

DRAFT

Rare Species Inventory of Sand Creek

Massacre National Historic Site

Interim Report (Year 1, 2006)



DRAFT

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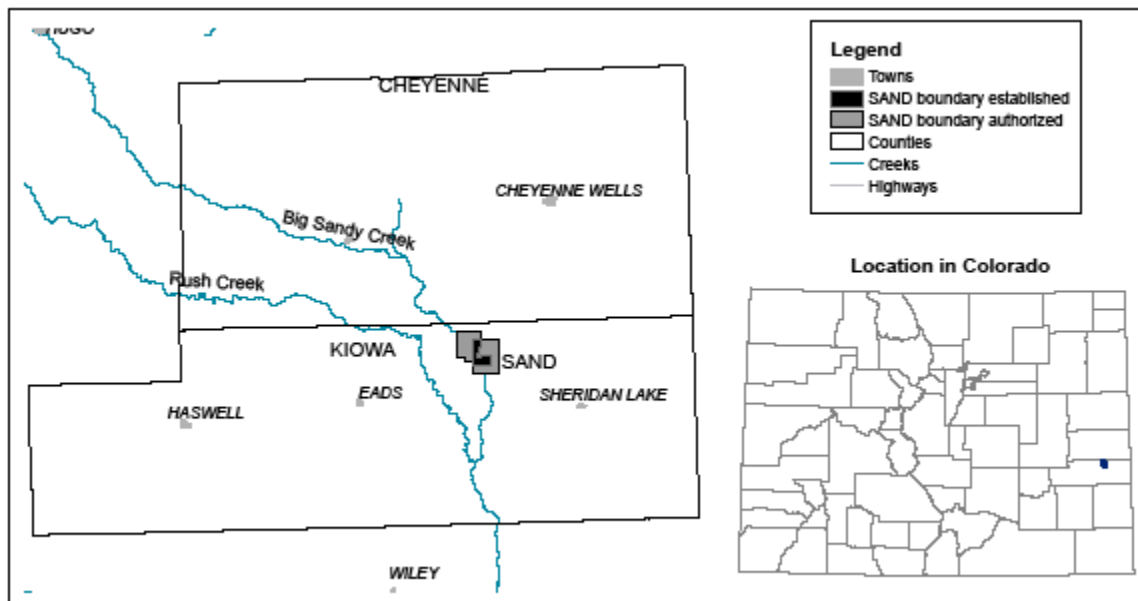
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INTRODUCTION

Sand Creek Massacre National Historic Site (SAND) was authorized by the U. S. Congress in November of 2000 with a commissioned area of 12,500 acres. SAND is on the high plains of southeastern Colorado. It is in north-central Kiowa County near the border with Cheyenne County and is located 14 miles NNE of Eads, Colorado (Figure 1). These counties are on the state line bordering Kansas and SAND is approximately 25 miles from the Kansas state line. SAND is surrounded by dryland agricultural fields and rangeland. The current established boundary of SAND encompasses approximately 2,400 acres, which is managed by the National Park Service (NPS). The objective of the NPS is to preserve, protect, interpret, commemorate and memorialize the site for future generations. This includes preservation of the native biological resources of the site.

Figure 1. The location of Sand Creek Massacre National Historic Site in Colorado.



There is little information on the biological resources at SAND. The primary habitat at the park is short-grass prairie and sandsage shrubland with the intermittent Big Sandy Creek bisecting the park. Short-grass prairie is home to several candidates for federal endangered or threatened species status and several State of Colorado listed species (Table 1). The presence of a prairie dog complex at SAND increases the chances of several State of Colorado listed species and federal candidate species being present.

Table 1. Priority species for consideration in the Sand Creek Rare Species Inventory.

Species	Common Name
<i>Ambrosia linearis</i>	plains ambrosia
<i>Athene cunicularia</i>	burrowing owl
<i>Buteo regalis</i>	ferruginous hawk
<i>Charadrius montanus</i>	mountain plover
<i>Cynomys ludovicianus</i>	black-tailed prairie dog
<i>Etheostoma cragini</i>	Arkansas darter
<i>Phrynosoma cornutum</i>	Texas horned lizard
<i>Tympanuchus pallidicinctus</i>	lesser prairie chicken

Species	Common Name
<i>Vulpes velox</i>	swift fox

This park is part of the Southern Plains Inventory and Monitoring Network (SOPN), but it was a late addition to the network and was not part of the Inventory and Monitoring Program's original 270 target parks. The development of park management plans and monitoring programs requires the knowledge of the presence and condition of T and E species and species of concern. Specifically, several of species with the potential to inhabit SAND are sensitive to grazing practices (including lack of grazing). All grazing has ceased since this park has been acquired by NPS. SAND cannot manage for T and E species and species of concern and develop appropriate general management plans, resource management plans or grassland management practices if the status of these species is unknown.

The NPS and the SOPN are interested in surveying the land within the current established boundary for the occurrence of T and E species and species of concern with the potential, or that are known, to inhabit SAND. The NPS and the SOPN contracted with Colorado State University and the Colorado Natural Heritage Program (CNHP) to perform a rapid assessment biological inventory of the biological resources at SAND. The objectives of this project are listed below in order of importance.

1. Determine relative abundance and presence of the swift fox.
2. Determine relative abundance and condition of the Arkansas darter population.
3. Determine extent and density estimates in black-tailed prairie dog colony according to Plumb et al. (2001).
4. Conduct species specific survey to detect presence of lesser-prairie chicken.
5. Conduct species specific survey to detect presence of *Ambrosia linearis*.
6. Determine density and condition of mountain plover, ferruginous hawk, and burrowing owl populations.
7. Determine relative abundance and presence of Texas horned lizard.
8. When taxonomic experts are present during surveys for above species, record incidental observations of vertebrate and vascular plant species that have not previously been documented at SAND.

This interim report identifies the location, quality, and abundance/density of nine federal candidate species or State listed and/or endemic species of conservation priority at SAND (Table 1).

Preserving Biological Resources and the Natural Heritage Network

To place into perspective the need for preserving biological resources, and how to prioritize what is most in need of preservation, it is useful to understand what is meant by rarity and how the Colorado Natural Heritage Program (CNHP) defines the rarity of a biological resource.

Just as ancient artifacts and historic buildings represent our cultural heritage, a diversity of plant and animal species and their habitats represent our "natural heritage". Colorado's natural heritage encompasses a wide variety of ecosystems from tallgrass prairie and

shortgrass high plains to alpine cirques and rugged peaks, from canyon lands and sagebrush deserts to dense subalpine spruce-fir forests and wide-open tundra.

These widely diversified habitats are determined by water availability, temperature extremes, altitude, geologic history, and land use history. The species that inhabit each of these ecosystems have adapted to the specific set of conditions found there. Because human influence today touches every part of the Colorado environment, we are responsible for understanding our impacts and carefully planning our actions to ensure our natural heritage persists for future generations.

Some generalist species, like house finches, have flourished over the last century, having adapted to habitats altered by humans. However, many other species are specialized to survive in vulnerable Colorado habitats; among them are Bell's twinpod (a wildflower), the greenback cutthroat trout, and the Pawnee montane skipper (a butterfly). These species have special requirements for survival that may be threatened by incompatible land management practices and competition from non-native species. Many of these species have become imperiled not only in Colorado, but also throughout their range of distribution. Some species exist in less than five populations in the entire world. The decline of these specialized species often indicates disruptions that could permanently alter entire ecosystems. Thus, recognition and protection of rare and imperiled species is crucial to preserving Colorado's diverse natural heritage.

Recognizing that rare and imperiled species are more likely to become extinct than common species, the Natural Heritage Methodology ranks species according to their rarity or degree of imperilment. The ranking system is scientifically based upon the number of known locations of the species as well as its biology and known threats. By ranking the relative rarity or imperilment of a species, the quality of its populations, and the importance of associated conservation sites, the methodology can facilitate the prioritization of conservation efforts so the most rare and imperiled species may be preserved first. As the scientific community realized that plant communities are equally important as individual species, this methodology has been applied to ranking and preserving rare plant communities, as well as the best examples of common communities.

The Natural Heritage Methodology is used by Natural Heritage Programs throughout North, Central, and South America, forming an international database network. NatureServe, the umbrella organization of this international network, and its member programs are a leading source for information about rare and endangered species and threatened ecosystems. The 85 Natural Heritage Network data centers are located in each of the 50 U.S. states, 11 Canadian provinces and territories, and many countries and territories in Latin America and the Caribbean. This network enables scientists to monitor the status of species from a state, national, and global perspective. Information collected by the Natural Heritage Programs can provide a means to protect species before the need for legal endangerment status arises. It can also enable conservationists and natural resource managers to make informed, objective decisions in prioritizing and focusing conservation efforts.

The Natural Heritage Ranking System

Key to the functioning of Natural Heritage Programs is the concept of setting priorities for gathering information and conducting inventories. The number of possible facts and observations that can be gathered about the natural world is essentially limitless. The financial and human resources available to gather such information are not. Because biological inventories tend to be under-funded, there is a premium on devising systems that are both effective in providing information that meets users' needs and efficient in gathering that information. The cornerstone of Natural Heritage inventories is the use of a ranking system to achieve these twin objectives of effectiveness and efficiency.

Ranking species and ecological communities according to their imperilment status provides guidance for where Natural Heritage Programs should focus their information-gathering activities. For species deemed secure, only general information needs to be maintained by Natural Heritage Programs. Fortunately, the more common and secure species constitute the majority of most groups of organisms. On the other hand, for those species that are by their nature rare, more detailed information is needed. Because of these species' rarity, gathering comprehensive and detailed population data can be less daunting than gathering similarly comprehensive information on more abundant species.

To determine the status of species within Colorado, CNHP gathers information on plants, animals, and plant communities. Each of these biological entities are collectively referred to as "elements" of natural diversity and are assigned ranks that indicate their relative degree of imperilment on a five-point scale (for example, 1 = extremely rare/imperiled, 5 = abundant/secure). The primary criterion for ranking elements is the number of occurrences (in other words, the number of known distinct localities or populations). This factor is weighted more heavily than other factors because an element found in one place is more imperiled than something found in twenty-one places. Also of importance are the size of the geographic range, the number of individuals, the trends in both population and distribution, identifiable threats, and the number of protected occurrences.

Element imperilment ranks are assigned both in terms of the element's degree of imperilment within Colorado (its State-rank or S-rank) and the element's imperilment over its entire range (its Global-rank or G-rank). Taken together, these two ranks indicate the degree of imperilment of an element. For example, the lynx, which is thought to be secure in northern North America but is known from less than five current locations in Colorado, is ranked G5 S1 (globally-secure, but critically imperiled in this state). The Rocky Mountain Columbine, which is known only in Colorado from about 30 locations, is ranked a G3 S3 (vulnerable both in the state and globally, since it only occurs in Colorado and then in small numbers). Further, a tiger beetle that is only known from one location in the world at the Great Sand Dunes National Monument is ranked G1 S1 (critically imperiled both in the state and globally, because it exists in a single location). CNHP actively collects, maps, and electronically processes specific occurrence information for animal and plant species considered extremely imperiled to vulnerable in the state (S1 - S3). Several factors, such as rarity, evolutionary distinctiveness, and endemism (specificity of habitat requirements), contribute to the conservation priority of each species. Certain species are "watchlisted," meaning that specific occurrence data are collected and periodically analyzed to determine

whether more active tracking is warranted. A complete description of each of the Natural Heritage ranks is provided in Table 2.

Table 2. Definition of Natural Heritage imperilment ranks.

G/S1	Critically imperiled globally/state because of rarity (5 or fewer occurrences in the world/state; or 1,000 or fewer individuals), or because some factor of its biology makes it especially vulnerable to extinction.
G/S2	Imperiled globally/state because of rarity (6 to 20 occurrences, or 1,000 to 3,000 individuals), or because other factors demonstrably make it very vulnerable to extinction throughout its range.
G/S3	Vulnerable through its range or found locally in a restricted range (21 to 100 occurrences, or 3,000 to 10,000 individuals).
G/S4	Apparently secure globally/state, though it may be quite rare in parts of its range, especially at the periphery. Usually more than 100 occurrences and 10,000 individuals.
G/S5	Demonstrably secure globally/state, though it may be quite rare in parts of its range, especially at the periphery.
G/SX	Presumed extinct globally, or extirpated within the state.
G#?	Indicates uncertainty about an assigned global rank.
G/SU	Unable to assign rank due to lack of available information.
GQ	Indicates uncertainty about taxonomic status.
G/SH	Historically known, but usually not verified for an extended period of time.
G#T#	Trinomial rank (T) is used for subspecies or varieties. These taxa are ranked on the same criteria as G1-G5.
S#B	Refers to the breeding season imperilment of elements that are not residents.
SNR	Not yet ranked.
SNA	Not Applicable. A conservation status rank is not applicable because the species is not a suitable target for conservation activities.
SR	Reported to occur in the state but unverified.
S?	Unranked. Some evidence that species may be imperiled, but awaiting formal rarity ranking.

Note: Where two numbers appear in a state or global rank (for example, S2S3), the actual rank of the element is uncertain, but falls within the stated range.

This single rank system works readily for all species except those that are migratory. Those animals that migrate may spend only a portion of their life cycles within the state. In these cases, it is necessary to distinguish between breeding, non-breeding, and resident species. As noted in Table 2, ranks followed by a "B," for example S1B, indicate that the rank applies only to the status of breeding occurrences. Similarly, ranks followed by an "N," for example S4N, refer to non-breeding status, typically during migration and winter. Elements without this notation are believed to be year-round residents within the state.

Partners in Flight (PIF) and the U. S. Shorebird Conservation Plan and Council (SCPC) have both identified bird species that are of conservation concern in North America. Both PIF and the SCPC are cooperative efforts that involve partnerships among federal, state and local government agencies, non-governmental organizations, and many others, with the goal of conserving North American birds. These two organizations use a formal species assessment process that provides consistent, scientific evaluations of conservation status across all bird species in North America, and identifies areas important to conservation for each species. This process uses biological data on population size, distribution, population trend, threats, and regional abundance to generate simple numerical scores that rank the biological vulnerability and regional status of each species. The process results in global and regional conservation assessments of each bird species that can be used to objectively assign regional and continental conservation priorities among birds. A complete description of each of the PIF and SCPC ranks is provided in Table 3.

Table 3. Definition of Partners In Flight and U. S. Shorebird Conservation Plan and Council Ranks.

<i>Partners In Flight</i>	
Watch List Species	Species that have multiple reasons for conservation concern across their entire ranges
Stewardship Species	Species that have a high proportion of their global population or range within a particular regional planning area and for which threats are considered high or moderate.
<i>U. S. Shorebird Conservation Plan and Council</i>	
1. Species Not at Risk	All other species where there is apparently no current risk of population decline.
2. Species of Low Concern	Populations of these species are either: a) stable with moderate threats and distributions; b) increasing but with known or potential threats and moderate to restricted distributions; or c) of moderate size.
3. Species of Moderate Concern	Populations of these species are either: a) declining with moderate threats or distributions; b) stable with known or potential threats and moderate to restricted distributions; c) relatively small; d) relatively restricted; or e) declining but with no other known threats.
4. Species of High Concern	Populations of these species are known or thought to be declining, and have some other known or potential threat as well.
5. Highly Imperiled	All species listed as threatened or endangered nationally, plus all species with significant population declines and either low populations or some other high risk factor.

Legal Designations for Rare Species

Natural Heritage, PIF, and SCPC imperilment and vulnerability ranks should not be interpreted as legal designations. Although most species protected under state or federal endangered species laws are extremely rare, not all rare species receive legal protection. Legal status is designated by either the U.S. Fish and Wildlife Service under the Endangered Species Act or by the Colorado Division of Wildlife under Colorado Statutes 33-2-105 Article 2. In addition, the U.S. Forest Service recognizes some species as “Sensitive,” as does the Bureau of Land Management. Table 4 defines the special status assigned by these agencies and provides a key to abbreviations used by CNHP.

Table 4. Federal and State agency special designations for rare species.

Federal Status:	
1. U.S. Fish and Wildlife Service (58 Federal Register 51147, 1993) and (61 Federal Register 7598, 1996)	
LE	Listed Endangered: defined as a species, subspecies, or variety in danger of extinction throughout all or a significant portion of its range.
LT	Listed Threatened: defined as a species, subspecies, or variety likely to become endangered in the foreseeable future throughout all or a significant portion of its range.
P	Proposed: taxa formally proposed for listing as Endangered or Threatened (a proposal has been published in the Federal Register, but not a final rule).
C	Candidate: taxa for which substantial biological information exists on file to support proposals to list them as endangered or threatened, but no proposal has been published yet in the Federal Register.
PDL	Proposed for delisting.
XN	Nonessential experimental population.
2. U.S. Forest Service (Forest Service Manual 2670.5) (noted by the Forest Service as “S”)	
FS	Sensitive: those plant and animal species identified by the Regional Forester for which population viability is a concern as evidenced by: - Significant current or predicted downward trends in population numbers or density. - Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.
3. Bureau of Land Management (BLM Manual 6840.06D) (noted by BLM as “S”)	
BLM	Sensitive: those species found on public lands designated by a State Director that could easily become endangered or extinct in a state. The protection provided for sensitive species is the same as that provided for C (candidate) species.
4. State Status:	
The Colorado Division of Wildlife has developed categories of imperilment for non-game species (refer to the Colorado Division of Wildlife's Chapter 10 – Nongame Wildlife of the Wildlife Commission's regulations). The categories being used and the associated CNHP codes are provided below.	
E	Endangered: those species or subspecies of native wildlife whose prospects for survival or recruitment within this state are in jeopardy, as determined by the Commission.
T	Threatened: those species or subspecies of native wildlife which, as determined by the Commission, are not in immediate jeopardy of extinction but are vulnerable because they exist in such small numbers, are so extremely restricted in their range, or are experiencing such low recruitment or survival that they may become extinct.
SC	Special Concern: those species or subspecies of native wildlife that have been removed from the state threatened or endangered list within the last five years; are proposed for federal listing (or are a federal listing “candidate species”) and are not already state listed; have experienced, based on the best available data, a downward trend in numbers or distribution lasting at least five years that may lead to an endangered or threatened status; or are otherwise determined to be vulnerable in Colorado.

METHODS

Sampling protocols were designed to maximize the potential of observing each of the nine targeted species, and were necessarily different for each of those nine species; although, there was some overlap between the sampling methods. Four survey trips were made to SAND between May and September, 2006 (Table 5), representing 35 people days. Each trip included a two-person crew except for the trip completed at the end of July. An account of the methods used to survey for each of the nine target species is given below.

Table 5. Sampling dates at SAND and focal species sampled at each sample date during the 2006 field season.

Dates	Focus of the Survey Effort								
	Plains ambrosia	Burrowing owl	Ferruginous hawk	Mountain plover	Black-tailed prairie dog	Arkansas darter	Texas horned lizard	Lesser prairie chicken	Swift fox
5/3 – 5/7		X	X	X		X		X	X
6/14 – 6/18		X	X	X	X	X	X	X	X
7/24 – 7/28 ¹		X	X				X		X
9/6 – 9/10	X								

¹ A single person completed the July trip.

Plains Ambrosia (*Ambrosia linearis*)

Given the relatively small area of SAND, targeted searches were completed within the entire suitable habitat, which typically includes open, sandy, sparsely vegetated areas. Given the survey dates and the phenology of plains ambrosia, searches were for plants in fruit.

Burrowing Owl (*Athene cunicularia*)

Burrowing owls can be found in annual and perennial grasslands, deserts, and scrublands characterized by low-growing vegetation (Zarn 1974). Burrowing owls typically use burrows made by fossorial mammals, such as ground squirrels or badgers, but in eastern Colorado burrowing owls are most closely associated with prairie dog towns and the burrows created by this fossorial mammal.

Occupancy of suitable burrowing owl habitat can be verified at a site by an observation of at least one burrowing owl, or, alternatively, its molted feathers, cast pellets, prey remains, eggshell fragments, or excrement at or near a burrow entrance. Burrowing owls exhibit high site fidelity, reusing burrows year after year (Rich 1984, Feeney 1992).

Each black-tailed prairie dog town present within the boundary of SAND was walked twice, once during early May when owls should have established nest burrows and may have initiated egg incubation, and once during mid-June when young-of-the year should begin to be visible above ground. The June survey was necessary for mapping burrow concentration areas and for completing a census during breeding season. Pedestrian survey transects were spaced to allow 100 percent visual coverage of the ground surface within each prairie dog colony. The distance between transects was no more than 50 meters.

In addition, all burrowing owl observed during completion of other field work, including the census of each black-tailed prairie dog town, were documented.

Ferruginous Hawk (*Buteo regalis*)

Ferruginous hawks inhabit grassland and semi-desert shrubland, and are rare in pinyon-juniper woodlands (Andrew and Righter 1994). Habitat records for ferruginous hawks in Colorado indicate that the vast majority of records occur in shortgrass prairie and lowland cottonwood riparian forests (Kingery 1998). Ferruginous hawks are a common winter resident of Colorado's eastern plains, but are uncommon in other habitats and during other seasons (Andrews and Righter 1994).

Occupancy of suitable ferruginous hawk habitat can be verified through the quadrat technique (Taylor 2003). In this technique the landscape is divided into equally sized areas (e.g. 4 x 4 miles) and a randomly selected sub-sample of these quadrates are intensely surveyed. This technique is usually reserved for large landscapes, while SAND represented a smaller study area. Point counts along road transects can produce accurate estimates of abundance for grassland bird species (Saunders 2001), but drawbacks to this method include visibility concerns, which can lead to road bias (since roads do not exist everywhere within a study site). At SAND roads exist on nearly every portion of the installation suitable for ferruginous hawks, only the area behind and west of the irrigation canal is outside of binocular or spotting scope range. As a result, ferruginous hawk were surveyed at SAND using the road transect technique supplemented by intensely hiking those areas or quadrates that represented blind spots unobservable from roads. Roads within SAND were traveled daily during three, five-day sampling periods identified in Table 2.

Mountain plover (*Charadrius montanus*)

Mountain plover surveys were conducted between local sunrise and 10:00 am (a period of horizontal light, which facilitates spotting the white breast of the adult plovers). Suitable habitat (areas of low grasses and black-tailed prairie dog towns) within the project area was driven to minimize early flushing. Flushing distances for mountain plovers may be within 3 meters for vehicles, but plovers often flush at 50 to 100 meters when approached by humans on foot (U. S. Fish and Wildlife Service 2002). Binoculars and spotting scopes were used to confirm sightings. Surveys were not conducted in poor weather (e.g., high wind, precipitation, etc.). Surveys for mountain plovers were conducted during the breeding period, April through July, when the highest numbers of plovers are likely to be tending nests and territories, and therefore are most likely to be detected. Surveys for plovers were conducted in early May and mid-June (Table 2) and all mountain plover observed during this surveying were recorded from a stationary vehicle (plovers did not appear to be wary of vehicles).

Black-tailed prairie dog (*Cynomys ludovicianus*)

The black-tailed prairie dog monitoring protocol developed for seven national parks was used to determine the abundance of prairie dogs at SAND.

The census was conducted from June 14th to June 18th, 2006 (Table 2). In summary, the field methodology followed the sampling approach of Plumb et al. (2001). This method required setting up a 200 m x 200 m (4-ha) plot in each prairie dog colony and conducting visual counts of prairie dogs. Plots were established 24 hours prior to conducting counts in order

for prairie dogs to return to normal behavior following the intrusion of people walking through the colony.

Arkansas darter (*Etheostoma cragini*)

Seines have been effectively used to sample fish in small, relatively simple streams. Hand-held seines and dip nets were used to sample fish at SAND (Photo 1). All sampling was performed by a 2-person crew, with the primary investigator present to assist with species identification and to ensure uniform application of the seining technique. Collections were made from ponds, pools and backwaters along Big Sandy Creek and its tributaries on SAND. Fishes were identified, enumerated, photo vouchered, and released. Sampling was performed in May and June (Table 3).



Photo 1. A research scientist dipnets for small fishes at a wetland within SAND.

Texas horned lizard (*Phrynosoma cornutum*)

Texas horned lizards were surveyed using visual encounter surveys along transects in suitable habitat. Searches for Texas horned lizards and their sign (i.e., remains of Texas horned lizards, their scat, and track patterns) were conducted between 0800 to 1700 hours during the June and July trips (Table 2).

The field methodology followed was similar to the approach of Henke and Fair (1998). Suitable habitat, which includes broken shortgrass prairie with ample bareground as results from occupation by prairie dogs or through grazing by livestock (Hammerson 1999), was searched during periods when lizards would have been active. Little of this habitat type occurs at SAND except for on the two prairie dog towns. Two censuses were conducted during the summer field season (Table 2). Transects were slowly walked and intense visual surveys for Texas horned lizards (and burrowing owl) were conducted.

Lesser prairie chicken (*Tympanuchus pallidicinctus*)

Auditory and visual surveys were conducted to detect leks of lesser prairie chickens. Surveys were completed in suitable weather (no rain, sustained winds <10 m.p.h.) between 0530 and 0900 hours. Routes were driven on existing roads, or walked in suitable habitat (sparsely vegetated areas in sandsage shrubland). Five minute listening stops at 0.5-mile intervals were conducted along the routes. Sampling took place during May and June, 2006 (Table 2).

Swift fox (*Vulpes velox*)

Suitable habitat (shortgrass prairie usually devoid of shrubs) at SAND was systematically searched for active and inactive dens on foot at an effort of 1–2 hours/3 square km. Swift fox dens were differentiated from those of other prairie burrowers by the presence of tracks or the size and keyhole shape of openings. The UTM coordinates of each den, whether it was a swift fox den or the den of another carnivore species, were recorded. This work was conducted in May, June and July (Table 2) when pups would be present above ground making dens more obvious to a surveyor. In addition to the systematic daytime searches, spot-lighting for carnivore species was conducted for two nights during the June trip and for three nights in July.

RESULTS

A total of 35 person days were spent at SAND spread across the months of May, June, July, and September.

The threatened, endangered and species of conservation concern recorded from SAND are listed in Table 6. Black-tailed prairie dog (Photo 2) colonies occupied 16.6 hectares of the northwest corner of SAND and 75.7 hectares of the site's southeast corner (Figure 1). Densities of those portions of each colony within the boundary of SAND were estimated as 33 prairie dogs/hectare and 49 prairie dogs/hectare, respectively. In addition, burrowing owls (*Athene cunicularia*) (Photo 3) were observed on the southern colony and mountain plover (*Charadrius montanus*) were observed just offsite on the north prairie dog colony on private land (Figure 1). Numerous carnivore dens as well as additional species of conservation concern were recorded from SAND during the survey including the following: bleached skimmer (*Libellula composite*) (Photo 4), northern harrier (*Circus cyaneus*), northern leopard frog (*Rana pipiens*) (Photo 5), loggerhead shrike (*Lanius ludovicianus*), red-headed woodpecker (*Melanerpes erythrocephalus*), scaled quail (*Callipepla squamata*), Swainson's hawk (*Buteo swainsoni*), and white-faced ibis (*Plegadis chilis*) (Table 6) (Figure 1).

In addition, numerous other animals were observed during field survey work (Table 7).



Photo 2. Black-tailed prairie dog.



Photo 3. Burrowing owl.



Photo 4. Bleached skimmer.



Photo 5. Northern leopard frog.

Table 6. Endangered, threatened, and species of conservation concern recorded from SAND.

Species	Common Name	Abundance/ Density ¹	Heritage Status	Federal and State Status ²	PIF and SCP Status ³
Endangered, Threatened, and Species of Conservation Concern					
<i>Athene cunicularia</i>	burrowing owl	18	G4S4B	FS, ST	
<i>Charadrius montanus</i>	mountain plover	4	G2S2B	FS, BLM, SC	SCP highly imperiled
<i>Cynomys ludovicianus</i>	black-tailed prairie dog north colony south colony	33/ha 49/ha	G4S3	FS, SC	
Other Species of Conservation Concern					
<i>Buteo swainsoni</i>	Swainson's hawk	8	G5S5B		PIF watch list species
<i>Callipepla squamata</i>	scaled quail	2	G5S4		PIF watch list species
<i>Circus cyaneus</i>	northern harrier	2	G5S3B	FS	
<i>Lanius ludovicianus</i>	loggerhead shrike	2	G5S5	FS	PIF stewardship species
<i>Libellula composita</i>	bleached skimmer (a dragonfly)	4	G3S1		
<i>Melanerpes erythrocephalus</i>	red-headed woodpecker	1	G5S3B		PIF watch list species
<i>Plegadis chilis</i>	white-faced ibis	1	G5S2B	BLM	
<i>Rana pipiens</i>	northern leopard frog	10	G5S3	FS, BLM, SC	

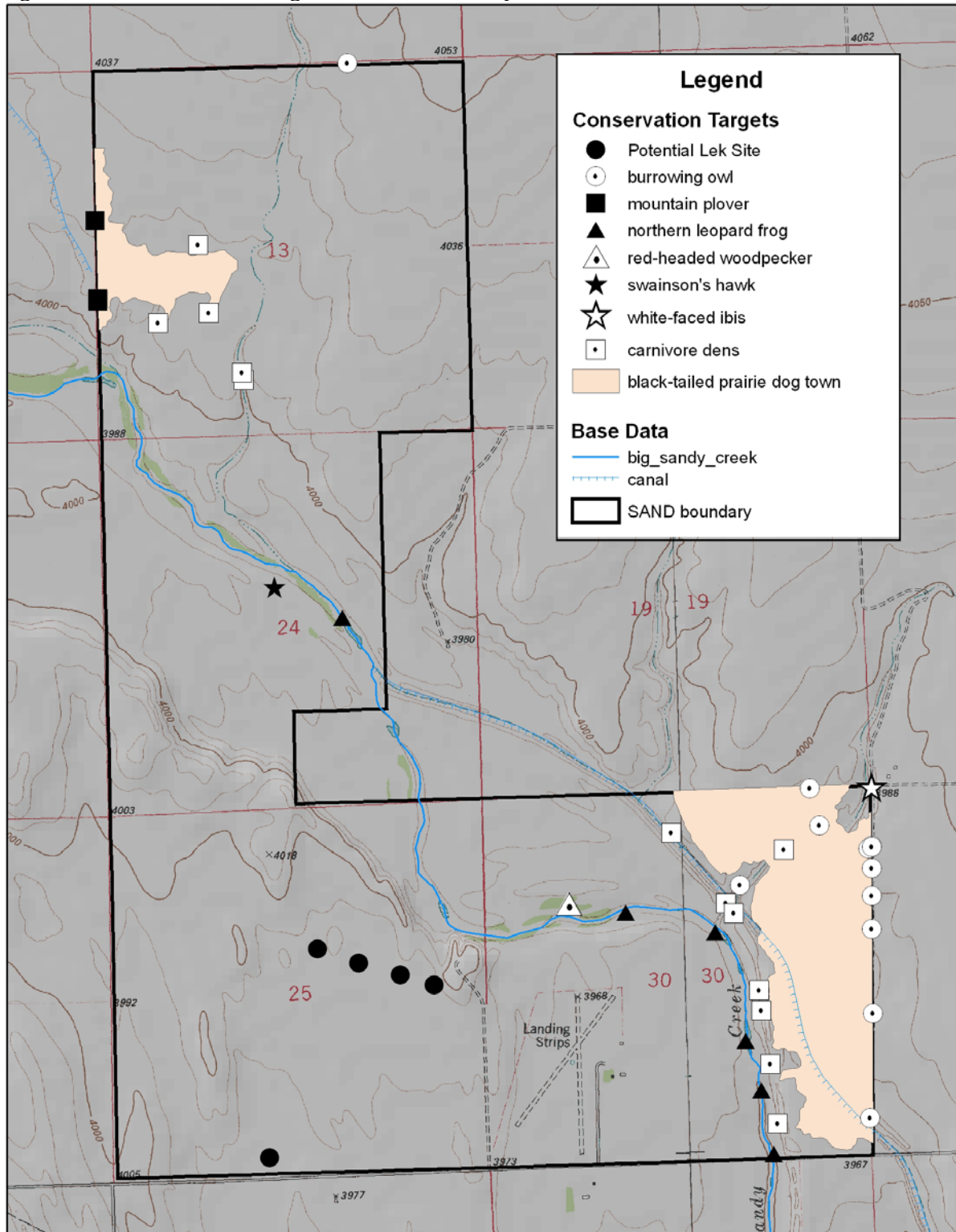
¹ Abundance: total number of animals observed without accounting for double counting; density was calculated only for the black-tailed prairie dogs.

² FS = Forest Service sensitive species, BLM = Bureau of Land Management sensitive species, ST = State of Colorado threatened, SC = State of Colorado special concern.

³ PIF: the Partners in Flight Landbird Conservation Plan lists species of landbirds of continental importance that deserve special attention; watch listed species are most in need of conservation action and stewardship species are birds with restricted distributions that merit special attentions for conservation action within their core ranges.

³ SCP: the Shorebird Conservation Plan lists U. S. and Canadian shorebird populations that most urgently need conservation action; highly imperiled shorebirds are all species listed as threatened or endangered nationally, plus all species with significant population declines and either low populations or some other high risk factor.

Figure 2. Distribution of endangered, threatened and species of concern at SAND.



Species that were not recorded, but which were surveyed for extensively were the Arkansas darter (*Etheostoma cragini*), ferruginous hawk (*Buteo regalis*), lesser prairie chicken (*Tympanuchus pallidicinctus*), swift fox (*Vulpes velox*), and Texas horned lizard (*Phrynosoma cornutum*). Areas that appear suitable for lesser prairie chicken leking sites do exist on SAND (Figure 1).

Table 7. Common animal species observed at the Sand Creek National Historic Site during summer 2006.

Scientific Name	Common Name	Global Rank ¹	State Rank ¹	Federal and State Status ¹
AMPHIBIANS				
<i>Ambystoma tigrinum</i>	tiger salamander	G5	S5	
<i>Bufo woodhousii</i>	Woodhouse's toad	G5	S5	
<i>Rana pipiens</i>	northern leopard frog	G5	S3	BLM, FS, SC
BIRDS				
<i>Agelaius phoeniceus</i>	red-winged blackbird	G5	S5	
<i>Anas discors</i>	blue-winged teal	G5	S5	
<i>Anas platyrhynchos</i>	mallard	G5	S5	
<i>Ardea herodias</i>	great blue heron	G5	S3B	
<i>Athene cunicularia</i>	burrowing owl	G4	S4B	FS, ST
<i>Bubo virginianus</i>	great horned owl	G5	S5	
<i>Buteo jamaicensis</i>	red-tailed hawk	G5	S5B	
<i>Buteo regalis</i>	ferruginous hawk	G4	S3B S4N	BLM, FS, SC
<i>Buteo swainsoni</i>	Swainson's hawk	G5	S5B	
<i>Calamospiza melanocorys</i>	lark bunting	G5	S4	
<i>Callipepla squamata</i>	scaled quail	G5	S4	
<i>Cathartes aura</i>	turkey vulture	G5	S4B	
<i>Catharus ustulatus</i>	Swainson's thrush	G5	S5B	
<i>Charadrius montanus</i>	mountain plover	G2	S2B	FS, BLM, SC
<i>Charadrius vociferus</i>	killdeer	G5	S5	
<i>Chondestes grammacus</i>	lark sparrow	G5	S4	
<i>Chordeiles minor</i>	common nighthawk	G5	S5	
<i>Circus cyaneus</i>	northern harrier	G5	G3	
<i>Colaptes auratus</i>	northern flicker	G5	S5	
<i>Columba livia</i>	rock dove	G5	SNA	
<i>Cyanocitta cristata</i>	blue jay	G5	S5	
<i>Dendroica coronata</i>	yellow-rumped warbler	G5	S5	
<i>Dendroica petechia</i>	yellow warbler	G5	S5	
<i>Eremophila alpestris</i>	horned lark	G5	S5B	
<i>Euphagus cyanocephalus</i>	Brewer's blackbird	G5	S5B	
<i>Falco sparverius</i>	American kestrel	G5	S5B	
<i>Hirundo rustica</i>	barn swallow	G5	S5	
<i>Icterus bullockii</i>	Bullock's oriole	G5	S5	
<i>Icterus spurius</i>	orchard oriole	G5	S4B	
<i>Melanerpes erythrocephalus</i>	red-headed woodpecker	G5	S3B	
<i>Mimus polyglottos</i>	Northern mockingbird	G5	S5	
<i>Molothrus ater</i>	brown-headed cowbird	G5	S5	
<i>Phasianus colchicus</i>	ring-necked pheasant	G5	SNA	
<i>Picoides pubescens</i>	downy woodpecker	G5	S5	
<i>Pipilo maculatus</i>	spotted towhee	G5	S5	
<i>Plegadis chilis</i>	white-faced ibis	G5	S2B	
<i>Poocetes gramineus</i>	vesper sparrow	G5	S5	
<i>Sayornis saya</i>	Say's phoebe	G5	S5B	
<i>Sialia sialis</i>	eastern bluebird	G5	S2B	

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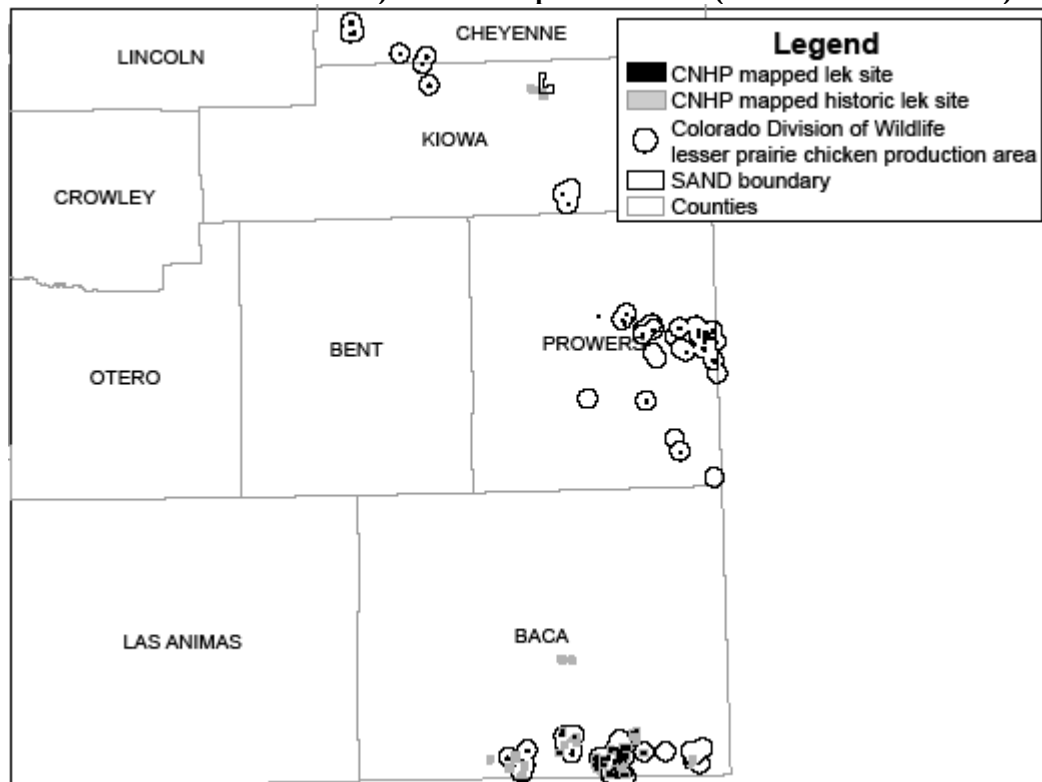
Scientific Name	Common Name	Global Rank ¹	State Rank ¹	Federal and State Status ¹
<i>Spizella passerina</i>	chipping sparrow	G5	S4B, S5N	
<i>Sturnella neglecta</i>	western meadowlark	G5	S5	
<i>Sturnus vulgaris</i>	European starling	G5	SNA	
<i>Toxostoma rufum</i>	brown thrasher	G5	S4	
<i>Troglodytes aedon</i>	house wren	G5	S5	
<i>Turdus migratorius</i>	American robin	G5	S5	
<i>Tyrannus tyrannus</i>	eastern kingbird	G5	S5B	
<i>Tyrannus verticalis</i>	western kingbird	G5	S5B	
<i>Zenaida macroura</i>	mourning dove	G5	S5	
<i>Zonotrichia leucophrys</i>	white-crowned sparrow	G5	S5	
<i>Xanthocephalus xanthocephalus</i>	yellow-headed blackbird	G5	S5	
FISH				
<i>Fundulus zebrinus</i>	plains killifish	G5	SNA	
INSECTS				
BUTTERFLIES				
<i>Celastrina neglecta</i>	summer azure	G5	SNR	
<i>Danaus plexippus</i>	monarch	G5	S5	
<i>Nymphalis antiopa</i>	mourning cloak	G5	S5	
DRAGONFLIES AND DAMSELFLIES				
<i>Enallagma civile</i>	familiar bluet	G5	S5	
<i>Erythemis simplicicollis</i>	eastern pondhawk	G5	S4	
<i>Libellula pulchella</i>	twelve-spotted skimmer	G5	S5	
<i>Libellula luctuosa</i>	widow skimmer	G5	S5	
<i>Libellula lydia</i>	common whitetail	G5	S5	
<i>Pachydiplax longipennis</i>	blue dasher	G5	S3S4	
MAMMALS				
<i>Canis latrans</i>	coyote	G5	S5	
<i>Dipodomys ordii</i>	Ord's kangaroo rat	G5	S5	
	North American			
<i>Erethizon dorsatum</i>	porcupine	G5	S5	
<i>Lepus californicus</i>	black-tailed jackrabbit	G5	S5	
<i>Mephitis mephitis</i>	striped skunk	G5	S5	
<i>Odocoileus hemionus</i>	mule deer	G5	S4	
<i>Odocoileus virginianus</i>	white-tailed deer	G5	S5	
<i>Procyon lotor</i>	raccoon	G5	S5	
<i>Sylvilagus audubonii</i>	desert cottontail	G5	S4	
<i>Taxidea taxus</i>	American badger	G5	S4	
MOLLUSKS				
<i>Physa</i> sp.	Physid snail	NA	NA	
REPTILES				
<i>Aspidoscelis sexlineata</i>	six-lined racerunner	G5	S5	
<i>Crotalus viridis</i>	plains rattlesnake	G5	S5	
<i>Holbrookia maculata</i>	lesser earless lizard	G5	S5	
<i>Pituophis catenifer</i>	bullsnake/gopher snake	G5	S5	
<i>Terrapene ornata</i>	ornate box turtle	G5	S5	

¹ See Table 1 for explanations of global and state imperilment ranks and Table 2 for legal designations.

TRANSLOCATION OF LESSER PRAIRIE CHICKEN

Lesser prairie chickens historically occupied the area surrounding SAND and historic lek sites existed on lands adjacent to SAND, to both the west and south of the current Park site. In recent times it appears that none of these lek sites have been active and populations of lesser prairie chicken may be extirpated from SAND and the immediate area surrounding the Park (Figure 3) (Colorado Natural Heritage Program 2006, Colorado Division of Wildlife 2006).

Figure 3. Lek sites, historic lek sites, and production areas (nesting and brood rearing habitat defined as 2.4 km buffer zone around each lek site) of the lesser prairie chicken (after CNHP and CDOW).



Prairie grouse (*Tympanuchus* spp.) populations experienced wide ranging declines in abundance throughout North America in the twentieth century and the conversion of native plant communities to agriculture lands and to pastures for livestock grazing are thought to be an important factor contributing to this decline (Snyder et al. 1999). Attempts to translocate prairie grouse populations into formerly occupied areas have meet with varied success. None of the attempts to translocate lesser prairie chickens in Colorado have been successful, as determined from lek surveys (Giesen 2000). Little information is available on why translocations of prairie grouse succeed or fail, but there is evidence that translocation projects that are of long duration (≥ 6 years), utilize spring releases, release a large total number of grouse (≥ 100 birds), and release grouse using remotely triggered boxes have a greater chance of success (Snyder et al. 1999).

Confounding the issue for lesser prairie chicken translocation is that they are not migratory and require a complex of habitats within a relatively limited area to meet their needs across seasons (Finch 2005). One predictor of successful translocation for prairie grouse is the amount of high quality habitat within the release area (Toepfer 1990). Areas of potential habitat may fail to meet species needs if one critical element is missing; conversely, superior habitat may fail to conserve the species if the area is too small to host viable breeding populations and too isolated for dispersal to occur. Invariably, the translocation of birds into areas of too small size, that are overly fragmented, or that will not meet all lesser prairie chicken seasonal needs will fail. Understanding the habitat requirements of lesser prairie chicken and the development of a landscape-level habitat model (Table 8) combined with GIS digitally mapped layers of vegetation type and landuse (Niemuth 2003) would assist in assessing habitat suitability for the potential translocation of lesser prairie chicken at SAND.

The habitat requirements for lesser prairie chicken are diverse and a fairly large area is needed to support a populations' needs. The combined home ranges of all birds at a lek may exceed 12,000 acres, or 19 square miles, and it is estimated that 25,000 acres of contiguous high-quality native rangeland may be the minimum land area required to maintain a healthy and sustainable lesser prairie chicken population (Bidwell et al. 2001); others state that most birds will spend their entire life within a 5 km radius of the lek site (Applegate and Riley 1998). Regardless of the true size needed to support a viable population of lesser prairie chickens, it will out of necessity be large, probably falling somewhere between 19,000 acres and 25,000 acres. To meet the habitat requirements necessary for the successful translocation of lesser prairie chicken at SAND will require the Park to partner with local landowners, governmental agencies including the Colorado Division of wildlife, and non-governmental conservation organizations such as The Nature Conservancy.

Table 8. Habitat requirements for the lesser prairie chicken.

Life History Stage	Habitat Characteristics	References
General Requirements	Sandsage or sandshinnery oak grasslands dominated by sand bluestem <i>Andropogon hallii</i> , little bluestem <i>Schizachyrium scoparium</i> , sand dropseed <i>Sporobolus cryptandrus</i> , three-awn <i>Aristida</i> spp., and blue grama; sideoats grama <i>B. curtipendula</i> , hairy grama <i>B. hirsuta</i> and buffalograss may also occur. The combined home ranges of all birds at a lek may exceed 12,000 acres, or 19 square miles. This includes a central 2-4 square mile core of prime nesting and brood-rearing habitat, and a larger surrounding area for year-round foraging. For a LPC population to remain viable even in the short term, breeding must take place across a series or complex of leks. It is estimated that 25,000 acres of contiguous high-quality native rangeland may be the minimum land area required to maintain a healthy and sustainable LPC population.	New Mexico LPC/SLD Working Group 2005, Bidwell et al. 2001, Giesen 1998, Copelin 1963,
Lek	Small, elevated areas with bare soils or very sparse vegetation that allows for excellent visibility; the sites are often on elevated knolls or ridges and are always surrounded by sand sagebrush or sand shinnery oak grassland. Disturbed areas created by human activities, such as oil pads, roads, burning, or herbicide treatment, may be used as display sites.	New Mexico LPC/SLD Working Group 2005, Hagen et al. 2004, Giesen 1998, Taylor and Guthery 1980, Copelin 1963, Jones 1963, ,

Life History Stage	Habitat Characteristics	References
Nesting	High density sagebrush (>6,500/ha), shrub height $\geq$ 40cm, moderate sagebrush cover (18–20% cover), moderate grass cover (37%), mixed grass at height >25 cm affording high visual obstruction readings, minimal building, improved road, transmission line, center-pivot field, and wellhead density (these structures reduce potential nesting habitat for a radius of up to 1 km).	New Mexico LPC/SLD Working Group 2005, Pitman et al. 2005, Hagen et al. 2004
Brooding	High bare ground cover (>50%), moderate density sagebrush (>4,000/ha), shrub height $\geq$ 30cm, moderate sagebrush cover (18–20% cover), moderate grass cover (37%), mixed grass at height >20 cm, minimal building, improved road, transmission line, center-pivot field, and wellhead density (these structures reduce potential nesting habitat for a radius of up to 1 km).	New Mexico LPC/SLD Working Group 2005, Hagen et al. 2004, Riley and Davis 1993,
Wintering	Riparian corridors comprised of deciduous shrubs and young trees in the sand sagebrush regions, grain fields (where available) once harvest has begun if near sandsage rangeland, and when available native tallgrasses >80 cm tall.	New Mexico LPC/SLD Working Group 2005, Hagen et al. 2004

RECOMMENDED FUTURE RESEARCH

Ferruginous hawk surveys should be conducted during the winter (November to mid-March) when over-wintering birds focus their foraging activities on prairie dog towns. Surveying during the winter might verify the occurrence of ferruginous hawks at SAND. Also, track plate surveys are recommended for assessing the occurrences of swift fox at SAND, with the placement of one transect each in the north and south prairie dog colonies. It is recommended that track plate surveys be conducted during the summer of 2006.

Because the success of translocating lesser prairie chickens will ultimately be determined by the quantity and quality of habitat at the translocation site, evaluating habitat at SAND prior to translocation should be a critical consideration. The development of a habitat model identifying suitability of landscapes for greater prairie chickens in southeast Colorado and applying that model to digital landcover data of southeastern Colorado, including the area of SAND, will help to identify suitable unoccupied landscapes for translocation of lesser prairie chickens in the State.

The occurrence of permanent wetlands at SAND within what is a relatively dry landscape where water resources are limited represents an opportunity for the occurrence of rare and uncommon invertebrate species including butterflies, dragonflies, and damselflies along with other invertebrates. It is recommended that a future survey for invertebrates also be conducted at SAND.

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