Estimation of Occupied and Unoccupied Black-Tailed Prairie Dog Colony Acreage in Colorado

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ABSTRACT Black-tailed prairie dogs (*Cynomys ludovicianus*) are a species of concern and accurate estimates of occupied area are required to assess their status. We conducted aerial line-intercept surveys to estimate colony areas in Colorado, USA, 2006–2007. Optimal allocation based on results from a previous (2002) survey was used to distribute flight time to sample 28 counties. Uncorrected estimates of active and inactive colony areas from the aerial surveys were 329,529 (SE = 16,841) ha and 18,292 (SE = 2,366) ha, respectively. We attempted to ground-truth a randomly selected sample of 186 colony intercepts but gained complete access to only 150. Ground-truthing demonstrated that aerial surveys estimated only 96% of the true lengths of colony intercepts but overestimated the proportion of active colonies. Corrected estimates of active and inactive colony areas are 319,165 (SE = 20,105) ha and 42,422 (SE = 11,485) ha, respectively. Because ground-truthing was not conducted in the original 2002 survey, uncorrected estimates from this survey are the appropriate metric to be used for comparison to the 2002 data. Our estimates demonstrated a 29% increase (SE = 6.3) in area occupied since surveys were conducted in 2002. These results are useful to state and federal agencies and other conservation partners in determining the condition of the species when conducting status reviews.
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Black-tailed prairie dogs (*Cynomys ludovicianus*) are an ecologically important and politically sensitive species so it is important to establish a valid sampling protocol to assess their status. Prairie dogs influence vegetative communities, overall vegetative structure, and species diversity of prairie ecosystems and create or enhance habitat for a variety of birds, mammals, and amphibians (Clark et al. 1982; Whicker and Detling 1988; Weltzin et al. 1997; Kotliar et al. 1999, 2006). For example, the black-footed ferret (*Mustela nigripes*), swift fox (*Vulpes velox*), mountain plover (*Charadrius montanus*), ferruginous hawk (*Buteo regalis*), burrowing owl (*Athene cunicularia*), and numerous other species are dependent upon prairie dogs to varying degrees. Black-tailed prairie dogs have been the subject of 2 petitions for listing under the Endangered Species Act (1998 and 2007). Many states have developed conservation plans (including MT, WY, KS, CO, TX, and SD) and a range-wide conservation assessment and strategy has been written and addended to (Van Pelt 1999, Luce 2002). In Colorado, the black-tailed prairie dog occurs in the plains and grasslands east of the foothills and historically was found in all eastern counties except the County of Denver up to an elevation of about 1,850 m (Lechleitner 1969, Armstrong 1972).

Responding to a petition to list the black-tailed prairie dog under the Endangered Species Act filed in 1998, the United States Fish and Wildlife Service (USFWS) initially found that a listing was warranted but precluded (USFWS 2000). In 2003 the Colorado Division of Wildlife (CDOW) finalized a conservation plan for shortgrass prairie species including the black-tailed prairie dog, partly in response to the previously filed petition (CDOW 2003). As part of the conservation plan, CDOW needed information on the area occupied by black-tailed prairie dogs in eastern Colorado, with the plan calling for repeated surveys at 5-year intervals.

In 2002, CDOW conducted a line-intercept survey to estimate the area occupied by black-tailed prairie dogs in eastern Colorado (White et al. 2005*a*). It was estimated that 255,398 ha of active colonies were present in Colorado. Estimates of this survey were questioned by Miller et al. (2005) as being biased high, with a response by White et al. (2005*b*) that described the consistency of the reported estimate with previous surveys and with surveys conducted in Wyoming for similar habitats. In 2004, the USFWS changed their determination and stated that the black-tailed prairie dog did not warrant protection under the ESA (USFWS 2004). This decision was heavily influenced by estimates of occupied acreage provided by states within the range of black-tailed prairie dogs.

Because of the demonstrated ecological importance of the black-tailed prairie dog, influence upon other species of concern (i.e., mountain plover, burrowing owls), and continued political interest in this species as demonstrated by lawsuits and petitions to the USFWS for protection under the Endangered Species Act, it is critical to sample this species at regular intervals and to test improvements in technological and methodological developments in aerial surveying.

STUDY AREA

Black-tailed prairie dogs inhabited the eastern portion of Colorado, USA, from the foothills of the Front Range east to the state line. Land use for much of eastern Colorado was either in agricultural status or in native shortgrass and

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midgrass prairie. Dominant species in the shortgrass system were buffalograss (*Buchloe dactyloides*) and blue grama (*Bouteloua gracilis*). Dominant species in the midgrass system included western wheatgrass (*Pascopyrum smithii*), little bluestem (*Schizachyrium scoparium*), and green needlegrass (*Stipa viridula*). Black-tailed prairie dogs inhabited native range and some agricultural areas, as well as some of the more developed, urbanized areas along Colorado's Front Range.

METHODS

Surveys

Aerial surveys followed the same protocol as White et al. (2005*a*), first used by Sidle et al. (2001), but with improvements. We determined number of transects flown and the offset between transects on a county-by-county basis based on optimal allocation in a stratified random-sampling scheme. We treated each county as a stratum to disperse the sampling across the sampling frame and to allocate sampling intensity so as to minimize variance of the estimate. To determine placement of transects, we selected a random start point some distance into the county from the border parallel to the direction of the transects. We computed the offset between survey lines to provide the number of transects needed as estimated by the optimal allocation procedure. Results from the previous survey effort provided critical information on areas where higher sampling frequency (shorter offsets between transects and, hence, more transects in that county) was necessary to maximize accuracy and minimize variance (White et al. 2005*a*). Transects we flew for this effort were not the same transects flown in 2002. Transects varied in length, based on the width of counties in eastern Colorado. In every county except El Paso, we flew transects in an east–west direction and the length of each transect was influenced by the geographic borders of the county. We flew transects in a in a north–south orientation in El Paso County to avoid conflicts with military lands and a regional airport. In nonrectangular-shaped counties, transect length also varied within the county. We flew all transects from county line to county line, and we calculated this distance for each transect, so different transect lengths do not affect the results.

We conducted surveys from 28 August 2006 through 8 December 2006, resumed them 22 March 2007 and completed them 20 April 2007. Our aerial surveys were limited to areas where we could conduct flights approximately 55 m above ground level. We conducted flights in a Cessna 185 (Cessna Aircraft Company, Wichita, KS) at approximately 160 km/hour. Federal aviation restrictions precluded flights from occurring within urbanized areas at this altitude. Due to these constraints we avoided metropolitan areas known to have active black-tailed prairie dog colonies such as Colorado Springs, Boulder, and Fort Collins. Thus, our estimates of occupied acreage should be considered a minimum estimate within Colorado.

An improvement over the methods of White et al. (2005*a*) was that we recorded intercepts for transect start and stop points (county lines) and start and stop points for both active and inactive prairie dog colonies on a tablet personal computer with an integrated Global Positioning System (GPS) unit (Xplore Technologies Rugged iX104 Tablet PC and xGPS Module; Xplore Technologies, Austin, TX). We developed a custom ArcGIS extension to simplify data collection and reduce potential for any user error (Imap Solutions, Fort Collins, CO).

While in flight and using the touch-screen on the Tablet PC, the observer demarcated points when a black-tailed prairie dog colony was visible by both the pilot and observer on their respective sides of the airplane. We collected GPS points for the start and end points for every colony that was intersected by the predefined flight transects. We collected additional attribute data for each colony encountered, including colony activity status (active or inactive). We developed the ArcGIS extension to clearly distinguish when the airplane was over a colony versus over noncolony areas. For example, when a colony was visible directly under the plane by both the pilot and observer, sitting on opposite sides of the airplane, the observer marked the GPS location as the start of the prairie dog colony. We marked the end point of the colony at the point where either the observer or the pilot no longer saw the colony on their respective side of the airplane. Additionally, we recorded the path of the airplane on a separate, yoke-mounted GPS so we could assess deviations of the flight path off of the intended transect. We recorded active and inactive colony intercepts separately, allowing us to estimate areas for both active and inactive colonies on a county-by-county basis throughout eastern Colorado. We marked active colonies as such if animals were visible, we detected recent excavation, or vegetation was clearly recently clipped and shorter than surrounding vegetation. We described inactive colonies as such if mounds were covered with vegetation and the colony did not appear to have recent prairie dog activity on it. Otherwise, we followed the aerial survey protocols of White et al. (2005*a*).

A second extension over the methods of White et al. (2005*a*) was that we attempted to ground-truth 1 of every 10 recorded colony intercepts. Colonies selected for ground-truthing were spatially representative of the distribution of black-tailed prairie dogs across the landscape of eastern Colorado. For example, in a county where we encountered 110 colonies during the flight transects, we then selected 11 colonies for ground-truthing. For each series of 10 consecutive colonies encountered in the air, we selected one for ground-truthing, assuring a spatially representative sample. As flights were completed for each county, we selected the colony to be examined on the ground with a size-biased sample (i.e., we selected colonies to sample with probability equal to their proportional length for the sum of the series of 10 intercepts). We then attempted to obtain land owner(s) permission to visit the colony on the ground. During the ground visit, we recorded length of the colony using GPS and also classified prairie dog activity along the colony as >50% active burrows, <50% active burrows, or inactive within 10 m of the transect line flown. We trained biologists to identify active and inactive burrows based on signs of fresh scat, fresh diggings, spider webs, and direct observations. This degree of resolution of activity level is greater than what is feasible to collect from the air. Because of the dynamic nature of black-tailed prairie dog colonies, the use of activity level at a finer resolution is of marginal value (see Discussion). Our protocol required that the ground visit occur within 60 days of the aerial survey, but this condition was not always met because of snow storms and other logistical constraints.

Statistical Methods

We computed estimates of colony area within strata (counties) using the same techniques as Sidle et al. (2001) and White et al. (2005*a*). We computed the ratio of colony length (active and inactive, separately) to total line length for each transect line across a county. The mean ratio for the county multiplied by the county area provided an estimate of the active or inactive colony area for the county, with the standard error of this estimate computed as the standard error of the mean ratio multiplied by county area.

We corrected these estimates based on ground-truthing surveys. We developed 2 corrections a priori, one for intercept length and one for classification of colony activity. For the 150 intercepts where complete ground access was allowed, we computed the ratio of aerial intercept length (y) by ground intercept length (x) using linear regression through the origin. For the 144 intercepts classified as active during the aerial survey and completely surveyed on the ground, we used ordinal response logistic regression (PROC LOGISTIC; SAS Institute, Inc. 2003) to predict the probability of misclassification and change in classification (active to $>$50% active, to $<$50% active, or to inactive) as a function of the number of days between aerial and ground surveys, aerial survey intercept length, ground survey intercept length, and also a discrete covariate for time between aerial and ground surveys of $\leq$60 days (within protocol) or $>$60 days (outside of protocol). In ordinal logistic regression, we assumed a common slope but separate intercepts for 2 of the 3 categories, with the reference category obtained by subtraction. For the 6 ground-truthed colony intercepts that we classified as inactive during the aerial survey, we computed a probability of misclassification directly without use of covariates because of the small sample size. Note that corrections from the ordinal logistic regression can only lower the estimate of active colony area because we surveyed no nonintercept areas on the ground that could potentially be classified as colony areas.

RESULTS

We logged approximately 219 hours of flight time covering 28,699 km of transects flown. We detected 1,749 colonies from the aerial transects, with 186 colonies selected for ground-truthing surveys.

Uncorrected estimates of active and inactive colony areas from the aerial surveys were 329,529 (SE = 16,841) ha and 18,292 (SE = 2,366) ha for active and inactive colonies, respectively (Table 1). Our estimates are directly comparable to the 2001–2002 estimates of White et al. (2005*a*) and demonstrate a statistically significant 29% increase (SE = 6.3) in active colony area over the White et al. (2005*a*) estimate of 255,398 ha (SE = 12,420) because 95% confidence intervals on the 2 estimates do not overlap. White et al. (2005*a*) did not collect data on inactive colonies; therefore, we cannot compare our estimate of area of inactive colonies to 2002 survey results.

Of the 186 aerial intercepts selected for ground-truthing surveys, we were able to completely survey only 150 because $\geq$1 land owners denied access for all or portions of 36 colony intercepts. For the colony intercepts visited on the ground, the regression estimate of colony intercept length measured during the aerial survey to the length measured on the ground was 0.962 (SE = 0.014). This correction will increase colony area estimates made from the aerial surveys for both active and inactive colonies.

Activity classifications of these 150 colony intercepts suggested we classified more colonies as active from the air than actually were (Table 2). However, the time between aerial and ground visits varied from 22 days to 231 days ($\bar{x}$ = 130.7, SD = 73.5). We used ordinal logistic regression models (Table 3) to correct for the time between visits (a procedure we planned prior to performing the aerial survey) as well as the estimated ground or aerial colony-intercept lengths for the 144 intercepts classified as active from the air. The number of days between aerial and ground visits was the most important predictor, with models including time between visits accounting for 90% of the Akaike's Information Criterion (AIC_c) weight. Southeastern Colorado was hit with a major blizzard during midwinter 2006–2007, which is likely the explanation for why the number of days between aerial and ground visits was this heavily weighted (see Discussion). Most of the remaining 10% of the AIC_c weight was associated with the model that compared colony intercepts measured within or outside of the 60-day window specified for the ground-truthing protocol. Correct classification of activity levels was not influenced by the lengths of colony intercepts (Table 3). We took from the minimum AIC_c model estimates of the correction for colony intercepts classified as active from the air, with logistic regression parameter estimates intercept of $<$50% active 0.367 (SE = 0.331), intercept of $<$50% and $>$50% active 2.353 (SE = 0.392), and slope for days between surveys −0.008 (SE = 0.002). From this model (Fig. 1), the estimated proportion of colony intercepts correctly classified as active was 0.913 (SE = 0.031), with 0.087 (SE = 0.031) of active intercepts incorrectly classified as inactive. Also predicted by this model is that 0.591 (SE = 0.080) of the aerial colony intercepts classified as active should be classified as $>$50% active.

Ground-truthing results showed that 2 of 6 colonies classified as inactive from the air were actually active colonies (0.333, SE = 0.192). We performed no correction for time between aerial and ground surveys because of the small sample size.

Table 1. Results of aerial line-intercept stratified simple random sample of black-tailed prairie dog colonies in eastern Colorado, USA, 2006–2007.

County	County area (ha)	Distance flown (km)	No. lines flown	Active colony			Inactive colony		
				Area (ha)	SE	95% CI	Area (ha)	SE	95% CI
Adams	306,550	482	6	5,453	1,356	3,487	0	0	0
Arapahoe	208,132	533	5	4,738	913	2,536	0	0	0
Baca	662,505	3,317	36	35,932	4,337	8,805	2,833	838	1,701
Bent	399,129	2,831	49	17,187	2,726	5,481	4,575	949	1,909
Boulder	191,766	459	9	7,588	2,020	4,658	0	0	0
Cheyenne	461,535	876	9	21,931	4,542	10,473	0	0	0
Crowley	207,229	560	12	10,038	2,515	5,535	992	674	1,483
Douglas	218,092	207	5	6,167	3,834	10,645	0	0	0
El Paso	551,222	540	8	17,209	4,054	9,587	0	0	0
Elbert	479,093	384	6	973	973	2,502	0	0	0
Fremont	397,060	421	5	6,011	3,141	8,722	0	0	0
Huerfano	412,361	277	4	675	675	2,147	0	0	0
Jefferson	200,167	173	6	10,923	5,328	13,696	0	0	0
Kiowa	462,572	1,796	15	21,909	1,886	4,045	661	463	992
Kit Carson	560,027	764	8	7,421	1,632	3,859	1,257	1,171	2,769
Larimer	681,539	829	10	7,551	2,567	5,807	791	433	980
Las Animas	1,236,250	2,374	17	15,858	6,254	13,257	156	156	330
Lincoln	669,425	916	16	14,703	4,776	10,181	0	0	0
Logan	477,781	689	9	12,046	3,273	7,548	225	149	343
Morgan	334,903	289	5	5,666	2,784	7,730	592	383	1,065
Otero	328,489	753	16	8,085	2,003	4,269	642	442	942
Phillips	178,295	259	5	114	114	316	0	0	0
Prowers	426,031	2,398	39	27,264	3,011	6,096	1,772	685	1,386
Pueblo	620,671	2,113	30	18,922	3,109	6,360	1,657	549	1,122
Sedgwick	142,344	253	5	2,874	1,739	4,828	0	0	0
Washington	653,540	328	5	1,536	1,536	4,265	0	0	0
Weld	1,039,668	3,177	34	32,984	4,209	8,564	2,140	781	1,589
Yuma	613,699	699	11	7,769	3,718	8,285	0	0	0
Total	13,120,074	28,699	385	329,529	16,841	33,008	18,292	2,366	4,638

Given the above corrections, our revised estimates of active and inactive colony areas were 319,165 (SE = 20,105) ha and 42,422 (SE = 11,485) ha, respectively. Precision was lower than for uncorrected estimates, predominantly because of the poor precision for the corrections involving the 6 colonies classified as inactive in the aerial survey.

DISCUSSION

Our uncorrected estimate of active colony area was 29% greater than the White et al. (2005*a*) estimate, and our uncorrected estimate is appropriate for comparison to the 2002 estimate because no ground-truthing was performed for the earlier surveys. Therefore, we conclude that area occupied by prairie dogs increased by 29% from 2002 to 2007. Although biologists conducting aerial surveys had improved technology and tools to assure that we collected only high-quality data, the fundamental methodology was similar to the White et al. (2005*a*) survey. Therefore, our results reflect actual changes in area occupied by black-tailed prairie dogs and are not an artifact of improved methodology. After implementing improved methodologies for our 2006–2007 survey, we have provided additional support that our initial attempt at estimating black-tailed prairie dog acreage in 2002 in Colorado was reasonably accurate despite the claims made by Miller et al. (2005). In fact, our results strongly argue that the ground-truthing conducted by Miller et al. (2005) 2 years after the aerial data were originally

Table 2. Comparison of activity levels between aerial and ground-truthing surveys of colony intercepts for black-tailed prairie dogs in eastern Colorado, USA, 2006–2007.

Ground-survey classification	Aerial survey classification		
	Active	Inactive	Total
>50% active	61	2	63
<50% active	48	0	48
Inactive	35	4	39
Total	144	6	150

Table 3. Model selection results to develop a correction of the ground classifications for time between aerial and ground surveys, plus colony intercept lengths, of eastern Colorado, USA, black-tailed prairie dogs, 2006–2007.

Model	$-2\log$ likelihood	K[a]	AIC_c[b]	ΔAIC_c[c]	w_i[d]
Days between	294.640	3	300.811	0.000	0.5227
Days between+air length	294.537	4	302.825	2.013	0.1910
Days between+ground length	294.608	4	302.896	2.084	0.1843
In protocol	297.945	3	304.116	3.305	0.1001
Intercept only	309.270	2	313.355	12.544	0.0010
Air length	308.790	3	314.961	14.150	0.0004
Ground length	308.937	3	315.108	14.297	0.0004

[a] K is the no. of parameters estimated in the model.
[b] AIC_c is Akaike's Information Criterion corrected for small sample sizes.
[c] ΔAIC_c is the AIC_c distance of a model from the min. AIC_c model.
[d] w_i is the AIC_c wt of a model.

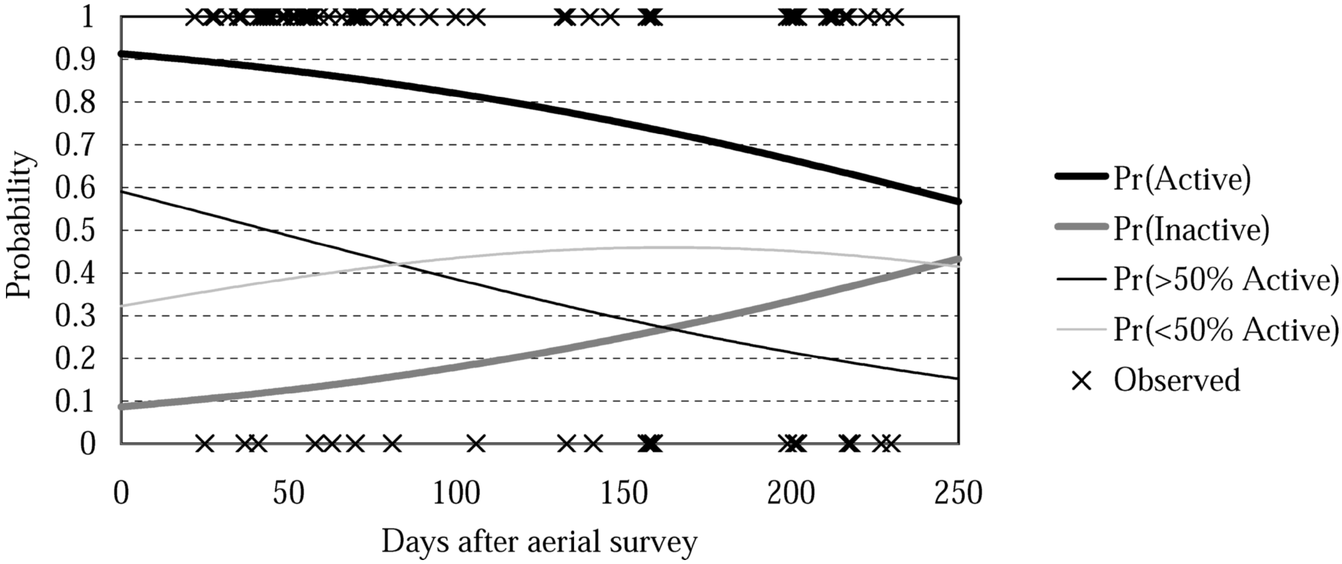

Figure 1. Predictions of ground-truthed activity levels of colony intercepts classified as active from the air using ordinal logistic regression of the days between aerial and ground surveys for eastern Colorado (USA) prairie dogs, 2006–2007. Heavy black line is the predicted probability of a colony being active when checked on the ground, given we classified the colony as active from the air. Heavy gray line is the probability a colony we classified as active in aerial survey was classified as inactive on the ground. Thin black line is the probability a colony that we classified as active in aerial survey was classified during ground-truthing as >50% active, and thin gray line is the probability such a colony was classified during ground-truthing as <50% active. The X symbols are observed data, with 1 meaning classified as active on the ground and 0 inactive on the ground.

collected was meaningless because of the extremely long interval between surveys and the natural dynamics of prairie dog populations.

At state-wide scales, most estimates of prairie dog populations are based on estimates of the amount of occupied habitat rather than numbers of individual animals. The actual number of animals present depends upon the prevailing density of animals in that locality. The USFWS believes that estimates of habitat occupied by black-tailed prairie dogs provide the best available and most reasonable means of gauging population status across the extensive range of this species, providing support for our methodology (USFWS 2004).

One of the difficulties with using area occupied as a monitoring metric is that areas can be occupied to various degrees. Determination of activity levels from the air is subjective, as shown by our comparisons of activity levels determined on the ground compared to aerial classifications (Table 2). We were not confident classifying colony intercepts as <50% active or >50% active from the air, although we conducted such a classification during the ground visit.

However, the usefulness of these categories, even in the ground-truthing effort, is questionable. We could subjectively say that areas >50% active are on average 75% occupied, and areas <50% active are 25% active, and thus correct our overall estimate of active areas by these subjective weights. However, black-tailed prairie dog acreages are quite dynamic, as shown by the increase we detected over a 5-year interval and the change in status predicted by the days between aerial and ground surveys. Although distinguishing active from inactive from the air is subjective, the general category of active seems to be the most useful metric to monitor black-tailed prairie dog areas.

Our survey efforts are a snapshot in time, and it is impossible to differentiate the trend for a particular colony using our technique. Colonies that are active at any level (i.e., not inactive) could be recovering from, say, a plague event in the past, and could thus be expected to increase in occupied acreage. Alternatively, active colonies could be on a downward trend, from a similar but opposite effect. Our intent was not to identify the trend for individual colonies, but rather the trend throughout the species' range within Colorado.

Our protocol called for ground-truthing to take place as soon as possible after the aerial flight occurred and for all ground-truthing to occur within 60 days of flying the transects, which would have provided a limited time for events to occur that would change either the size or activity level of the colony (i.e., plague or poisoning, which would cause colony contraction, or colonization, which would cause colony expansion). In many cases it was possible to visit the colonies on the ground within the time period described in the protocol (<60 days). However, an extreme winter storm in southeast Colorado precluded efforts to ground-truth colonies for up to 231 days. Snow began to fall in southeast Colorado on 21 December 2006 and covered the ground for ≥65 days. Temperatures did not consistently reach above freezing until late February (National Oceanic and Atmospheric Administration 2007). The snow cover and lack of access due to muddy roads precluded ground-truthing in some instances for several months. For example, some colonies that we flew in late October were not accessible for ground-truthing until May. In a post hoc analysis, colonies classified as active from the air before the

Table 4. Changes in activity levels observed during ground-truthing of black-tailed prairie dog colonies in eastern Colorado, USA, conducted before and after a major winter blizzard, 21 December 2006.

Ground-truth categorization	No. of colonies categorized prior to 21 Dec 2006	No. of colonies categorized after 21 Dec 2006
>50% active	32	24
<50% active	19	46
Inactive	8	28

storm were more likely to be classified as inactive during ground-truthing after the storm compared to those that were ground-truthed prior to the onset of the storm ($\chi^2 = 14.69$, df = 2, $P = <0.001$; Table 4). This suggests that natural population dynamics and time alone did not cause the observed decrease in activity level, but that the extreme weather event may have caused much of this trend in this short time frame. Prairie dogs could have suffered mortality from suffocation, starvation, or perhaps plague outbreaks that may have occurred in the moist spring melt conditions following this storm (Stapp et al. 2004). Further, reduced activity levels within a colony, without widespread mortality, should be expected after a storm of this magnitude (J. Hoogland, University of Maryland, personal communication).

An additional concern with the ground-truthing methodology was the censored sample we were required to use for inference, where only 150 of 186 intercepts were actually available for visiting on the ground. Although we found no relationship between the activity category (active or inactive) determined from the air and 3 levels of access (complete, partial, none; $\chi^2 = 1.70$, df = 2, $P = 0.428$), such censoring is still worrisome. That is, status of colonies on lands owned by landowners that prevented access may not be the same as status of colonies on lands where we gained access.

MANAGEMENT IMPLICATIONS

Conducting an inventory that covers this large of a geographic area with the associated level of detail is time-consuming and expensive in terms of logistical and labor costs. It is important, however, to monitor the status of this species, due to the ecological role it plays in North American grasslands and because of the conservation concern of both the black-tailed prairie dog and other associated species (Van Pelt 1999). Of the 11 states that encompass the range of the black-tailed prairie dog, each has its own methodology used to monitor these populations. Establishment of a range-wide methodology that is accurate, precise and relatively safe, and easy and inexpensive to implement should be an objective of the state wildlife agencies responsible for the management of the black-tailed prairie dog. If aerial inventory is the method of choice, 3 important recommendations should be considered. First, flights should be conducted in as short a time period as is practically feasible to minimize changes in area occupied during the survey period. Second, ground-truthing should be used to correct estimates for errors in both colony length and activity levels. Third, ground-truthing should be conducted as soon as possible following flights, and all ground-truthing should be conducted within 60 days of aerial surveys, to minimize changes in activity level between flights and ground surveys.

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