

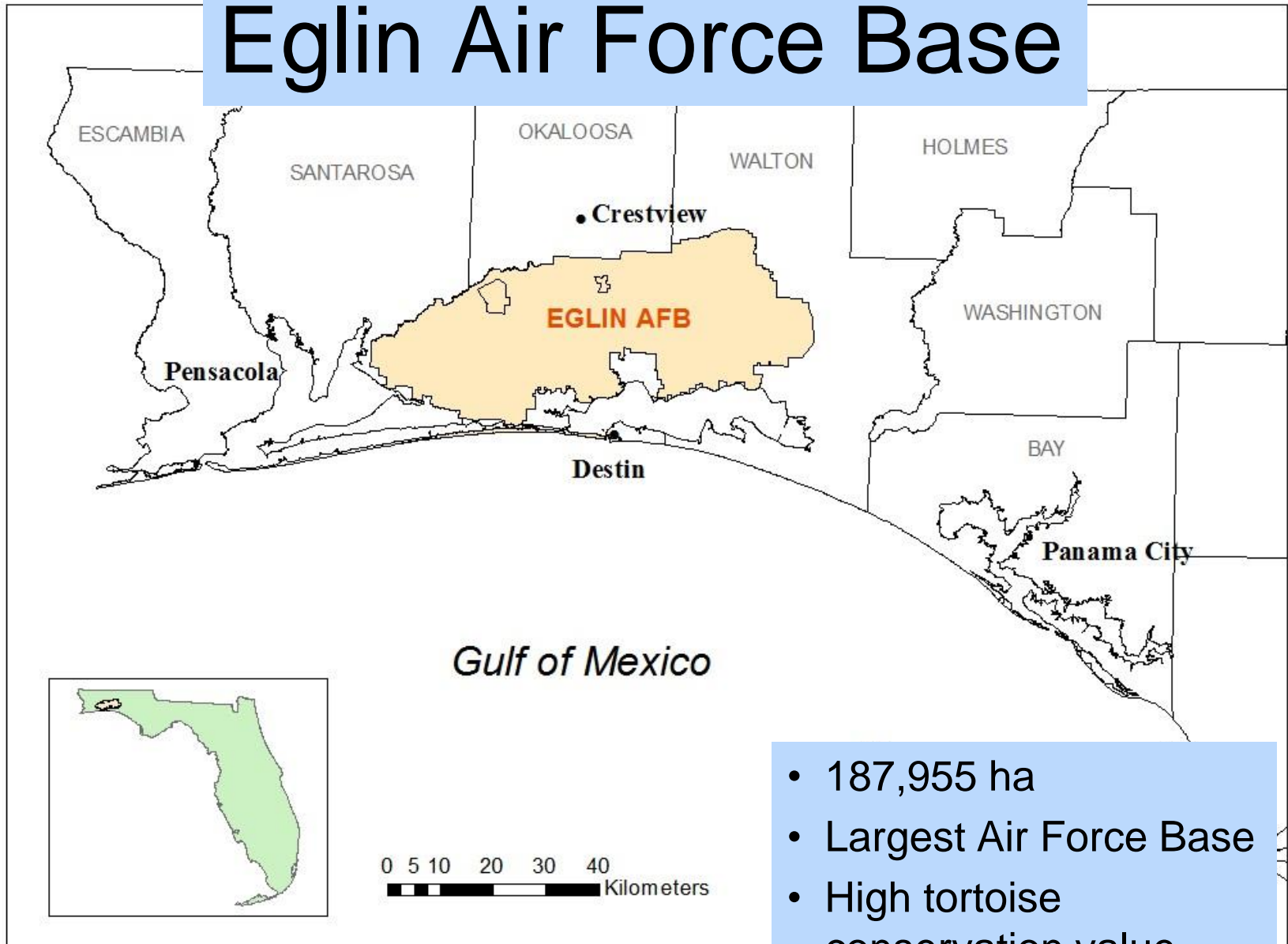
# Understanding Occupancy Patterns in a Low-Density Population of Gopher Tortoises (DoD Legacy Program Project 14-762)



Kelly Jones

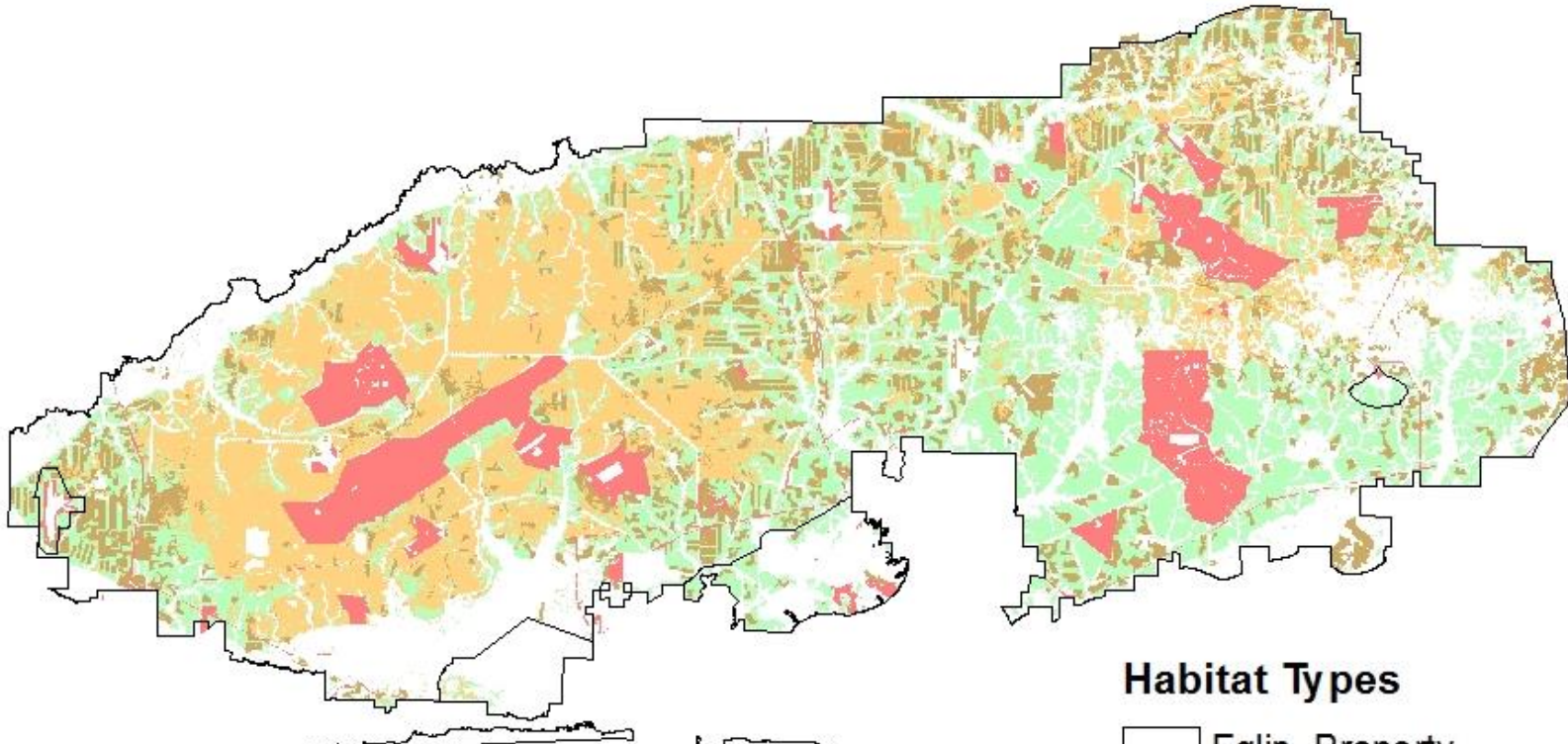
S.J. Goodman, T.A. Gorman, C.A. Haas, J.A. Smith, and H.C. Chandler  
Dept. of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA

# Eglin Air Force Base



- 187,955 ha
- Largest Air Force Base
- High tortoise conservation value

# Habitat and Management



## Habitat Types

- Eglin\_Property
- High-quality Sandhills
- Low-quality Sandhills
- Non-forested (Test Ranges)
- Pine Production
- Other habitats

- Primarily Lakeland soil series
- Prescribed fire of ~40,000 ha/year
- Recovered RCW population
- Highest potential habitat (DoD lands)

# Test Ranges vs. Sandhill Sites



# Tortoise Life History



- Fossorial
- Habitat for 300+ commensals
- Adult survivorship is key
- Construct/use multiple burrows

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# Status

- ESA candidate (Eastern Range)
- Eglin status – low-density and patchy
- Primary causes of decline
  - Fire suppression
  - Human consumption
- Currently, primary threats diminished on Eglin
  - Signs of recruitment

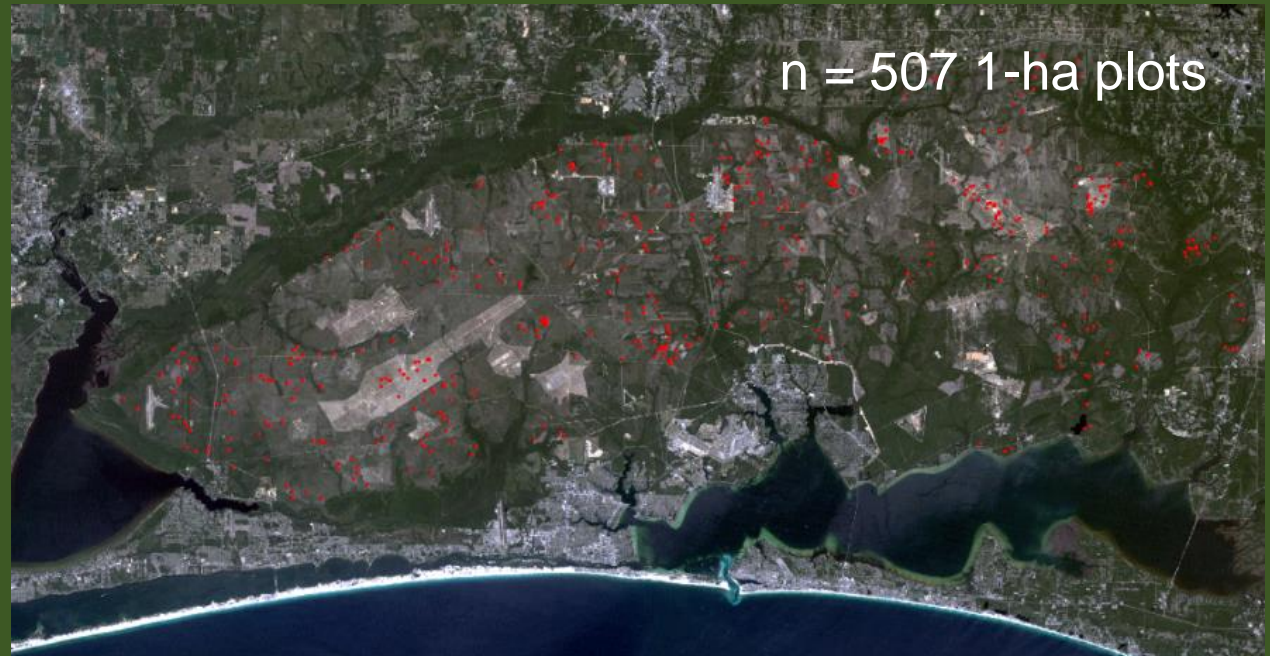


# Challenges to understanding patterns of distribution and in developing a monitoring program:

- Fossorial nature and low-densities of tortoises
- Clumped distribution across mosaic of habitat types and conditions
- Large landscape
- Limited resources
- No perfect approach
- **Need to assess ongoing conservation efforts**

# Occupancy Sampling

- Objective 1: describe patterns of distribution
- Objective 2: test approach for long-term trend detection





# Approach/Methods

- Stratified by habitat type and distance to known clusters of tortoise activity
- 10-meter **burrow** transects (1-ha plot size)
- Occupancy = presence of active or inactive burrows

# Stratifications

- Habitat category:
  - High-quality Sandhill
  - Low-quality Sandhill
  - Non-forested (Test Ranges)
  - Pine Production
  - Upland Pine
- Distance categories:
  - 0–60m
  - 60–1500m
  - >1500m

# Burrow Activity Status

Active



Inactive



Abandoned



# Data Summary

Habitat category	Distance category					
	60m		>60m<1500m		>1500m	
High-quality sandhills	39 (16)	36 (13)	55 (5)	19 (0)	85 (0)	35 (0)
Low-quality sandhills	6 (2)	6 (2)	34 (0)	15 (0)	66 (0)	31 (0)
Cleared vegetation	41 (19)	41 (20)	36 (3)	36 (4)	5 (1)	2 (0)
Pine production	7 (0)	6 (0)	36 (2)	21 (0)	59 (2)	26 (2)
Upland pine*	0 (0)	0 (0)	19 (0)	6 (0)	19 (0)	8 (0)

\*not used in occupancy analysis

n = 507 1-ha blocks

2<sup>nd</sup> survey at >50% of blocks (p)

Total occupied 1-ha blocks = 53

# Modeling Results

## Single-season occupancy model

Model*	AIC	$\Delta$ AIC	$W_i$	k
psi (habitat + distance), p (.)	276.65	0.00	0.47	7
psi (habitat + distance), p (time)	277.84	1.19	0.26	8
psi (distance), p (.)	278.70	2.05	0.17	4
psi (distance), p (time)	279.85	3.20	0.09	5

\*Only top four models shown

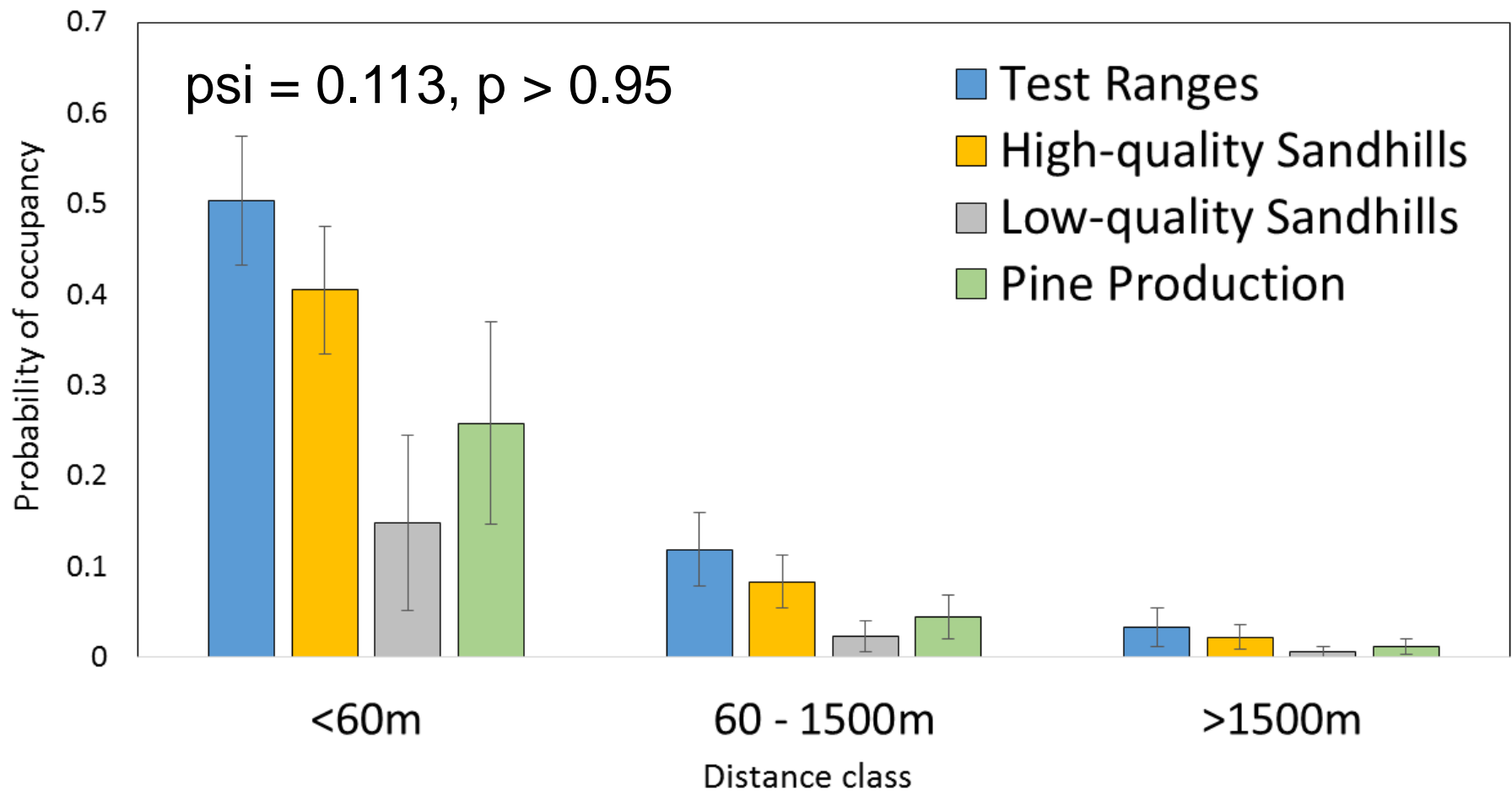
psi = occupancy probability

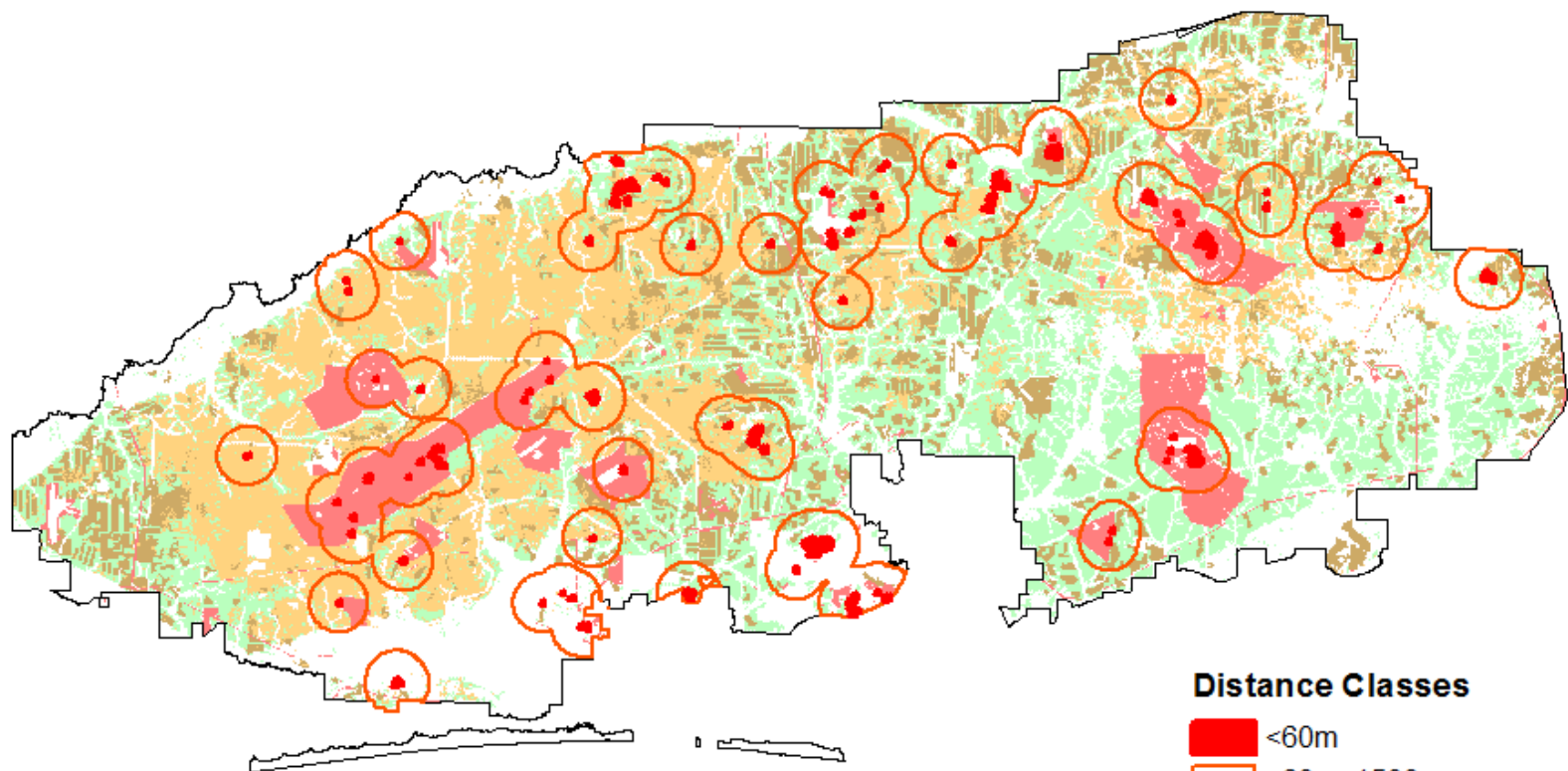
p = detection probability

k = number of parameters

$W_i$  = relative support of models

# Occupancy Results



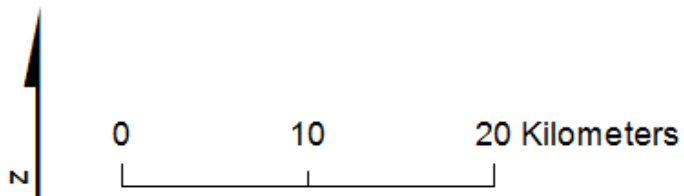


### Distance Classes

- <60m
- >60m<1500m
- >1500m (To Egin Boundary)

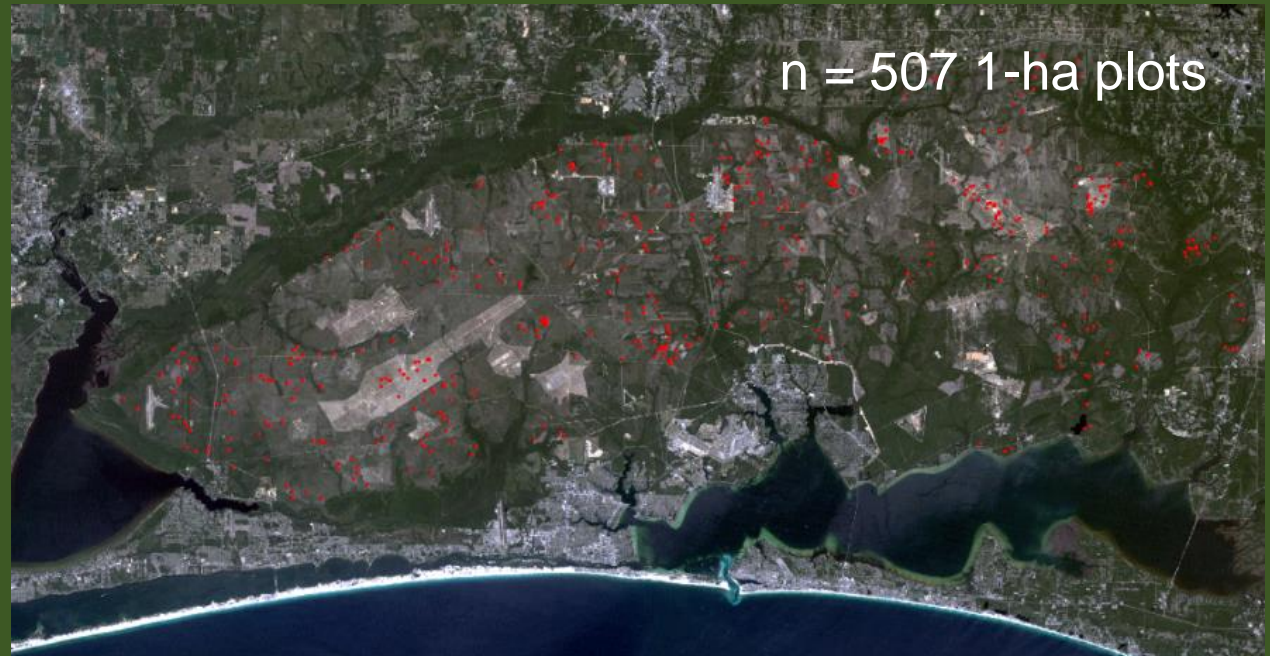
### Habitat Types

- High-quality Sandhills
- Low-quality Sandhills
- Non-forested (Test Ranges)
- Pine Production
- Unsuitable



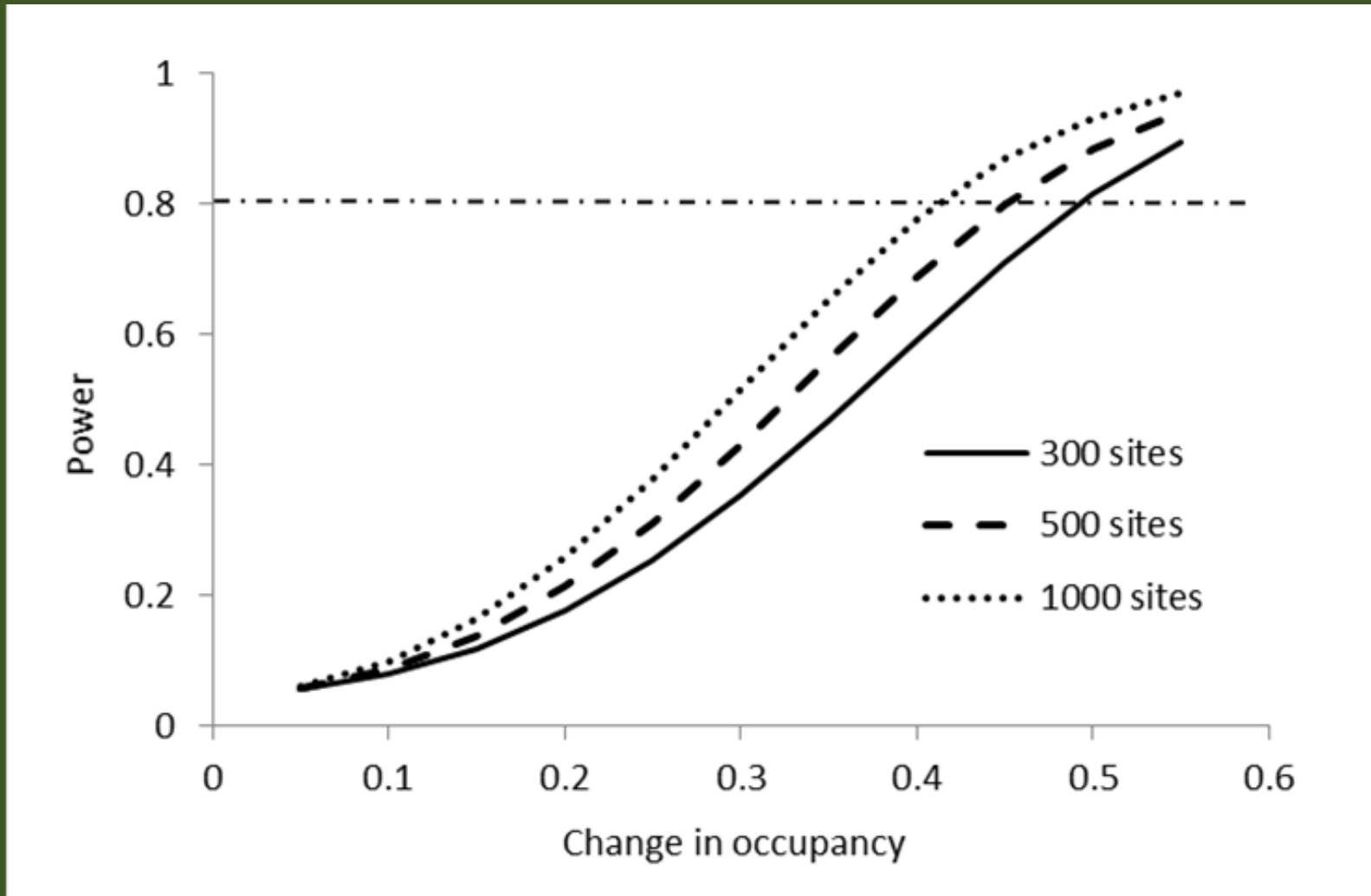
# Occupancy Sampling

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# Detecting Long-term Occupancy Trends



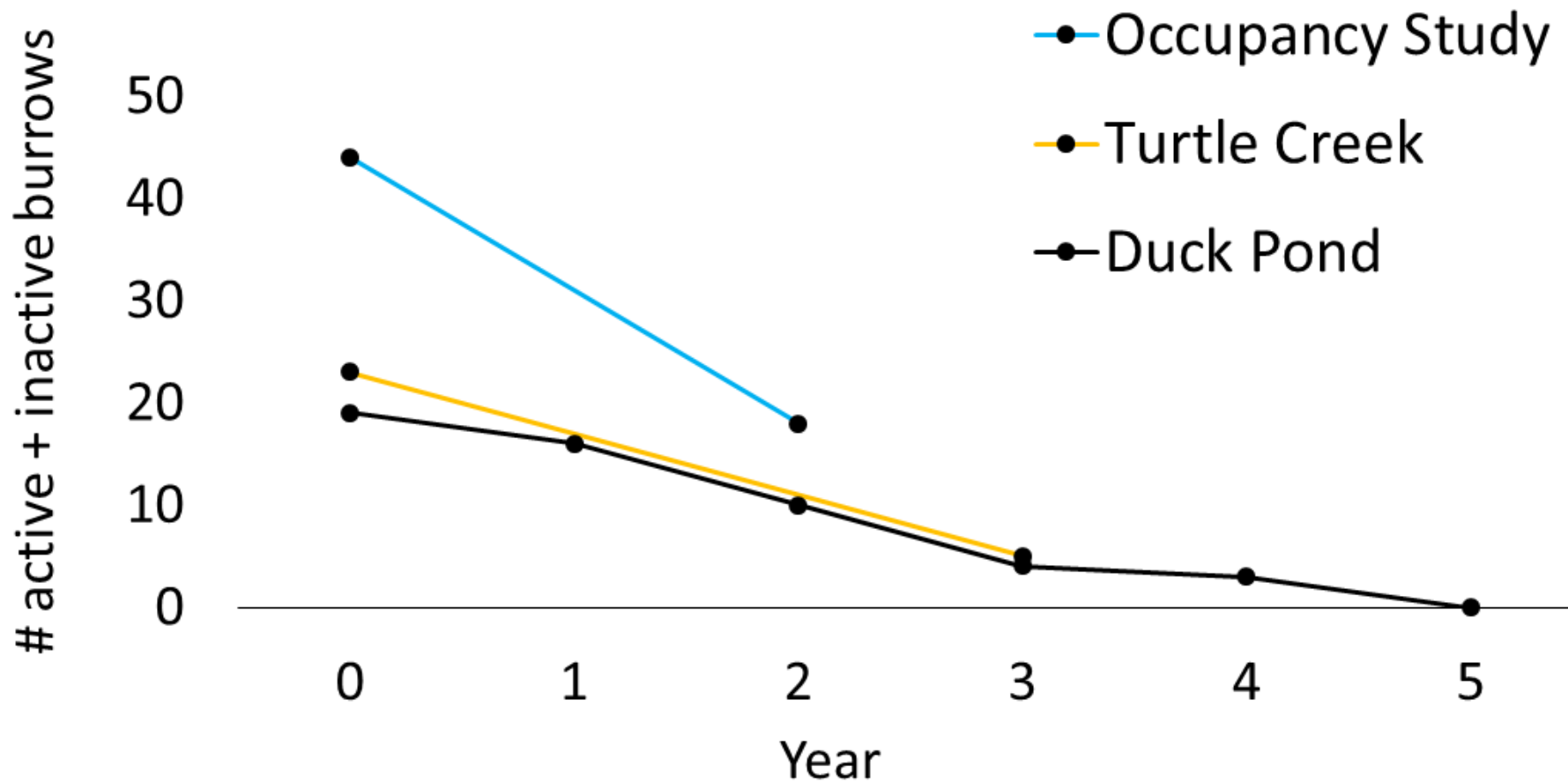
Guillera-Arroita and Lahoz-Monfort's (2012) closed-form power estimator (USGS 2014)

# Burrow as an index

The underlying relationships between sign and animal should be known and measurable and constant across space and time for a given study area (Karanth and Nichols 2002, Stanley and Royle 2005, Rhodes et al. 2011).

1. Estimate burrow longevity after a tortoise ceases maintaining it
2. Estimate burrow occupancy rates

# Burrow longevity (years to abandoned status)



# Burrow occupancy



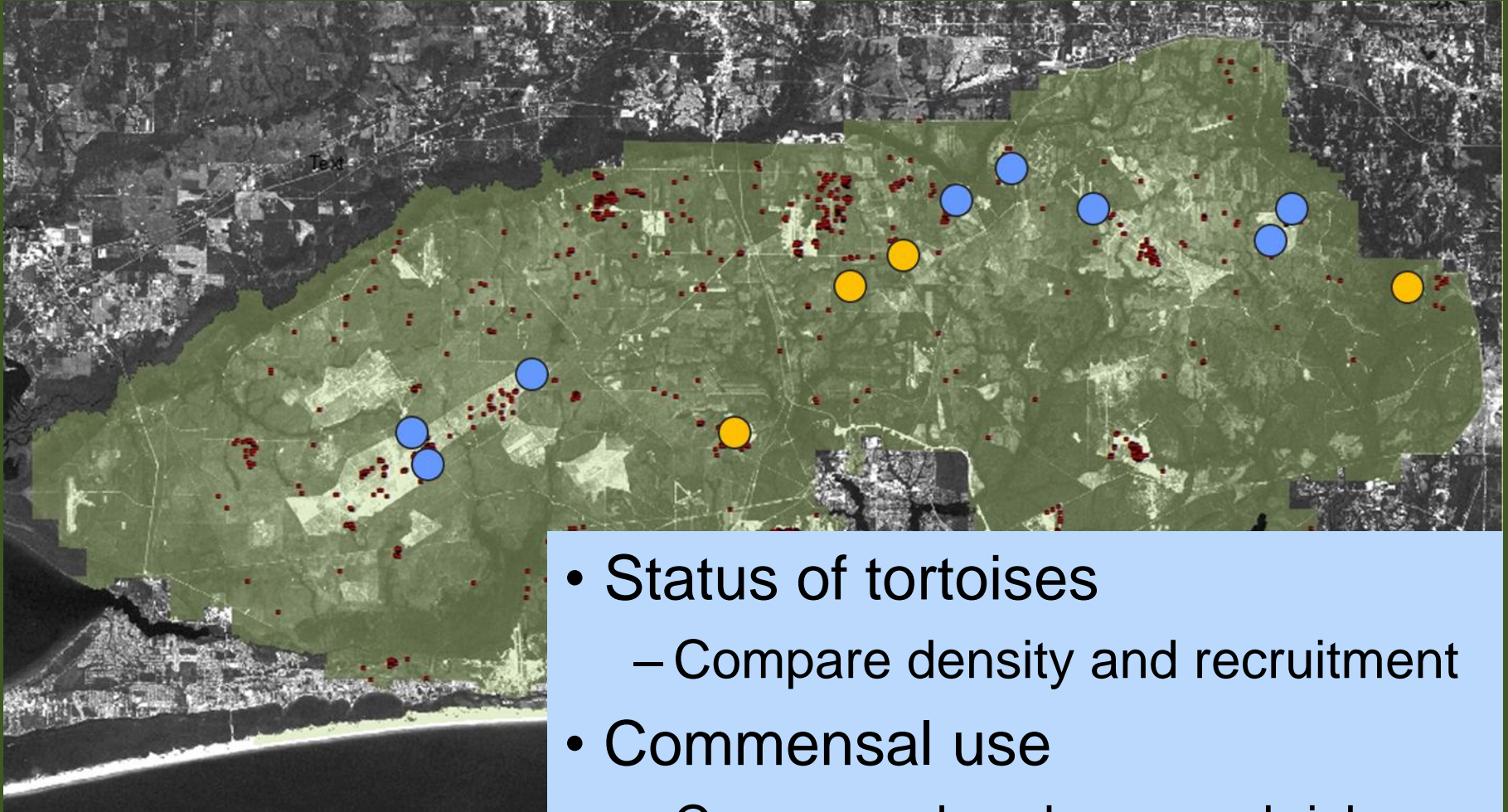
- 2016-17 camera study
- 12 sites, 4 seasons, 5-day rounds  
Forested sites = 0.51 (n=39)  
Test ranges = 0.49 (n=79)

# Take Homes

- Occupancy approach was effective in describing patterns of tortoise distribution
- Offers a promising approach for detecting long-term trends and future population expansion
- Using the burrow as an index of occupancy improves monitoring efficiency, but burrow longevity and occupancy rates should be measurable and uniform
- **High tortoise occupancy on test ranges**

# Gopher Tortoises on Test Ranges

(DoD Legacy Program Project 16-818)



- Status of tortoises
  - Compare density and recruitment
- Commensal use
  - Compare abundance and richness

# Size-age relationship

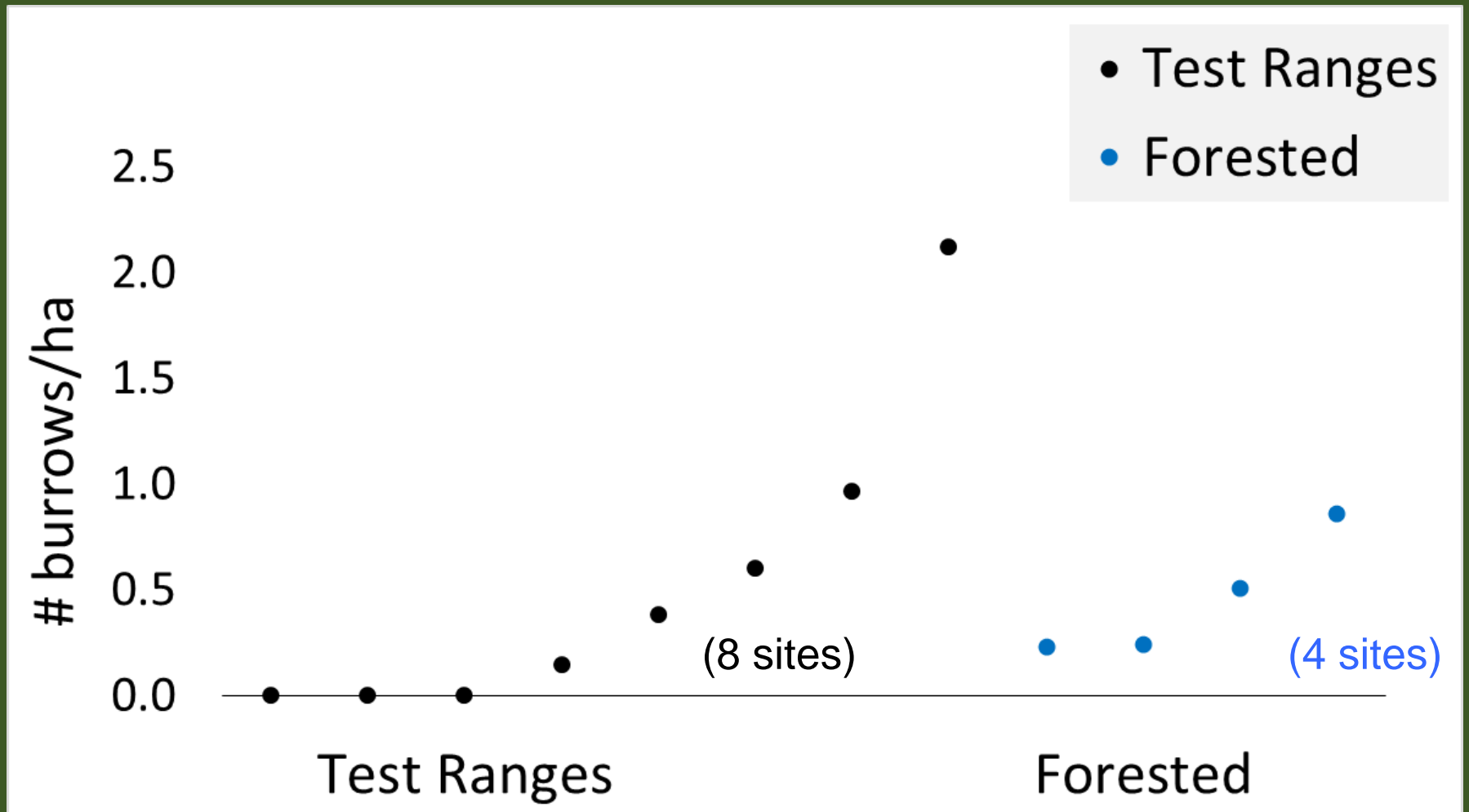


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# Variation in early recruitment (burrow width <130mm)





# Commensals of Special Concern



VT2

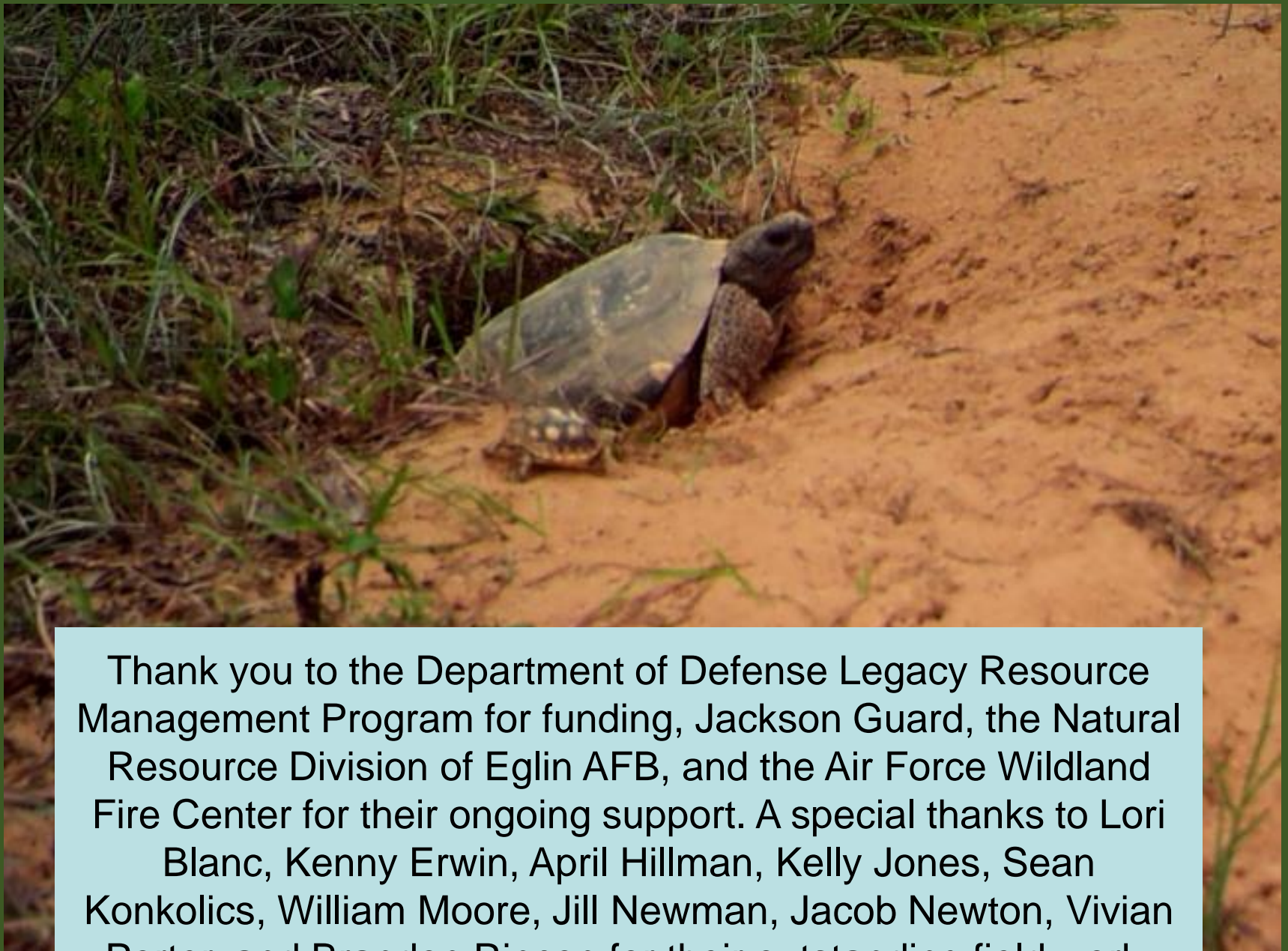
# Management Considerations

- Some test range tortoise populations may be serving as sources, some as sinks
- Type of habitat management (bush hogging, roller-drum chopping, chemical etc.), intensity, and timing likely important
  - potential for direct mortality (eggs, juveniles)
  - plant diversity issues (forage quality)
- Commensals also an important consideration
- **Goal: provide insight into best management practices on test ranges**

# Proposed Legacy Work

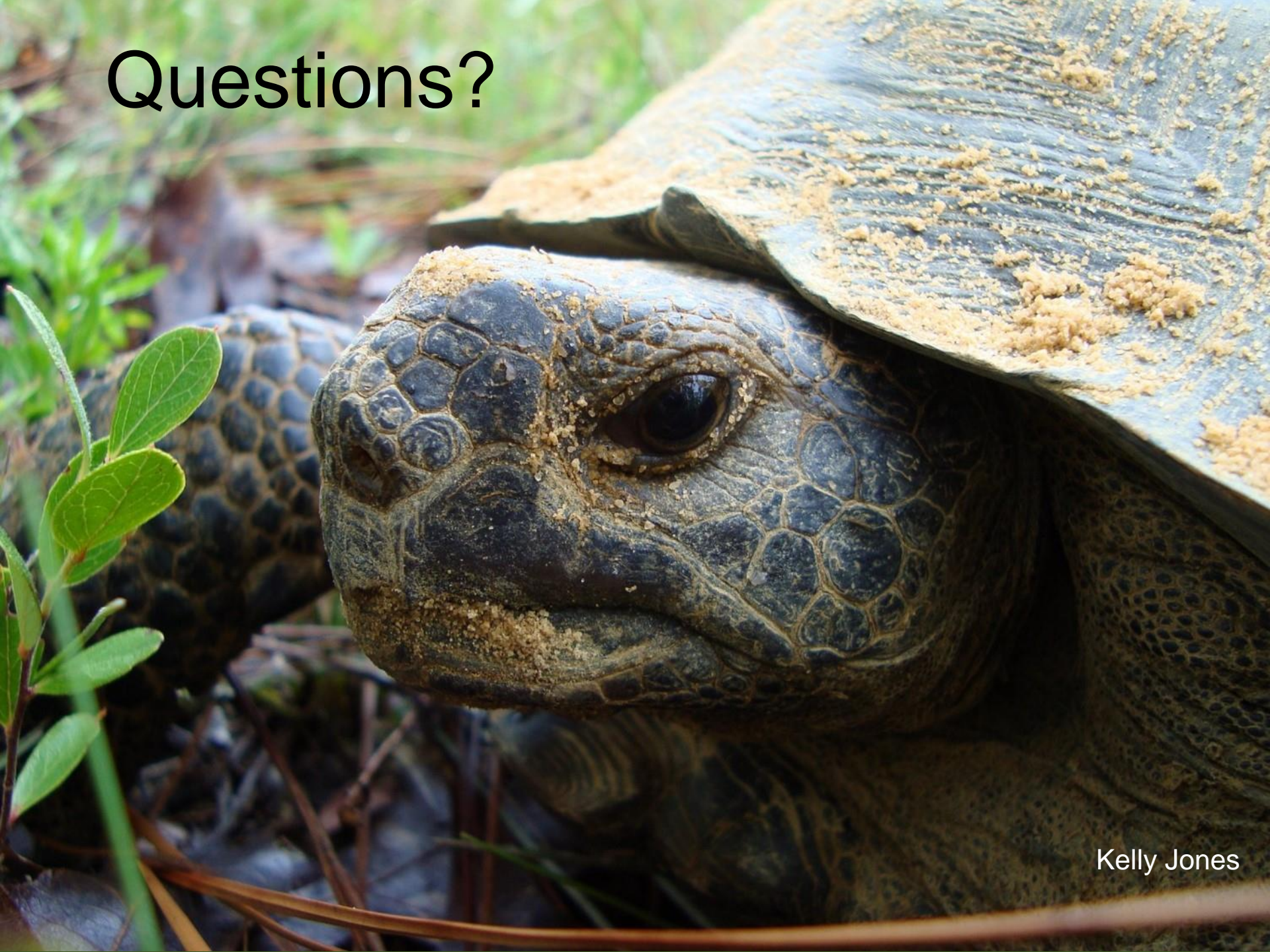
(year two funding)

- Continuation of current project
- Radio-telemetry of tortoises to determine habitat preferences and movements
- Reach out to range managers at 10–15 other installations with gopher tortoise populations



Thank you to the Department of Defense Legacy Resource Management Program for funding, Jackson Guard, the Natural Resource Division of Eglin AFB, and the Air Force Wildland Fire Center for their ongoing support. A special thanks to Lori Blanc, Kenny Erwin, April Hillman, Kelly Jones, Sean Konkolics, William Moore, Jill Newman, Jacob Newton, Vivian Porter, and Brandon Rincon for their outstanding field work.

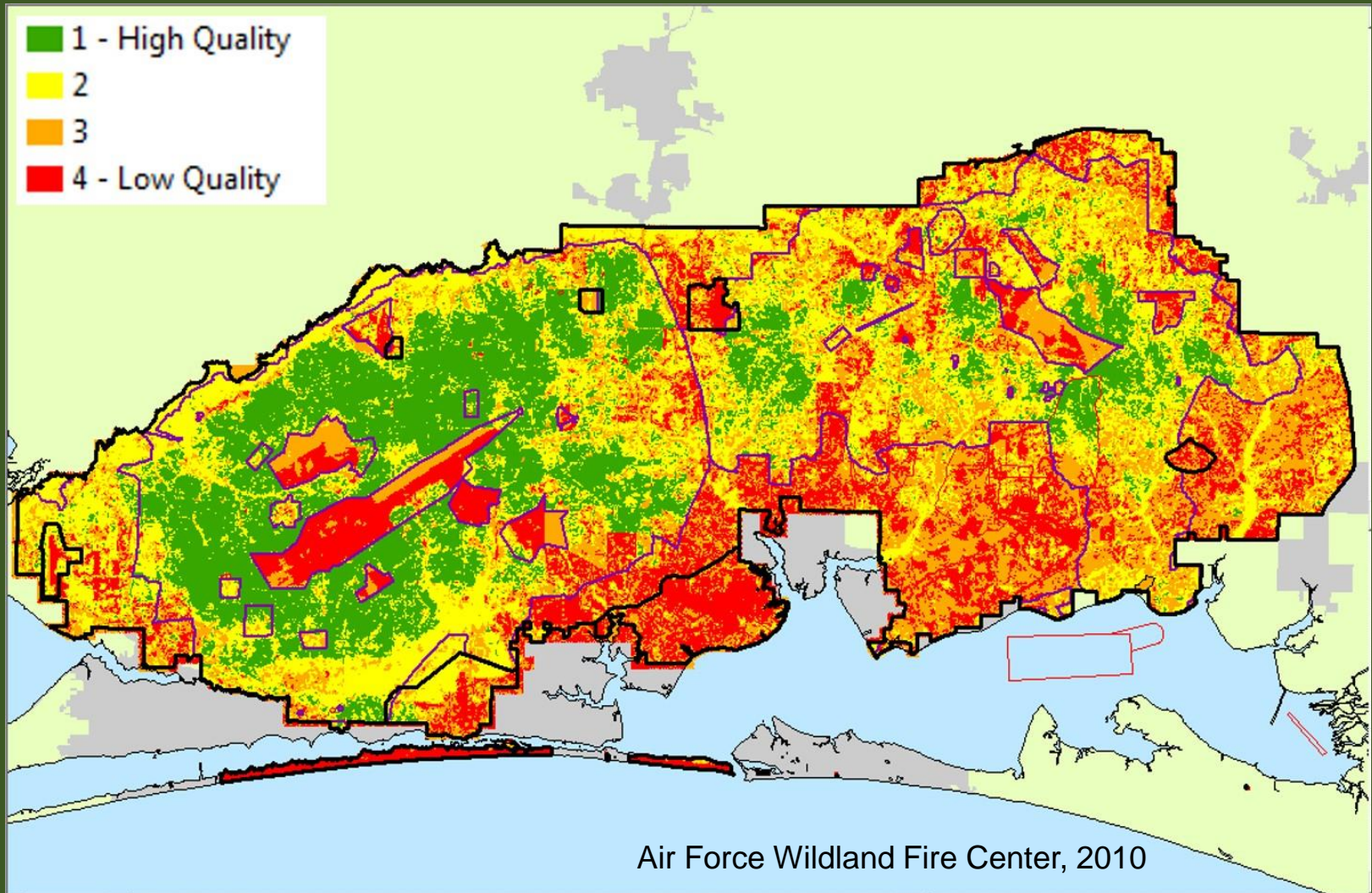
Questions?



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# Supplemental Slides

# Ecological Condition Model



# Distance Classes

