TO BE* OR NOT TO BE*:

*detected

A STATE-SPACE MODEL OF MOJAVE DESERT TORTOISE LATENT OCCUPANCY, APPARENT OCCUPANCY, AND DETECTION PROBABILITY

ANNUAL DESERT CONSERVATION SYMPOSIUM   -   AUG 23RD, 2023   -   LAS VEGAS, NEVADA

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desert conservation
PROGRAM

INTRODUCTION

- We need to know:
    - where animals occur (i.e., is a given site occupied)
    - what is associated with their occurrence (e.g., covariates)
- The problem with most animals: imperfect detection

1.

1.

INTRODUCTION

- We need to know:
  - where animals occur (i.e., is a given site occupied)
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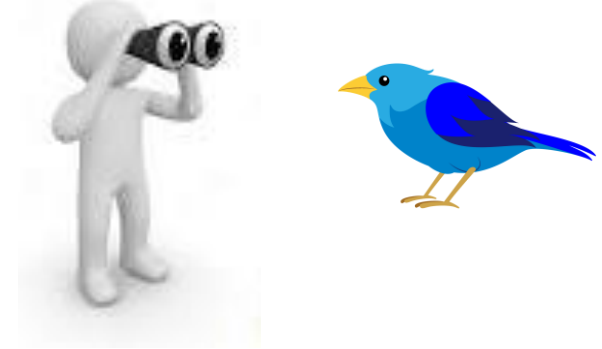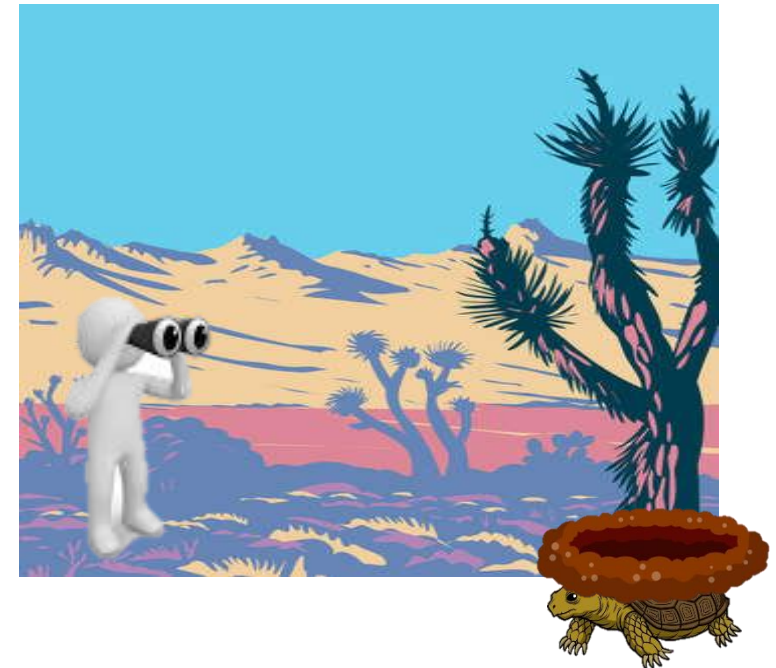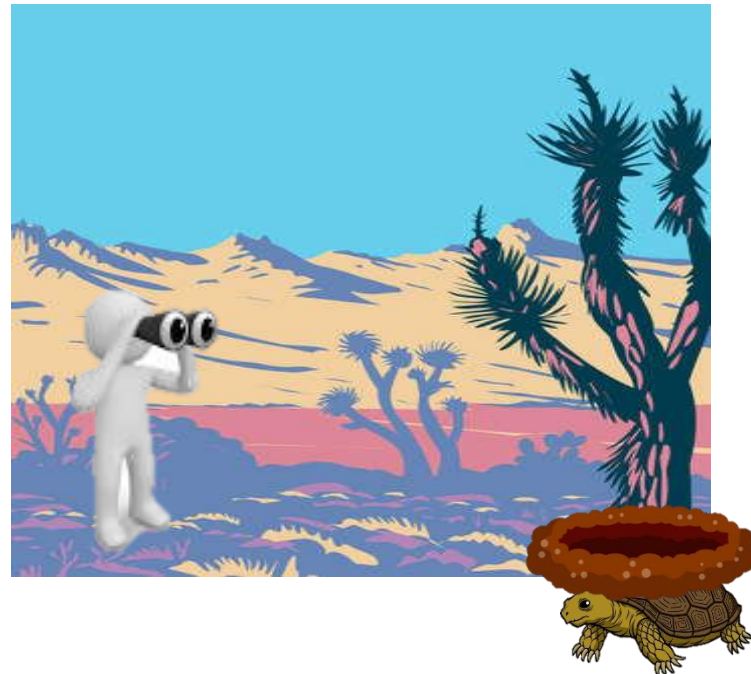- The problem with most animals: imperfect detection

SOLUTION!

1.
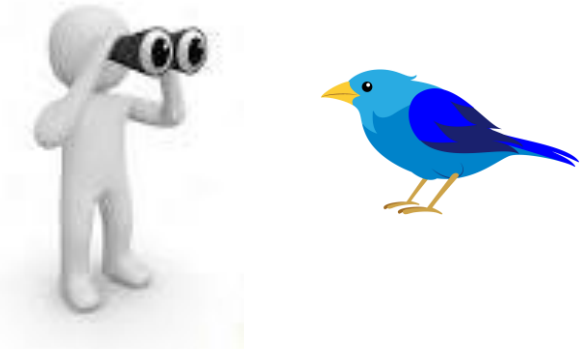
2.
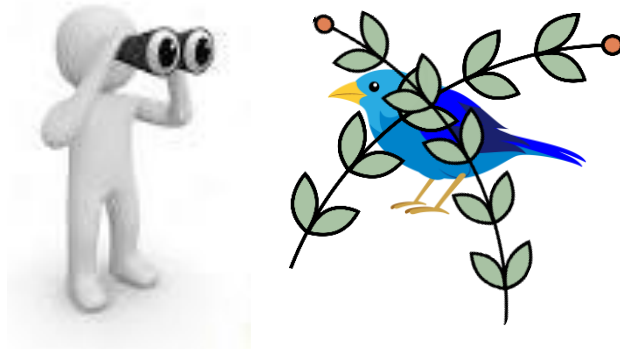
3.

INTRODUCTION

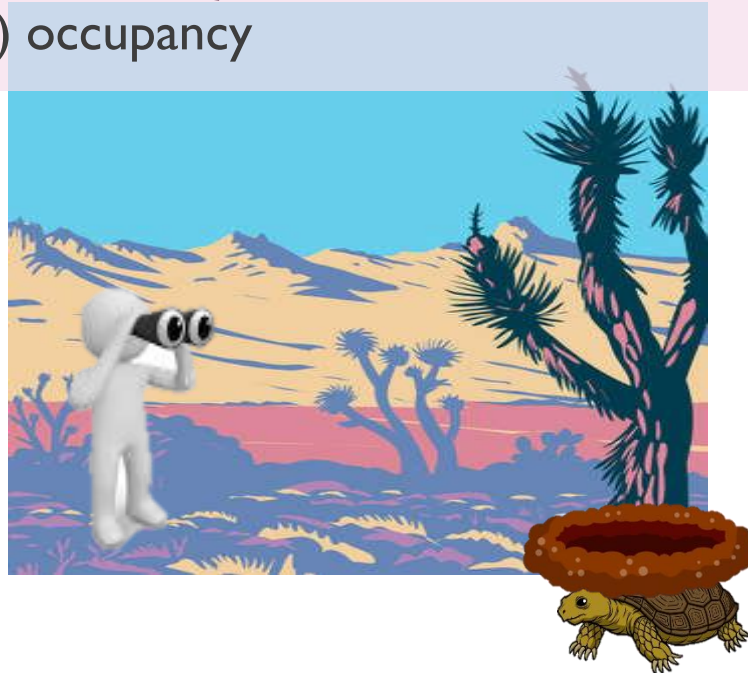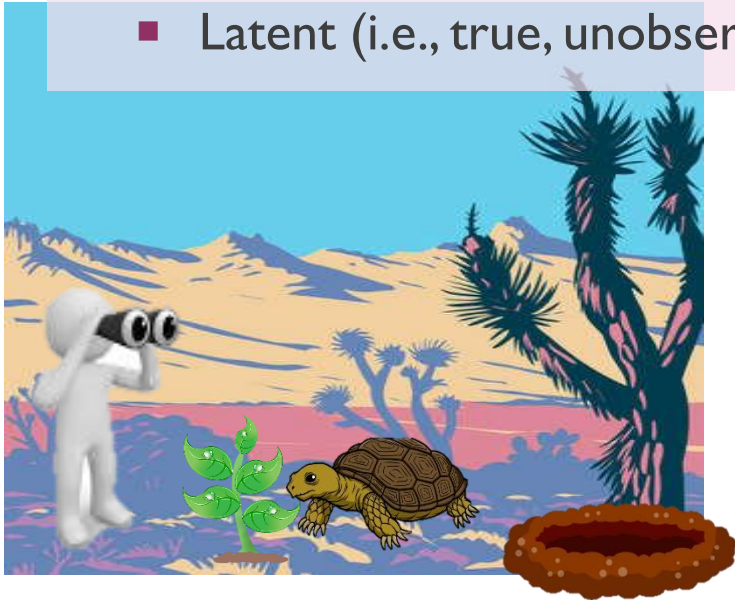* (and many plants, salamanders, insects, etc.)

- The additional problem with desert tortoises*:

  - Non-detectability highly variable

INTRODUCTION

- This study - Simultaneously estimate:
  - Detection probability
  - Apparent occupancy
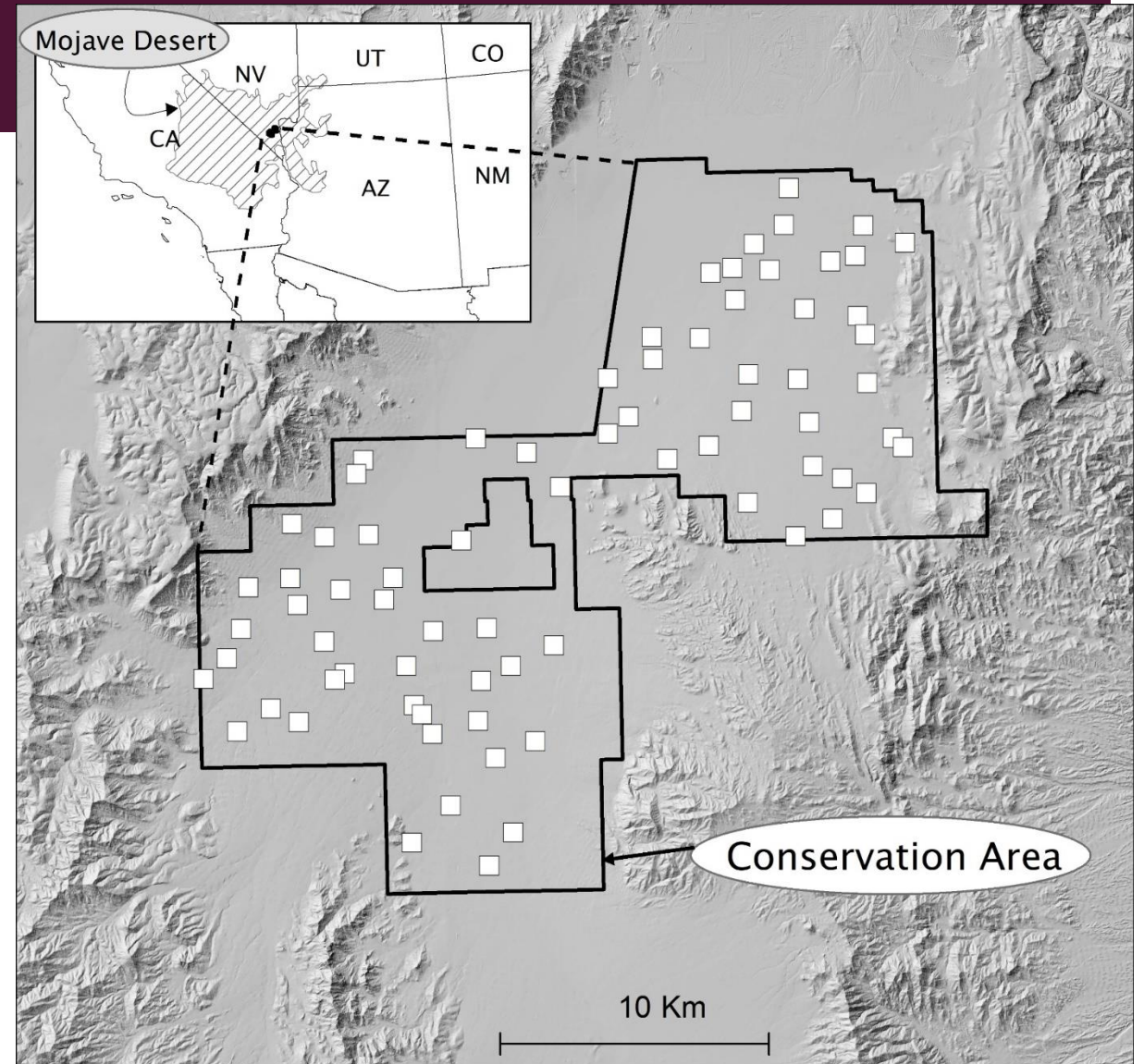 - Latent (i.e., true, unobserved) occupancy

Covariates

METHODS

- Occupancy surveys

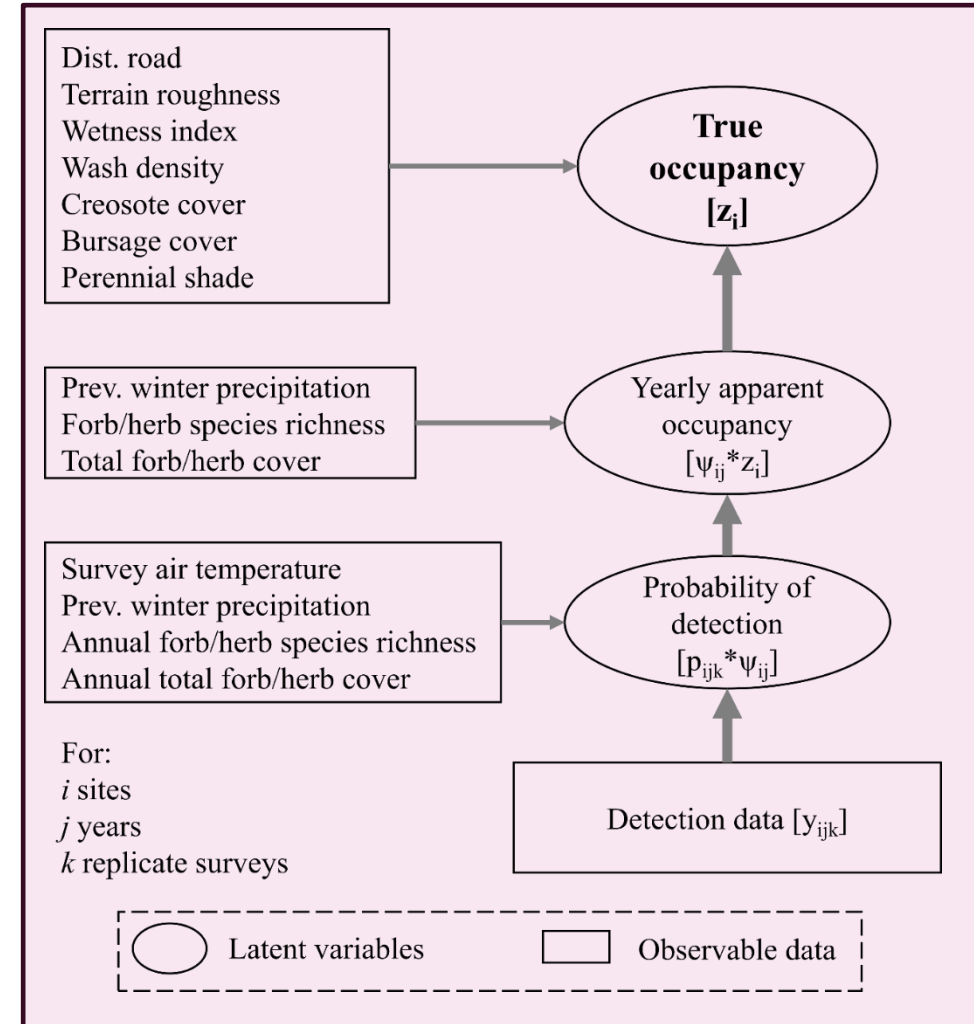| Year	# Plots	#Visits	# Plot-Visits
2014	75	3	225
2015	60	7	420
2016	60	7	420

- Plant surveys each year

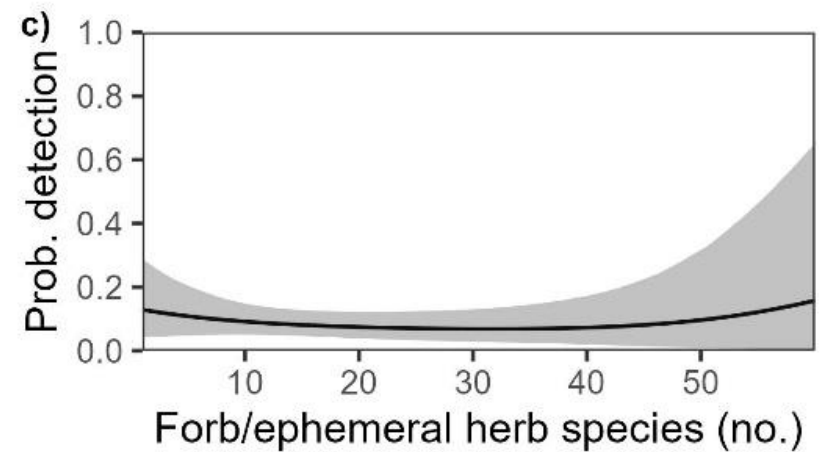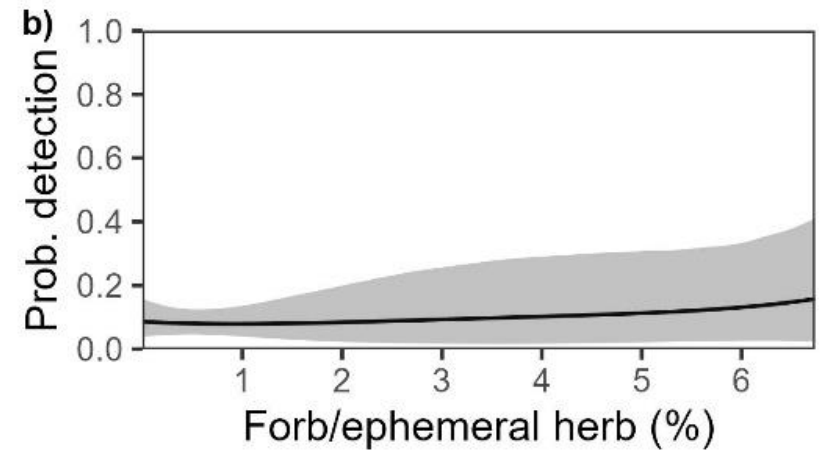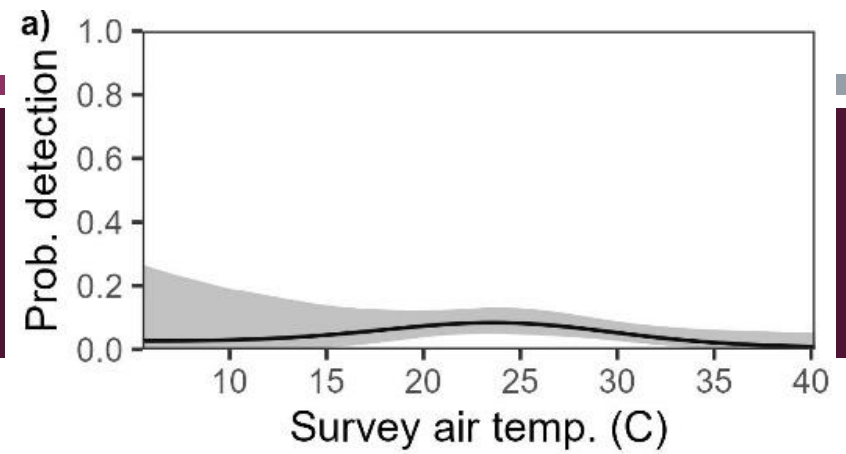– forb and ephemeral herbaceous cover and richness

METHODS

Expansion of Harju and Cambrin (2019)
"Identifying habitat correlates of latent occupancy
when apparent annual occupancy is confounded
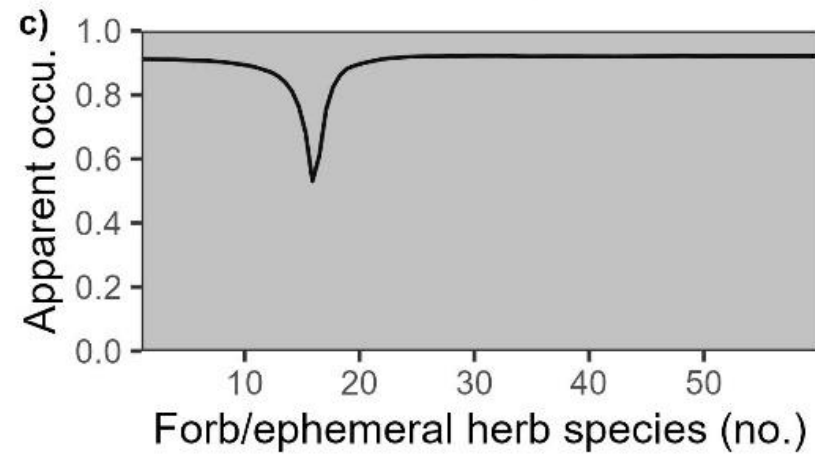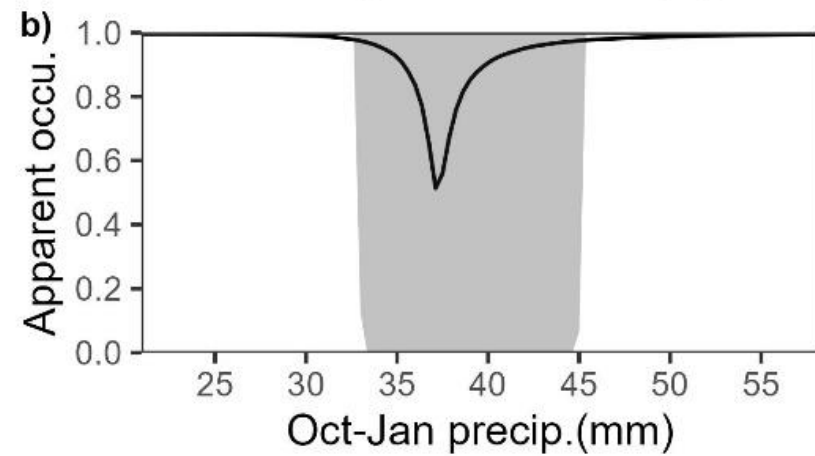with availability for detection

RESULTS

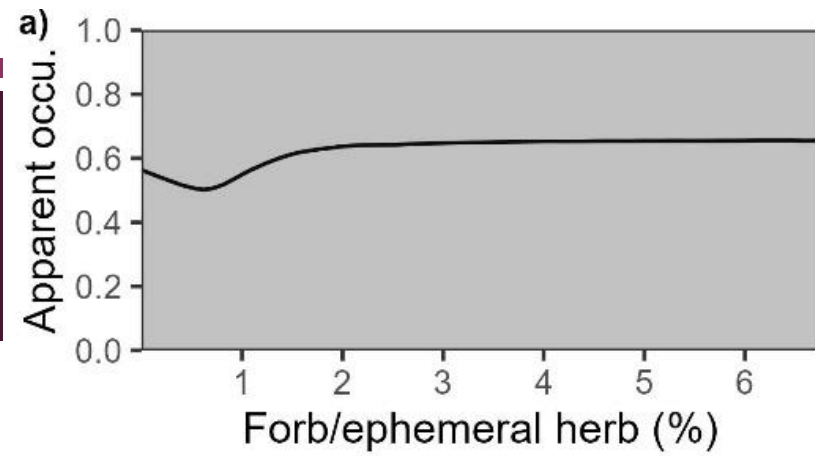Probability of detection

a) Prob. detection vs Survey air temp. (C)

b) Prob. detection vs Forb/ephemeral herb (%)

c) Prob. detection vs Forb/ephemeral herb species (no.)

RESULTS

Yearly apparent occupancy

↑

Probability of detection

RESULTS

True occupancy

Yearly apparent occupancy

Probability of detection
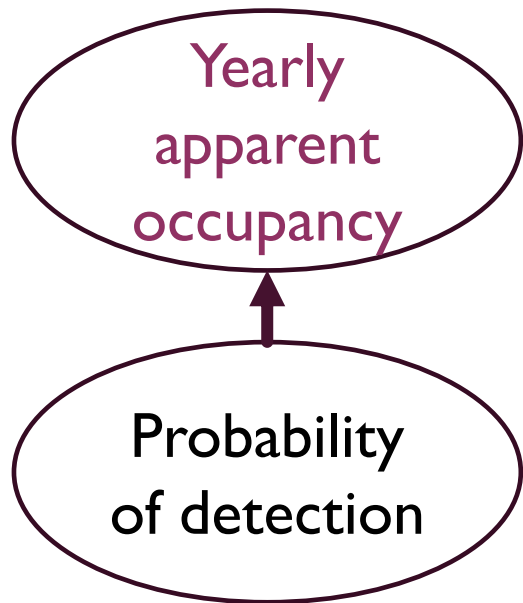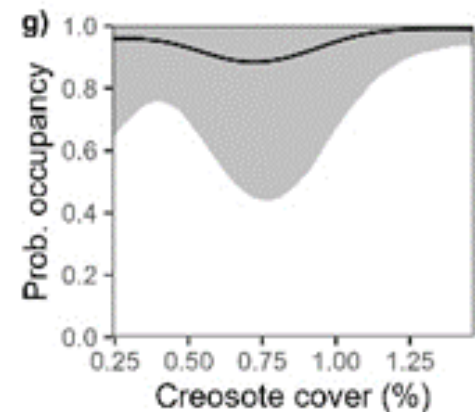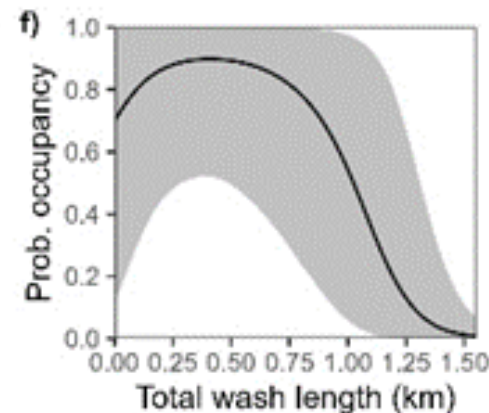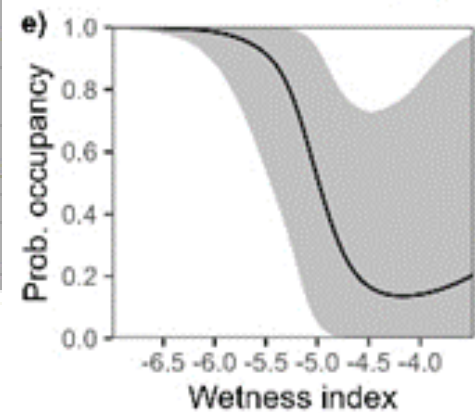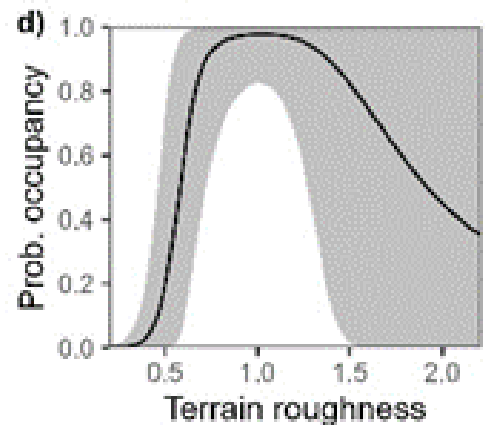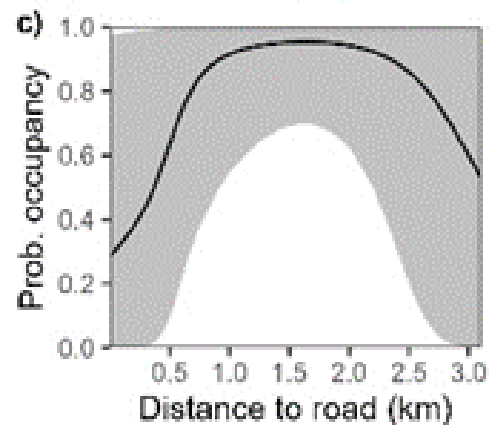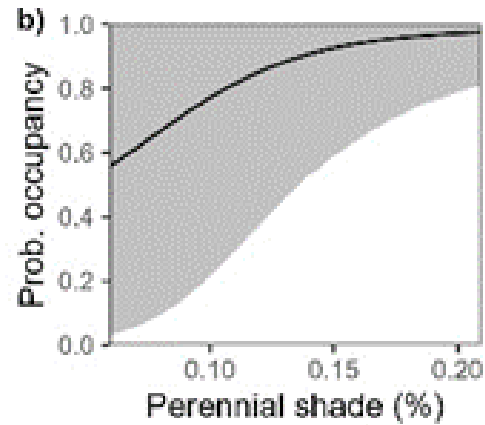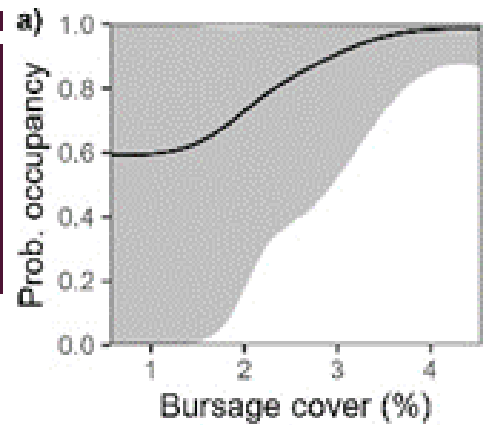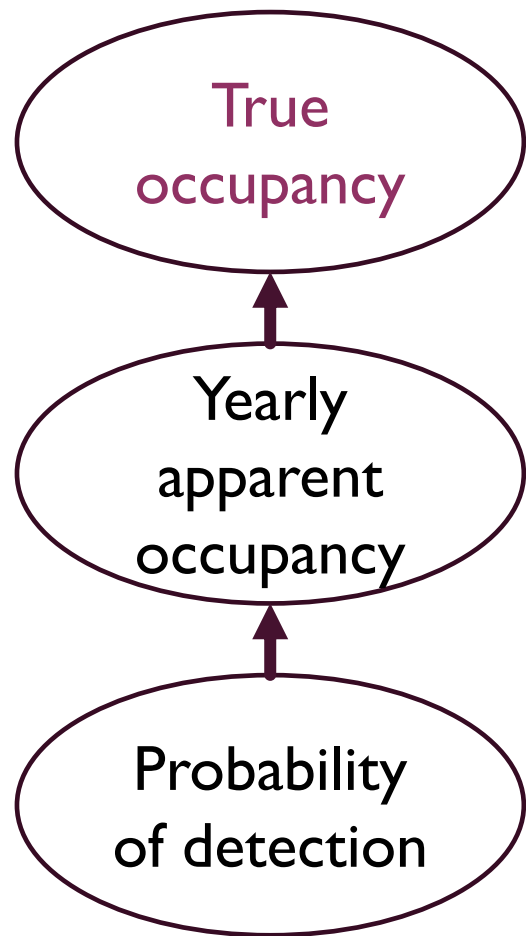
Proportion BCCE occupied (2014-2016)

Model-adjusted proportion: 0.51

41.7% higher occupancy

Naïve proportion: 0.36

Proportion of Boulder City Conservation Easement occupied
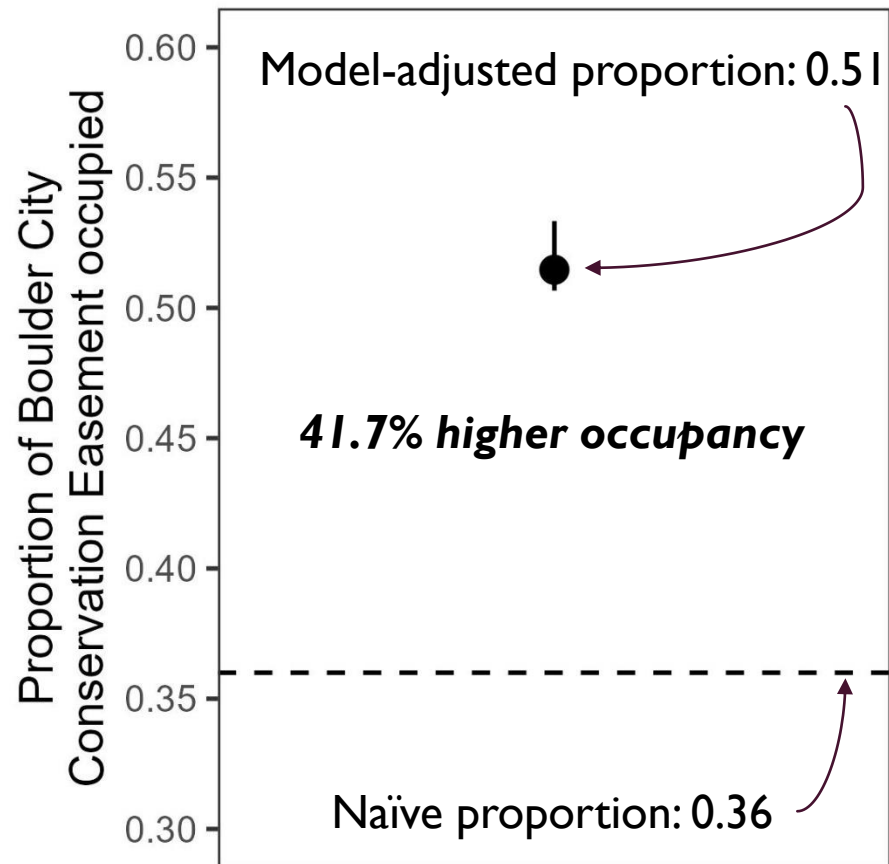
DISCUSSION

- Ignoring imperfect detection can bias estimation of relationships between landscapes and occurrence

- Imperfect detection results in occupancy rates biased low

- Sites can appear unoccupied, even when occupied

DISCUSSION

- <u>Detection probability</u>
  - Moderate temperatures
  - Higher forb and ephemeral herbaceous cover?
  - Probably not species richness

- More food and moderate temperatures more activity aboveground

DISCUSSION

- **<u>Yearly apparent occupancy</u>**
  - Nothing mattered!
  - Only three years, difficult to tease out trends
  - Nonetheless, no strong signal from previous winter precip or current food availability
   - not driving whether a site was more likely to *appear* occupied in a given year.

DISCUSSION

- ## True occupancy
  - Most variables mattered!
  - Topography and vegetation drive baseline patterns in tortoise occurrence
  - Higher bursage cover, more shade (opposite Todd et al. 2016)
  - Avoid roads, higher terrain roughness (Nafus et al. 2013)
  - Lower wetness, fewer washes (unexpected; Todd et al. 2016, Nafus et al. 2017)
  - Creosote unrelated (opposite Todd et al. 2016)
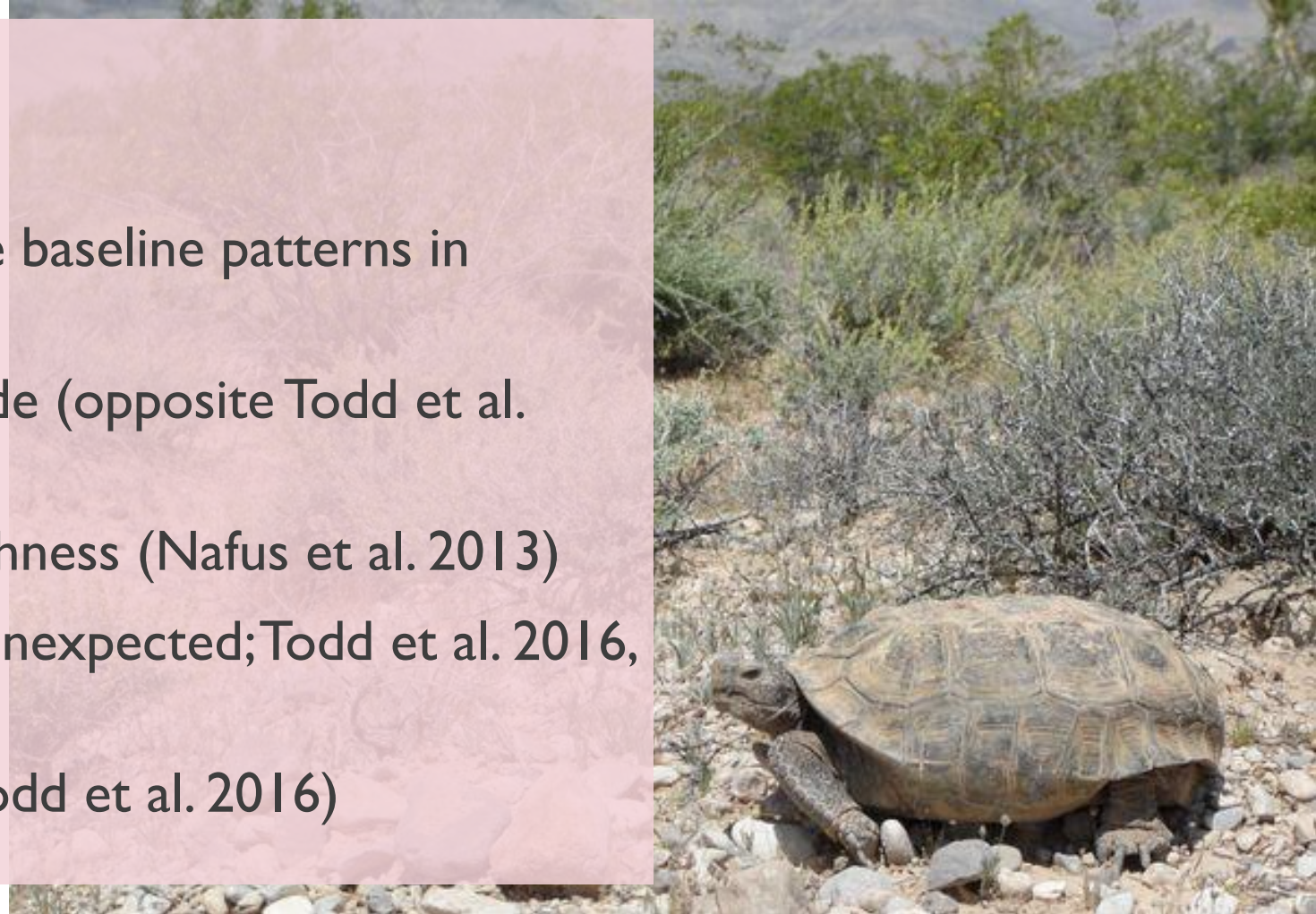
DISCUSSION

- True occupancy
  - Unexpected bursage, creosote, wetness, and wash density results
  - Possible explanation: different ecological processes and scales
    - Occurrence not the same as 3rd-order resource selection
    - For example: broad landscape features drive occurrence, and then selection occurs within those landscapes

THE END

Thank you for your attention.

Questions?

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