# Trophic Ecology Warrants Multi-Species Management in a Grassland Setting: Modeling Swift Fox–Burrowing Owl–Mountain Plover Interactions on Black-tailed Prairie Dog Colonies

[1]Ryan A. Parker, MS Student; [2]Angela M. Dwyer, MS; [3]Cristi Painter, BS; [1]Laurel M. Hartley, PhD; [1]Diana F. Tomback, PhD; and [1]Michael B. Wunder, PhD
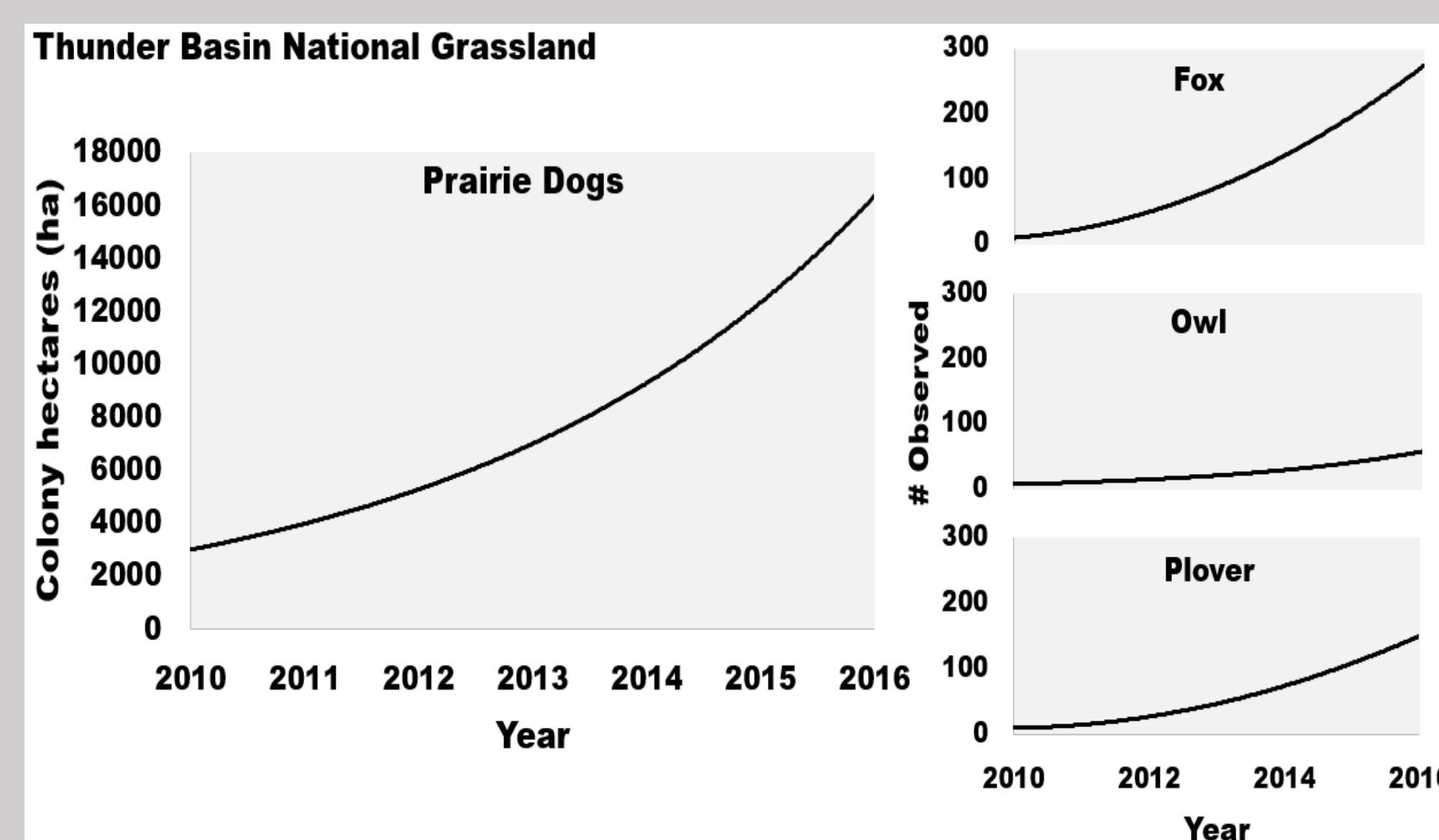
[1]University of Colorado Denver – Department of Integrative Biology, [2]Bird Conservancy of the Rockies, [3]U.S. Forest Service – Comanche & Cimarron National Grasslands

Background

- Black-tailed Prairie Dogs (*Cynomys ludovicianus*) engineer bare-ground habitat required for breeding Mountain Plover (*Charadrius montanus*), and provide nesting/denning opportunity and prey availability for Burrowing Owls (*Athene cunicularia*), and Swift Fox (*Vulpes velox*).

- Patterns suggesting trophic interactions emerged from trend data for co-occurring plovers, owls, and foxes collected on prairie dog colonies on the Thunder Basin National Grassland (TBNG) in eastern Wyoming.

- All are species of conservation concern → Multi-species management implications?
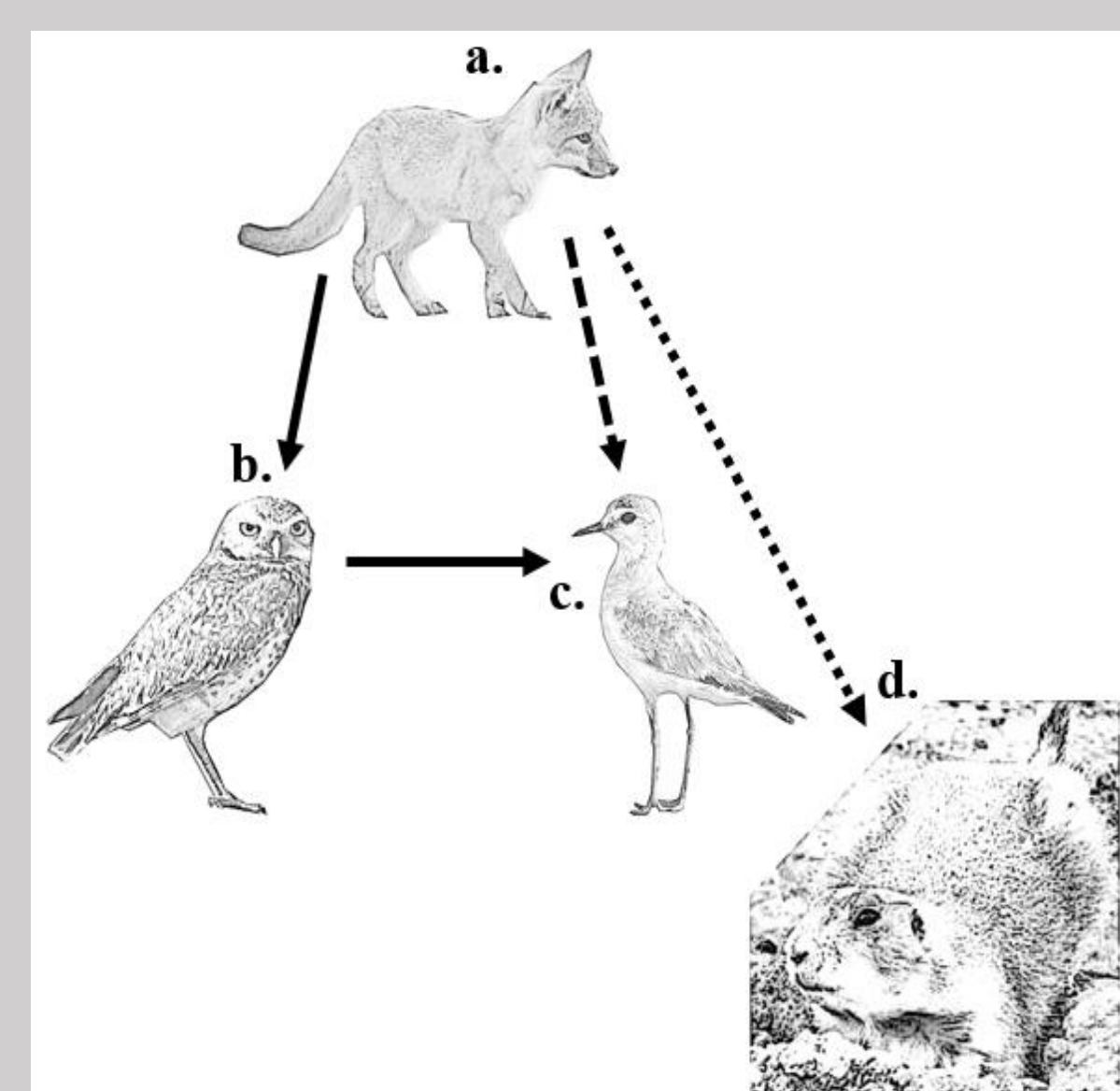
Left: We hypothesized that (a.) foxes consume (b.) owls (solid arrow) and owls consume (c.) plovers (solid arrow). Foxes also consume plovers (dashed arrow) and (d.) prairie dogs (dotted arrow), making this a highly interactive predator/prey community.
Right: Patterns in trend data for prairie dogs, foxes, owls, and plovers collected on TBNG between 2010-2016. (Parker et al. in review)

Methods

- Repeat Survey Effort: Multiple visits/occasions (3) at each site. N = 24 (year 2016), 36 (year 2017) prairie dog colonies, May-July, record presence/absence.

- Model estimates of Occupancy (Ψ), Detection Probability (*P*) using Robust Design single-species, multi-season models (program Mark, Package RMark). Will possibly include extinction (E) and colonization (G) parameters.

- Covariates: Colony size, area to perimeter ratio, presence of co-occurring sp., years since plague, prairie dog control, predation?

- Surveys: drive "weaving" transects across the entirety of a colony, 400m apart, frequently stopping to scan for plover, owl, and fox presence.

- Colony size ranges from 4 ha to 3000 ha

Right: Colonies surveyed for occupancy on TBNG. Category 1 (red) and 2 (blue) represent FS priority management areas as outlined in the Black-tailed Prairie Dog Conservation Assessment and Management Strategy (USFS, 2015).
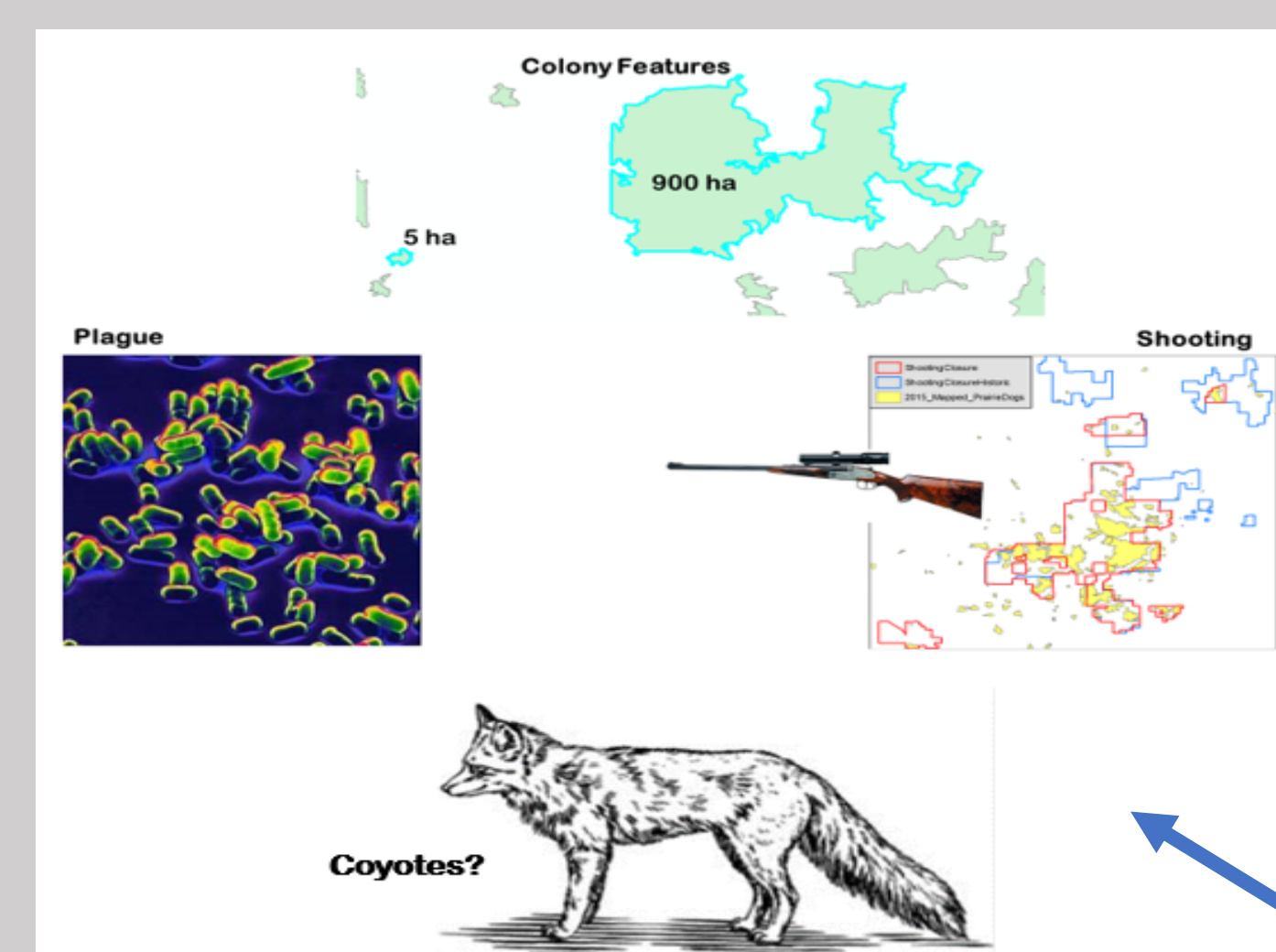
Questions

- To what extent does the rate of occupancy for plovers change as a function of colony size, area to perimeter ratio, plague, prairie dog control, predation?
  - For owls? foxes?

- To what extent does the rate of occupancy for plovers change as a function of presence of associated species?
  - For owls? foxes?

Study Area:

WYOMING
Thunder Basin National Grassland
Cheyenne

Hypotheses

- As colony area ⬆, occupancy of plovers will ⬆
  - Occupancy of owls will ⬆
  - Occupancy of foxes will ⬆

- When owls are present on a colony, occupancy of plovers will ⬇

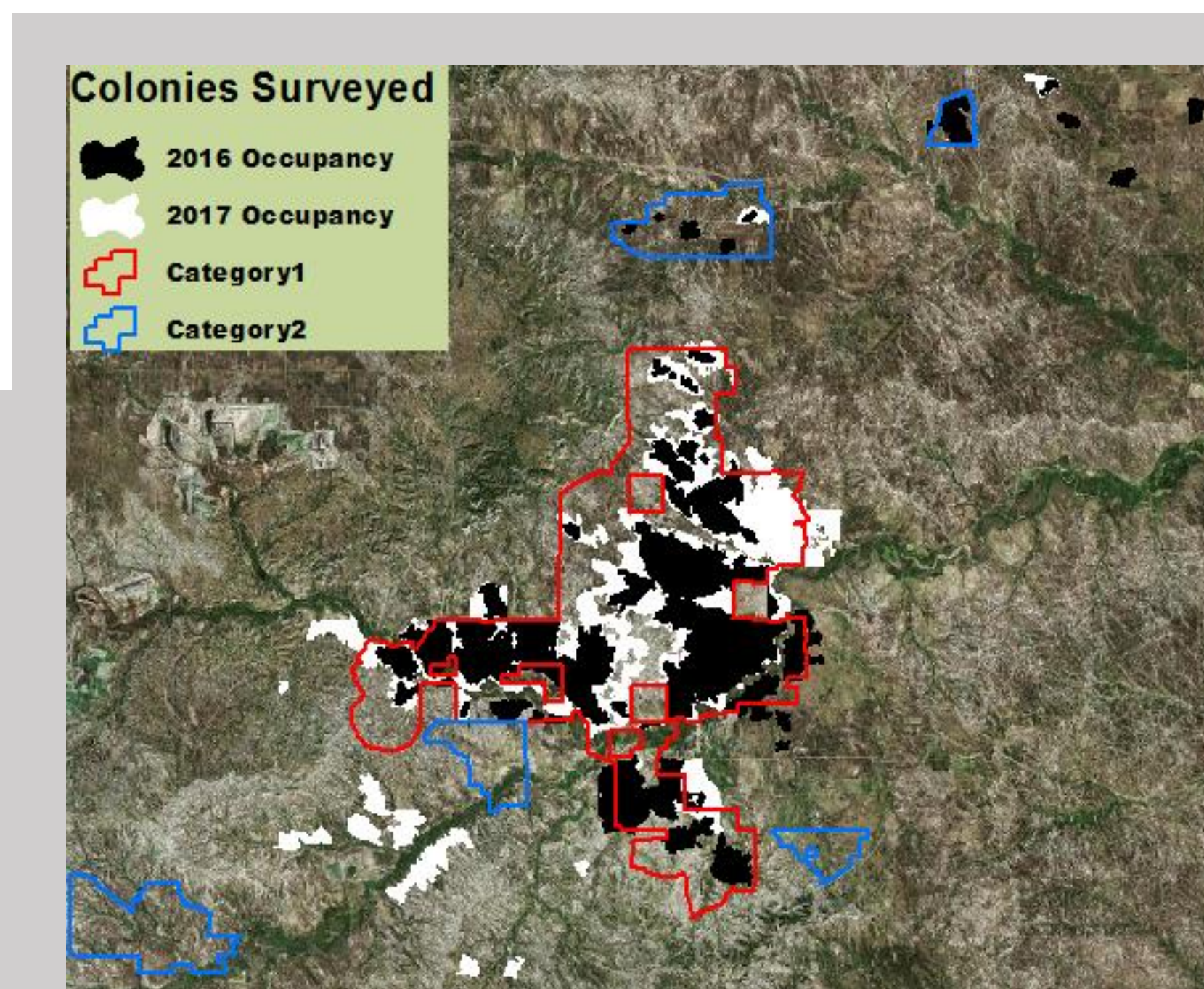- When foxes are present on a colony, occupancy of owls will ⬇

Preliminary Results

Right: Top ranked single-species, multi-season models for occupancy of plovers, owls, and foxes using Akaike Information Criterion (AIC), and reported using AIC_c for small sample size, with w_i representing model weights. Parameters include probability of occupancy Ψ and probability of detection p. Covariates include year 1 and 2 colony area, presence of fox, owl, and plover, and a constant (.) .

Ψ () p () Models, E(.) G(.)	ΔAICc	w_i
Mountain Plover		
Ψ (Yr2Area) p (FoxPres) ➕	0.000	0.342
Ψ (Yr1Area) p (FoxPres)	1.044	0.202
Ψ (OwlPres) p (FoxPres)	2.706	0.088
Burrowing Owl		
Ψ (.) p (FoxPres) ➖	0.000	0.258
Ψ (FoxPres) p (FoxPres)	0.597	0.191
Ψ (PlovPres) p (FoxPres)	1.826	0.103
Swift Fox		
Ψ (Yr1Area) p (PlovPres) ➕	0.000	0.305
Ψ (.) p (PlovPres)	1.226	0.165
Ψ (Yr2Area) p (PlovPres)	1.574	0.139

Moving Forward

- Expand models to multi-species, multi-season: address whether foxes and/or owls influence the presence/absence (rate of occupancy) of plover, or any combination of the three species.

- Determine which covariates best fit the proposed trophic interaction.

- Support multi-species management decisions for co-occurring species of conservation concern.

Acknowledgements and References:

Photo Credit: Cristi Painter

Email: ryan.parker@ucdenver.edu

"If you take away all the prairie dogs, there will be no one to cry for the rain…"
- Terry Tempest Williams

University of Colorado Denver
Bird Conservancy of the Rockies
U.S. Forest Service