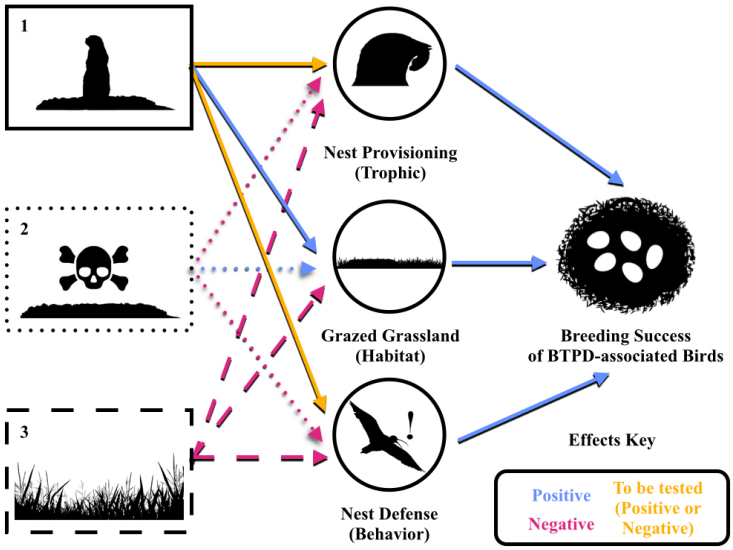
Introduction: Animal communities on North American grasslands were once structured by three primary disturbance forces: bison, fire, and prairie dogs. Like bison, black-tailed prairie dogs (*Cynomys ludovicianus*; hereafter BTPD) were eradicated during Euro-American colonization and now occupy less than 2% of their historical range. These social, colonial rodents are an often overlooked keystone species of the Great Plains: their intensive grazing and burrowing on their "towns" form landscape-scale disturbances that create open habitat which supports distinct animal communities, including many birds that are closely tied to BTPD towns or sometimes use them[1]. Avian occurrence patterns on BTPD towns versus surrounding grasslands have been described in their effects on habitat structure; however, we don't understand how trophic and behavioral aspects of BTPDs affect birds, which may respond positively or negatively depending on the species and interaction context. BTPD burrowing promotes more diverse and abundant arthropod communities[2] and could provide a resource bloom for birds, but BTPD grazing also decreases plant biomass and vertical structure for arthropods[3]. BTPDs use sophisticated alarm call networks for predator defense which birds may eavesdrop on[4] and use for nest defense, but BTPD towns attract predators that also eat birds[1].

These putative trophic-mediated and behavior-mediated effects could influence bird populations by affecting not just occurrence, but bird breeding success, which has rarely been studied on BTPD towns. Studying bird breeding success on and off BTPD towns would provide insight on the mechanisms underpinning BTPD effects on bird communities. Introduced sylvatic plague (*Yersinia pestis*) provides a natural experiment to test the mechanisms of BTPD ecosystem effects because the disease causes 95-100% BTPD mortality during outbreaks and causes BTPD towns to gradually return to grassland unless recolonized. This enables examination of unmodified grassland (no BTPD effects), inactive towns with recent plague (habitat effects only), and active towns (trophic, behavioral, and habitat effects). **I will investigate two mechanisms potentially driving BTPD effects on bird communities in an experimental framework by combining trophic ecology (feeding rates, arthropod and diet sampling, chick growth) and behavioral ecology (antipredator responses, nest survival) to compare overall breeding success (chicks fledged/nest) between grassland, active BTPD towns, and inactive, former BTPD towns (Figure 1).** I will focus my study on four bird species, representing two key groups of the bird community: 1) two open habitat species known to favor BTPD towns for breeding, and 2) two grassland species that breed adjacent to BTPD towns but which may benefit from BTPD effects. Songbirds [Horned Lark (*Eremophila alpestris*) and Chestnut-collared Longspur (*Calcarius ornatus*)], and shorebirds [Mountain Plover (*Charadrius montanus*) and Long-billed Curlew (*Numenius americanus*)] have tractable life histories for testing trophic and behavioral effects, respectively.



Hypotheses: (H1) the arthropod resource bloom will allow birds to feed chicks faster and promote chick growth rates on BTPD towns and **(H2)** the BTPD alarm network will serve as an early warning system that enables birds to have faster nest defense responses and higher nest survival on BTPD towns. Following that, **(H3)** all bird species will have higher breeding success (chicks fledged/nest) on BTPD towns over inactive towns and grassland, but **(H4)** known BTPD associates (lark/plover) will have higher breeding success than grassland species (longspur/curlew).

Study Site: The Northern Great Plains of Montana hosts the most intact temperate grassland ecosystem in North America. This vast stretch of public, private, and Native land, including Bureau of Land Management rangeland, Fort Belknap Reservation, and American Prairie Reserve (APR) will enable a landscape-scale study of BTPD effects, a rare perspective due to prairie fragmentation elsewhere.
Methodology: I will use a Before-After, Control-Impact (BACI) study design to test my hypotheses[5]. Annual mapping of BTPD towns within APR's grasslands forms a habitat matrix of Control (grassland)/Impact (BTPD town), while long-term monitoring of BTPD town activity provides a Before (active)/After (inactive) assessment of plague impacts. I will sample a minimum of 10 grassland sites, 4 inactive BTPD towns, and 10 active BTPD towns at least 1 km apart to avoid overlap between breeding birds. To compare breeding success between active towns, inactive towns, and grassland, I will **(R1)** determine trophic effects by analyzing arthropod composition from sweep-netting across habitats alongside feeding rate data from nest cameras, chick diet via molecular analysis of fecal samples, and by directly measuring chick growth. I will also **(R2)** study behavioral effects by conducting predator simulation trials with nest cameras and a remote control badger to measure two known predator vigilance behaviors (cryptic posture and defensive mobbing) of nesting shorebirds. I will score latency to attain cryptic posture and duration of posture, plus mobbing latency and intensity to see if nesting birds respond faster or harsher near BTPD alarm networks. I will evaluate differences in trophic and behavioral effects between treatments with structured equation models.
Intellectual Merit: Understanding how species interactions influence community composition has been a major goal of ecology for decades[6]. Despite their ecosystem engineering, prairie dogs and related social, burrowing, herbivorous mammals like marmots, bettongs, vizcachas are poorly understood globally[1]. My research would help fill knowledge gaps on this group with a unique natural experiment that melds trophic and behavioral ecology. These topics are often studied separately, but the importance of behavior in shaping community structure is increasingly recognized. Researching these effects in tandem will help us understand the potential mechanisms driving bird associations with BTPDs and provide novel insight into how keystone species affect breeding birds. I expect to produce: a literature review on known BTPD effects on birds, a checklist of birds that interact with BTPDs, and several publications. My findings will produce foundational knowledge that can be broadly applied to avian, trophic, and behavioral ecology, grassland community ecology, and keystone species theory.
Broader Impacts: Grassland birds are the most steeply declining birds in North America[7], while prairie dogs are persecuted as vermin across their range[1]. My project will provide actionable knowledge on prairie dog and bird community ecology and grassland restoration, and will thus contribute to ecosystem-wide and species-specific conservation strategies across the distribution of prairie dogs from Canada to Mexico. APR directly incorporates science into management, and my findings can be readily applied to conservation plans across their huge reserve. To further reach crucial stakeholders, I will conduct targeted local and international outreach. Locally, I will build on APR's partnership with Fort Belknap Reservation by developing an outreach plan in equitable collaboration with the Aaniiih Nakoda Community College so we can engage indigenous students in ecological and cultural exchange.

I will also convey the value of prairie dogs for bird conservation to federal and NGO stakeholders. This will enable practitioners to directly incorporate my findings into their conservation planning and in turn, promote them to managers across the U.S., Canada, and Mexico. I have already begun discussions with the Fish and Wildlife Service on filling demographic data gaps for declining species to maximize my research's conservation value. Lastly, my partnership with SCBI allows me to further disseminate my findings to a broad audience through their media resources. I will continue my efforts writing popular articles with them to engage a wide audience on the importance of prairie dogs and birds, grasslands, and their joint conservation.

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