: Hann, W. 2003a. Reference conditions for Northern Plains Grassland (with shrubs) and Northern Plains Grasslands (without shrubs). *In:*Interagency and The Nature Conservancy fire regime condition class website (http://www.frcc.gov). USDA Forest Service, US Department of the Interior, The Nature Conservancy, and Systems for Environmental Management.

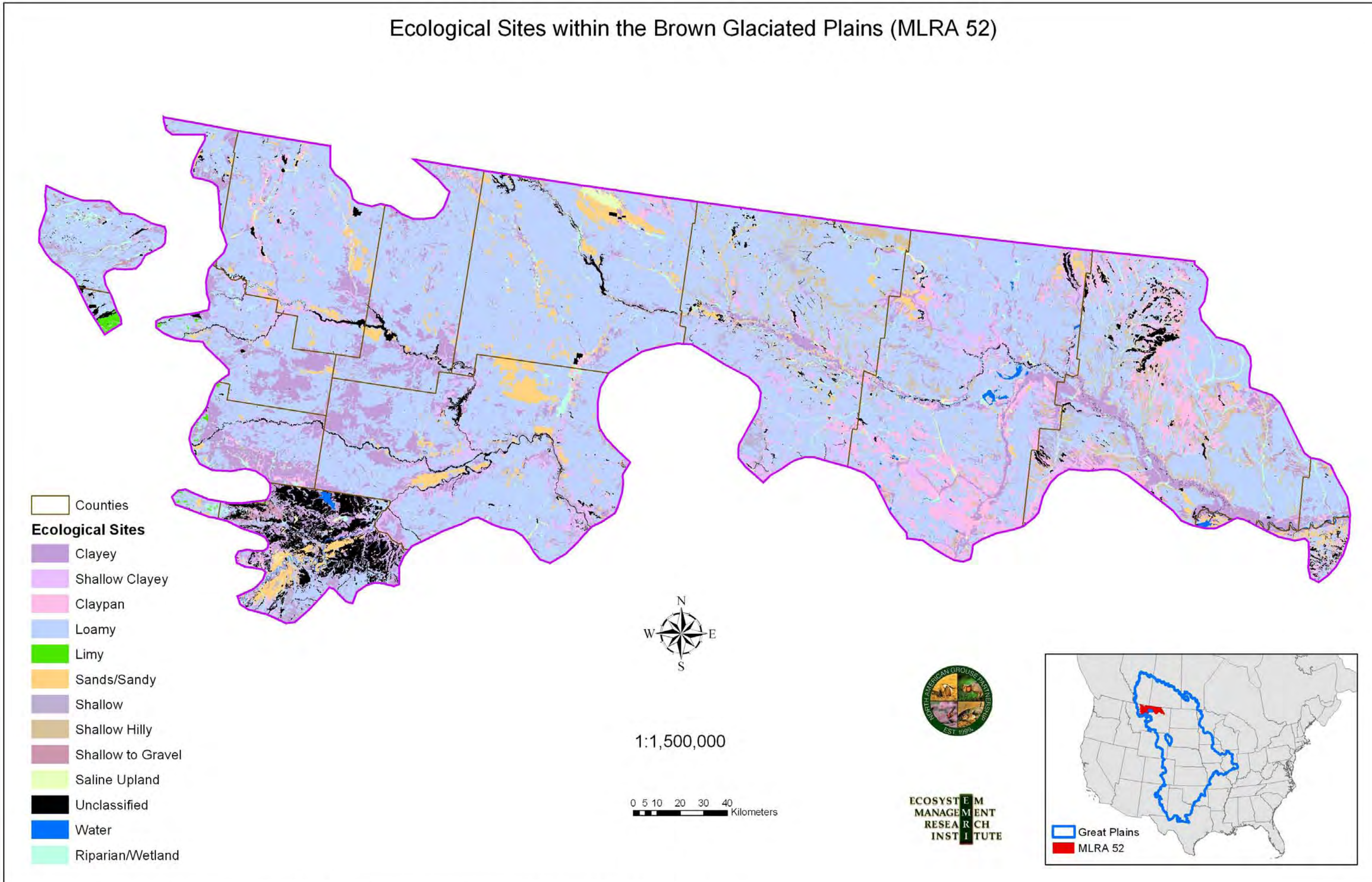

Figure A-9. Map of ecological site groupings within the Brown Glaciated Plains (MLRA 52) as derived from NRCS soils data.