Grassland Bird Surveys in North Valley County, Montana: Progress Report

Prepared for:

Bureau of Land Management
Glasgow Field Office

By:

Susan Lenard, John Carlson, Paul Hendricks, and Coburn Currier

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Photo by: John Carlson

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EXECUTIVE SUMMARY

Populations of grassland associated birds have exhibited the steepest declines of any suite of bird species in North America over the past several decades. Loss of habitat throughout North America, resulting from conversion of native prairie to agricultural production, has been identified as the primary cause of historic grassland bird declines. Large blocks of intact prairie lands remaining in Montana, therefore, provide critically important breeding habitat for many grassland bird species. Bureau of Land Management (BLM) lands, especially in the northeastern and northcentral portions of the state, are important breeding habitats for many imperiled grassland species endemic to the Great Plains as the primary landcover in this area is native mixed-grass prairie. Few areas in the state contain such extensive blocks of intact grasslands.

Recognizing land management decisions can greatly influence native fauna by altering vegetation structure and plant composition, biologists in the Glasgow Field Office of the BLM initiated a grassland bird project to identify the diversity and abundance of prairie birds on BLM lands in north Valley County. Livestock grazing, the Bureau's primary land management activity in the county, has long been documented with the potential to either positively or negatively impact native flora and fauna. The degree to which grazing can influence native bird species varies widely and is dependent upon many factors including habitat type, timing and intensity of grazing, soil type, weather, and the specific habitat requirements of the bird species under consideration. To better understand the impact of different grazing histories on presence and relative abundance of native prairie bird species, fixed-radius point counts were randomly placed across BLM lands in north Valley County in areas with native grassland plant cover. Transects consisting of three point locations were surveyed using standard avian point count protocols to document bird species abundance and diversity across pastures with differing grazing histories. The project, which began in 2001, evolved into a multi-year inventory, currently in its fifth year. No other project focused on grassland birds in Montana has gathered consistent data at the same locations for this length of time. The information gathered during this project will provide critical information on grassland bird/grazing dynamics and the current status of prairie birds in this increasingly rare ecosystem. This project is especially significant as it encompasses the most extensive remaining piece of prairie in Montana (Figure 1).

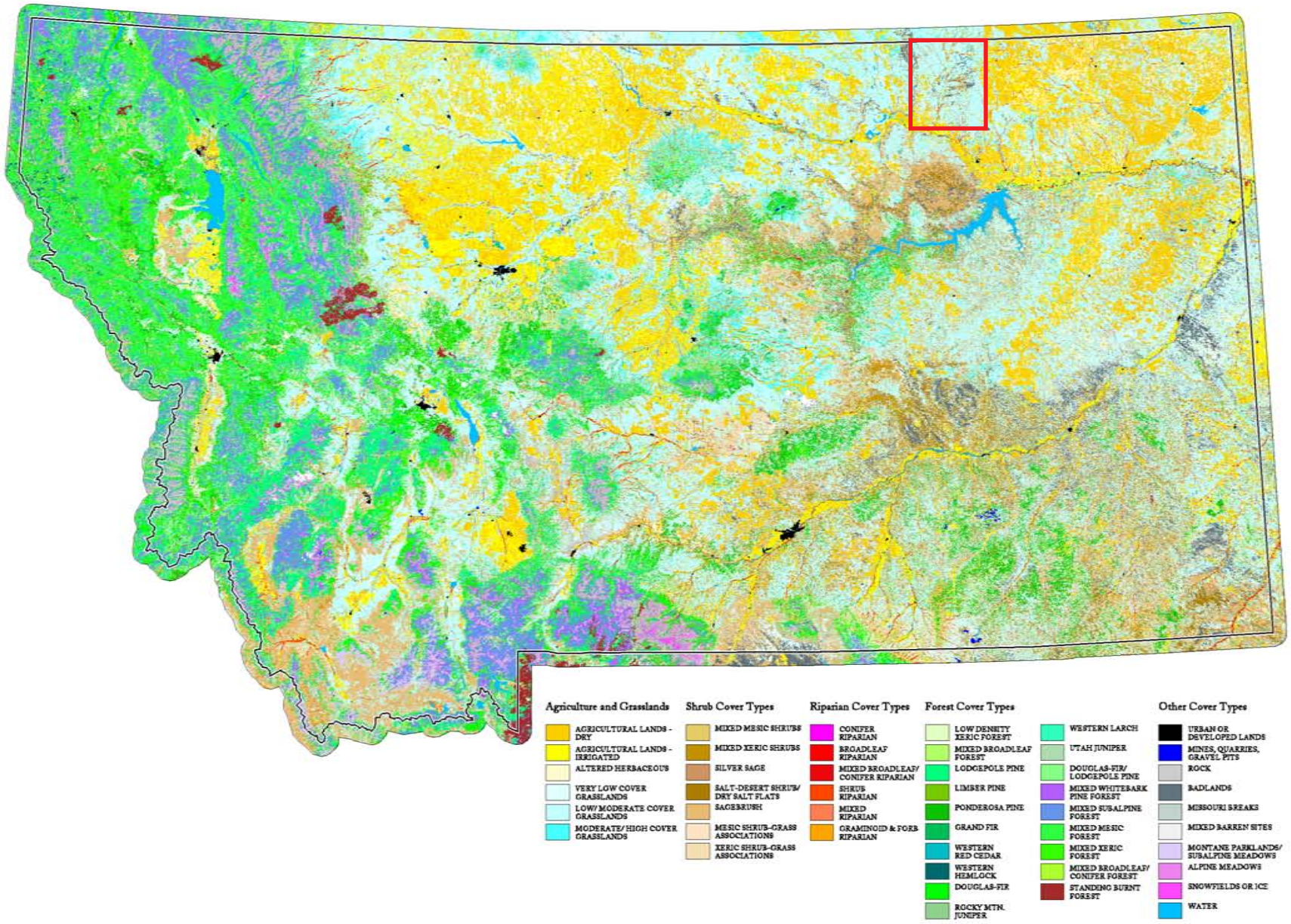
Seventy-three species of birds, representing 12,121 total individuals, were recorded during 996 avian point counts (332 three-point transects) conducted in north Valley County during the early summer months of 2001 through 2005. Fifteen of the species recorded are state Species of Concern, including the following seven which are endemic to the Northern Great Plains: Ferruginous Hawk (*Buteo regalis*), Long-billed Curlew (*Numenius americanus*), Sprague's Pipit (*Anthus spragueii*), Lark Bunting (*Calamospiza melanocorys*), Baird's Sparrow (*Ammodramus bairdii*), McCown's Longspur (*Calcarius mccownii*), and Chestnut-collared Longspur (*Calcarius ornatus*). Eight more widespread grassland associated Species of Concern also recorded on the project include: Greater Sage-Grouse (*Centrocercus urophasianus*), Swainson's Hawk (*Buteo swainsoni*), Franklin's Gull (*Larus pipixcan*), Common Tern (*Sterna hirundo*), Loggerhead Shrike (*Lanius ludovicianus*), Brewer's Sparrow (*Spizella breweri*), Grasshopper Sparrow (*Ammodramus savannarum*), and Bobolink (*Dolichonyx oryzivorous*).

The most abundant species recorded on the project was Chestnut-collared Longspur (3,116 individuals), followed by Western Meadowlark (1,878 individuals), Horned Lark (1,638 individuals) and Sprague's Pipit (1,213 individuals). In total, these four species represented more than 64% of the total number of individual birds observed over the five years of study. The fifth and sixth most abundant species were Baird's Sparrow (691 individuals) and Lark Bunting (658 individuals), increasing the total percentage to over 75% of all birds recorded. While the abundance of each varied from year to year across the five year time period, these six species were consistently the most abundant. Local weather conditions do not appear to explain variations in abundance across the five years, although drought conditions elsewhere may have had some influence on

the abundance of select species in Montana during some years. Timing of the field inventory during the first two years of the study may explain a portion of these trends, at least possibly for Lark Bunting. Fieldwork started approximately one week earlier during the first 2 years of the project. The abundances for these years could reflect birds newly arrived and not yet on established territories. The effects of grazing activities and a variety of other factors could also explain the trends, although the influence of these variables has not yet been investigated.

Eighty-nine percent of the total number of individuals recorded are represented by 12 species, 7 of which are state Species of Concern. Six of these seven species are species endemic to the Northern Great Plains. Their presence and relative abundance reflects the uniqueness and importance of this area; few places remain in the Northern Great Plains ecosystem that support such a composition of species. Their abundance also reflects a landscape of diverse vegetation characteristics as each species requires unique habitat elements for breeding and foraging. Chestnut-collared Longspurs and Sprague's Pipits require areas with moderate levels of grass cover and litter, for example, while Baird's Sparrows require dense grass and litter, and McCown's Longspurs require sparse grass and bare ground. In addition to the availability of habitat, the condition is also critical. A heterogeneous prairie mosaic can support a greater number of grassland endemics. Although once plentiful across the Northern Great Plains, large blocks of intact native prairie habitat are now rare. Protecting these lands from conversion and other activities in conflict with historic disturbances (e.g. grazing and fire regimes that mimic the natural frequency and intensity) is critical to maintaining native prairie capable of supporting a diverse species assemblage. Without this protection, many of these endemics would likely disappear from the landscape.

Figure 1. Montana Land Cover Map. The study area is outlined in red. This represents the most extensive intact prairie north of the Missouri River. The surrounding lands have primarily been converted to agriculture (in yellow) (Redmond et al. 1998).



ACKNOWLEDGEMENTS

Considerable thanks and appreciation to Dave Waller, former Glasgow BLM Field Office wildlife biologist, and Roxanne Falise, former BLM State Wildlife Program Director, for recognizing the importance of this project and providing the funds to make it possible. We also thank Bryce Maxell, Montana Natural Heritage Program, for editing and improving the contents of this report.

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INTRODUCTION

In recent decades, grassland bird populations have exhibited range-wide declines (Knopf 1994, Herkert 1995). Historic conversion of the landscape to agricultural cropland is clearly the greatest contributing factor to loss of suitable habitat (Samson and Knopf 1994, Fitzgerald et al. 1999, Knapp et al. 1999, Blann 2006). Habitat loss resulting from fragmentation and conversion of land for agricultural, industrial, and human habitation purposes continues, contributing to further grassland bird population declines. Additionally, a variety of land management practices in areas of remaining intact prairie, can negatively impact prairie bird populations (Saab et al. 1995). Worldwide, grasslands are recognized as the most imperiled ecosystem (Samson and Knopf 1996).

The structure and composition of prairie habitats is a result of fire, grazing, and drought disturbances interacting with local and regional soil, moisture, and temperature patterns (Samson et al. 2004). Temperature and moisture gradients are extensions of continental gradients ranging from drier, colder grasslands in the northwestern portion of the Great Plains to hotter moister conditions in the southeast. In general, average annual rainfall in the study area ranges from 10-14 inches. Much of eastern Montana is dominated by clay soil. From a historical perspective, large scale grazing events either by bison (*Bos bison*) or Rocky Mountain locusts (*Melanoplus spretus*) (Lockwood 1999) and fire were episodic and resulted in large areas recently grazed or burned, or grazed or burned over a range of temporal intervals (Fuhlendorf and Engle 2001, 2004). In the past, these disturbances operated at large spatial scales throughout the Great Plains. Individual grassland bird species thus selected suitable habitat from a matrix of habitats available across this landscape. Each species probably exhibited pronounced fluctuations in local abundance as vegetation conditions changed.

The extermination of bison, the extinction of Rocky Mountain locust, and aggressive control of fire during the settlement of the Great Plains profoundly altered the composition of grasslands (Knapp 1999, Samson et al. 2004). Although much of the land was grazed after bison were replaced by domestic cattle, the dynamic nature of historic grazing patterns was lost; most of the Great Plains became uniformly heavily grazed. Current range management practices have reduced grazing pressures from historic levels, yet indicators of rangeland health still promote a uniform moderate level of grazing (Fulendorf and Engle 2004, Holechek et al. 2003). This results in more homogenous grasslands without the dynamic patchwork of vegetative composition and structure upon which a variety of native wildlife depend (Fuhlendorf and Engle 2001, Samson et al. 2004).

Since individual prairie bird species select appropriate habitat for breeding and nesting from a narrow range of vegetation conditions within a heterogeneous matrix, current grassland management practices can impact different species in a myriad of ways. Grassland associated species favoring vegetation structure and composition promoted by human activities (managed grazing, fire suppression, and annual mowing) have generally benefited while species requiring a more natural disturbance regime (periodic fire and historic grazing patterns) have generally experienced declines (Sauer et al. 2005). Because of the tremendous loss of native grasslands, remaining tracts of prairie grassland vegetation are increasingly valuable for native bird species. Grazing management practices can differ significantly in timing, intensity, and duration (Fuhlendorf and Engle 2001) and can ultimately impact local avian breeding and nesting events. Understanding how grassland birds respond to different grazing practices and histories on a large landscape managed for multiple-use can contribute to the conservation of prairie bird species range-wide. Unlike other areas in the Northern Great Plains, populations of many native grassland bird species have been relatively stable in northeastern Montana over the last 40 years (Sauer et al. 2005). Thus, this region is ideal for exploring the response of native bird species to different grazing histories and grazing allotment size. Neither of these disturbances is currently well understood, but both have obvious

implications for grassland bird conservation. Furthermore, having long-term grazing histories for grazing allotments allows for an analysis of past management practices and their effects on current grassland bird abundance and habitat selection.

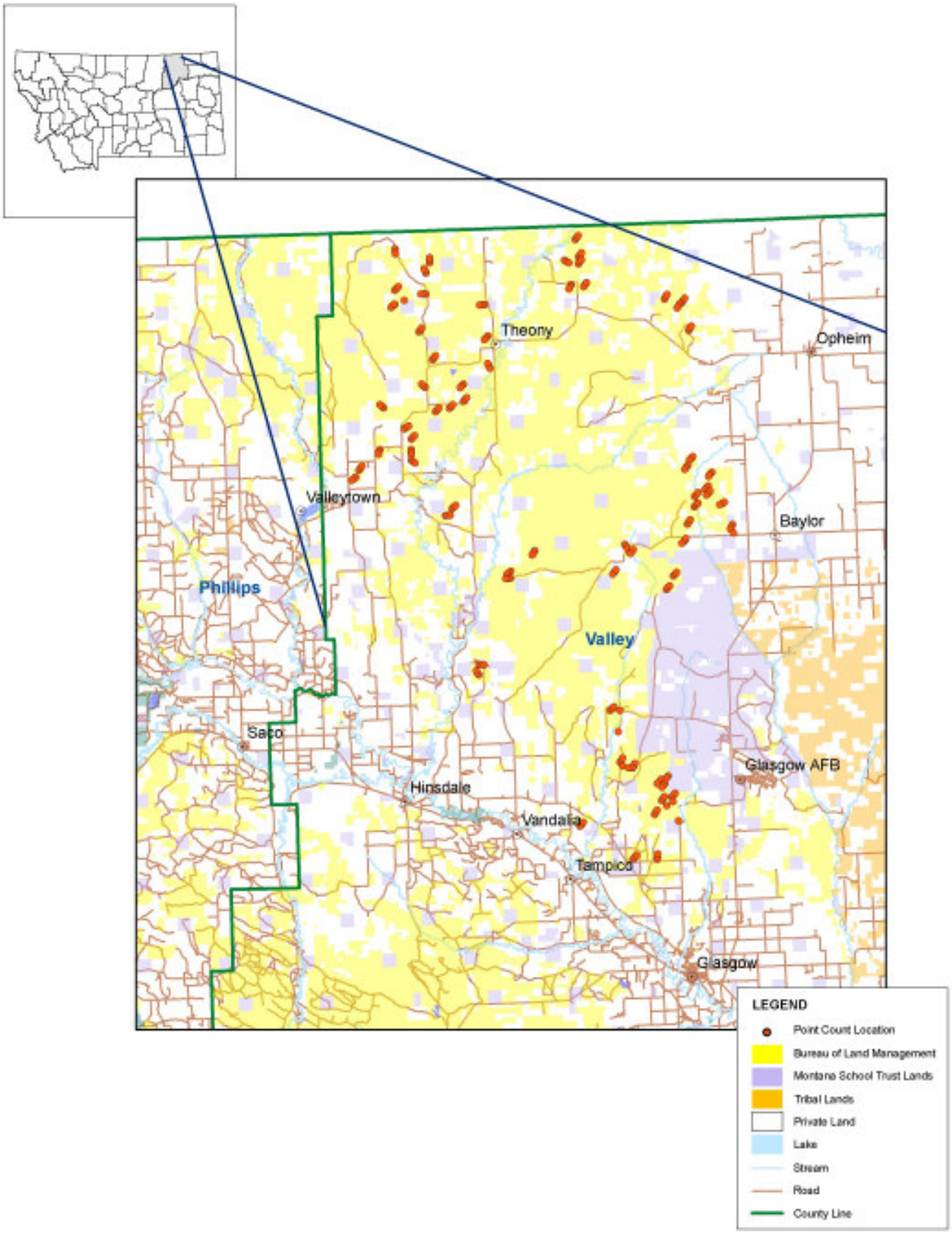
The purpose of this progress report is to describe the project activities to date, report on the diversity and relative abundance of grassland dependent bird species present in the project area, and organize the data for future analysis. Additionally, this report identifies bird species in need of conservation, including several endemic to the Northern Great Plains, and provides management information in order to assist in the conservation of these species.

STUDY AREA

Located on the Northern Glaciated Plains, the study area lies in the northern half of Valley County in northeastern Montana. The county lies adjacent to the border with Saskatchewan, Canada and is bounded by the Missouri River to the south, Phillips County to the west and Daniels and Roosevelt Counties to the east. The project area includes BLM lands north of Glasgow, east of Opheim and west of Valleytown. Bitter Creek, Frenchman Creek, Crow Creek, Rock Creek, Willow Creek, and Buggy Creek, all located generally within the project boundaries, drain to the Milk River. The Bitter Creek Wilderness Study Area, nearly 60,000 acres of highly eroded badlands, recognized for its unique, isolated and unspoiled nature, is situated approximately at the project center. To the east and adjacent to the project area is Dry Fork Creek, primarily contained within a large block of Montana Department of Natural Resources Conservation lands. Cooper et al. (2001) describe this area as possibly the best intact site of a rare mid-grass (northern porcupine grass-thickspike wheatgrass) prairie remaining in the United States.

The physical characteristics of this area are similar to the surrounding lands. Glacial till and outwash cover the terrain as the area's gently rolling landscape was scoured by at least two glacial events. The most common substrate in the project area is clay shale, marine in origin and dark grey in color (Cooper et al. 2001). The local climate is considered semi-arid with precipitation of approximately 10 to 14 inches per year, much of it falling as early summer rains in late May and early June. Winters are generally frigid while the summers can be hot, punctuated by hail-producing thunderstorms that can result in flash floods. The county's greatest topographic variation occurs at its eastern half; the highest elevation of approximately 3,300 feet occurs near Opheim to the north, while the lowest elevation of approximately 2,000 feet occurs where the Missouri River leaves the county to the south. Specific point locations on the project ranged from 2,448 to 3,049 feet in elevation. While the primary landcover within the project boundary is native mixed-grass prairie, the majority of the surrounding land has been cropped for agricultural production. This area is significant as it encompasses the most extensive remaining piece of intact prairie land in Montana. For a more detailed description of vegetative communities and distinguishing attributes specific to the study area see Cooper et al. (2001).

Figure 2. Map of Study Area with Point Count locations



METHODS

Point Selection and Project Design

The project was limited to BLM lands in north Valley County. Initial steps involved using a Geographic Information System (GIS) to stratify the area under consideration by soil type using the University of Montana Satellite Image Land Cover Classification (SILC) soil data. Areas classified as having silty soils, those that support growth of native grass species important to grassland birds, were used to delineate the area within which inferences were to be made (i.e., the target population). Areas classified as high clay content soils were eliminated from survey as the vegetation associated with clay soils does not generally support grassland birds. Eliminating high-clay soils effectively eliminated the badlands area surrounding Bitter Creek located at the center of the study area. However, some areas on the western portion of the project ended up being located in areas with high clay content soil.

Within the area targeted for sampling, 120 bird survey point locations were randomly generated from which transects for the project would originate. The project was originally designed for each bird point count transect to consist of four points. However, since the original point locations were random, it would have been difficult, if not impossible, to generate a line of four points within one pasture (generally a quarter-section) given the 300 meter minimal distance required between points for standard point count protocol (Hutto et al. 1986, Drapeau et. al 1999). Thus, the scope of the project was changed to accommodate transect lines consisting of three points. After locating the randomly generated point on the ground via a GPS unit, the second and third points were identified by field personnel walking no less than 300 meters from each previous point, resulting in a total straight line transect length of approximately 600 meters. Each of the three points defined the spot at which each point count survey was conducted. Coordinates for all points were recorded on GPS units for finding survey locations in subsequent years. The second and third points in each transect were generally established to the northeast if there was room to do so and remain in the same pasture as the original point. If this wasn't the case, then the points were oriented to the southwest of the original point. Efforts were made to keep all three points within the same pasture/grazing treatment. This sometimes necessitated placing the second and third points on opposite sides of the first point (one to the northeast and one to the southwest). If a northeast-southwest placement wasn't possible, then a northwest-southeast orientation was followed, in whichever direction allowed the points to be contained within one pasture. Inadvertantly, and due to time constraints at the start of the project, nine transects ended up with points not wholly contained within one pasture. One transect contains one point entirely in a different pasture; 7 transects contain one of the 100 m radius point count circles within 2 pastures; and 2 transects contain one point in the adjacent pasture with a portion of the 100 m point count circle within 2 pastures.

During the first field season (2001) the points were divided among two field personnel such that points west of the Willow Creek/Bitter Creek area were assigned to one observer while those on the east were assigned to the second observer. The points ultimately surveyed were selected across each region based upon accessibility and distribution. Points were generally considered accessible if they could be reached by vehicle (on existing two-tracks) to within a walking distance of approximately one mile. Effort was also made to survey both the eastern and western points such that the maximum north-south distribution was accomplished. Field personnel attempted to maximize the number of point counts conducted in a day; at least 3 transects (9 points) were targeted each morning.

Point counts were conducted by Paul Hendricks and John Carlson during the first three years of survey. In year four (2004), the point counts were conducted by four individuals: Paul Hendricks, John Carlson, Susan Lenard, and Coburn Currier. In year five (2005), three individuals conducted the counts: Hendricks, Lenard, and Currier. During the initial year (2001), 69 of the 120 original random points were

surveyed, with three points per transect for a total of 207 point counts. These original 69 transects became the targeted transects for survey each subsequent year through 2005. Although we attempted to conduct point count surveys on all points every year, weather conditions and time restrictions prevented this from occurring. See Table 1 for total number of points surveyed each year of the project.

Table 1. Point Survey Summary

Year	Total Number of Transects	Total Number of Point Counts	Observer	Number of Point Counts By Observer
2001	69	207	Paul Hendricks	117
			John Carlson	90
2002	69	207	Paul Hendricks	117
			John Carlson	90
2003	63	189	Paul Hendricks	117
			John Carlson	72
2004	65	195	Paul Hendricks	93
			John Carlson	18
			Susan Lenard	45
			Coburn Currier	39
2005	66	198	Paul Hendricks	69
			Susan Lenard	81
			Coburn Currier	48

Survey Timing

Across all years, point count survey work commenced on or after May 21 and was completed on or before July 12. Except for two transects during 2001, point counts began as early as sunrise and were completed by 10:37 am. During the start of the project, Paul Hendricks observed the level of vocalization of prairie birds in the evening hours appeared comparable to the early morning hours and conducted six point counts (two transects) in the evening hours, between 7:00 and 7:40 p.m. Subsequently, the decision was made to restrict surveys to the morning hours.

Avian Point Count Methodology

All point counts were ten minutes in duration and were conducted within approximately six hours following sunrise. During each point count survey, birds observed during time intervals of zero to three minutes, three to five minutes, and five to ten minutes were recorded. All birds detected visually and/or aurally within a visually-estimated 100 meter radius circle from the fixed-radius point were included in the tally. Each individual species was documented with the appropriate 4-letter AOU code, abundance, and identified as within the 100-meter circle, on the edge, or outside of the circle. Birds that flew over the circle and did not land during the count were recorded as flyovers. Counts were not conducted if continuous rain or high winds were present.

Vegetation Measurement Protocols

Vegetation measurements were recorded at each bird point count survey location. For these purposes, the bird point count survey location defined the center of a 25-meter diameter circle in which maximum height, plant frequency, litter depth, and ground cover were recorded. Ground cover measurements were taken along a 50 meter straight line inscribed in each circle, with end points at opposite cardinal compass directions. At each meter along this transect, the ground cover type was recorded as bare ground (including rock) or non-bare ground (grass/forb/moss). The center (the original point count survey location) was not included in the ground cover measurements.

An index of vegetation density was recorded at points in each of the 4 cardinal directions 25 meters from the original point count survey location. At each of these points, a one-meter rod was placed perpendicular to the ground at each of the points. All vegetation contacts with the rod were recorded in one decimeter increments (0-1 dm, 1-2 dm, or >2 dm). The plant contacts were recorded as either grass or forb and alive or dead. For maximum height, the height of the tallest plant within a one-meter radius of each point was recorded to the nearest centimeter. Litter depth, to the nearest millimeter, was also recorded at each of the four points where the one-meter stick was placed perpendicular to the ground.

RESULTS

Nine hundred ninety-six avian point counts were conducted in north Valley County from 2001 through 2005. A combined total of 12,121 individual birds were recorded, representing 73 species. Of this total, 15 species are state Species of Concern: Greater Sage-Grouse (*Centrocercus urophasianus*), Swainson's Hawk (*Buteo swainsoni*), Ferruginous Hawk (*Buteo regalis*), Long-billed Curlew (*Numenius americanus*), Franklin's Gull (*Larus pipixcan*), Common Tern (*Sterna hirundo*), Loggerhead Shrike (*Lanius ludovicianus*), Sprague's Pipit (*Anthus spragueii*), Brewer's Sparrow (*Spizella breweri*), Lark Bunting (*Calamospiza melanocorys*), Grasshopper Sparrow (*Ammodramus savannarum*), Baird's Sparrow (*Ammodramus bairdii*), McCown's Longspur (*Calcarius mccownii*), Chestnut-collared Longspur (*Calcarius ornatus*), and Bobolink (*Dolichonyx oryzivorous*) (MNHP 2004). Seven of these species are endemic to the Northern Great Plains: Ferruginous Hawk, Long-billed Curlew, Sprague's Pipit, Lark Bunting, Baird's Sparrow, McCown's Longspur, and Chestnut-collared Longspur (Samson and Knopf 1996). Nine additional species recorded on the project are secondary, or more widespread species of the prairie: Sharp-tailed Grouse, Northern Harrier, Swainson's Hawk, Upland Sandpiper, Short-eared Owl, Horned Lark, Vesper Sparrow, Bobolink, and Western Meadowlark (Samson and Knopf 1996). Nine additional species recorded during the project are identified either as BLM Sensitive Species or as Species of Conservation Concern in the Montana Partner's in Flight Draft Bird Conservation Plan for Montana (Casey 2000, BLM 2004).

Table 2. Species of Conservation Concern

Species Common Name	Scientific Name	Global and State Ranks	BLM Status	PIF Rank
Greater Sage-Grouse	*Centrocercus urophasianus*	G4/S3B	Sensitive	I
Northern Harrier	*Circus cyaneus*			III
Swainson's Hawk	*Buteo swainsoni*	G5/S3B	Sensitive	
Ferruginous Hawk	*Buteo regalis*	G4/S2B	Sensitive	II
Killdeer	*Charadrius vociferus*			III
Willet	*Catoptrophorus semipalmatus*		Sensitive	III
Long-billed Curlew	*Numenius americanus*	G5/S2B	Sensitive	II
Marbled Godwit	*Limosa fedoa*		Sensitive	
Wilson's Phalarope	*Phalaropus tricolor*		Sensitive	III
Franklin's Gull	*Larus pipixcan*	G4G5/S3B	Sensitive	II
Common Tern	*Sterna hirundo*	G5/S3B		II
Loggerhead Shrike	*Lanius ludovicianus*	G4/S3B	Sensitive	II
Short-eared Owl	*Asio flammeus*			III
Sprague's Pipit	*Anthus spragueii*	G4/S2B	Sensitive	I
Clay-colored Sparrow	*Spizella pallida*			III
Brewer's Sparrow	*Dolichonyx oryzivorous*	G5/S2B	Sensitive	II
Lark Sparrow	*Chondestes grammacus*			III
Lark Bunting	*Calamospiza melanocorys*	G5/S3B		II
Grasshopper Sparrow	*Ammodramus savannarum*	G5/S2B		II
Baird's Sparrow	*Ammodramus bairdii*	G4/S2B	Sensitive	I
McCown's Longspur	*Calcarius mccownii*	G5/S2B	Sensitive	II
Chestnut-collared Longspur	*Calcarius ornatus*	G5/S3B	Sensitive	II
Bobolink	*Dolichonyx oryzivorous*	G5/S2B		III
Red-winged Blackbird	*Agelaius phoeniceus*			III
Brewer's Blackbird	*Euphagus cyanocephalus*			III

Montana Animal Species of Concern

(**G** = global rank status : **S** = state rank status)

G2 or S2 -At risk because of very limited and/or declining populations, range, and/or habitat, making it vulnerable to global extinction or extirpation in the state.

G3 or S3 -Potentially at risk because of limited and/or declining populations, range, and/or habitat, even though it may be abundant in some areas.

G4 or S4 -Uncommon but not rare (although it may be rare in parts of its range), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern.

G5 - Common, widespread, and abundant (although it may be rare in parts of its range), and usually widespread.

B -State rank modifier indicating the breeding status for a migratory species.

BLM

Sensitive: species that are proven imperiled in at least part of their ranges and are documented to occur on BLM lands.

Montana Partners in Flight Priority Levels

I Conservation Action: These are species for which Montana has clear obligations to implement conservation.

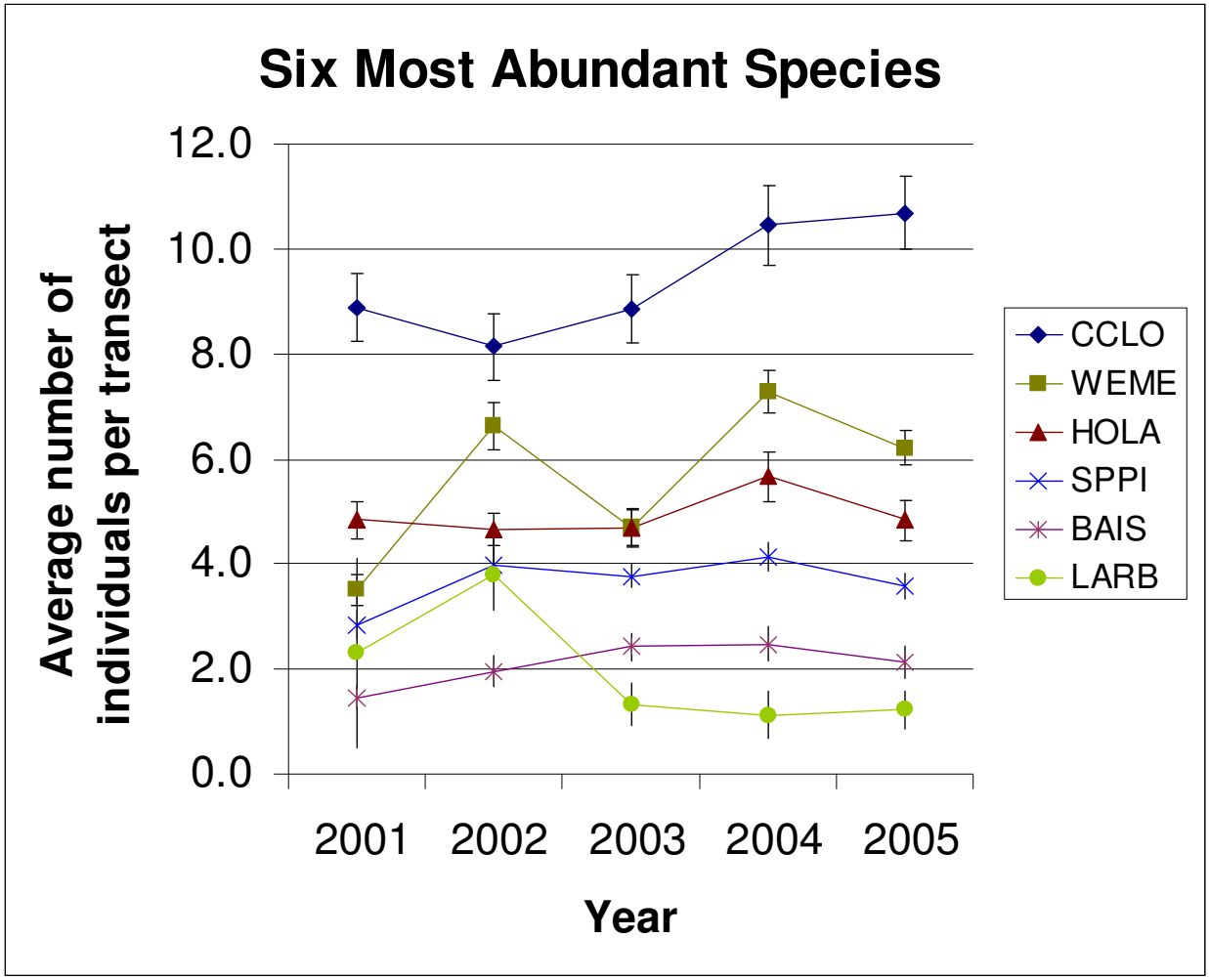
II Monitoring Species: Montana has a high responsibility to monitor the status of these species, and/or to design conservation actions.

III Local Concern: Presence of these species may serve as added criteria in the design and selection of onservation or monitoring strategies (Casey 2000).

Species Abundance and Distribution

The most abundant species recorded on the project was Chestnut-collared Longspur, followed by Western Meadowlark, Horned Lark, and Sprague's Pipit. In total, these four species represent more than 64% of the total number of individual birds observed over the five years of the study. The fifth and sixth most abundant species are Baird's Sparrow and Lark Bunting, increasing the total percentage of individual birds to over 75% of all birds recorded (see Appendix B). These six species were consistently the most abundant species each year, although the overall rank of four of these species was not consistent year to year. Because of a fluctuation in abundance, the Western Meadowlark and Horned Lark shared the second and third most abundant species status over the five year period. While Sprague's Pipit was consistently the fourth most abundant species, Lark Buntings were clearly the fifth most abundant species during the first and second years of the study, then dropped to sixth, trading places with Baird's Sparrow.

Figure 3. Average Number of Individuals Per Transect for the Six Most Abundant Species: North Valley County 2001-2005.



CCLO – Chestnut-collared Longspur
BAIS – Baird's Sparrow
HOLA – Horned Lark
LARB – Lark Bunting
SPPI – Sprague's Pipit
WEME – Western Meadowlark

Local climate conditions (average monthly temperature and average monthly precipitation), for three years prior to and including the study years, do not appear to explain the differences in abundance for these six species (see Figures 4 and 5). As anticipated, the months of May and June generally accounted for the greatest precipitation across all years, yet variations from year to year for these two months appear to have little to do with the recorded local bird species abundance. Even a snow event in late May in 2002, which resulted in lower than usual temperatures, and caused a fairly large fall-out of relatively uncommon bird species to the area, doesn't appear to have had any influence (MBD 2006). Nor can the differences be explained by overall annual precipitation. Although the total precipitation in 1998 and 2001 was recorded at around nine inches, all other years averaged approximately 12 inches of rain or more: 2 years had approximately 12 inches, 3 years averaged approximately 13 inches, and one year received over 14 inches of precipitation. While differences in bird abundance between year one and two may be explained by increased observer experience, the differences in abundance between year two and three are not explained by this hypothesis because the same two observers conducted the counts these three years.

Figure 4. Average monthly temperature for Glasgow, Montana 1998-2005

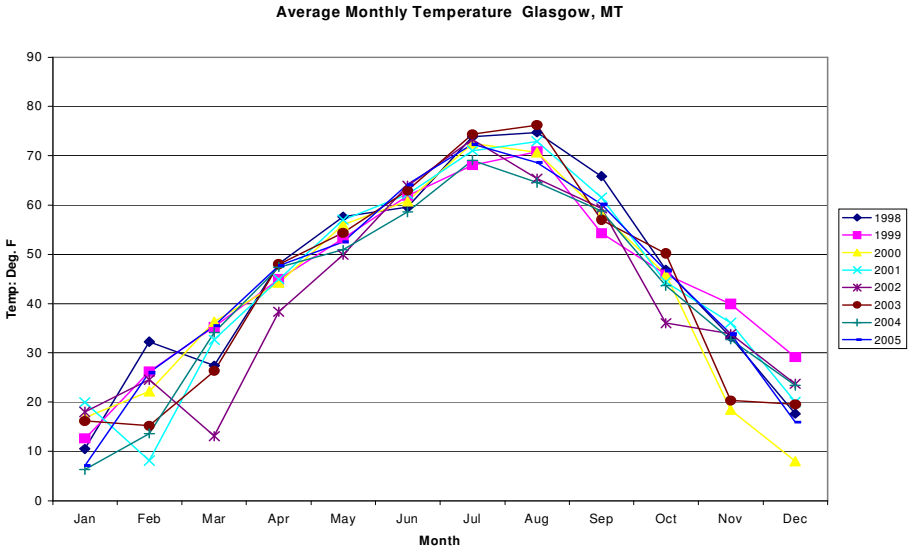
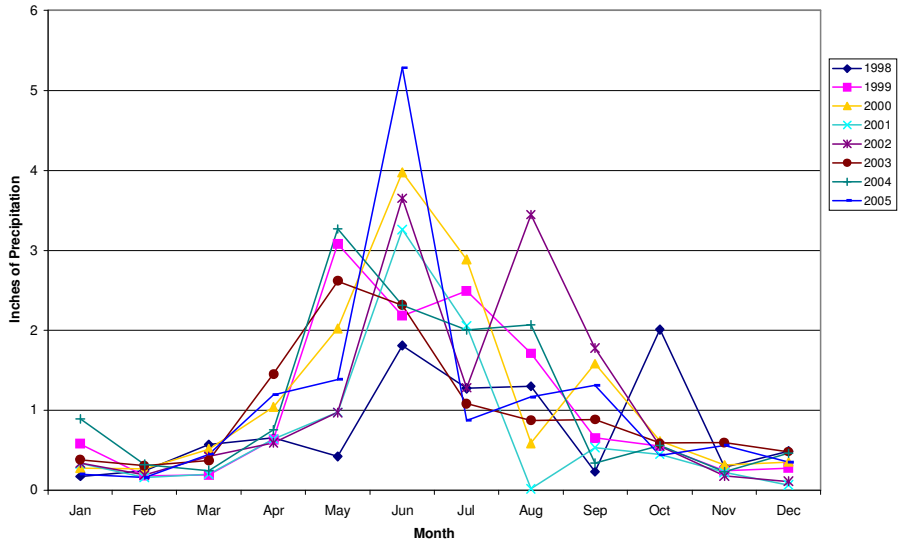


Figure 5. Average monthly precipitation for Glasgow/Opheim, Montana 1998-2005



We identify at least two possible explanations for the differences in Lark Bunting abundance across the first three years. First, Yackel Adams et al. (2006) indicate a severe drought in the southern portion of the species range (Colorado) in 2002. Individuals that normally nest in Colorado may have ended up in Montana in search of more suitable breeding habitat. The abundances noted could reflect a northern shift of the species that year because of poorer nesting habitat elsewhere. Abundances in subsequent years may reflect a return to suitable breeding conditions to the south. Second, counts during these first 2 years occurred approximately one week earlier than subsequent years and may reflect recently returned males still engaged in pre-territorial behavior. Upon first arrival, small groups of highly visible males are generally still flocked together, and are not yet on established territories (Shane 2000). The difference in abundance between the fourth and fifth years (2004 and 2005) for these species is much less pronounced than that of the first three years. This could be the result of a greater number of individuals conducting the counts and during a somewhat shorter, later timeframe, i.e it took less time for three individuals to complete the counts versus just two, and birds may have been more established on territories when these point counts were conducted.

Four species (Western Meadowlark, Chestnut-collared Longspur, Horned Lark, and Sprague's Pipit) were distributed across more than 75% of the survey locations over the five year inventory period. Although the overall percent of points with a detection was highest for Western Meadowlark at 89.4 percent of the points, the Chestnut-collared Longspur was the only species consistently present at more than 80% of the points surveyed. All four species were present at greater than 74% of the points every year, except for Sprague's Pipit when the species was present at only 60.9% of the points in 2001. This difference could be a result of inexperience with the species. Sprague's Pipits' song is thin, relatively high pitched and occurs during high aerial displays at 50-100 meters above ground (Robbins and Dale 1999), making them much less apparent than birds that display at ground or eye level. Increased awareness of this species might help explain the difference in distribution and abundance between the first and subsequent years.

All species recorded are likely to breed in or near the project area as field inventory occurred during the breeding season and observations included singing males and territorial displays in appropriate breeding habitat. Direct evidence of breeding (nests with eggs or nestlings, or recently fledged dependent young) was confirmed for a number of species, but the observations were not part of the survey protocol and have not been summarized at this time. The Montana Bird Distribution database (MBD 2006) confirms breeding or indicates indirect evidence of breeding for the project area in Valley County for most of the species observed during this project.

Table 3. Relative Abundance (number and percent of points) of Detection for 9 Grassland Bird Species: North Valley County 2001-2005 (n = number of points sampled/year were the same for the first two years, and varied thereafter).

Species Common Name	2001 n=207 (%)	2002 n=207 (%)	2003 n=189 (%)	2004 n=195 (%)	2005 n=195 (%)	TOTAL n=996	Overall %	X(SD)
Western Meadowlark	155 (74.9)	194 (93.7)	165 (87.3)	186 (95.4)	190 (96.0)	890	89.4%	178.0/17.04
Chestnut-collared Longspur	170 (82.1)	168 (81.2)	162 (85.7)	167(85.6)	172 (86.9)	839	84.2%	167.8/3.77
Horned Lark	162 (78.3)	168 (81.2)	146 (77.2)	159 (81.5)	152 (76.8)	787	79.0%	157.4/8.59
Sprague's Pipit	126 (60.9)	157 (75.8)	153 (81.0)	160 (82.1)	158 (79.8)	754	75.7%	150.8/14.09
Baird's Sparrow	67 (32.4)	79 (38.2)	102 (54.0)	93 (47.7)	85 (42.9)	426	42.8%	85.2/13.35
Vesper Sparrow	46 (22.2)	60 (29.0)	56 (29.6)	53 (27.2)	37 (18.7)	252	25.3%	50.4/9.07
Lark Bunting	18 (8.7)	83 (40.1)	34 (18.0)	17 (8.7)	37 (18.7)	189	19.0%	37.8/26.85
McCown's Longspur	29 (14.0)	34 (16.4)	35 (18.5)	34 (17.4)	50 (25.3)	182	18.3%	36.4/7.96
Long-billed Curlew	34 (16.4)	46 (22.2)	32 (16.9)	27 (13.8)	40 (20.2)	179	18.0%	35.8/7.36
Marbled Godwit	22 (10.6)	40 (19.3)	25 (13.2)	40 (20.5)	50 (25.3)	177	17.8%	35.4/11.65

Species underlined are state Species of Concern. Marbled Godwit is a BLM Sensitive Species.

CONCLUSIONS

North Valley County is an exceptionally rich example of native grassland, representing some of the most intact remaining prairie in Montana (MTGAP 1998) and the entire North American continent (The Nature Conservancy 1999). The area, which lies adjacent to Canada's Grasslands National Park, is recognized nationally and internationally for its importance to prairie-dependent species (The Nature Conservancy 1999, Cooper et al. 2001, Smith Fargey 2004). Seven of the top twelve most abundant species recorded during this project are state Species of Concern (MTNHP 2004). Five are Great Plains prairie endemic birds (Samson and Knopf 1996) and are present at greater abundances here than other regions in Montana (Cooper at al. 2001). The extent of this area makes it especially important to species with severely limited breeding distributions, such as the McCown's Longspur (With 1994), Baird's Sparrow (Green et al. 2002) and Sprague's Pipit (Robbin and Dale 1999), and those species dependent upon larger blocks of land, such as Baird's Sparrow, Bobolink, and Marbled Godwit (Johnson and Igl 2001, Dechant et al. 2003f). While the historic combination of bison, pronghorn, elk, locusts, and fire that created a wide range of site conditions is long past, land management activities can mimic characteristics of this historically heterogeneous landscape by creating areas with low, sparse vegetative structure to those with taller, denser vegetation (Gillihan and Hutchings 2000). Each of these habitat conditions is suited to individual prairie-dependent species. Primary prairie endemics generally have more restricted breeding ranges with less flexibility in habitat requirements than more generalist species (Davis et al. 1999). It is important to recognize the subtle differences in foraging and breeding habitat requirements for each species when land management activities are considered. Providing suitable foraging and breeding sites to a diverse assemblage of avifauna will require a mosaic of vegetation characteristics likely to be beneficial to a host of other prairie species. The following table identifies some of the important characteristics of each species of conservation concern recorded during this project (see Table 4).

Table 4. Species of Conservation Concern Natural History Information and Management: Not all grassland habitat is suitable for all prairie bird species. Subtle differences on the landscape can result in suitable nesting habitat for one species, but not another.

Species Name Species Status	General Habitat Characteristics	Nest Site Characteristics	Management Recommendations to Promote Species	Notes	Arrival Date Departure Date	Nesting Dates	Incubation Period Days to Fledging	Number of Broods	Primary Summer Diet	Secondary Summer Diet
Low to Intermediate Grassland Cover Associated Species										
McCown's Longspur [1] prairie endemic G5/S2B	Open sparse grassland; areas structurally similar to heavily grazed pastures.	Ground nester. Shallow depression in the ground: either in the open or beside vegetation.	Maintain short, sparsely vegetated native prairie. Moderate to heavy, or season long grazing can make mixed-grass prairie suitable.	Limited shrubs in area are suitable; Nestlings suffer high rates of (mammalian) predation.	late April mid-August	early May to late July	12 days 10-12 days	2	seeds/plant material	insects
Chestnut-collared Longspur [2] prairie endemic G5/S3B	Sparse; recently grazed, mowed, or burned; minimal litter.	Ground nester: often protected on south and east sides	Keep native pastures intact. Manage for fairly short vegetation with sparse litter accumulation.	Native prairie specialist. Areas with occasional shrubs suitable.	mid-April late September	early May to late July	10-13 days 9-14 days	2	insects	seeds
Lark Bunting [3] prairie endemic G5/S3B	Primarily short-to-mid grass prairie. Prefers areas with some shrubs. Generally prefers areas $\geq$ 10 km^2.	Ground nester. Nest placed next to/under various plant species	Provide areas of short vegetation with protective cover for nesting.	May be present in agricultural fields, but use is limited. Highest densities in native prairie, though will nest in CRP lands.	early May late August	Mid-May to mid-August	12 days 8-9 days	1 to 2	insects	secondary seeds/plant material
Long-billed Curlew [4] prairie endemic G5/S2B	Open sparse grassland preferred; taller, denser grass during brood rearing.	Ground nester. Nest is a scrape in the ground lined with various bits of vegetation, pebbles, and other organic matter.	Provide large, open level to gently rolling grasslands with short vegetation.	Generally avoids areas with high density of shrubs.	early April mid-September	mid-to late April	28-31 days (able to leave nest within hours of hatching) 32-45 days	1	carnivorous (terrestrial invertebrates, vertebrates, eggs, etc.)	-
Sprague's Pipit [5] prairie endemic G4/S2B	Intermediate height with moderate litter.	Ground nester; dense, grassy, relatively tall vegetation, minimal forbs present, little bare ground	Provide native prairie with intermediate vegetation height and low visual obstruction.	Avoids areas with shrubs.	early May mid-September	late May to mid-July	13-14 days 9-12 days	2?	almost entirely insects	very minimal seeds/plant material

Table 4. Continued

Species Name Species Status	General Habitat Characteristics	Nest Site Characteristics	Management Recommendations to Promote Species	Notes	Arrival Date Departure Date	Nesting Dates	Incubation Period Days to Fledging	Number of Broods	Primary Summer Diet	Secondary Summer Diet
Ferruginous Hawk [6] prairie endemic G4/S2B	Prefer open prairie and shrubsteppe habitat.	Exposed: on cliffs, trees, ground, or manmade structures.	Provide/protect suitable nest sites, protect active nest areas from disturbance, and improve habitat for prey.	Prefers flat, rolling terrain. Avoids high elevation, forested areas and narrow canyons. Avoids areas recently altered for cultivation	March late September	late April to mid-July	28-33 days 44-48 days	1	small mammals (inc. jackrabbits, cottontail rabbits, ground squirrels, and prairie dogs)	birds, reptiles, insects
Swainson's Hawk [7] G5/S3B	Grasslands, sparse shrublands, and small open woodlands,	Nest in deciduous trees (about 50% of nests reused).	Provide open grasslands with occasional trees for nesting and perching.	Species unique in switching from primarily small mammal diet to insects after young birds fledge.	mid-March early November	early May to mid-July	28-35 days 30 days	1	mainly vertebrates during breeding season (mammals, birds, & reptiles)	invertebrates at other times
Intermediate to Tall Grassland Cover Associated Species										
Grasshopper Sparrow [8] G5/S3B	Prefers moderately open grasslands with patchy bare ground. Generally avoids areas with extensive shrub cover, although some shrub cover is desirable.	Ground nester: nest often domed with grasses and side entrance.	Provide/protect large areas of contiguous grassland of intermediate height with moderately deep litter cover and low shrub density.	May be locally abundant, generally rare throughout range. Somewhat area sensitive. Moderate-to-high nest predation.	early May early September	mid-June to late July	11-12 days 8-9 days	2 (poss. 3)	insects	rarely seeds/plant material in summer
Baird's Sparrow [9] prairie endemic G4/S2B	Ungrazed to moderately grazed, generally with litter depth of ~2 cm.	Ground nester; shallow scrape at base of grass clump.	Provide areas of native grassland (or idle tame pastures) with moderately deep litter. Avoid excessive grazing and limit shrub encroachment.	Scattered low shrubs and residual vegetation from last year are preferred habitat; area sensitive (favors large parcels). Nesting densities change according to local habitat conditions.	mid-May early September	late May to late July	11-12 days 8-10 days	1	insects	seeds/plant material

Table 4. Continued

Species Name Species Status	General Habitat Characteristics	Nest Site Characteristics	Management Recommendations to Promote Species	Notes	Arrival Date Departure Date	Nesting Dates	Incubation Period Days to Fledging	Number of Broods	Primary Summer Diet	Secondary Summer Diet
Bobolink [10] G5/S2B	Tall grass, flooded meadows, prairie. Most suitable habitat is moderate-to-tall vegetation, moderate-to-dense vegetation and moderately deep litter.	Ground nester: often located in wet habitats, often at the base of large forbs.	Provide large areas of native and tame grasslands of moderate height and density with adequate litter.	Somewhat area sensitive. Highly susceptible to nest abandonment if disturbed during breeding season.	mid-May early September	mid-June to late July	11-13 days 10-11 days	1	insects	seeds/plant material
Brewer's Sparrow [11] G5/S2B	Suitable breeding habitat contains dense shrubs, generally sagebrush. Average height generally <1.5 meters.	Nests built in taller, dense sagebrush, with limited bare ground and herbaceous cover.	Maintain extensive areas of sagebrush-dominated shrublands with average shrub cover of 10-30%, average shrub height of 0.4-1.5 m, and an understory of native grasses and forbs.	Can tolerate up to 3 weeks without water while on seed diet.	early May late September	late May to mid-July	10-12 days 8-9 days	2	insects	secondary seeds/plant material
Loggerhead Shrike [12] G4/S3B	Open prairie, pastures with fencerows, agricultural fields, riparian areas.	Usually well-hidden in crook of deciduous tree or robust shrub.	Provide grassland habitat with scattered trees and shrubs for foraging, nesting, and perching.	Lacking talons, may impale dead prey on barbed wire, branch, or thorn for easier consumption.	late April early September	mid-June to late July	16-17 days 17-21 days	2 broods possible	insects	small vertebrates, carrion
Greater Sage-Grouse [13] G4/S3	Sagebrush communities; generally prefers larger-stature sagebrush, but will use other habitats during the non- breeding season including meadows and grasslands.	Ground nester: nest generally placed under sagebrush. Depression lined with grass and sagebrush leaves.	Maintain expansive stands of sagebrush (*Artemisia* spp.), with forb understory; open sites for leks; and perennial grass and forb stands intermixed with sagebrush for brood rearing.		permanent resident	mid-April to late July	25-27 days 7-10 days	1	forb buds and flowers	-
Wetland Associated Species										
Franklin's Gull [14] G4G5/S3B	Extensive prairie marshes with emergent vegetation.	Nest is a floating mat of reeds anchored to suitable emergent vegetation (bulrush important). Colonial nester.	Maintain water levels at nesting sites. Protect nesting sites from human disturbance.	Highly susceptible to human disturbance while nesting. Water must be present at wetland at time young fledge.	late Apri late September	early June to early July	24-25 day 32 days	1	Insects, worms	small vertebrates, other invertebrates, grains/seeds

Table 4. Continued

Species Name Species Status	General Habitat Characteristics	Nest Site Characteristics	Management Recommendations to Promote Species	Notes	Arrival Date Departure Date	Nesting Dates	Incubation Period Days to Fledging	Number of Broods	Primary Summer Diet	Secondary Summer Diet
Common Tern [15] G3S3B	Open water bodies with islands for nesting.	Nests colonially; ground nester. Nest is a scrape in the ground generally lined with organic material.	Maintain water levels at nesting sites. Protect nesting colonies from human recreation or disturbance.	Generally, nesting sites are sparsely vegetated.	mid-May late September	early June to late July	21-27 days 26-27 days	1, rarely 2	Fish	Aquatic invertebrates/ insects
Marbled Godwit [16] BLM Sensitive species	Short, sparse to moderately vegetated uplands for nesting and foraging. Wetland complexes for foraging.	Ground nester. Nests in wet and dry areas of wet meadow, upland areas of short (<30 cm) grass.	Provide large expanses of short, sparse to moderately vegetated native grasslands with wetland complexes.	This species may be area sensitive, rarely occurring on blocks of contiguous grassland <100 ha. Territories are large and include both feeding and nesting areas	early May early September	mid-May to early July	21-23 days 21 days	?	Aquatic invertebrates	Insects
Willet [17] BLM Sensitive species	Short native grasslands idle during the nesting season. Prefer shallow-water wetlands with sparse vegetation.	Ground nester: often nest near a conspicuous object such as a piece of wood, a rock, or dried cattle dung.	Provide large expanses of native grasslands and wetland complexes		late April early October	Mid-May to mid-June	22-29 days 27-31 days	1	Aquatic invertebrates	-
Wilson's Phalarope [18] BLM Sensitive species	Both fresh and alkali wetlands with open water, emergent vegetation, and open shoreline.	Ground nester: nests are placed on the ground in wetlands, wet meadows and in grasslands adjacent to wetlands.	Provide suitable wetland with open water, emergent vegetation, and open shoreline in addition to upland habitat throughout the breeding season.	Males, the less colorful of the sexes, incubate the eggs and tend the young.	mid-April early September	early May to late July	18-27 days Young leave nest within 24 hrs of hatching. Actual days to fledging unknown	1, occ. 2	Aquatic invertebrates	seeds

1 - With 1994, Dechant et al. 2003j
2 - Hill and Gould 1997, Dechant et al. 2003c
3 - Shane 2000, Dechant et al. 2003m
4 - Dugger and Dugger 2002, Dechant et al. 2003i
5 - Robbins and Dale 1999, Dechant et al. 2003g
6 - Bechard and Schmutz 1995, Dechant et al. 2003l
7 - England et al. 1997, Dechant et al. 2003a
8 - Vickery 1996, Dechant et al. 2003d
9 – Johnson & Igl 2001, Green et al. 2002, Dechant et al. 2003b
10 - Martin and Gavin 1995, Dechant et al. 2003k
11 - Rotenberry et al. 1999, Ehrlich et al. 1988
12 – Yosef 1996, Dechant et al. 2003e
13 - Rowland 2004, Ehrlich et al. 1988
14 - Burger and Gochfeld 1994, Ehrlich et al. 1988
15 - Nisbet 2002, Ehrlich et al. 1988
16 - Dechant et al. 2003f, Ehrlich et al. 1988
17 - Lowther et al. 2001, Dechant et al. 2003h
18 - Colwell and Jehl 1994, Ehrlich et al. 1988

SUMMARY/RECOMMENDATIONS

The present diversity and abundance of prairie endemic bird species in north Valley County suggests that habitat elements in this area may be closer to historic conditions relative to other areas in the state. In addition, the different habitat requirements suitable for each species recorded during this study suggest that a wide range of habitats are available. Given modern rangeland management objectives to remove approximately half of the annual growth through grazing (Adams et al. 2004, Holechek et al. 2003), it is not surprising that Sprague's Pipits and Chestnut-collared Longspurs, which show a preference for areas with moderate grass cover and litter, (Hill and Gould 1997, Robbins and Dale 1999, Dechant et al. 2003g) were two of the most commonly encountered birds during this study. It is encouraging to note, however, that both Baird's Sparrows, which require dense grass and litter (Green et al. 2002, Dechant et al. 2003b), and McCown's Longspurs, which require sparse grass and bare ground (With 1994, Dechant et al. 2003j), were also two of the most numerous bird species detected, suggesting that habitats preferred by these species are also represented in this landscape.

The current manageable activity affecting remaining native grasslands is grazing by livestock. In contrast to the concerns of Fuhlendorf and Engle (2001), that current grazing practices do not provide a range of habitats, management of this area appears to be providing habitat suitable to a diversity of prairie endemic species. At primary issue, however, is whether current management activities address grassland bird population objectives and if current conditions are sufficient to sustain these prairie species in the long term. Although this landscape was shaped by thousands of years of grazing by bison, the effect of domestic cattle grazing on vegetation structure and density can differ markedly from that of bison (Peden et al. 1974, Schwartz and Ellis 1981). Plumb and Dodd (1993) note, however, that grazing effects of cattle and bison can be similar at the right scale. This scale is dependent, certainly, upon the species in question and the ability of land managers to address habitat elements specific to each species. Maintaining both grazing and other natural disturbance (e.g. fire) regimes that mimic the frequency and intensity of historic conditions will result in a mosaic of vegetation structures. These conditions are critical to supporting high species diversity; without them many species would likely disappear from this landscape. North Valley County is critical to the conservation of Montana's grassland bird species. Continued work is necessary, however, to identify the implications of current land management practices on the future of these unique species.

Detailed analysis on this dataset will be conducted in future years to identify the relationships between pasture grazing regimes and bird distribution, diversity, and abundance. The intent of this analysis is to identify how differences in vegetation structure, as a result of different grazing timing and intensity affect bird abundance patterns. Summary information on grazing history, bird abundance, and vegetative characteristic for each point and transect from the existing dataset are available in Microsoft Excel format and are electronic appendices to this progress report.

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Appendix A. Global/State Rank Definitions

HERITAGE PROGRAM RANKS

The international network of Natural Heritage Programs employs a standardized ranking system to denote global (range-wide) and state status. Species are assigned numeric ranks ranging from 1 to 5, reflecting the relative degree to which they are "at-risk". Rank definitions are given below. A number of factors are considered in assigning ranks — the number, size and distribution of known "occurrences" or populations, population trends (if known), habitat sensitivity, and threat. Factors in a species' life history that make it especially vulnerable are also considered (e.g., dependence on a specific pollinator).

GLOBAL RANK DEFINITIONS (NatureServe 2003)

G1	Critically imperiled because of extreme rarity and/or other factors making it highly vulnerable to extinction
G2	Imperiled because of rarity and/or other factors making it vulnerable to extinction
G3	Vulnerable because of rarity or restricted range and/or other factors, even though it may be abundant at some of its locations
G4	Apparently secure, though it may be quite rare in parts of its range, especially at the periphery
G5	Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery
T1-5	**Infraspecific Taxon** (trinomial) —The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank

STATE RANK DEFINITIONS

S1	At high risk because of extremely limited and potentially declining numbers, extent and/or habitat, making it highly vulnerable to extirpation in the state
S2	At risk because of very limited and potentially declining numbers, extent and/or habitat, making it vulnerable to extirpation in the state
S3	Potentially at risk because of limited and potentially declining numbers, extent and/or habitat, even though it may be abundant in some areas
S4	Uncommon but not rare (although it may be rare in parts of its range), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern
S5	Common, widespread, and abundant (although it may be rare in parts of its range). Not vulnerable in most of its range

COMBINATION RANKS

G#G# or S#S#	**Range Rank**—A numeric range rank (e.g., G2G3) used to indicate uncertainty about the exact status of a taxon

QUALIFIERS

NR	Not ranked
Q	**Questionable taxonomy that may reduce conservation priority**—Distinctiveness of this entity as a taxon at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority (numerically higher) conservation status rank

X	**Presumed Extinct**—Species believed to be extinct throughout its range. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered
H	**Possibly Extinct**—Species known from only historical occurrences, but may never-the-less still be extant; further searching needed
U	**Unrankable**—Species currently unrankable due to lack of information or due to substantially conflicting information about status or trends
HYB	**Hybrid**—Entity not ranked because it represents an interspecific hybrid and not a species
?	**Inexact Numeric Rank**—Denotes inexact numeric rank
C	**Captive or Cultivated Only**—Species at present is extant only in captivity or cultivation, or as a reintroduced population not yet established
A	**Accidental**—Species is accidental or casual in Montana, in other words, infrequent and outside usual range. Includes species (usually birds or butterflies) recorded once or only a few times at a location. A few of these species may have bred on the one or two occasions they were recorded
Z	**Zero Occurrences**—Species is present but lacking practical conservation concern in Montana because there are no definable occurrences, although the taxon is native and appears regularly in Montana
P	**Potential**—Potential that species occurs in Montana but no extant or historic occurrences are accepted
R	**Reported**—Species reported in Montana but without a basis for either accepting or rejecting the report, or the report not yet reviewed locally. Some of these are very recent discoveries for which the program has not yet received first-hand information; others are old, obscure reports
SYN	**Synonym**—Species reported as occurring in Montana, but the Montana Natural Heritage Program does not recognize the taxon; therefore the species is not assigned a rank
*	A rank has been assigned and is under review. Contact the Montana Natural Heritage Program for assigned rank
B	**Breeding**—Rank refers to the breeding population of the species in Montana
N	**Nonbreeding**—Rank refers to the non-breeding population of the species in Montana

APPENDIX B. SUMMARY OF DISTRIBUTION

Species Common Name	Total Overall Abundance	Total Number of Transects Species was Detected on all Years (n= 332)	Percentage of Overall Abundance across all years
Chestnut-collared Longspur	3116	307	25.7%
Western Meadowlark	1878	322	15.5%
Horned Lark	1638	313	13.5%
Sprague's Pipit	1213	307	10.0%
Baird's Sparrow	691	190	5.7%
Lark Bunting	658	94	5.4%
Vesper Sparrow	315	149	2.6%
McCown's Longspur	309	98	2.5%
Marbled Godwit	277	116	2.3%
Long-billed Curlew	257	106	2.1%
Brown-headed Cowbird	249	109	2.1%
Grasshopper Sparrow	192	83	1.6%
Savannah Sparrow	132	80	1.1%
Willet	117	74	1.0%
Brewer's Blackbird	107	55	0.9%
Killdeer	79	49	0.7%
Mallard	75	29	0.6%
Wilson's Phalarope	65	24	0.5%
Red-winged Blackbird	62	37	0.5%
Sharp-tailed Grouse	60	18	0.5%
Northern Harrier	59	54	0.5%
Bobolink	56	18	0.5%
Mourning Dove	46	26	0.4%
Brewer's Sparrow	42	25	0.3%
Canada Goose	37	8	0.3%
Upland Sandpiper	32	18	0.3%
Franklin's Gull	29	2	0.2%
Barn Swallow	27	16	0.2%
Northern Shoveler	27	10	0.2%
Ring-necked Pheasant	21	14	0.2%
Double-crested Cormorant	19	3	0.2%
Eastern Kingbird	17	13	0.1%
Black-billed Magpie	16	7	0.1%
Common Nighthawk	14	9	0.1%
Blue-winged Teal	13	7	0.1%
European Starling	13	2	0.1%
Ferruginous Hawk	13	7	0.1%
Northern Pintail	12	7	0.1%
American Kestrel	11	11	0.1%

Species Common Name	Total Overall Abundance	Total Number of Transects Species was Detected on all Years (n= 332)	Percentage of Overall Abundance across all years
American Wigeon	11	7	0.1%
Cliff Swallow	10	3	0.1%
California Gull	9	7	0.1%
Ring-billed Gull	9	7	0.1%
Short-eared Owl	9	8	0.1%
Wilson's Snipe	7	4	0.1%
Gadwall	6	3	0.0%
American Goldfinch	5	4	0.0%
Clay-colored Sparrow	5	4	0.0%
Swainson's Hawk	5	4	0.0%
Yellow-headed Blackbird	5	3	0.0%
Lesser Scaup	4	2	0.0%
Merlin	4	4	0.0%
Western Kingbird	4	4	0.0%
American Crow	3	2	0.0%
Bank Swallow	3	1	0.0%
Red-tailed Hawk	3	3	0.0%
Common Tern	2	2	0.0%
Field Sparrow	2	1	0.0%
Great Blue Heron	2	2	0.0%
Lark Sparrow	2	1	0.0%
Loggerhead Shrike	2	2	0.0%
Prairie Falcon	2	2	0.0%
Greater Sage-Grouse	2	1	0.0%
Spotted Sandpiper	2	2	0.0%
American Avocet	1	1	0.0%
American Coot	1	1	0.0%
American Robin	1	1	0.0%
Common Grackle	1	1	0.0%
Green-winged Teal	1	1	0.0%
Pied-billed Grebe	1	1	0.0%
Song Sparrow	1	1	0.0%
Tree Swallow	1	1	0.0%
Turvey Vulture	1	1	0.0%

Appendix C. Average Number of Birds per Transect

Species Common Name	2001	2002	2003	2004	2005	Average Number of Birds per Transect per year (n=5)	Standard Deviation of Abundance across Transects
Chestnut-collared Longspur	8.9	8.1	8.9	10.4	10.7	9.40	1.11
Western Meadowlark	3.5	6.6	4.7	7.3	6.2	5.66	1.54
Horned Lark	4.8	4.7	4.7	5.7	4.8	4.94	0.41
Sprague's Pipit	2.8	4.0	3.8	4.1	3.6	3.66	0.50
Baird's Sparrow	1.5	2.0	2.4	2.5	2.1	2.09	0.41
Lark Bunting	2.3	3.8	1.3	1.1	1.2	1.95	1.13
Vesper Sparrow	0.9	1.1	1.0	1.1	0.7	0.95	0.18
McCown's Longspur	0.8	0.7	0.8	0.9	1.4	0.93	0.28
Marbled Godwit	0.5	0.9	0.6	1.0	1.2	0.84	0.30
Long-billed Curlew	0.8	0.9	0.7	0.6	0.9	0.77	0.14
Brown-headed Cowbird	0.6	0.8	0.8	1.0	0.5	0.75	0.19
Grasshopper Sparrow	0.4	0.4	0.7	0.3	1.0	0.58	0.29
Savannah Sparrow	0.3	0.4	0.5	0.5	0.3	0.40	0.13
Willet	0.2	0.5	0.3	0.3	0.4	0.35	0.12
Brewer's Blackbird	0.4	0.2	0.3	0.4	0.2	0.32	0.09
Killdeer	0.3	0.3	0.3	0.1	0.2	0.24	0.08
Mallard	0.2	0.4	0.3	0.1	0.2	0.23	0.12
Wilson's Phalarope	0.0	0.1	0.3	0.4	0.2	0.20	0.16
Red-winged Blackbird	0.1	0.2	0.1	0.3	0.2	0.19	0.08
Sharp-tailed Grouse	0.3	0.2	0.2	0.1	0.1	0.18	0.08
Northern Harrier	0.3	0.2	0.2	0.1	0.1	0.18	0.07
Bobolink	0.0	0.1	0.3	0.3	0.2	0.17	0.10
Mourning Dove	0.1	0.3	0.1	0.1	0.1	0.14	0.10
Brewer's Sparrow	0.2	0.1	0.1	0.2	0.1	0.13	0.06
Canada Goose	0.0	0.4	0.0	0.0	0.1	0.11	0.19
Upland Sandpiper	0.0	0.1	0.2	0.1	0.1	0.10	0.06
Franklin's Gull	0.0	0.0	0.0	0.4	0.0	0.09	0.19
Barn Swallow	0.0	0.1	0.1	0.1	0.1	0.08	0.05
Northern Shoveler	0.0	0.1	0.2	0.1	0.0	0.08	0.07
Ring-necked Pheasant	0.0	0.1	0.1	0.1	0.1	0.06	0.03
Double-crested Cormorant	0.0	0.1	0.0	0.0	0.2	0.06	0.08
Eastern Kingbird	0.0	0.0	0.0	0.1	0.1	0.05	0.03
Black-billed Magpie	0.1	0.1	0.1	0.0	0.0	0.05	0.03
Common Nighthawk	0.0	0.0	0.0	0.1	0.1	0.04	0.05
Blue-winged Teal	0.0	0.0	0.0	0.1	0.0	0.04	0.05
European Starling	0.0	0.0	0.2	0.0	0.0	0.04	0.07
Ferruginous Hawk	0.0	0.0	0.0	0.0	0.1	0.04	0.04
Northern Pintail	0.0	0.1	0.0	0.1	0.0	0.04	0.05
American Kestrel	0.1	0.0	0.0	0.0	0.0	0.03	0.03
American Wigeon	0.1	0.1	0.0	0.0	0.0	0.03	0.03
Cliff Swallow	0.0	0.1	0.0	0.1	0.0	0.03	0.04

Species Common Name	2001	2002	2003	2004	2005	Average Number of Birds per Transect per year (n=5)	Standard Deviation of Abundance across Transects
California Gull	0.0	0.1	0.0	0.0	0.0	0.03	0.02
Ring-billed Gull	0.0	0.0	0.0	0.0	0.0	0.03	0.02
Short-eared Owl	0.0	0.0	0.0	0.1	0.0	0.03	0.06
Wilson's Snipe	0.0	0.0	0.0	0.0	0.0	0.02	0.02
Gadwall	0.0	0.1	0.0	0.0	0.0	0.02	0.02
American Goldfinch	0.0	0.0	0.0	0.0	0.0	0.01	0.02
Clay-colored Sparrow	0.0	0.0	0.0	0.0	0.0	0.01	0.01
Swainson's Hawk	0.0	0.1	0.0	0.0	0.0	0.01	0.03
Yellow-headed Blackbird	0.0	0.0	0.0	0.0	0.0	0.02	0.02
Lesser Scaup	0.0	0.0	0.0	0.0	0.0	0.01	0.02
Merlin	0.0	0.0	0.0	0.0	0.0	0.01	0.01
Western Kingbird	0.0	0.0	0.0	0.0	0.0	0.01	0.02
American Crow	0.0	0.0	0.0	0.0	0.0	0.01	0.01
Bank Swallow	0.0	0.0	0.0	0.0	0.0	0.01	0.02
Red-tailed Hawk	0.0	0.0	0.0	0.0	0.0	0.01	0.01
Common Tern	0.0	0.0	0.0	0.0	0.0	0.01	0.01
Field Sparrow	0.0	0.0	0.0	0.0	0.0	0.01	0.01
Great Blue Heron	0.0	0.0	0.0	0.0	0.0	0.01	0.01
Lark Sparrow	0.0	0.0	0.0	0.0	0.0	0.01	0.01
Loggerhead Shrike	0.0	0.0	0.0	0.0	0.0	0.01	0.01
Prairie Falcon	0.0	0.0	0.0	0.0	0.0	0.01	0.01
Greater Sage-Grouse	0.0	0.0	0.0	0.0	0.0	0.01	0.01
Spotted Sandpiper	0.0	0.0	0.0	0.0	0.0	0.01	0.01
American Avocet	0.0	0.0	0.0	0.0	0.0	0.00	0.01
American Coot	0.0	0.0	0.0	0.0	0.0	0.00	0.01
American Robin	0.0	0.0	0.0	0.0	0.0	0.00	0.01
Common Grackle	0.0	0.0	0.0	0.0	0.0	0.00	0.01
Green-winged Teal	0.0	0.0	0.0	0.0	0.0	0.00	0.01
Pied-billed Teal	0.0	0.0	0.0	0.0	0.0	0.00	0.01
Song Sparrow	0.0	0.0	0.0	0.0	0.0	0.00	0.01
Tree Swallow	0.0	0.0	0.0	0.0	0.0	0.00	0.01
Turkey Vulture	0.0	0.0	0.0	0.0	0.0	0.00	0.01