

GRASSLAND BIRDS IN PRAIRIE-DOG TOWNS IN NORTHWESTERN CHIHUAHUA, MEXICO

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Abstract. From November 1994 to December 1995 we studied the species composition, distribution, seasonality, and abundance of grassland birds in the prairie dog (*Cynomys ludovicianus*) towns of northwestern Chihuahua state, Mexico. We recorded 71 species of birds on the grasslands, 22 of which were grassland specialists. Most (52 percent) of the 71 species were residents, followed by winter migrants, summer migrants, and transients. Horned Larks (*Eremophila alpestris*) and Lark Buntings (*Calamospiza melanocorys*) were the most abundant species. The abundance of all species was generally low, possibly because of a prolonged drought. The low abundance could also reflect a decline in grassland birds in North America, however. Because there were no data on grassland birds in this area prior to our study, it was not possible to assess population trends. On the basis of our study, we suggest conservation measures to enhance maintenance of grassland-bird habitat and of biodiversity in general.

LAS AVES DE PASTIZAL EN COLONIAS DE PERROS LLANEROS DEL NOROESTE DE CHIHUAHUA, MÉXICO

Sinopsis. Se estudió la composición de especies, distribución, temporalidad y abundancia de aves de pastizal en colonias de perros llaneros (*Cynomys ludovicianus*) del noroeste de Chihuahua, México. Se registraron 71 especies en los pastizales, de las cuales 22 se consideran como aves exclusivas de pastizal. La mayoría de las especies fueron residentes (un 52 por ciento), seguidas de las migratorias de invierno, las migratorias de verano y las transitorias. La Alondra Cornuda (*Eremophila alpestris*) y el Gorrión Alipálido (*Calamospiza melanocorys*) fueron las especies más abundantes. La abundancia de todas las especies fue en general baja, probablemente debido a la prolongada sequía. Sin embargo, la baja abundancia observada podría ser un reflejo de la disminución de este grupo en Norteamérica. Desafortunadamente, no existe información previa sobre aves de pastizal en el área, para determinar las tendencias en la variación de las poblaciones. Basados en nuestro estudio, se sugieren medidas regionales de conservación para apoyar el mantenimiento de hábitat para las aves de pastizal en particular y de la biodiversidad en general.

Key Words: Chihuahua; grassland birds; prairie-dog towns.

North American prairies, considered one of the most biologically diverse grasslands in the world (Mountfort 1988), once stretched almost continuously from Mexico to Canada (Shelford 1963). These grasslands, however, have suffered the most extensive fragmentation and transformation of the natural communities in North America (Marsh 1984, Miller et al. 1994). Habitat fragmentation and destruction have become leading causes of species extinctions (Ehrlich and Ehrlich 1981). Habitat fragmentation usually reduces the number of populations and population sizes and increases the risk of extinction because of demographic, genetic, or stochastic processes (Wilcove et al. 1986, Robinson et al. 1995). The impact of fragmentation can be viewed as a combination of the percentage of habitat left and the isolation and connectivity of habitat fragments (Wilcove et al. 1986, McCullough 1996).

In the nineteenth century, prairie dogs (*Cynomys* spp.) occupied up to 100 million ha of native grasslands in North America (Merriam 1902, Nelson 1919). The expansion of human activities early in the twentieth century, how-

ever, led to extensive eradication campaigns, and the area occupied by prairie dogs has been reduced to approximately 2% of the original range (Marsh 1984, Miller et al. 1994).

The largest complex of prairie-dog towns left in North America is found in northwestern Chihuahua state, Mexico (Ceballos et al. 1993). This area is important for the maintenance of regional biodiversity because it holds populations of many endangered vertebrate species, is a wintering ground for many grassland birds (Manzano-Fischer 1996), and is one of the last relatively well preserved grasslands in Mexico (Miller et al. 1994).

Since the late 1980s there has been growing concern about North America's grassland birds, which have shown consistent, sharp declines (Knopf 1994). Although many species are threatened or of conservation concern in the United States and Canada (McNicholl 1988, Knopf 1994), their status in Mexico has not been assessed (see Peterson and Robbins 1999). Birds in general, however, are quite threatened in Mexico, where approximately 35% of all avian species are considered at risk of extinction (Ce-

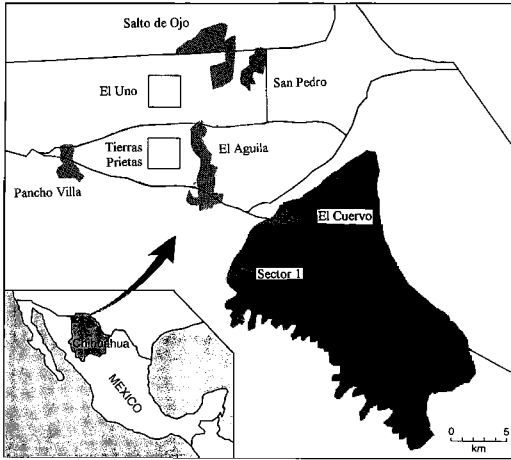


FIGURE 1. Location of the Janos-Nuevo Casas Grandes prairie-dog complex, Chihuahua, Mexico, showing the distribution of bird localities studied in 1994–1995 (modified from Moehrenschlager and List 1996).

ballos and Márquez in press). The purpose of this study was to determine the composition, distribution, seasonality, and abundance of grassland birds in northwestern Mexico. The grasslands in this region provide critical habitat for resident and migrant grassland birds (Manzano-Fischer 1996), among them Mountain Plover (*Charadrius montanus*), Long-billed Curlew (*Numenius americanus*), and Ferruginous Hawk (*Buteo regalis*).

STUDY AREA

The study was carried out from November 1994 to December 1995 in the Janos-Nuevo Casas Grandes (JNCG) prairie-dog complex in northwestern Mexico (Ceballos et al. 1993). The complex is located approximately 75 km south of the Mexico–United States border, on the grasslands and scrublands southeast of the

Sierra Madre Occidental in Chihuahua state (approximately 30°50' N, 108°25' W; Fig. 1). The area extends west and north to the arid scrub of the Chihuahuan Desert and south and east of the foothills of the Sierra Madre Occidental. The climate is arid, with hot summers and cold winters. Mean annual precipitation is 307 mm, with most precipitation in July and August and scattered showers in winter (Rzedowsky 1981). The mean temperature is 15.7 C (García 1973), with a range from –15 C in winter to 50 C in summer.

Grasslands dominate the area and are characterized by grasses and annual herbs, including *Bouteloua gracilis*, *B. curtipendula*, *B. hirsuta*, *Aristida hamulosa*, *Fouquieria splendens*, *Prosopis laevigata*, *Festuca imbricata*, and toboso (*Hilaria mutica*). Isolated patches of cholla (*Opuntia* spp.), yucca (*Yucca* spp.), ephedra (*Ephedra trifurca*), and mesquite (*Prosopis* spp.) scrub occur in the grasslands. From mid-1993 to January 1996 the region suffered one of the worst droughts in recent decades. This drought, combined with overgrazing and dust burial, resulted in a great reduction of vegetation cover and created extensive areas of bare ground in the prairie-dog complex.

METHODS

We used point counts on fixed transects to determine the abundance of birds in the JNCG prairie-dog complex. Transects were carried out in the fall (8–28 Nov) and winter (17 January–26 February) of 1994 and in the spring (12 May–13 June), summer (18 July–7 August), early fall (27 September–17 October), and late fall (20 November–4 December) of 1995.

We selected eight study sites: six sites with prairie dogs, one site where the prairie dogs were poisoned in 1989 and were no longer present, and one toboso grassland site without prairie dogs (Table 1). Two transects were established at each site. Each transect was 2,500 m long with 10 point counts at 250-m intervals. Point counts had a fixed radius of 50 m and were conducted according to Hutto et al. 1986. We recorded all birds within the 50-m radius, beyond the 50-m radius, and between point counts. Point counts were conducted for 10 min. Censuses began 30 min after sunrise and lasted 3 hr. Censuses were not carried out when it rained or when wind velocities exceeded 24 km/hr.

We identified bird species using the field guides of

TABLE 1. DESCRIPTION OF GRASSLAND LOCALITIES STUDIED IN THE JANOS-NUEVO CASAS GRANDES PRAIRIE-DOG COMPLEX, CHIHUAHUA, MEXICO, 1994–1995

Locality	Coordinates	Land ownership	Vegetation
San Pedro (dog town)	30°53'N, 108°22'W	Communal	<i>Ephedra</i> spp. and annual plants
Pancho Villa (dog town)	30°48'N, 108°37'W	Communal	<i>Aristida</i> spp. and annual plants
Salto de Ojo (dog town)	30°54'N, 108°26'W	Private	<i>Hilaria mutica</i> and annual plants
El Aguila (dog town)	30°49'N, 108°26'W	Private	<i>Aristida</i> spp., <i>Bouteloua</i> spp., <i>Hilaria mutica</i> , and annual plants
Sector 1 (dog town)	30°42'N, 108°21'W	Communal	<i>Prosopis</i> spp. and annual plants
El Cuervo (dog town)	30°43'N, 108°17'W	Communal	<i>Opuntia</i> spp., <i>Yucca</i> spp., and annual plants
El Uno (poisoned town)	30°51'N, 108°27'W	Private	<i>Bouteloua</i> spp. and <i>Muhlenbergia utilis</i>
Tierras Prietas (toboso grassland)	30°46'N, 108°30'W	Private	<i>Hilaria mutica</i> and <i>Opuntia</i> spp.

TABLE 2. GRASSLAND BIRD ABUNDANCE DURING EACH SEASON IN THE JANOS-NUEVO CASAS GRANDES PRAIRIE-DOG COMPLEX, CHIHUAHUA, MEXICO, 1994–1995

Species	Abundance ^a					
	Fall 1994	Winter 1994	Spring 1995	Summer 1995	Early fall 1995	Late fall 1995
Northern Harrier	13	4	0	0	3	0
Swainson's Hawk	0	0	7	10	0	0
Ferruginous Hawk	38	22	0	0	8	19
Prairie Falcon	1	3	0	0	1	0
Mountain Plover	0	3	0	0	0	0
Long-billed Curlew	1	32	1	73	156	0
Burrowing Owl	2	0	37	42	21	7
Horned Lark	2,017	662	126	141	391	903
Grasshopper Sparrow	0	0	5	6	0	0
Vesper Sparrow	0	0	0	0	18	0
Lark Sparrow	0	0	1	20	1	0
Cassin's Sparrow	0	0	0	4	0	0
Brewer's Sparrow	0	0	2	1	20	1
longspur sp.	144	12	0	0	60	4
Lark Bunting	105	0	0	2	183	674
meadowlark sp.	61	33	60	32	29	59
Total no. individuals	2,382	771	234	325	891	1,667
Total no. species	9	8	8	10	12	7

^a Total number of birds observed in the 16 transects per season.

the National Geographic Society (1983), Robbins et al. (1983), Edwards (1989), and Howell and Webb (1995). Species names follow the check-list of the American Ornithologists' Union (AOU 1983, 1991).

The seasonality of each species was determined from our field records and from Howell and Webb 1995. We classified species as belonging to one of four seasonal groups: (1) resident (species found year-round), (2) summer migrant (species that breed and summer), (3) winter migrant (species that winter), and (4) transient (species that pass by on migration).

We determined abundance only for the 18 species of grassland birds we observed on transects, but we noted observations of other significant species (e.g., Golden Eagle [*Aquila chrysaetos*]). Species that we observed in the grassland during the study period but did not record on transects (including four grassland species) were listed as present in the area and were included in our inventory of species; we provided no information on their abundance, however. Waterfowl were not included in the study because they were associated primarily with reservoirs.

The conservation statuses of species in Mexico, the United States, and Canada were determined from government and scientific lists (McNicholl 1988, Knopf 1994, SEDESOL 1994, U.S. Fish and Wildlife Service 1996a, b).

RESULTS

SPECIES COMPOSITION, DISTRIBUTION, SEASONALITY, AND ABUNDANCE

We observed 71 bird species representing 11 orders, 24 families, and 57 genera in the grasslands of the JNCG complex (Appendix). As expected, the order Passeriformes and the family Emberizidae had the highest species richness. A

few species were abundant (> 500 individuals), but most species were relatively scarce (Table 2). The temporal and spatial distribution of species was very heterogeneous. Most species (52%) were residents, followed by winter migrants (24%), summer migrants (17%), and transients (7%). The number of species present in the JNCG complex at one time varied from 21 to 29, with the highest number in early fall, when both resident and transient species were present simultaneously.

GRASSLAND BIRDS

Twenty-two (31%) of the 71 species we recorded at the JNCG complex were grassland specialists (Mengel 1970). They represented 4 orders, 8 families, and 17 genera. We classified 45% of the grassland specialists as residents, 45% as winter migrants, 5% as summer migrants, and 5% as transients.

We observed 18 of the 22 grassland specialists on transects. Savannah Sparrows (*Passerculus sandwichensis*), Short-eared Owls (*Asio flammeus*), Sprague's Pipits (*Anthus spragueii*), and Baird's Sparrows (*Ammodramus bairdii*) were recorded only in grasslands outside our transects.

Two of the grassland specialists we observed on transects—Horned Larks (*Eremophila alpestris*) and Lark Buntings (*Calamospiza melanocorys*)—were abundant (> 500 individuals) and accounted for 65% of all individuals recorded (Tables 2 and 3). Six species were common (≥

TABLE 3. SPATIAL VARIATION IN RELATIVE ABUNDANCE OF GRASSLAND BIRDS IN EIGHT LOCALITIES IN THE JANOS-NUEVO CASAS GRANDES PRAIRIE-DOG COMPLEX, CHIHUAHUA, MEXICO, 1994–1995

Species	Localities ^a							
	SP	PV	SO	EA	S1	EC	EU	TP
Northern Harrier	5	0	7	1	0	2	4	1
Swainson's Hawk	0	8	5	1	0	2	1	0
Ferruginous Hawk	9	4	39	6	12	14	3	0
Prairie Falcon	1	0	0	0	1	0	2	1
Mountain Plover	0	0	0	3	0	0	0	0
Long-billed Curlew	15	28	75	11	0	100	33	1
Burrowing Owl	8	31	25	8	16	11	10	0
Horned Lark	599	215	841	958	98	309	889	331
Grasshopper Sparrow	0	0	0	2	0	0	4	5
Vesper Sparrow	10	0	0	0	0	7	0	1
Lark Sparrow	0	22	0	0	0	0	0	0
Cassin's Sparrow	4	0	0	0	0	0	0	0
Brewer's Sparrow	0	1	0	1	21	0	0	1
longspur sp.	0	1	0	45	0	0	173	1
Lark Bunting	0	105	0	0	0	859	0	0
meadowlark sp.	30	109	33	25	3	12	24	38
Total no. species	9	10	7	11	6	9	10	9

^a SP = San Pedro, PV = Pancho Villa, SO = Salto de Ojo, EA = El Aguila, S1 = Sector 1, EC = El Cuervo, EU = El Uno, TP = Tierras Prietas.

100 individuals), and 10 species were uncommon (< 100 individuals; Tables 2 and 3). Mountain Plovers were common in the region but were recorded on only three transects.

The abundance of each species varied among seasons (Table 2), and the number of individual birds increased from spring to fall (Fig. 2). The total number of grassland species recorded per locality varied from 6 to 11 (Table 3). El Aguila had the highest number of grassland species (11) and Sector 1 the lowest (6).

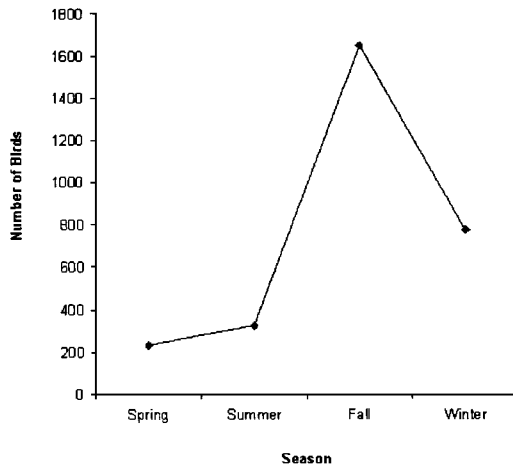


FIGURE 2. Seasonal variation in the number of grassland birds at the Janos-Nuevo Casas Grandes prairie-dog complex, Chihuahua, Mexico, 1994–1995.

SPECIES OF CONSERVATION CONCERN

Of the 71 species we recorded in the JNCG complex, 29 are considered to be of conservation concern in Mexico, the United States, or Canada; 21 of the 29 species are grassland specialists (Appendix). In Mexico, 11 of these 29 species have formal conservation status: 9 (all grassland specialists) are Threatened and 2 (Golden Eagle and Bald Eagle [*Haliaeetus leucocephalus*]) are Endangered. Six of the 11 species are residents, and 5 are migrants. In the United States, 1 of the 29 species of concern (Bald Eagle) is formally listed as Threatened, and an additional 22 species (19 of which are grassland specialists) are declining. In Canada, three species (Ferruginous Hawk, Burrowing Owl [*Athene cunicularia*], and Loggerhead Shrike [*Lanius ludovicianus*]) are formally listed as Threatened, and an additional three species (Grasshopper Sparrow [*Ammodramus savannarum*], Baird's Sparrow, and Western Meadowlark [*Sturnella neglecta*]) are declining.

All together, six species—Ferruginous Hawk, Burrowing Owl, Loggerhead Shrike, Grasshopper and Baird's sparrows, and Western Meadowlark—have formal conservation status in the United States and Canada. Four species—Northern Harrier (*Circus cyaneus*), Mountain Plover, Burrowing Owl, and Lucy's Warbler (*Vermivora luciae*)—are listed as Threatened in Mexico and are declining in the United States; Bald Eagle is listed as Endangered in Mexico and as Threatened in the United States. Finally, Burrowing

Owl is listed as Threatened in Canada and Mexico and is declining in the United States.

SPECIES ACCOUNTS

Raptors

Northern Harriers were observed on transects in fall and winter (Table 2) and outside transects throughout the year. The latter was of particular interest because the JNCG complex is located in an area that had previously been considered to be in this species' wintering range only (Howell and Webb 1995). Harriers occurred in five of the eight localities and accounted for 8% of all raptors observed along transects. Golden Eagles feed on prairie dogs regularly and were seen in prairie-dog towns year-round. A pair of Golden Eagles nested near a small prairie-dog colony in March 1996 and produced two chicks, one of which fledged. Prairie Falcons (*Falco mexicanus*) were observed mainly in fall and winter, in small numbers, at four of the eight localities (Tables 2 and 3).

Ferruginous Hawks were common and comprised 41% of all raptors recorded (Tables 2 and 3). They were observed from October into February, mainly near prairie-dog towns, as prairie dogs are their main prey in the JNCG complex. They occurred at all but one locality (Tierras Prietas). Swainson's Hawks (*Buteo swainsoni*) were summer migrants and accounted for 8% of all raptors seen on transects. Recorded in five of the eight localities, they bred in mesquite scrub and spent the summer feeding on small mammals and grasshoppers.

Bald Eagles were present in winter and were observed hunting prairie dogs and sometimes fighting with Golden Eagles for prey. Remains of prairie dogs (bones, skulls, and even entire bodies) were found in Bald Eagle pellets. Burrowing Owls were both resident and migratory and bred in the JNCG complex. They were recorded in seven of the eight localities and were most abundant in summer, decreasing in winter when part of the population migrated south (Tables 2 and 3). Great Horned Owls (*Bubo virginianus*) were also residents. They roosted and nested in riparian areas but foraged in prairie-dog towns, probably hunting kangaroo rats (*Dipodomys* spp.) and other nocturnal rodents. Great Horned Owls were usually observed at night perching on the fence posts near El Uno and El Aguila.

Shorebirds

We were particularly interested to find Mountain Plovers wintering in the JNCG complex (Tables 2 and 3). Although we observed only three individuals on transects, we observed approximately five groups outside transects in Sal-

to de Ojo and Sector 1. Groups contained approximately 30 individuals, and one group had more than 120. These observations constituted new records for Mountain Plovers in Chihuahua state and are of special interest because the wintering range of this species in Mexico is unknown.

Long-billed Curlews were generally observed in groups and were most abundant in Salto de Ojo and El Cuervo (Table 3). We recorded the highest numbers of this species in early fall (Table 2).

Passerines

Horned Lark was the most abundant species in the JNCG complex (Table 2). Individuals were present year-round but were most abundant in fall and winter, probably because of their migratory habits. They migrate south early in fall and return north before spring. This species occurred at all eight localities (Table 3).

Lark Buntings were the most abundant sparrows in the area (Table 2). They were recorded mainly in fall and had a local distribution; they were present in only two localities, El Cuervo, where they accounted for 66% of all individual birds observed, and Pancho Villa, where they comprised 14% of all individual birds observed (Table 3).

McCown's Longspurs (*Calcarius mccownii*) and Chestnut-collared Longspur (*C. ornatus*) were most numerous in two localities, El Aguila and El Uno (Table 3). These localities previously formed a single prairie-dog town before they were fragmented by poisoning in 1989. Nevertheless, even in the absence of prairie dogs, these localities had the same vegetation type. The longspurs were probably present throughout the original area covered by the prairie-dog town. Longspurs were observed mainly in fall (Table 2), generally near reservoirs.

Brewer's Sparrows (*Spizella breweri*), Lark Sparrows (*Chondestes grammacus*), and Cassin's Sparrows (*Aimophila cassinii*) were locally distributed in the complex (Tables 2 and 3). Brewer's Sparrows were most abundant in fall and in Sector 1, with just one sighting in each of three other localities. Lark Sparrows were observed only in Pancho Villa and almost exclusively in summer. Cassin's Sparrows were observed in ephedra plants in San Pedro, in very low numbers and only in summer. Vesper Sparrows (*Pooecetes gramineus*) were also observed in low numbers, mainly in San Pedro and El Cuervo and only in early fall (Tables 2 and 3). Grasshopper Sparrows were recorded in spring and summer, mainly in grasslands without prairie dogs, except for two that were observed in El Aguila (Tables 2 and 3). Meadowlarks (*Stur-*

nella spp.) were present in all seasons and in all localities (Tables 2 and 3); their abundance was highest in Pancho Villa, Tierras Prietas, and Salto de Ojo, all of which had mesquite scrub or tall grasses such as toboso.

DISCUSSION

Grasslands in northwestern Chihuahua provide important habitat for birds in general and for grassland birds in particular. In North America, populations of grassland birds have declined more than any other group of birds since the early 1970s (Knopf 1994). This decline is probably related to the massive decrease, fragmentation, and degradation of grasslands across the continent, which has resulted in habitat loss on breeding and wintering grounds as well as a shortage of nest sites (McNicholl 1988, Johnson and Schwartz 1993, Herkert 1994, Knopf 1994). Grasslands in the JNCG region support the largest remaining prairie-dog complex in North America (Ceballos et al. 1993, Miller et al. 1994). This complex has been severely affected since the late 1980s, however. Prairie-dog poisoning, overgrazing, urbanization, and agriculture are the main environmental problems in the region (List 1997). It is important to assess how these factors may be affecting grassland birds in the JNCG complex, especially when considering that many of these species are declining throughout North America.

Many species whose breeding populations are declining were observed in the JNCG complex, generally in low numbers, with the exception of Horned Larks and Lark Buntings. We lack sufficient data to determine causal factors of these small numbers, however. There are at least two possible explanations. First, it is likely that the low bird abundance we observed in 1994–1995 was caused by the prolonged drought that affected the region from 1993 to 1996. Droughts can profoundly affect species diversity and abundance of grassland bird communities (George et al. 1992). It is also possible, however, that the low abundance was the result of the general decline that grassland birds in North America have been experiencing. Most likely, our results reflect natural variation on population numbers related to environmental factors such as food availability and to anthropogenic factors such as habitat degradation and fragmentation. For example, since the late 1980s more than 10,000 ha of prairie-dog towns in the JNCG complex have been converted to croplands and cattle ranches (List 1997; J. Pacheco and G. Ceballos, pers. comm.). Such changes undoubtedly have negative impacts on some species of grassland birds. It is important to develop monitoring schemes for grassland birds in the JNCG region

to properly evaluate long-term temporal and spatial population changes, and to understand these changes in relation to human disturbances.

Preserving the prairie-dog ecosystem will benefit and protect declining bird species as well as other grassland birds and vertebrates that use prairie-dog towns (Agnew et al. 1986, Ceballos et al. 1993, Miller et al. 1994). It is not feasible, of course, to eliminate established human settlements, but it may be feasible to control and limit the number of people and livestock in the JNCG complex.

Some measures that may help decrease the impact of humans and livestock in the area include the following.

1. Establish a protected area or nature reserve. This would prevent further decline of prairie dogs and other species that depend on their ecosystem (Miller et al. 1994). It would also reinforce the law and stop illegal hunting. Additionally, it would prevent future changes in land use and help control the expansion of human settlements. The JNCG region is considered to be a priority area for the conservation of Mexico's biological diversity (SEMARNAP 1996). We are presently working with the Mexican government to have this region recognized as a biosphere reserve.

2. Stop poisoning prairie dogs. Prairie dogs are protected in Mexico, so their poisoning is forbidden by Mexican law. Poisoning affects all vertebrate species that use prairie-dog burrows. Some grassland birds, such as Burrowing Owls, are especially vulnerable to poisoning because they nest in prairie-dog burrows and use them to escape from predators. Changes in habitat heterogeneity and vegetation associated with prairie-dog disappearance may have major impacts on grassland birds (e.g., Miller et al. 1994). Eradication of prairie dogs usually results in increased mesquite scrub cover; prairie dogs inhibit mesquite growth (Koford 1958). In addition, mesquite seed propagation by livestock could have a detrimental effect on the preservation of grasslands and grassland bird species. Finally, poisoning can also affect raptors, such as eagles and Ferruginous Hawks, that feed on prairie dogs.

3. Encourage technical support and training. Overgrazing is a serious problem on the JNCG complex. Livestock grazing affects bird communities by influencing food supply, food availability, plant growth, and plant diversity (McNicholl 1988, Brady et al. 1989). Technical training and support should include improving grazing techniques and herd management in order to reduce the effects of overgrazing in the JNCG complex.

4. Encourage education programs. Establish-

ing an environmental education program would increase awareness of the importance of the prairie-dog ecosystem and its conservation. The main goal should be to promote an integrated view of wildlife conservation and sustainable use of resources. Education programs should be aimed at local residents, ranchers, and school children, as well as at visitors from neighboring towns and cities.

5. Conduct scientific research in the area. There are few data on grassland birds in Mexico. Further research is needed, especially in relation to the habitat requirements, abundance, and distribution of declining, threatened, and endangered species in the JNCG complex and the rest of the country.

The long-term survival of the JNCG complex and its biological diversity clearly depend on establishing and implementing a well-designed conservation strategy. Success will depend on the understanding and cooperation of local people, the scientific community, and the government. The long-term maintenance of one of the largest relatively pristine grasslands in the continent represents a major challenge for Mexico.

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APPENDIX. SPECIES OBSERVED IN THE GRASSLANDS OF THE JANOS-NUEVO CASAS GRANDES PRAIRIE-DOG COMPLEX, CHIHUAHUA, MEXICO, 1994–1995

Species	Seasonality	Conservation status		
		Mexico	US	Canada
Turkey Vulture (<i>Cathartes aura</i>)	Re			
Golden Eagle (<i>Aquila chrysaetos</i>)	Re	En		
Bald Eagle (<i>Haliaeetus leucocephalus</i>)	Wi	En	Th	
Northern Harrier (<i>Circus cyaneus</i>)	Re	Th	De	
*Red-tailed Hawk (<i>Buteo jamaicensis</i>)	Re			
Swainson's Hawk (<i>B. swainsoni</i>)	Su			
Ferruginous Hawk (<i>B. regalis</i>)	Wi		De	Th
Zone-tailed Hawk (<i>B. albonotatus</i>)	Su			
*Osprey (<i>Pandion haliaetus</i>)	Tr			
American Kestrel (<i>Falco sparverius</i>)	Re			
*Merlin (<i>F. columbarius</i>)	Wi	Th		
Prairie Falcon (<i>F. mexicanus</i>)	Re	Th		
*Peregrine Falcon (<i>F. peregrinus</i>)	Re	Th		
Scaled Quail (<i>Callipepla squamata</i>)	Re			
Killdeer (<i>Charadrius vociferus</i>)	Re			
Mountain Plover (<i>C. montanus</i>)	Wi	Th	De	
*Whimbrel (<i>Numenius phaeopus</i>)	Tr			
Long-billed Curlew (<i>N. americanus</i>)	Re		De	
Mourning Dove (<i>Zenaidra macroura</i>)	Re			
*Inca Dove (<i>Columbina inca</i>)	Re			
Greater Roadrunner (<i>Geococcyx californianus</i>)	Re			
*Short-eared Owl (<i>Asio flammeus</i>)	Tr	Th		
*Great Horned Owl (<i>Bubo virginianus</i>)	Re	Th		
Burrowing Owl (<i>Athene unicularia</i>)	Re	Th	De	Th
*Lesser Nighthawk (<i>Chordeiles acutipennis</i>)	Su			
*White-throated Swift (<i>Aeronautes saxatalis</i>)	Re			
*Belted Kingfisher (<i>Ceryle alcyon</i>)	Wi			
Ladder-backed Woodpecker (<i>Picoides scalaris</i>)	Re			
Western Kingbird (<i>Tyrannus verticalis</i>)	Su			
Ash-throated Flycatcher (<i>Myiarchus cinerascens</i>)	Su			
Say's Phoebe (<i>Sayornis saya</i>)	Re			
Horned Lark (<i>Eremophila alpestris</i>)	Re		De	

APPENDIX. CONTINUED

Species	Seasonality	Conservation status		
		Mexico	US	Canada
*Tree Swallow (<i>Tachycineta bicolor</i>)	Tr			
Violet-green Swallow (<i>T. thalassina</i>)	Su			
*Bank Swallow (<i>Riparia riparia</i>)	Tr			
*Northern Rough-winged Swallow (<i>Stelgidopteryx serripennis</i>)	Su			
*Cliff Swallow (<i>Hirundo pyrrhonota</i>)	Su			
Barn Swallow (<i>H. rustica</i>)	Su			
Chihuahuan Raven (<i>Corvus cryptoleucus</i>)	Re			
Cactus Wren (<i>Campylorhynchus brunneicapillus</i>)	Re			
*Rock Wren (<i>Salpinctes obsoletus</i>)	Re			
Eastern Bluebird (<i>Sialia sialis</i>)	Re			
Loggerhead Shrike (<i>Lanius ludovicianus</i>)	Re		De	Th
Northern Mockingbird (<i>Mimus polyglottos</i>)	Re			
Curved-billed Thrasher (<i>Toxostoma curvirostre</i>)	Re			
*Sprague's Pipit (<i>Anthus spragueii</i>)	Wi		De	
*Lucy's Warbler (<i>Vermivora luciae</i>)	Su	Th	De	
Yellow-rumped Warbler (<i>Dendroica coronata</i>)	Wi			
Blue Grosbeak (<i>Guiraca caerulea</i>)	Su			
Grasshopper Sparrow (<i>Ammodramus savannarum</i>)	Wi		De	De
*Baird's Sparrow (<i>A. bairdii</i>)	Wi		De	De
Vesper Sparrow (<i>Poocetes gramineus</i>)	Wi		De	
*Savannah Sparrow (<i>Passerculus sandwichensis</i>)	Wi		De	
Song Sparrow (<i>Melospiza melodia</i>)	Wi			
Lark Sparrow (<i>Chondestes grammacus</i>)	Re		De	
Black-throated Sparrow (<i>Amphispiza bilineata</i>)	Re		De	
Cassin's Sparrow (<i>Aimophila cassinii</i>)	Re		De	
*Chipping Sparrow (<i>Spizella passerina</i>)	Wi			
Brewer's Sparrow (<i>S. breweri</i>)	Wi		De	
*Dark-eyed Junco (<i>Junco hyemalis</i>)	Wi			
McCown's Longspur (<i>Calcarius mccownii</i>)	Wi		De	
*Chestnut-collared Longspur (<i>C. ornatus</i>)	Wi		De	
Lark Bunting (<i>Calamospiza melanocorys</i>)	Re		De	
Eastern Meadowlark (<i>Sturnella magna</i>)	Re		De	
Western Meadowlark (<i>S. neglecta</i>)	Re		De	De
Yellow-headed Blackbird (<i>Xanthocephalus xanthocephalus</i>)	Re			
Red-winged Blackbird (<i>Agelaius phoeniceus</i>)	Re			
Northern Oriole (<i>Icterus galbula</i>)	Su			
Brown-headed Cowbird (<i>Molothrus ater</i>)	Re			
*Pine Siskin (<i>Carduelis pinus</i>)	Wi			
House Finch (<i>Carpodacus mexicanus</i>)	Re			

Note: Seasonality: Re = resident, Wi = winter migrant, Su = summer migrant, Tr = transient. Conservation Status: De = declining. Th = Threatened, En = Endangered.

* Species not observed on transects.