Colorado Black-tailed Prairie Dog Range-wide Monitoring 2020

Abstract

Black-tailed prairie dogs (*Cynomys ludovicianus*, BTPD) are an important conservation species throughout their range, providing vital habitat features and prey base for many other species. Colorado Parks & Wildlife began monitoring BTPD in 2002, with subsequent work in 2006-2007, and 2016. The 2016 effort followed the rangewide monitoring methodology developed in 2011, which utilizes a three step process – aerial imagery analysis, aerial truthing, and ground truthing. The 2020 monitoring effort repeated the protocols used in 2016. The current goal of BTPD monitoring in Colorado is to determine total acreage of the species in the state and not to determine the specific location of those acres. Comparisons of total acreage across time are used to determine the stability of the species in the state. Based on the current effort, we estimated that BTPD occupied 500,375 acres in Colorado (95% CI: 414,011 - 580,561). This estimate is stable compared to the 2016 effort and remains in the Blue Abundant Zone (>450,000 acres) as defined in the *Conservation Plan for Grassland Species in Colorado* (Colorado Division of Wildlife 2003).

Introduction

Black-tailed prairie dogs (Cynomys ludovicianus, BTPD) are an important conservation species throughout their range and have experienced threats from habitat conversion, direct take, and introduced disease since the early 1900's. Many species, including black-footed ferrets, burrowing owls, swift fox, and ferruginous hawks, depend on BTPD colonies due to the development of underground burrow structures, alteration of vegetative communities, and the availability of BTPD as prey. For these reasons, it is important to monitor BTPD populations in Colorado to both ensure continued stability of the species and availability of their habitat for other species of conservation concern.

BTPD were petitioned for listing under the Endangered Species Act in both 1998 and 2007, but subsequently found to be 'not warranted' for listing as threatened or endangered (USFWS 2004, USFWS 2009). In response to these petitions and other concerns, Colorado Parks & Wildlife (CPW, formerly Colorado Division of Wildlife) developed the *Conservation Plan for Grassland Species in Colorado* (Colorado Division of Wildlife 2003). This plan outlines the acreage goals for BTPD in the state to ensure both the stability of the species and the continued ecosystem services they provide for other dependent species. Under this plan, overall BTPD acreages are assigned to a zone as follows:

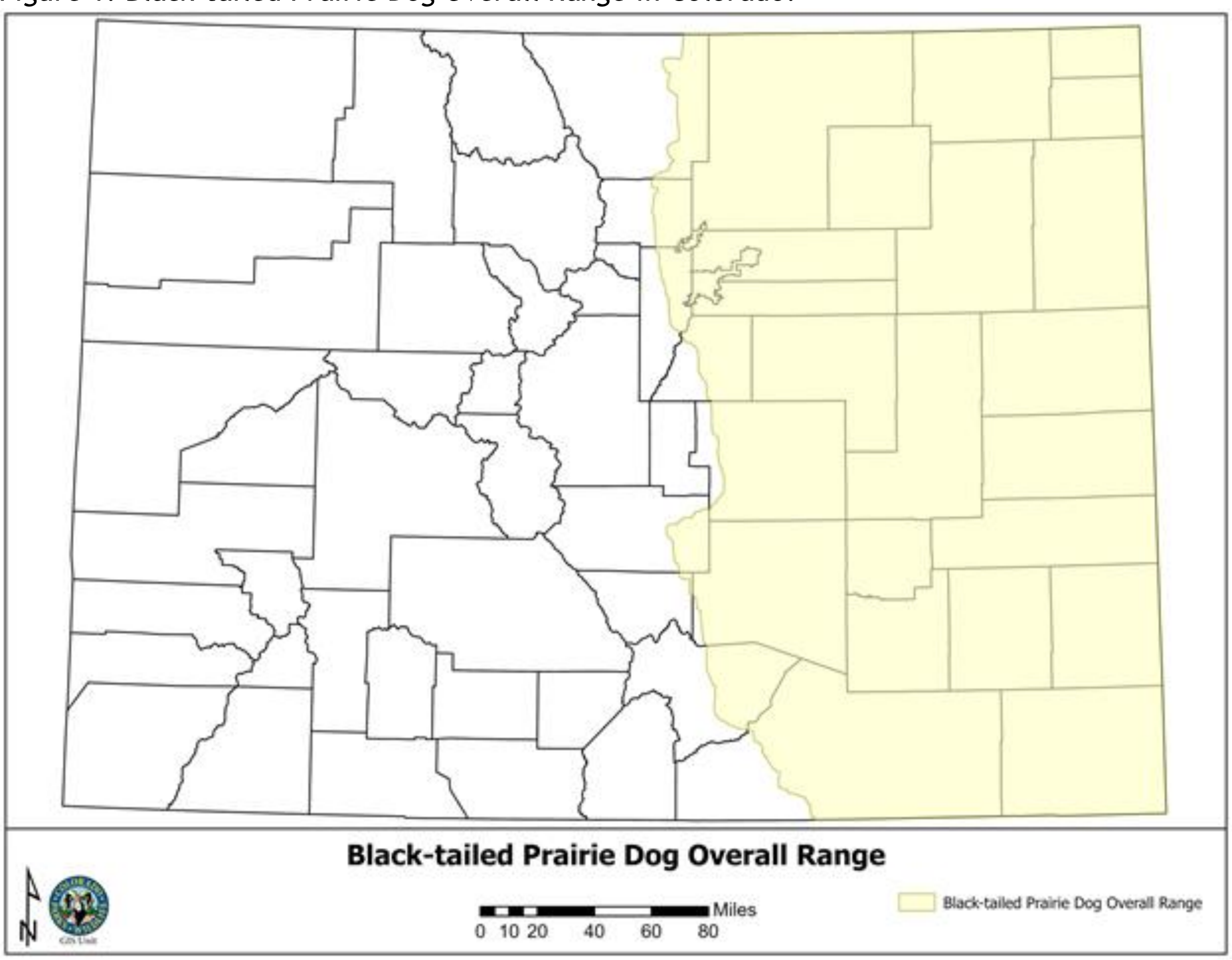
- Blue zone, Abundant, >450,000 acres
- Green zone, Secure, 350,000-450,000 acres
- Yellow zone, Vulnerable, 250,000-350,000 acres
- Orange zone, At Risk, 150,000-250,000 acres
- Red zone, Danger, <150,000 acres

Within each of these zones are recommended conservation measures, including plague management, shooting closures, and monitoring frequency. BTPD are also identified as a Tier

1 Species of Greatest Conservation Need in the *Colorado State Wildlife Action Plan* (Colorado Parks and Wildlife 2015), which lists conservation actions specific to the species.

Colorado Parks & Wildlife began monitoring BTPD in 2002, using a line-intercept survey methodology (White et al. 2005) and repeated the effort in 2006-2007 (Odell et al. 2008). In 2010, Federal and State partners from throughout the BTPD range met to develop consistent survey methods resulting in the publication of *Recommended Methods for Range-wide Monitoring of Prairie Dogs in the United States* (McDonald et al. 2011). CPW implemented these recommended methods in 2016, through a contract with Western EcoSystems Technology (Howlin and Mitchell, 2016). Based on the previous acreage, the monitoring frequency identified in the *Conservation Plan for Grassland Species in Colorado* (Colorado Division of Wildlife 2003) was 3 years; this effort was delayed a year until 2020, when the 2019 aerial imagery became available. The protocols below are based on the *Recommended Methods for Range-wide Monitoring of Prairie Dogs in the United States* (McDonald et al. 2011) and *Monitoring Black-Tailed Prairie Dogs in Colorado with the 2015 NAIP Imagery* (Howlin and Mitchell, 2016).

Figure 1. Black-tailed Prairie Dog Overall Range in Colorado.

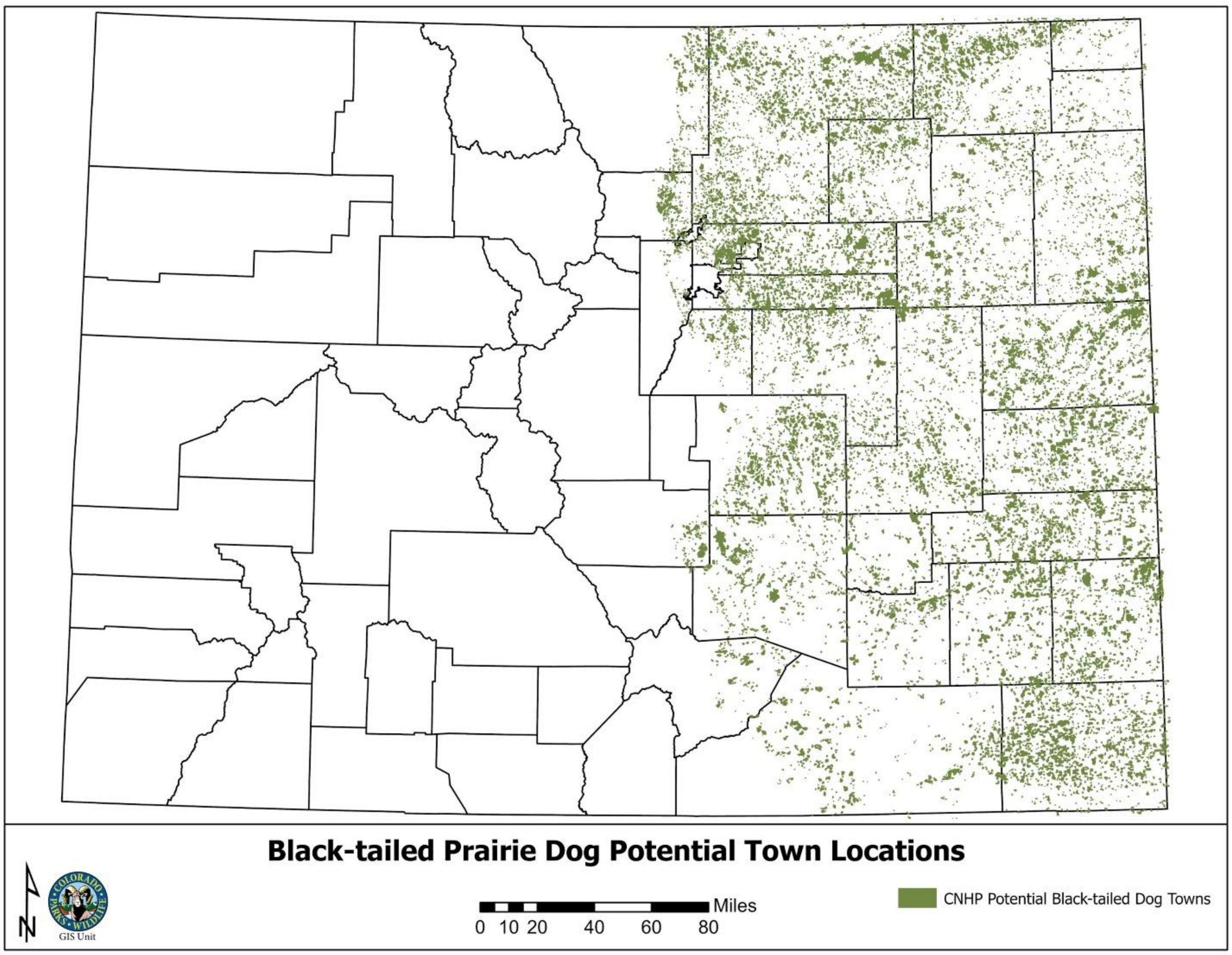


The current goal of BTPD monitoring in Colorado is to determine total acreage of the species in the state and not to determine the specific location of those acres. BTPD colonies can be influenced by a number of factors, including disease outbreaks, habitat conversion, and weather impacts. These influences can cause colonies to decline or increase very frequently. For this reasons, CPW relies on comparisons of total acreage to determine the stability of the species in the state.

Methods

We used a multi-step process to identify potentially occupied areas and estimate the total acreage across the potential range of BTPD in Colorado. The first step was analysis of aerial imagery, followed by ground and aerial truthing, and finished with estimation and modeling.

Figure 2. BTPD potential town locations, as identified during aerial imagery analysis.



Aerial Imagery Analysis

Range-wide monitoring for BTPD relies on accurate aerial image analysis. We began analysis as soon as possible after the aerial images were taken and became available. This project utilized the 2019 National Agriculture Imagery Program (NAIP) images as accessed on January 27, 2020. The study area was defined as the current known range of BTPD in Colorado, generally the eastern third of the state (Figure 1). We overlaid the NAIP images with a 2.0-by-2.0-mile grid and clipped the overall extend to the current known BTPD range (shapefile accessed from https://www.arcgis.com/home/item.html?id=d3c3879990c94b73a00412cb2597234d). This produced 11,232 grid cells in the 44,404 square-mile (approximately 28,420,000 acres) overall range in ColoradoWe systematically reviewed all grid cells throughout the range of the species in Colorado to identify possible BTPD colonies. During this review, when the observer identified what they believed to be a BTPD colony, they drew a polygon around the outermost burrows. To estimate the probability an observer missed a BTPD colony during this review (false negatives), a second observer independently reviewed approximately 10% of the grid cells throughout the range. The aerial imagery analysis identified 23,607 polygons as potential prairie dog colonies in the northern and middle strata and 2,222 in the southern stratum (Figure 2). Specific protocols are included in Appendix A.

Aerial Truthing

Aerial surveys of identified polygons were conducted to estimate the false positive rate, i.e. the probability of identifying a polygon that is not a prairie dog colony. To select polygons for aerial truthing, a set of inclusion and exclusion criteria were applied (Appendix B). These criteria included proximity to paved public roads to ensure success in subsequent ground truthing. The polygons that were available for selection and aerial truthing had to be identified by August 1, 2020. On this date, approximately 10% of the grid cells had been evaluated (1,232 of 11,232 cells) and 1,006 cells had polygons identified. A total of 6,763 polygons within these grid cells formed the sampling frame for aerial and ground truthing. After August 2, 2020, observers continued to examine the remaining grid cells; however, any polygons identified after this date were not included as candidates for truthing.

The full range of the species was divided into 3 regions – North, Middle, and South. Of the 6,763 total identified polygons identified at the time of selection, there were 3,322 polygons identified in the North region, 3,018 polygons identified in the Middle region and 423 polygons identified in the South region. In an effort to optimize the time spent truthing polygons and reduce travel time, the sampling frame was limited to the North and South regions. This also serves as a practical means of capturing the variability across the full range in the state. A total of 436 polygons (382 in the North and 54 in the South) were randomly selected within each region for aerial truthing. As with the preceding analysis (Howlin and Mitchell 2016), we assumed that occupancy and detection rates in the Middle region were equal to those in the North region.

Aerial truthing occurred from August 15 to October 31, 2020. During aerial truthing, polygons were identified as either “Active”, “Inactive”, or “Null”. Active described those polygons with obvious recent prairie dog sign or individuals observed, while the inactive category described polygons that were former prairie dog colonies with no sign or individuals visible. The null category subsumed all digitized polygons that were something other than prairie dog colonies, e.g., anthills or ground squirrel burrows. Specific protocols for feature selection and aerial truthing are included in Appendix B and C, respectively.

Ground Surveys

Ground truthing occurred from September 1 to October 31, 2020. Polygons for ground truthing were selected from the 436 polygons visited during the aerial truthing. We visited 124 polygons following the same random selection of the aerial truthing. An additional 30 polygons were visited by ground that had not been visited by air. Specific protocols for ground truthing are included in Appendix D.

Estimation Methods

From the 23,607 potential colonies identified in aerial imagery analysis, we randomly selected 382 polygons in the North region and 54 in the South region, as described above, to estimate occupancy. We assumed the Middle region had the same occupancy rate as the North region, as per the same assumption in the 2016 WEST study (Howlin and Mitchell, 2016).

We conducted the occupancy analysis in Program MARK (White and Burnham 1999). We first fit a global model that included all relevant predictors of occupancy and detection including strata for occupancy and a strata * visit interaction for detection, where visit was either an assessment from the air or the ground. We fit all models nested within the global model, resulting in estimates for 10 total models.

We used Akaike's Information Criterion adjusted for small sample size (AICc) to compare how well the models fit the data (Akaike 1973, Hurvich and Tsai 1979). We also investigated model selection uncertainty by averaging estimates across all models we fit (Burnham and Anderson 2002).

We multiplied strata-specific occupancy rates by the total number of potential colony acres found during the aerial image analysis in the South and North regions, and summed these to determine total statewide-occupied acres for BTPD.

Results

We estimated that BTPD occupied 500,375 acres in Colorado (95% CI: 414,011 - 580,561) in 2020. We found higher occupancy rates in the South region (0.515 95%CI: 0.364 - 0.664) than the North/Middle (0.454 95%CI: 0.367 - 0.544), though the confidence intervals broadly overlapped.

The best model found no differences in detection among strata or visits but did find a difference in occupancy between strata. There was considerable model selection uncertainty (Table 1), with 67% of the remaining models within 2.00 AICc units of the best model. Model-averaged estimates were 0.732 for detection probability by aircraft in the North stratum, 0.697 by ground in the North stratum, 0.765 by aircraft in the South stratum and 0.772 by ground in the South stratum (Table 2). This protocol did not capture enough data to estimate a false positive rate. Compared to the 2016 survey, we found no significant difference in area occupied, with the point estimate of the 2016 survey in the 90% CI of the 2020 survey and vice versa (Table 3). Note that the 2016 effort did not provide a 95% CI for the 2016 survey, so we were unable to compare 95% CIs.

Table 1. Model selection results for the occupancy analysis. The values in the Detection or Occupancy column indicate the factors that were used for that specific model with '.' indicating that pooling across all groups occurred for that parameter. ΔAICc is the difference in AICc units between the best model and the referenced model. AICc wt is a relative measure of our confidence in that model being the best model. k is the number of parameters in the model, and -2log(L) is the measure of residual deviance for that particular model.

Detection	Occupancy	ΔAICc	AICc wt	k	-2log(L)
.	Strata	0.000	0.195	3	671.092
.	.	0.496	0.153	2	673.616
Strata	.	0.717	0.137	3	671.809
Visit	Strata	1.494	0.093	4	670.549
Strata	Strata	1.542	0.090	4	670.597
Strata*Visit	.	1.740	0.082	5	668.748
Strata*Visit	Strata	1.951	0.074	6	666.903
Visit	.	2.139	0.067	3	673.231
Strata+Visit	.	2.196	0.065	4	671.251
Strata+Visit	Strata	2.955	0.045	5	669.963

Table 2. Model-averaged estimates for all parameters fit across all models, including the point estimate, standard error and 95% lower and upper confidence limits.

Parameter	Estimate	SE	95% LCL	95% UCL
Detection North, Aircraft	0.732	0.066	0.584	0.841
Detection North, Ground	0.697	0.079	0.525	0.827
Detection South, Aircraft	0.765	0.074	0.593	0.880
Detection South, Ground	0.772	0.086	0.564	0.899
Occupancy North	0.454	0.046	0.367	0.544
Occupancy South	0.515	0.079	0.364	0.664

Table 3. Comparison of estimated acres occupied by black-tailed prairie dog in the 2016 WEST and 2020 CPW surveys with 90% lower and upper confidence limits.

Year	Acres occupied	90% LCL	90% UCL
2016	500,570	435,524	556,617
2020	500,375	433,416	564,704

Discussion

The 2020 effort found the acreage occupied by BTPD in the state to be stable compared to the 2016 effort. The current estimate of 500,375 acres occupied by BTPD remains in the Blue Abundant Zone (>450,000 acres) as defined in the *Conservation Plan for Grassland Species in Colorado* (Colorado Division of Wildlife 2003). Under this category, there are no additional or increased conservation measures or protections recommended for the species within the state. We will continue to address the Conservation Actions outlined in the *State Wildlife Action Plan* (Colorado Parks and Wildlife 2015) for BTPD and other species dependent on their colonies, including management of epizootic plague and habitat loss.

This effort was the second time Colorado utilized the range-wide survey methodology for BTPD. We continue to find the method an efficient and effective tool for this broad ranging species yet the process remains time intensive with full results taking up to a year from the point when aerial images were captured. Considering the broad range this species covers in the state, this amount of time is to be expected. We plan to undertake this effort again in 3-5 years depending on the availability of appropriate aerial imagery.

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Appendix A

Aerial Imagery Analysis Protocols

We used ArcMap 10.6 to generate a 2.0-by-2.0-mile grid to overlay on the NAIP imagery. Using the Generate Tessellation tool in ArcMap, we generated a 2-mile by 2-mile vector (polygon) grid and used the BTPD overall range layer as the extent. The 2-mile by 2-mile grid was then converted to a raster using the Feature to Raster tool which was used to generate a spatially balanced mapping order for the grid cells. To create a spatially balanced grid using Generalized Random Tessellation Stratified (GRTS) Sampling, we used the Create Spatially Balanced Points tool in the Geostatistical Analyst toolbar in ArcMap to generate a point file with the raster created above as the input. The inclusion probability was equal for each grid cell. The number of points was equal to 11,232, which is the same as the number of grid cells in the raster. The map order was then generated using the FID of the point file, which was intersected with the 2-mile by 2-mile grid.

Observers systematically searched each cell at a scale of 1:4,000. Searchers were randomly assigned grid cells from within the study area to allow spatial evenness of any observer related effects in detecting potential BTPD colonies. To ensure complete coverage of each grid cell and search consistency among observers, a smaller mini-grid comprised of 5 rows and 5 columns within each 2.0-by-2.0-mile cell was generated. Given a cell, observers initialized searches by starting in the northwest corner. Observers then worked their way to the southeast corner scanning the cells of the mini-grid one at a time on a row-by-row basis. Observers visually inspected each grid cell in order of the spatially balanced selection and digitized those areas judged to be potential black-tailed prairie dog colonies (subsequently referred to as “features”). Observers zoomed in and out on the images depending on the geographic area and the feature to be digitized. Using the Freehand tool in ArcGIS, observers drew a boundary around the outermost burrows that could be identified on the aerial imagery. For some features, visible clip lines of vegetation were observable to help identify the outermost burrows. Digitizers did not digitize the feature perimeter by following the clip line in an effort to provide consistency across years with variable vegetation growth and to produce the most comparable results through time. Observers digitized the entire perimeter of the potential colony that overlapped the assigned grid cell. Even in situations where the centroid of the polygon did not belong to the cell assigned, the observer still digitized the entire potential colony. This occurred frequently and required a common geodatabase to be updated nightly with each observer’s mapping for the day so that each new grid cell that was to be mapped could be viewed with features that may have overlapped into the new grid cell from previously digitized adjacent grid cells.

Observers participated in training exercises involving the presentation of aerial images showing known BTPD colonies. Images of ant colonies, rocks, patches of bare ground, etc. were included in the training exercises to help observers develop a search image for active or inactive colonies. BTPD burrows are usually surrounded by mounds of bare soil one to three meters in diameter. Mounds are often of a different color than surrounding surface soil. Vegetation is typically reduced, or absent, contrasting in texture with vegetation outside the clip line. The size of mounds, color contrasts, presence of clip lines, and distances between mounds together form the search image by which digitizers seek to identify potential BTPD colonies.

Double Sampling Methods

To estimate of the probability an observer missed a potential BTPD colony during initial review of the 2.0-by-2.0-mile cell (false negatives), an additional observer independently digitized detected features on a double sample of 10% (1,123) of the grid cells in the sampling frame. Grids to be double-sampled were selected using GRTS Sampling with the methods used above to create the overall mapping order for the 2-mile by 2-mile grid. During the double-observer process, we started from scratch and did not have any polygons mapped from a previous mapper. Because the double-observer selection was only 10% of the cells and also spatially-balanced, we had very few, if any, cells that were adjacent to one another so the issue of polygons overlapping into adjacent cells was minimized.

After the second observer digitized the features in a grid cell selected for a double sample, the two observers met to reconcile the grid cell. The process of reconciliation involved discussion and editing to obtain one set of digitized features that each observer can agree on. The initial observer was designated as the primary observer. The optimal scenario occurs when both observers find and digitize the same feature in an assigned cell or when they agree that no features are present. If features are present, the two observers discuss each feature and make decisions about the size and shape of the potential colony in question. To obtain the “reconciled” feature, either an originally sampled feature is selected, or the primary observer re-digitizes the feature while the secondary observer is present.

Another scenario occurred when one observer found and digitized a feature missed by the other observer. In this case, the observers discussed the feature in question and made the decision whether it was a potential colony or not. When observers decided it was a potential colony, the primary observer was responsible for “re-digitizing” the reconciled feature while the secondary observer was present. This could be done by digitizing the colonies in a grid from scratch, but more often it involved copying a portion or all of one of the original polygon(s) in the cell. The observers deleted polygons they decided were not potential colonies. Original polygons digitized by each observer were recorded in their original shapefile and post-reconciliation polygons were recorded in a reconciliation shapefile. With these different sets of shapefiles, it was possible to compare the size of original versus reconciled ploygons.

Appendix B

Aerial Truthing of Black-tailed Prairie Dog Towns

Feature Selection Protocols

Due to limitations of aerial and ground truthing, the polygons were selected using both inclusion and exclusion criteria. The first step was to apply three inclusion criteria to the polygons identified as of August 1, 2020. All three criteria comprise different linear road shapefiles; these are the Highways, Local Roads, and Major Roads shapefiles from the OTIS website. To increase the probability that identified features could be surveyed during ground truthing, all three were restricted in similar ways to ensure the inclusion of paved roads. The Highways shapefile excluded all roads that variable PRISURF identified as "5 Unpaved (OnSystem)." The Local Roads shapefile excluded all roads that variable SURFNAME identified as either "11 Other", "13 Primitive," or "14 Unimproved." Finally, the Major Roads shapefile excluded roads that variable SURFNAME identified as either "11 Other" or "14 Unimproved." Following shapefile subsetting with these road attribute data, each line shapefile was then buffered by 25 meters, thus creating 50-meter-wide sampling strips. Resulting polygonal shapefiles for each of the inclusion criteria were then combined by a union operation to create one final inclusion polygon for the state.

We also utilized three exclusion criteria for polygons in the aerial sample. For this effort, 41 airports, 152 cities, and 10 military installations were excluded from surveys. The first criteria excluded polygons within 1 km of airports, where 1-km-radius circular polygonal extents originate from a point shapefile. The second criteria excluded polygons within 100 meters of city boundaries. Finally, the third criteria excluded polygons that overlap the identified Colorado polygonal military installations. Polygonal shapefiles for each of the three exclusion criteria were then combined through a union operation to create one final exclusion polygon for the state. All shapefiles originated from the CDOT (Colorado Department of Transportation) OTIS (Online Transportation Information System) Data Catalog, with the exception of the military installation shapefile, which originated from the Military Surface Deployment and Distribution Command.

Digitized polygons intersecting the polygonal inclusion set, with at least some extent outside the exclusion set, were then identified as valid candidates for truthing. In an effort to optimize the survey time spent examining colonies, and reduce time traveling between polygon clusters, the sampling frame was reduced to two geographic subsets, the North region and the South region. Two subsets in opposite quarters of the state also serves as a practical means of examining the variability in the proportion of digitized polygons that were ultimately identified as active.

The first area comprised the northern portion of the state demarcated by a buffer 100 kilometers each side Interstate 76, i.e., the “North region.” Interstate 76 follows the South Platte River in a northeasterly direction from Denver in the center of the state to its northeast corner, thus served as a natural partition. The North region contributed 23,607 polygons for possible selection.

The second region, or the “South region,” focused on the southeastern quarter of the state, with New Mexico and Kansas serving as the southern and eastern boundary. Colorado State Route 109 formed the western extent from Las Animas County Road 90 south to the terminus of 109 near Kim, Colorado. At its terminus, the western extent extended south to the New Mexico border. The northern extent followed County Road 90 east until Ninaview, Colorado, at which point a diagonal to Lamar, Colorado formed its northwestern extent. U.S. Routes 50 and 400 from Lamar to the Kansas state line formed the rest of its northern extent. The South region contributed 2,222 polygons for possible selection.

The area between the North and South regions makes up the Middle region.

Within the combined northern and southern geographic extent, 436 polygons (382 in the North and 54 in South) were randomly selected for aerial truthing with balanced acceptance sampling (BAS). The BAS sampling paradigm ensured spatial heterogeneity across the sampling frame. Once visited, features were identified as either "Active," "Inactive," or "Null." Active described those polygons with obvious recent prairie dog sign or individuals observed, while the inactive category describes polygons that were former prairie-dog colonies with no sign or individuals visible. The null category subsumes all digitized polygons that are something other than prairie-dog colonies, e.g., anthills or ground squirrels. The proportion of polygons identified as active or inactive was used to adjust the estimated acreage and number of potential colonies digitized to correct for false positives (i.e., digitized polygons that are not active or inactive BTPD colonies).

Appendix C

Aerial Truthing
STANDARD OPERATING PROCEDURES

Equipment Checklist - The following equipment should be taken on board the aircraft each day of the survey:

- Laptop or iPad with fully charged battery, and power cord and inverter,
- GPS/GPS puck,
- Pencils and clipboard,
- Maps of region showing topography, locations of airports, and prairie dog features,
- Printed list of potential prairie dog features,
- Cell phone with the appropriate numbers programmed

All flights will be conducted in accordance with Colorado Parks and Wildlife Administrative

Directive P-4 Aircraft Operation, Maintenance, Acquisition Equipment.

Health and Safety - The safety of the crew should be the first consideration each day.

Observers/Aircraft – There will be one observer in a Cessna 185 Skywagon The observer will primarily be responsible for collecting data on the prairie-dog towns, however he/she will also aid in navigating the pilot to the next BTPD feature.

Timing of Surveys – Surveys should begin on or after August 15th and end no later than October 31st. Surveys will be conducted during daylight hours, starting at sunrise and ending at sundown subject to the following weather conditions and local flight restrictions.

Weather Restrictions - The relative safety of each flight will be determined in the field, is the responsibility of the pilot & observers, and will depend upon weather conditions and local flight restrictions. The pilot and the observer will determine if the standard survey protocol can be followed in a safe manner. If the pilot in consultation with the observer determines that surveys cannot be conducted safely, surveys will be halted until conditions improve.

Flights – Safety should be the primary concern during the survey. Surveys will be conducted at an approximate airspeed of 100 knots per hour, and the aircraft will be maintained at a safe 300 ft. above the ground level (AGL) to complete the surveys.

Off-Feature Flight – The pilot will determine the most appropriate airspeed and altitude for flying between features and airports.

Black-tailed Prairie Dog Features - An equal probability sample of approximately 400 features identified on NAIP imagery will be selected for aerial truthing by balanced acceptance sampling (BAS) (Robertson et al. 2013).

Observer will fly with an IPad/Laptop/Cellphone loaded with an appropriate application and pre-cached maps for navigating as well as the boundaries of BTPD towns (features). Pilots will also have a waypoint for the middle of the feature to aid in navigation. Observer will have the pilot fly to the feature that is being truthed. Once at the feature the observer will need to define if the target is actually a black- tailed prairie dog town and if so is it:

- **Active**: Black-tailed prairie dogs observed or fresh diggings at burrow entrance.
- **Inactive**: No black-tailed prairie dogs observed, no fresh diggings, and no evidence of current use by black-tailed prairie dogs.
- **Null**: Is not a black-tailed prairie dog colony.

Recording Other Pertinent Data – Flight path will be recorded using the observer's GPS unit. The observer should record the start time of the survey, sunrise, and landing as well as changes in weather and visibility throughout the survey. Weather information will include estimated cloud cover percentage (0 to 100% CC), air temperature and wind speed.

Data Entry and Back-Up – At the end of each survey day, the observer will be responsible for transmitting the field data to the lead for this project. This will help ensure that any discrepancies/errors in the field data forms are corrected while the survey and data are fresh in the minds of the crew. At the end of each survey day, waypoint locations and survey information should be saved using DNRGPS (https://gisdata.mn.gov/dataset/dnrgps). Include the date in the file name.

Restricted Airspace and Other Restrictions on Flying - Before the flight period begins, the pilot and observers will identify which features will be surveyed and if any features or off survey flight lines cross restricted airspace. If the features are recognized as running through restricted airspace, over new housing/office building development, or close to a grass fire and access cannot be obtained or it is deemed unsafe, then the closest feature on the sample list should be flown if logistically feasible. The only circumstances under which features can be dropped or not fully surveyed are: grass fire, restricted airspace, crossing over large housing or industrial developments, sudden dangerous weather, or limited visibility. Every effort must be made to identify restricted airspace prior to survey flights. If features intersect a farmyard, town, housing development, feedlot, etc., then the part of the feature which can be surveyed without harassing people or livestock should be viewed and waypoints on boundaries be recorded. The pilot should increase elevation and, if possible, avoid harassment of people or livestock.

Appendix D

Ground Truthing of Black-tailed Prairie Dog Features
STANDARD OPERATING PROCEDURES

Equipment Checklist - The following equipment should be taken in the field each day of the survey:

- Laptop or iPad with fully charged battery, and power cord and inverter,
- GPS/GPS Puck,
- Pencils and clipboard,
- Maps of region showing topography and prairie dog features,
- Printed list of potential prairie dog features,
- Binoculars and spotting scope,
- Cell phone with appropriate numbers programmed

Timing of Surveys – Surveys should begin on or after September 1st and end no later than October 31st. Depending on weather conditions, surveys can be conducted during any daylight hours, starting at sunrise and ending at sundown.

Black-tailed Prairie Dog Features – A representative sample of approximately 100 features identified for aerial flights will be selected for ground truthing. The biologist will navigate with an IPad/Laptop/Cellphone loaded with an appropriate application and pre-cached maps for navigating as well as the boundaries of BTPD towns (features). Once at the feature the biologist will need to define if the target is actually a black-tailed prairie dog town and if so is it:

- **Active**: Black-tailed prairie dogs observed or fresh diggings at burrow entrance
- **Inactive**: No black-tailed prairie dogs observed, no fresh diggings, and no evidence of current use by black-tailed prairie dogs (fresh feces, tracks, etc.).
- **Null**: Not a black-tailed prairie dog colony

If there is any doubt that the road(s) leading to a target are public, the observer should comment that the target cannot be ground truthed because there is no access on public roads.

Recording Other Pertinent Data –The biologist should record the time at each feature. Weather information should include cloud cover percentage (0 to 100% CC), air temperature and wind speed.

Data Entry and Back-Up – At the end of each survey day, the biologist will be responsible for transmitting the field data to the lead for this project. This will help ensure that any discrepancies/errors in the field data forms are corrected while the survey under question is fresh in the mind of the observer. Recorded data will also serve as a backup in case field data forms are lost or damaged during the study.

Restricted Travel – Crews will stay on public roads and lands for this survey.