Rainwater Basin Joint Venture Landbird Plan

A regional contribution to the

North American Landbird Conservation Plan

and the

Rainwater Basin Joint Venture Implementation Plan

By the Rainwater Basin Joint Venture

Contents

List of Figures

List of Tables

Executive Summary

The Rainwater Basin Joint Venture partnership (RWBJV) was formed in 1992 with a primary focus of protecting, restoring, and enhancing wetland habitat in the Rainwater Basin Wetland Complex (RWB). The RWB contains a high density of playa wetlands, which provide critical stopover habitat for various species of migratory waterfowl, waterbirds, and shorebirds. Because of its diversity of wetland types and mid-latitude landscape juxtaposition, the RWB is the focal point of spring migration for millions of waterfowl. Although it was not within the RWBJV's initial purview, the RWBJV Management Board embraced the 1999 North American Bird Conservation Initiative, expanding the partnership's geographic focus and acknowledging the conservation objectives outlined in all four of the national bird conservation plans (North American Waterfowl Management Plan, Partners in Flight North American Landbird Conservation Plan, North American Waterbird Conservation Plan, and the United States Shorebird Conservation Plan). The expanded RWBJV Administrative Area includes the portions of Bird Conservation Regions 11 (BCR 11; Prairie Pothole Region) and 19 (BCR 19; Central Mixed-grass Prairies) that lie within Nebraska. This expanded geography contains the Sandhills region of Nebraska, one of the largest intact grass-stabilized dune systems in the world. This 19,000 square-mile region contains a rich diversity of breeding grassland birds and associated habitats.

In order to help guide landbird conservation, the RWBJV developed a preliminary set of priority species and established population objectives and habitat goals necessary to sustain priority species at target levels. Based on the Partners in Flight North American Landbird Conservation Plan (PIF NALCP), a set of six vulnerability factors were used as criteria to scale down regional priority species and identify which landbird species require attention within the RWBJV Administrative Area. The RWBJV refined the PIF NALCP list of 31 landbird species of regional concern and the 13 stewardship species to create a list of 19 priority species. Priority was given to species designated in the PIF NALCP as being in need of Critical Action, Immediate Action, Management Action, or Long-term Planning and Responsibility. While the PIF NALCP designates species of concern and stewardship species within each Bird Conservation Region, the RWBJV Administrative Area is limited to Nebraska's portion of BCR 19 and BCR 11. Therefore, any species whose populations mainly fall outside of Nebraska were eliminated from the planning process.

In an effort to establish landbird conservation benchmarks, the RWBJV used the Hierarchical All Bird Strategy (HABS) database developed by the Playa Lakes Joint Venture and refined by the Nebraska Bird Partnership. Species-specific estimates of landscape carrying capacity were calculated by integrating multiple species density estimates from directed research projects and land cover data describing the RWBJV Administrative Area. Estimates of landscape carrying capacity for individual species were used in conjunction with Breeding Bird Survey population trend data to establish species population goals for the next 20 years. For priority landbird species demonstrating drastic declines over the last 60 years, a goal was set to double the current landscape carrying capacity for each species by 2030. Population goals were established at 1966 population levels for species that have undergone moderate declines. Lastly, goals were set to

maintain current population levels for species that have seen no declines in the RWBJV Administrative Area.

To help reach carrying capacity benchmarks, scenarios were developed for six Geographic Focus Areas within the RWBJV Administrative Area. A majority of the landbird species that the RWBJV has identified as priorities use grassland habitats; the six Geographic Focus Areas have significant grassland acres and/or large tracts necessary to support sustainable populations of grassland birds. Two strategies were developed to accomplish landscape carrying capacity goals for the priority species. The first strategy reduces grassland habitat fragmentation by removing 220,000 acres of the invasive eastern red cedar throughout the RWBJV Administrative Area. The intensity of eastern red cedar removal will vary by Geographic Focus Area. For example, regions like the Central Loess Hills have a conservation goal of removing 75% of the eastern red cedar, whereas areas with less established populations of red cedar (i.e., the Northeast Prairies /Elkhorn River GFA) have a goal of 50% removal. The second conservation strategy focuses on increasing grassland habitat throughout four Geographic Focus Areas in the RWBJV Administrative Area. For planning purposes, the RWBJV assumed there would be 450,000 Conservation Reserve Program (CRP) acres in the RWBJV Administrative Area. Therefore an additional 42,000 acres of CRP could still be enrolled before meeting this acreage level, which would assist in achieving landbird population goals.

Research and monitoring efforts will help the RWBJV refine conservation benchmarks as new information becomes available. The RWBJV will continue to coordinate with partners to acquire landbird survey data that can be used to assess the productivity of current management actions and to inform future conservation efforts by integrating research and monitoring data into decision support tools. These tools will help further the RWBJV's efforts in implementing the Strategic Habitat Conservation framework (SHC; National Ecological Assessment Team 2006, USFWS 2008), by providing a framework to assist in conservation design, implementation, and research/inventory/monitoring.

Introduction

In 1992, the RWBJV partnership was formed. The RWBJV was initially focused on habitat delivery for waterfowl within the Rainwater Basin Wetland Complex (RWB). In 2001, a national call was made for joint ventures to expand their conservation focus to all species of birds. In response, the RWBJV extended its administrative area and mission to include portions of Bird Conservation Regions (BCRs) 11 (Prairie Pothole Region) and 19 (Central Mixed-grass Prairie Region) within Nebraska. The RWBJV Landbird Plan represents an initial effort by the RWBJV to effectively guide landbird conservation and management actions in the RWBJV Administrative Area.

Although the administrative boundary has expanded, the name of the RWBJV remains the same. The need to retain the name outweighs the confusion it may pose to those unfamiliar with the organization or the geography of Nebraska. Within this document, "RWBJV" is used to reference the partnership, "RWBJV Administrative Area" describes the geographic area administered by the partnership (Figure 1), and the 21-county area that was the impetus for the creation of the RWBJV is designated as the "RWB" (Figure 1). Every attempt will be made to clarify to the reader which element is being addressed.

The Rainwater Basin Joint Venture (RWBJV) Landbird Plan was completed to complement the actions taken to prioritize, conserve, and protect landbird populations at the regional, national, and international levels. Over the past several decades, there has been a precipitous decline in many avian populations spanning North America, but some of the most highly imperiled species fall among the approximately 1,200 terrestrial species (landbirds) that inhabit Canada, the United States, and Mexico (Knopf 1994, Peterjohn and Sauer 1999, Sauer et al. 2008, Sauer et al 2011). Although many factors have contributed to the decline, intensified land-use practices are largely the driving cause of habitat degradation and loss, and consequently have reduced landbird populations across the continent (Murphy 2003, Peterjohn 2003, Smith and Lomolino 2004, Askins et al. 2007). In addition, the impacts of climate change have exacerbated existing threats and accelerated new threats to birds and the resources they depend on to survive and reproduce. In 2000, the first Partners in Flight North American Landbird Conservation Plan (PIF NALCP; Pashley et al. 2000) was written to guide landbird conservation. In 2004, the second version of the PIF NALCP was drafted (Rich et al. 2004). This version provided a framework for species prioritization and development of population objectives to guide habitat conservation.

The PIF NALCP was developed by various conservation constituents, including state and federal agencies, non-government conservation organizations, and individual researchers from across North America. The PIF NALCP was designed to complement the existing landscape-scale conservation efforts of the North American Waterfowl Management Plan (U.S. Fish and Wildlife Service and Canadian Wildlife Service 1986), the Canadian Shorebird Plan (Donaldson et al. 2000), the U.S. Shorebird Conservation Plan (Brown et al. 2001), and the Waterbird Conservation for the Americas Plan (Kushlan et al. 2002). Given the complexity in managing the several hundred landbird species found throughout North America, the PIF NALCP focused on a continental scale to serve as a "blueprint" to help guide conservation plans at regional, state, provincial, territorial, and local levels (Rich et al. 2004).

The RWBJV Administrative Area

Approximately 90% of the RWBJV Administrative Area is in Bird Conservation Region 19 (BCR 19), the Central Mixed-grass Prairies Region, while 10% is in BCR 11, the Prairie Pothole Region, (North American Bird Conservation Initiative 1999). The area of BCR 11 that is administered by the RWBJV is at the southern edge of the Prairie Pothole Region. This area has no true prairie pothole wetlands and the landscape is dominated by land uses and habitats characteristic of BCR 19. In Nebraska, BCR 11 is dominated by row-crop agriculture, while the wetlands and grasslands generally are confined to the drainages of the Missouri and Niobrara rivers (Bishop et al. 2009; Bishop et al. 2011). To define the RWBJV Administrative Area, all of BCRs 11 and 19 in Nebraska were therefore combined into a single unit.

The RWBJV Administrative Area is part of the Great Plains, a region known for its wide variations in temperature and precipitation. West of the 100th meridian, evaporation and transpiration exceed precipitation, commonly drying up wetlands even in wetter years. Precipitation occurs sporadically, which results in variable amounts of water in wetland systems. In some years, precipitation and snow melt may come early and be abundant enough to fill most palustrine wetlands and sustain flows in riverine wetlands. In other years, the greatest precipitation occurs as a result of summer thunderstorms. This temporal variation of precipitation alters the phenology, species composition, and structure of the wetland vegetation communities.

A wide variety of human alterations that impact the palustrine and riverine wetlands are found in the RWBJV Administrative Area. Modifications include water concentration pits, land leveling, culturally accelerated sedimentation, road ditches, drainage ditches, invasive species, stream channelization and degradation, dams, diversions, water withdrawals, and other watershed modifications. These modifications directly impact wetland numbers, size, and function (LaGrange 2005; LaGrange et al. 2011).

Grasslands dominated by mixed-grass, tallgrass, and sandhill prairie communities once occupied a majority of the RWBJV Administrative Area. Outside of the Sandhills, many of these grasslands have been converted to row-crop agriculture. The grasslands that survive are generally associated with the region's riverine systems or lands not suitable for row-crop agriculture because of the potential for wind and/or water erosion. The remaining grasslands are often integrated into agricultural operations for grazing or haying, which, depending on timing and intensity, can significantly impact the habitat values these lands provide to wildlife.

Woodlands are generally confined to the drainages of the major river systems found in the RWBJV Administrative Area. Along the Loup, Missouri, Platte, and Republican rivers, the woodlands are generally composed of deciduous species. Russian olive and eastern red cedar are the primary invasive species impacting these woodlands. Along the Niobrara River there is a greater diversity of species, including both deciduous and coniferous woodlands. Invasion by eastern red cedar is a major threat to these communities as well.

Geographic Focus Areas in the RWBJV Administrative Area

For planning purposes the RWBJV Administrative Area is divided, based on landscape characteristics, into eight Geographic Focus Areas (Figure 1): 1) Central Loess Hills, 2) Central and North Platte River, 3) Missouri River, 4) Northeast Prairies/Elkhorn River, 5) Rainwater Basin 6) Republican River/Blue River Drainages and Loess Canyons, 7) Sandhills, and 8) Verdigris – Bazile Creek Drainages (Figure 1).

In order for states to receive federal funds through the Wildlife Conservation and Restoration Program and the State Wildlife Grants Program, Congress charged each state to develop a State Wildlife Action Plan. Nebraska's plan is known as the *Nebraska Natural Legacy Project* (Schneider et al. 2011), which was developed as a state-wide plan to direct and focus the actions

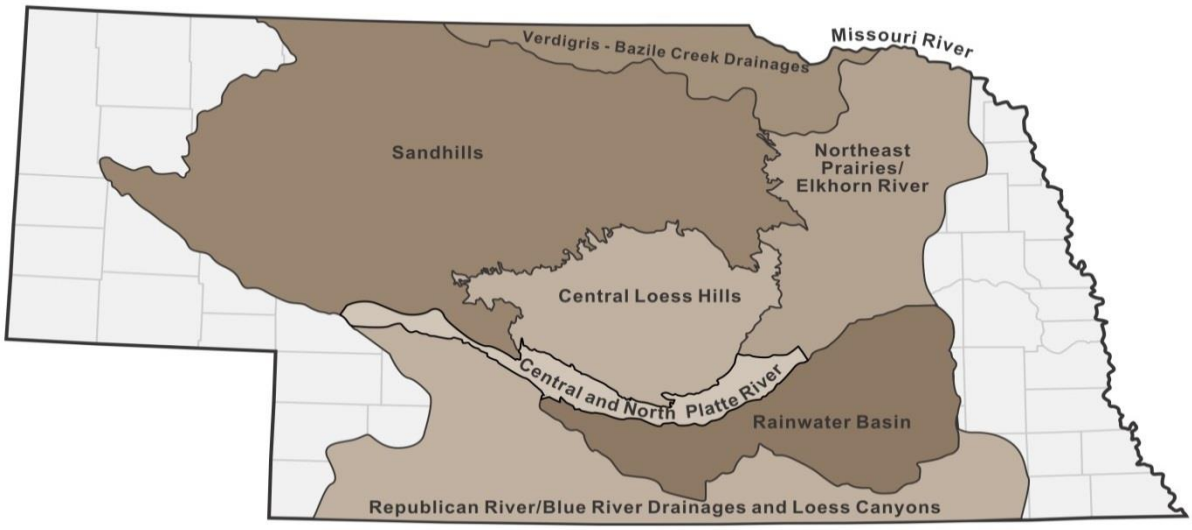

Figure 1. Geographic Focus Areas in the RWBJV Administrative Area.

of conservation partners in Nebraska. To provide geographic focus, Biologically Unique Landscapes (BULs) were identified, including 23 located within the RWBJV Administrative Area. These geographic areas were determined to have the highest probability of meeting the criteria of representing the various habitats within the state, and keeping common species common, while not overlooking pockets of habitat that support at-risk species. The 23 BULs in the RWBJV Administrative Area are:

Calamus River
Central Loess Hills
Central Platte River
Cherry County Wetlands
Dismal River Headwaters
Elkhorn River Headwaters
Elkhorn Confluence
Keya Paha
Loess Canyons
Lower Loup River
Lower Niobrara River
Middle Loup River
Middle Niobrara
North Loup River
Panhandle Prairies
Platte Confluence
Rainwater Basin
Sandhills Alkaline Lakes
Sandstone Prairies
Snake River
Southeast Prairies
Verdigris-Bazile

The RWBJV Administrative Area encompasses approximately 35 million acres and contains over 2.3 million acres of wetland habitats and over 20 million acres of grasslands (Table 1). Wetlands comprise nearly 7% of the RWBJV Administrative Area, while grasslands cover approximately 60% of the landscape (Table 1). Each Geographic Focus Area contains a variety of wetland, grassland, and woodland habitats. Over half of the wetlands found within the RWBJV Administrative Area are located in the Sandhills, with a majority of these acres classified as sub-irrigated wet meadows (palustrine wetlands). The RWB Geographic Focus Area contains the highest density of playa wetlands (palustrine wetlands), followed by the Central Loess Hills (Central Table Playa Complex), Northeast Prairies/Elkhorn River (Todd Valley Wetland Complex), and Republican River/Blue River Drainages and Loess Canyons (Southwest Playa Wetland Complex). The Republican River/Blue River Drainages and Loess Canyons GFA contains the most human-made wetland features (reservoirs, stock dams, and irrigation reuse pits; Table 1). Outside of the Sandhills, grasslands are generally confined to the floodplains of the major river systems or on environmentally sensitive lands. The primary Geographic Focus Areas with significant grasslands are the Central Loess Hills, Northeast

Table 1. Wetland and grassland acres and their distribution by Geographic Focus Area (Bishop et al. 2011).

Geographic Focus Area	Geographic Focus Area (Acres)	Total Wetland (Acres)	Lakes & Reservoirs (Acres)	Palustrine Wetlands (Acres)	Riverine Wetlands (Acres)	Lacustrine Wetlands (Acres)	Grassland (Acres)
Central Loess Hills	3,598,453	169,185	20,504	12,473	136,209	0	2,166,456
Central and North Platte River	1,035,879	107,514	6,597	1,590	99,327	0	160,448
Missouri River	77,852	40,858	12,309	7,714	20,835	0	6,279
Northeast Prairies/ Elkhorn River	4,792,660	339,339	19,676	16,774	302,889	0	1,320,359
Rainwater Basin	3,830,130	120,852	25,703	44,198	50,950	0	677,965
Republican River/Blue River Drainages and Loess Canyons	5,826,800	226,427	60,937	5,437	160,054	0	3,140,230
Sandhills	13,587,519	1,253,724	25,719	1,120,700	22,331	84,974	11,535,386
Verdigris – Bazile Creek Drainages	2,004,581	91,833	7,766	4,770	79,297	0	1,383,183
Total	**34,753,873**	**2,349,733**	**179,212**	**1,213,656**	**871,891**	**84,974**	**20,390,306**

Prairies/Elkhorn River, Republican River/Blue River Drainages and Loess Canyons, Sandhills, and Verdigris-Bazile Creek Drainages (Table 1).

Central Loess Hills

The Central Loess Hills Geographic Focus Area, located in the center of the RWBJV Administrative Area, contains rolling to steep loess hills dissected by the valleys of the North, Middle, and South Loup rivers. Ridge tops (tables) are nearly level to gently sloping and covered with loess soils. Scattered across these table lands are numerous playa wetlands referred to as the Central Table Playas (LaGrange 2005). Based on hydric soil mapping units (polygons) and depressional wetland points defined in the Soil Survey Geographic Database (SSURGO), as well as the palustrine wetlands delineated in the National Wetlands Inventory (NWI; Cowardin et al. 1979), it is estimated that there were once over 6,300 playas covering more than 18,000 acres. Based on an assessment of aerial photography completed in 2010, just over half of the playas (3,470 individual wetland footprints) continue to demonstrate some level of function, such as ponding water or growing hydric vegetation (Bishop et al. 2011). These playa wetlands are generally smaller than the playas found in the RWB and are characterized by seasonal and temporary water regimes.

The steep, erodible side slopes of the Central Loess Hills drop off into the broad floodplains of the Loup rivers. The Central Loess Hills GFA contains the lower reaches of the Middle Loup, North Loup, and South Loup rivers, all of which are spring-fed and originate in the Sandhills. These broad and shallow sand-bed rivers maintain relatively constant year-round stream flow. Sandbars and shallow side channels are typical features within and adjacent to the active river channels.

Based on a 2011 habitat assessment, the Central Loess Hills GFA contains approximately 12,500 acres of palustrine wetlands, 136,000 acres of wet meadows and other riverine wetlands, and approximately 2.2 million acres of grasslands (Table 1). The playa wetlands found in this GFA provide important migration stopover habitat for the endangered Whooping Crane (Austin and Richert 2001), as well as numerous other species of migratory waterbirds (e.g., waterfowl, shorebirds, and wading birds). The riverine wetlands associated with the Loup rivers provide breeding habitat for the threatened Northern Great Plains population of Piping Plovers and the endangered Interior Least Tern. The wet meadows and associated grasslands found in the Central Loess Hills currently support an estimated 875,000 grassland nesting birds (Appendix C).

Row-crop agriculture and ranching are dominant land uses in the Central Loess Hills. Row-crop agriculture is generally confined to the river valleys and areas of limited topographic relief. Crops generally include alfalfa, corn, milo, soybeans, and wheat. Most of the steep, more erodible slopes remain as native grasslands dominated by mixed-grass prairie communities. Higher commodity prices and the guaranteed income provided by the Federal Crop Insurance Program have contributed to the conversion of environmentally sensitive grasslands and wetlands to row-crop agriculture. This conversion has reduced the quantity and distribution of grassland, wetland, and wet-meadow habitats found throughout the Central Loess Hills. The encroachment of undesirable plant species (i.e., eastern red cedar, Russian olive, smooth brome, etc.) has occurred on thousands of acres of native habitats. Fire suppression is believed to be a

major factor that has contributed to the expansion of invasive species throughout this Geographic Focus Area.

Central and North Platte River

The Central Platte River is a 90-mile segment of the Platte River, extending from Lexington, Nebraska to Chapman, Nebraska. Historically, the Platte River was a wide, shallow river with multiple channels that meandered across an expansive floodplain. Large, scouring floods regularly set back vegetation succession and maintained a diversity of habitats across the floodplain. Following European settlement, the Platte River was extensively regulated, and the flood pulses and river flows that once shaped the ecosystem were greatly reduced. As a result, the areas of active floodplain and associated wet meadows were reduced, the river channels narrowed and deepened, and extensive riparian forests became established on islands and along river banks. For example, a comparison of average annual discharge levels at the city of North Platte, Nebraska, before 1930 and after 1930, shows a 70% reduction in river flows (U.S. Fish and Wildlife Service 1981). At the same monitoring location, the channel width narrowed from nearly 2,950 ft. to less than 330 ft. between 1870 and 1970. Similarly, the average channel width near Overton, Nebraska, declined from 4,800 ft. in 1865 to 740 ft. in 1998 (Murphy et al. 2004). Sidle et al. (1989) reported that 60% to 80% of the open riverine/sandbar habitat and 55% of wet meadow habitat had been lost in this reach of the Platte River because of agricultural conversion, development, and hydrologic changes.

Despite the highly altered nature of this system, the combination of broad, braided river channels, adjacent wet meadows, and abundant food supplies continues to attract millions of wetland-dependent migratory birds each year. The 60,000 acres of palustrine and riverine wetlands and over 140,000 acres of grassland that occur along the Central Platte River (Table 1) continue to provide necessary roosting, loafing, and foraging habitat for millions of migratory birds. These habitats are used by endangered Whooping Cranes (USFWS 1978), and approximately 90% of the world's population of Sandhill Cranes, and serve as migration and wintering habitat for millions of waterfowl. They also provide stopover habitat for a myriad of waterbirds and non-breeding habitat for numerous shorebirds. In addition to migration habitat, the Central Platte River provides breeding habitat for the threatened Northern Great Plains population of Piping Plovers and the endangered Interior Least Tern, and for an estimated 160,000 priority grassland-nesting birds (Appendix C).

Today, the Central Platte River valley is intensely cultivated. Based on the 2009 United States Department of Agriculture (USDA) Cropland Data Layer, over 60% of the historic floodplain is planted to corn, soybeans, or alfalfa (USDA 2009). In 2004, because of the diversion of water for irrigation, much of the Platte River was declared over-appropriated by the Nebraska Department of Natural Resources (DNR). This designation required new groundwater and surface water depletions to be offset, with the intent of managing the system in a sustainable manner. Although cropland conversion has slowed, gravel mining and residential and commercial development continue to result in the loss of riverine and wet-meadow habitats. Invasive plant species also continue to degrade in-channel habitats and adjacent wet meadows. Primary threats include: eastern red cedar, Kentucky bluegrass, *Phragmites*, purple loosestrife, reed canary grass, and smooth brome.

The North Platte River is one of the two tributaries that form the Platte River. The North Platte River originates in Colorado and flows through Wyoming before entering Nebraska. The stretch of the North Platte River within the Central and North Platte River GFA is located approximately 60 miles upstream from the river stretch designated as the Central Platte River. This stretch of river has a high density of palustrine and riverine wetland habitats, including approximately 36,000 acres of wet meadows and 16,000 acres of grasslands dominated by mixed-grass prairie species (Bishop et al. 2011).

The wetland and grassland habitats in this 80-mile stretch of river from Lewellen, Nebraska to North Platte, Nebraska have also been negatively impacted by the extensive regulation of North Platte River flows since European settlement. It is estimated that 25% of the historic wet meadows have been converted to row-crop agriculture (LaGrange 2005). The altered flow regimes have resulted in an increase of scrub-shrub and forested wetlands at the expense of riverine and emergent wetlands (LaGrange 2005).

Despite the negative impacts of land-use conversion and altered flow regimes, this stretch of river contains a diverse mix of riverine and marsh-like wetlands within the historic floodplain and river channel. Approximately 80% of the wetlands are either temporary or seasonal in nature (LaGrange 2005). This area is extremely important to the portion of the mid-continent population of Sandhill Cranes (approximately 56,000 individuals) that do not stage in the Central Platte River valley (Krapu et al. 2011).

Although the conversion of grasslands and wet meadows to row-crop agriculture has slowed as a result of the moratorium on new irrigated acres, these habitats continue to be converted for gravel mining operations and urban/suburban/commercial development. Wet meadows and grasslands in the North Platte River valley are also being invaded by eastern red cedar, Kentucky bluegrass, *Phragmites*, purple loosestrife, reed canary grass, Russian olive, and smooth brome.

Missouri River

The Missouri River GFA forms the northeast boundary of the RWBJV Administrative Area. This 125-mile stretch of river, between Ponca, Nebraska and Spencer, Nebraska, is the southernmost unchannelized portion of the Missouri River. Because this portion of the river remains unchannelized, the active channel and associated floodplain contain a myriad of riverine and palustrine wetlands.

Prior to the 1930s, the Missouri was an unmanaged, natural river that supported a tremendous number and diversity of fish and wildlife. The river occupied a sandy channel and flowed between erodible banks, from 1,500 feet to over one mile apart, with braided, sinuous channels twisting among sheltered backwaters, sloughs, chutes, oxbows, gravel bars, sandbars, mudflats, snags, alluvial islands, deep pools, marshland, and shallow-water areas (U.S. Fish and Wildlife Service 1980). The character of the Missouri was drastically altered between 1930 and 1970 as channelization and main-stem dams narrowed and deepened the river channel, and associated floodplain wetlands disappeared. The six main-stem dams in the Dakotas, Montana, and Nebraska have changed water quality, quantity, and timing throughout the Missouri River system (LaGrange 2005). The controlled release of water from the upstream dams has reduced the flood pulse that was a key factor in maintaining the in-channel habitat and adjacent floodplain wetlands. Although the stretch of river in the GFA is not channelized,it is still negatively impacted by the upstream dams. Reduced sediment loads negatively influence channel

morphology, while controlled releases from upstream dams reduce scouring and in-channel habitat maintenance (LaGrange 2005). Many of the off-channel wetlands historically associated with this system have been altered to increase row-crop agriculture. Today 18,000 acres, or 25% of the landscape, are under row-crop agriculture production (USDA 2009).

Based on a 2011 habitat assessment, the Missouri River GFA contains approximately 28,500 acres of palustrine and riverine wetlands, and just over 6,000 acres of grassland. (Table 1). Despite the numerous alterations to the system, these wetlands still provide vital stopover habitat for numerous migratory waterfowl and shorebirds, as well as breeding habitat for the threatened Northern Great Plains population of Piping Plovers and the endangered Interior Least Tern.

The greatest threat to the unchannelized portion of the Missouri River is riverbed degradation (LaGrange 2005). Other key threats include residential/agricultural/commercial development, transportation, water pollution, water development projects, stream bank stabilization, drainage, and filling (LaGrange 2005). Projects associated with each of these threats have both direct and indirect impacts that cumulatively impair river functions by isolating the floodplain from the river and reducing the natural dynamics. Invasive vegetation also threatens habitat for migrating waterfowl, shorebirds, and other wetland-dependent species. Purple loosestrife and *Phragmites* have become established throughout this stretch of the Missouri River, including the confluence of the Niobrara River. Expansion of these species into the backwaters of Lewis and Clark Lake and the Niobrara and Missouri rivers is a threat to native plants and habitat.

Northeast Prairies/Elkhorn River

The Northeast Prairies/Elkhorn River GFA is located in the northeastern portion of the RWBJV Administrative Area. This Geographic Focus Area is intensely farmed and has a higher human population density than other Geographic Focus Areas in the RWBJV Administrative Area, creating a fragmented landscape. At one time, the uplands were dominated by grasslands with a diverse assemblage of tallgrass and mixed-grass prairie species (Schneider et al. 2011). Some localized regions in this GFA contained a high density of playa wetlands. The playa wetland complex associated with this GFA is described as the Todd Valley Playa Wetland Complex (LaGrange 2005).

Today the mesic floodplains and steeper drainages associated with the Elkhorn River contain savannahs, woodlands, and densely forested habitats. Remnant tallgrass prairies are scattered across the region. The remaining playa wetlands contain a diverse mix of early successional wetland vegetation communities.

Despite the intensive row-crop and agricultural/urban/suburban development, this Geographic Focus Area contains significant grassland and wetland acres. Approximately 320,000 acres of palustrine and riverine wetlands and over 1.3 million acres of grassland occur throughout the Northeast Prairies/Elkhorn River GFA (Table 1). This landscape provides breeding habitat for numerous grassland nesting birds, while the Elkhorn River provides breeding habitat for the threatened Northern Great Plains population of Piping Plovers and the endangered Interior Least Tern. The Elkhorn River and Todd Valley wetlands provide secondary habitat for migrating wetland-dependent species (shorebirds, waterbirds, and waterfowl).

As with most of eastern Nebraska, this region is intensely cultivated. Nearly all of the grasslands have been converted and many of the embedded playa wetlands drained to promote row-crop

agriculture. Based on the 2009 USDA Cropland Data Layer, 55% of this landscape is cultivated to corn, soybeans, or alfalfa (USDA 2009; Bishop et al. 2011). Nearly 10% of the grassland cover has been re-established through the Conservation Reserve Program (CRP). Although many of these acres were not planted exclusively to native species, the acres complement the native tallgrass remnants scattered throughout the region. A majority of the CRP contracts are expiring, and current high commodity prices, plus the safety net provided by the Federal Crop Insurance Program, are accelerating conversion of these acres back to row-crop agriculture.

Invasive plant species, such as eastern red cedar, Kentucky bluegrass, *Phragmites*, purple loosestrife, reed canary grass, and smooth brome, continue to degrade wet meadows and adjacent mesic floodplains in this region. The loss of grasslands in the region has resulted in higher stocking rates and a shift to year-long grazing regimes. The transitions in grazing practices, as well as fire suppression, are believed to be a major factor contributing to the encroachment of undesirable plant species (i.e., Kentucky bluegrass, eastern red cedar, and smooth brome, etc.).

Rainwater Basin

The RWB encompasses 6,150 square miles, including parts of 21 counties in the south-central portion of the RWBJV Administrative Area. Condra (1939) identified this landscape as the Loess Plains Region of Nebraska. This region has expansive rolling loess plains formed by deep deposits of wind-blown silt with a high density of clay-pan playa wetlands. Overland runoff from intense summer storms and melting winter snowfall fill these playa wetlands.

Analysis of historic soil surveys (1910–1917), NWI (1980–1982), and SSURGO data (1961–2004) indicates that playa wetlands were once a prominent feature of this landscape. Combined, these datasets identified approximately 11,000 individual playa wetlands (204,000 acres) that were historically part of the landscape. It has been estimated that there were over 1,000 semi-permanent and seasonal wetlands, which covered over 70,000 acres, and more than 10,000 temporary wetlands that accounted for an additional 134,000 acres.

The Nebraska Game and Parks Commission (NGPC) conducted a breeding waterfowl habitat survey (McMurtrey et al. 1972), and used the historic soil surveys as a reference to evaluate the distribution of remaining wetlands. McMurtrey et al. (1972) reported that 82% of the major wetlands had been converted to agriculture, removing approximately 63% of the total wetland acres from the landscape. The fast-paced degradation continued, and by 1985 only 10% of the surveyed wetlands remained. The remaining wetlands represented only 22% of the original surveyed acres, and virtually all were hydrologically impaired (Schildman and Hurt 1984). Because of the extensive wetland loss and continued degradation, RWB wetlands were given a Priority 1 ranking, the most imperiled status, in the Nebraska Wetlands Priority Plan (Gersib 1991).

Land use in the RWB is dominated by row-crop agriculture (70% of the acres), predominantly in a corn and soybean rotation. Grassland habitats make up approximately 20% of the region, while 3% of the area is covered by savannahs, woodlands, and forest communities that are confined to the steeper drainages associated with the Republican and Blue river systems. Riverine wetlands associated with these systems comprise about 2% of the landscape. Of the historic 204,000 RWB wetland acres, roughly 40,000 acres remain, or about 17% of the historic distribution. Today, playa wetlands in the RWB make up less than 1% of the total landscape (Bishop and Vrtiska 2008; Bishop et al. 2011).

Approximately 44,000 acres of palustrine wetlands, 51,000 acres of riverine wetlands, and 678,000 acres of grassland presently occur throughout the RWB Geographic Focus Area (Table 1). Despite the extensive wetland loss, this region still hosts one of the greatest wildlife migration spectacles on earth. During spring migration, the RWB provides roosting, loafing, and foraging habitat for millions of migratory waterfowl and other wetland-dependent species. The RWB provides essential staging habitat for an estimated 8.6 million waterfowl (RWBJV 2013*c*) and nearly 600,000 shorebirds (RWBJV 2013*a*), as well as vital stopover habitat for the endangered Whooping Crane.

Over the years, a variety of wetland rules and laws have helped to significantly reduce active wetland drainage; however, wetland function across the landscape continues to decline as a result of intentional human activity, such as active drainage, and through ecological processes, including natural and culturally accelerated sedimentation (LaGrange et al. 2011). In addition, wetland modifications, including water concentration/irrigation reuse pits, land leveling, culturally accelerated sediment, and drainage ditches, directly impact the wetlands or limit the amount of runoff reaching the wetlands. Furthermore, the combination of sedimentation and altered watershed hydrology leads to conditions that promote invasive species. Depending on the water regime and duration of saturated conditions, primary threats include reed canary grass, hybrid cattail (Grace and Harrison 1986), and river bulrush (Kaul et al. 2006, Rolfsmeier and Steinauer 2010).

Republican River/Blue River Drainages and Loess Canyons

The Republican River/Blue River Drainages and Loess Canyons GFA lies along the southern boundary of the RWBJV Administrative Area. A limited surface and groundwater supply differentiates the region from other Geographic Focus Areas within the RWBJV Administrative Area. As a result, a significant proportion of the cropland is cultivated with dry-land farming practices. Despite the limited ground- and surface-water resources, significant irrigation development occurred in the Republican River drainage through 2004. The unsustainable irrigation development ultimately led the Nebraska DNR to designate the Republican River drainage as an over-appropriated river basin. This designation led to a combination of restrictions on new acres developed for irrigation and on irrigation water allocations. The Blue River basins are defined by the drainage area of the Big and Little Blue rivers. At this time the Blue river basins have no limitations on groundwater development, but triggers are in place should further groundwater depletions occur.

In the western portion of this region, there are numerous playa wetlands that are part of the Southwest Playa complex (LaGrange 2005). These freshwater wetlands receive water from runoff and are small (mostly less than 5 acres), temporarily and seasonally flooded wetlands. Most have no natural outlet for water. In most years, these wetlands dry up early enough in the growing season to be farmed. Southwest Playa wetlands are similar to RWB wetlands farther east, except that the RWB complex receives greater rainfall, and the wetlands there tend to be larger (LaGrange 2005).

The topography and soils of this GFA vary from steep hills and canyons with highly erodible soils in the west, to relatively flat and highly productive plains, rolling hills, and breaks in the east. Stream flows vary and are dependent on precipitation. Grasslands are dominated by mixed-grass prairie communities, with tallgrass prairies occurring along the eastern boundary.

Fire suppression and year-long grazing regimes are believed to be major factors contributing to the establishment of invasive species in many of the grasslands in this GFA.

Approximately 5,000 acres of palustrine wetlands, 160,000 acres of riverine wetlands, 61,000 acres of lakes and reservoirs, and 3.1 million acres of grassland are found throughout the Republican River/Blue River Drainages and Loess Canyons GFA (Table 1). With the exception of Harlan County Reservoir, a 16,000 acre flood-control reservoir, water bodies are typically associated with small watershed impoundments created for flood control, grade stabilization, and livestock water. These man-made wetland features (reservoirs and stock ponds) provide migration, and at times wintering, habitat for waterfowl, as well as stopover habitat for numerous species of shorebirds. The grasslands in this Geographic Focus Area provide breeding habitat for an estimated 1.5 million grassland nesting birds (Appendix C).

Habitat loss from grassland conversion and wetland drainage for row-crop agriculture has occurred to varying degrees throughout this GFA. Row-crop agriculture development has been slower in the Republican River Basin, primarily because of a limited groundwater aquifer and moratoriums on irrigation development. Invasive species continue to threaten habitat quality of both wetlands and uplands in the GFA. *Phragmites*, purple loosestrife, and reed canary grass have played a role in reducing habitat, constricting river channel widths, and depleting surface water flows.

Sandhills

The Sandhills are a 19,300 square-mile sand dune formation located in north-central Nebraska. Although located in a semi-arid climate, the Sandhills contain an abundance of lakes, wetlands, wet meadows, and spring-fed streams scattered across the largest contiguous grass-stabilized dune system in North America (Schneider et al. 2011).

Between the dune formations are long, gently sloping valleys containing spring-fed meandering streams, lakes, wetlands, and wet meadows. Groundwater recharge is the prominent characteristic of the sands, creating a vast aquifer that stores 700-800 million acre-feet of groundwater (Keech and Bentall 1971). This volume represents twice the volume of Lake Erie. Most of the area's lakes, wetlands, and streams are sustained by groundwater discharge from adjoining dunes. About 90 % of the stream flow (2.4 million acre-feet) comes from groundwater discharge (Bentall 1990). The Niobrara River flows along the Sandhills' northern border, and the North Platte and Platte rivers flow along part of the southern boundary. The Calamus, Cedar, Dismal, Elkhorn, and Loup rivers originate within the Sandhills.

Approximately 1.1 million acres of palustrine and riverine wetlands, 85,000 acres of lacustrine wetlands, and over 11.5 million acres of grassland are found throughout the Sandhills Geographic Focus Area (Table 1). The mosaic of wetlands and grasslands was identified by Bellrose (1980) as the most significant waterfowl nesting habitat outside of the Prairie Pothole Region. Vrtiska and Powell (2011) estimated that 275,000 waterfowl annually nest in the Sandhills. The larger Sandhills lakes provide nesting habitat for a majority of the High Plains flock of Trumpeter Swans (Grosse et al. 2012). The wet meadows and grasslands provide vital nesting habitat for an estimated 4 million grassland birds (Appendix C). A significant proportion of the estimated 400,000 breeding shorebirds found in the RWBJV Administrative Area occur in the Sandhills (RWBJV 2013*a*). Nearly all of the nesting waterbirds in the RWBJV Administrative Area occur in the Sandhills (RWBJV 2013*b*).

Wetland loss in the Sandhills has occurred primarily through draining by surface ditches, beginning as early as 1900 (U.S. Fish and Wildlife Service 1960; McMurtrey et al. 1972; LaGrange 2005). With the introduction of center-pivot irrigation systems to the Sandhills in the early 1970s, land leveling/shaping and local water-table declines resulted in extensive wetland losses in some areas. While quantifiable data are not available for the Sandhills, estimates of wetland acres drained range from 15% (McMurtrey et al. 1972) to 46% (U.S. Fish and Wildlife Service 1986). Sandhills wetlands were given a Priority 1 ranking, the most imperiled status in the Nebraska Wetlands Priority Plan, because of very extensive past losses (Gersib 1991). Wetlands in the Sandhills continue to be threatened by drainage ditches, generally created to increase hay acreage. This drainage directly impacts the lake or wetland where the project occurs and also can lead to cumulative wetland loss, both downstream and upstream, as the channel becomes entrenched, lowering the water table, and causing lateral drainages that impact adjacent wetlands. Many smaller wetlands are also threatened by conversion from ranching to irrigated row-crop agriculture. Concentrated, large-scale irrigation development can result in long-term effects on wetland communities by lowering the groundwater table. Many of the lands originally developed for row-crop production have been planted back to grasslands. This was incentivized by the CRP program. However, CRP acres could be rapidly converted to row-crop agriculture. As CRP contracts expire, there are multiple factors that could influence conversion of these lands back to row-crop agriculture. For example, current commodity prices, land values, and cash rent remain at all-time highs, and the Federal Crop Insurance Program provides a source of guaranteed income for cultivation of these environmentally sensitive lands.

Verdigris-Bazile Creek Drainages

This landscape, located in the northern portion of the RWBJV Administrative Area, is defined by the watersheds of Verdigris and Bazile creeks, which originate in and flow through Cedar, Knox, Holt, and Antelope counties, emptying into the Niobrara and Missouri rivers in northeast Nebraska.

Topography is variable, resulting in a mosaic of cropland, grasslands, and woodlands. This Geographic Focus Area is located at the transition zone between the tallgrass and mixed-grass prairie ecoregions. As a result, the grasslands contain a diverse assemblage of tallgrass and mixed-grass prairie communities. Tallgrass prairie communities dominate the native grasslands along the eastern boundary, while species strongly associated with mixed-grass prairie prevail in grasslands along the western border. Woodlands are generally confined to the drainages and bluffs associated with the major riverine systems (Verdigris Creek, Bazile Creek, Missouri River bluffs and breaks) (Schneider et al. 2011). These woodlands are dominated by deciduous species. The dominant cultivated crops in this region include corn, soybeans, and alfalfa (Bishop et al. 2009).

Approximately 4,800 acres of palustrine wetlands, 79,000 acres of riverine wetlands, 7,800 acres of lakes and reservoirs, and 1.4 million acres of grassland occur throughout the Verdigris-Bazile Creek Drainages GFA (Table 1). The CRP program has been utilized to re-establish grasslands on former row-crop acres with steeper topography and water erosion problems. Although many of these acres were not planted exclusively to native species, the re-established grassland acres complement the native tallgrass and mixed-grass remnants scattered throughout the region. It is estimated that this landscape provides nesting habitat for 600,000 grassland breeding birds

(RWBJV 2013*a*). The Niobrara River provides breeding habitat for the threatened Northern Great Plains population of Piping Plovers and the endangered Interior Least Tern.

A majority of the CRP contracts are expiring, and current high commodity prices, plus the safety net provided by the Federal Crop Insurance Program, are accelerating conversion of these acres back to row-crop agriculture. Grassland conversion is also occurring as a result of current farm economics and farm policy. Fire suppression and year-long grazing regimes are suspected of creating conditions that allow eastern red cedars, Kentucky bluegrass, and smooth brome to invade grasslands. Eastern red cedars have also invaded the woodlands and forests associated with the Verdigris - Bazile Creek Drainages.

Continental Priority Landbird Species

Land-use intensification is commonly identified as the major cause of landbird population declines (Murphy 2003, Smith and Lomolino 2004, Askins et al. 2007). Although the type and intensity of land use varies among regions in North America, grassland conversion to agriculture is the primary driver of species' population declines in the Great Plains and the RWBJV Administrative Area. The conversion of wetlands and grasslands has increased habitat fragmentation. Encroachment into native habitats by invasive species has continued to decrease the distribution and abundance of high-quality native grassland habitat. Collectively, the effects of land-use change, habitat fragmentation, and invasive species reduce suitable habitat. The Grassland Conservation Plan for Prairie Grouse (Vodehnal and Haufler 2008) identifies grassland conversion, fire suppression, improper grazing management, invasive exotic species, and human development as threats to prairie grouse, which are often used as surrogate species in landscape management. Loss of suitable habitat increases predation and nest parasitism, reducing survival and recruitment of landbirds.

Previous habitat conservation efforts have succeeded in reversing downward trends for some species; however, numerous landbird species continue to experience population declines. The formation of the PIF NALCP was a step toward collaborative conservation for landbirds. Composed of individual researchers, government agencies, and non-government conservation organizations, Partners in Flight is committed to maintaining the science and planning base for hundreds of species of landbirds. The PIF NALCP was developed in 2004 and has become the guiding document in partnership-based landbird conservation. One of its purposes is to assess species vulnerability at continental and regional scales. The PIF NALCP identified six factors to evaluate the status of each species of landbird. These factors include: population size, breeding distribution, non-breeding distribution, threats to breeding, threats to non-breeding, and population trend (Rich et al. 2004).

In developing the continental watch list for the PIF NALCP, a scoring system was established that weighted various factors associated with a species' vulnerability. Species with elevated vulnerability scores based on multiple factors were added to the continental watch list, of which about 40% of the species were included as a result of declining trends or high threats within the Great Plains—primarily the loss of grassland. Within the RWBJV Administrative Area, PIF NALCP identified 31 landbird species of regional concern (Table 2), of which the Bell's Vireo is the only species in the category calling for "Critical Recovery Action." The remaining 30 species are classified as species needing "Management Action" to stop their downward

population trends. The species are listed in descending order by their combined (breeding and non-breeding) continental scores—the higher the score, the greater the threat (Table 2).

Table 2. Species considered by PIF NALCP to be of regional concern that occur within the RWBJV Administrative Area (RWBJV AA) (Partners in Flight Science Committee 2012. Species Assessment Database, version 2012. Available at http://mbo.org/pifassessment and Sharpe et al. 2011).

Species	Distribution	Habitat	PIF NALCP Score
Critical Recovery Action Needed			
Bell's Vireo	Breeds throughout RWBJV AA	Shrub/Successional	16
Management Action Needed			
Greater Prairie-Chicken*	Resident, throughout RWBJV AA	Grassland	19
Sprague's Pipit*	Migrant throughout RWBJV AA	Grassland	19
Baird's Sparrow*	Migrant, western $^1/_3$ of RWBJV AA	Grassland	19
Northern Harrier	Resident throughout RWBJV AA	Grassland/Wetland	17
Short-eared Owl	Breeds, northwest RWBJV AA (Sandhills) Winters throughout RWBJV AA	Grassland	17
Scissor-tailed Flycatcher	Breeds, very southeast corner of RWBJV AA	Grass/Woodland	17
Ferruginous Hawk	Breeds northeast Winters throughout RWBJV AA	Grassland	16
Grasshopper Sparrow	Breeds throughout RWBJV AA	Grassland	16
Eastern Meadowlark	Breeds, Sandhills & eastern edge of RWBJV AA	Grassland	16
Swainson's Hawk	Migrant throughout RWBJV AA Breeds, western ¾ of RWBJV AA	Grassland	15
Prairie Falcon	Winters throughout RWBJV AA	Grassland	15
Yellow-billed Cuckoo	Migrant throughout RWBJV AA Breeds throughout RWBJV AA	Shrub/Successional	15
Black-billed Cuckoo	Breeds throughout RWBJV AA	Woodland	15
Barn Owl	Breeds throughout RWBJV AA	Grass/Woodland	15
Loggerhead Shrike	Breeds throughout RWBJV AA	Grassland with scattered small trees/shrubs	15
Dickcissel	Breeds throughout RWBJV AA	Grassland	15
Lark Sparrow	Breeds throughout RWBJV AA	Grass/Woodland	15
Management Action Needed			
Henslow's Sparrow*	Breeds, eastern 1/3 of RWBJV AA	Grassland	15

Table 2. Species considered by PIF NALCP to be of regional concern that occur within the RWBJV Administrative Area (RWBJV AA) (Partners in Flight Science Committee 2012. Species Assessment Database, version 2012. Available at http://mbo.org/pifassessment and Sharpe et al. 2011).

Species	Distribution	Habitat	PIF NALCP Score
Baltimore Oriole	Breeds throughout RWBJV AA	Woodland, edge, successional, grassland	15
Burrowing Owl	Breeds, western ¾ of RWBJV AA	Grassland	14
Red-headed Woodpecker*	Breeds throughout RWBJV AA	Woodland	14
Brown Thrasher	Breeds throughout RWBJV AA	Shrub/Grassland	14
Golden Eagle	Migrant throughout RWBJV AA	Grassland	14
Bank Swallow	Breeds throughout RWBJV AA	Grassland/Wetland	14
Golden-winged Warbler*	Rare migrant	Shrub/Successional	14
Field Sparrow	Breeds throughout RWBJV AA	Shrub/Successional	14
Lark Bunting	Migrant, west $^1/_3$ of RWBJV AA Breeds, west $^1/_3$ of RWBJV AA	Grassland	14
Bobolink*	Breeds throughout RWBJV AA	Grassland/Wetland	13
Western Meadowlark	Resident throughout RWBJV AA	Grassland	13
Horned Lark	Resident throughout RWBJV AA	Grassland/Agriculture Fields	10

*Identified on the PIF Watch List as a species vulnerable at the continental scale.

The PIF NALCP also identified "stewardship species" within individual BCRs. Stewardship species are described as species with restricted distribution; specific regions have a high proportion of the species' global population or range. The Greater Prairie-Chicken is an example of a stewardship species: 80% of its entire population occurs within BCR 19. In the RWBJV Administrative Area, PIF identified 13 stewardship species as needing management action (Table 3). They are listed in descending order by their combined (breeding and non-breeding) continental scores, with higher scores reflecting greater threat. Five species were identified as not needing management action, but because BCR 19 contains a significant portion of their population or range, they are identified as stewardship species.

Red-headed Woodpecker is the only species deemed to be in need of "Long-Term Planning" by the PIF NALCP. Continent-wide, this species has experienced significant declines, yet these population reductions have not been observed in BCR 19. However, because 22.8% of the Red-headed Woodpecker's continental population occurs within BCR 19, it was designated as a priority for long-term planning.

Table 3. Stewardship species, recognized by Partners in Flight, which occur within the Rainwater Basin Joint Venture Administrative Area (RWBJV AA) (Partners in Flight Science Committee 2012. Species Assessment Database, Version 2012. Available at http://rmbo.org/pifassessment and Sharpe et al. 2001).

Species	Distribution	Habitat	PIF NALCP Score
Management Action Needed			
Baird's Sparrow	Migrant, west $^1/_3$ of RWBJV AA	Grassland	19
Sprague's Pipit*	Migrant throughout RWBJV AA	Grassland	19
Greater Prairie-Chicken*	Resident throughout RWBJV AA	Grassland	19
Northern Harrier	Resident throughout RWBJV AA	Grassland/Wetland	17
Eastern Meadowlark	Breeds, Sandhills & east edge of RWBJV AA	Grassland	16
Grasshopper Sparrow	Breeds throughout RWBJV AA	Grassland	16
Ferruginous Hawk	Migrant throughout RWBJV AA. Breeds west and Northern ¾ of RWBJV AA	Grassland	16
Baltimore Oriole	Breeds throughout RWBJV AA	Woodland	15
Dickcissel	Breeds throughout RWBJV AA	Grassland	15
Lark Sparrow	Breeds throughout RWBJV AA	Grassland/Woodland	15
Swainson's Hawk	Migrant throughout RWBJV AA Breeds, west ¾ of RWBJV AA	Grassland	15
Western Meadowlark	Resident throughout RWBJV AA	Grassland	14
Bobolink*	Breeds throughout RWBJV AA	Grassland/Wetland	13
Long-Term Planning Needed			
Red-headed Woodpecker*	Breeds throughout RWBJV AA	Woodland	15
No Action Identified			
Sharp-tailed Grouse	Resident throughout RWBJV AA	Grassland	16
Nelson's Sparrow	Migrant, eastern edge of RWBJV AA	Wetland	15
Le Conte's Sparrow	Migrant throughout RWBJV AA	Grassland	15
Clay-colored Sparrow	Migrant throughout RWBJ V AA	Shrub/Grassland	14
Brown Thrasher	Breeds throughout RWBJV AA	Woodland	14

*Identified on the PIF Watch List as a species vulnerable at the continental scale.

In addition to the PIF NALCP, the NGPC identified 10 landbirds occurring within the RWBJV Administrative Area as Tier I at-risk species in the Nebraska State Wildlife Action Plan (Schneider et al. 2011). Tier I species are defined as species that are globally or nationally most at risk of extinction.

Nebraska's Tier I At-risk Species:

- Baird's Sparrow
- Bell's Vireo
- Burrowing Owl
- Ferruginous Hawk
- Greater Prairie-Chicken
- Henslow's Sparrow
- Loggerhead Shrike
- Short-eared Owl
- Sprague's Pipit
- Wood Thrush

Priority Landbird Species for the RWBJV Administrative Area

Unlike other Joint Ventures, which administer entire BCRs across multiple states, the RWBJV Administrative Area is confined entirely within Nebraska. Given the limited geographic scale, the RWBJV identified priority species as those whose populations would be most influenced through conservation actions in Nebraska. For planning purposes, the RWBJV focused on the breeding phase of the annual life cycle. Like other Joint Ventures in the Great Plains, the RWBJV assumed that if sufficient habitat for breeding species existed, there would be adequate habitat to support migrant landbirds passing through the RWBJV Administrative Area during the non-breeding phase of their annual life cycle.

Conservation planning for landbirds in the RWBJV Administrative Area focused on "priority" breeding species whose populations are most dependent on the grasslands and other native habitats of the RWBJV Administrative Area. In order to identify these species, the RWBJV utilized a hierarchical approach based on the criteria outlined in the PIF NALCP, which provides a transparent method of defining and identifying priority landbird species. Priority was given to species which the PIF NALCP designates with one of the following Regional Action Codes: Immediate Action (IM), Management Action (MA), or Long-term Planning and Responsibility (PR). Several species that do not breed regularly in the RWBJV Administrative Area were excluded: Baird's Sparrow, Bank Swallow, Black-billed Cuckoo, Bobolink, Burrowing Owl, Golden Eagle, Golden-winged Warbler, Horned Lark, Lark Sparrow, Prairie Falcon, Scissor-tailed Flycatcher, and Sprague's Pipit. Species identified for PIF NALCP as "No Action Identified" were also excluded from the RWBJV planning process.

Although Barn Owl was identified as a priority species, it was excluded from the planning process, since there are no accurate density measurements available for the species. The RWBJV will address this key uncertainty in the future through directed research and monitoring activities.

For planning purposes, the RWBJV also included Ring-necked Pheasant and Northern Bobwhite as priority species in the RWBJV Landbird Plan. These highly prized game species are priorities for many of the RWBJV partners. By focusing some attention on upland game, conservation organizations can help raise public awareness of the importance of grassland conservation and can leverage additional funding to support management actions that benefit not only game species, but also other priority landbird species dependent on the RWBJV Administrative Area.

Based on these criteria, the RWBJV identified 19 priority species (Table 4). These species will be used to guide conservation planning, set habitat benchmarks, and ultimately guide habitat delivery for landbirds in the RWBJV Administrative Area. Not all species were planned for in each Geographic Focus Area. Range maps and breeding records were referenced, and when

necessary, species were removed from the planning process for specific Geographic Focus Areas. For example, Henslow's Sparrows and Ferruginous Hawks are not found in the Central Loess Hills and were not planned for in this GFA.

Population Objectives

Population trends for each of the 19 priority species were derived from annual Breeding Bird Survey (BBS) data (1966–2010; Sauer and Link 2011). The estimated current carrying capacity was derived from the Hierarchical All Bird Strategy (HABS) database (Appendix B; Dobbs 2007), and BBS population trends were used to establish population goals. The HABS database calculates a species-based estimate of landscape carrying capacity by integrating both directed research projects (species-specific density estimates by habitat type) and Geographic Information System (GIS) data that describe the number of acres of each habitat type on the landscape

Table 4. Priority species and population goals established for the Rainwater Basin Joint Venture Administrative Area.

Species	BCR 19 BBS Trend (1966–2010) (%)	RWBJV Planning Trend (%)	Current Carrying Capacity	Population Goal
Baltimore Oriole	-0.4	0.6	322,198	361,911
Bell's Vireo	1	0	68,298	68,298
Dickcissel	0.9	0	1,140,415	1,140,415
Eastern Meadowlark	1.7	0	38,308	38,308
Ferruginous Hawk	1	0	1,673	1,673
Field Sparrow	-0.4	0.6	94,791	106,475
Grasshopper Sparrow	-0.6	0.9	5,054,301	6,018,052
Greater Prairie-Chicken	8.5	0	7,431	7,431
Henslow's Sparrow	19.9	0	3,899	3,899
Lark Bunting	-6.5	3.7	849,866	1,699,732
Loggerhead Shrike	-4	3.7	31,319	62,638
Northern Bobwhite	-0.5	0.8	102,713	118,783
Northern Harrier	-3.2	3.7	327,064	654,128
Red-headed Woodpecker	-0.7	1.1	20,959	25,695
Ring-necked Pheasant	-0.2	0.3	179,882	190,635
Short-eared Owl	-2.1	3.3	2,561	4,739
Swainson's Hawk	-1.9	3	20,307	35,420
Western Meadowlark	-0.8	1.2	4,261,010	5,378,660
Yellow-billed Cuckoo	-1	1.6	51,424	68,825

*Species' carrying capacities and population goals are relative estimates developed for planning purposes only and do not represent absolute population sizes

(Appendix A). For species with stable or increasing trends, the population goals were set to maintain current populations. For species with significant population declines, the RWBJV capped the population goals at double the current landscape carrying capacity. Population goals were set at the 1966 level for species that have shown only moderate declines. The projected time frame for meeting population goals was set to 2030. Species population goals and carrying capacity estimates were developed for planning purposes only. All current carrying capacity estimates and populations goals are *relative* estimates produced through a deterministic modeling approach in HABS, and are not necessarily representative of true population sizes.

Although the BBS population trends differ between BCRs 11 and 19, the land cover acreages of both areas were combined within the RWBJV Administrative Area. The Planning Species and their respective population goals (Table 4) are those associated with BCR 19. The small portion of BCR 11 located within the RWBJV Administrative Area is not representative of BCR 11's overall landscape, but rather is similar to BCR 19.

Primary Landbird Habitat in the RWBJV Administrative Area

Grasslands are an abundant feature in many of the Geographic Focus Areas in the RWBJV Administrative Area. Yet, each GFA contains a unique distribution and diversity of grassland communities, depending on climatic conditions and soil types. Following the east-west longitudinal gradient, grassland communities shift from tallgrass prairie to mixed-grass, and finally to short-grass prairie. Grassland habitat is critical to about 72–84% of the PIF NALCP species of concern, and to stewardship species identified in the RWBJV Administrative Area (Tables 1 & 2). Given the large percentage of grassland obligate species identified as a conservation priority, the RWBJV is focused on improving and managing prairie habitats for the various landbirds using the region during the breeding phase of their annual life cycle.

Grassland habitat selection by landbirds is influenced by various local and landscape factors (Johnson and Igl 2001, Davis 2004, Fuhlendorf et al. 2006). At a site-specific scale, vegetation composition (Fisher and Davis 2010), habitat management (Kim et al. 2008), and available moisture (Niemuth et al. 2008) are all examples of local factors that annually determine habitat selection, species composition, and density. For example, thick litter layers and tall, dense vegetation associated with wet meadows attract ground-nesting species such as Northern Harrier, Short-Eared Owl, Henslow's Sparrow, and Sedge Wren (Sharpe et al. 2001). In contrast, short vegetation caused by reduced moisture, burning, or elevated grazing intensities attracts Western Meadowlarks and Grasshopper Sparrows (Sharpe et al. 2001). At a landscape scale, woody cover has consistently been reported to negatively influence both occupancy and abundance for obligate grassland birds (Patterson and Best 1996, Bakker et al. 2002, Buskirk and Willi 2004, Kelsey et al. 2006). Habitat fragmentation caused by woody encroachment reduces the available grassland habitat for area-sensitive species (Helzer and Jelinski 1999). Across the RWBJV Administrative Area, most native grassland communities are highly susceptible to woody encroachment. Altered grazing regimes and the absence of fire can create favorable conditions for biological invasions, allowing species such as eastern red cedar to encroach into grasslands and reduce functional breeding habitat for grassland birds. Although certain biotic and abiotic conditions may play a prominent role in habitat selection (e.g., most grassland birds respond negatively to woody cover), it is the combination of landscape and site-specific features that creates the diversity and composition of habitat communities in the region. These various local and landscape drivers build a continuum of habitat conditions suitable to various species of

landbirds, specifically grassland species, at different times of the year in the RWBJV Administrative Area.

Conservation Design – Geographic Focus Area Targets and Strategies

At the conceptual level, landbird conservation practices must be developed to address the various factors that limit species distribution and abundance, especially for species of concern, or priority species recognized by state and federal agencies. Though there are many contributing factors, habitat loss and fragmentation are commonly identified as major causes of landbird population declines (Knopf 1994, Samson and Knopf 1994, Vickery and Herkert 2001, Askins et al. 2007, Utrup and Davis 2007). For non-breeding birds, habitat loss reduces resting and foraging habitat. This can impact body condition and ultimately reproductive success on the breeding grounds. For breeding birds, the degradation of habitats, both in quality and quantity, may increase the exposure of nesting birds to predators and brood parasites (Fahrig 2003, Askins et al. 2007, Ribic et al. 2009). Many grassland nesting species are area-sensitive, and therefore restoration of numerous small patches of habitat may not provide as many benefits as restoration of a single large area (Helzer and Jelinski 1999, Askins et al. 2007).

Habitat patch size may be an important predictor of species occurrence (Helzer and Jelinski 1999, Askins et al. 2007), yet species-habitat relationships are scale dependent (Wiens 1973, Patterson and Best 1996, Fisher and Davis 2010) and vary by species' life-history strategies, mobility, and body size (Bowman et al. 2002, Jenkins et al. 2007, Fisher et al. 2011). Although obligate grassland birds may cue in on similar cover types (i.e., grassland and woody cover), individual species respond to landscape-level processes at various spatial scales (Ribic and Sample 2001, Cunningham and Johnson 2006, Thogmartin et al. 2006). Identifying the spatial scales at which different species begin to form habitat decisions is critical and has strong implications for the outcome of a management action. To help address scale-dependent species-habitat relationships, the RWBJV will continue to develop spatially explicit species distribution models using GIS moving-window analysis to assess relationships at multiple spatial scales (Thogmartin et al. 2006, Franklin 2009). With regard to landbirds, many of which have recently undergone drastic declines, consideration should be taken prior to habitat improvements, to make certain that any management actions are conducted at an appropriate spatial scale and can benefit targeted species.

The RWBJV used the HABS database (Appendix B; Dobbs 2007) to create management scenarios in six Geographic Focus Areas in an effort to identify what specific management actions can be implemented to achieve desired landscape carrying capacities for landbirds. The Geographic Focus Areas are: Central Loess Hills, Central and North Platte River, Northeast Prairies/Elkhorn River, Republican River/Blue River Drainages and Loess Canyons, Sandhills, and Verdigris-Bazile Creek Drainages. These six areas were chosen because they contain the highest-density and largest grassland patches in the mixed-grass and tallgrass eco-regions. In addition, all six areas have a significant proportion of the grassland habitat available and suitable to support large populations of landbirds, specifically grassland-obligate species. Using both the HABS database and the Nebraska Landcover Dataset (Bishop et al. 2011), two targets were identified (see below) to help guide and achieve landscape carrying capacity to support landbirds

in the RWBJV Administrative Area. For the purposes of creating these scenarios, it is assumed that grazing intensity and grassland suitability are uniform throughout the landscape. Although not all species objectives are met, the carrying-capacity objectives were met for nine of the 20 planning species, and more than 75% of our goals were met for an additional nine species (Appendix C, Table C-8).

The figures used in each target and its associated strategies are not absolute, but represent a scenario that would allow the RWBJV to help meet habitat objectives for landbird species. These scenarios are based on the assumption that, on average, species respond as predicted to the habitat modifications prescribed in these scenarios. Changes in policies, programs, public support, and funding can and will determine which conservation opportunities will arise. As one target is exceeded, other target numbers will be adjusted.

Central Loess Hills Conservation Targets and Strategies

Target 1. By 2030, work with partners to remove 75% of eastern red cedar from grasslands, reducing woody encroachment on 124,200 acres (Table C-1, C-2).

Strategy A: Work with willing landowners to remove eastern red cedar from grasslands on their property.

Strategy B: Coordinate with local partners to conduct controlled burns to control and manage encroachment of eastern red cedar and other invasive species.

Strategy C: Create a decision support tool to prioritize management of cedar-infested areas and conduct targeted mailings to landowners to generate interest in cedar removal projects.

Target 2. By 2030, work with partners to enroll 10,500 additional acres in CRP in this Geographic Focus Area (Table C-1, C-2).

Strategy A: Work with willing landowners to re-establish grassland habitat in crop fields through the CRP program.

Strategy B: Create habitat suitability indices or species distribution models for a planning species or group of species to identify areas of the landscape where CRP contracts are most likely to benefit the targeted species. Work with partners on directed mailings to encourage landowner interest in CRP sign-up.

Strategy C: Based on habitat suitability indices and/or species distribution models, work with willing landowners to enhance habitat on existing CRP and other grassland acres through development of rotational grazing systems.

Central and North Platte River Conservation Targets and Strategies

Target 1. By 2030, work with partners to remove 10% of invasive woody vegetation from grasslands, reducing woody encroachment on 6,000 acres (Table C-1, C-3).

Strategy A: Work with willing landowners to remove undesirable and invasive woody vegetation from grasslands on their property.

Strategy B: Coordinate with local agencies to conduct controlled burns to manage and control encroachment of invasive species in problem areas.

Strategy C: Create a decision support tool to prioritize infested areas and conduct targeted mailings to landowners to promote interest in projects to remove undesired plant species.

Target 2. By 2030, work with partners to increase acres of grassland restored through conservation programs by 5,000 acres. (Table C-1, C-3).

Strategy A: Work with willing landowners to re-establish grassland habitat in crop fields through conservation programs.

Strategy B: Create habitat suitability indices or species distribution models for a planning species or group of species to identify areas of the landscape where conservation programs are most likely to benefit the targeted species. Work with partners on directed mailings to promote landowner interest in grassland restoration programs.

Strategy C: Based on habitat suitability indices and/or species distribution models, work with willing landowners and conservation organizations to enhance, manage, and maximize benefits for planning/targeted species on existing grasslands.

Northeast Prairies/Elkhorn River Conservation Targets and Strategies

Target 1. By 2030, work with partners to remove 50% of eastern red cedar from grasslands, reducing woody encroachment on 460 acres (Table C-1, C-4).

Strategy A: Work with willing landowners to remove eastern red cedar and other invasive species from grasslands on their property.

Strategy B: Coordinate with local partners to conduct controlled burns to manage and control eastern red cedar encroachment in problem areas.

Strategy C: Create a decision support tool to prioritize management of cedar-infested areas and conduct targeted mailings to landowners to promote interest in projects to remove eastern red cedar.

Target 2. By 2030, work with partners to increase CRP enrollment by an additional 4,200 acres. (Table C-1, C-4).

Strategy A: Work with willing landowners to re-establish grassland habitat in crop fields through the CRP program.

Strategy B: Create habitat suitability indices or species distribution models for a planning species or group of species to identify areas of the landscape where CRP contracts are most likely to benefit the targeted species. Work with partners on directed mailings to encourage landowner interest in CRP sign-up.

Strategy C: Based on habitat suitability indices and/or species distribution models, work with willing landowners on existing CRP acres and other grassland to manage and maximize benefits for planning/targeted species.

Republican River/Blue River Drainages and Loess Canyons Conservation Targets and Strategies

Target 1. By 2030, work with partners to remove 75% of eastern red cedar from grasslands, reducing woody encroachment on 53,200 acres (Table C-1, C-5).

Strategy A: Work with willing landowners to remove eastern red cedar from grasslands on their property.

Strategy B: Coordinate with local partners to conduct controlled burns to manage and control eastern red cedar encroachment in problem areas.

Strategy C: Create a decision support tool to prioritize management of cedar-infested areas and conduct targeted mailings to landowners to generate interest in projects to remove eastern red cedar.

Target 2. By 2030, work with partners to enroll an additional 16,800 acres in CRP (Table C-1, C-5).

Strategy A: Work with willing landowners to re-establish grassland habitat in crop fields through the CRP program.

Strategy B: Create habitat suitability indices or species distribution models for a planning species or group of species to identify areas of the landscape where CRP contracts are most likely to benefit the targeted species. Work with partners on directed mailings to encourage landowner interest in CRP sign-up.

Strategy C: Based on habitat suitability indices and/or species distribution models, work with willing landowners on existing CRP acres and other grassland to enhance, manage, and maximize benefits for planning/targeted species.

Sandhills Conservation Targets and Strategies

Target 1. By 2030, work with partners to remove 50% of eastern red cedar from grasslands, reducing woody encroachment on 8,410 acres (Table C-1, C-6).

Strategy A: Work with willing landowners to remove eastern red cedar and other invasive species from grasslands on their property.

Strategy B: Coordinate with local partners to conduct controlled burns to manage and control eastern red cedar encroachment in problem areas.

Strategy C: Create a decision support tool to prioritize management of cedar-infested areas and conduct targeted mailings to landowners to generate interest in projects to remove eastern red cedar.

Verdigris–Bazile Creek Drainages Conservation Targets and Strategies

Target 1. By 2030, work with partners to remove 75% of eastern red cedar from grasslands, reducing woody encroachment on 32,350 acres (Table C-1, C-7).

Strategy A: Work with willing landowners to remove eastern red cedar from grasslands on their property.

Strategy B: Coordinate with local partners to conduct controlled burns to manage and control eastern red cedar and other invasive species encroachment in problem areas

Strategy C: Create a decision support tool to prioritize management of cedar-infested areas and conduct targeted mailings to landowners to promote interest in projects to remove eastern red cedar.

Target 2. By 2030, work with partners to increase CRP acreage through enrollment of an additional 10,500 acres (Table C-1, C-7).

Strategy A: Work with willing landowners to re-establish grassland habitat in crop fields through the CRP program.

Strategy B: Create habitat suitability indices or species distribution models for a planning species or group of species to identify areas of the landscape where CRP contracts are most likely to benefit the targeted species. Work with partners on directed mailings to encourage landowner interest in CRP sign-up.

Strategy C: Based on habitat suitability indices and/or species distribution models, work with willing landowners on existing CRP acres and other grasslands to enhance, manage, and maximize benefits for planning/targeted species.

Conservation Delivery

The RWBJV has developed a GIS landcover dataset and associated habitat indices (Bishop et al. 2011) to describe habitat conditions at multiple spatial scales. For several priority species, the spatial data have been analyzed in conjunction with species occurrence data to develop empirical models that describe species response to habitat features and landscape juxtaposition. For example, Greater Prairie-Chickens are area-sensitive, requiring large tracts of grassland habitat with relatively few trees (Vodehnal and Haufler 2008). As a result, this species has been used as a surrogate for the other priority species for which the RWBJV does not have sufficient data to describe landscape-level priorities. By designing landscapes and delivering conservation projects that contribute to or enhance a large landscape, it is hypothesized that habitat niches will be available not only for the surrogate planning species, but also for other species in the guild. This approach helps the planning process move forward without the need for sufficient data to

develop demographic models for all species. Initial work often begins with the development of a species distribution model (Figure 2).

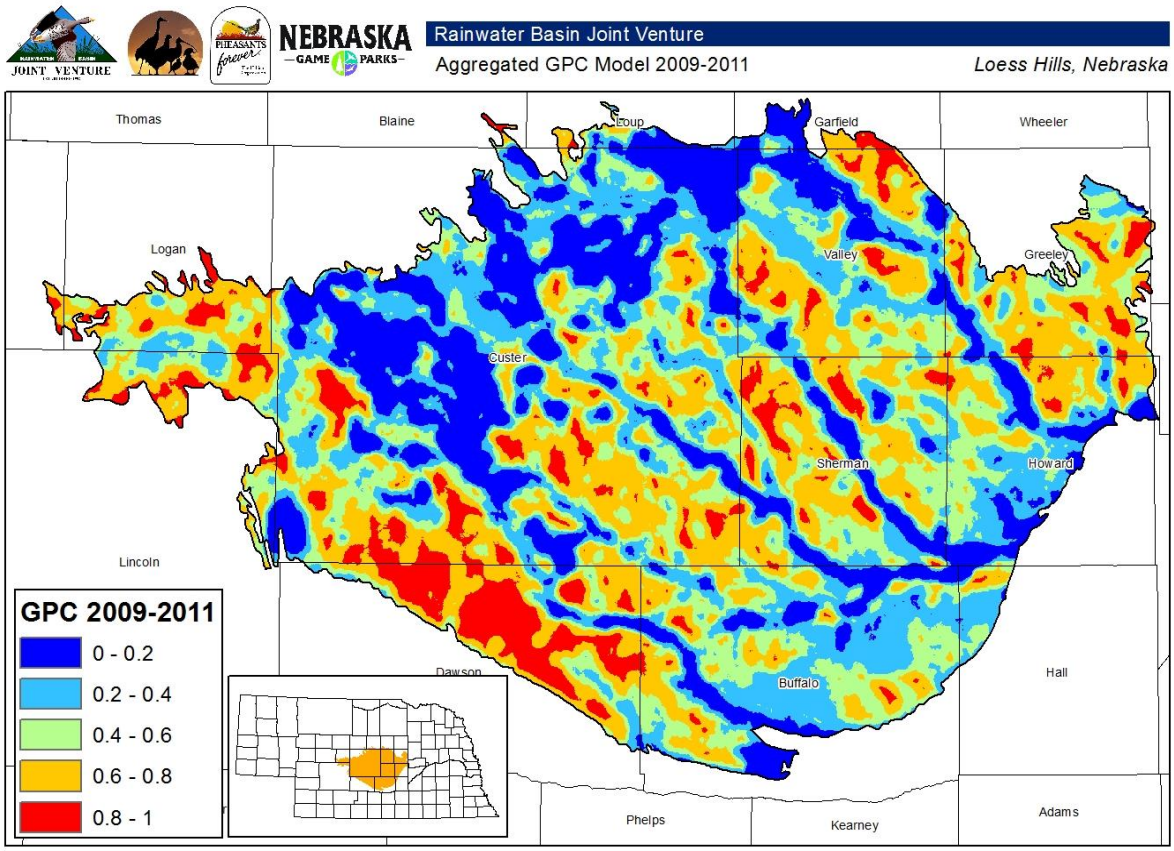

Figure 3. Species distribution model to describe probability of occurrence of Greater Prairie-Chickens.

The RWBJV's approach to conservation will be to continue to work directly with landowners and farm managers to develop wildlife-friendly agricultural practices (Derner et al. 2009). Moreover, the RWBJV will work with land managers to target restoration and enhancement actions to benefit priority species. For example, specific tracts infested by eastern red cedar will be targeted to minimize grassland habitat fragmentation, while grasslands with limited eastern red cedar will be prioritized for rotational grazing systems that can increase the grassland structure and stature. To optimize these approaches, the RWBJV has developed Decision Support Tools (DST) which spatially identify landscapes and specific tracts with the greatest potential to benefit priority species (e.g., Figure 2). Other DSTs incorporate species' life history, habitat models, limiting factors, and conservation programs.

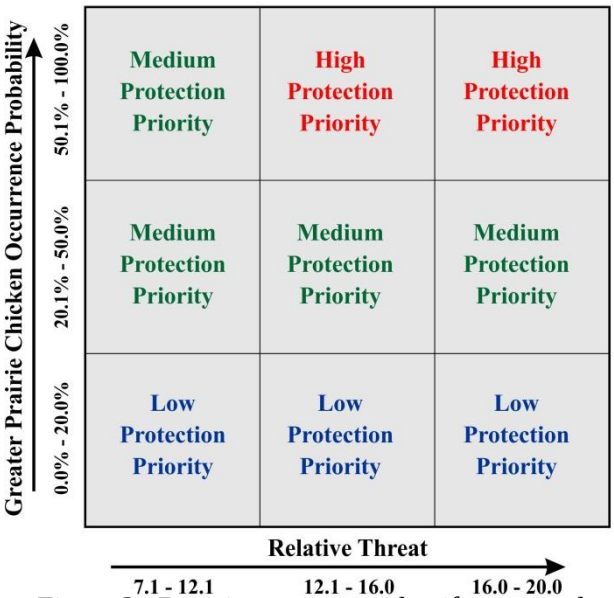

Figure 3. Decision matrix to identify priority level of grassland habitat benefiting Greater Prairie-Chickens.

A decision matrix (Figure 3) helps translate DST criteria into a GIS dataset. In this example, the matrix identifies high-protection areas as having >50% probability of occurrence for Greater Prairie-Chickens and a relative threat >12.0. The data are then applied to a Common Land Units (CLU) dataset. CLU is the the Farm Service Agency (FSA) field boundary dataset, used to administer the USDA Farm Program. Areas in red delineate quality habitat for Greater Prairie-Chickens on land under the greatest risk (Figure 4). As habitat is rehabilitated, species distribution models may be updated to reflect changes in probability of occurrence, and the decision matrix can be revisited.

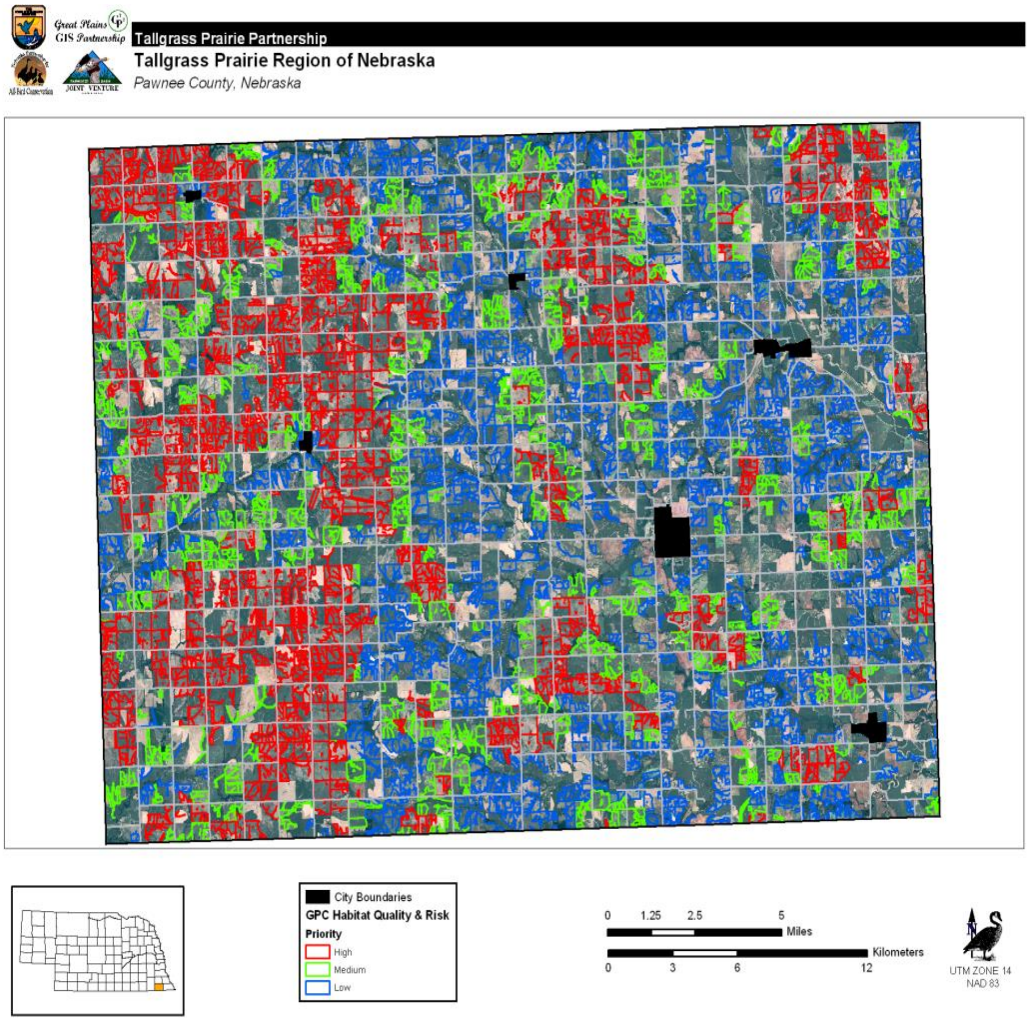

Figure 4. Prioritization of habitats for Greater Prairie-Chickens where habitat is delineated by U.S. Department of Agriculture's Common Land Units for Pawnee County, Nebraska.

Research and Monitoring

Research and monitoring efforts will assist the RWBJV in refining conservation objectives and actions for priority landbird species as new information is collected. It remains a priority of the RWBJV to continue to embrace the SHC framework (National Ecological Assessment Team 2006, U.S. Fish and Wildlife Service 2008). This framework provides guidance for biological planning, conservation design, implementation, and research/evaluation/monitoring. In order to continue using the guidelines outlined in SHC, the RWBJV will devote efforts to coordinating with partner agencies to acquire additional landbird research and monitoring data that can be analyzed to evaluate the effectiveness of current conservation actions. In addition, data from research and monitoring efforts can be used to inform future management actions through the use of decision support tools.

Research and monitoring efforts are necessary to assess the effectiveness of our management actions for priority species. More specifically, monitoring and evaluation efforts may focus on landbird response to pre- and post-management and vegetation treatments, particularly if a DST was used to identify suitable landscapes where habitat enhancement would most likely benefit targeted species. In addition, monitoring efforts can be established to help identify whether managing for a surrogate species effectively increases populations for other priority landbirds. It is also the intent of the RWBJV to refine the HABS deterministic modeling approach to more accurately predict current and future carrying capacity estimates for priority landbird species, making every attempt to reduce uncertainty and improve the conservation planning phase of the SHC framework.

It is the intent of the RWBJV to have spatially explicit models that help describe habitat relationships for all priority species within the RWBJV Administrative Area. In 2012, the RWBJV developed the first of these models by analyzing prairie grouse route data provided by NGPC, Pheasants Forever, and USDA Forest Service (Nebraska National Forest & Grasslands) in conjunction with land cover and GIS-derived habitat indices. In 2013, the RWBJV continued its initial efforts by using BBS data from Nebraska, collected during 2005–2011, to create species distribution models for 12 landbird species (Jorgensen et al. 2013). These models will allow conservation agencies throughout the state to identify where in the landscape various species are most likely to occur, where the most abundant populations exist, and what population responses may result from implementation of future conservation actions on a landscape level.

Summary

The RWBJV Administrative Area has an abundance of habitat available for breeding landbirds, particularly grassland-obligate species that rely on prairie habitats to maintain their life-history strategies. Conservation for breeding landbird species will mainly focus on grassland restoration and management in the Central Loess Hills, Central and North Platte River, Northeast Prairies/Elkhorn River, Republican River/Blue River Drainages and Loess Canyons, Sandhills, and Verdigris-Bazile Creek Drainages GFAs. Strategies will include a combination of long- and short-term conservation programs, management of invasive species, and grassland restoration and enhancement projects.

The RWBJV will support research and monitoring activities to validate planning assumptions and address key uncertainties in our conservation efforts. Future priority research and monitoring will include the construction and use of species distribution models and habitat suitability indices. In the process of creating these models, we can acquire further understanding of the spatial scales at which landbirds are responding to management actions, and identify where land managers should target their conservation programs in the landscape in order to have the greatest benefit.

Appendix A

Species List

The species list contains only the plants and birds (native and non-native to Nebraska) mentioned within this plan.

Plants	
Common Name	**Scientific Name**
Alfalfa	*Medicago sativa*
Cattail	*Typha* spp.
Corn	*Zea mays*
Common reed grass/*Phragmites*	*Phragmites* spp.
Eastern red cedar	*Juniperus virginiana*
Hybrid broadleaf cattail	*Typha latifolia*
Hybrid narrowleaf cattail	*Typha angustifolia*
Kentucky bluegrass	*Poa pratensis*
Milo	*Sorghum bicolor*
Common reed grass/*Phragmites*	*Phragmites* spp.
Purple loosestrife	*Lythrum salicaria*
Reed canary grass	*Phalaris arundinacea*
River bulrush	*Schoenoplectus fluviatilis*
Russian olive	*Elaeagnus angustifolia*
Smooth brome	*Bromus inermis*
Soybean	*Glycine max*
Wheat	*Triticum aestivum*

Birds	
Common Name	**Scientific Name**
Baird's Sparrow	*Ammodramus bairdii*
Baltimore Oriole	*Icterus galbula*
Bank Swallow	*Riparia riparia*
Barn Owl	*Tyto alba*
Bell's Vireo	*Vireo bellii*
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Bobolink	*Dolichonyx oryzivorus*
Brown Thrasher	*Toxostoma rufum*
Burrowing Owl	*Athene cunicularia*
Clay-colored Sparrow	*Spizella pallida*
Dickcissel	*Spiza americana*
Eastern Kingbird	*Tyrannus tyrannus*
Eastern Meadowlark	*Sturnella magna*
Ferruginous Hawk	*Buteo regalis*
Field Sparrow	*Spizella pusilla*
Golden Eagle	*Aquila chrysaetos*
Golden-winged Warbler	*Vermivora chrysoptera*
Grasshopper Sparrow	*Ammodramus savannarum*
Greater Prairie-Chicken	*Tympanuchus cupido*
Henslow's Sparrow	*Ammodramus henslowii*
Horned Lark	*Eremophila alpestris*
Interior Least Tern	*Sternula antillarum anthalassos*
Lark Bunting	*Calamospiza melanocorys*
Lark Sparrow	*Chondestes grammacus*
Le Conte's Sparrow	*Ammodramus leconteii*
Loggerhead Shrike	*Lanius ludovicianus*
Nelson's Sparrow	*Ammodramus nelsoni*
Northern Bobwhite	*Colinus virginianus*
Northern Harrier	*Circus cyaneus*
Piping Plover	*Charadrius melodus*
Prairie Falcon	*Falco mexicanus*
Red-headed Woodpecker	*Melanerpes erythrocephalus*
Ring-necked Pheasant	*Phasianus colchicus*
Sandhill Crane	*Grus canadensis*
Scissor-tailed Flycatcher	*Tyrannus forficatus*
Sedge Wren	*Cistothorus platensis*
Sharp-tailed Grouse	*Tympanuchus phasianellus*
Short-eared Owl	*Asio flammeus*
Sprague's Pipit	*Anthus spragueii*
Swainson's Hawk	*Buteo swainsoni*
Trumpeter Swan	*Cygnus buccinator*
Western Meadowlark	*Sturnella neglecta*
Whooping Crane	*Grus americana*
Willow Flycatcher	*Empidonax traillii*
Wood Thrush	*Hylocichla mustelina*
Yellow-billed Cuckoo	*Coccyzus americanus*

Appendix B

The Hierarchical All Bird Strategy (HABS) Database

The Hierarchical All Bird Strategy (HABS) database was originally designed by the Playa Lakes Joint Venture and later modified by the Nebraska Bird Partnership for statewide application in Nebraska. This tool is a key resource in the biological planning phase of the SHC (National Ecological Assessment Team 2006, U.S. Fish and Wildlife Service 2008) framework (Playa Lakes Joint Venture 2006, Dobbs 2007). The HABS tool allows conservation planners to evaluate landscape habitat conditions for specific planning areas to formulate carrying capacity estimates for multiple priority bird species. The database's hierarchical design allows the user to obtain a species-based estimate of landscape carrying capacity by integrating both species-specific density estimates developed from directed research projects (species-specific density by habitat) and Geographic Information System (GIS) data that describe the number of acres of habitat on the landscape. The HABS database provides a mechanism to integrate and account for complex relationships that many species demonstrate. For example, individual species often use multiple habitats at different densities; the HABS database allows the carrying capacity to be determined for each habitat and summed over an entire area (i.e., the Rainwater Basin Joint Venture Administrative Area).

HABS allows users to compare carrying capacity among species and assist in stepping down national conservation objectives to identify what types of habitat work should take place, and where. In addition, the database can create scenarios that mimic species response to implementation of different habitat programs and practices. Scenarios can also be constructed to evaluate the effects of past habitat programs and their potential success at conserving targeted species.

The hierarchical structure of HABS is based on the habitat conditions present in the geographic area of interest (for the purpose of this plan the geographic area of interest is the RWBJV Administrative Area). The total acres of all landscape habitat associations and conditions are calculated using the Nebraska Landcover dataset (Table B-1, Bishop et al. 2011) and entered into the HABS database. Bird density estimates per habitat association and condition -- obtained from peer-reviewed scientific literature and long-term monitoring databases (Rocky Mountain Bird Observatory's Avian Data Center) -- are included in the HABS database. Density estimates by species are multiplied by all of the acres of habitat associations and habitat conditions appropriate to the species and summed together to form a landscape "carrying capacity" estimate. When multiple priority species are targeted, HABS allows users to compare carrying capacity estimates among species. By changing the acres of the available habitat associations and habitat conditions, scenarios are constructed to compare the carrying capacity before and after the habitat work is completed.

For planning purposes, Breeding Bird Survey (BBS) trend data (Sauer and Link 2011) can be integrated with HABS to create population goals for priority species. Population goals are calculated as:

$$\frac{\theta}{1 - Abs(\sigma)^{1-y}}$$

where θ is equal to the current carrying capacity identified by HABS, σ is equal to the BBS trend and y is equal to the number of years expected to be required to reach the population goals. The RWBJV used a 20-year time frame to set population benchmarks for the RWBJV Administrative Area's priority species (Table 4).

Table B-1. Habitat associations and conditions identified in the RWBJV Administrative Area in the Nebraska Landcover Dataset (Bishop et al. 2011).

Division	Type	Association	Condition
Aquatic	Open Water	Reservoirs Lakes Ponds	Freshwater lake
			Lagoon
			Pit
			Reservoir
			Stock pond
	Wetlands	Playas	Wet
			Wet pit only
			Dry
		Sandhills Wetlands	NA
		Other wetlands	Moist-soil unit
			Emergent marsh
			Saline
	Riverine Systems	Riverine Systems	Riparian canopy (early succession w/o understory)
			Riparian canopy (early succession with understory)
			Riparian canopy (late succession w/o understory)
			Riparian canopy (late succession with understory)
			Exotic riparian shrubland
			Native riparian shrubland
			River channel
			Unvegetated sandbar
			Warm-water slough
			Wet meadow
			Floodplain marsh
		Arroyo/Ravine	NA
Anthropogenic	Agricultural	Cropland	Alfalfa
			Corn
			Fallow
			Hay
			Millet
			Sorghum
			Soybean
			Sunflower
			Wheat
			Peanut
			Pasture
			Other
			Sod farm
		CRP	Native grasses

Table B-1 (cont.). Habitat associations and conditions identified in the RWBJV Administrative Area in the Nebraska Landcover Dataset (Bishop et al. 2011).

Division	Type	Association	Condition
Other	Other	Other	Non-native grasses
			Urban/Suburban
			4 – lane roads
			Other roads
			All other types not important to SMA-Hs
Terrestrial	Sparsely Vegetated	Badlands/Cliffs/Outcrops	NA
	Forests/Woodlands	Forest/Woodland (upland)	Eastern red cedar
		Pinyon/Juniper	Few trees, grassy understory
		Ponderosa Pine	Many trees, little grassy understory
		Crosstimbers Woodland	NA
		Hillside Woodland	NA
		Juniper	NA
		Juniper/Mesquite	NA
		Other	NA
	Grasslands	Mixed Grass	Few shrubs/Low grass
			Few shrubs/High grass
			Many shrubs/Low grass
			Many shrubs/High grass
			Prairie dog colony
		Sandhills Grasslands	Few shrubs/Low grass
			Few shrubs/High grass
			Many shrubs/Low grass
			Many shrubs/High grass
		Shortgrass	Few shrubs/Low grass
			Few shrubs/High grass
			Many shrubs/Low grass
			Many shrubs/High grass
			Prairie dog colony
		Tallgrass	Few shrubs/Low grass
			Few shrubs/High grass
			Many shrubs/Low grass
			Many shrubs/High grass
	Shrublands	Mesquite Savannah	Savannah
			Shrubland
		Shinnery	Few shrubs/Low grass
			Few shrubs/Low grass
			Many shrubs/High grass
			Many shrubs/High grass
		Sand Sage	Low grass
			High grass

Appendix C

Developing Species Carrying Capacity Estimates Based on Management Scenarios within the RWBJV Geographic Focus Areas

The Rainwater Basin Joint Venture (RWBJV) created two management scenarios using the Hierarchical All Bird Strategy (HABS) database (Dobbs 2007) to create habitat objectives in six of the nine Geographic Focus Areas within the RWBJV Administrative Area (Table C-1). HABS is particularly suited for scenario planning, in that landscape associations (habitat classes) and habitat conditions (types of vegetation community associated with each habitat class) can be mapped or quantified. Based on these assumptions, the HABS database can be used to create scenarios to understand the impacts of specific or multiple conservation programs on priority species within a specific geography (Appendix B; Playa Lakes Joint Venture 2006). By adjusting the acres of one habitat condition and transferring them to alternative habitats, scenarios can be built for a number of priority species, and the overall likelihood of success of a conservation program can be evaluated prior to implementation. The population goals and predicted carrying capacity estimates produced by the deterministic modeling process in HABS do not represent absolute values, but rather are relative estimates developed for planning purposes only.

For the first habitat objective, the RWBJV set a habitat improvement scenario of removing eastern red cedar from grasslands, to reduce habitat fragmentation. The percentage of eastern red cedar removal varied by geographic area; for more problematic areas, such as the Central Loess Hills, Republican River/Blue River Drainages and Loess Canyons, and the Verdigris-Bazile Creek Drainages GFAs, a 75% reduction in cedar acres was planned. Less problematic areas, such as the Northeast Prairies/Elkhorn River GFA and the Sandhills, were modeled with 50% cedar removal (Table C-1). Species responses to cedar removal scenarios varied by region, but the overall response to removal was positive for most grassland bird species (Tables C-2 – C-7).

The second habitat objective was directed towards increasing grassland acres through the Conservation Reserve Program (CRP) or other conservation programs in the RWBJV Administrative Area. Although not in its initial purview, CRP is an example of an agro-ecosystem conservation practice that is widely regarded to benefit wildlife, including grassland species (Peterjohn 2003, Giudice and Haroldson 2007, Nielson et al. 2008). By working with partners to increase CRP throughout the RWBJV Administrative Area, the RWBJV can reduce land-use intensity (row-crop agriculture) and provide additional grassland habitat that will benefit a majority of its priority planning species. Assuming there will continue to be 450,000 acres of CRP within the RWBJV Administrative Area, the CRP scenario divided up the remaining acres not currently enrolled (~42,000 acres) and distributed them among five of the six Geographic Focus Areas (Table C-1). The available CRP acres were allocated to the Geographic Focus Areas, based on the expected benefits to the RWBJV planning species. Grassland-obligate species tended to respond positively to the CRP scenario, but a few species showed no response, or even responded negatively to the proposed management action (Tables C-2 – C-7).

Overall, the two conservation design scenarios benefited the majority of the RWBJV's planning species. Based on the proposed scenarios, the RWBJV met the population objectives for nine of

the twenty planning species and achieved 75% of the goals outlined for an additional nine species (Table C-8). The RWBJV conservation design scenarios failed to meet the needs of five of the partnership's planning species: Lark Bunting, Loggerhead Shrike, Northern Harrier, Short-eared Owl, and Swainson's Hawk. Although the RWBJV will make every effort to coordinate with its partners to protect and conserve habitat for these species, the RWBJV recognizes that limitations do arise, and additional monitoring and research is needed to address habitat requirements for these species of concern.

Table C-1. Scenario description for two habitat objectives set by the Rainwater Basin Joint Venture to increase habitat for grassland obligate landbirds.

Geographic Focus Area	Woody Vegetation Removal Scenario	Acres of Eastern Red Cedar Removed	CRP Scenario*	CRP Acreage Enrollment	Total Grassland Acre Increase (Cedar Removal + CRP enrollment)
Central Loess Hills	75% reduction in cedar trees; converted to grassland	124,200	Allocation of 25% of CRP acres	10,500	134,700
Central and North Platte River	10% reduction in cedar trees and other woodland communities; converted to grassland	6,000	CRP not active, but conversion to grassland through other programs		11,000
Northeast Prairies/Elkhorn River	50% reduction in cedar trees; converted to grassland	460	Allocation of 10% of CRP acres	4,200	4,660
Republican River/Blue RiverDrainages & Loess Canyons	75% reduction in cedar trees; converted to grassland	53,200	Allocation of 40% of CRP acres	16,800	70,000
Sandhills	50% reduction in cedar trees; converted to grassland	8,410	--	--	8,410
Verdigris – Bazile Creek Drainages	75% reduction in cedar trees; converted to grassland	32,350	Allocation of 25% of CRP acres	10,500	42,850

*Assumption: 42,000 acres of CRP available for sign-up

Table C-2. Priority species response to Rainwater Basin Joint Venture conservation design scenarios in the Central Loess Hills Geographic Focus Area.

Species	Estimated Current Carrying Capacity	Predicted Carrying Capacity Post-Cedar Removal	Predicted Carrying Capacity Post-CRP Grassland Increase	Predicted Carrying Capacity Post-Management Treatments
Baltimore Oriole	25,073	25,073	25,073	25,073
Bell's Vireo	7,174	7,274	7,174	7,274
Dickcissel	75,264	76,872	81,501	83,109
Eastern Meadowlark	2,527	2,630	2,821	2,924
Field Sparrow	1,108	1,108	18,211	18,211
Grasshopper Sparrow	336,446	354,997	340,878	359,429
Greater Prairie-Chicken	808	855	812	859
Lark Bunting	15,445	16,111	16,129	16,795
Loggerhead Shrike	3,498	3,697	3,498	3,697
Northern Bobwhite	7,355	7,355	7,623	7,623
Northern Harrier	34,617	36,294	34,547	36,224
Red-headed Woodpecker	2,467	2,467	2,467	2,467
Ring-necked Pheasant	15,702	16,075	15,832	16,205
Short-eared Owl	270	285	270	285
Swainson's Hawk	735	772	735	772
Western Meadowlark	290,898	308,091	291,140	308,333
Yellow-billed Cuckoo	6,051	6,051	6,051	6,051

*Species' carrying capacities and population goals are relative estimates developed for planning purposes only and do not represent absolute population sizes

Table C-3. Priority species response to RWBJV conservation design scenarios in the Central and North Platte River Geographic Focus Area.

Species	Estimated Current Carrying Capacity	Predicted Carrying Capacity Post-Cedar Removal	Predicted Carrying Capacity Post-CRP Grassland Increase	Predicted Carrying Capacity Post-Management Treatments
Baltimore Oriole	17,261	16,057	17,261	16,057
Bell's Vireo	10,528	10,014	10,528	10,014
Dickcissel	17,704	17,782	17,436	17,514
Eastern Meadowlark	190	196	251	257
Field Sparrow	112	112	112	112
Grasshopper Sparrow	27,680	28,575	27,680	28,575
Greater Prairie-Chicken	59	61	59	61
Henslow's Sparrow	43	43	43	43
Lark Bunting	1,924	1,956	1,924	1,956
Loggerhead Shrike	364	366	364	366
Northern Bobwhite	14,685	14,452	14,822	14,589
Northern Harrier	5,897	5,977	6,053	6,133
Red-headed Woodpecker	2,711	2,440	2,711	2,440
Ring-necked Pheasant	6,489	6,483	7,014	7,008
Short-eared Owl	20	21	23	24
Swainson's Hawk	73	74	75	76
Western Meadowlark	21,503	22,332	21,503	22,332
Yellow-billed Cuckoo	6,651	5,986	6,651	5,986

*Species' carrying capacities and population goals are relative estimates developed for planning purposes only and do not represent absolute population sizes

Table C-4. Priority species response to RWBJV conservation design scenarios in the Northeast Prairies/Elkhorn River Geographic Focus Area.

Species	Estimated Current Carrying Capacity	Predicted Carrying Capacity Post-Cedar Removal	Predicted Carrying Capacity Post-CRP Grassland Increase	Predicted Carrying Capacity Post-Management Treatments
Baltimore Oriole	56,837	56,837	56,837	56,837
Bell's Vireo	11,589	11,589	11,589	11,589
Dickcissel	369,561	369,567	372,056	372,062
Eastern Meadowlark	14,474	14,474	14,591	14,591
Field Sparrow	88,239	88,243	88,258	88,262
Grasshopper Sparrow	270,163	270,230	271,935	272,002
Greater Prairie-Chicken	494	494	495	495
Henslow's Sparrow	1,332	1,332	1,332	1,332
Loggerhead Shrike	2,055	2,056	2,055	2,056
Northern Bobwhite	25,544	25,544	25,651	25,651
Northern Harrier	34,283	34,289	34,255	34,261
Red-headed Woodpecker	4,170	4,170	4,170	4,170
Ring-necked Pheasant	26,937	26,939	26,989	26,991
Short-eared Owl	158	158	158	158
Swainson's Hawk	249	250	249	250
Western Meadowlark	164,189	164,251	164,286	164,348
Yellow-billed Cuckoo	10,230	10,230	10,230	10,230

*Species' carrying capacities and population goals are relative estimates developed for planning purposes only and do not represent absolute population sizes

Table C-5. Priority species response to RWBJV conservation design scenarios in the Republican River/Blue River Drainages and Loess Canyons Geographic Focus Area.

Species	Estimated Current Carrying Capacity	Predicted Carrying Capacity Post-Cedar Removal	Predicted Carrying Capacity Post-CRP Grassland Increase	Predicted Carrying Capacity Post-Management Treatments
Baltimore Oriole	57,456	57,456	57,456	57,456
Bell's Vireo	14,818	14,861	14,818	14,861
Dickcissel	194,005	194,694	203,984	204,673
Eastern Meadowlark	8,952	8,996	9,422	9,466
Field Sparrow	27,873	28,304	27,948	28,379
Grasshopper Sparrow	543,841	551,787	550,931	558,877
Greater Prairie-Chicken	968	987	974	993
Henslow's Sparrow	544	544	544	544
Lark Bunting	76,527	76,812	77,619	77,904
Loggerhead Shrike	3,762	3,848	3,762	3,848
Northern Bobwhite	23,340	23,340	23,769	23,769
Northern Harrier	43,034	43,753	42,922	43,641
Red-headed Woodpecker	6,324	6,324	6,324	6,324
Ring-necked Pheasant	26,340	26,499	26,546	26,705
Short-eared Owl	366	372	366	372
Swainson's Hawk	1,501	1,517	1,501	1,517
Western Meadowlark	440,901	448,265	441,288	448,652
Yellow-billed Cuckoo	15,516	15,516	15,516	15,516

*Species' carrying capacities and population goals are relative estimates developed for planning purposes only and do not represent absolute population sizes

Table C-6. Priority species response to RWBJV conservation design scenario in the Sandhills Geographic Focus Area.

Species	Estimated Current Carrying Capacity	Predicted Carrying Capacity Post-Cedar Removal	Predicted Carrying Capacity Post-Management Treatments
Baltimore Oriole	14,478	14,478	14,478
Bell's Vireo	13,408	13,415	13,415
Dickcissel	256,747	256,908	256,908
Eastern Meadowlark	7,376	7,379	7,379
Ferruginous Hawk	522	523	523
Field Sparrow	87,909	87,981	87,981
Grasshopper Sparrow	1,739,478	1,740,735	1,740,735
Greater Prairie-Chicken	4,333	4,336	4,336
Lark Bunting	122,428	122,516	122,516
Loggerhead Shrike	18,309	18,323	18,323
Northern Bobwhite	10,939	10,939	10,939
Northern Harrier	161,981	162,094	162,094
Red-headed Woodpecker	1,084	1,084	1,084
Ring-necked Pheasant	41,112	41,137	41,137
Short-eared Owl	1,494	1,495	1,495
Swainson’s Hawk	8,666	8,672	8,672
Western Meadowlark	1,124,502	1,125,287	1,125,287
Yellow-billed Cuckoo	2,660	2,660	2,660

*Species' carrying capacities and population goals are relative estimates developed for planning purposes only and do not represent absolute population sizes

Table C-7. Priority species response to RWBJV conservation design scenarios in the Verdigris-Bazile Creek Drainages Geographic Focus Area.

Species	Estimated Current Carrying Capacity	Predicted Carrying Capacity Post-Cedar Removal	Predicted Carrying Capacity Post-CRP Grassland Increase	Predicted Carrying Capacity Post-Management Treatments
Baltimore Oriole	44,907	44,907	44,907	44,907
Bell's Vireo	4,635	4,661	4,635	4,661
Dickcissel	61,328	61,747	67,565	67,984
Eastern Meadowlark	3,060	3,086	3,060	3,086
Field Sparrow	21,674	21,936	21,721	21,983
Grasshopper Sparrow	219,496	224,327	223,927	228,758
Greater Prairie-Chicken	516	528	520	532
Henslow's Sparrow	582	582	582	582
Loggerhead Shrike	2,228	2,280	2,228	2,280
Northern Bobwhite	4,917	4,917	5,185	5,185
Northern Harrier	20,010	20,447	19,940	20,377
Red-headed Woodpecker	1,391	1,391	1,391	1,391
Ring-necked Pheasant	7,660	7,757	7,789	7,886
Short-eared Owl	173	177	173	177
Swainson's Hawk	560	570	560	570
Western Meadowlark	174,249	178,726	174,491	178,968
Yellow-billed Cuckoo	3,412	3,412	3,412	3,412

*Species' carrying capacities and population goals are relative estimates developed for planning purposes only and do not represent absolute population sizes

Table C-8. Predicted population response to eastern red cedar removal and increased Conservation Reserve Program enrollments and grasslands in the Rainwater Basin Joint Venture Administrative Area.

Species	Current Carrying Capacity	Regional Predicted Change in Species Carrying Capacity Post-Management Treatments (# of Individuals)						Post-Management Carrying Capacity	Population Goal	% Goal Achieved
		Central Loess Hills	Central & North Platte River	Northeast Prairies/ Elkhorn River	Republican River/ Blue River Drainages, and Loess Canyons	Sandhills	Verdigris-Bazile Creek Drainages			
Baltimore Oriole	322,198	0	-1,204	0	0	0	0	320,994	361,911	89
Bell's Vireo	68,298	100	-514	0	43	7	26	67,960	68,298	x
Brown Thrasher	115,781	0	-213	0	0	0	0	115,568	137,858	84
Dickcissel	1,140,415	7,845	-190	2,501	10,668	161	6,656	1,168,056	1,140,415	x
Eastern Kingbird	827,922	752	-1,682	2	322	51	196	827,563	985,790	84
Eastern Meadowlark	38,308	397	67	117	514	3	26	39,432	38,308	x
Ferruginous Hawk	1673	0	0	0	0	0	0	673	1,673	x
Field Sparrow	94,791	17,103	0	23	506	72	309	112,804	106,475	x
Grasshopper Sparrow	5,054,301	22,983	895	1,839	15,036	1,257	9,262	5,105,573	6,018,052	85
Greater Prairie-Chicken	7,431	51	2	1	25	3	16	7,529	7,431	x
Henslow's Sparrow	3,899	0	0	0	0	0	0	3,899	3,899	x
Lark Bunting	849,866	1,350	32	0	1,377	88	0	852,713	1,699,732	50
Loggerhead Shrike	31,319	199	2	1	86	14	52	31,673	62,638	51
Northern Bobwhite	102,713	268	-96	107	429	0	268	103,689	118,783	87
Northern Harrier	327,064	1,607	236	-22	607	113	367	329,972	654,128	50
Red-headed Woodpecker	20,959	0	-271	0	0	0	0	20,688	25,695	81
Ring-necked Pheasant	179,882	503	519	54	365	25	226	181,574	190,635	95
Short-eared Owl	2,561	15	4	0	6	1	4	2,591	4,739	55
Swainson's Hawk	20,307	37	3	1	16	6	10	20,380	35,420	58
Western Meadowlark	4,261,010	17,435	829	159	7,751	785	4,719	4,292,688	5,378,660	80
Willow Flycatcher	7,072	0	-37	0	0	0	0	7,035	7,072	99
Yellow-billed Cuckoo	51,424	0	-665	0	0	0	0	50,759	68,825	74

[X] Species' population goal was met or exceeded based on management treatment scenarios

* Species' carrying capacities and population goals are relative estimates developed for planning purposes only and do not represent absolute population sizes

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