FINAL PERFORMANCE REPORT

FEDERAL AID GRANT NO. T-26-P-1

STATUS AND DEMOGRAPHY OF GRASSLAND RAPTORS OF CONSERVATION CONCERN IN THE OKLAHOMA PANHANDLE

OKLAHOMA DEPARTMENT OF WILDLIFE CONSERVATION

July 1, 2005 through December 31, 2008

FINAL PERFORMANCE REPORT

STATE: OKLAHOMA **PROJECT NUMBER:** T-26-P-1

GRANT PROGRAM: State Wildlife Grant Program

GRANT TITLE: Status and Demography of Grassland Raptors of Conservation Concern in the Oklahoma Panhandle

GRANT PERIOD: July 1, 2005 – June 30, 2008 (extended to Dec 31, 2008)

PROJECT LEADER: Mark Howery

PRINCIPAL INVESTIGATOR: Gary D. Schnell

Objective

The goal of this research program is to assess the population trend of several declining predatory bird species in the Oklahoma Panhandle. The study will: (1) provide a current (2005-2007) picture of the breeding status of several bird species of greatest conservation need in the western Panhandle counties; (2) monitor reproductive success of the focal species and thereby determine whether populations are currently maintaining themselves; and (3) correlate nest-site and nest-success data with patterns of local land use and, thus, provide management recommendations for site-specific and regional actions that may improve the status of these species on the southern High Plains. The final project report will summarize points 1-3 above and will provide both large-scale (e.g. federal, state biologists) and small scale (private ranchers) land managers with specific land-use recommendations that will benefit a suite of species on the southern High Plains.

Summary of Progress:

Attached document serves as the final report.

Significant Deviations: None

Cost: $ 138,645.18

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Status and demography of grassland raptors of conservation concern in the Oklahoma Panhandle

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Abstract. We studied the distribution and reproductive success of several species of raptors in primarily agricultural areas of Cimarron County, Oklahoma, during the 2006-2008 breeding seasons. Ferruginous Hawks (*Buteo regalis*) and Chihuahuan Ravens (*Corvus cryptoleucos*) were uncommon and nested primarily in and around the Rita Blanca National Grassland (NG) in the southwestern portion of the county. Swainson's Hawks (*B. swainsoni*) were common and nested throughout the study area. Burrowing Owls appeared to be most abundant in 2006, before a local crash in the number and extent of prairie dog (*Cynomys ludovicianus*) colonies in Cimarron County. Loggerhead Shrikes (*Lanius ludovicianus*) were rare breeders (< 3 pairs) in all years, with nests located near areas of sandsage and *Yucca*. Finally, Common Ravens (*Corvus corax*) have extended their breeding range onto the primarily agricultural flatlands in central Cimarron County and a few pairs now appear to regularly breed in the area.

Reproductive success was relatively high for Ferruginous Hawks (≥ 67%) and Loggerhead Shrikes (100%), while Swainson's Hawks showed low success (61%) relative to studies elsewhere in the species' range. We suggest that nest-site availability is the primary factor regulating the abundance of Swainson's and Ferruginous Hawks, Chihuahuan Ravens, and Loggerhead Shrikes in our study area. Large areas of the eastern portion of the study are devoid of trees, whereas in the western portion of the county, abandoned farms provide a number of suitable nesting areas. Ferruginous Hawks and Chihuahuan Ravens often nest on man-made platforms (nest platforms on the Rita Blanca NG, and windmills) that are most common in and around the Rita Blanca NG.

Together with the results of previous studies, our results suggest that the Ferruginous Hawk population is currently stable in Cimarron County – the population could likely be increased by the provision of nesting platforms on private lands. Although Swainson's Hawks are widespread breeders in the Oklahoma Panhandle, Breeding Bird Survey data show a long-term population decline in the state. As a consequence, reproductive success should be monitored over a longer time period to determine whether the Cimarron County population is stable. Loggerhead Shrikes and Chihuahuan Ravens both appear to be declining in abundance, with very few shrikes breeding away from areas of sandsage, and Chihuahuan Ravens are now largely restricted to southern and central portions of Cimarron County. The reason for the low (and apparently declining) numbers of these two species is unclear, though conversion of native grassland and sandsage to row-crop agriculture has been cited as a contributing factor. Our study highlights the need for further research on

Swainson's Hawks, Loggerhead Shrikes, and Chihuahuan Ravens to determine the causes of the decline in abundance in Oklahoma over the past 50 years.

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INTRODUCTION

A large percentage of bird species endemic to the Great Plains have undergone dramatic population declines in the past century (Knopf and Sampson 1997). The widespread nature of the declines suggests that a single factor, typically cited as conversion of native grasslands to agricultural use, is largely responsible for the declines. However, it has proven difficult to link changes in land use practices to changes in the population densities of bird species. Part of the problem in documenting the effects of land use changes on Great Plains bird populations is that there are few areas where natural (or "control") areas can be compared to altered landscapes.

The U.S. Fish and Wildlife Service (USFWS 2002) has designated several grassland raptors as "Birds of Conservation Concern" in Bird Conservation Region 18 (shortgrass prairie; Ferruginous Hawk *Buteo regalis*, Burrowing Owl *Athene cunicularia*), as well as nationally (Ferruginous Hawk, Swainson's Hawk *Buteo swainsoni*, Burrowing Owl, Loggerhead Shrike *Lanius ludovicianus*). In Oklahoma, these raptors are considered Tier I (Swainson's Hawk, Burrowing Owl, Loggerhead Shrike) and Tier II (Ferruginous Hawk) species within the state Comprehensive Wildlife Conservation Strategy (ODWC 2005). In addition, the U.S. Forest Service (USFS 2007) has designated several grassland bird species as "Sensitive Species", for which management activities should be directed. Several of the Forest Service Sensitive Species, including Ferruginous Hawks, Burrowing Owls, and Loggerhead Shrikes, nest on National Grassland units within the southern High Plains and on adjoining private lands. Chihuahuan Ravens (*Corvus cryptoleucus*) have not been recognized as a species of conservation concern, but have suffered significant range contraction and have declined in abundance in the last 40 years (Wiggins, *in prep.*), especially in Colorado, Kansas and Oklahoma. Although all of these species have undergone recent population declines on the Great Plains, it is unclear how land-use patterns and land-management practices may have contributed to population declines. Several studies (e.g., Schmutz 1984, Bechard and Schumtz 1995, Yosef 1996) have suggested that the conversion of native grasslands to cropland and degradation of native grasslands are the primary contributing factors. The key design component of the study is to compare raptor demography on and off the National Grassland system, as the National Grasslands currently represent the best available approximation of short-grass prairie and sand-sage ecosystems under natural conditions.

Data from the Breeding Bird Survey indicate that Burrowing Owls have decreased in abundance in recent years in the Oklahoma Panhandle, likely as a result of a decrease in the extent of black-tailed prairie dog (*Cynomys ludovicianus*) colonies (Sheffield and Howery 2001). Ferruginous Hawks and Chihuahuan Ravens have both declined in abundance in Oklahoma and are largely restricted as breeding species to Cimarron and Texas counties in the western portion of the Oklahoma Panhandle (Smith 2004a, Patti 2004). Swainson's Hawks have shown significant declines (-4.5% per year) in abundance in Oklahoma since 1966 (Smith 2004b). Loggerhead Shrikes also have experienced significant long-term, declines range-wide (Cade and Woods 1997) and in Oklahoma (-5.4%/year; Smith 2004c), and although they have a wide breeding distribution throughout the Panhandle, breeding density is low and reproductive success has been poor in shortgrass prairie areas in recent years (e.g., Wiggins 2003).

The goal of this research program was to assess the population trend of several declining predatory bird species in the Oklahoma Panhandle. The study provides 1) a current (2006-2008) picture of the breeding status of several raptor species of greatest conservation need in the western Oklahoma Panhandle; 2) digital maps of the distribution of nest sites throughout the study area, 3) an indication of reproductive success of the focal species, and 4) analysis of land-use patterns around Ferruginous Hawk nest sites.

METHODS

From 2006 to 2008, field surveys were conducted in Cimarron County, Oklahoma, during the period from late April to early July. Study areas were concentrated around the Rita Blanca National Grassland in southwestern Cimarron County and on private lands to the southwest, northwest, north, and northeast of Boise City. The Rita Blanca National Grasslands were a focal point of the study and, as a consequence, private land with similar vegetation and topography (primarily flat grassland areas) were surveyed to provide a comparative data set. The Black Mesa area in northwestern Cimarron County, as well as the Beaver River drainage in the south-central portion of the county were not surveyed during this study. In addition, southeastern Cimarron County was not surveyed due to limited survey time.

Surveying was carried out in 3-4 intensive periods each year, in late April and early May (when Ferruginous Hawks were incubating and when Swainson's Hawks were establishing territories), in late May (when Loggerhead Shrikes were incubating eggs or feeding young), in mid-

to late June (when Ferruginous Hawks were fledging and when Loggerhead Shrikes were feeding fledged young), and in early July (when Swainson's Hawk young were large enough to easily count in the nest). These three species were the focal species of this study and attempts were made to access each nest to determine nest contents and the outcome of each breeding attempt. As Swainson's Hawks often nested higher than the reach of our extendable mirror, we were often unable to establish the exact number of young in nests.

For the other species considered in this study, data on nest sites were collected when feasible. There were difficulties in collecting information on Chihuahuan and Common ravens, on Barn Owls, and especially on Burrowing Owls. Both raven species are very sparsely distributed in Cimarron County and nest primarily in or near man-made structures in the study area. Due to the difficulty in accessing private lands, it was not always possible to survey abandoned farm houses (where both species sometimes nest) and isolated windmills (preferred nest sites of Chihuahuan Ravens). Consequently, the data for these species likely represent a rough estimate (50% of Common Ravens, 70% of Chihuahuan Ravens) of the number of pairs breeding in the study area.

Burrowing Owls were especially difficult to survey for as they are cryptic and often most active at dawn and dusk. Whenever a prairie dog colony was found, it was surveyed for 2-3 minutes for the presence of adult Burrowing Owls. However, few data were available on brood sizes as young often remain in burrows during the day and the time needed to adequately survey at individual nest burrows was not available. In addition, some burrowing pairs nest in isolated burrows far from roads, making surveying especially difficult. We found Barn Owls nesting only in abandoned farm homes and barns in our study area. We did not survey in the dry river valleys or mesas in the county, where Barn Owls are known to nest in considerable numbers (e.g., McConnell et al. 2006). In addition, due to a lack of access to private land and to the difficulty in finding nests in some abandoned structures, we were likely only assessing a small proportion of the total number of breeding Barn Owls in the study area.

All nest sites or locations of adults (Burrowing Owls) were digitally mapped using a portable Garmin GPS, and later entered into ArcGIS (v.9) software. Data were collected and plotted using NAD 1927 projections. We projected the nest site layers onto maps comprised of Cimarron County land use taken from the 2002 National Land Cover Dataset (NLCD) for Cimarron County, as well as a layer comprised of Conservation Reserve Program land provided by the Cimarron County Farm Service Agency.

To examine land use around Ferruginous Hawk nests, we quantified land codes in 2-km buffers around each nest. Because of the similarity (and close proximity) in habitat types, we lumped sandsage savannah and sandsage prairie (vegetation codes 59 and 67 in our digital files).

RESULTS

Ferruginous Hawk *(Buteo regalis)*

Oklahoma Comprehensive Wildlife Conservation Strategy Ranking: Tier II
USFWS: Species of Conservation Concern

Ferruginous Hawks are a species of conservation concern due to loss of breeding habitat throughout the North American range, and because they are highly sensitive to disturbance while nesting (Bechard and Schmutz 1995). The available data on long-term population trends show no discernible range-wide change (Collins and Reynolds 2005), but local population declines are apparent in Kansas (Busby and Zimmerman 2001) and in the Canadian prairies (e.g., Schmutz 1999). In addition, the species is generally considered more at risk on the Great Plains, due to the large percentage of land in private ownership, the prevalence of crop production in this area (relative to livestock grazing in other parts of the species' range), and the decline in the number of prairie dogs on the Great Plains (Miller et al. 2002).

In Oklahoma, previous studies have given a wide range of estimates of the number of Ferruginous Hawks breeding in Cimarron County. McConnell et al. (2006) estimated a total breeding population of about 20 pairs in Cimarron County in 2004-2005. Voelker (cited in McConnell et al. 2006) estimated a long-term (1968 – onwards) population of ca. 35 breeding pairs of Ferruginous Hawks in Cimarron County. Our estimate of ca. 10 pairs over approximately 40% of the county suggests a current total of 25 Ferruginous Hawk nests in Cimarron County.

Breeding distribution

In all years of the study, we found the highest concentration of breeding Ferruginous Hawks in and around the Rita Blanca National Grasslands, in southern Cimarron County (**Figure 1**). Ferruginous Hawk nests were located on artificial nesting platforms (5 = sites), in isolated trees (6 = sites; e.g.,

Woffinden and Murphy 1989). There are no data available on the cause of the nest failures in this study, although on the nearby Comanche National Grassland in Colorado, extreme weather (e.g., hailstorms) is thought to have caused some nestling mortality (Wiggins 2003-2007). Disturbance can also be a problem for nesting Ferruginous Hawks (e.g., Olendorff 1993), and pairs typically choose nest sites far from roads (relative to Swainson's Hawks: Bechard et al. 1990, Wiggins 2007).

Table 1. The number of nesting pairs and reproductive success of Ferruginous Hawks in the Cimarron County study area from 2006-2008.

Year	Active nests	Nests with young	Failed nests	Nests with unknown outcome	Minimum* brood size at fledging (n)	No. of fledglings per active territory (n)	% active nests that were successful
2006	9	6	1	2	3.8 (6)	2.6 (9)	≥ 66%
2007	10	5	4	1	3.0 (5)	1.5 (10)	≥ 50%
2008	7	6	0	1	≥ 2.2 (6)**	≥ 1.7 (7)**	≥ 86%
Mean	8.3	6.3	-	-	3.0	1.9	≥ 67%

* At successful nests only.

** This is a minimum estimate. At 3 nests, it was not possible to quantify the exact brood size.

When considering failed and successful nests (**Table 2**), the number of fledged young per nest noted in this study (1.9 yg/nest attempt) was similar to that found in other studies (range = 1.3-2.9).

Table 2. The mean number of young fledged from active Ferruginous Hawk territories (including failed nests) across the species' range.

Study area	Years	No. of fledglings per active territory (n)	Citation
South Dakota	1973-1974	1.8 (27)	Lokemoen and Duebbert 1976
South Dakota	1976-1977	1.8 (41)	Blair and Schitoskey 1982
North Dakota	1977-1979	2.2 (103)	Gilmer and Stewart 1983
Idaho	1973	1.8 (27)	Howard and Wolfe 1976
Idaho	1977-1994	1.3	Steenhof cited in Bechard and Schmutz 1995
Colorado	1969-1972	2.1 (53)	Olendorff 1973
Colorado	2002-2007		Wiggins 2003-2007
Utah	1966-1974	2.0 (121)	Smith et al. 1981
Manitoba	1987-1988	1.5 (42)	De Smet and Conrad 1991
Saskatchewan	1978-1988	2.4 (341)	Harris 1989
Saskatchewan	1969-1988	2.9	Houston 1991
Saskatchewan	1985-1987	1.6 (97)	Schmidt 1988
Alberta	1975-1988	2.1	Schmutz and Hungle 1989
Oklahoma	**2006-2008**	**1.9 (26)**	**This study**

Analysis of long-term Breeding Bird Survey (BBS) data (**Table 3**) show a significant change only in Colorado, where populations increased from 1980 to 2007. One problem in interpreting BBS data is that declines in some areas on the edge of the species' range (e.g., Saskatchewan, Kansas) are difficult to analyze due to very low sample sizes.

Table 3. Breeding Bird Survey long-term (1980-2007) trend data for Ferruginous Hawks on the southern High Plains. Data from Sauer et al. (2008).

State/Area	Sample size (routes)	Trend (% decline/yr)	Significance (P value)
OK	Insufficient data	-	-
TX	Insufficient data	-	-
NM	12	+ 15.9	0.06
CO	33	+ 4.8	**0.03**
KS	7	- 17.9	0.24

Nest-site selection and land-use patterns

Schmutz (1987) found a significant negative correlation between the density of breeding Ferruginous Hawks and the percentage of land in active cultivation, apparently as a result of a decrease in the abundance of their primary prey (pocket gophers, ground squirrels, and hares) in croplands. However, Schmutz (1987) also found that Ferruginous Hawks flushed from their nest sites at an average of 110 m (from the observer) when approached, which suggests that disturbance due to agricultural activities might also play a role in nest site choice and nesting success. Due to the low number of nests found outside of the National Grasslands, we were unable to assess the role of land-use on the breeding success of Ferruginous Hawks in Cimarron County. However, the density of Ferruginous Hawks nesting on the National Grasslands in Cimarron County was certainly higher than the density in agricultural areas, as only 2-3 nests were found in areas outside the NG in any year, despite much larger study area outside the NG (**Figure 1**).

Our data suggest that land use around Ferruginous Hawks nests was relatively heterogeneous in structure (**Table 4**). McConnell et al. (2006) found a high percentage of grassland and a lower percentage of cropland in Ferruginous Hawk territories in Cimarron County. However, their study encompassed the entire county, with the exception that they did not survey the area in and around the Rita Blanca National Grassland. Consequently, they surveyed areas (e.g., extensive grasslands in north-central Cimarron County) that differed significantly from those in this study.

Table 4. Percentage of land in different land use categories in 2-km buffers around each Ferruginous Hawk nest and a comparison with previous results in the same general area.

Land use type	Mean % located in Ferruginous Hawk territories*	McConnell et al. 2006
CRP	17%	12%
Grassland	37%	77%
Sandsage**	19%	20%***
Cropland	26%	9%
Residential	< 1%	
Pasture	< 1%	

* Territories defined here as 2-km buffer zones around each nest site used from 2006-2008.
** Sandsage savannah and sandsage prairie were lumped into "sandsage" for this analysis.
***Sandsage was analyzed with a separate layer, so the total exceeds 100%.

Land management recommendations

We found Ferruginous Hawks nesting primarily within or near the Rita Blanca National Grassland in southwestern Cimarron County. In this area, Ferruginous Hawks often nested on man-made nesting platforms that were erected in the late 1970s. In areas away from the Rita Blanca National Grassland, the density of Ferruginous Hawks decreased – only 4 nesting sites were found away from the Rita Blanca in this study. We suspect this result is due more to a lack of suitable habitat than to a lack of nest sites. Although we did not attempt to accurately quantify the size and location of prairie dog colonies in this study, at least 2 of the 4 nest sites outside the Rita Blanca were located within 1 km of an active prairie dog colony, and the majority of nest sites on the Rita Blanca were within 1 km of an active prairie dog colony. Further, the density of and the year-to-year persistence of prairie dog colonies was significantly higher on the Rita Blanca NG, relative to private lands. In 2008, the majority (> 50%) of prairie dog colonies located on private lands away from the Rita Blanca NG appeared to be inactive.

Another potentially significant factor in determining the distribution and success of Ferruginous Hawks on the southern High Plains is disturbance. Ferruginous Hawks are known to nest on relatively isolated structures (trees, nest platforms, etc.) as adults are sensitive to disturbance during the nesting season (Bedard and Schmutz 1995, Boal et al., unpublished report), and we suspect that human disturbance is less common on the National Grasslands than it is on surrounding private lands. On private lands, the protection of existing nest sites as well as the erection of nesting platforms in relatively isolated areas would help to maintain and/or increase the number of breeding Ferruginous Hawks. In addition, reversing the trend of declining prairie dog abundance (Sheffield

and Howery 2001, Lomolino et al. 2003) in the Oklahoma Panhandle may help to provide preferred breeding habitat for Ferruginous Hawks.

Swainson's Hawk (*Buteo swainsoni*)

Oklahoma Comprehensive Wildlife Conservation Strategy Ranking: Tier I
USFWS: Species of Conservation Concern

Swainson's Hawk is a species of conservation concern due to the loss/degradation of suitable breeding habitat in some areas (Houston and Schmutz 1995, England et al. 1997), and because of susceptibility to pesticide use on the wintering grounds (southern South America; e.g., Woodbridge et al 1995). In some areas of the Great Plains, the gradual loss of nesting trees has been cited as primary cause of declining abundance of Swainson's Hawks (Olendorff and Stoddart 1974, Gilmer and Stewart 1984, Houston and Schmutz 1995).

Breeding distribution

In Cimarron County, Swainson's Hawks nested in a wide variety of habitats including sand-sage, grazed grasslands, CRP, and in fields of row-crops (**Figure 2**). Swainson's Hawks nests were typically placed high in tall trees, which often precluded the monitoring of nest contents. Unlike Ferruginous Hawks, Swainson's Hawks did not appear to avoid areas with intensive agricultural use (i.e., row-crops).

large number of studies of Swainson's Hawk breeding ecology, there remains relatively little information on the causes of nest failures (England et al. 1997). Although considered to be relatively tolerant of disturbance near the nest (Estep 1989, England et al. 1995), some pairs abandoned nests when disturbed during egg-laying and incubation (Bent 1937, Houston 1974). The extent to which this may be the case in areas of Cimarron County with intensive agricultural activity (e.g., the area northeast of Boise City) is unknown, but is deserving of further study.

Table 5. The number of nesting pairs and reproductive success of Swainson's Hawks in the Cimarron County study area from 2006-2008.

Year	Active nests	Nests with young	Failed nests	Nests with unknown outcome	% nests successful
2006	69	11	2	56	-
2007	41	26	2	13	≥ 63%
2008	36	21	15	0	58%
Mean	49	-	-	-	61%

Table 6. The success of Swainson's Hawk nesting attempts across the species' range.

Study area	Years of study	Percentage of nesting attempts that were successful	Citation
Washington	3	81%	Fitzner 1978
Alberta	3	71%	Schmutz et al. 1980
California	5	82%	England et al. 1995
California	11	66%	Woodbridge et al. 1995
Idaho	3	77%	Hansen and Flake 1995
Saskatchewan	22	ca. 70%	Houston and Schmutz 1995
New Mexico	3	81%	Bednarz 1988
Colorado	3	55%	Olendorff 1978
Oklahoma	**2 (2007-2008)**	**ca. 61%**	**This study**

Long-term Breeding Bird Survey data show a significant decline in Oklahoma, but a significant increase in Texas (**Table 7**). Overall, trends across the southern High Plains tend to be negative, though the trends are not statistically significant in most areas.

Table 7. Breeding Bird Survey long-term (1980-2007) trend data for Swainson's Hawks on the southern High Plains. Data from Sauer et al. (2008).

State/Area	Sample size (routes)	Trend (% decline/yr)	Significance (P value)
OK	28	- 6.0	**0.01**
TX	38	+ 2.9	**0.01**
NM	98	- 1.2	0.12
CO	68	- 1.9	0.17
KS	29	- 4.4	0.17
Staked Plains	32	0.3	0.67
High Plains	71	- 1.9	0.17

The combination of relatively low reproductive success seen in this study, together with BBS data showing a long-term population decline in Oklahoma, suggest that further study of the factors affecting nesting success of Swainson's Hawks is warranted.

Nest-site selection and land-use patterns

Studies of land use around Swainson's Hawks nests in other areas have shown that a wide variety of habitats are typically used. In the northwestern portion of their range, 43% (California; Woodbridge 1991) and 50% (Washington; Bechard et al. 1990) of foraging habitat around Swainson's Hawks nests was in active agricultural production, whereas in North Dakota, only 18% was in cultivated crops (Gilmer and Stewart 1984). In southeastern Alberta, Schmutz (1989) found that the density of breeding Swainson's Hawks increased as the percentage of land in cultivation increased, up to a limit of 30% cropland. This result suggests that in some areas of the Great Plains, habitat diversity may be an important component of Swainson's Hawk nest site selection.

For Cimarron County our data show that Swainson's Hawk territories include a diversity of land-use types (**Table 8**) dominated by grassland and CRP, but also including a significant proportion (33%) of row-crop agriculture. Our analysis shows higher proportions of CRP and cropland, and a lower percentage of grassland compared to a similar analysis by McConnell et al. (2006) in the same general study area (Cimarron County, Oklahoma). The striking differences in the two studies are likely a result of different habitat sampling as McConnell et al. included grassland-dominated areas (e.g., northwestern and north-central Cimarron County) not included in this study.

Land management recommendations

Our results suggest that Swainson's Hawks are widely distributed in Cimarron County across a variety of habitats. We suspect that, rather than land-use patterns, nest-site availability may be the primary factor limiting Swainson's Hawk density in Cimarron County and in general across the southern High Plains. Trees were used as nest sites for all but one breeding pair in this study. In addition, Swainson's Hawks tend to nest in areas with few trees, away from more heavily wooded riparian areas in the county (McConnell et al. 2006). In the Oklahoma Panhandle, trees are uncommon in areas away from homesteads and thus Swainson's Hawks are likely very limited in their choice of nest sites.

Table 8. Percentage of land in different land use categories in 2-km buffers around 12 randomly chosen Swainson's Hawk nests from the 2008 breeding season, with a comparison to a similar analysis in the same general study area.

Land use type	Mean % located in Swainson's Hawk territories*	McConnell et al. 2006 (same area)
CRP	25%	12%
Grassland	37%	77%
Sandsage**	4%	20%***
Cropland	33%	9%
Residential	< 1%	
Pasture	< 1%	

* Territories defined here as 2-km buffer zones around each nest site used from 2006-2008.
** Sandsage savannah and sandsage prairie were lumped into "sandsage" for this analysis.
***Sandsage was analyzed with a separate layer, so the total exceeds 100%.

Chihuahuan Raven (*Corvus cryptoleucos*)

Oklahoma Comprehensive Wildlife Conservation Strategy Ranking: Not listed
USFWS: Not listed

Despite a widespread range contraction over the past 50 years on the southern Great Plains (Wiggins *in prep*), Chihuahuan Ravens have typically not been considered a species of conservation concern (e.g., USFWS 2002). The breeding range of Chihuahuan Ravens in Oklahoma has contracted, with the species now breeding only in Cimarron County and western Texas County. Formerly, the species bred throughout the Oklahoma Panhandle, as well as in the western quarter of the main body of the state (Sutton 1968, Baumgartner and Baumgartner 1992).

(12%/yr) in Colorado (**Table 10**). Lockwood and Freeman (2004) reported a decline in the breeding population in northwestern Texas. The recent Breeding Bird Atlas project in Kansas suggested an historical decline there with breeding now restricted to only the extreme southwestern corner of the state (Busby and Zimmerman 2001). Possible reasons given for the decline in Kansas include the conversion of rangeland to cropland, a decrease in nest-site availability, and nest disturbance. Among nests placed on windmills on the Comanche National Grasslands in southeastern Colorado, nest failure was typically due to disturbance or nest destruction by humans (D. Wiggins, pers. obs.).

Table 9. The number of nesting pairs and reproductive success of Chihuahuan Ravens in the Cimarron County study area from 2006-2008.

Year	Active nests	Nests with large young	Failed nests	Nests with unknown outcome	% nests successful
2006	13	-	1	12	No data
2007	22	6	6	10	≥ 27%
2008	6	4	1	1	66%
Mean					

Table 10. Breeding Bird Survey long-term (1980-2007) trend data for Chihuahuan Ravens on the southern High Plains. Data from Sauer et al. (2008).

State/Area	Sample size (routes)	Trend (% decline/yr)	Significance (P value)
OK	3	- 17.0	0.45
TX	50	- 4.6	0.08
NM	39	- 0.6	0.50
CO	10	+ 12.1	**0.04**
KS	Insufficient data	-	-
Staked Plains	20	- 4.0	**0.02**
High Plains	7	+ 9.9	0.20

Common Raven (*Corvus corax*)

Oklahoma Comprehensive Wildlife Conservation Strategy Ranking: Unranked
USFWS: Not listed

Breeding distribution and abundance

Common Ravens have not recently been noted as a nesting species on the grassland areas of the southern High Plains, but are relatively common nesters in the mesa country of extreme

Figure A1), and on old windmills (n = 2 sites). Sites outside of the National Grasslands included two nests on windmills in landscapes dominated by CRP and sandsage, another nest in a tree in sandsage habitat, and a nest in a tree in an area of primarily cropland. Thus, outside of the Rita Blanca National Grassland, it is difficult to characterize the preferred landscape of Ferruginous Hawks in Cimarron County.

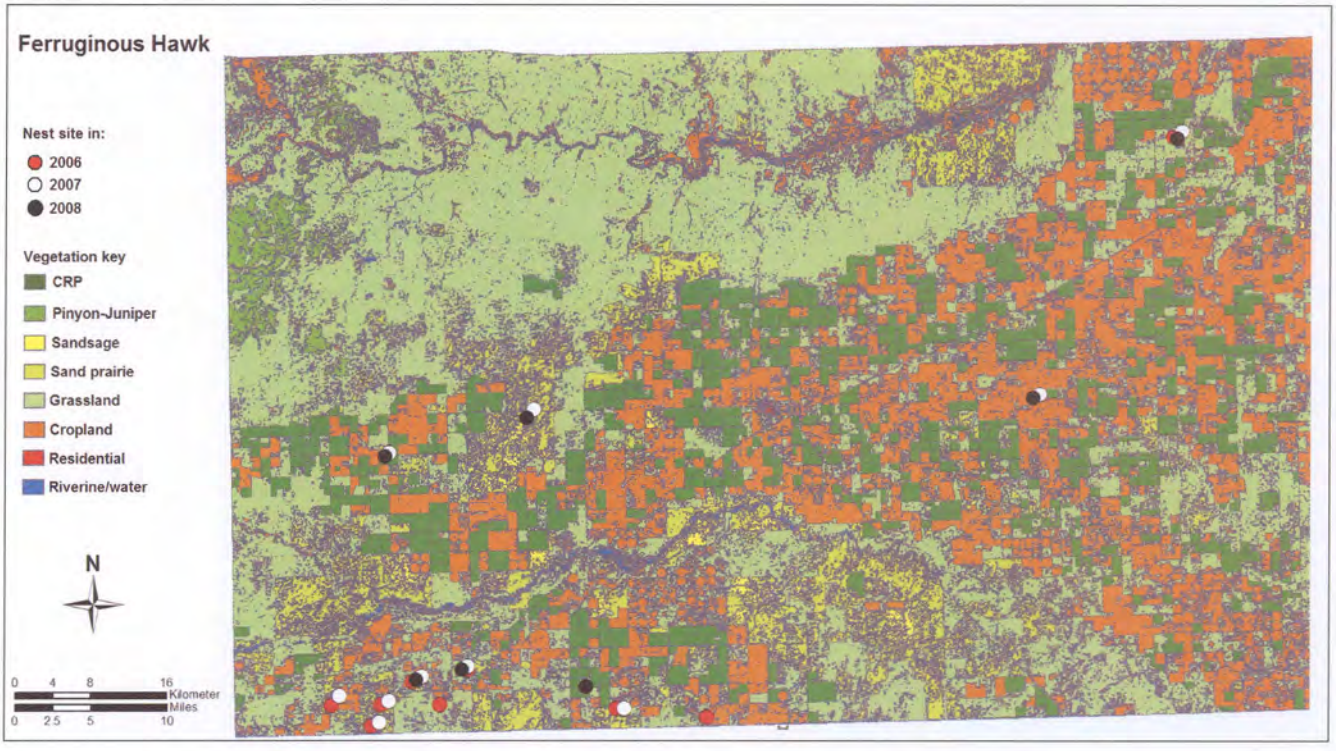

Figure 1. Location of active Ferruginous Hawk nest sites in Cimarron County, Oklahoma, 2006-2008. Note that slightly overlapping circles are presented for clarification only and represent nesting attempts at the same nest site.

Nesting success

Nest success (% of active nests that fledged at least one young) was above 50% in each of the three years in this study (**Table 1**). Comparative studies from elsewhere in the species' range have shown nest success averaging 59% (from 1991-1994) in Idaho (Lehman et al. 1998), 72% in Utah (Smith and Murphy 1973), and 75% (range 57-93%, from 1996-2006) in southeastern Colorado (Wiggins 2007). Several studies have shown that reproductive success fluctuates with local prey availability, with poor success in years with low prey availability (Olendorff 1972, Schmutz and Hungle 1989,

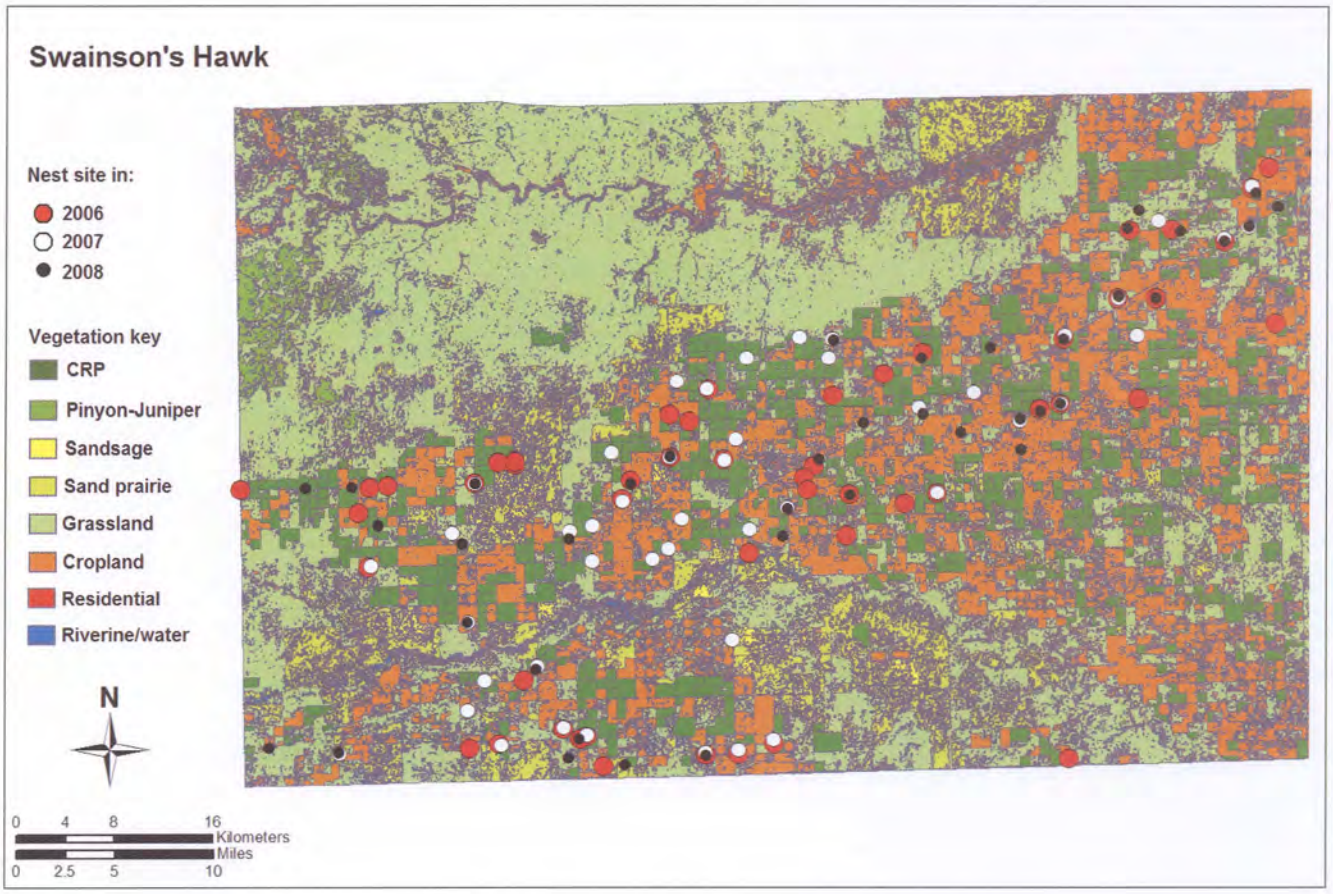

Figure 2. Location of Swainson's Hawk nest sites in Cimarron County, Oklahoma, 2006-2008.

Nesting success

The reproductive success of Swainson's Hawks in Cimarron County was difficult to determine (**Table 5**), due to the high placement (above the limit of our mirror pole) of many nests. However, extra effort was expended in 2008 and a nest success rate of 58% was recorded. In 2007, nest success was at least 63%. This nest success rate is somewhat below that found in most other studies of Swainson's Hawks, with 6 of 8 studies finding success rates of at least 70% (**Table 6**).

In this study, we were typically unable to determine the cause of Swainson's Hawks nest failure. In almost all cases, formerly active nests were found empty on a subsequent visit (**Figure A2**). Although many studies have shown a significant effect of prey availability on overall nesting success, such an effect probably does not explain the total nest failures noted in this study. Despite a

Most Chihuahuan clutch-initiation dates in this study occurred from mid-May to early-June. Nests were typically located on inactive windmills (n= 27; **Figure A3**) with a few nests in trees (n = 6; **Figure A4**), in barns (n = 1), on platforms (n = 6) and on a railroad trestle (n = 1).

Breeding distribution and abundance

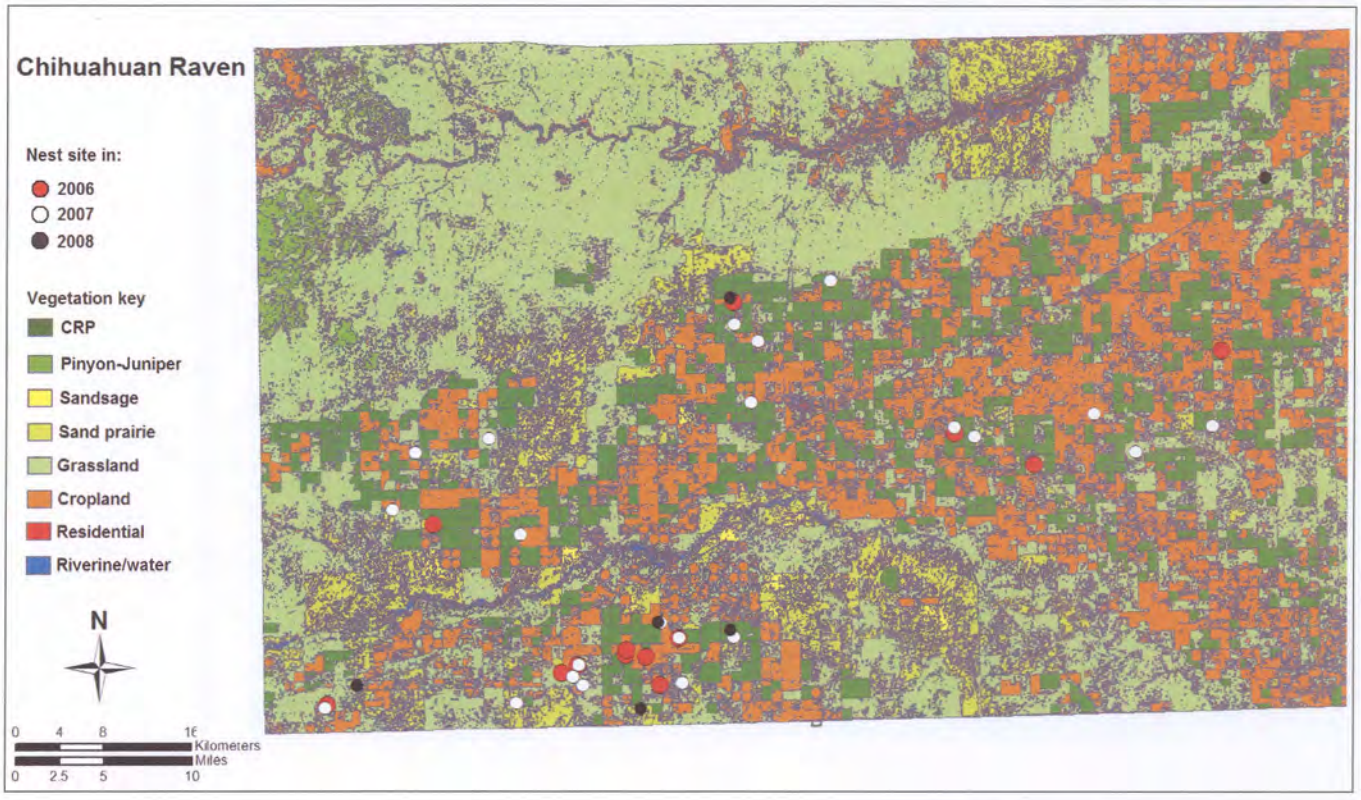

Figure 3. Location of Chihuahuan Raven nest sites in Cimarron County, Oklahoma, 2006-2008.

We found Chihuahuan Ravens breeding primarily in southern and central Cimarron County, with only a single pair breeding in the northeastern portion of the county (**Figure 3**). We also found only 6 pairs breeding in 2008, down from a high of 22 in 2007 (**Table 9**). Long-term BBS data show a strong decline in Oklahoma, although a low sample size (only 3 routes) precludes rigorous statistical analysis. We had difficulty in accessing Chihuahuan Raven nests until 2008, and thus were unable to quantify nesting success in 2006-2007.

BBS data also suggest that since 1980 a significant decline (-4%/year) has occurred on the Staked Plains, with a 4.6% (marginally non-significant) decline in Texas, and a significant increase

northwestern Cimarron County. Because of the similarity in size between Common and Chihuahuan ravens, identification of the two species in the field can be difficult. However, circumstantial evidence in this study suggested that several pairs are now nesting in or adjacent to abandoned homes in the study area. Although egg-size data (which would unequivocally identify the species involved) were not collected, the extremely early breeding date (egg-laying in early April) of some ravens suggest that Common Ravens were involved. Throughout their range in the United States, Chihuahuan Ravens typically do not begin egg-laying until May (Bednarz and Raitt 2002), while Common Ravens typically initiate clutches from early March to mid-April (Boarman and Heinrich 1999). The presence of large young in the nest in late April suggests that the pairs noted in **Table 11** and **Figure 4** are Common Ravens and, consequently, that Common Ravens have recently extended their breeding range onto the High Plains of Cimarron County. It should also be noted that a similar breeding-range expansion has been documented in western Texas (Anthony Floyd, pers. comm.) and in southwestern Kansas, where breeding was recorded in 2006 and 2007 and represents the first documented nesting in Kansas in over 80 years.

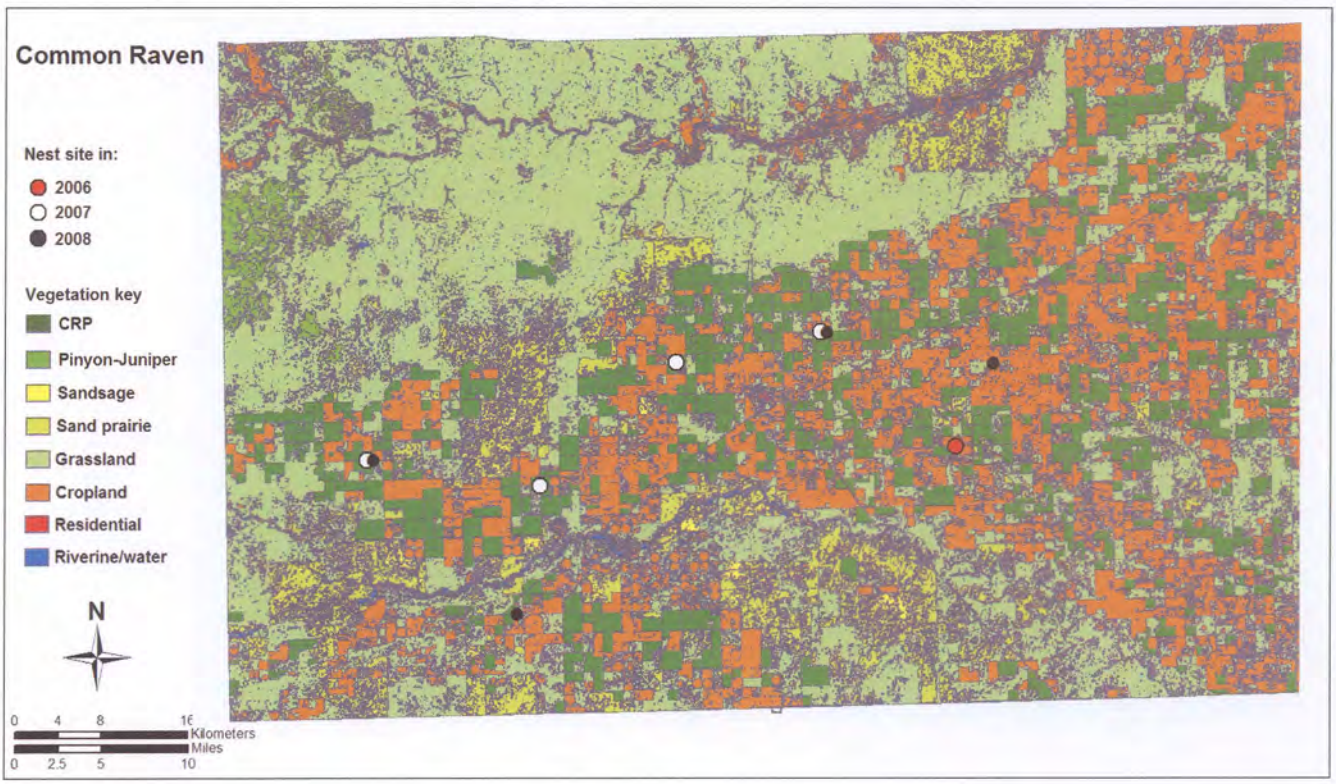

Figure 4. Location of Common Raven nest sites in Cimarron County, Oklahoma, 2006-2008.

Table 11. The number of nesting pairs and reproductive success of Common Ravens in the Cimarron County study area from 2006-2008.

Year	Active nests	Nests with young	Failed nests	Nests with unknown outcome	Mean brood size at fledging	% nests successful
2006	1	1	0	0	5	100%
2007	4	4	0	0	3.33*	100%
2008	4	4	0	0	2.75*	100%
Mean						

* At some nests, an accurate count of young was not possible – instead, a minimum number of fledged young was recorded in such cases.

Loggerhead Shrike (*Lanius ludovicianus*)

Oklahoma Comprehensive Wildlife Conservation Strategy Ranking: Tier I
USFWS: Species of Conservation Concern

Loggerhead Shrikes were a focus of this study as the species has undergone range-wide declines in abundance over the past 50 years (Wiggins 2004b, 2004c). The species was formerly considered a common breeder in Oklahoma, especially in the western half of the state (Sutton 1968, Baumgartner and Baumgartner 1992).

Breeding distribution and abundance

We found very few breeding shrikes in Cimarron County in this study (**Table 12**, **Figure 5**). Three nests were found in 2006 and one each in 2007 and 2008. The very few number of nests found was surprising given the extra effort expended in searching for shrike nests, and we are confident that our data accurately reflect a marginal breeding population in the study area. Breeding Bird Survey results suggest a significant decline in the breeding population of shrikes not only in Oklahoma, but also in the neighboring states of Texas, Kansas, and New Mexico (**Table 13**).

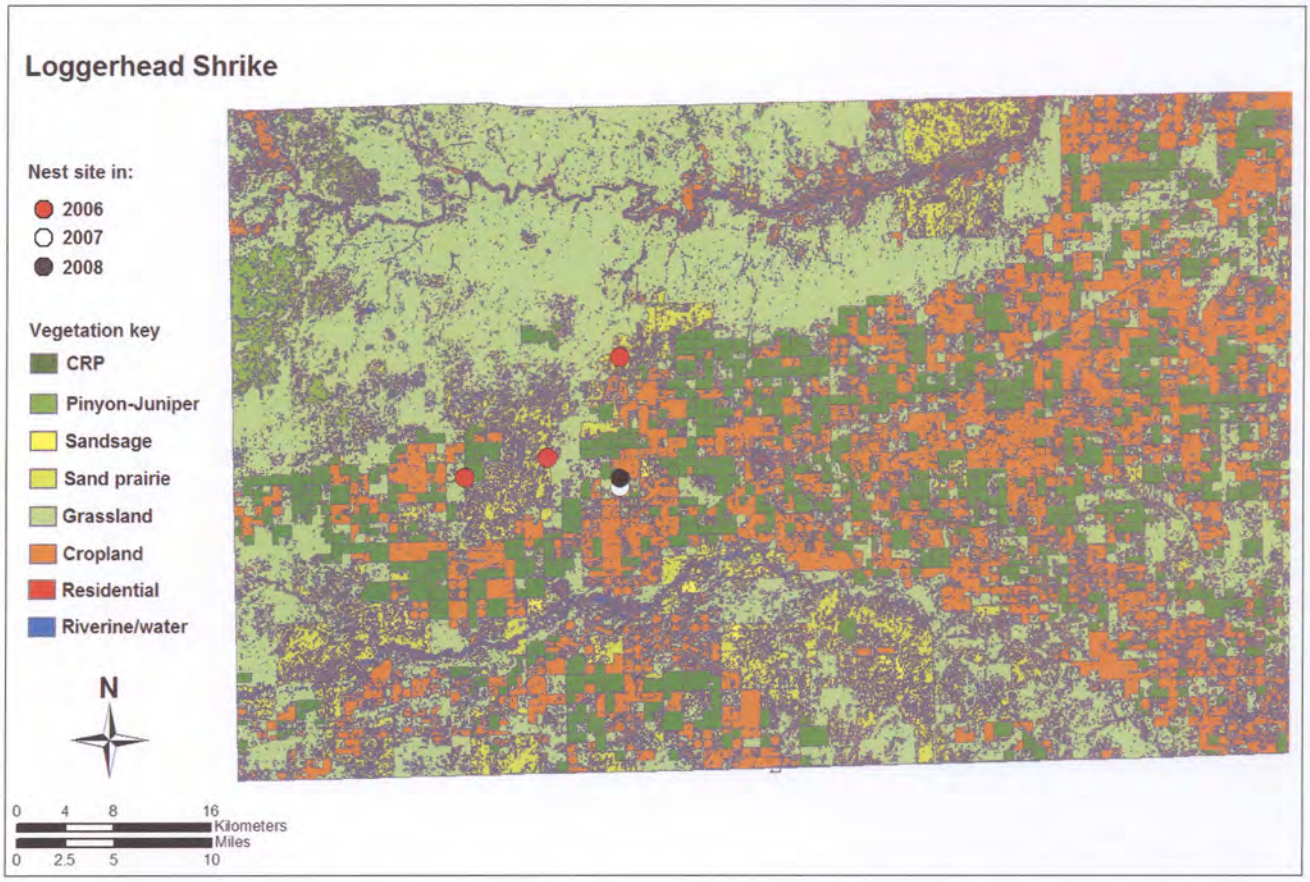

Figure 5. Location of Loggerhead Shrike nest sites in Cimarron County, Oklahoma, 2006-2008.

Despite 100% nesting success (all nests fledged at least one young), the few nests observed in this study suggest that other factors may be limiting Loggerhead Shrikes in Cimarron County. In nearby Baca County, Colorado, Loggerhead Shrikes breeding on the Cimarron National Grassland nested almost exclusively in fenced exclosures, where cattle grazing did not occur (Wiggins 2006). Although such exclosures also occur on the Rita Blanca National Grassland, shrikes were not found nesting in them. Rather, the few shrike nests found in this study were all in trees along roadways. Three of these nest trees were located outside cattle-grazing areas (i.e., along road shoulders), whereas the third was located in a grazed sandsage field, in a large tree with an active Swainson's Hawk nest. **Figure A5** shows a nest site used in at least 2 years prior to the initiation of this study. All 4 nest sites were located immediately adjacent to extensive areas of sandsage with abundant stands of *Yucca glauca*. The presence of *Yucca* may be a key habitat component for shrikes in the Oklahoma Panhandle, as *Yucca* provides plentiful perching sites, a factor that is known to positively

correlate with shrike abundance and that typically acts to reduce home range size (e.g., Bohall-Wood 1987, Yosef 1996).

Table 12. The number of nesting pairs and reproductive success of Loggerhead Shrikes in the Cimarron County study area from 2006-2008.

Year	Active nests	Nests with young	Failed nests	Nests with unknown outcome	Brood size at fledging	% nests successful
2006	3	3	0	0	2.7*	100%
2007	1	1	0	0	3*	100%
2008	1	1	0	0	6	100%

* Brood size is a minimum estimate as the total number of fledged young was uncertain.

Table 13. Breeding Bird Survey long-term (1980-2007) trend data for Ferruginous Hawks on the southern High Plains. Data from Sauer et al. (2008).

State/Area	Sample size (routes)	Trend (% decline/yr)	Significance (P value)
OK	55	**- 5.8**	< 0.01
TX	144	**- 4.4**	< 0.01
NM	55	**- 2.1**	0.03
CO	54	+ 1.3	0.38
KS	50	**- 4.3**	< 0.01
Staked Plains	20	- 1.3	0.30
High Plains	61	+ 0.3	0.76

Burrowing Owl (*Athene cunicularia*)

Oklahoma Comprehensive Wildlife Conservation Strategy Ranking: Tier I
USFWS: Species of Conservation Concern

Burrowing Owls are a species of conservation concern throughout their range in western North America. Long-term population declines have occurred range-wide, with habitat loss (including secondary effects caused by the elimination of prairie dogs, *Cynomys* spp.) cited as the primary cause of the decline. In Oklahoma, the species formerly bred throughout the western half of the state (Sutton 1968) but is now largely restricted scattered locations in the southwestern and extreme northwestern (Ellis, Harper Counties) portions Oklahoma, as well as the Panhandle. In Cimarron County, long-term conversion of sandsage prairie and native grassland to cropland may have contributed to declines in the abundance of both prairie dogs and Burrowing Owls (Butts and Lewis 1982, Sheffield and Howery 2001, Lomolino et al. 2003, D. Wiggins pers. obs.).

Breeding distribution and abundance

We found Burrowing Owls breeding throughout our study area in Cimarron County, though numbers of adults (**Table 14**) and distribution (**Figure 6**) varied among years. Burrowing Owls were most common in 2006 and declined in abundance in both 2007 and 2008. This decline appeared to be linked to a significant decrease in the abundance of black-tailed prairie dogs – many prairie dog colonies that were active in 2006 were inactive in 2007 and 2008. Although the causes of this decline are unknown, sylvatic plague (*Yersinisia pestis*; Cully 1991, 1993) and direct persecution (shooting and poisoning) by humans (Butts 1973, Sheffield 1997, D. Wiggins pers. obs.) are common causes of prairie dog colony failure. Data from the Breeding Bird Survey show no significant change in Burrowing Owl abundance since 1980 (**Table 15**).

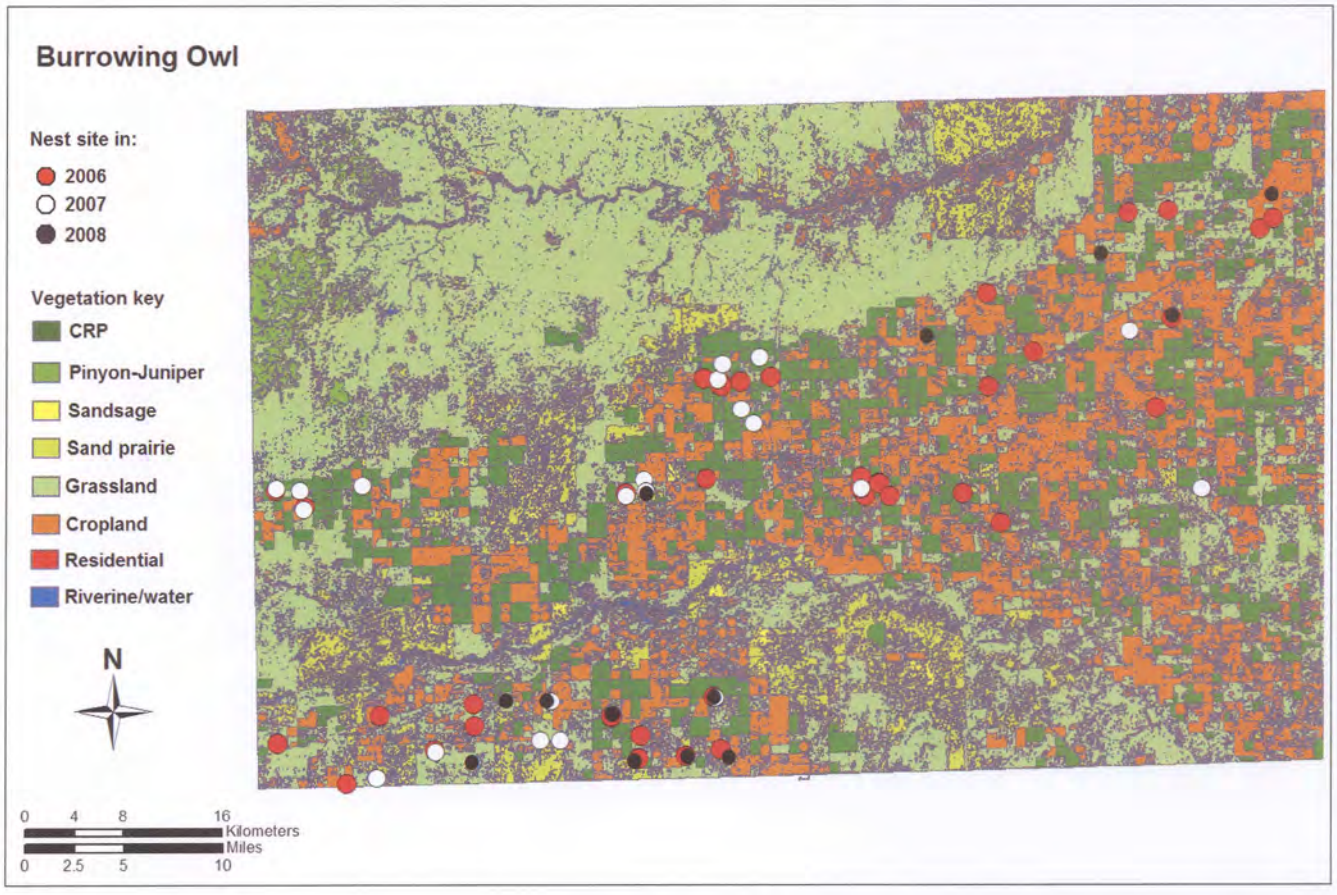

Figure 6. Location of sites (primarily prairie dog towns) where adult Burrowing Owls were sighted in Cimarron County, Oklahoma, 2006-2008.

Table 14. The number of sites with adult Burrowing Owls, as well as the total number of adult owls seen in the Cimarron County study area from 2006-2008.

Year	Active sites*	Number of adults seen
2006	45	116
2007	21	43
2008	14	28
Mean	27	62

*For Burrowing Owls, the number of active sites was defined as the number of (separate) sites at which at least one adult was observed at a burrow from late May to early July. Data on Burrowing Owls were collected opportunistically – dedicated surveys for Burrowing Owls were not made in any year and thus these numbers should be viewed as minimum estimates for the study area.

Table 15. Breeding Bird Survey long-term (1980-2007) trend data for Burrowing Owls on the southern High Plains. Data from Sauer et al. (2008).

State/Area	Sample size (routes)	Trend (% decline/yr)	Significance (P value)
OK	9	+ 4.5	0.31
TX	34	- 4.3	0.24
NM	40	+ 5.6	0.15
CO	44	- 1.6	0.61
KS	14	+ 14.0	0.54
Staked Plains	26	- 1.1	0.75
High Plains	59	-0.20	0.95

Barn Owl (*Tyto alba*)

Oklahoma Comprehensive Wildlife Conservation Strategy Ranking: Unranked
USFWS: Species of Conservation Concern

Breeding distribution and abundance

We found Barn Owls breeding only at abandoned homesteads, typically in the attic areas of abandoned homes (**Figure A6**), and in a few cases in old barns. This species appears to be nest-site limited in Cimarron County, with nests found in almost all suitable sites that we explored. Barn Owls appear to nest in a wide variety of habitats including grassland/rangeland, and in areas of heavy row-crop agriculture. McConnell et al. (2006) found many Barn Owl nests in bluffs along the dry Beaver River valley in south central Cimarron County, an area not included in this study.

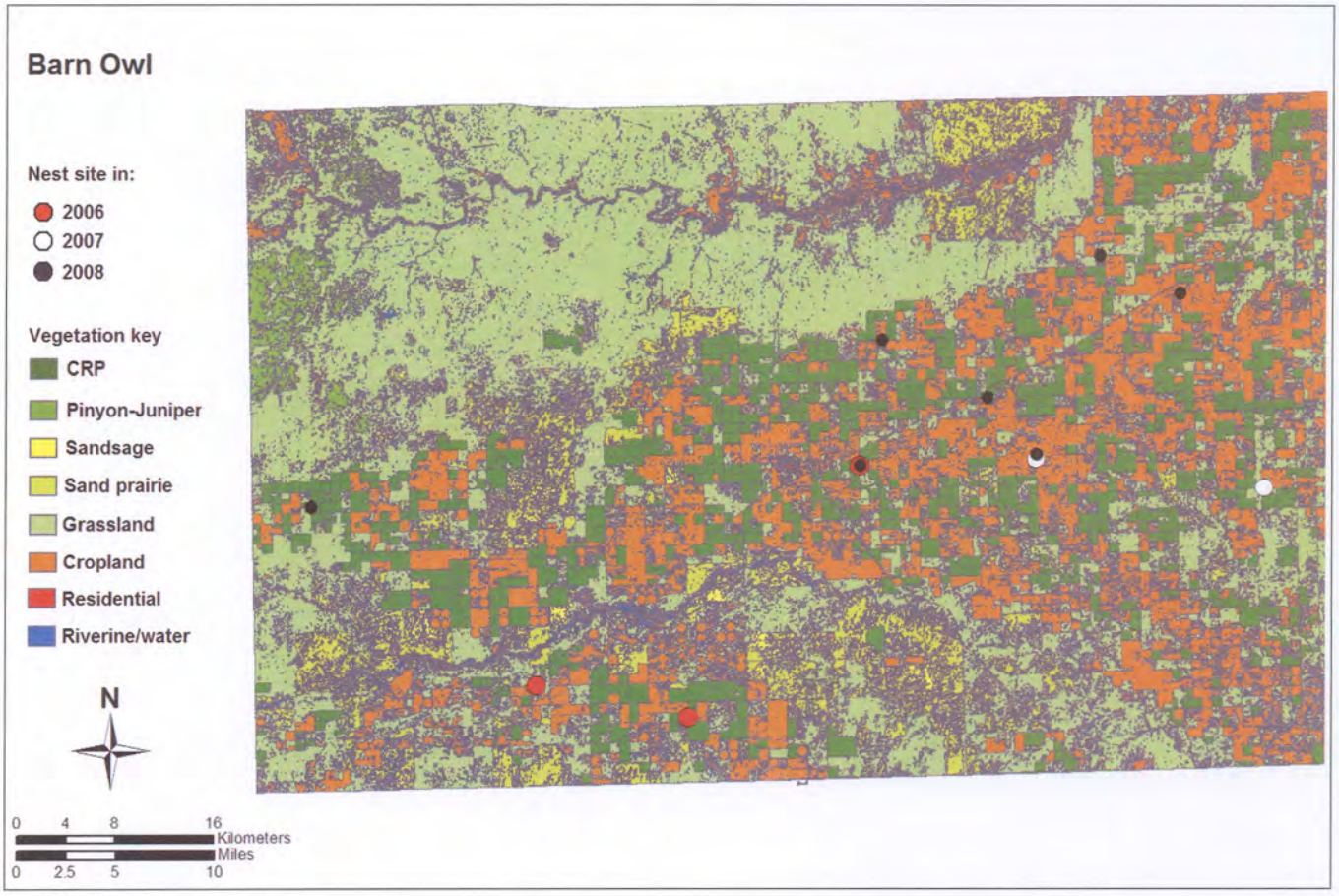

Figure 7. Location of Barn Owl nest sites in Cimarron County, Oklahoma, 2006-2008.

As data on Barn Owls were only collected when time was available and when nest sites were easily accessible, we don't consider the data (**Table 16**) sufficient to characterize the species' current status in Cimarron County. However, our perception was that the species was a widespread breeder whose abundance was principally regulated by the availability of suitable nest sites. A robust census for Barn Owls would involve careful searches for holes in the banks of dry river beds, attics of abandoned homes, and barns.

Table 16. The number of nesting pairs of Barn Owls in the Cimarron County study area from 2006-2008.

Year	Nests
2006	5
2007	2
2008	7

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APPENDIX

Figure A1. Adult Ferruginous Hawk on an inactive nest, northeastern Cimarron County.

Figure A2. Swainson's Hawk nest built on a center-pivot irrigation sprinkler in May 2007. Although this nest appeared to be complete, a follow-up check suggested that no clutch was initiated.

Figure A3. Checking nest contents at a Chihuahuan Raven nest on an old windmill, the primary nest substrate used by Chihuahuan Ravens in the Oklahoma Panhandle.

Figure A4. An unusually low Swainson's Hawk nest in a Conservation Reserve Program field south of Keyes, Oklahoma.

Figure A5. Typical grassland habitat just south of Wheeless, Oklahoma. The small shelterbelt in the background held Loggerhead Shrike nests in years prior to the initiation of this study.

Figure A6. Barn Owl adult and young on nest in the attic of an abandoned house northeast of Boise City.