

# **Falcon-Gondor Transmission Line Study: Year 8 Progress Report.**

A photograph of a transmission line under construction in a grassy field under a cloudy sky. The image shows several tall, dark metal lattice towers with cross-arms, supporting multiple high-voltage power lines. The lines are strung between the towers, creating a series of catenary curves. The towers are spaced out across a field of green and brown grass. In the background, there are more towers and a distant horizon line. The sky is filled with heavy, grey clouds, suggesting an overcast day. The overall scene depicts a large-scale infrastructure project in progress.

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24 Jan 2011**

# Presentation Outline

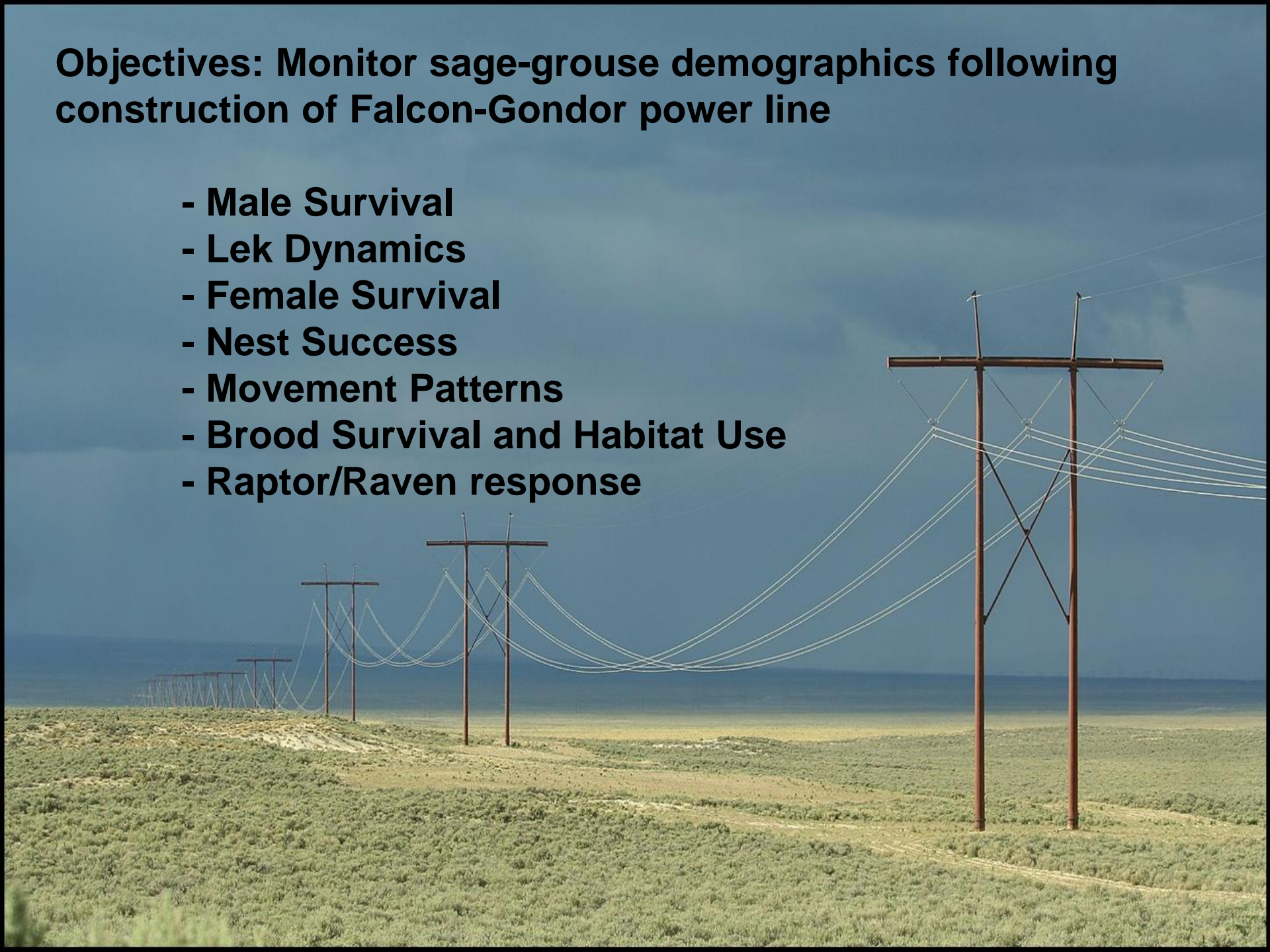
- Background Info
- Descriptive Data from 2010  
(Lek counts, raptor surveys, etc.)
- Program MARK analyses for 2010 progress report
- Conclusions





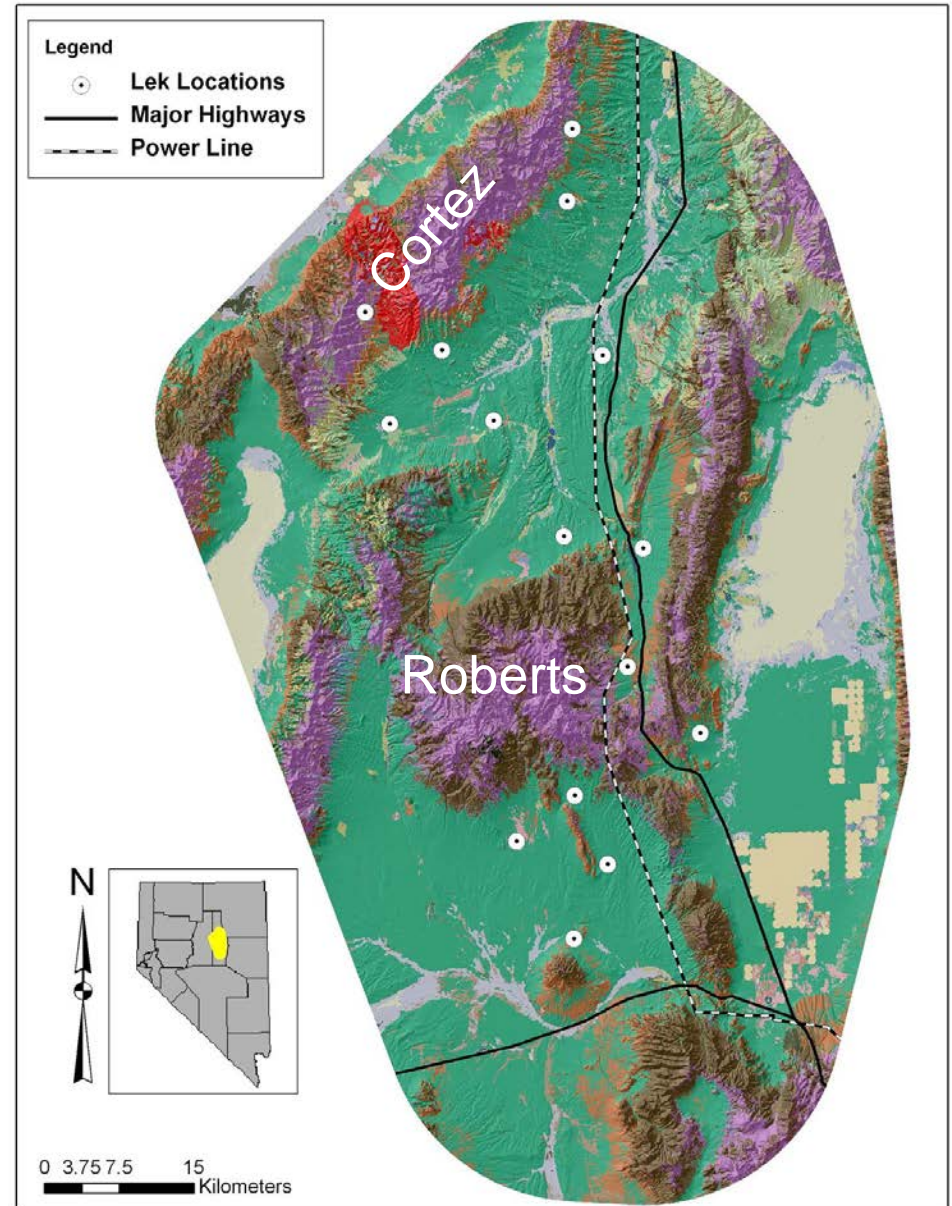
# **Objectives: Monitor sage-grouse demographics following construction of Falcon-Gondor power line**

- Male Survival**
- Lek Dynamics**
- Female Survival**
- Nest Success**
- Movement Patterns**
- Brood Survival and Habitat Use**
- Raptor/Raven response**



# Study area

-13 study leks  
associated with 2  
populations.

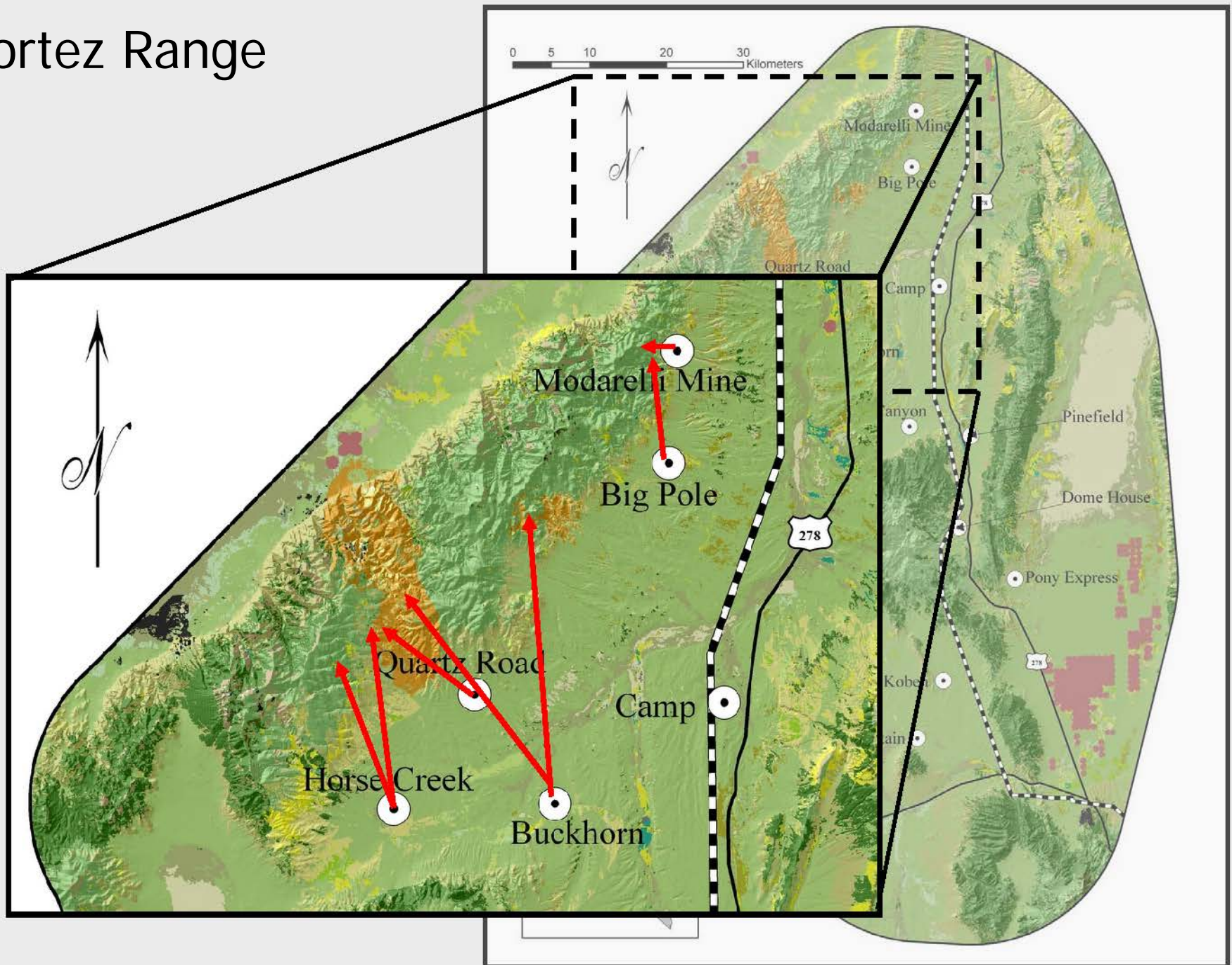




# Cortez Range



# Cortez Range





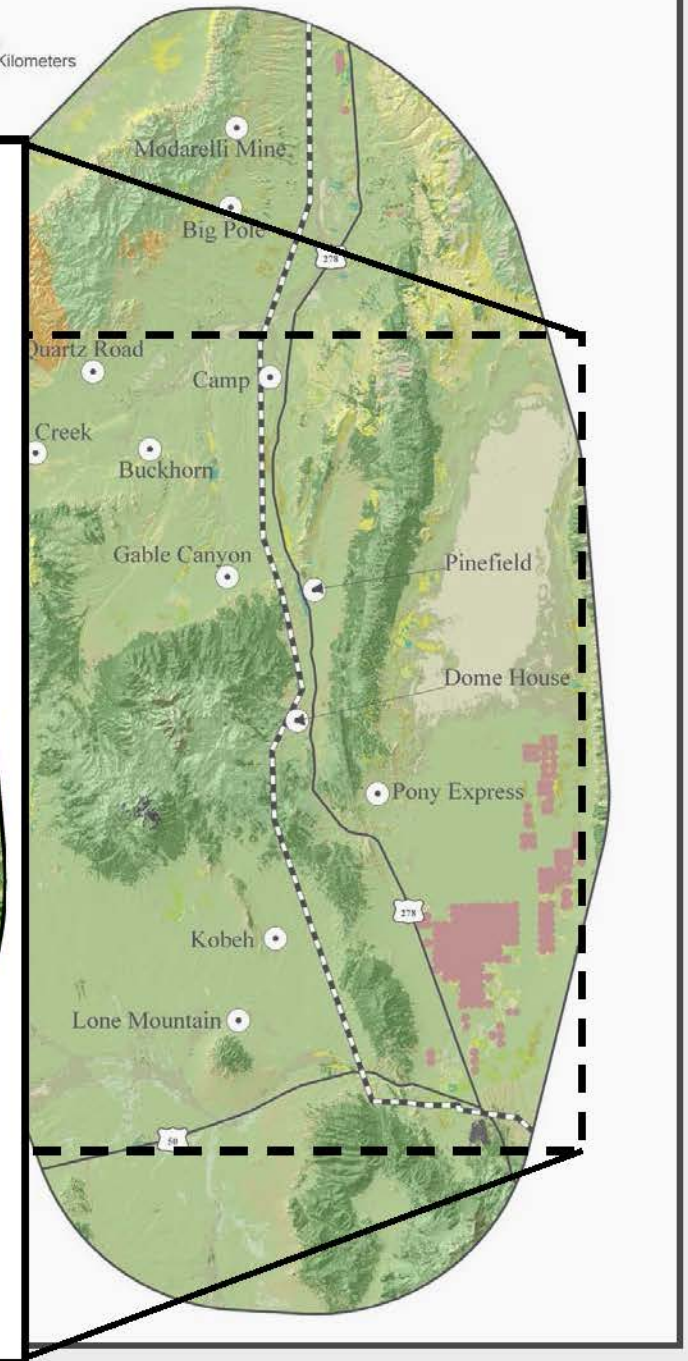
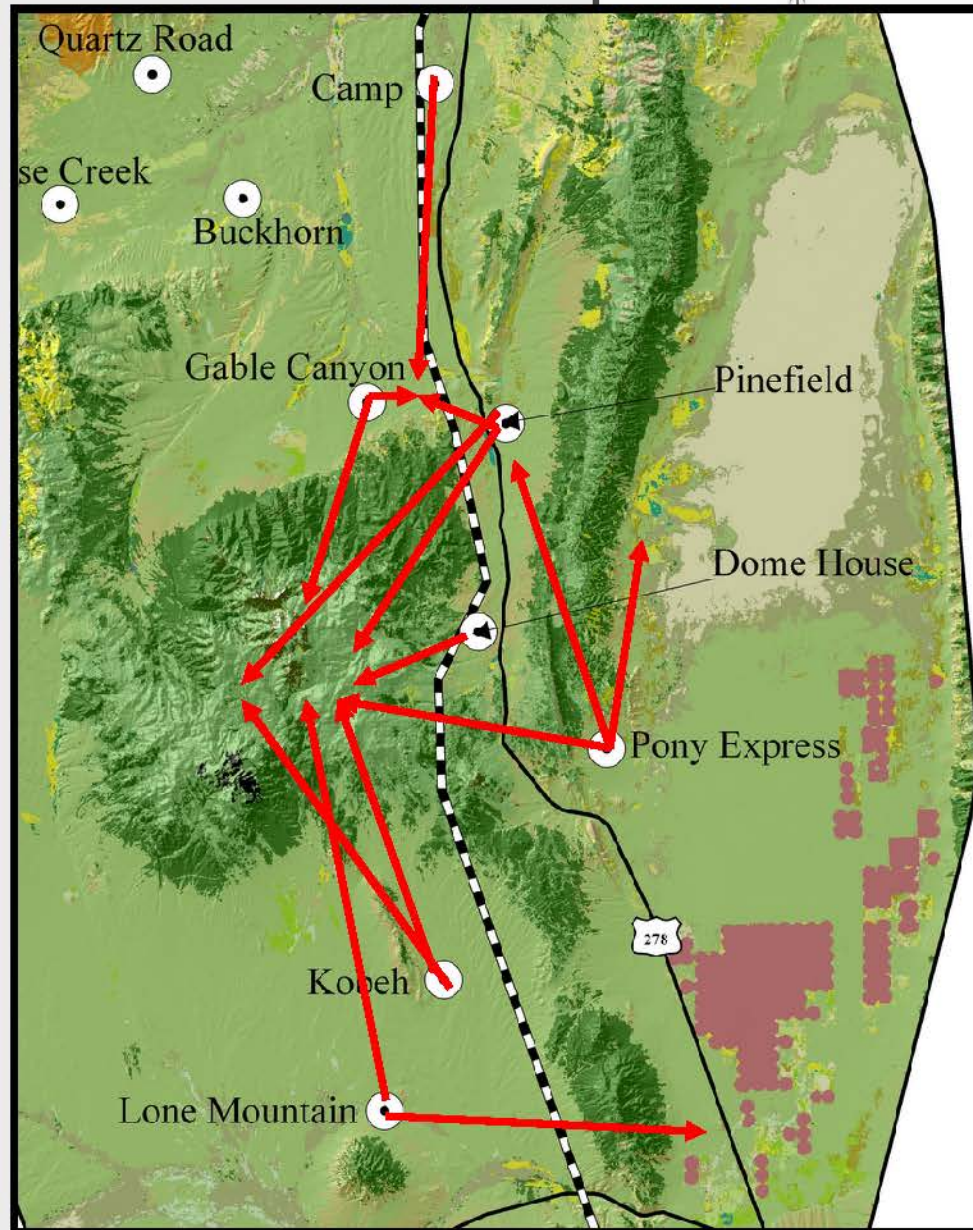
# Robert's Creek Mts.





# Robert's Creek Mts.

0 5 10 20 30 Kilometers





# Field Methods





# Field Highlights

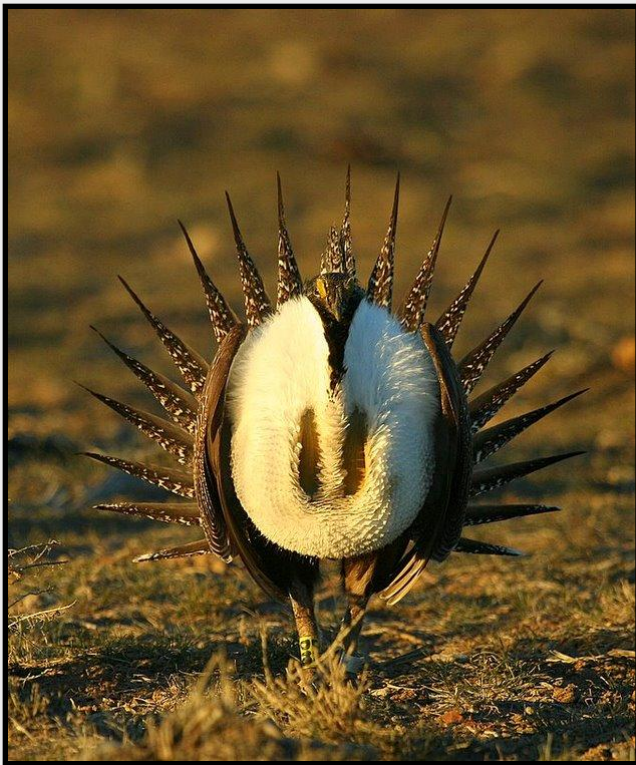
- We've logged 1493 total captures – 1167 male, 326 female.
- We've radio-tagged 290 hens and 67 males
- We've discovered and monitored 315 nests.
- We've tracked 102 broods, and trapped and marked 529 chicks





# 2010 Descriptive Data – Lek Surveys

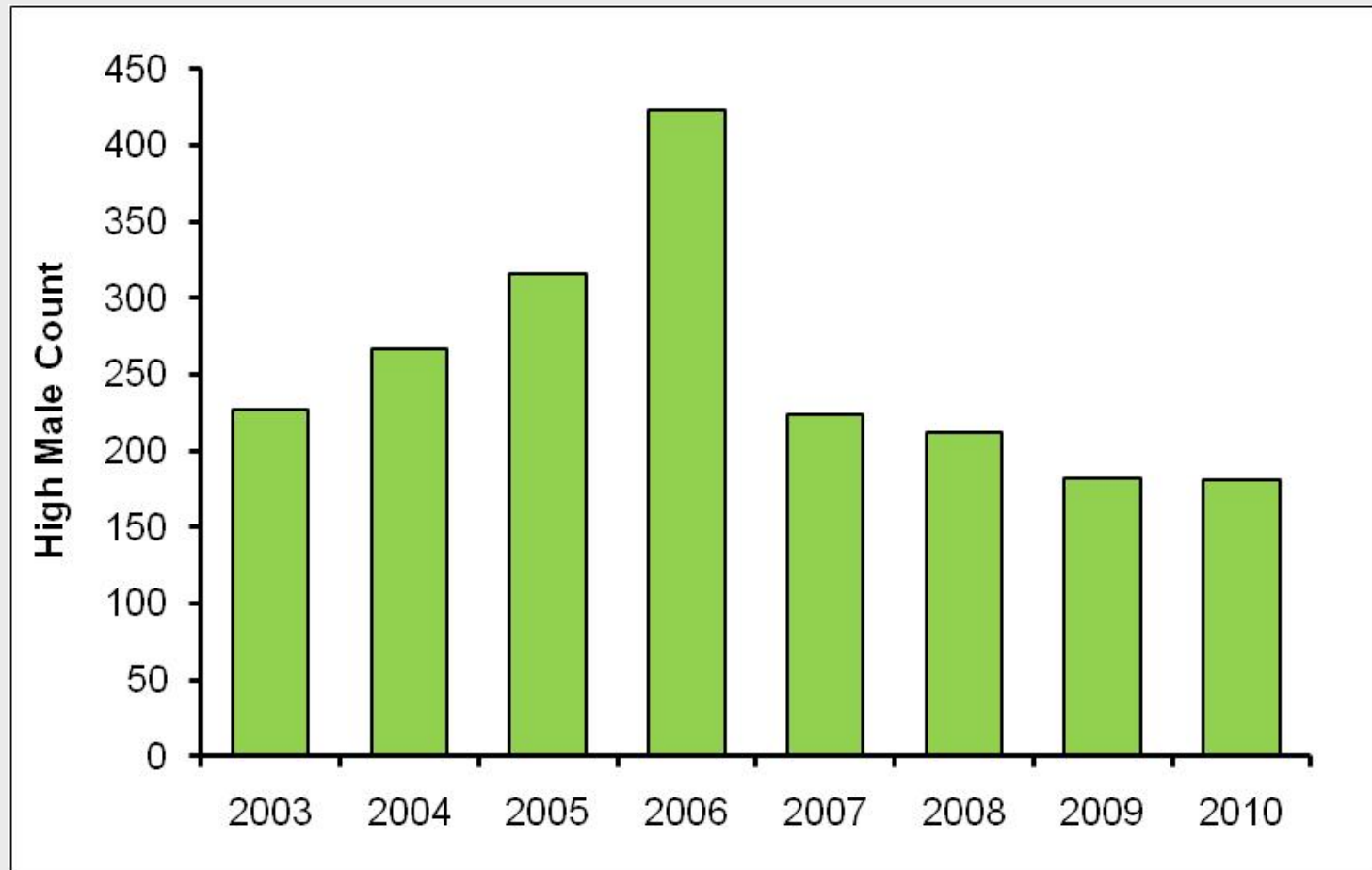
- Conducted 111 lek observations during spring 2010.



# 2010

## Descriptive Data – Lek Surveys

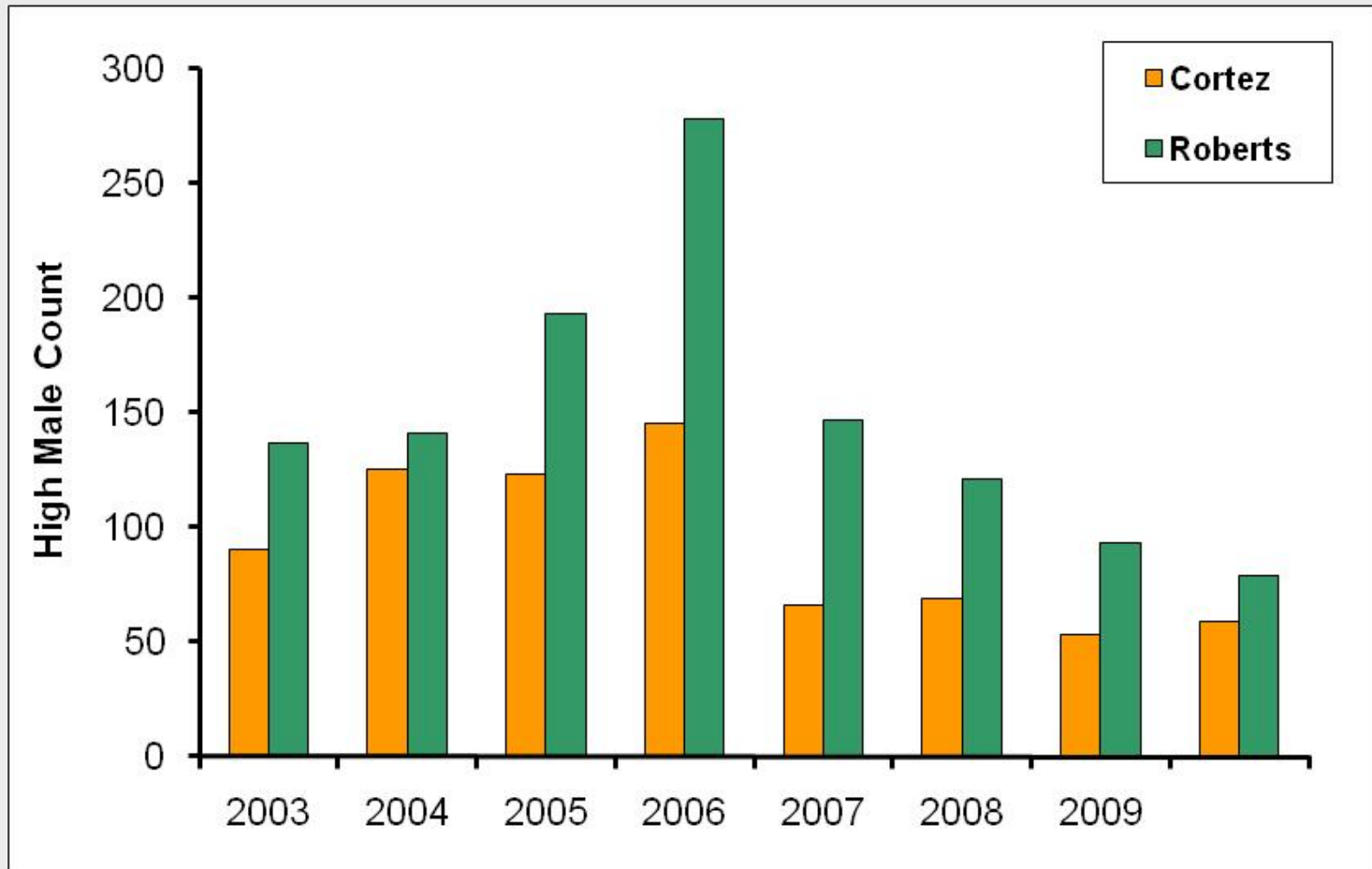
- High counts of males increased through 2006, but have declined since.





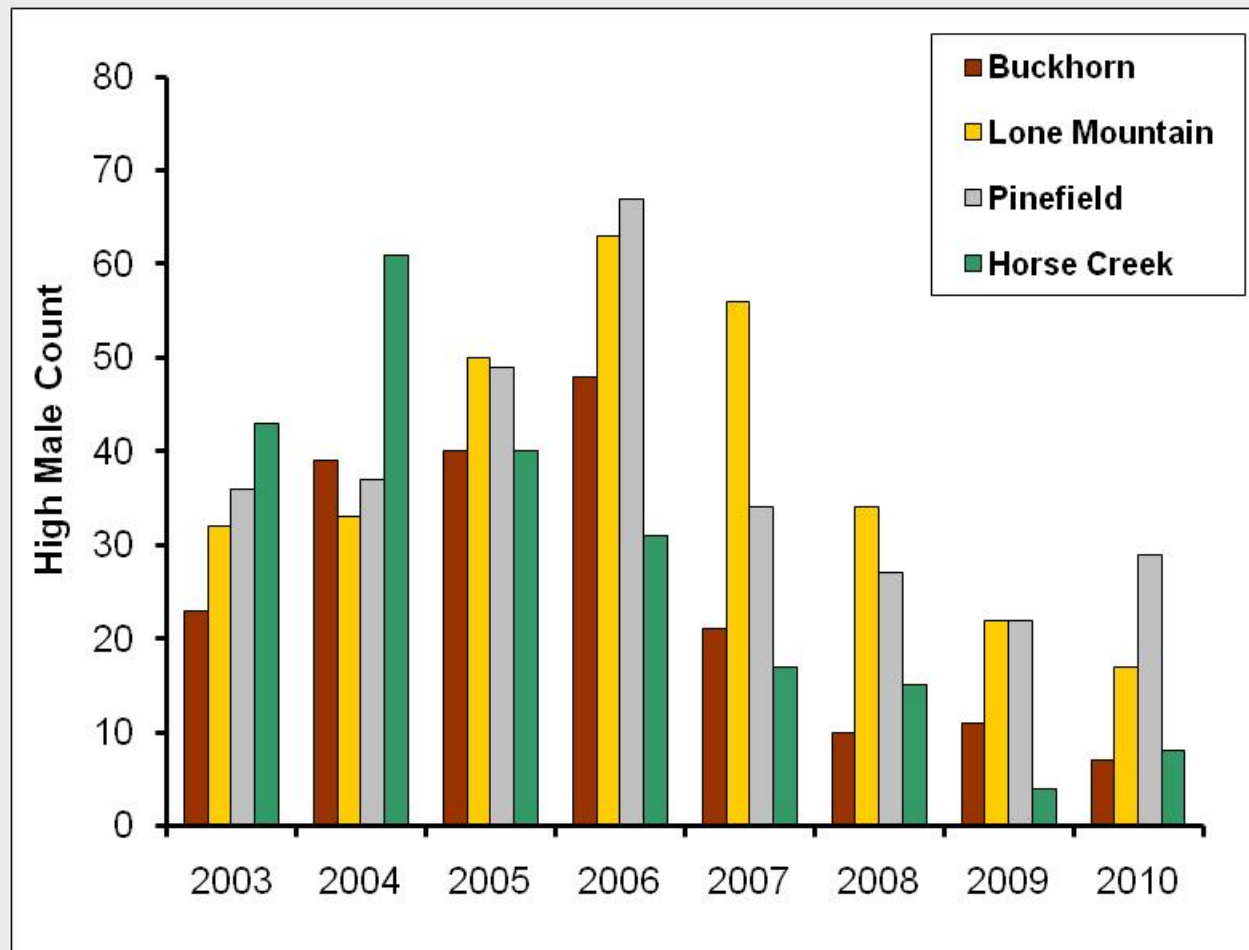
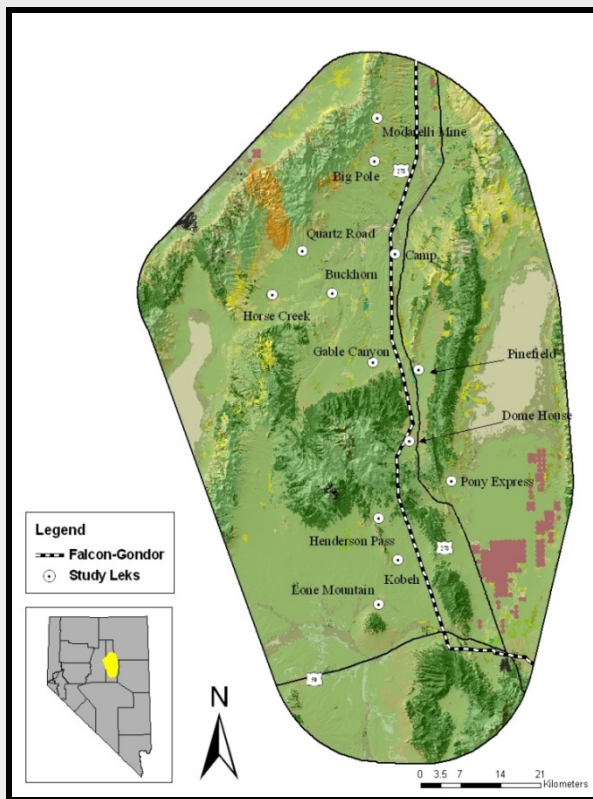
# 2010 Descriptive Data – Lek Surveys

- Declines observed for both populations.



# 2010 Descriptive Data – Lek Surveys

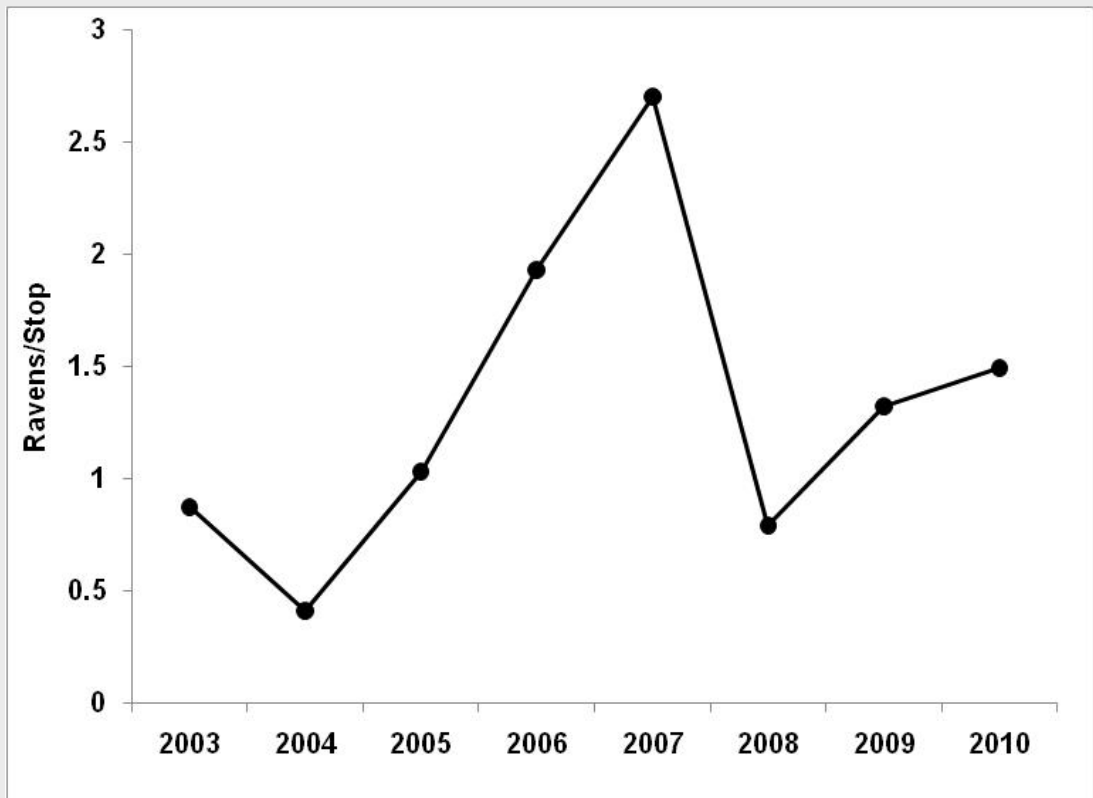
- Decline most apparent on large leks.





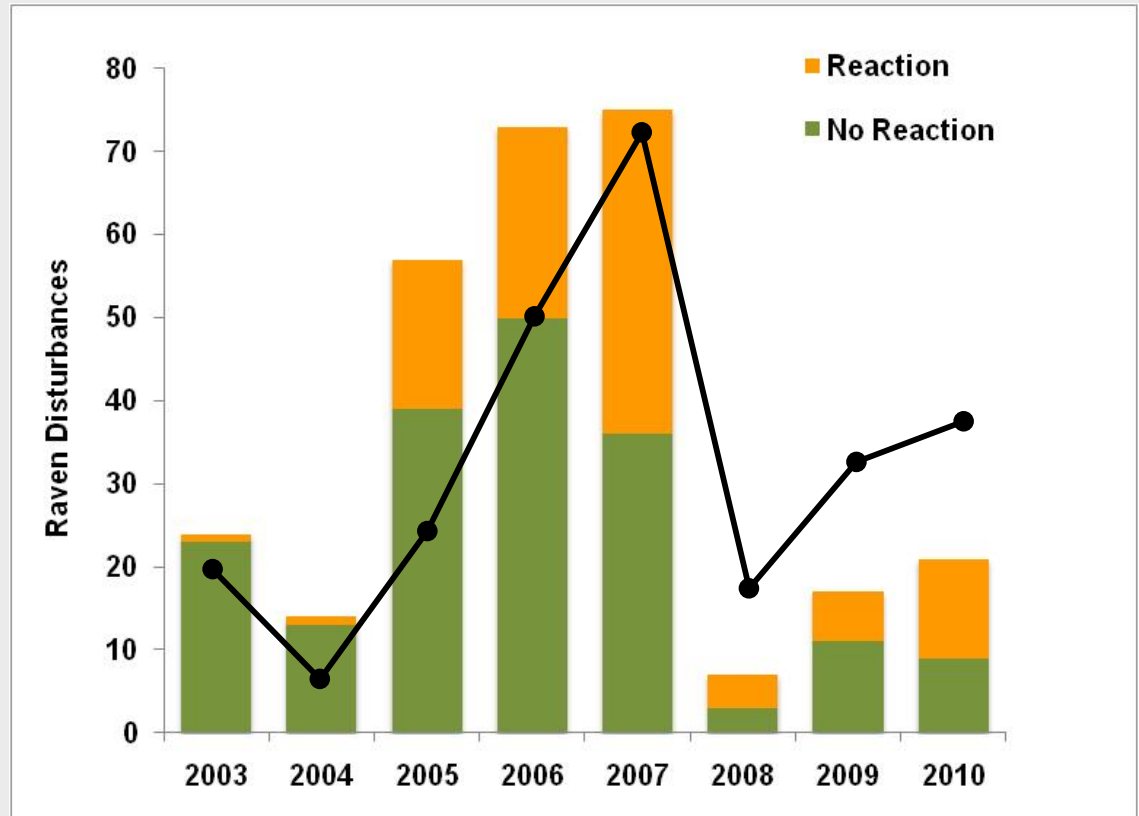
# 2010 Descriptive Data – Raptor Surveys

- No change in raptor use of F-G corridor throughout the course of the study.
- Common raven sightings remained low in 2010:



# 2010 Descriptive Data – Raptor Surveys

- No change in raptor use of F-G corridor throughout the course of the study.
- Lek disturbances by CORA down, but increasing since 2008:





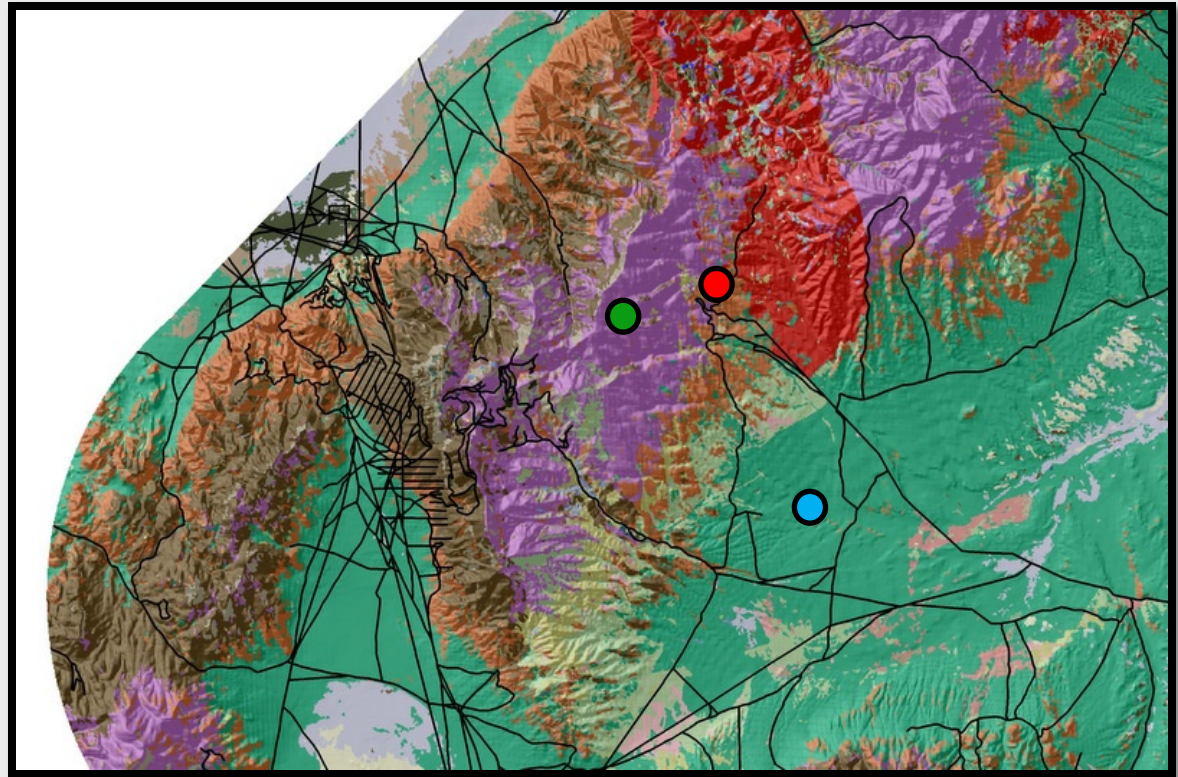
# 2010 Descriptive Data – Brood Survival

- Hatched 20 out of 81 nests
- 10 of 20 broods fledged at least 1 chick (50% brood survival)
- Lowest chick survival during first 2 weeks.



# 2010 Descriptive Data – Chick marking

- Marked chicks as day-olds using fish fingerling tags.
- Documented nesting by female marked as day-old chick in 2009.
- First hunter recovery of chick marked as day-old in 2009.
- Recaptured 39 chicks at 28 days.
- Estimate chick survival to 28 days at  $0.358 \pm 0.144$  SE.





# Demographic Analyses

- **Nest success – Daily survival and overall nest success**
- **Female survival – monthly survival of radioed hens**
- **Pradel models – Male survival, population rate of change.**
- **Robust Design – Male breeding propensity**




# Nest Survival Models

- Monitored 315 nests to date
- Estimated daily nest success, evaluated importance of local vegetation, spatial, individual fitness, temporal, and demographic covariates on nest survival
- Estimated overall nest success based on a 37-day nesting period (laying + incubation)



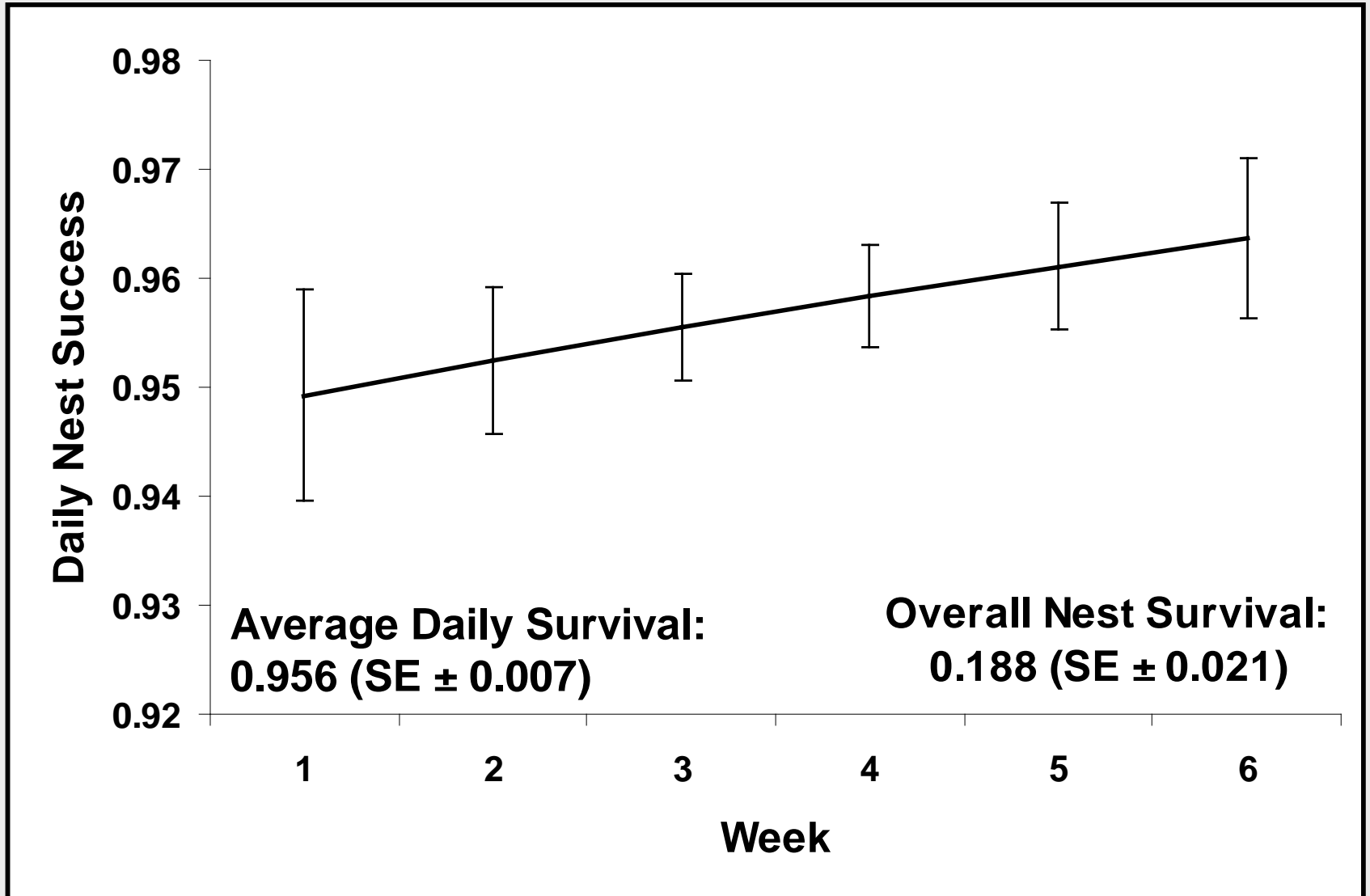


# Results

Parameter	Influence of parameter on top model ( $\Delta AIC_c$ )	Influence
Clutch	17.0	+
Area of Wildfire*	8.7	-
Season	8.5	-
Distance from Road*	4.9	+
Non-Sage Cover*	3.1	+
Nest Meter Grass Height *	2.3	+
Daubenmire Grass Height	1.0	+
Julian Date*	0.6	Quad
Distance from Falcon-Gondor 	+2.0	None

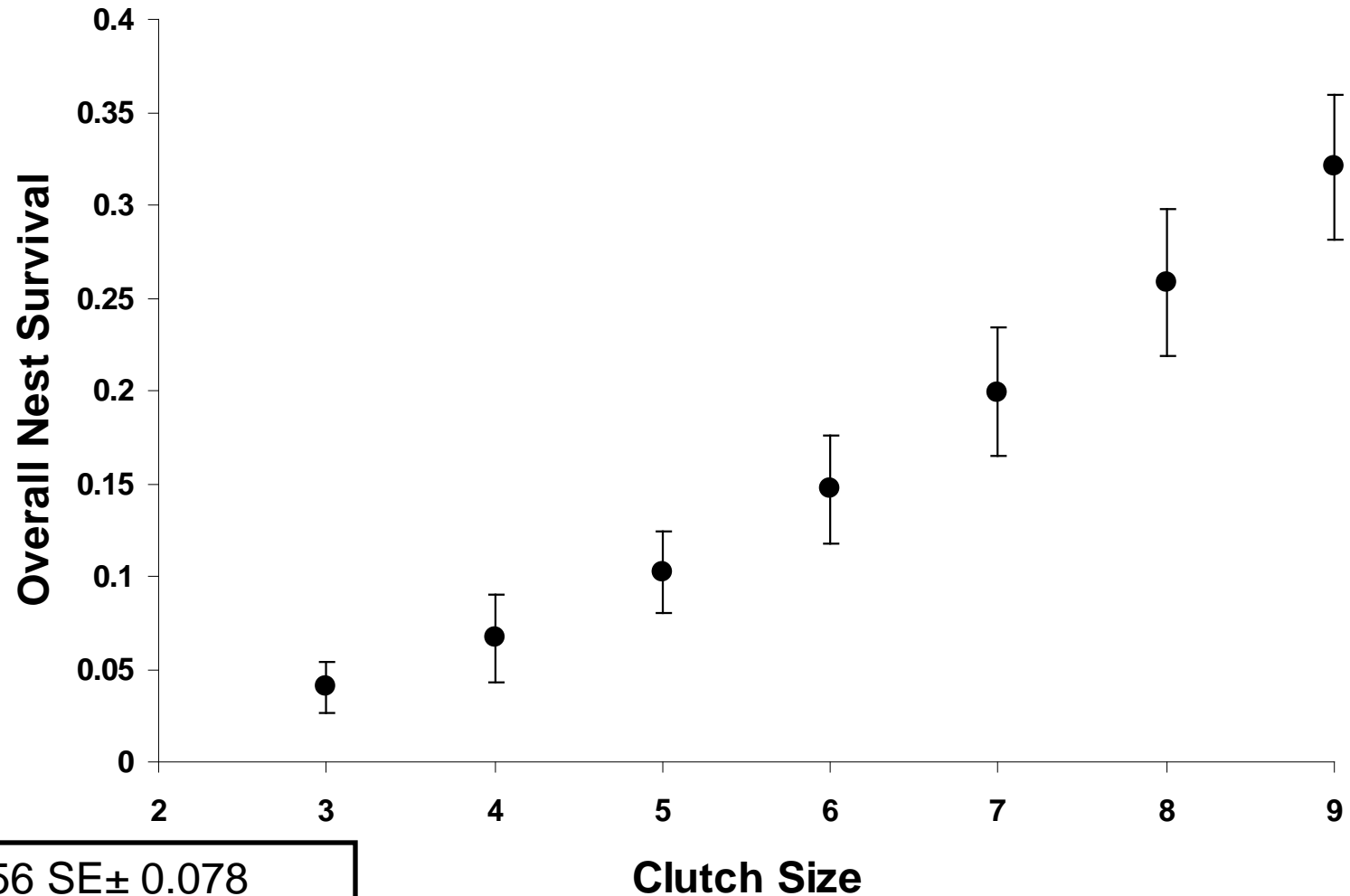
\* Top models considered interactions involving this parameter

# Model Averaged Nest Survival





# Nest Success: Clutch Size



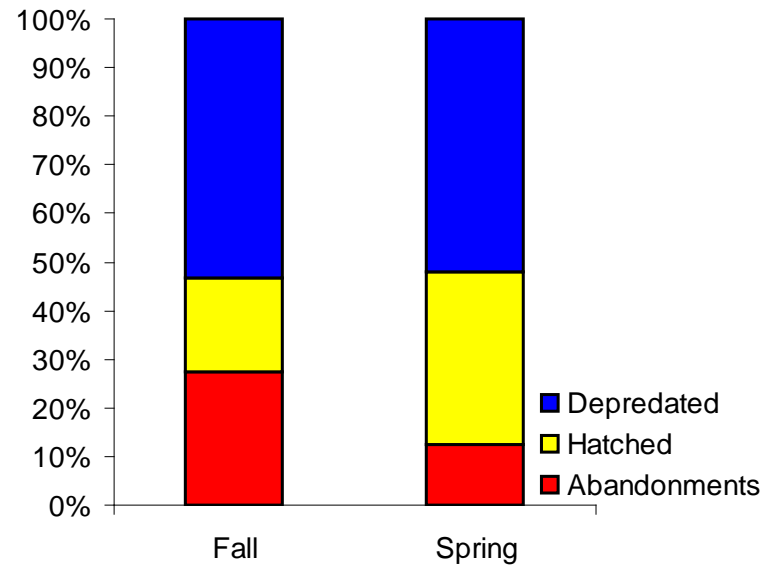
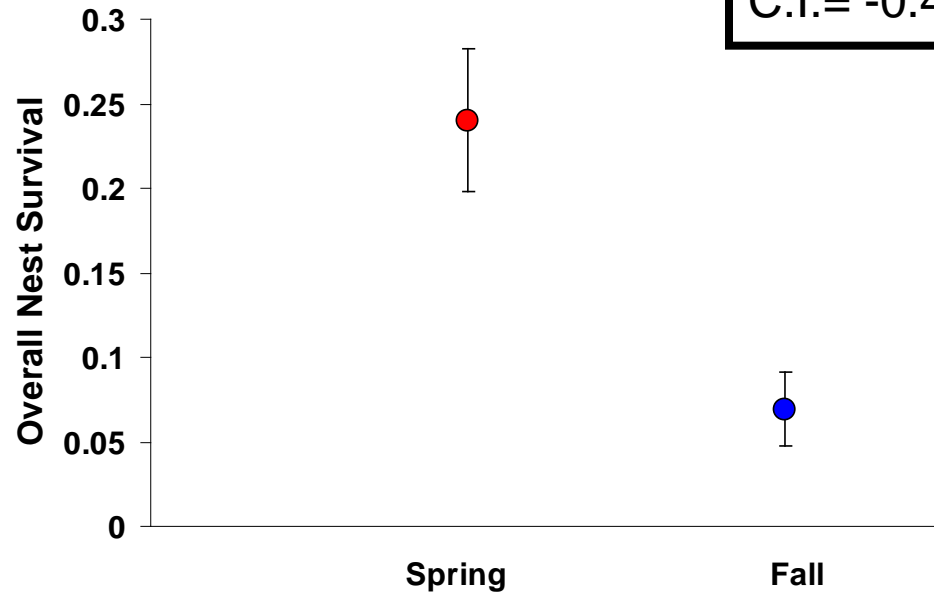
$\beta = 0.356$  SE $\pm$  0.078

C.I.= 0.202 – 0.509

# Nest Success: Season Trapped

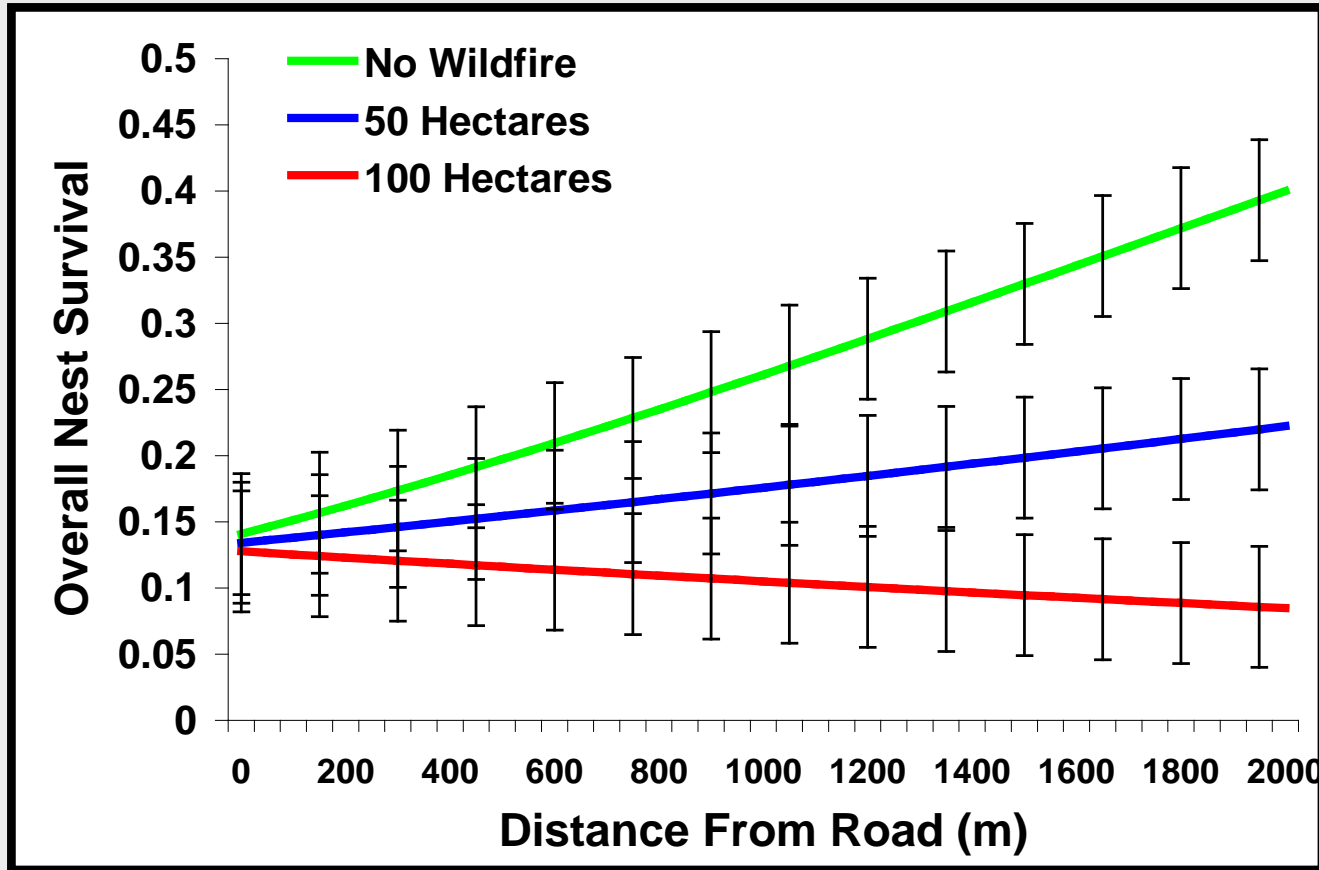
$$\beta = -0.256 \text{ SE } \pm 0.078$$

C.I. = -0.404 – -0.106





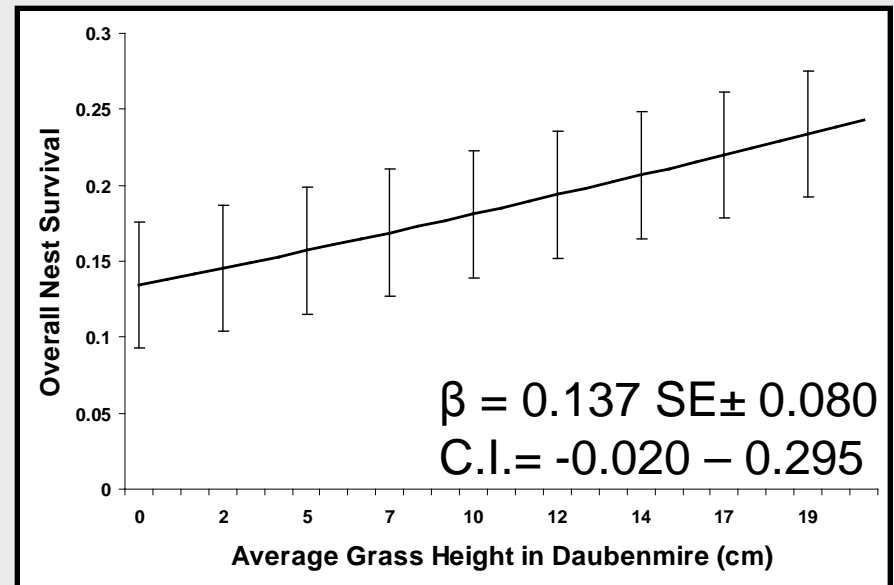
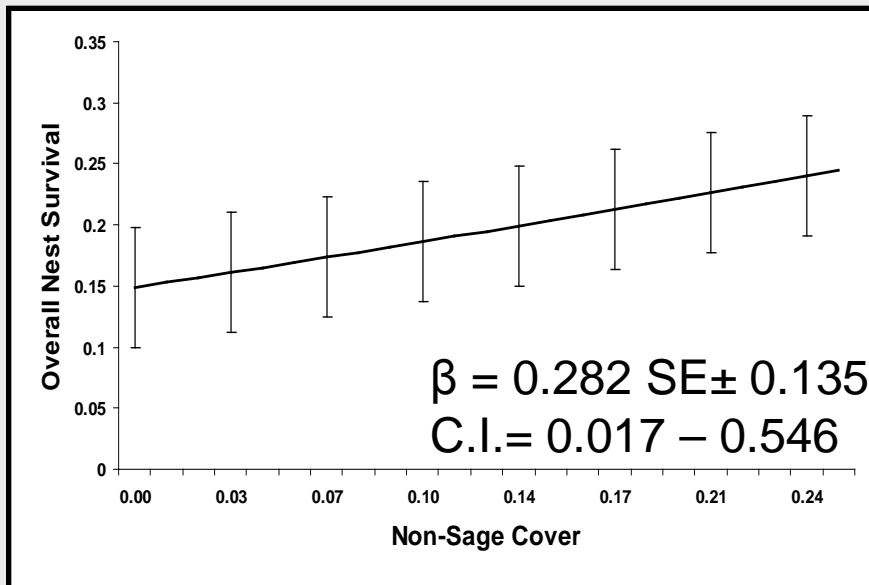
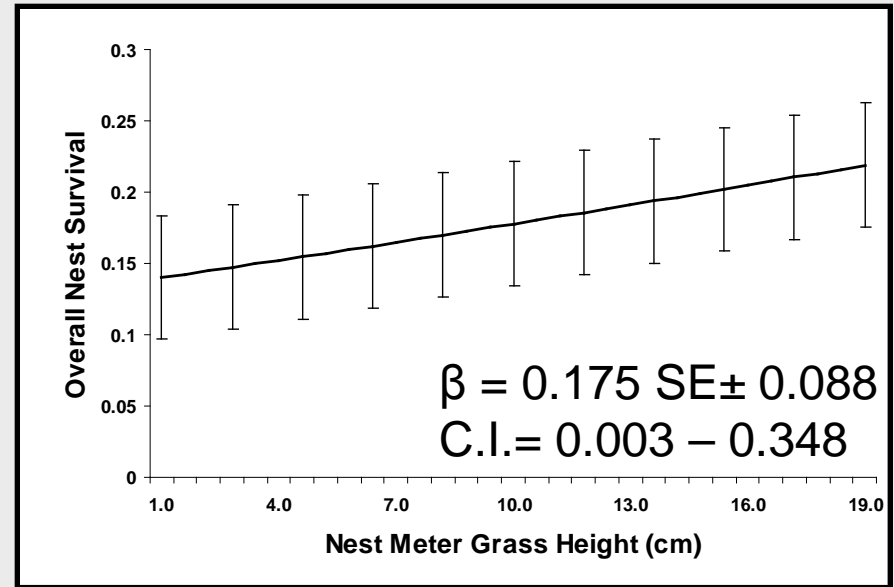
# Nest Success: Wildfire & Road Distance



Road:  $\beta = 0.198$  SE $\pm$  0.082  
WF:  $\beta = -0.255$  SE $\pm$  0.074  
WF\*RD:  $\beta = -0.148$  SE $\pm$  0.100

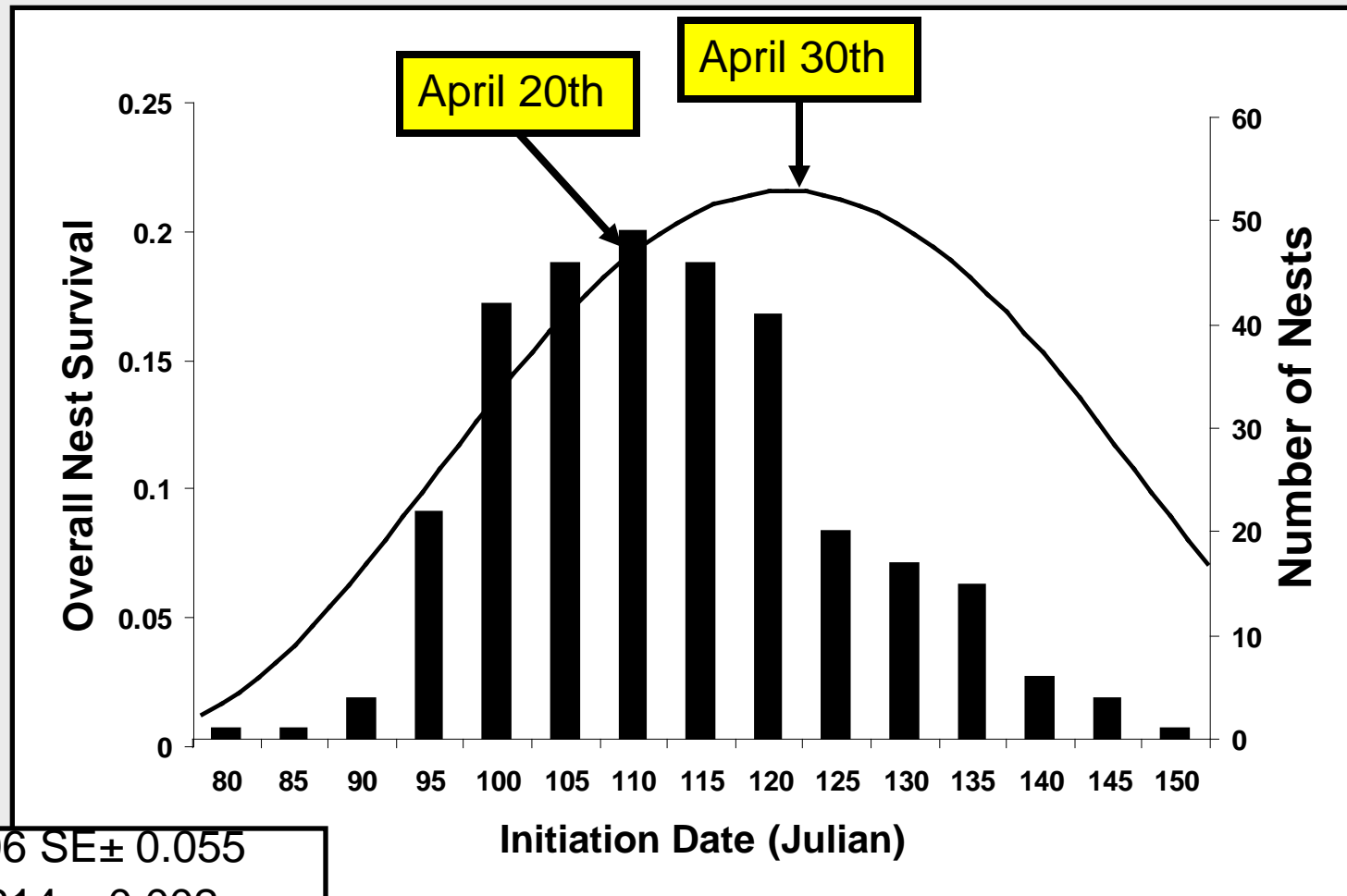
# Nest Success: Nest Site Vegetation

- Positive influence for each of the top competing nest site covariates on survival
- Some support for a slight negative interaction between Non-sage shrub cover and Nest Meter Grass height



# Nest Initiation Date

- Nests initiated around April 30th are estimated to have the highest probability of survival
- However, peak of nest initiation is around April 20<sup>th</sup>



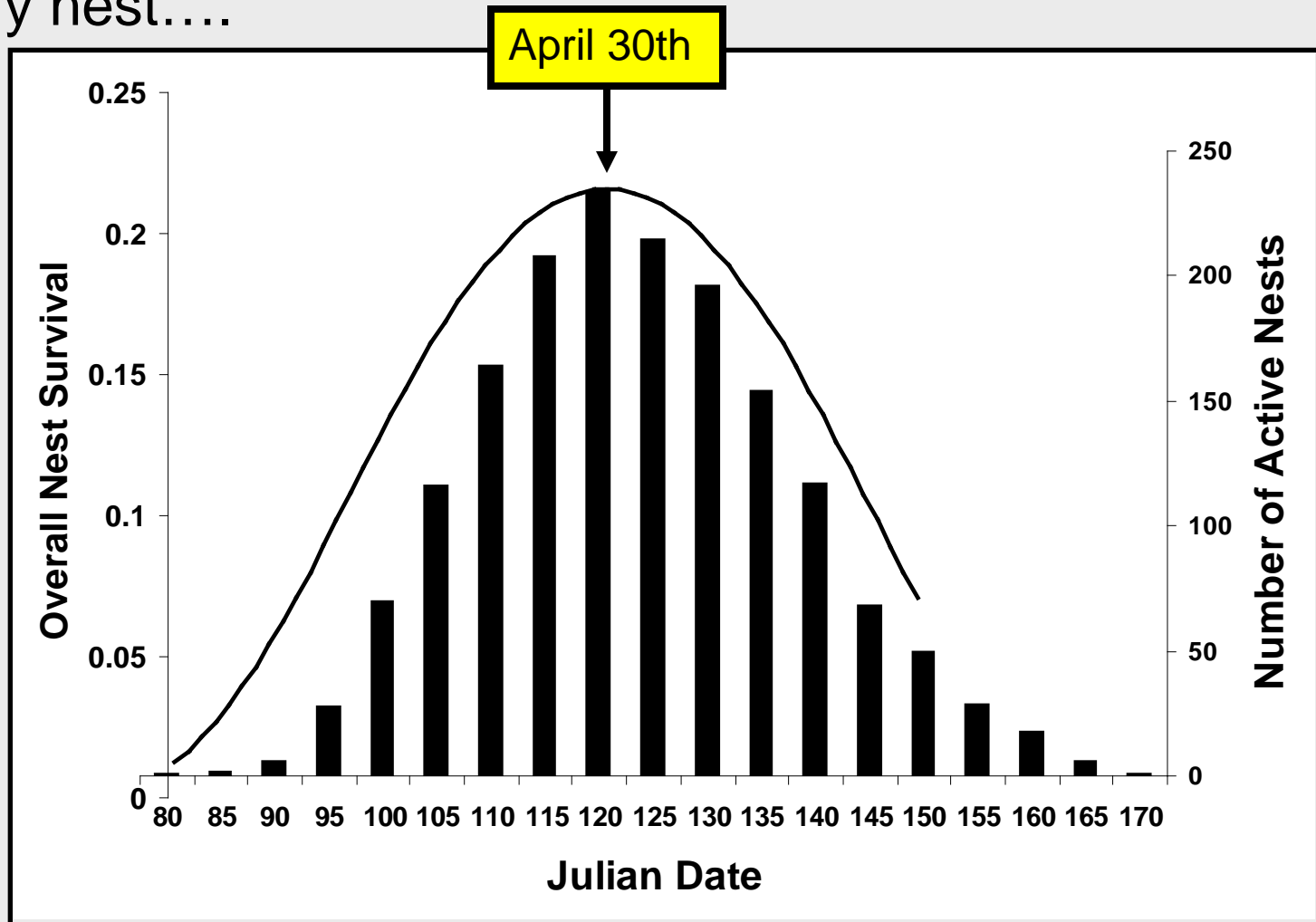
$\beta = -0.106$  SE  $\pm 0.055$

C.I. = -0.214 – 0.002



# Nest Initiation Date

- However, if we create a distribution of “estimated” active nests by adding the mean nest length (~26 days) to the initiation date of every nest....



# Nest Survival: Conclusions

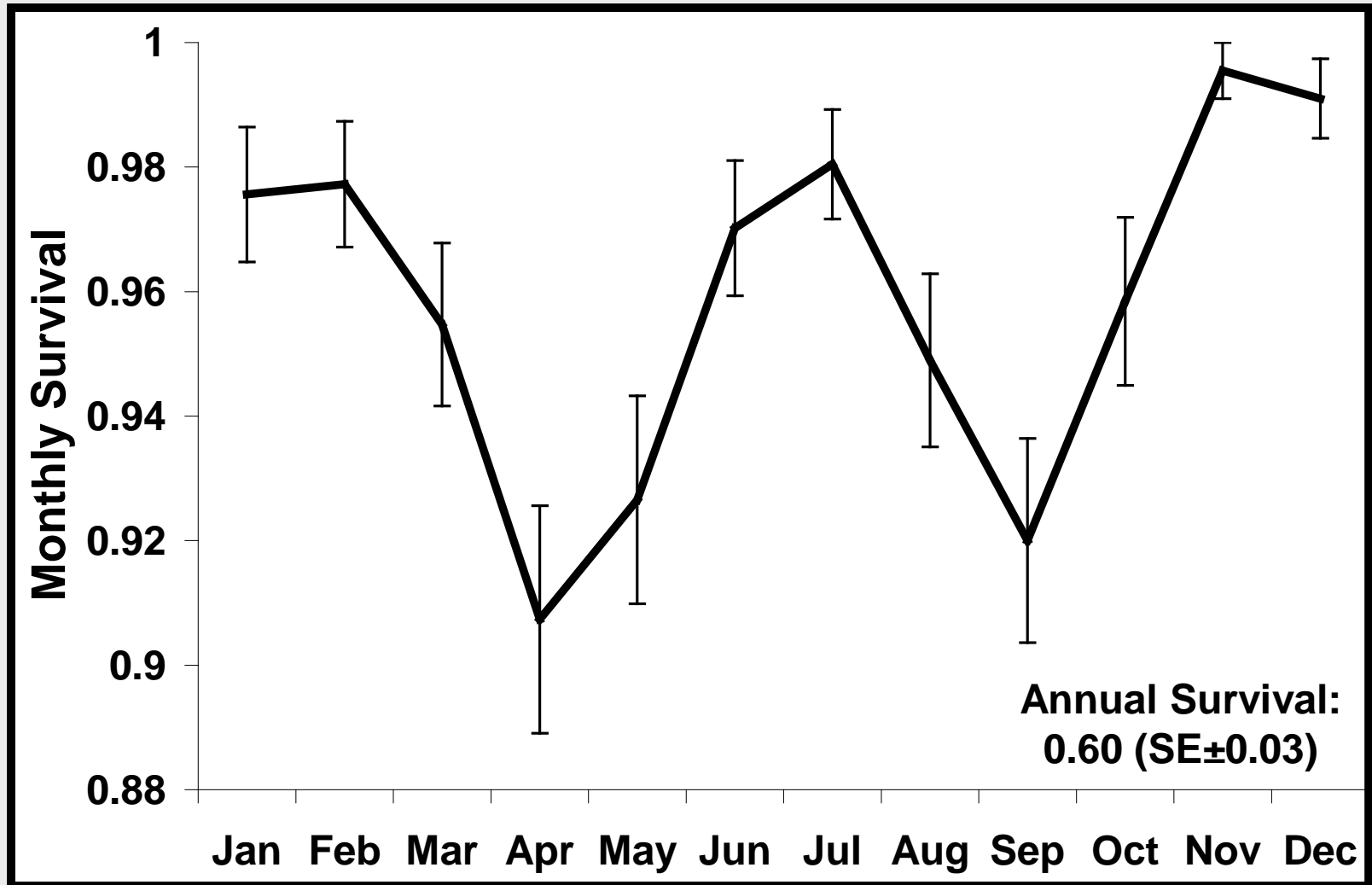
- Current nest survival estimates are too low to sustain a stable population given reasonable adult and chick survival estimates.
- Factors influencing nest survival are multifaceted.
- Strong support for both an influence of individual fitness on nest success, as well as large scale population-level spatial impacts

# Female Survival

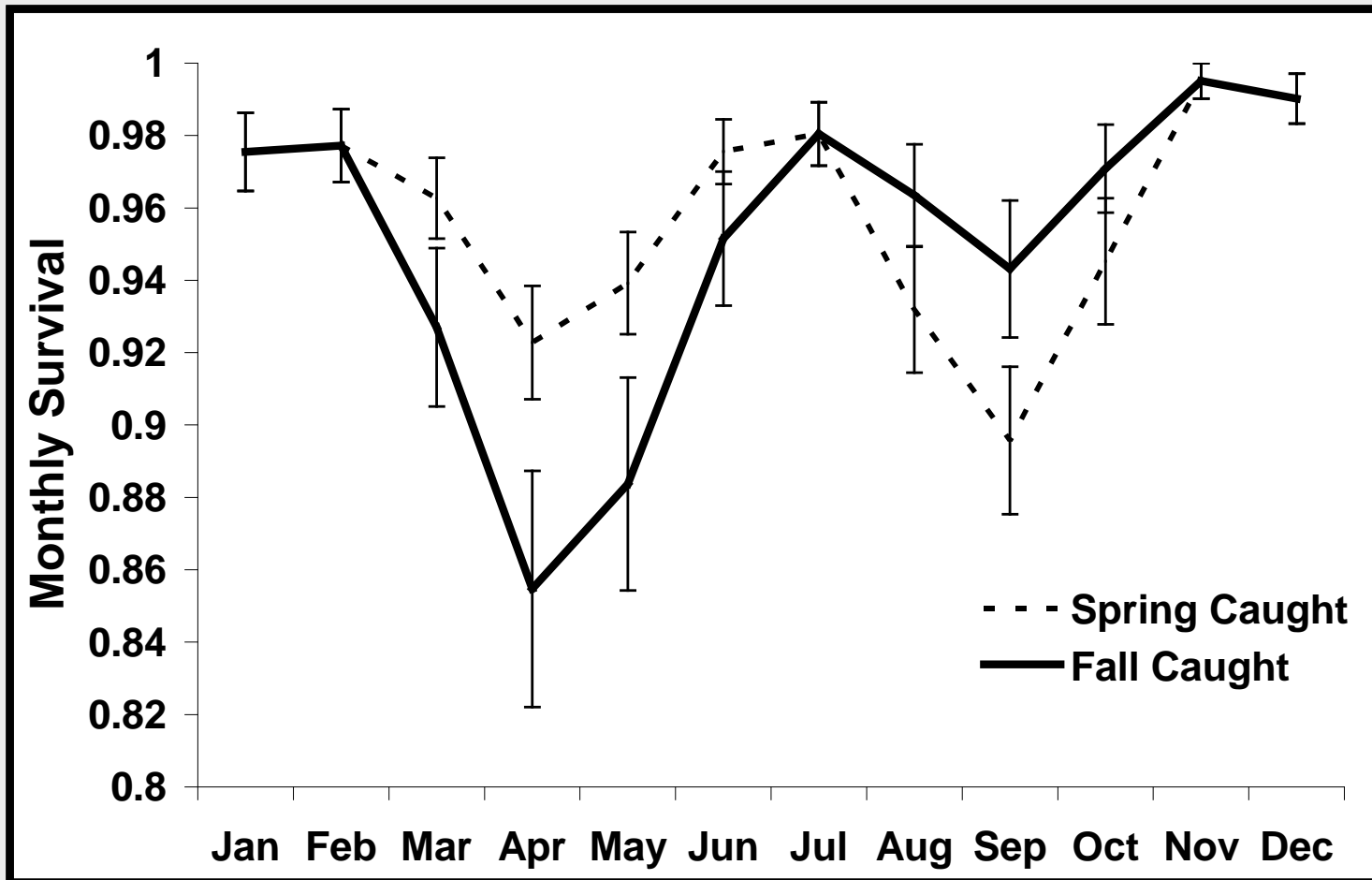
- Estimated monthly and annual survival of radioed females.
- Evaluated the effects of:
  - Month
  - Year
  - Hen age class
  - Population
  - An effect of where hen was trapped
  - Effect of reproduction



# Female Survival: Results

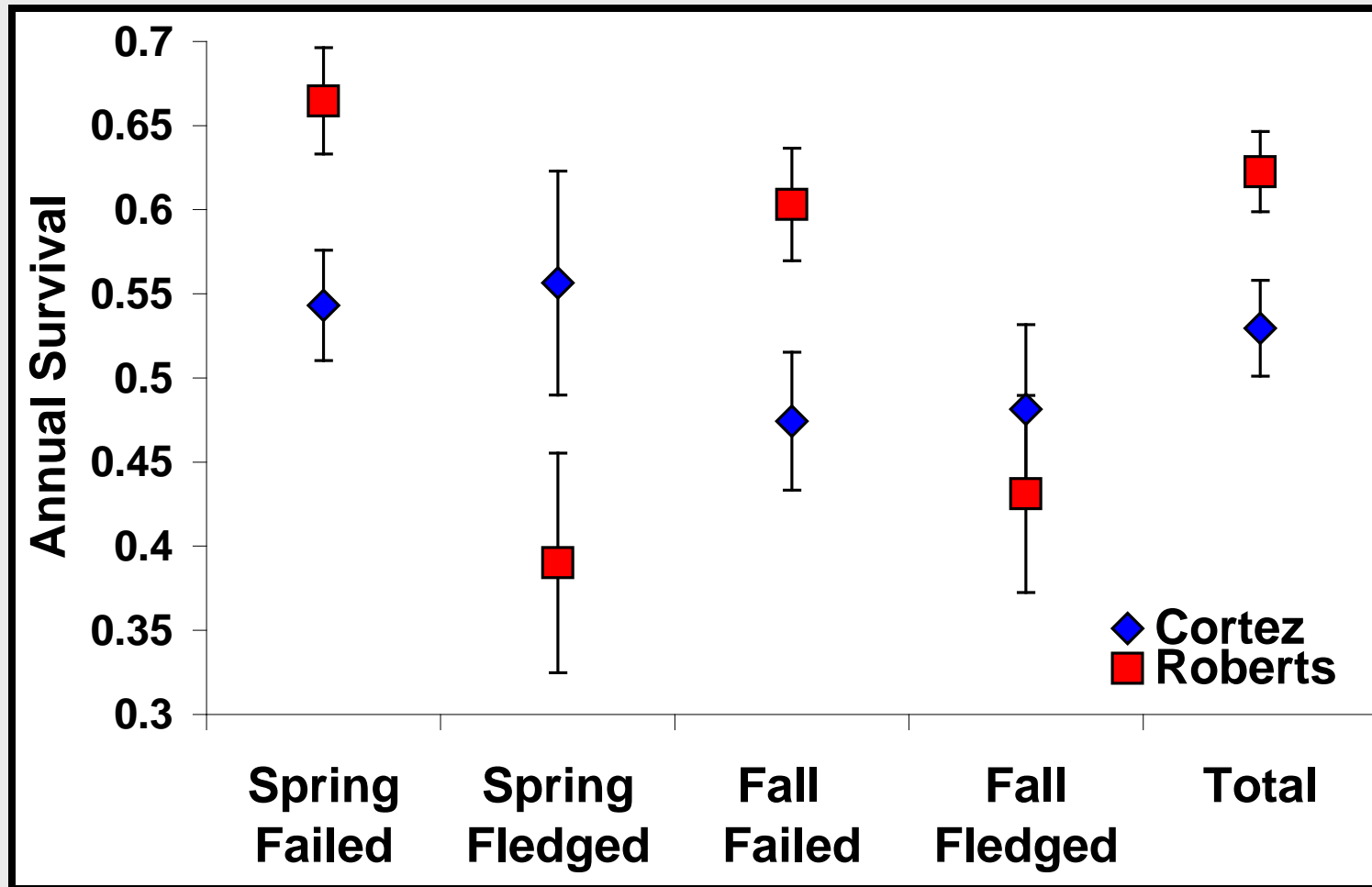


# Female Survival: Results



**Annual Survival**  
**Spring: 0.59 (SE  $\pm 0.03$ )**  
**Fall: 0.54 (SE  $\pm 0.04$ )**

# Female Survival: Results



Annual Survivals:  
Roberts: 0.62 (SE± 0.01)  
Cortez: 0.53 (SE± 0.02)



# Female Survival: Conclusions

- Periods of highest mortality continue to be the spring and fall.
- Successful breeders have higher survival in Cortez than the Roberts.
- There is some support for a difference in hen fitness between spring and fall caught females.

## Fall Survival



- What are sources of spatial, temporal, and individual variation?

All Radio-Collared Birds  
Monitored for Survival  
~ 3-5 times/week.



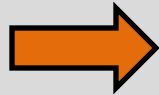
- Effect of Time, Sex, Age, Population,  
on survival.





## - How does habitat composition influence survival?

Adult females located weekly, location recorded and vegetation sampled.



Fine scale – Vegetation sampled within 100 m<sup>2</sup> of location:

- Shrub cover (sagebrush and non-sagebrush)
- Understory Cover (Live and Dead Forbs, annual grass, perennial grass).

Coarse Scale – GIS variables quantified within 3.14 km<sup>2</sup> of location:

- Mt Sagebrush Habitat
- Pinyon/Juniper forest
- Wildfire.

Distance to :

- Streams, springs, roads.



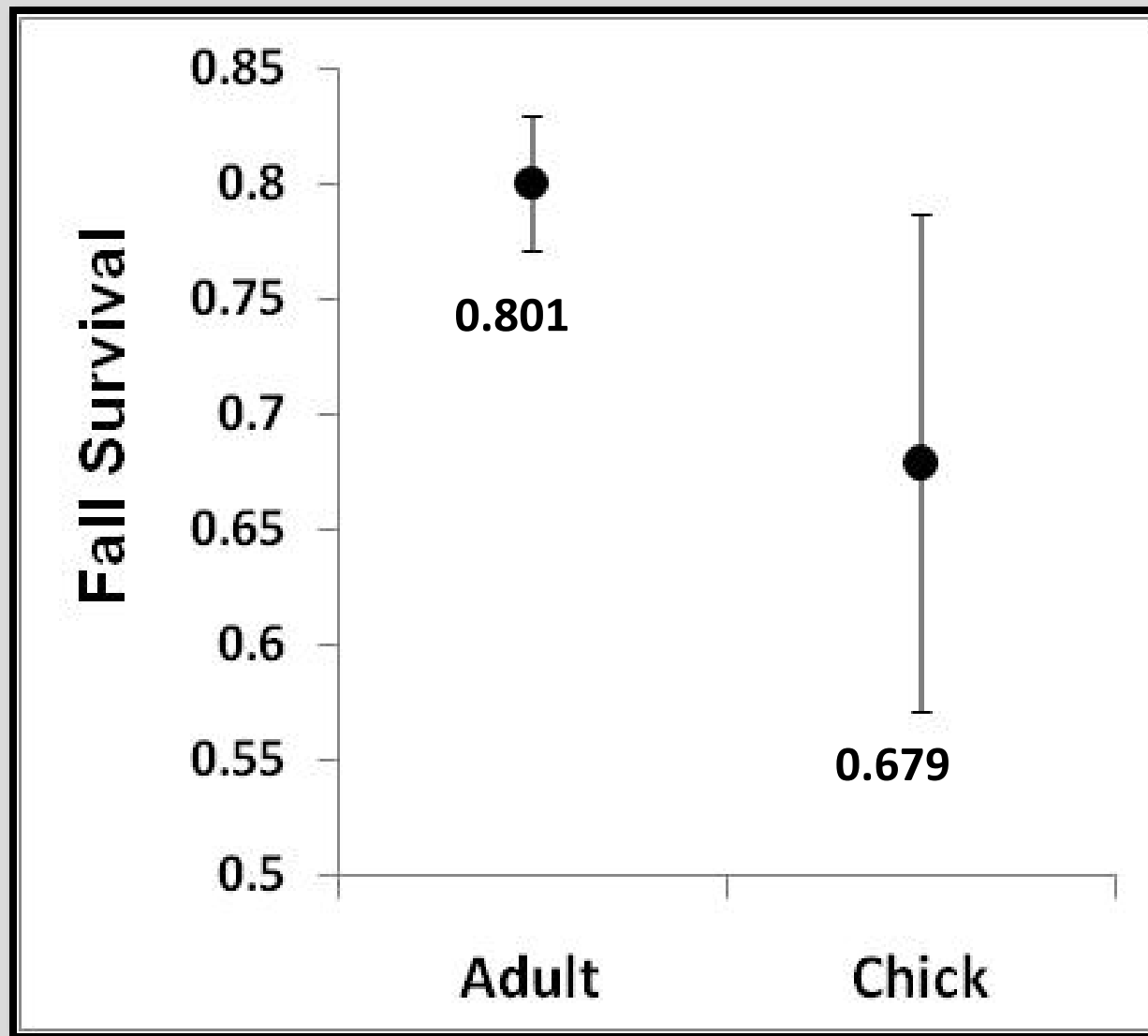
**\*Program Mark Known Fate, AICc and model selection**

# Field Results

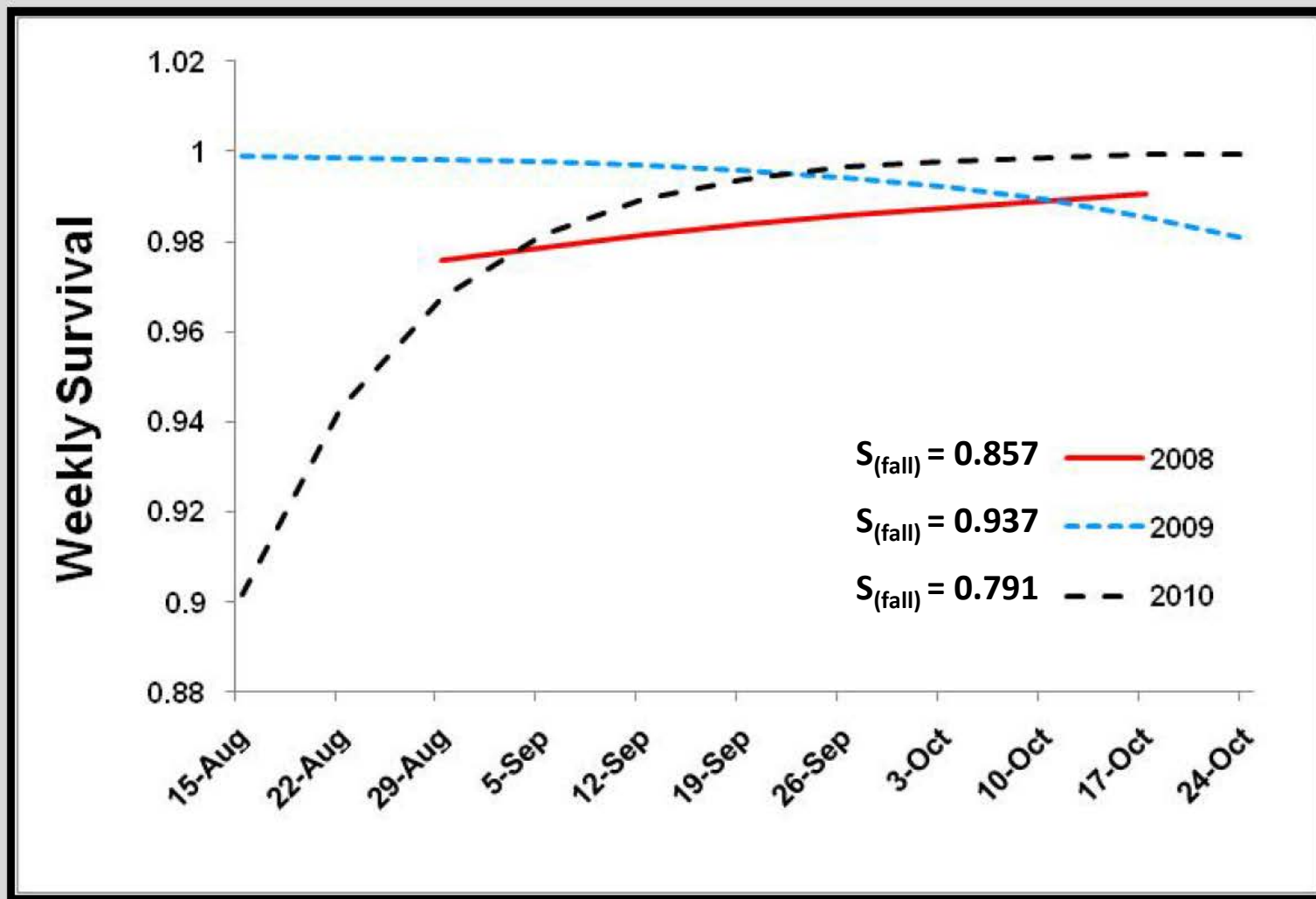
- Monitored survival of 174 individual sage-grouse.  
116 Females, 58 Males
- Collected locations from 79 unique adult females.
- Sampled habitat at 667 unique locations.



## Results – All Birds



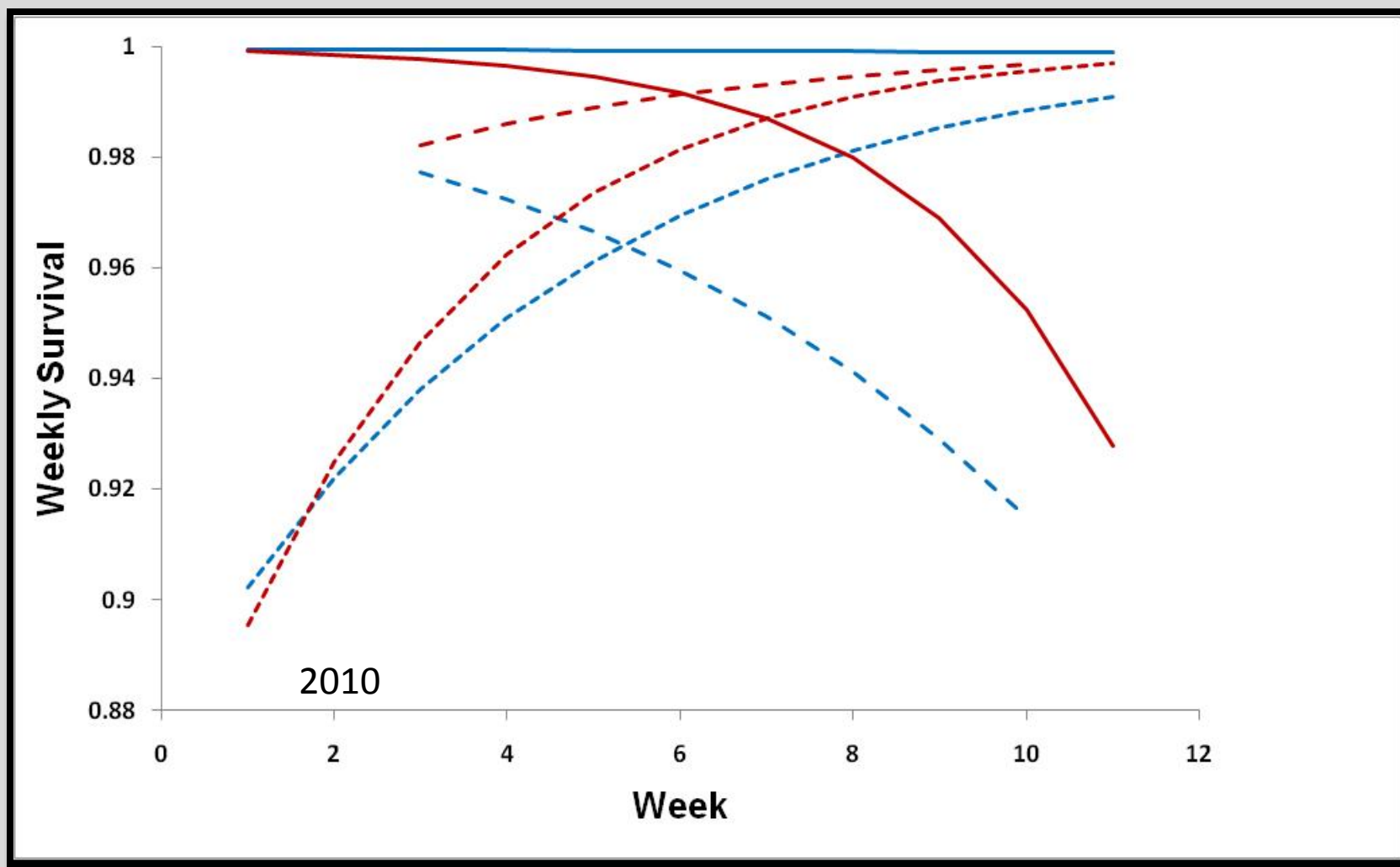
## Within and among year variation (year\*trend):





# Population-level variation:

Roberts Creek  
Cortez Range



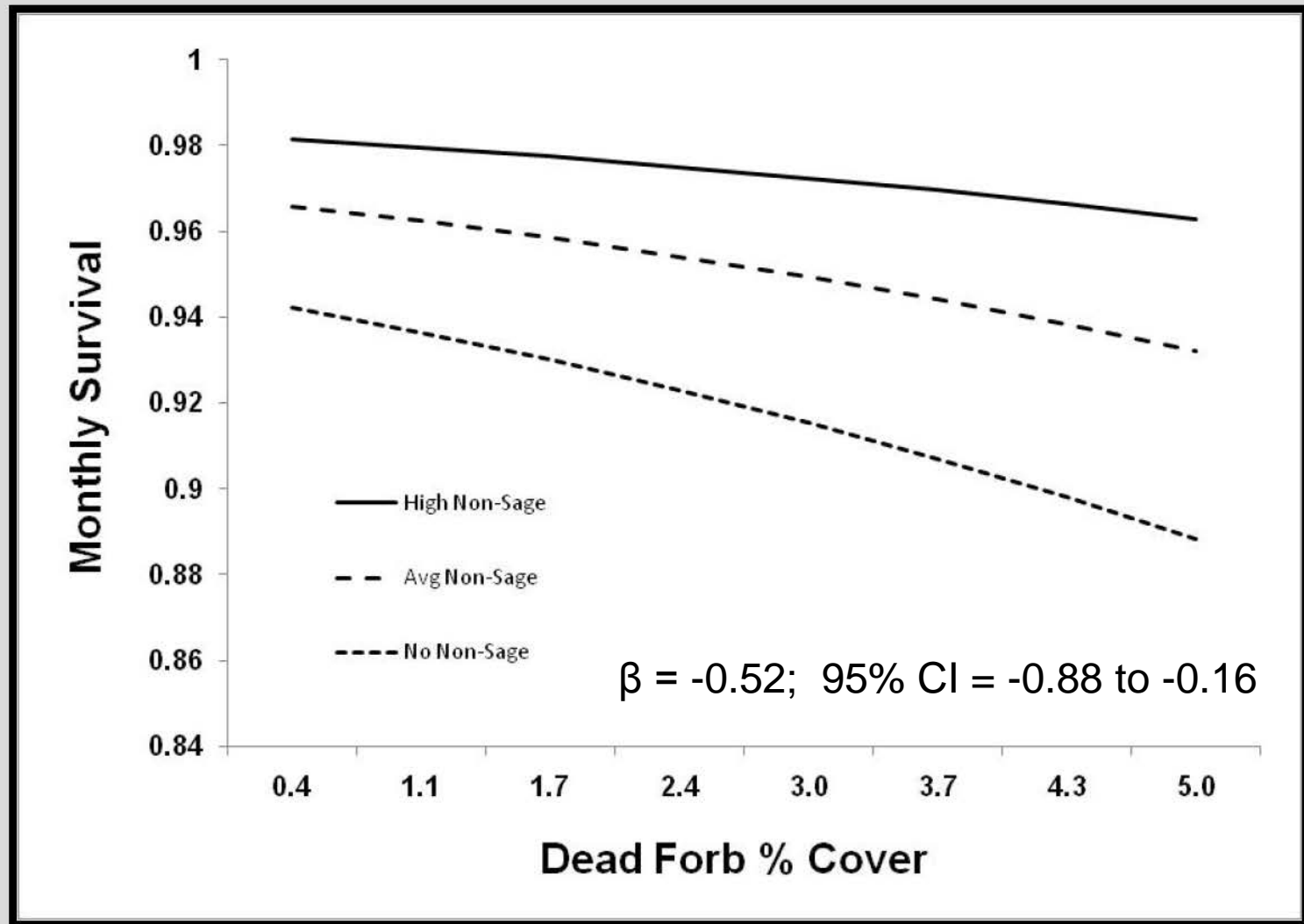
# Results – Adult Hens

**Three habitat variables contribute to survival:**

- % cover of dead forbs**
- % cover of non-sagebrush shrubs**
- Mountain Sagebrush habitat availability.**

**No support for effect of any other habitat covariates.**





Overall negative influence of dead forb cover, positive influence of non-sage shrub cover.

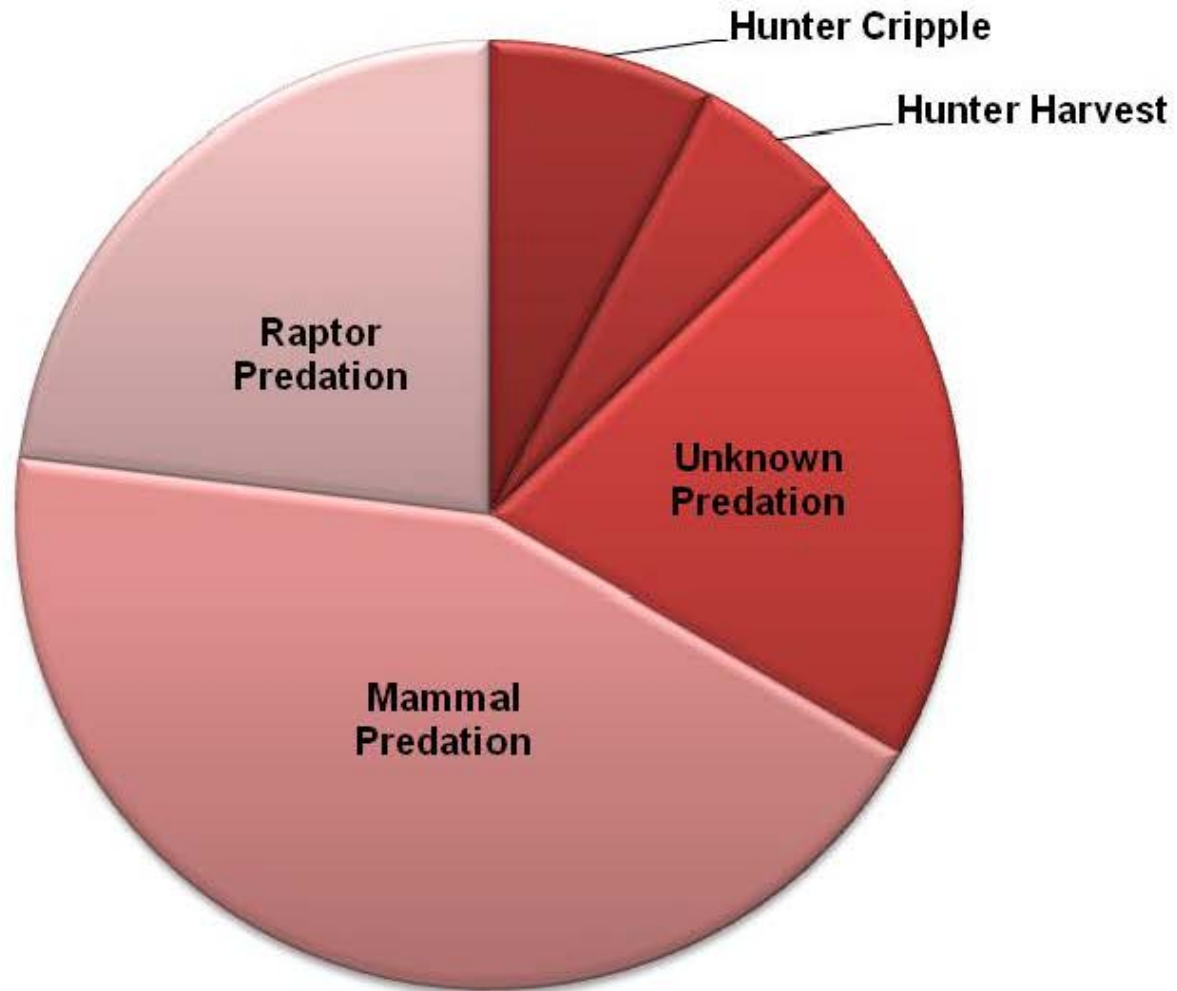
- Negative effect of mountain sage-brush habitat within 1 km of bird locations.

$\beta = -0.49$ ; 95% CI = -1.10 to 0.12

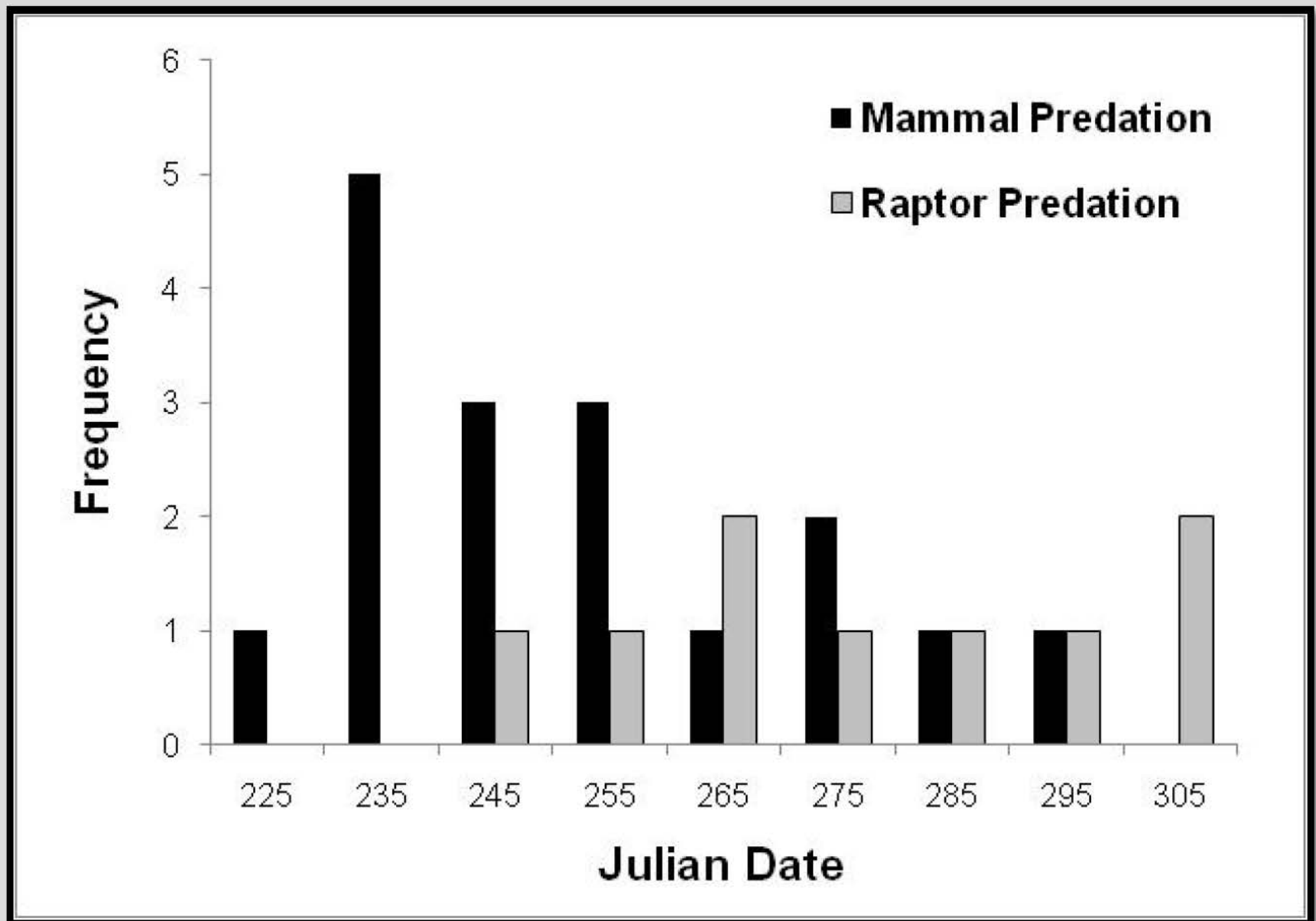




# Cause and timing of Mortality:



## Cause and timing of Mortality:



# Pradel Models – Male Cap-Recap

Pradel models generate 3 parameter estimates from Capture-recapture data: Survival, Seniority and Capture Probabilities.

Survival ( $\phi$ ) = Probability that if alive now (time  $t$ ) you'll be alive next year (time  $t+1$ ), i.e. you will not die in the next year.

Seniority ( $\gamma$ ) = Probability that if alive now (time  $t$ ) you were also alive last year (time  $t-1$ ), i.e. you were not born in the previous time step.

Used to estimate:  $\lambda_t = \Phi_t / \gamma_{t+1}$

- Can use Pradel  $\lambda$  to evaluate accuracy of lek count trend estimates.

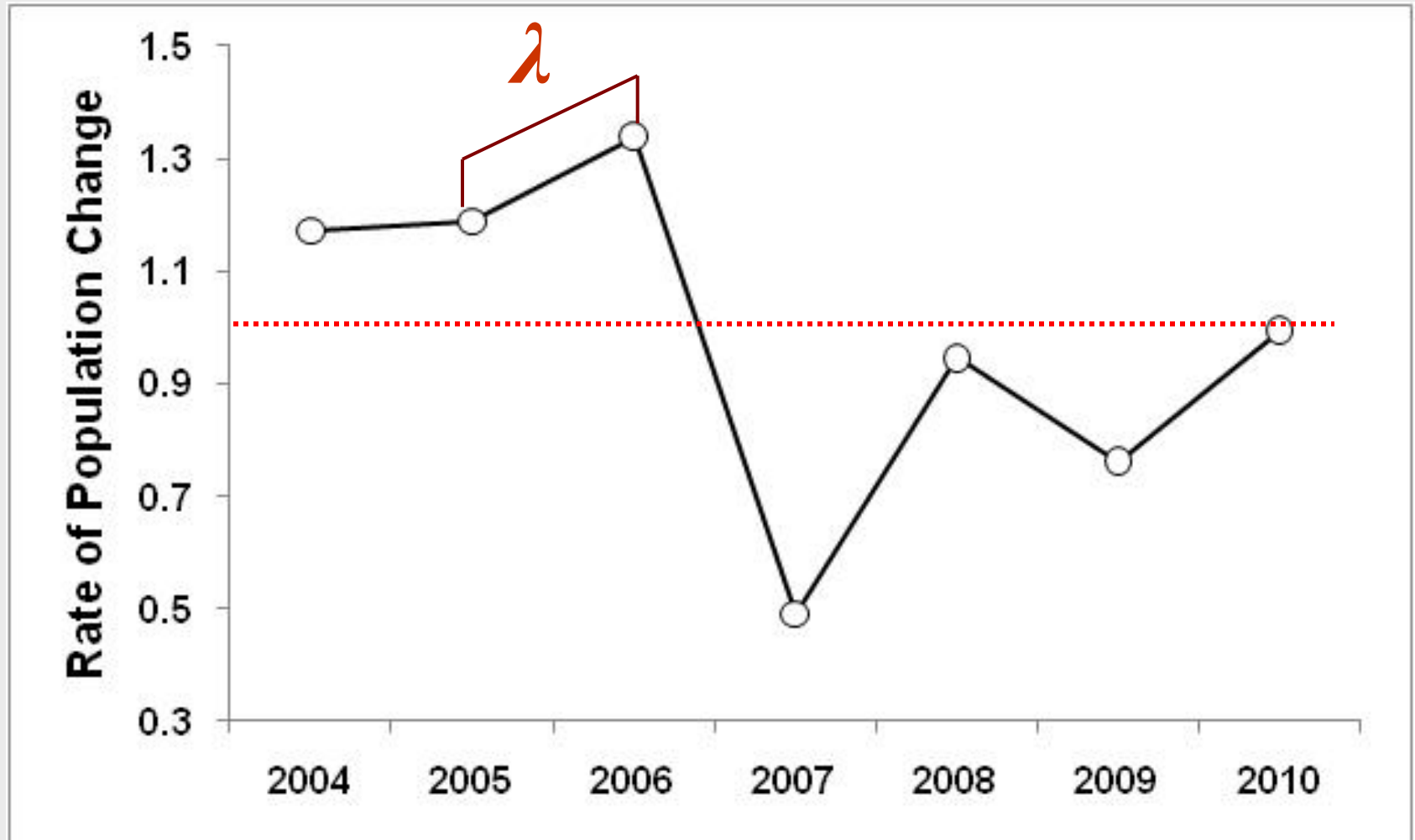
# Methods

- Constructed Pradel Models using spring male banding data.
- Estimated survival, detection probability,  $\Lambda$ .
- Compared Pradel  $\Lambda$ s to population trends derived from maximum daily lek attendance.
- Assessed influence of individual and group covariates on survival.

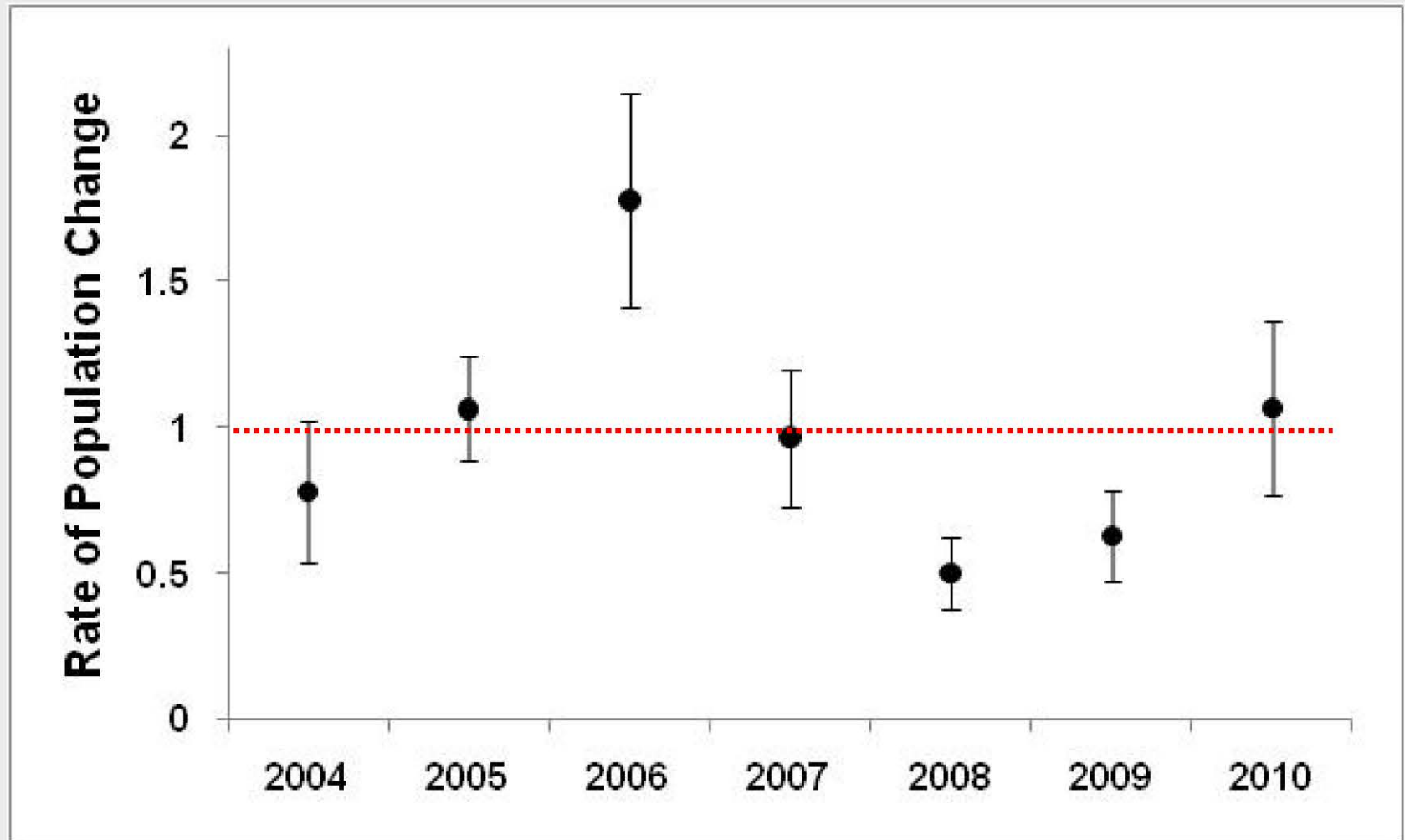




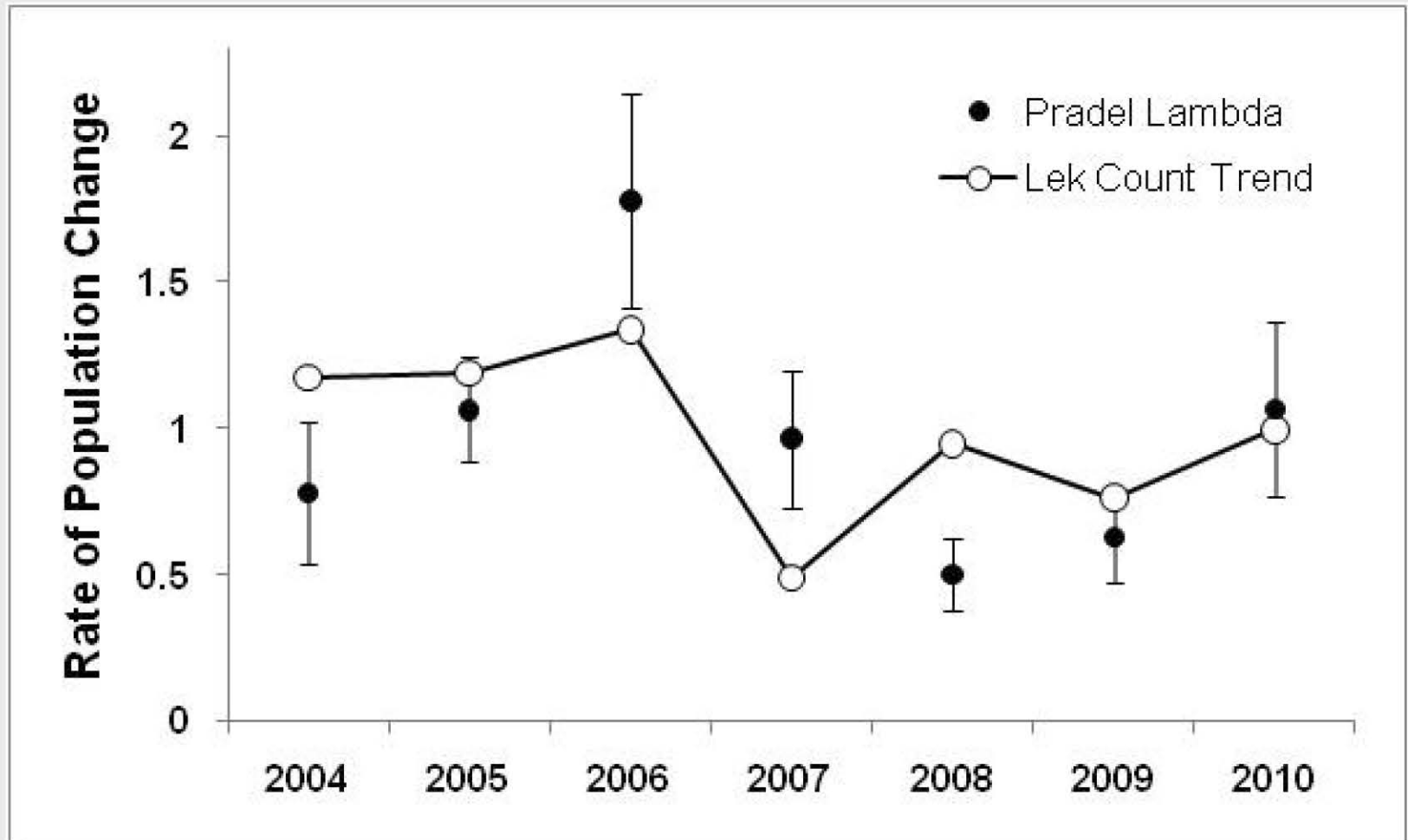
# Results – Lek Counts



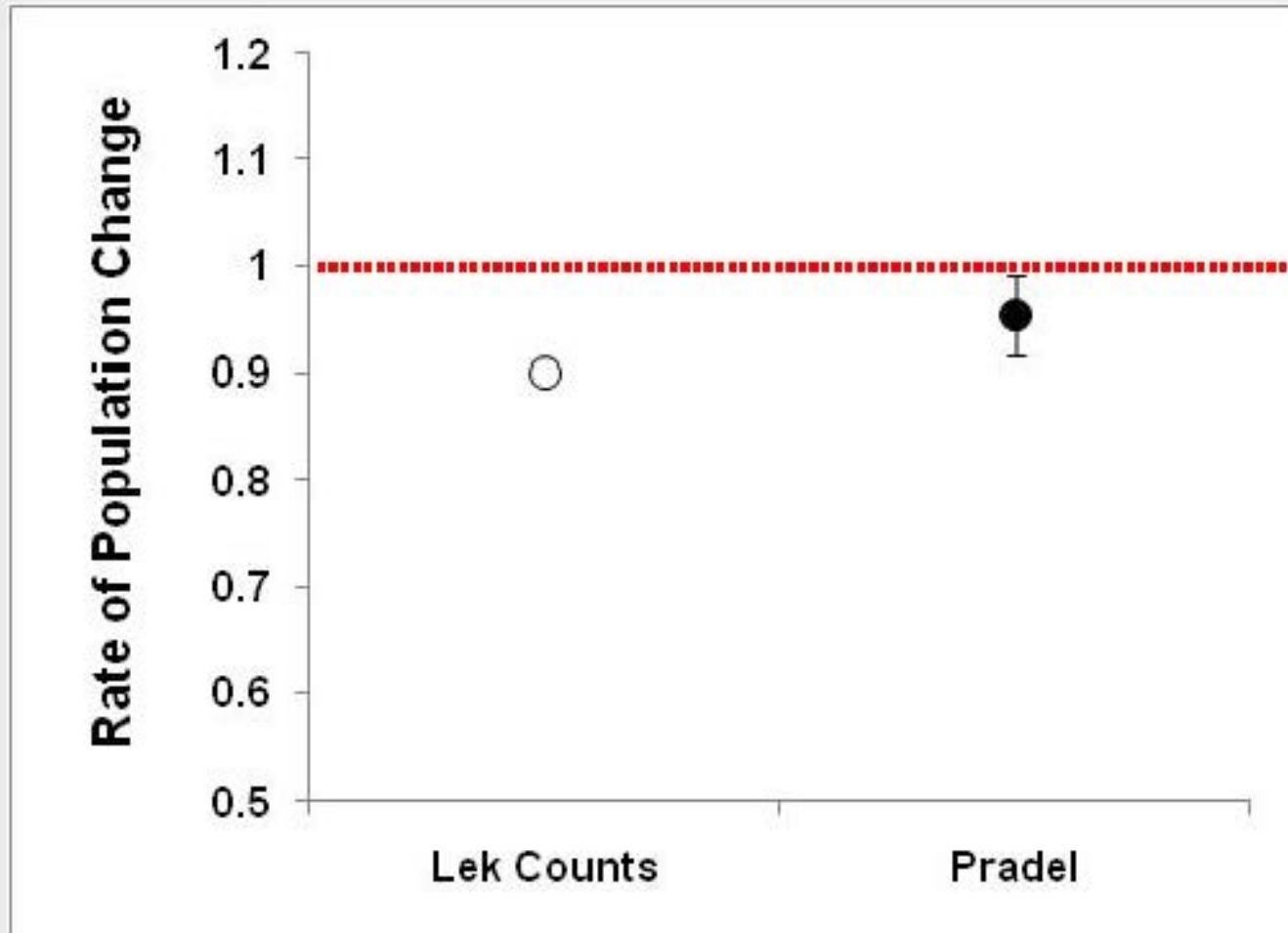
# Results – Pradel Lambda



# Results – Annual trends



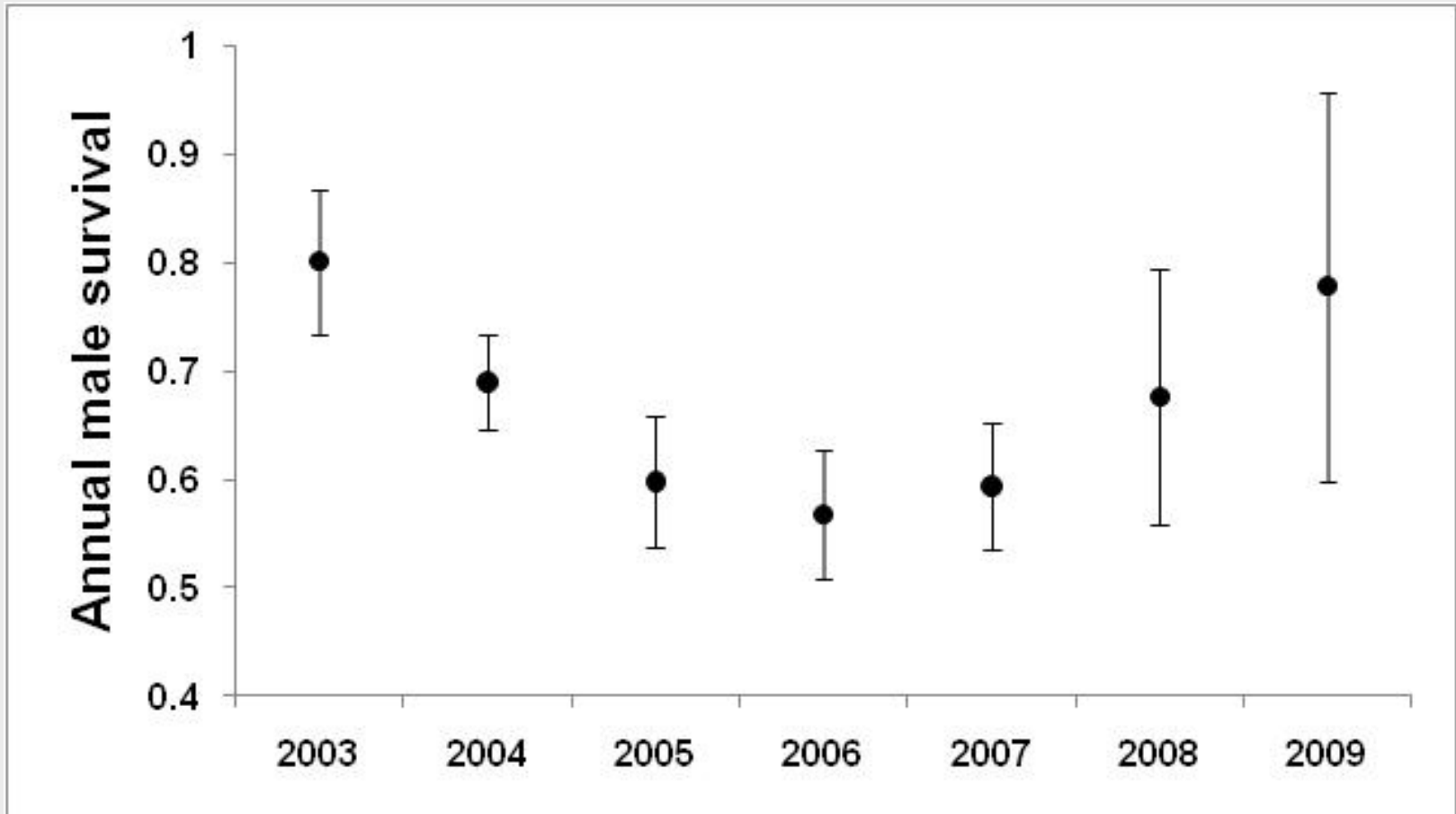
# Results – Long-term (7-year) trend





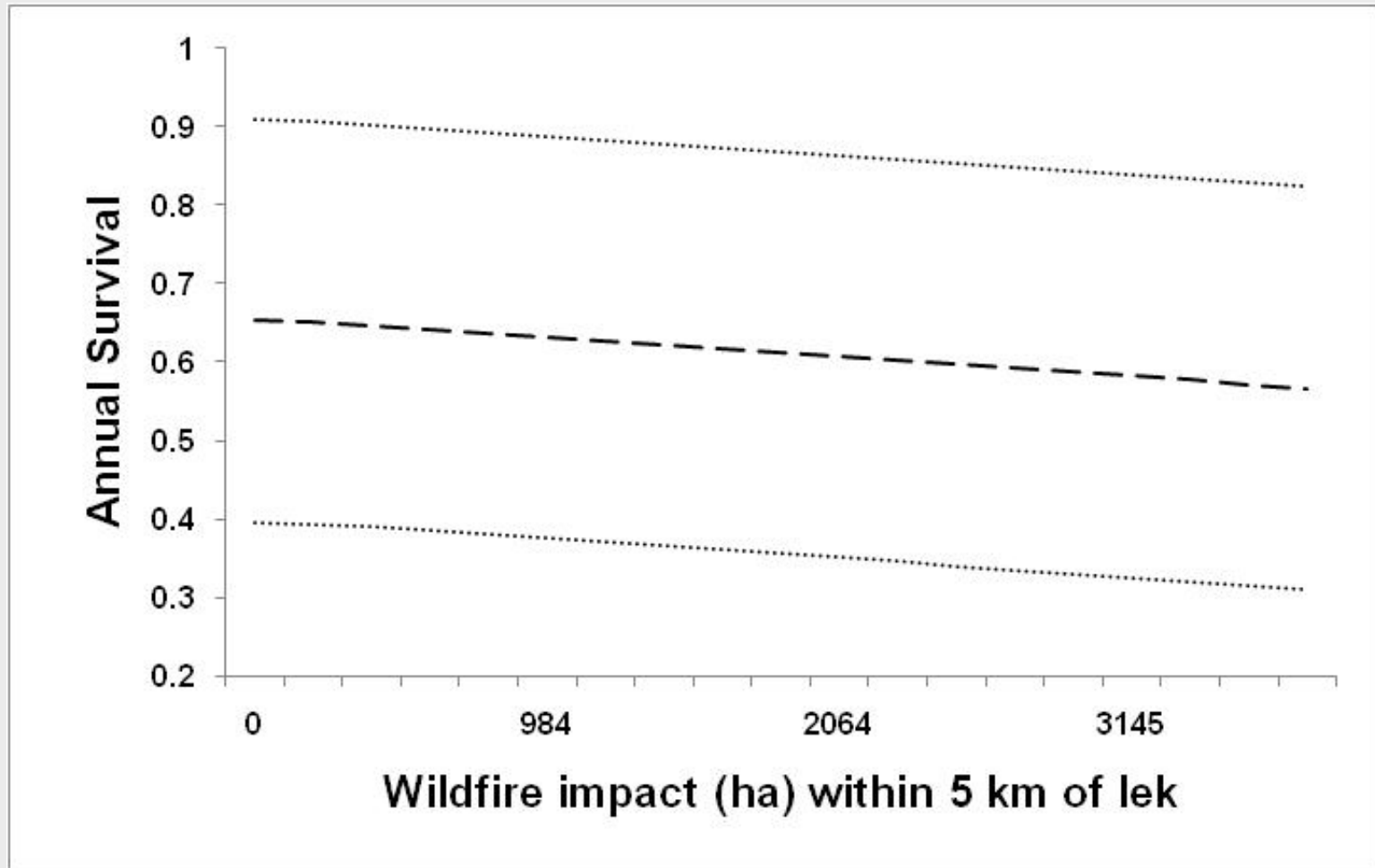
# Results – Annual Survival (Phi)

- Best supported model allows for a quadratic effect of year.



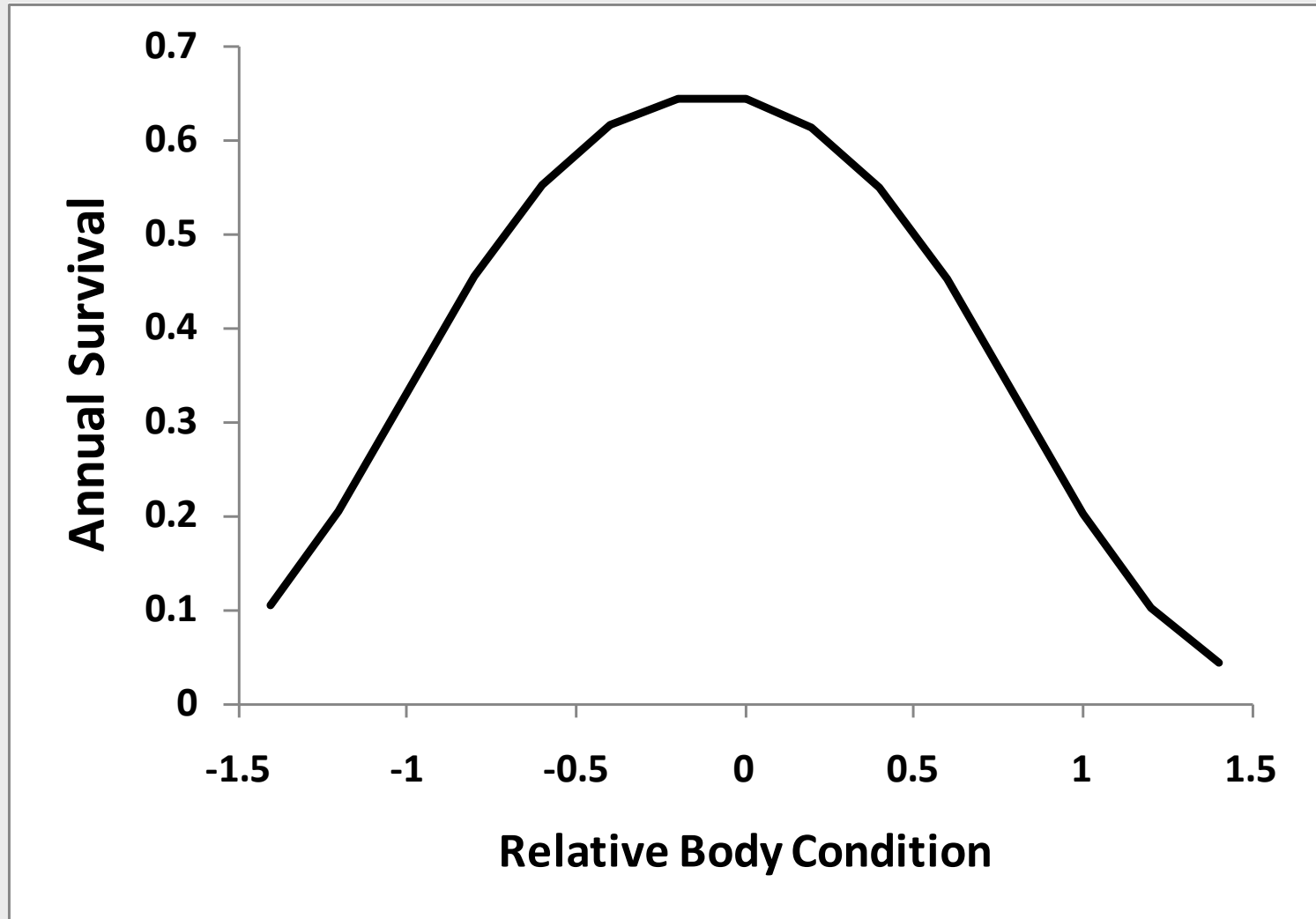
# Results – Annual Survival (Phi)

- Best supported model shows negative effect of wildfire impacts.



# Results – Annual Survival (Phi)

- Support for quadratic effect of individual body condition.



# What's responsible for discrepancy between lek count and Pradel results?

- Variation in male attendance rates.
- Movement of males to and from unmonitored leks.
- Annual variation in lek location.
- Unknown/unmonitored leks.
- etc.





# What's responsible for lack of precision in lek count results?

- Variation in male attendance rates.
- Movement of males to and from unmonitored leks.
- Annual variation in lek location.
- Unknown/unmonitored leks.
- etc.

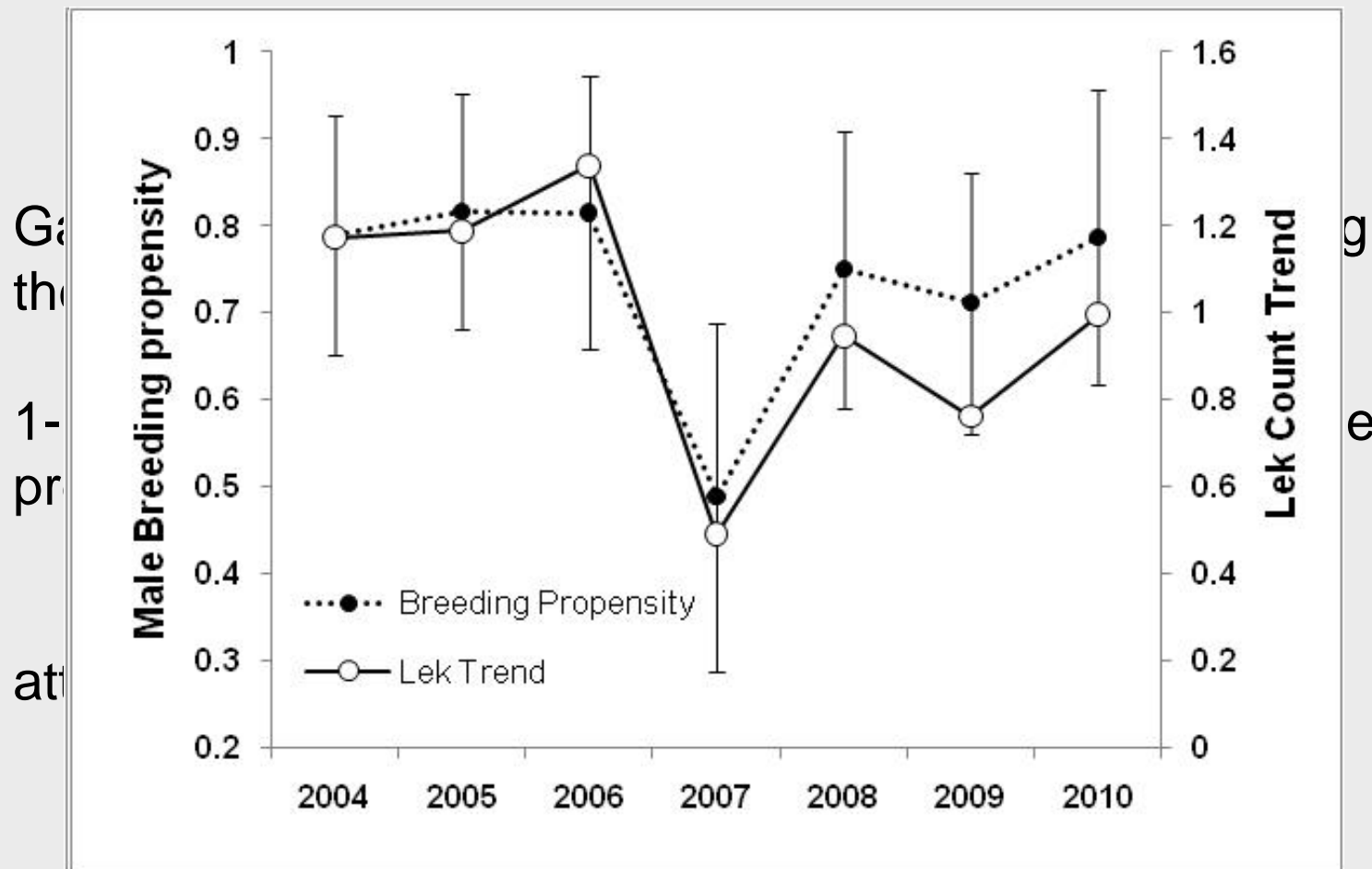


**- Does variation in male attendance influence trends observed using lek counts?**

Estimating probability of attendance using Robust Design.

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Estimating probability of attendance using Robust Design.



# Conclusions

- Lek counts produced reliable general trend estimates (declining vs. increasing).
- Estimation of absolute population change should be restricted to longer term data sets.
- Inferences of underlying dynamics are not possible from lek counts.
- Male attendance rates are variable between years, and are highly correlated with lek count results.



# Overall Conclusions

- Still no support for influence of Falcon-Gondor on nest success.





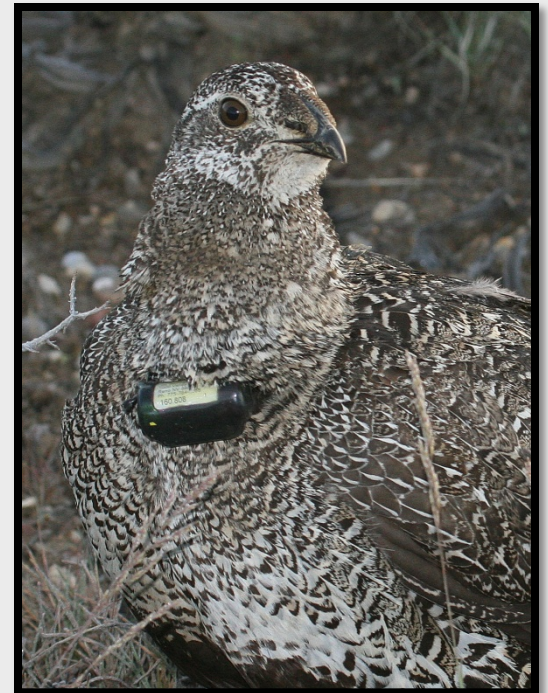
# Overall Conclusions

- Substantial demographic differences between the two populations.
- The presence of wildfire in the Cortez and relative lack of it around Roberts Creek Mountain may provide a mechanism for lower nest success and male survival, but does not seem to effect female survival in the fall.
- Inter-annual variation in predator communities may drive fall survival.



# Overall Conclusions

- Fall survival appears to be regulated by top-down processes.
- Some suggestive top-down regulation of nest success as well.





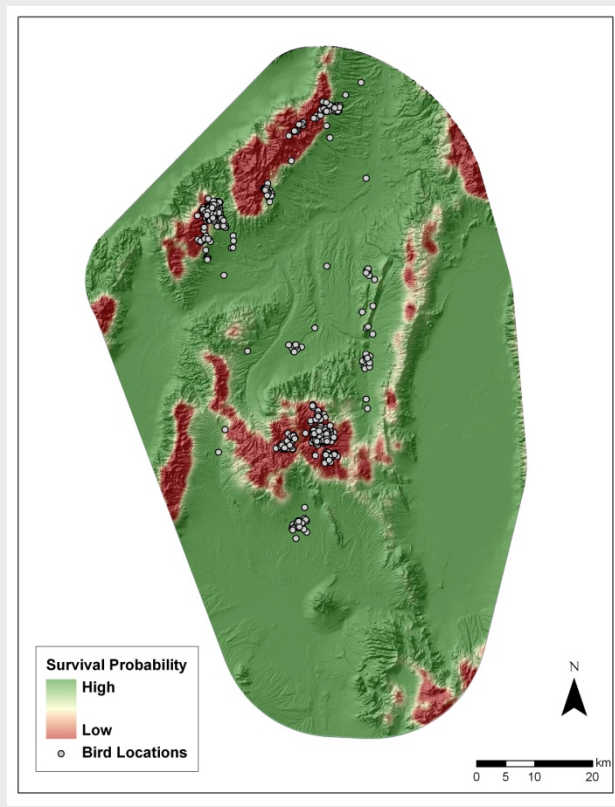
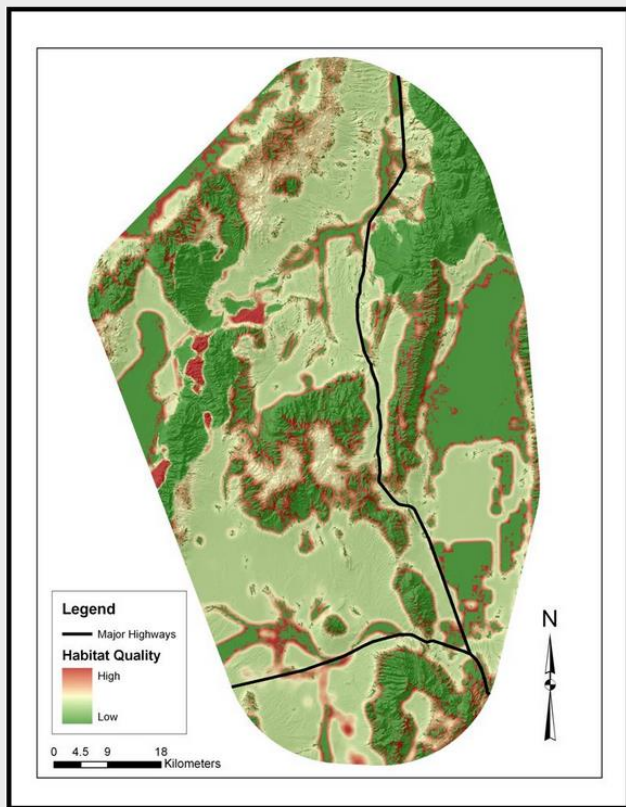
# Overall Conclusions

- In general low reproduction appears to be the major concern.
- Low nest survival may be more critical than brood/chick survival.



# Future Directions

- Population modeling and identification of limiting demographic rates.
- Integrating geospatial models of demographics.





# Questions?

