

**Grassland/Shrubland Species of Conservation Concern at Holloman
Air Force Base: Pilot Study of Nesting Priority Species**



Juvenile Burrowing Owls in atypical nesting habitat. Photo Jacqueline Smith

Kristine Johnson, Jacqueline Smith, and Nathan Petersen

*University of New Mexico Biology Department
Natural Heritage New Mexico Publication No. 16-GTR-391
January 2016*

Contents

Introduction.....	4
Burrowing Owl	4
Loggerhead Shrike	5
Crissal Thrasher	6
Cassin’s Sparrow	7
Methods.....	8
Results.....	9
Burrowing Owl	9
Loggerhead Shrike	11
Crissal Thrasher	11
Cassin’s Sparrow	11
Discussion.....	19
Burrowing Owl	19
Loggerhead Shrike	19
Crissal Thrasher	20
Cassin’s Sparrow	20
Conclusions.....	20
Literature Cited.....	21

List of Figures

Figure 1. Burrowing Owl with fledglings, Holloman AFB (J. Smith).	5
Figure 2. Loggerhead Shrike (Dave Menke).	6
Figure 3. Loggerhead Shrike prey impaled on thorn (J. Smith).	6
Figure 4. Crissal Thrasher.....	7
Figure 5. Old Crissal Thrasher nest in Mesquite (J. Smith).....	7
Figure 6. Cassin's Sparrow, singing. Photo VIREO, http:// vireo@ansp.org	8
Figure 7. Crissal Thrashers and nests 2015.	12
Figure 8. Burrowing Owl burrows 2015.....	13
Figure 9. Loggerhead Shrikes and nests 2015.	14
Figure 10. Cassin's Sparrows found between 8 April and 1 July 2015.	15
Figure 11. Cassin's Sparrows found during the week of 6 July 2015.	16
Figure 12. Cassin's Sparrows found during the week of 13 July 2015, also showing negative surveys.	17
Figure 13. Cassin's Sparrows found during the week of 27 July 2015, also showing negative surveys.	18

List of Tables

Table 1. Survey dates for each species of concern.	9
Table 2. Conservation status of HAFB grass/shrub species.	10
Table 3. Results of historical and recent Burrowing Owl surveys at HAFB.....	19

Introduction

Grassland birds are declining faster than any other avian group (Peterjohn and Sauer 1999, Vickery et al. 1999, Brennan and Kuvlesky 2005). North American grassland birds have experienced “steeper, more consistent, and more geographically widespread declines than any other behavioral or ecological guild of any North American species, including Neotropical migrants” (Knopf 1994), largely because of habitat loss and degradation. In response to the dramatic declines in grassland bird populations, conservation groups from The Nature Conservancy (McCready et al. 2005) to Partners in Flight (Rich et al. 2004) have proposed and taken action to conserve this group of birds.

Semi-desert grasslands are important habitats for grassland bird populations. Over 80% of grassland bird species that breed in western North America winter in Chihuahuan Desert Grasslands of the southwestern USA and Mexico (Panjabi et al. 2010). Holloman Air Force Base (HAFB) contains one of two key habitat types in the Chihuahuan Desert Ecosystem, the Chihuahuan Semi-desert Grasslands. This habitat type was identified for conservation by the World Wildlife Fund (Ricketts et al. 1999). HAFB also contains shrubland and mixed shrubland/grassland habitats. Minimally developed habitat outside the HAFB cantonment area is used by breeding, wintering, and migrating grassland and shrubland birds.

Under the Sikes Act and Sikes Act Improvement Act (1997, 16 U.S.C. 670); the Fish and Wildlife Conservation Act (16 U.S.C 2901-2911); Executive Order (EO) 13186, Responsibilities of Federal Agencies to Protect Migratory Birds; the Migratory Bird Treaty Act (1918, 16 U.S.C. 703-712), the Endangered Species Act (1973, 16 U.S.C 1531-1544), and several additional DoD and Air Force policies and directives, HAFB has responsibility to conserve natural resources on base, including native migratory birds and their habitats. HAFB has therefore supported survey, monitoring, and research efforts in its grasslands and shrublands, which are the prevalent bird habitats on base.

The purpose of this pilot study was to survey for nesting bird species of conservation concern in grassland and shrubland habitats at HAFB.

Burrowing Owl

The Western Burrowing Owl (*Athene cunicularia hypugaea*) is a small (19-25 cm long), diurnal owl that nests in underground burrows. This easily-recognized bird has a large, round head, bright yellow eyes, and long legs. The back is brown with buffy white spots; underparts of adults are barred with brown and white (Figure 1; Poulin et al. 2011).

Western Burrowing Owl populations have declined over the past 50 years (Poulin et al. 2011). As a result, it is a New Mexico Species of Greatest Conservation Need (SGCN, New Mexico Department of Game and Fish [NMDGF] 2015), US Fish and Wildlife Service (USFWS) Bird of Conservation Concern (BCC, USFWS 2008), BLM Sensitive Species (Biota Information System of New Mexico [BISON-M] 2015), and DoD Partners in Flight (PIF) Sensitive Species (DoD PIF 2014). Although no single cause of decline has been identified, the dramatic decline of prairie dogs has limited Burrowing Owl access to nest burrows, which historically were provided by prairie dogs in many areas.



Figure 1. Burrowing Owl with fledglings, Holloman AFB. Photo J. Smith.

The Burrowing Owl occurs in open grassland, desert, and prairie habitats and agricultural lands. It breeds across the western US and northern and central Mexico. Northern breeders winter in the southern parts of New Mexico, Arizona, Nevada, and California; and in Mexico. A dietary generalist, it eats mainly insects and small mammals but will take birds, frogs, snakes, and bats (Poulin et al. 2011).

Although Burrowing Owls are capable of excavating burrows, they typically nest in burrows excavated by other animals such as ground squirrels, badgers, prairie dogs, skunks, kangaroo rats, or tortoises. At Holloman they nest in April and young typically fledge in June (Envirological Services 2009, NHNM unpubl. data). Reported clutch sizes are variable: mean=7.4, range=2-12 (Conway et al 2012); mean=7.2, range=3-10 (Griebel and Savidge 2007, range=1-11 (Murray 1976); mode=9 (Wellicome 2005). Badgers and coyotes are primary nest predators, and birds and mammals prey on young fledglings. At one site in New Mexico, rate of reproductive success has been associated with precipitation and its effects on insect prey abundance, while nest failures have been attributed to predation by coyotes, badgers, skunks, and snakes (Cruz-McDonnell and Cruz-Carretero 2015).

Loggerhead Shrike

The Loggerhead Shrike (*Lanius ludovicianus*) is a medium-sized songbird (length 210 mm, mass 47.5 g). It is gray above and white below, with a black facial mask and small, hooked bill. The sexes are similar, except males are larger than females (Figure 2). The Northern Shrike (*Lanius excubitor*) is similar in appearance but 25% larger (Yosef 1996).

Although widely distributed across much of North America, the Loggerhead Shrike has experienced continent-wide decline in recent decades (Yosef 1996). Due to this decline, the Loggerhead Shrike is listed as a New Mexico SGCN (NMDGF 2015), a BCC (USFWS 2008), a BLM Sensitive Species (BISON-M 2015), New Mexico Partners in Flight Level 2 Species of Conservation Concern (New Mexico PIF 2007), and a DoD Partners in Flight Sensitive Species (DoD PIF 2014).



Figure 2. Loggerhead Shrike. Photo Dave Menke.

The Loggerhead Shrike inhabits grasslands and other open areas with short vegetation. Territories usually contain isolated trees or small shrubs, and nests are frequently placed in trees or shrubs having thorns, presumably for predator protection (Yosef 1996).



Figure 3. Loggerhead Shrike prey impaled on thorn. Photo J. Smith.

The Loggerhead Shrike is best known for impaling its prey, including insects, small reptiles, small mammals, amphibians, and birds, on sharp objects such as thorns and barbed wire fences (Figure 3). This behavior apparently assists in handling prey.

Loggerhead Shrikes are resident through the southern part of their range, and northern populations are migratory (Yosef 1996). Resident pairs defend permanent territories. A nest of small sticks is placed in a tree or shrub; typical clutch size is 4-5.

Crissal Thrasher

The Crissal Thrasher (*Toxostoma crissale*) is a medium-sized songbird (length 30 cm, mass ~ 63 g). Plumage is grayish brown with a black maxillary streak and a distinctive cinnamon-rufous crissum. It has a long graduated tail, large decurved bill, and long legs (Figure 4; Cody 1999).

Crissal Thrasher is a DoD PIF priority bird species (DoD PIF 2014), New Mexico PIF level 2 species of concern (New Mexico PIF 2007), and former BCC (USFWS 2002). Although it is widely distributed in southern California, Arizona, and New Mexico, it is not well known, largely because it is quite reclusive and patchily distributed. The BBS credibility measures for this species indicate that data are deficient (Sauer et al. 2014).



Figure 4. Crissal Thrasher. Photo VIREO, <http://vireo@ansp.org>.

In Arizona and New Mexico, Crissal Thrasher is found along riparian scrub belts, in mesquite thickets, and on foothill slopes, extending into pinyon-juniper habitats. In the extreme southeastern part of its range, it occupies Chihuahuan Desert washes (Cody 1999). Twig nests are placed in the interior of low shrubs and mesquite trees, in dense cover (Figure 5). Parents display stealthy behavior near the nest, running away on the ground while hidden by ground cover. The Crissal Thrasher breeding season is long and may extend from February to July. Normal clutch size is 2-3, ranging from 1-4. Both parents incubate (Cody 1999).



Figure 5. Old Crissal Thrasher nest in mesquite. Photo J. Smith.

Cassin's Sparrow

The Cassin's Sparrow (*Peucaea cassinii*) is a small (length 13-15 cm, mass 17-18 g), nondescript sparrow. Plumage is mainly gray-brown with plain face, pale lemon yellow at the shoulder, and white tips on outer rectrices (Figure 6; Dunning et al. 1999). Sexes are similar. It is most easily identified by its distinctive song and dramatic skylarking behavior while singing.

Cassin's Sparrow is listed as a BCC for the Chihuahuan Desert Bird Conservation Region (USFWS 2002, USFWS 2008) and a SGCN (NMDGF 2015)

The Cassin's Sparrow is a species of arid grass shrublands of the southern Great Plains, southwestern United States, and Northern Mexico. Arriving in New Mexico in large numbers in April and leaving by late September (Hubbard 1977), this secretive species can experience large yearly fluctuations in distribution and population size across its range, apparently in response to precipitation. These fluctuations make it difficult to study population trends in this nomadic species.

Cassin's Sparrow nests are built on the ground, or slightly elevated, in shrubs, cactus and bunchgrasses (Dunning et al. 1999). Foraging also takes place almost entirely on the ground, with prey items taken from the ground and plant stems (Schnase 1984). In the western portion of the range, they may breed only in abnormally wet years, while eastern populations may breed annually. Cassin's Sparrow is not well studied across its range. Information gaps remain, and geographic variation in breeding behavior suggests that results from one part of the range are not generalizable to other populations (Dunning et al. 1999).



Figure 6. Cassin's Sparrow, singing. Photo VIREO, <http://vireo@ansp.org>.

Methods

We assembled species of concern lists from management and regulatory agencies. Of these, we selected four species that we had detected in HAFB grasslands and shrublands during the spring and summer nesting seasons: Burrowing Owl, Loggerhead Shrike, Crissal Thrasher, and Cassin's Sparrow.

We compiled data for Burrowing Owl, Loggerhead Shrike, Crissal Thrasher, and Cassin's Sparrow on Holloman Air Force Base from previous grassland and raptor surveys performed by Natural Heritage New Mexico (NHNM, Smith and Johnson 2013, Smith et al. 2015). Historical Burrowing Owl nest locations were collected by NHNM (Johnson et al. 2011, Johnson and Smith 2012) and Envirollogical Services, Inc. (Envirollogical Services 2007a, 2007b, 2009). We loaded all historical locations of Burrowing Owl nest sites into a GPS unit and visited these waypoints in the field. A burrow was determined to be active if owls were seen nearby or recent owl sign, such as fresh pellets or feathers, was present. If we suspected that a burrow was active but saw no owl, we revisited the burrow until the presence of owls was confirmed, or twice more to confirm their absence. We periodically checked active burrows to determine nesting success. The HAFB natural resource manager provided additional active burrow locations. These burrows

were often found by maintenance workers or the Holloman public. We determined burrow activity as above.

Beginning in April of 2015, we conducted visual and auditory surveys for each of the other three species of concern from a vehicle or on foot in suitable habitat (Table 1). Initial surveys were guided by our observations of these three species on surveys we conducted for grassland (Sadoti et al. 2015) and raptor (Smith et al. 2015) species. We used 8X or 10X binoculars and when necessary a 20X spotting scope. We recorded a GPS waypoint of the location of target species and any pertinent notes. We estimated the location of the individual if it was heard but not seen (e.g., 150 m west.) We noted adults, juveniles, and nests. When searching for nests, we focused on the proper nesting substrate for each species (Birds of North America Online 2015).

Table 1. Survey dates for each species of concern.

Species	Survey Dates
Burrowing Owl	4/7/2015 - 7/17/2015
Loggerhead Shrike	4/8/2015 - 6/18/2015
Crissal Thrasher	4/7/2015 - 6/2/2015
Cassin's Sparrow	4/8/2015 - 7/2/2015

We detected most Loggerhead Shrikes perching on shrubs or wires along roadsides. We also recorded any shrikes seen on our walking transects through Crissal Thrasher and Cassin's Sparrow habitats. To survey for Crissal Thrasher, we walked approximately linear transects through mesquite habitats, on the eastern side of the base. We also walked through draws containing larger mesquite trees: Hay Draw, Carter Draw, and two unnamed draws (Figure 7).

In early July, at the onset of the monsoons, the number of Cassin's Sparrows at HAFB exploded from several pairs to hundreds of individuals, but they were active for only a short time around dawn. They were also quite skittish, which required that surveys be conducted at a distance. We therefore changed our search method for the Cassin's Sparrow, driving through suitable habitat, stopping approximately every 300-500 meters, and listening for singing males for two to four minutes at each stop. We estimated the location of each singing male on a satellite image of HAFB. We continued in this manner until bird activity decreased, generally around 0745 hours.

We entered all detection data in an Access database. Using ArcGIS (version 10.2, ESRI 2011), we mapped each survey route and bird detection.

Results

Species of Concern

A surprising number of bird species listed as sensitive have been detected at HAFB (Sadoti et al. 2015, Smith et al 2015; Table 2, below), especially considering that these habitats at HAFB are

Table 2. Conservation status of HAFB grass/shrub species. BCR35 – US FWS 2008, BCC Region 2 – USFWS 2008, BLM NMSO – BISON-M 2015, DoD PIF - DoD Partners in Flight 2014, PIF - PIF Science Committee 2012, SGCN – NM Dept. Game and Fish 2015, USFS – USFS 2013, Nat. Herit. S rank -NatureServe 2015.

Common Name	Scientific Name	BCC2008BCR35	BCC2008Region2	BLMsensitiveNMSO	DoDPIFpriority	PIFwatchlist	SGCN2015draft	USFSregion3sensitive	NMDGF status	StateRank
Ferruginous Hawk	<i>Buteo regalis</i>	X		X						S2
Golden Eagle	<i>Aquila chrysaetos</i>	X	X		X		X			S3
Lesser Yellowlegs	<i>Tringa flavipes</i>		X							S4
Long-billed Curlew	<i>Numenius americanus</i>	X	X		X		X			S3
Western Burrowing Owl	<i>Athene cunicularia hypugaea</i>	X	X	X	X		X	X		S3
Common Nighthawk	<i>Chordeiles minor</i>				X		X			S4
American Kestrel	<i>Falco sparverius</i>				X					S5
American Peregrine Falcon	<i>Falco peregrinus anatum</i>	X	X				X	X	T	S2
Prairie Falcon	<i>Falco mexicanus</i>				X		X			S4
Loggerhead Shrike	<i>Lanius ludovicianus</i>	X	X	X	X		X			S3
Horned Lark	<i>Eremophila alpestris</i>				X					S5
Cactus Wren	<i>Campylorhynchus brunneicapillus</i>				X					S5
Western Bluebird	<i>Sialia mexicana</i>						X			S4
Crissal Thrasher	<i>Toxostoma crissale</i>				X					S4
Sage Thrasher	<i>Oreoscoptes montanus</i>				X					S3
Chestnut-collared Longspur	<i>Calcarius ornatus</i>	X	X	X		X	X			S3
McCown's Longspur	<i>Rhynchophanes mccownii</i>	X	X				X			S3
Cassin's Sparrow	<i>Peucaea cassinii</i>	X								S5
Brewer's Sparrow	<i>Spizella breweri</i>				X					S3
Sagebrush Sparrow	<i>Artemisiospiza nevadensis</i>				X		X			S3
Lark Bunting	<i>Calamospiza melanocorys</i>	X	X							S3
Eastern Meadowlark	<i>Sturnella magna</i>				X					S4

not especially species-rich. Of 94 species detected in these habitats, 22 (23%) are listed by at least one agency or organization as a species of conservation concern (Table 2).

Burrowing Owl

We collected 41 historical locations (Envirological Services 2007a, 2007b, 2009; Johnson et al. 2011, Johnson and Smith 2012). Some of those locations were on runways or other difficult-to-

access areas. We visited 23 of those historical burrow locations; at four we observed signs of possible recent use (feathers, pellets), and Burrowing Owls later nested at two of those. In addition to the historical locations, we found 10 other possible burrows. Some of these were found by or pointed out to Environmental Services staff, and some we found. Five of these 10 possible new burrows and two historical burrows were occupied by owls in 2015 (Figure 8). Six burrows fledged young. Burrow 6, near the chapel (Figure 8), fledged six young; burrow 2, near the golf course and the wetlands, fledged at least four young; the other four burrows were only seen to have one or two young but may have had more.

Loggerhead Shrike

We observed 26 individual territories of Loggerhead Shrikes. Some of those were only seen once; they may not have been territories, rather individual birds from other territories. Shrikes nested on 14 of those 27 territories, as evidenced by nearby nests (two) or fledglings (12 sets), and 11 of those are known to have fledged young (Figure 9).

Crissal Thrasher

We found 15 Crissal Thrasher territories. Six of these pairs were known to have nested; we found three active nests and saw three sets of fledglings. Another four territories were occupied by pairs but we never found evidence of nesting. In addition to the three active nests, we found fourteen empty nests, many of them falling apart or in dead trees, from the previous year or older (Figure 7).

Cassin's Sparrow

Our surveys from 8 April to 1 July revealed 19 Cassin's Sparrow territories, three of which were seen to have paired adults, and one of which was found to have a nest with eggs (Figure 10). After a large rain during the week of 6 July, we found approximately 225 singing males (Figure 11). During the week of 13 July, we observed only 86 singing males (Figure 12). By the week of 27 July the number of singing males was down to 21 (Figure 13).

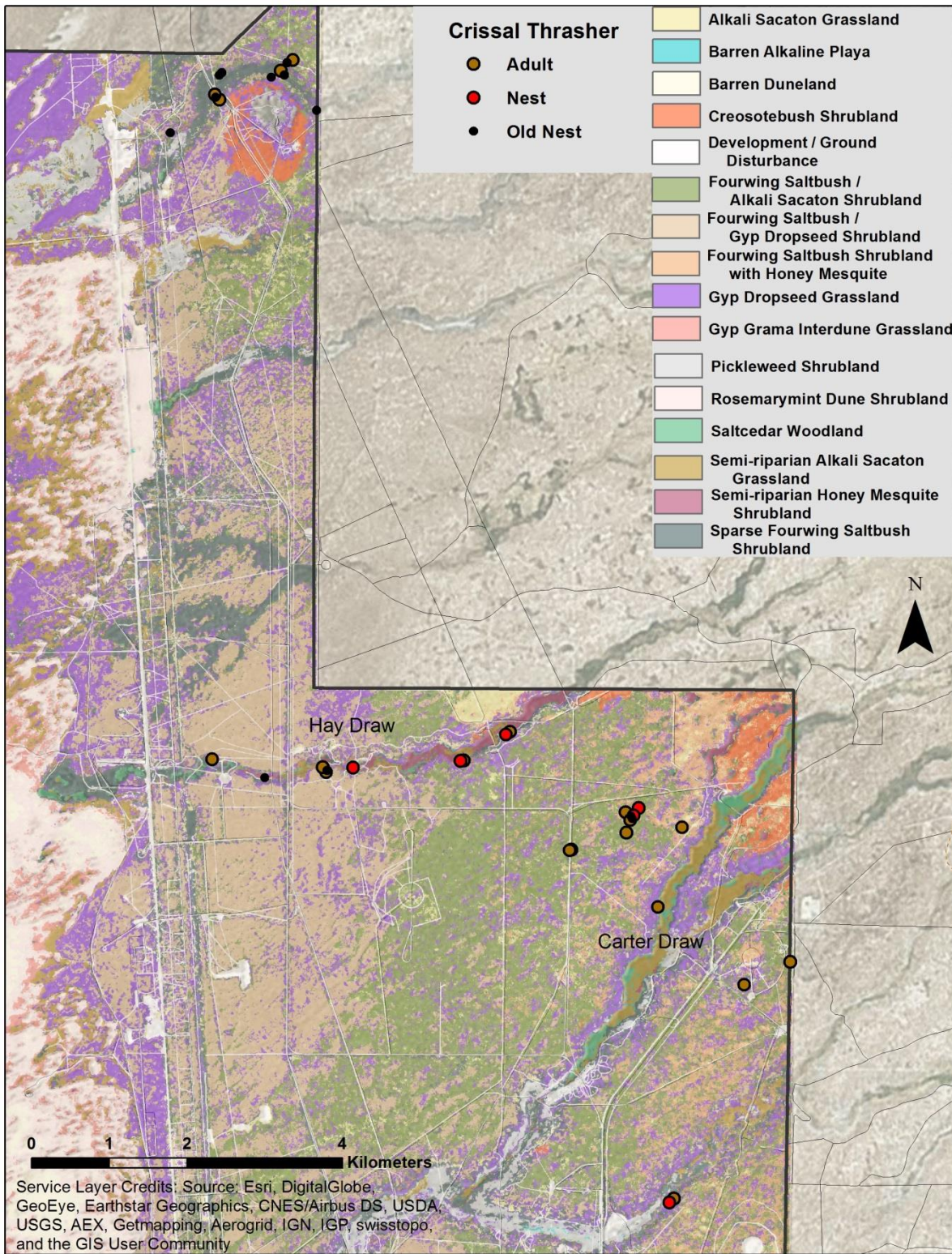


Figure 7. Crissal Thrashers and nests 2015.

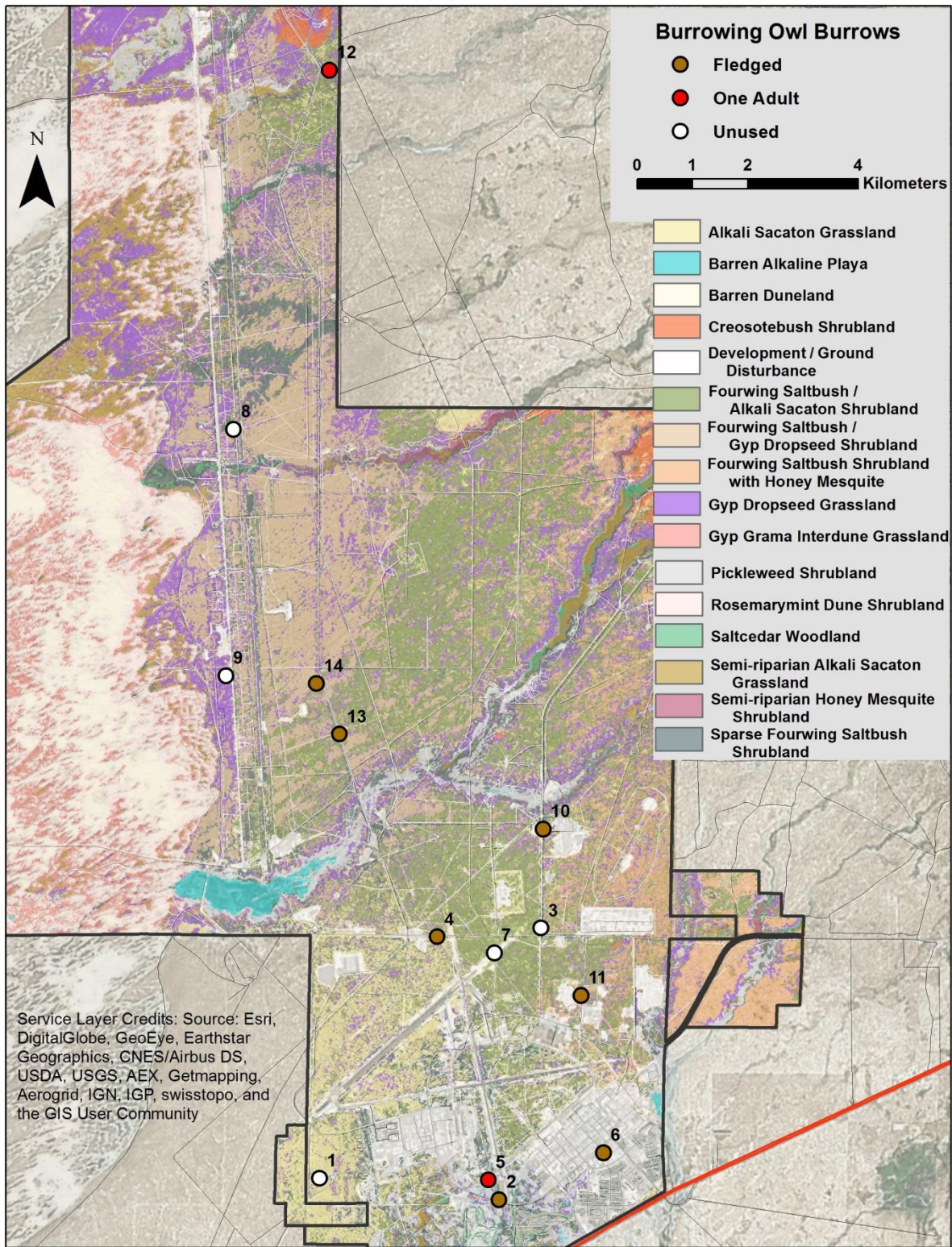


Figure 8. Burrowing Owl burrows 2015.

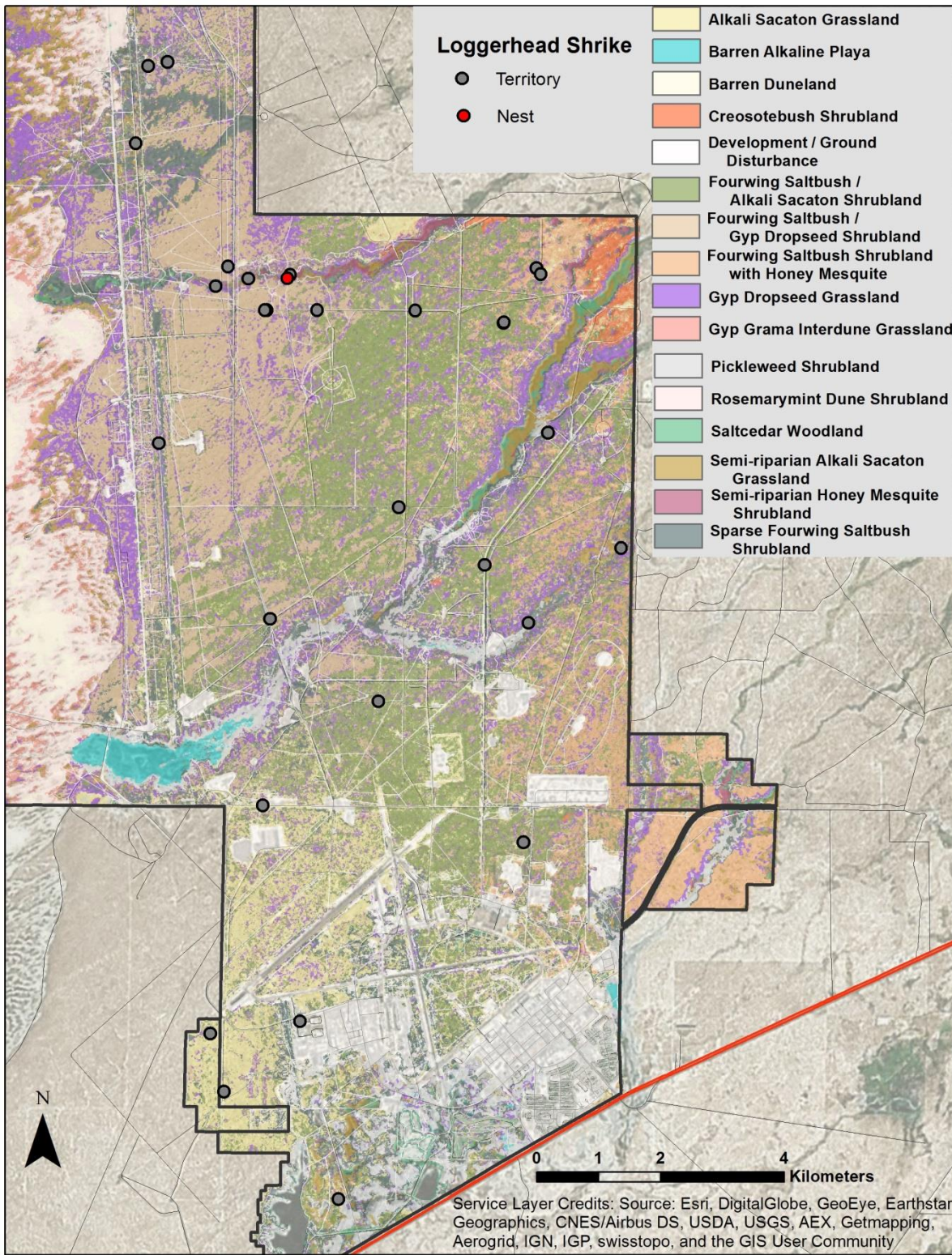


Figure 9. Loggerhead Shrikes and nests 2015.

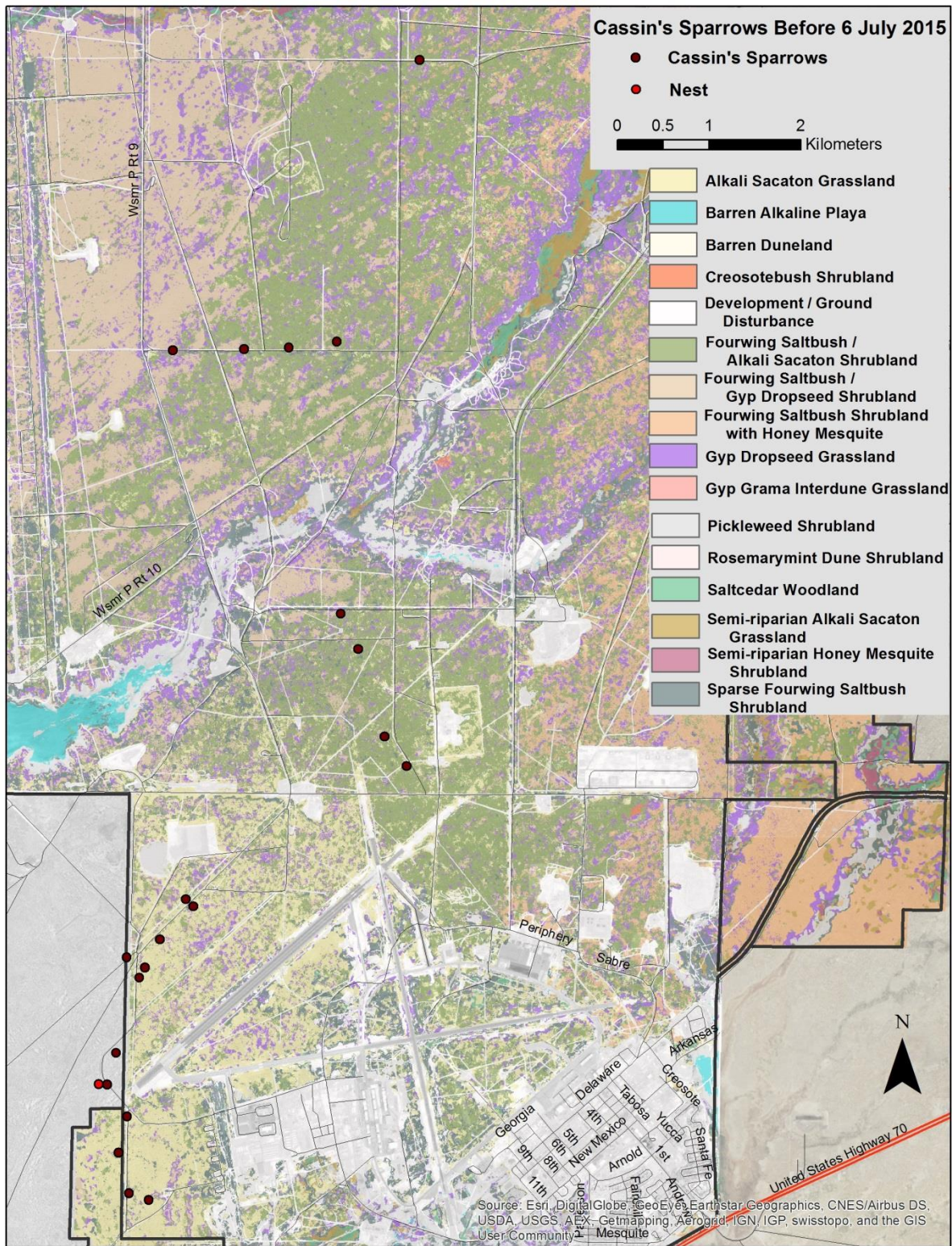


Figure 10. Cassin's Sparrows found between 8 April and 1 July 2015.

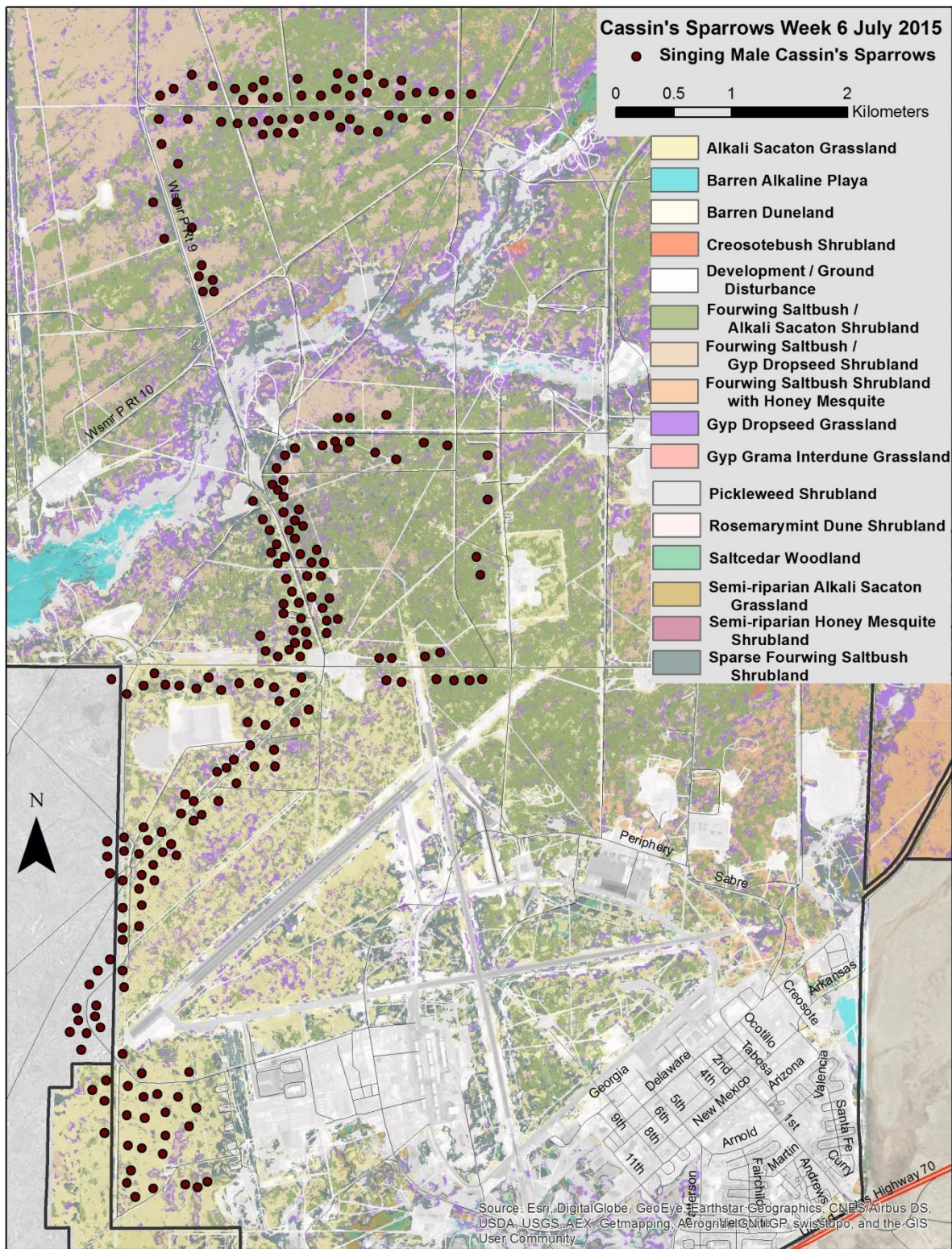


Figure 11. Cassin's Sparrows found during the week of 6 July 2015.

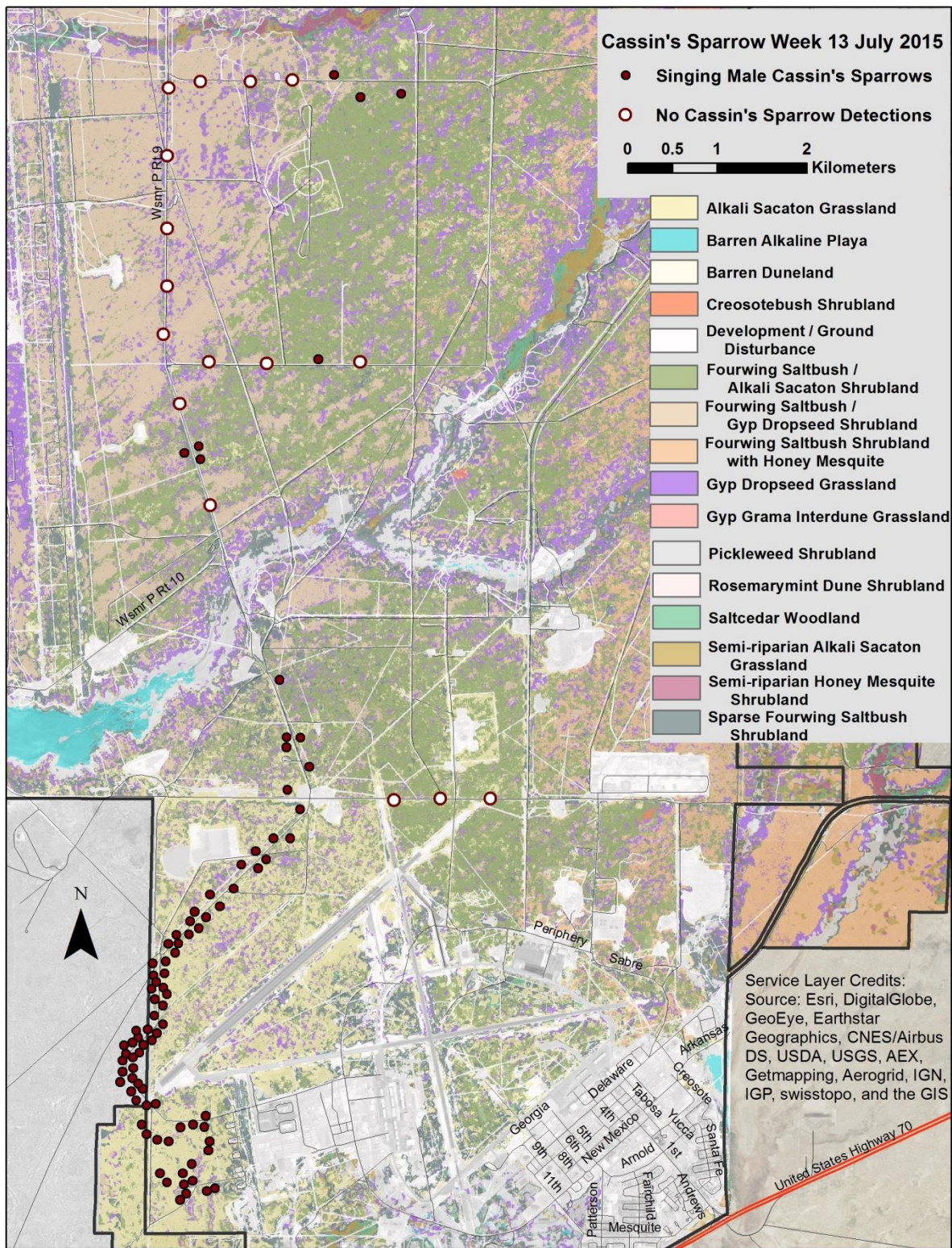


Figure 12. Cassin's Sparrows found during the week of 13 July 2015, also showing negative surveys.

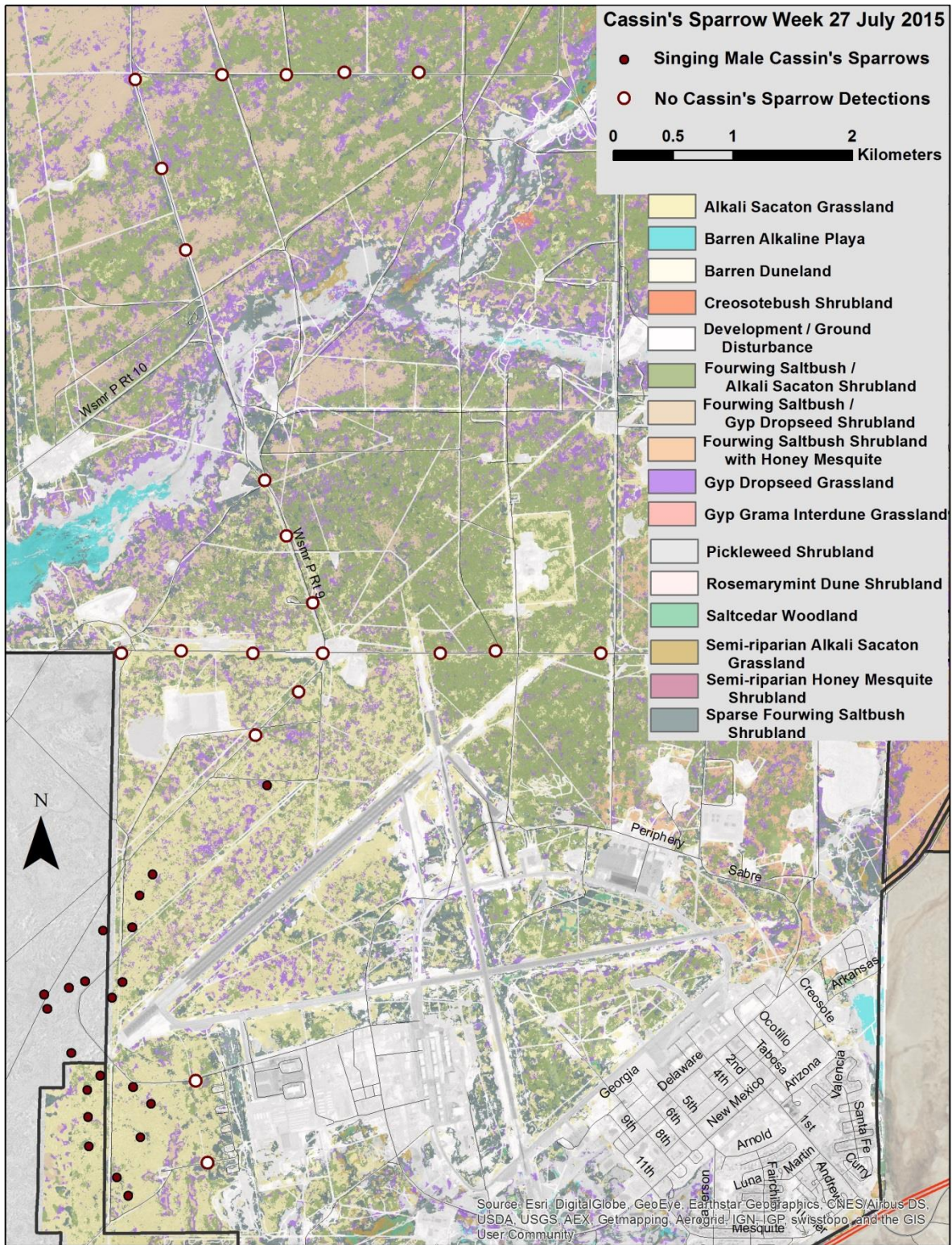


Figure 13. Cassin's Sparrows found during the week of 27 July 2015, also showing negative surveys.

Discussion

Burrowing Owl

Numbers of active Burrowing Owl burrows at HAFB have varied between zero and 24 (mean 8.7) in the 14 years they were surveyed since 1996. The causes of this fluctuation are unclear. Breeding Bird Surveys (BBS) data show no significant trends for Burrowing Owls in New Mexico, but there may be a decline in their numbers in the Western region and in the United States as a whole (Sauer et al. 2014). There may have been fewer owls in 2003-2005 (BBS data are analyzed for trends only), or perhaps fewer owls chose to breed at HAFB. Habitat at HAFB may have been poor relative to other areas, or fewer young from HAFB might have returned to nest. Burrowing Owl philopatry has been shown to range from 5% of nestlings and 16% of adults (Lutz and Plumpton 1999), to 80% males and 37% females returning to within 5 km of their previous breeding sites (Plumpton and Lutz 1993 as cited in Poulin et al. 2011).

Table 3. Results of historical and recent Burrowing Owl surveys at HAFB.

	Active Nests	Successful Nests	Young	Fledglings per successful nest	Successful Nest %	Source
1996	18	7	11	2.14	39%	Johnson et al. 1997
1997	19	10	31	2.7	53%	Johnson et al. 1997
1998						(No surveys)
1999						(No surveys)
2000	2	2	5	2.5	100%	Borgmann et al. 2003*
2001	2	2	6	3	100%	Borgmann et al. 2003*
2002	3	3	9	3	100%	Borgmann et al. 2003*
2003	0	0	0	-	-	49 CES/CEAN*
2004	0	0	0	-	-	49 CES/CEAN*
2005	1	1	5	5	100%	Envirological 2007b
2006	11	5	12	2.4	45%	Envirological 2007b
2007	15	10	41	4.1	67%	Envirological 2007b
2008	24	12	26	2.17	50%	Envirological 2009
2009						(No surveys)
2010	10	2			20%	Johnson and Smith 2012
2011	10	5			50%	Johnson and Smith 2012
2012						(No surveys)
2013						(No surveys)
2014						(No surveys)
2015	9	6			66.7%	(this study)

*As cited in Holloman Air Force Base 2011

Number of young fledged from successful nests has been recorded to range from 2.9 to 7.8 (Poulin et al. 2011). Average number of fledglings from a successful nest over the nine years when this was tracked at HAFB was 2.98. In 2015, the two nests confirmed to fledge more than this historical average were 1. near the chapel in the cantonment area (nest 6, Figure 8), which

may have increased access to prey living in and around buildings, and 2. near the wetlands and golf course (nest 2, Figure 8), which had abundant prey in those two wet environments. Nest 2 is near historical nests, where remains of amphibian prey have been found (Guy et al. 2012).

Guy et al. (2012) concluded that Burrowing Owl habitat is at risk of encroachment by invasive plants, particularly African rue (*Peganum harmala*) and Russian thistle (*Salsola kali*), which render burrows unusable. African rue grows in dense stands, reducing the amount of open area preferred by Burrowing Owls, and Russian thistle can physically obstruct burrows.

Loggerhead Shrike

Loggerhead Shrikes are the most conspicuous of the four species of concern in this study (except for Cassin's Sparrows when they appeared by the hundreds). The striking black, white, and gray Loggerhead Shrike plumage is conspicuous when they perch in the open on electrical wires and fences. We found more shrike territories and higher numbers than any of the other species of concern (excepting the Cassin's Sparrow irruption). Although it is possible that Loggerhead Shrikes were simply more conspicuous than the other species, they are also more general in their habitat use, being found all across the base, in Alkali Sacaton Grassland and various fourwing saltbush shrubland types (Figure 9). In contrast, Crissal Thrashers were found mainly along draws, where mesquite was present (Figure 7), and Cassin's Sparrows occurred in Alkali Sacaton Grassland and Fourwing Saltbush/Alkali Sacaton Shrubland (Figures 10-13), suggesting that alkali sacaton grass is a feature of their habitat.

Crissal Thrasher

Prior to this study, we had detected few Crissal Thrashers at HAFB, probably because they occur mainly in mesquite habitats not included in our grassland transects (Sadoti et al. 2015). When we surveyed in these mesquite-dominated habitats, we found 16 territories, six nesting pairs, and 14 empty nests from previous nesting attempts. HAFB mesquite areas provide important habitat for this species. Crissal Thrasher breeding seasons can be lengthy, and earlier-season surveys could turn up additional active nests.

Cassin's Sparrow

Cassin's Sparrow movements and breeding behaviors are poorly understood, probably because they are secretive and difficult to approach, and they breed irregularly, often in response to seasonal rains. We observed an irruption of Cassin's Sparrows after rains in July, when numbers of singing males jumped from 19 April through June to 225 on 6 July. Numbers stayed high for 1-2 weeks, then returned to their previous level (21) by 27 July. Before this surge in Cassin's Sparrow numbers, we observed three pairs and one active nest, which suggests that a moderate number (19-21) of resident breeders may be present normally, and that the influx of at least 200 additional singing males represented non-breeders responding to seasonal rains. We found no evidence that the 200 males nested at HAFB, and they were gone within two weeks of their arrival. This preliminary study demonstrated that the species has nested at HAFB, and that habitats there are suitable for at least small numbers of breeders, as well as large numbers of transient birds, when sufficient rainfall occurs.

Conclusions

HAFB grassland and shrubland habitats are important for many species of conservation concern. The goal of this pilot study was to survey for four bird species of conservation concern to

determine presence and find evidence of nesting. We found evidence of nesting for all four species and observed an irruption of over 200 Cassin's Sparrows, apparently in response to rainfall. This study provides baseline information for future nesting studies of these sensitive species. We recommend that similar surveys be conducted in the future, along with nest monitoring to better understand the importance of HAFB habitats to these four species of conservation concern.

Literature Cited

- Biota Information System of New Mexico. 2015. Database query. Accessed 3 September 2015 at: <http://www.bison-m.org/index.aspx>.
- The Birds of North America Online. 2015. P. Rodewald, Ed. Ithaca: Cornell Laboratory of Ornithology; Retrieved from The Birds of North America Online database: <http://bna.birds.cornell.edu/BNA/>; AUG 2015.
- Borgmann, K., G. Garber, and C. Finley. 2003. Status of burrowing owls (*Athene cunicularia hypugaea*) on Holloman Air Force Base 2000-2002. Hawks aloft, Inc., Albuquerque, NM. 61 pp.
- Brennan, L.A., and W.P. Kuvlesky. 2005. North American grassland birds: an unfolding conservation crisis? *Journal of Wildlife Management* 69:1-13.
- Cody, Martin L. 1999. Crissal Thrasher (*Toxostoma crissale*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/419>.
- Conway, M., C.P. Nadeau, and C.J. Conway. 2012. Intraspecific variation in reproductive traits of burrowing owls. *Journal of Ethology* 30:395-402.
- Cruz-McDonnell, K., and O. Cruz-Carretero. 2015. Annual Report on Population Status, Reproductive Success, Prey Availability, and Site Fidelity of Western Burrowing Owls (*Athene cunicularia hypugaea*) on Kirtland Air Force Base, 2015. Prepared for Kirtland Air Force Base, 377 MSG/CEANQ, 2050 Wyoming Blvd. SE Suite 119, Kirtland AFB, NM 87117.
- DoD Partners in Flight. 2014. DoD PIF Mission-Sensitive Priority Bird Species. Fact Sheet #11, June 2014. [Online version available at http://www.dodpif.org/downloads/factsheet11_priority-species_hi.pdf].
- Dunning, Jr., John B., Richard K. Bowers, Jr., Sherman J. Suter and Carl E. Bock. 1999. Cassin's Sparrow (*Peucaea cassinii*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/471>.

- Envirological Services. 2007a. Decline of the Western Burrowing Owl on Holloman Air Force Base, 2006 report. Report submitted to Holloman Air Force Base Environmental Management Division.
- Envirological Services. 2007b. Raptor surveys on Holloman Air Force Base, 2007 report. Report submitted to Holloman Air Force Base Environmental Management Division.
- Envirological Services. 2009. Raptor survey on Holloman Air Force Base, 2008. Report submitted to Holloman Air Force Base Environmental Management Division.
- ESRI 2011. ArcGIS Desktop: Release 10. Redlands, CA: Environmental Systems Research Institute.
- Griebel, R.L., and J.A. Savidge. 2007. Factors influencing burrowing owl reproductive performance in contiguous shortgrass prairie. *Journal of Raptor Research* 41(3): 212-221.
- Guy, R.K., K.G. Boykin, C. Caldwell, K.E. Young, and A.E. Ernst. 2012. Natural resource geographic changes HAFB Review: Influences of invasive plants and shifting dunes on White Sands pupfish and burrowing owl on Holloman Air Force Base, South central New Mexico. Technical Assistance Report. New Mexico Cooperative Fish and Wildlife Research Unit. Las Cruces, New Mexico, 89 pp.
- Holloman Air Force Base. 2011. Integrated Natural Resource Management Plan. 49 CES/CEA Holloman Air Force Base, New Mexico. February 2011.
- Hubbard, J. P. 1977. The status of Cassin's Sparrow in New Mexico and adjacent states. *American Birds* 31(5): 933-941.
- Johnson, K., L. DeLay, P. Mehlhop, and K. Score. 1997. Distribution, habitat, and reproductive success of Burrowing Owls on Holloman Air Force Base. New Mexico Natural Heritage Program, University of New Mexico Biology Department.
- Johnson, K., M. Baumann, C. Wolf, and J. Smith. 2011. Grassland/shrubland raptor surveys at Holloman Air Force Base 2009-2010. Natural Heritage New Mexico, University of New Mexico Biology Department.
- Johnson, K., J. Smith. 2012. Grassland/shrubland raptor surveys at Holloman Air Force Base 2009-2011. Natural Heritage New Mexico Publication No. 12-GTR-372. Biology Department, University of New Mexico, Albuquerque, NM.
- Knopf, F.L. 1994. Avian assemblages on altered grasslands. *Studies in Avian Biology* 15: 247-257.
- Lutz, R.S., and D.L. Plumpton. 1999. Philopatry and nest site reuse by burrowing owls: implications for productivity. *Journal of Raptor Research* 33(2): 149-153.

- McCready, B., D. Mehlman, D. Kwan, and B. Abel. 2005. The Nature Conservancy's Prairie Wings Project: A Conservation Strategy for the Grassland Birds of the Western Great Plains. USDA Forest Service Gen. Tech. Rep. PSW-GTR-191.
- Murray, G.A. 1976. Geographic variation in the clutch sizes of seven owl species. *The Auk* 93(3): 602-613/.
- NatureServe. 2015. NatureServe Web Service. Arlington, VA. U.S.A. Available <http://services.natureserve.org>. (Accessed: 3 September 2015).
- New Mexico Department of Game and Fish. 2015. State Wildlife Action Plan for New Mexico. New Mexico Department of Game and Fish. Santa Fe, New Mexico. 234 pp + appendices.
- New Mexico Partners in Flight. 2007. New Mexico Bird Conservation Plan, Version 2.1. C. Rustay and S. Norris, compilers. Albuquerque, NM.
- Panjabi, A., E. Youngberg and G. Levandoski. 2010. Wintering Grassland Bird Density in Chihuahuan Desert Grassland Priority Conservation Areas, 2007-2010. Rocky Mountain Bird Observatory, Brighton, CO, RMBO Technical Report I-MXPLAT-08-03. 83 pp.
- Partners in Flight Science Committee 2012. Species Assessment Database, version 2012. Available at <http://rmbo.org/pifassessment>. Accessed on <12 Nov. 2015>.
- Peterjohn, B.G and J.R. Sauer. 1999. Population status of North American grassland birds from the North American Breeding Bird Survey, 1966-1996. *Studies in Avian biology* 19:27-44.
- Poulin, R., L.D. Todd, E.A. Haug, B.A. Millsap and M.S. Martell. 2011. Burrowing Owl (*Athene cunicularia*), *The Birds of North America Online* (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America <http://bna.birds.cornell.edu/bna/species/061>.
- Rich, T.D., C.J. Beardmore, H. Berlanga, P.J. Blancher, M.S.W. Bradstreet, G.S. Butcher, D.W. Demarest, E.H. Dunn, W.C. Hunter, E.E. Iñigo-Elias, J.A. Kennedy, A.M. Martell, A.O. Panjabi, D.N. Pashley, K.V. Rosenberg, C.M. Rustay, J.S. Wendt, T.C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Lab of Ornithology, Ithaca, NY.
- Ricketts, T. H., E. Dinerstein, D. M. Olson, C. J. Loucks, W. Eichbaum, D. DellaSalla, K. Kavanagh, P. Hedao, P. Hurley, K. Carney, R. Abell, and S. Walters. 1999. Terrestrial ecoregions of North America: a conservation assessment (World Wildlife Fund Ecoregions Assessment). Island Press, Washington, D.C.
- Sadoti, G., J. Smith, N. Petersen, and K. Johnson. 2015. Seasonal habitat use by grassland and shrubland birds at Holloman Air Force Base, 2011-2014, draft final report. Natural Heritage New Mexico Publication No. 15-GTR-392, Biology Department, University of New Mexico, Albuquerque, NM.

- Sauer, J. R., J. E. Hines, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski, Jr., and W. A. Link. 2014. The North American Breeding Bird Survey, Results and Analysis 1966 - 2013. Version 01.30.2015 USGS Patuxent Wildlife Research Center, Laurel, MD.
- Schnase, J. L. 1984. The breeding biology of Cassin's Sparrow (*Aimophila cassinii*) in Tom Green County, Texas. Master's thesis. Angelo State University, Angelo, TX.
- Smith, J. and K. Johnson. 2013. Grassland and shrubland bird surveys at Holloman Air Force Base, NM 2009-2013, final report. Natural Heritage New Mexico Publ. No. 13-GTR-378, Albuquerque, NM.
- Smith, J., K. Johnson, N. Petersen. 2015. Grassland/shrubland raptor surveys at Holloman Air Force Base 2009-2014. Natural Heritage New Mexico Publication No. 15-GTR-389. Biology Department, University of New Mexico, Albuquerque, NM.
- U.S. Fish and Wildlife Service. 2002. Birds of conservation concern 2002. Division of Migratory Bird Management, Arlington, Virginia. 99 pp. [Online version available at <<http://migratorybirds.fws.gov/reports/bcc2002.pdf>>].
- U.S. Fish and Wildlife Service. 2008. Birds of Conservation Concern 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia. 85 pp. [Online version available at <<http://www.fws.gov/migratorybirds/>>].
- US Forest Service. 2013. USFS R3 Regional Forester's Sensitive Species: Animals- 2013. Accessed 5/23/2015 at http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_021328.pdf
- Vickery, P.D., P.L. Tubaro, J.M. Cardoso ds Silva, B.G. Peterjohn, J. R. Herkert, R.B. Cavalcanti. 1999. Conservation of grassland birds in the western hemisphere. *Studies in Avian Biology* 19:2-26.
- Wellicome, T.I. 2005. Hatching asynchrony in burrowing owls is influenced by clutch size and hatching success but not by food. *Oecologia* 142(2): 326-334.
- Yosef, R. 1992. Territoriality, nutritional condition, and conservation in Loggerhead Shrikes (*Lanius ludovicianus*). Ph.D. diss. Ohio State Univ. Columbus.
- Yosef, R. 1996. Loggerhead Shrike (*Lanius ludovicianus*), *The Birds of North America Online* (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/231>.