# PROJECT TITLE: Understanding population dynamics of Gunnison's prairie dogs and associated vertebrate species in New Mexico

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PROJECT OBJECTIVE: To understand the population dynamics of Gunnison's prairie dogs in different parts of their range and their consequent effects on associated vertebrate species.

PROJECT PURPOSE & NEED:

*Background* - **Prairie dogs (*Cynomys* spp.) play important roles in shaping the central grasslands of North America** [1,2]. By grazing and clipping vegetation they create a low mat of dense forbs and grazing tolerant grasses, and dot the landscape with numerous mounds [1,2]. Their colonies represent unique islands of open grassland habitat that attract numerous animals, such as burrowing owls (*Athene cunicularia*) and mountain plovers (*Charadrius montanus*), and predators that rely on prairie dogs as a primary food source, such as coyotes (*Canis latrans*), American badgers (*Taxidea taxus*), raptors, and the highly endangered black-footed ferret (*Mustela nigripes)* [2–5]. Although the magnitude of these impacts can vary by prairie dog species, colony density, or other site-specific factors, prairie dogs play important ecological roles in grasslands across their range [2].

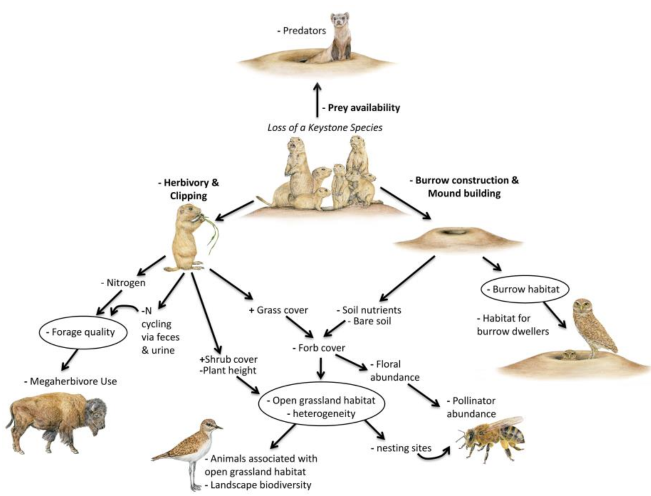


**Figure 1.** Conceptual diagram illustrating how the loss of prairie dogs cascades throughout an ecosystem. Drawings by Sharyn N. Davidson.

Prairie dog populations have declined by about 98% over the last century [6], and are consequently identified as a *Species of Greatest Conservation Need* (SGCN) by the state of New Mexico. Much of their decline is due to poisoning, introduced sylvatic plague, habitat loss, shooting [6], and increasingly, climate change in the southern portion of their range [7,8]. **The dramatic decline in prairie dogs has resulted in consequent losses in associated species and grassland habitat**. Indeed, because prairie dog populations have undergone severe numerical reductions, their key ecological roles have been greatly diminished throughout much of their geographic range. Loss of prairie dogs has resulted in declines in species associated with the habitats they create, including the burrowing owl and mountain plover, and those dependent or heavily reliant upon prairie dogs as prey, including black-footed ferrets and ferruginous hawks (*Buteo regalis*) [2,9]. Additionally, grasslands have been invaded by shrubs in areas where black-tailed prairie dogs (*Cynomys ludovicianus*) have been poisoned in the southern portion of their range, demonstrating their role in maintaining grasslands and the ecosystem services they provide to humans [8,10].

Prairie dogs are needed in large numbers across the greater grassland landscape in order to support associated species and maintain unique islands of important grassland habitat and associated biodiversity [2]. Because of their ecological importance, there is much interest in restoring and protecting their populations [7]. Our long-term research in the southern portion of their range in New Mexico and Mexico shows that both established and restored prairie dog colonies in more xeric environments have low population densities and are highly vulnerable to drought. Climate change increases this vulnerability [7,8]. Colonies in the more mesic parts of their range occur naturally at much higher densities and can thrive and rapidly expand following reintroductions. However, these colonies often require intensive management to prevent their extirpation from plague ([6] and D. Long, personal communication). Consequently, some of the most pressing questions facing grassland management and conservation are: 1) How do we successfully restore prairie dog colonies and their functional role to grasslands? and 2) Where should we focus our conservation efforts under a rapidly warming climate?

*Purpose* – **The purpose of our proposed research is three-fold. <u>First</u>,** *we aim to evaluate the population status and dynamics of a newly established (since 2010), large-scale restoration of prairie dogs at the Sevilleta National Wildlife Refuge (NWR) in central New Mexico*. This study is different from our previous smaller-scale Sevilleta NWR prairie dog reintroduction study initiated in 2005, recently published in the *Journal of Wildlife Management* [7], in that it is much larger-scale and has received intensive management attention by the FWS, including population augmentation and supplemental feeding. Our goal is to understand if this reintroduction effort, which has been strongly supported by NMDGF and USFWS, is exhibiting success and long-term viability, especially given the intensive management approach taken compared to, and informed by, our previous study [7]. Notably, a recent review in *Science* on wildlife reintroduction found that only 23% of all reintroductions are successful, and success is often determined by habitat quality, proximity to the core of the species' range, and the number of individuals initially translocated [11]. The long-term (multi-year) success of reintroductions is critical information for guiding management, but is rarely evaluated, and this information is lacking for most prairie dog reintroduction efforts because of logistical constraints [7]. Live trapping of prairie dogs is intensive, and is especially challenging in habitats with tall vegetation and where individuals are widely dispersed and occur at low densities, such as at the Sevilleta NWR. So, **<u>second</u>**, as part of the above effort, w*e will compare live trapping versus camera trapping methods with the long-term goal of using lower cost, less invasive camera trapping as a reliable method to assess trends in prairie dog abundance over a longer time frame.* Specifically, we will evaluate prairie dog populations and abundance using both live-trapping and camera-trapping methods in New Mexico, at the Sevilleta NWR and in a montane grassland habitat at the Valles Caldera National Preserve (NP). Camera trapping is showing promising new capabilities for monitoring wildlife populations, providing even better population trend estimates than live-trapping[12,13], and may be useful for monitoring prairie dog populations at the Sevilleta NWR and elsewhere throughout the State. **<u>Third</u>,** *we will quantify the role of prairie dogs in supporting vertebrate communities in New Mexico.* We will conduct this research at our reintroduced colony complex at the Sevilleta NWR (xeric site) and an established complex at the Valles Caldera NP (mesic site), using camera traps to compare the number and species of vertebrates (including NM SGCN species) occurring on and off the prairie dog colonies over time. By doing so, we will be able to: 1) evaluate if the functional role of reintroduced prairie dogs at the Sevilleta NWR shows signs of being restored, 2) quantify predation on newly released prairie dogs at the Sevilleta NWR, and 3) assess how vertebrate communities associated with prairie dogs in these two different habitat types (xeric vs. mesic) may provide insights into where management and conservation should focus future conservation priorities within the state.

### *Experimental design*

At the Sevilleta NWR, we established four Gunnison's prairie dog colonies in 2010 and installed 3-ha trapping plots on each colony (Fig. 2). Each colony is paired with an off-colony plot (i.e., no prairie dogs). During the second year of this project (FY2016), we will install a similar set of paired on-colony and off-colony plots at the Valles Caldera NP, across an established, naturally-occurring Gunnison's prairie dog colony complex, for a total of eight plots.

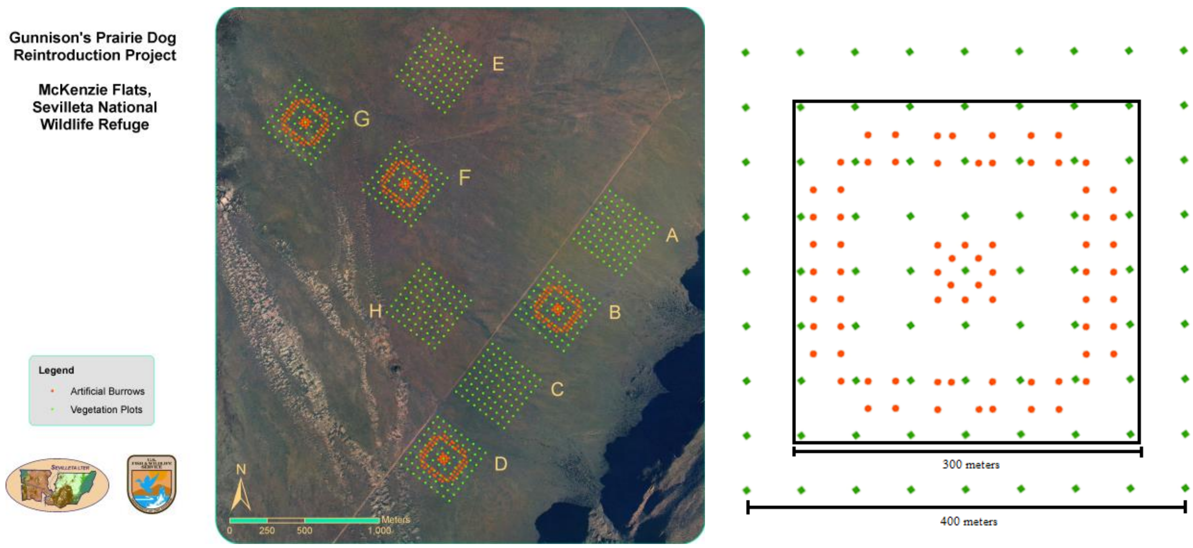


**Figure 2.** A) Layout of study plots at the Sevilleta NWR originally established in 2010, showing on colony (B, D, F, & G) plots and off-colony (A, C, E, H) plots. B) Layout of a 3-ha trapping plot at the Sevilleta NWR, where live and camera trapping will occur. Note that natural prairie dog burrows now exist throughout the trapping plots.

BULLETED LIST OF COMPLETED PROCEDURES:

### *Prairie dog reintroduction and population dynamics*

- Live Animal Trapping
  - Conduct annual capture-recapture 3-day live trapping in June of each year (after pups are born) at the Sevilleta NWR and Valles Caldera NP.

    COMPLETED: Live-trapping of prairie dogs was completed in June 2015 at the Sevilleta NWR (Fig. 3). We also have completed analysis to estimate abundances of prairie dogs from the June 2015 live-trapping data.

**Figure 3.** Photo of live-trapping effort at the Sevilleta NWR**.**

- Camera Trapping
  - Run camera traps March – November in four on-colony (i.e. , with prairie dogs) and four off-colony (i.e., without prairie dogs) 3-ha

study plots to assess over-winter population survival, population recruitment, and summer population survival at both study sites.

COMPLETED: Forty camera traps were installed at the Sevilleta NWR in Spring 2015, with five cameras located on each of the 3-ha trapping study plots. The GPS locations of all camera traps have been recorded and mapped in ArcGIS (Fig. 4A). All photos (nearly 500,000) have been georeferenced and catalogued, and the first run of occupancy analysis has been completed and reported here. Two Humboldt State University senor undergraduate students in the Wildlife Department helped catalogue all photos, and were an integral part of this project. Additionally, multiple volunteers were invaluable in helping to collect the camera trap data in the field.

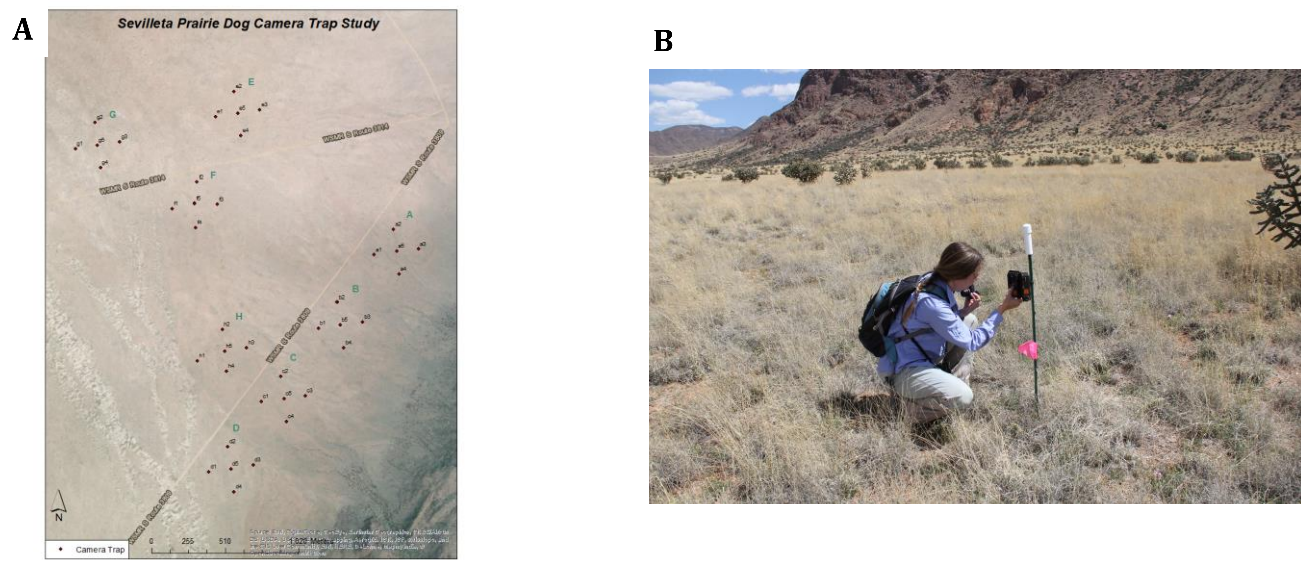


**Figure 4.** A) Location of the camera traps on each of the 3-ha study plots at the Sevilleta NWR. B) Photo of camera trap installation at the Sevilleta NWR.

TIMELINE:

| **Activity** | **Time period** |
|---|---|
| Purchase & install cameras at Sevilleta NWR | Spring 2015 (FY2015) **COMPLETED** |
| Purchase & install cameras at Valles Caldera NP | Summer 2015 (FY2016) |
| Live trap prairie dogs at Sevilleta NWR | Spring 2015 – 2016 **COMPLETED 2015 TRAPPING** |
| Run camera traps at Sevilleta NWR | 3 seasons, Spring 2015 – Summer 2016 **COMPLETED 2015** |
| Run camera traps at Valles Caldera NP | 2 seasons, Spring 2016 – Summer 2017 |
| Analyze population & occupancy data | Fall 2015 – Spring 2017 **COMPLETED 2015** |
| Present results at professional meeting | Summer 2016 **FINAL REPORT PROVIDED DEC 31, 2015** |
| Write up and publish results | Fall 2016 – Spring 2017 |

PROJECT RESULTS: We used the 'unmarked' package in R to conduct occupancy analysis of prairie dogs and other vertebrates captured on and off the prairie dog colonies at Sevilleta NWR [14]. The Function used for occupancy analysis was occuRN [15]. Our cameras captured over 6000 photos of animals from over the spring, summer, and fall 2015. These photos show that many species show positive associations with prairie dog colonies, and many of these species are those that are known to associate with prairie dog colonies (Figs. 5 and 6). Burrowing owls (*Athene cunicularia*), black-tailed jackrabbits (*Lepus californicus*), desert cottontails (*Sylvilagus audubonii*), and badgers (*Taxidea taxus*) exhibited the strongest associations with colonies ($P < 0.05$; Fig. 6). Mule deer were the only species that were significantly more common off the prairie dog colonies ($P < 0.05$; Fig. 6). We were also able to obtain photos that capture behavior of vertebrate species on prairie dog colonies, such as a photo of a burrowing owl pouncing on a badger as it crossed a prairie dog colony in an attempt to chase the badger off the colony. Burrowing owls will engage in this behavior while prairie dogs are also sounding alarm calls of a predator entering a colony (Fig. 7E). This is a neat example of multiple species working together to fend off a shared predator. Additionally, our camera trap photos revealed new information on the emergence of pups from their burrows. Pups emerged in late May, and our cameras captured photos of the first pups on May 23rd. **Overall, our results suggest that the reintroductions of prairie dogs at the Sevilleta NWR has helped restore their functional role in the grassland ecosystem, and that the camera traps are able to capture large numbers of prairie dog photos.**

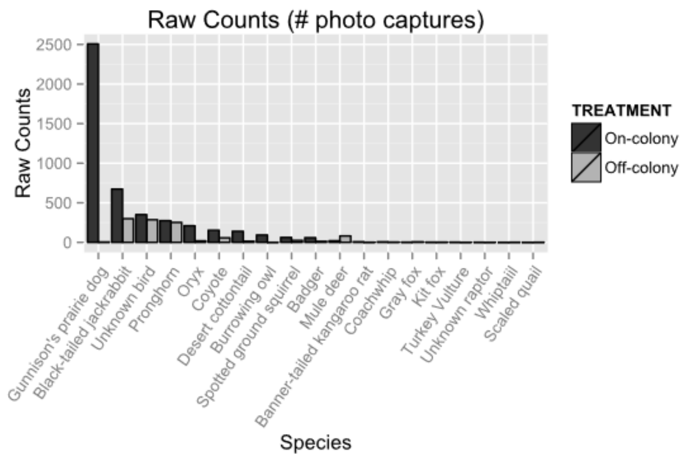


***Figure 5.*** *Camera trap photos taken on and off reintroduced prairie dog colonies at the Sevilleta NWR during spring 2015.*

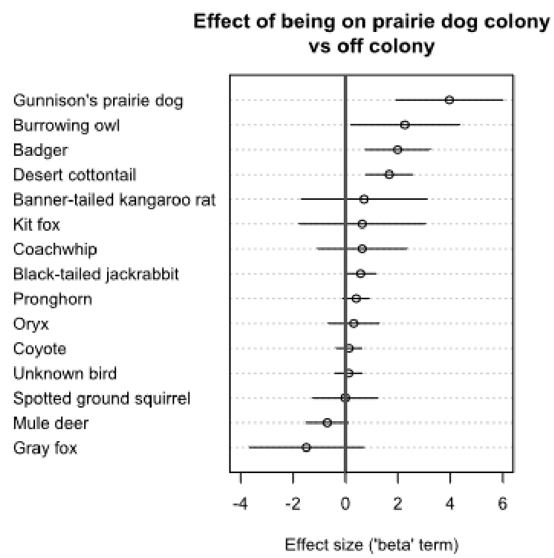


***Figure 6.*** *Effect sizes (with 95% confidence intervals) represent the increase in abundance of prairie dogs and other vertebrate species on prairie dog colonies versus off. Effect size is modeled here on a logarithmic scale. Species to the right of zero show a positive association with prairie dog colonies. Where the confidence interval does not cross zero, the result is significant at 95% CI.*


***Figure 7.*** *Photos from our camera traps at the Sevilleta NWR showing: A, B, C) prairie dogs, D) a coyote, E) a burrowing owl pouncing the back of a badger crossing a colony, F ) a burrowing owl on a mound and a spotted ground squirrel standing up next to the mound, G) a coachwhip snake looking over grass, H) a pronghorn, I) a black-tailed jackrabbit, J) pronghorn running, K) an oryx, and L) mule deer running.*

Our project originally aimed to evaluate the ability of camera traps to serve as a viable non-invasive sampling approach to understand trends in prairie dog population abundance over time. However, since the funding from our study was not continued after the first year, we are only able to compare one sample period of live trapping to one sample period of camera trapping. The only way to be able to address this question is to evaluate population trends over time, comparing the different methods. Nevertheless, we did compare the live trapping data we collected in summer of 2015 with the camera trapping data for 2015. Abundances from the live trapping data were estimated using a Bayesian robust design model, fitted in WinBUGS. These abundances represent total abundance of prairie dogs within each trapping grid. Abundances from the camera trap data are estimated from the Royle and Nichols (2003) model for estimating abundance from repeated presence-absence data [15]. *These estimates are not directly comparable with the abundance estimates from the live-capture analysis. However, it is informative to compare the relative abundance estimates among the three trapping grids derived from these two very different methods.*

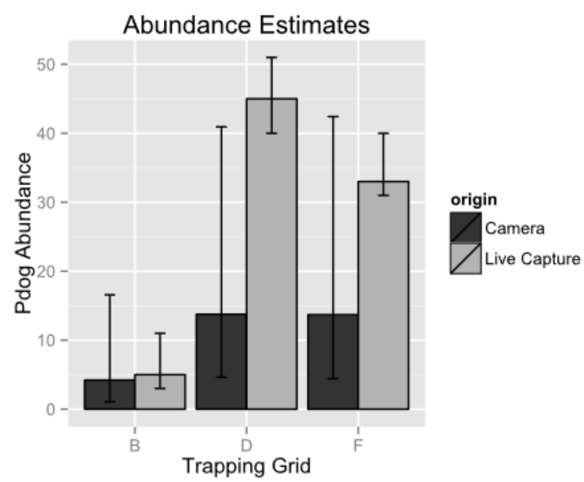


***Figure 8.*** *Estimated prairie dog abundance on the 3 study plots at the Sevilleta NWR 2015 based on camera trap and live trapping data.*

We will continue to work through our data and will provide NMDGF with any updates from our analysis. We acknowledge funding provided by NMDGF's Share with Wildlife program and State Wildlife Grant T-32-4.

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