Steve Perry

Survival of Red Desert Pronghorn in the Face of Environmental and Anthropogenic Change

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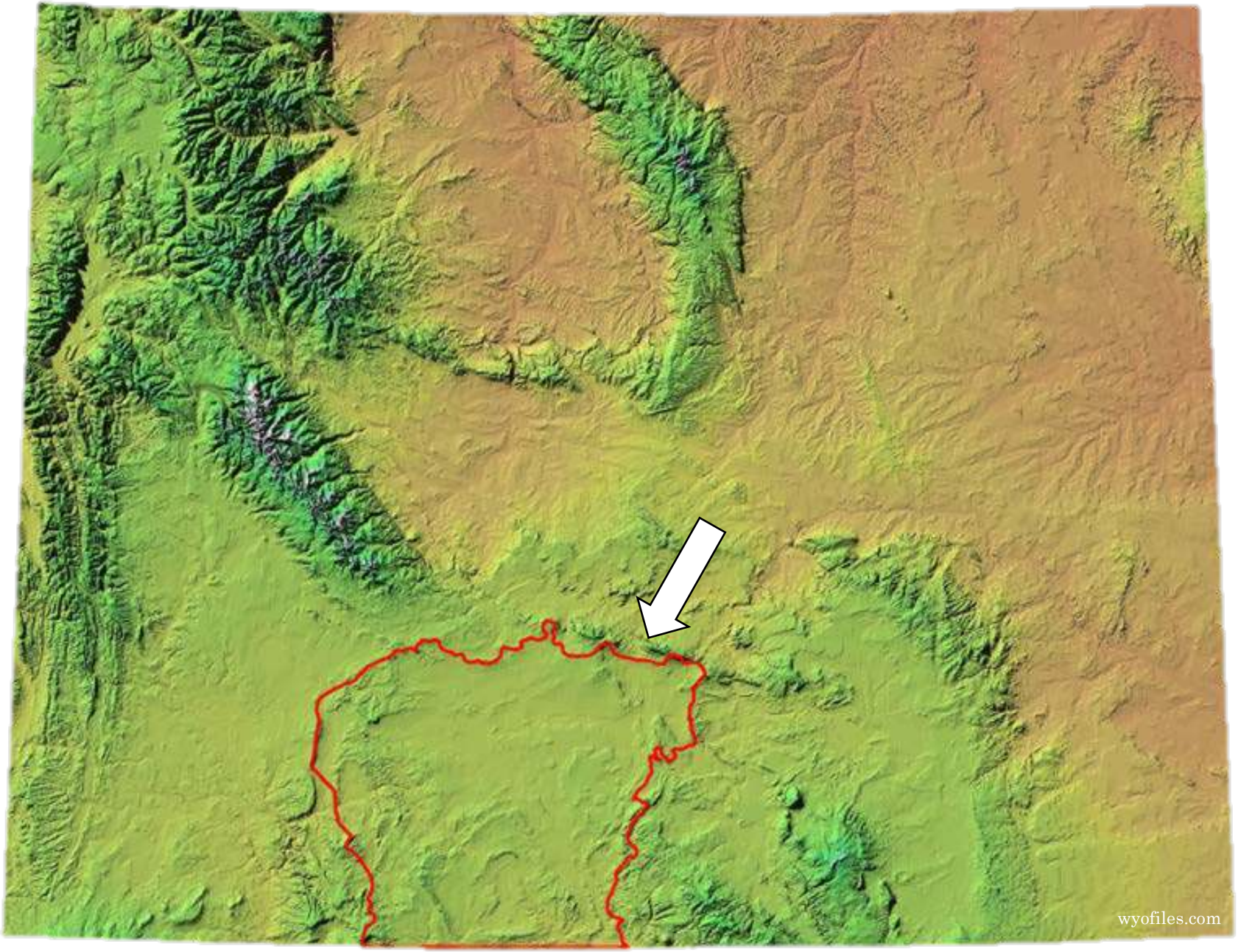
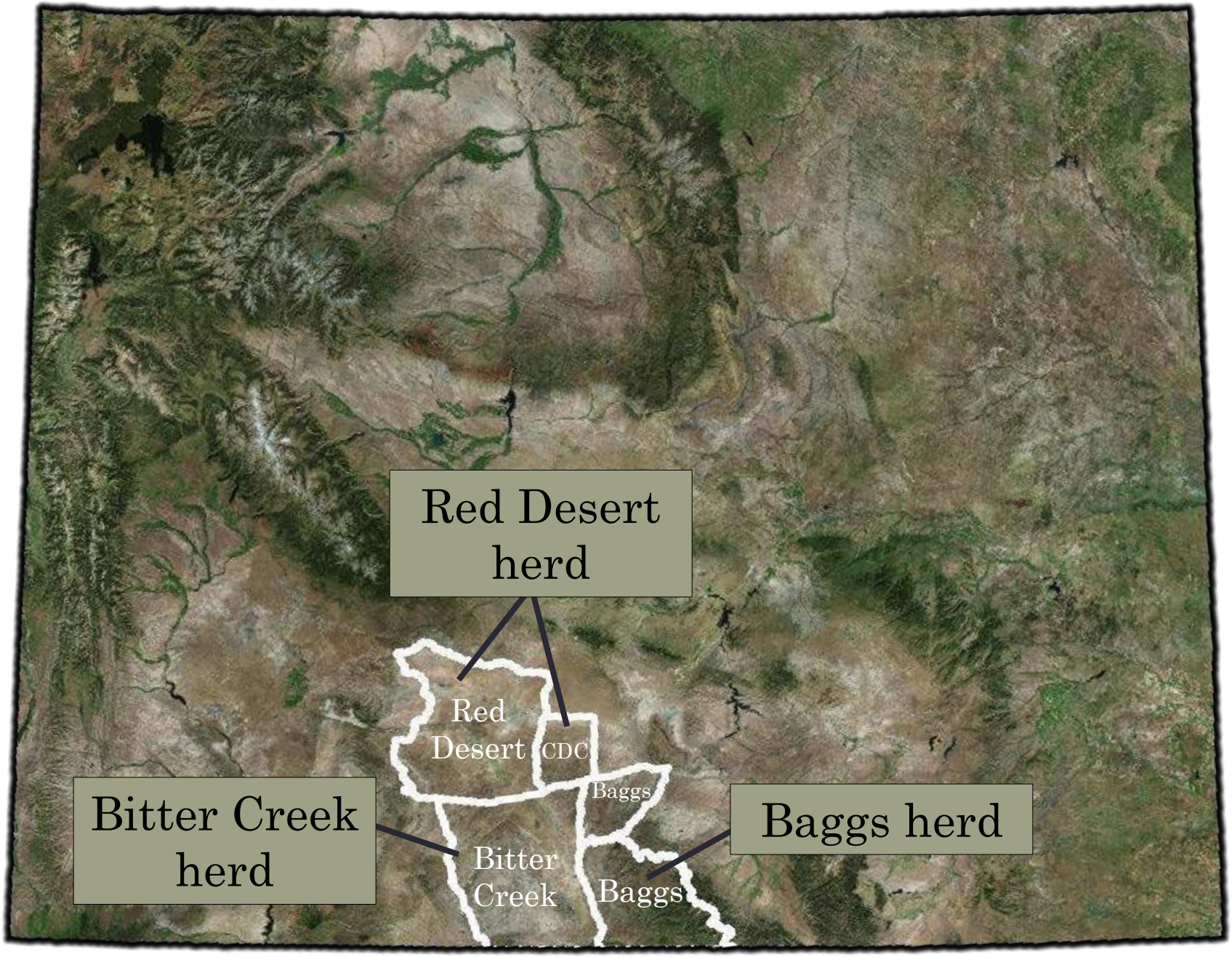
Wyoming Populations

- >50% of entire species found in WY (Yoakum and O'Gara 2000)
- ~410,000 currently (Tony Mong, personal communication)
  - Population increasing
  - Decline of 28% from population highs

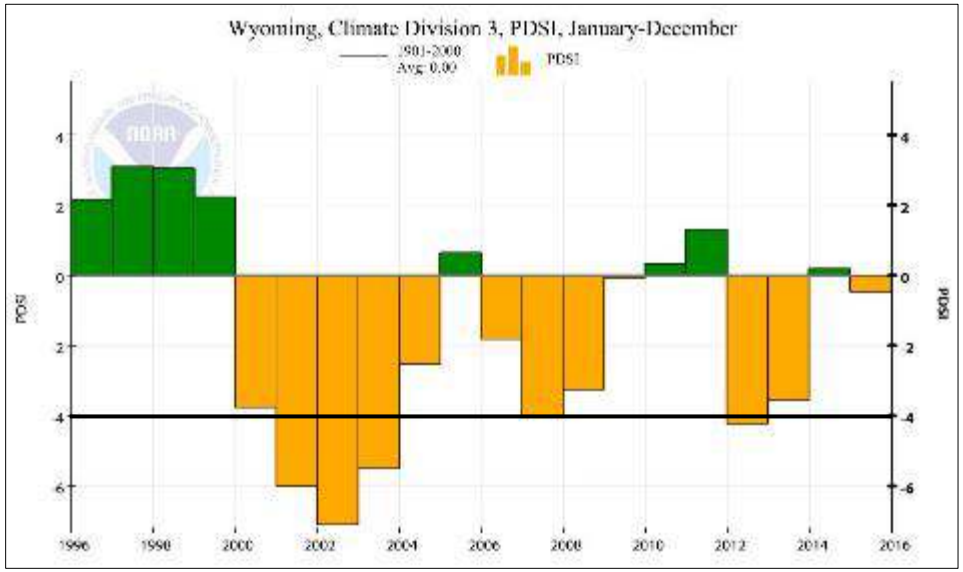
The Red Desert

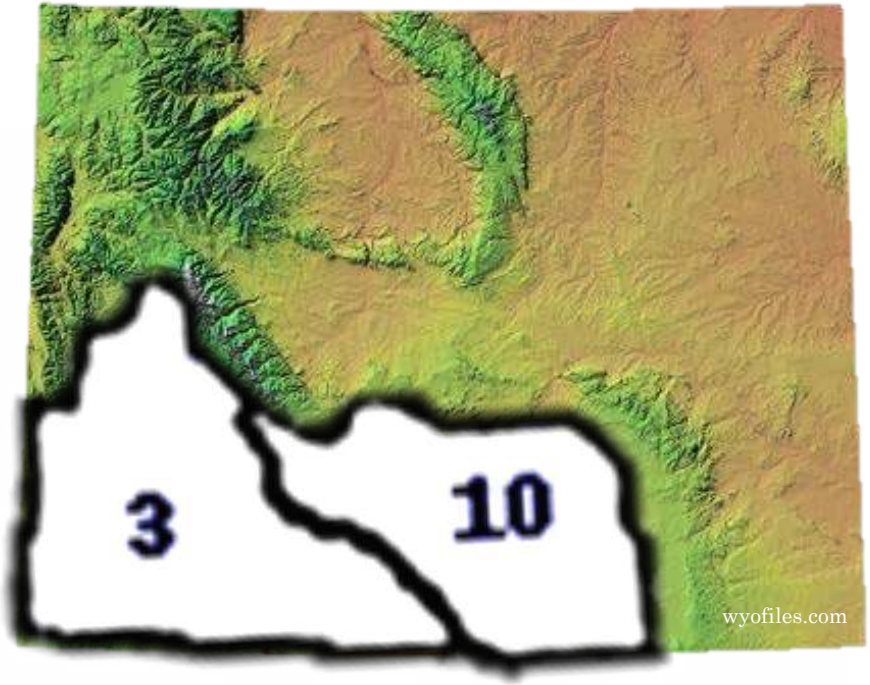


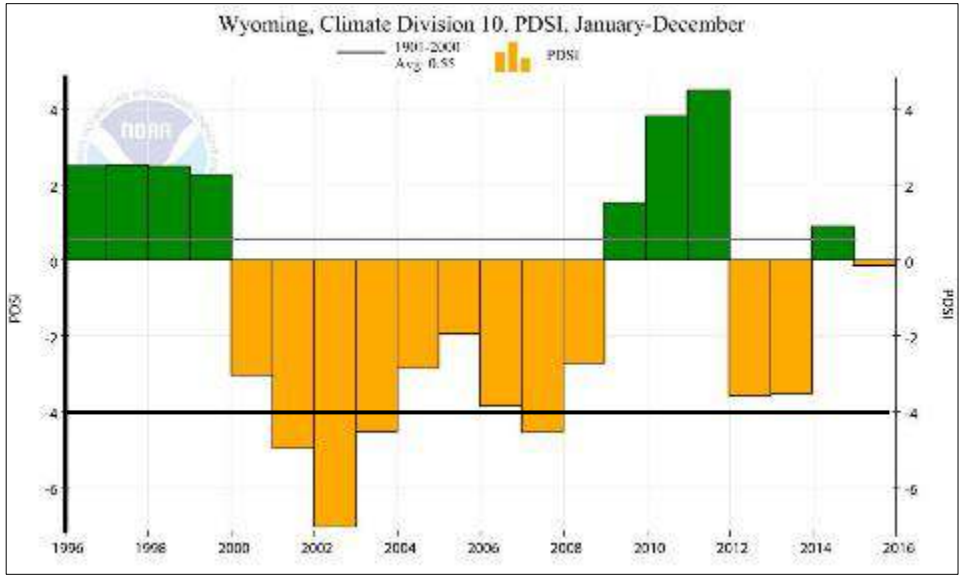
The Red Desert



National Oceanic and Atmospheric Administration (NOAA) Climate Divisions for State of Wyoming

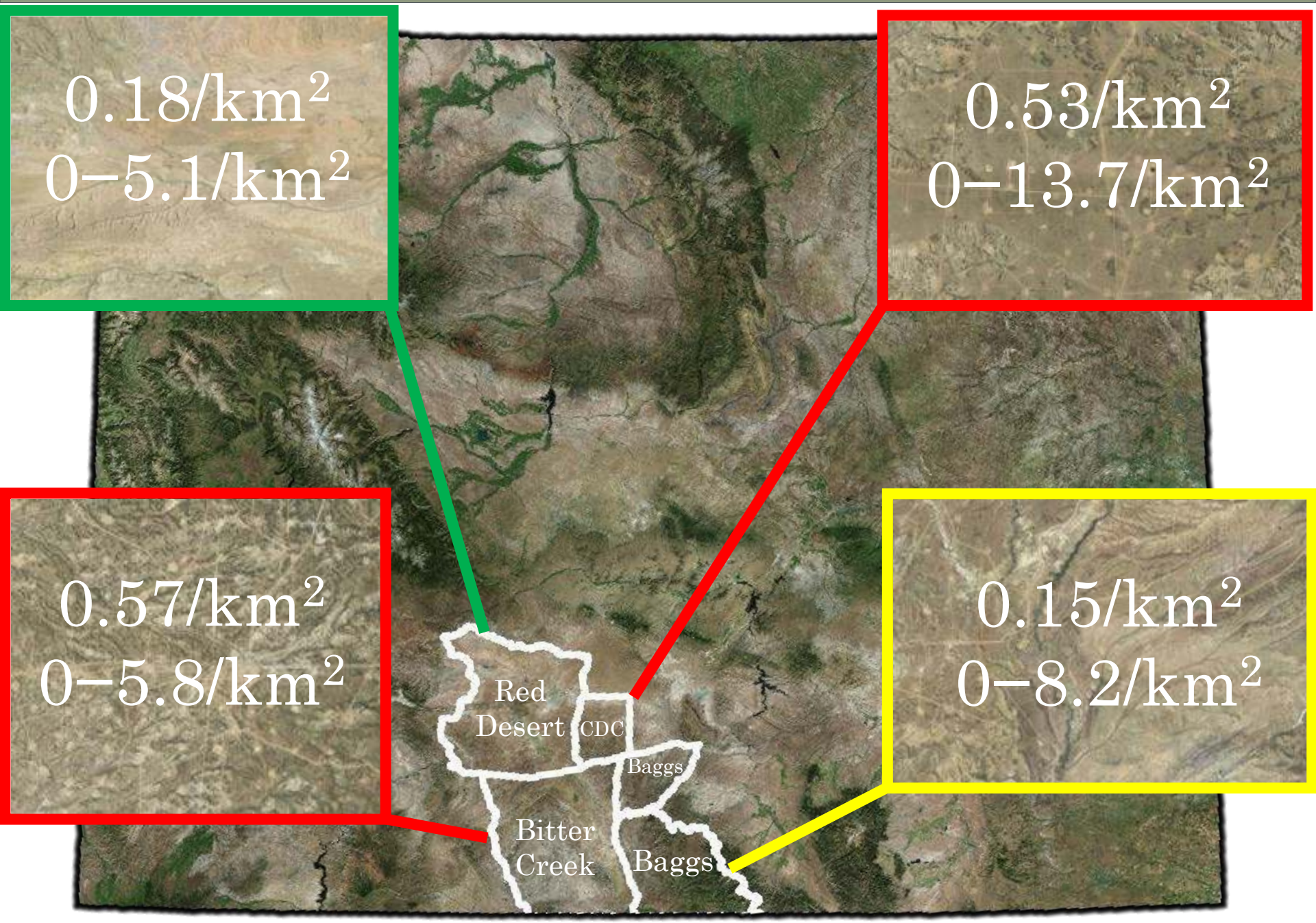






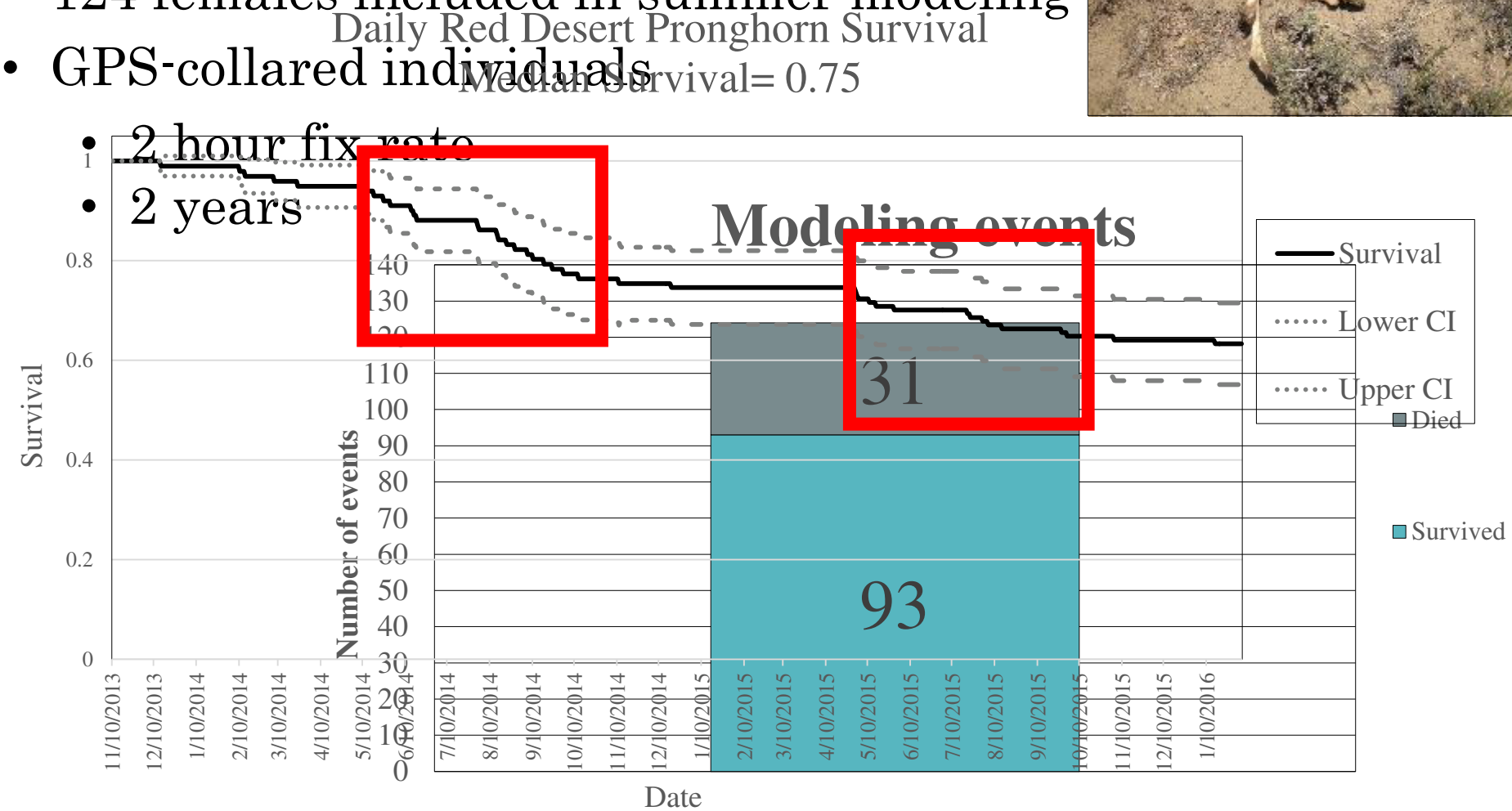
ncdc.noaa.gov

The Red Desert



Basic statistics:

- 186 adult female pronghorn collared
- 80% of deaths occurred in summer
- 124 females included in summer modeling
- GPS-collared individuals
  - 2 hour fix rate
  - 2 years



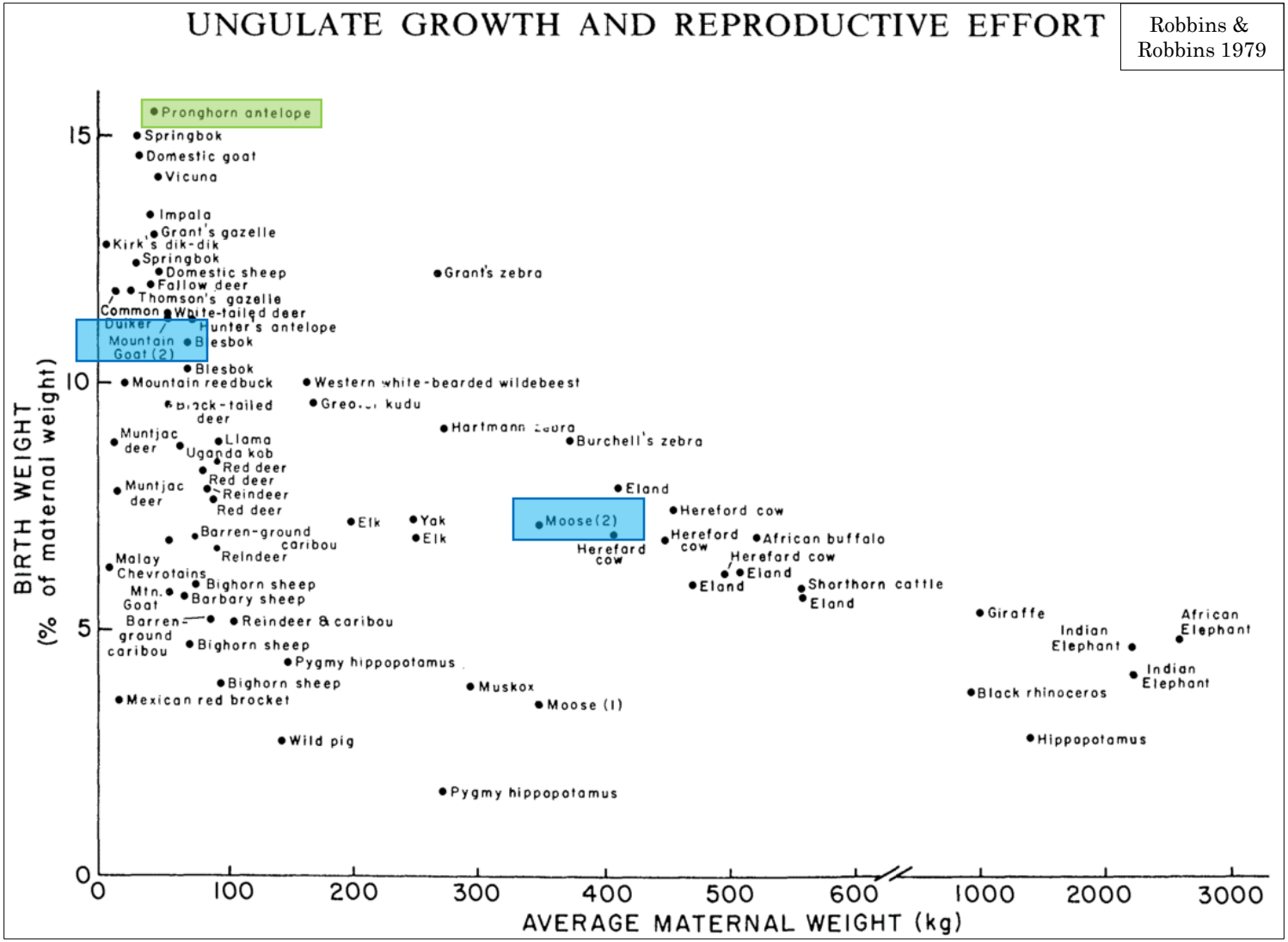
Mortality Risk Hypotheses

1) Habitat quality

2) Anthropogenic conditions

3) Intrinsic factors

Hypothesis 1: Habitat quality

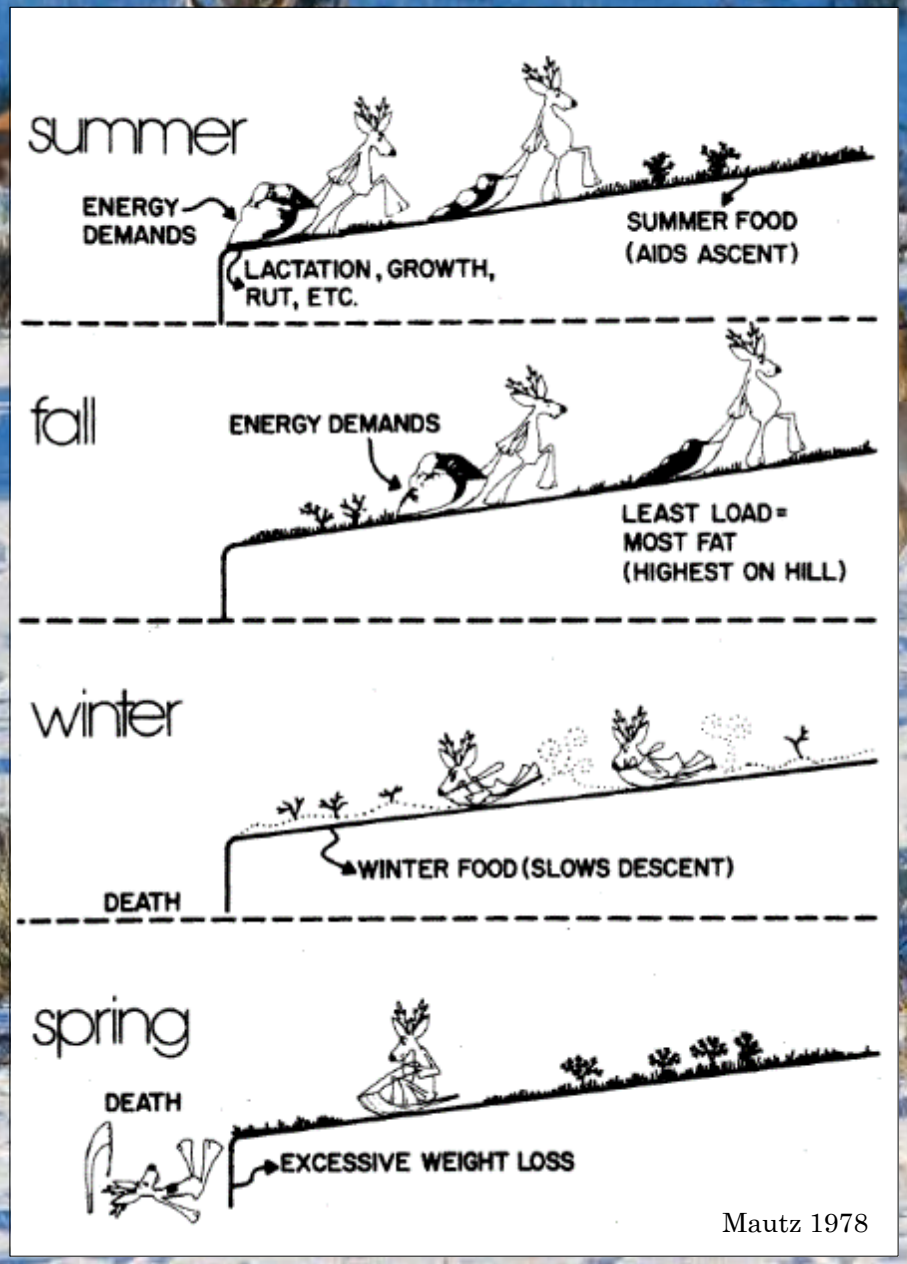


Hypothesis 1: Habitat quality

usgs.gov

Northern Focus Photography

Hypothesis 1: Habitat quality



Mautz 1978

Hypothesis 1: Habitat quality

Hypothesis 1: Habitat quality

Predicted Explanatory Covariates

Climate

Distance to water

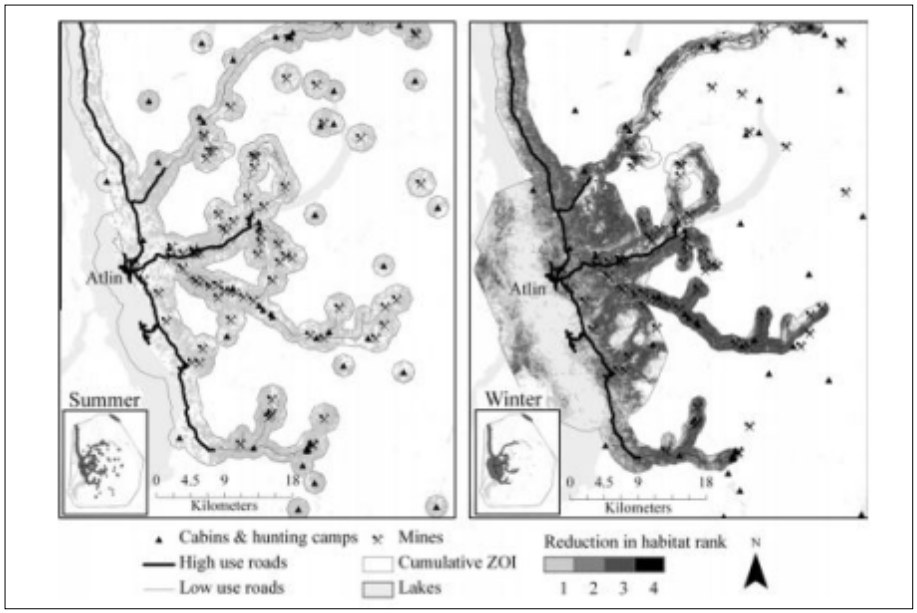
Temperature (time lag)

Precipitation (time lag)

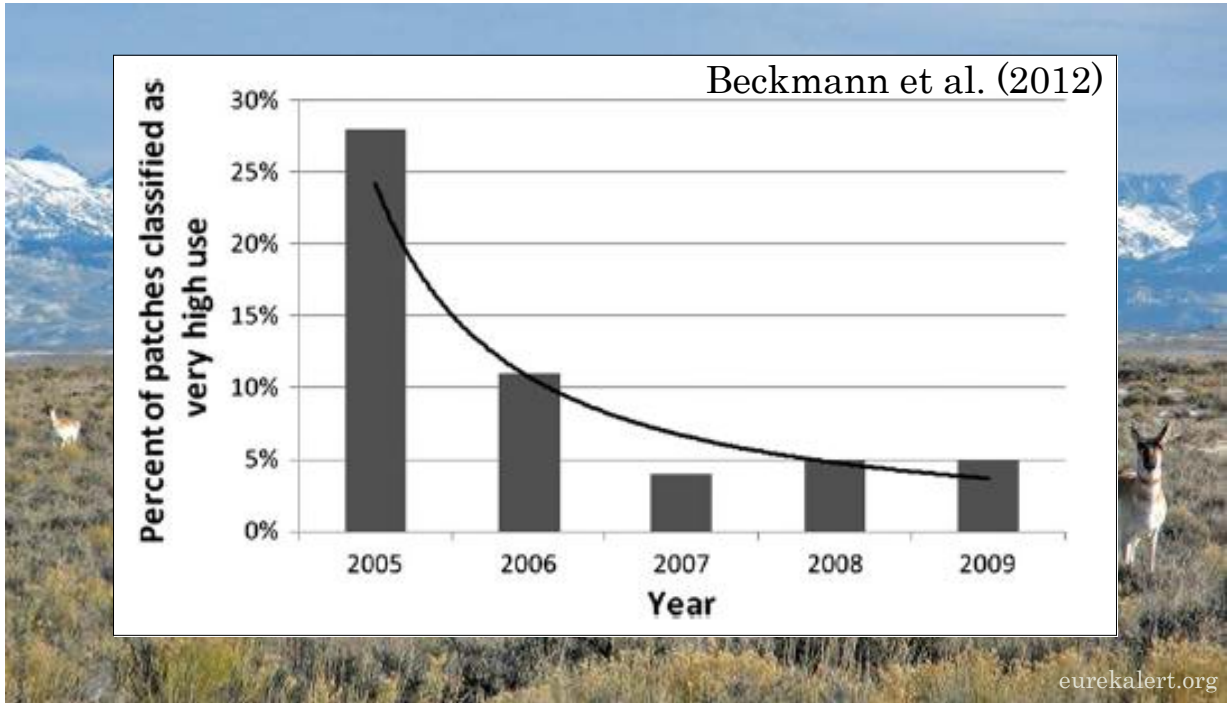
Sagebrush

Proportion locations in sagebrush (seasonally)

Hypothesis 2: Anthropogenic conditions



Polfus et al. (2011)



Hypothesis 2: Anthropogenic conditions

Predicted Explanatory Covariates

Roads

Wells

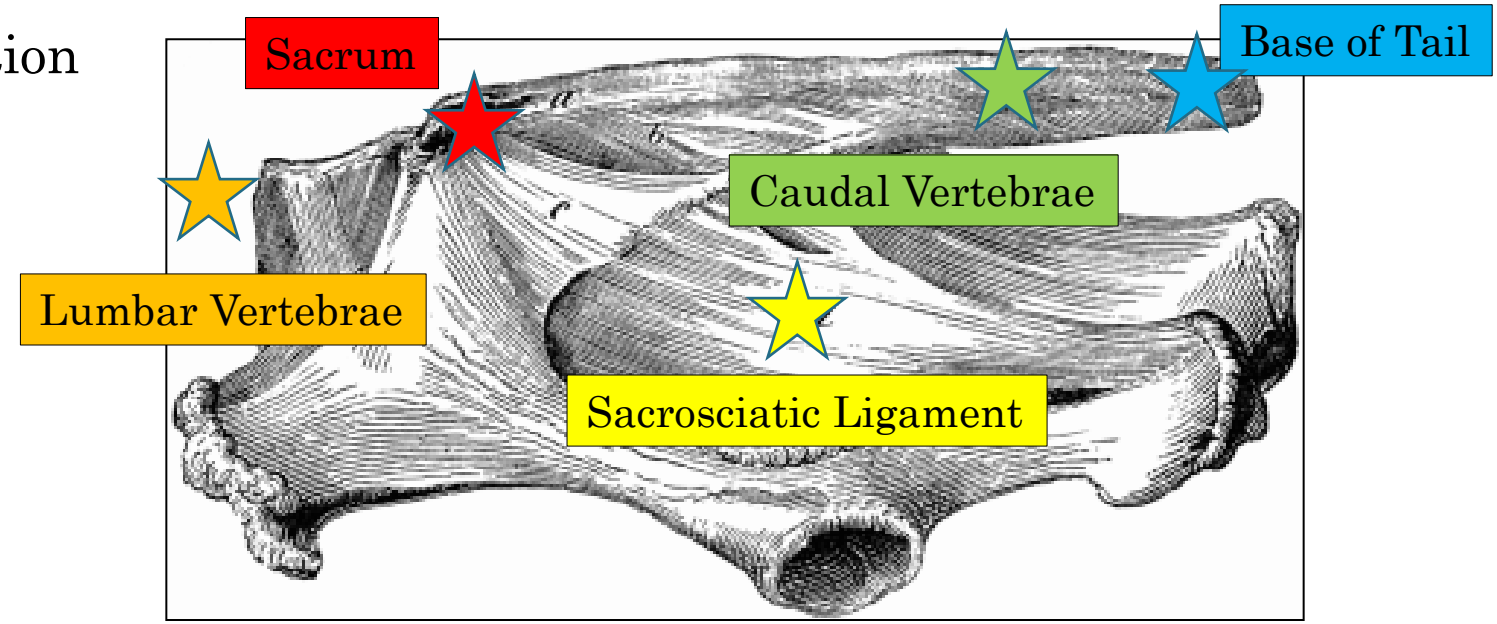
Fences

Distance

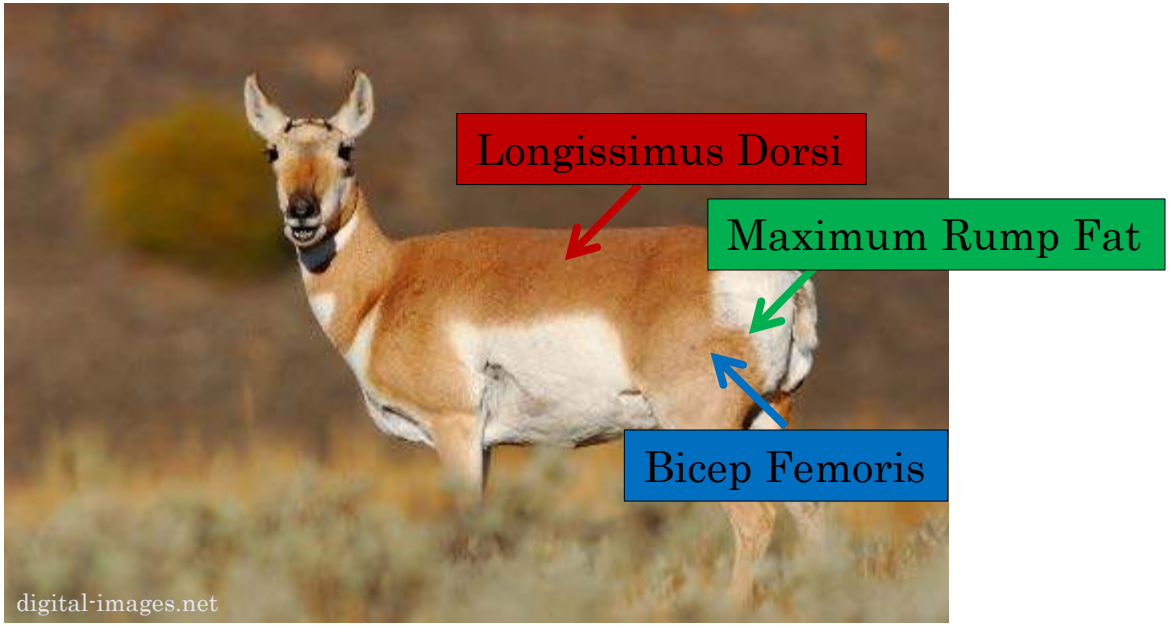
Density

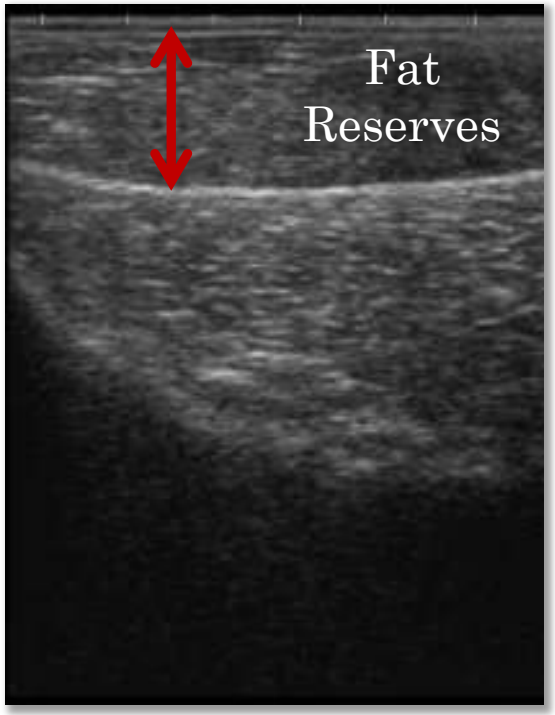
Hypothesis 3: Intrinsic factors

Palpation

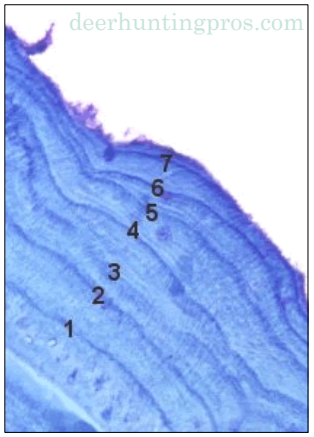


Ultrasonography





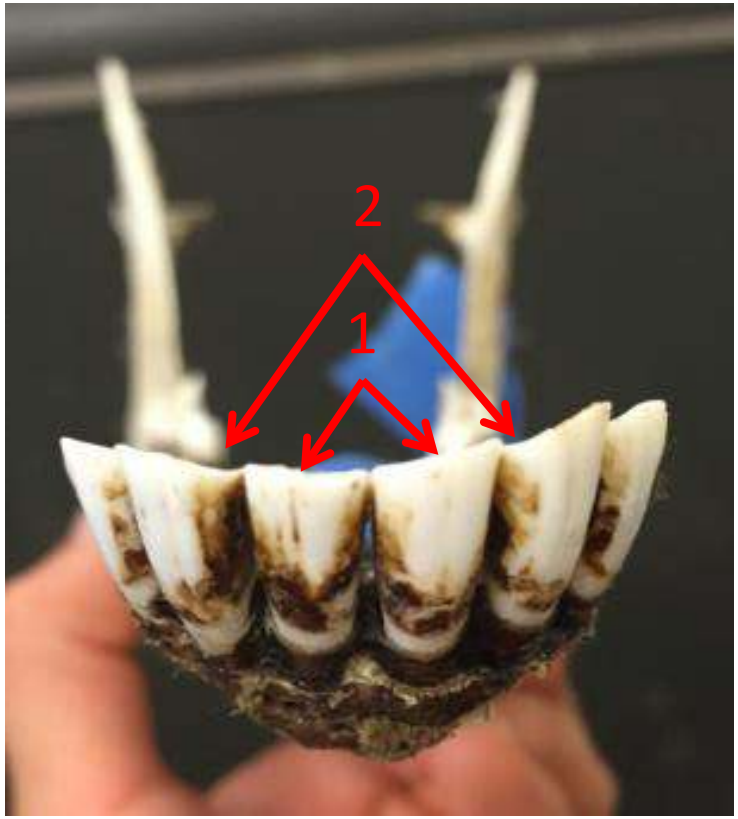
Hypothesis 3: Intrinsic factors



Estimated Age

Corrected Age

0.7855*Est. Age + 2.00093



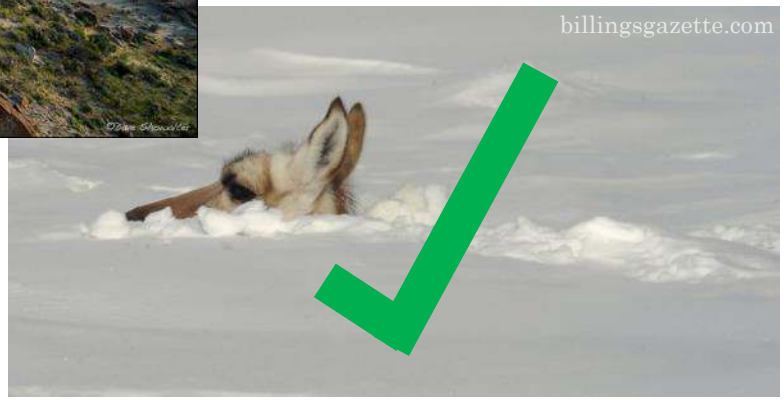
Cox mixed effects proportional hazards modeling

Modeling results

Habitat quality hypothesis best supported model

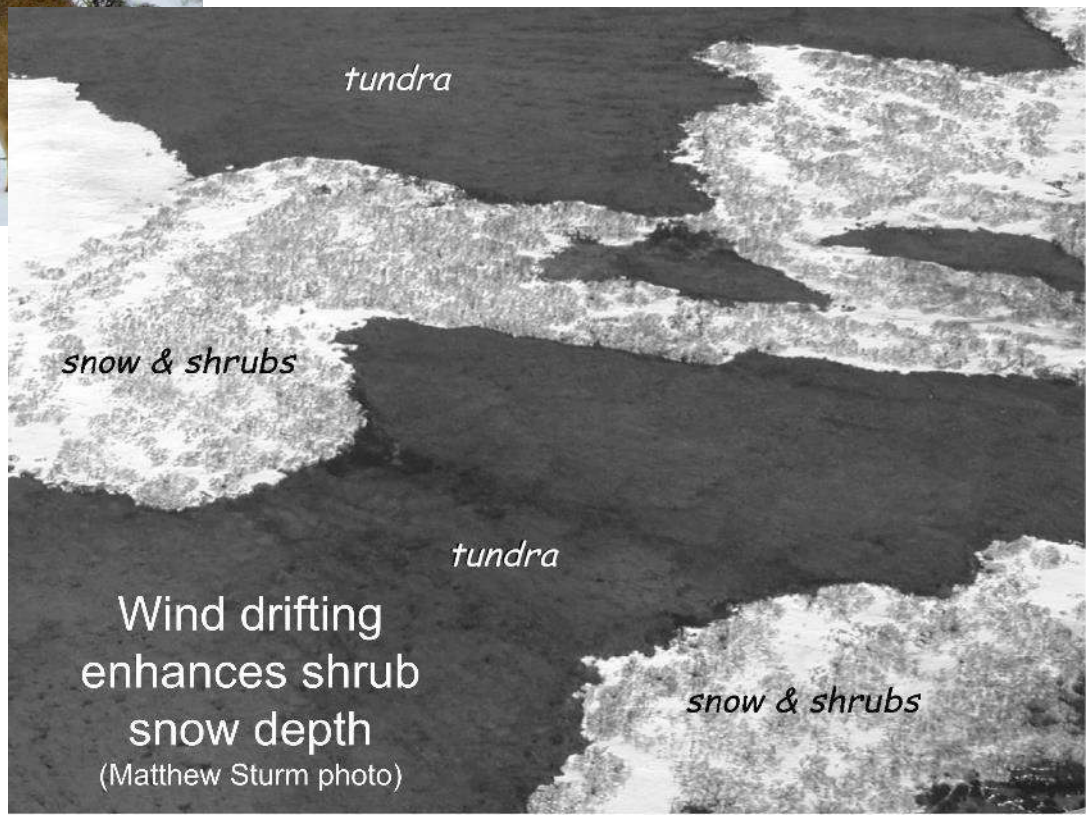
Mortality risk increases with:

- ↑ Proportion time spent in sagebrush during previous winter (p-value = 0.013)
- ↓ Total terrain ruggedness for the week (p-value < 0.001)
- ↑ Variation in snow depth during previous winter (p-value = 0.076)



Discussion

Proportion time spent in sagebrush during previous winter



Wind drifting enhances shrub snow depth
(Matthew Sturm photo)

Future directions

- Evaluate potential influence of NDVI
- Write and disseminate results

Thank you to our funders

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WGBGLC

bp

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QUESTIONS?
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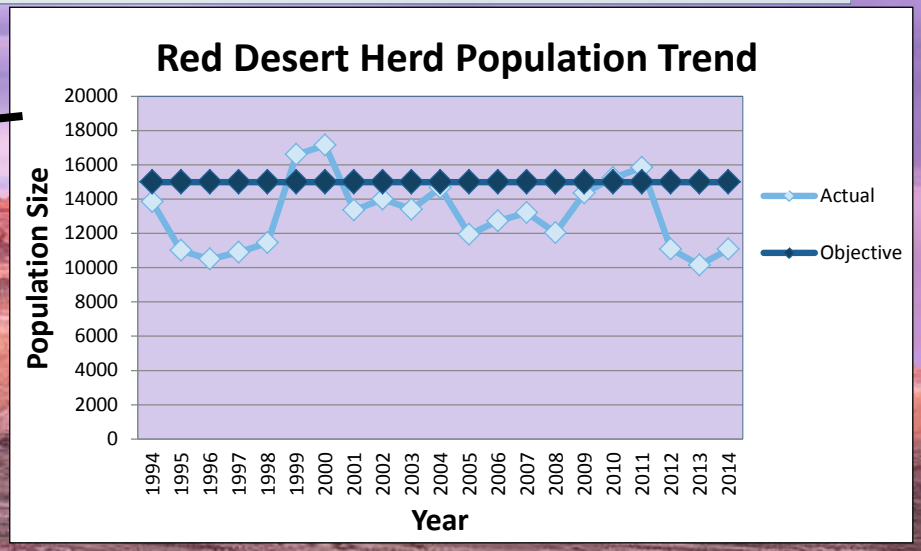
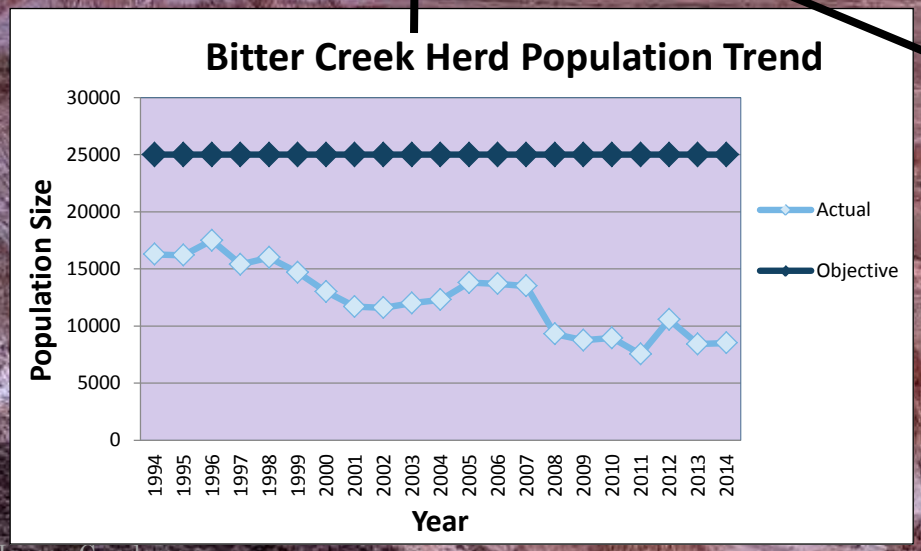
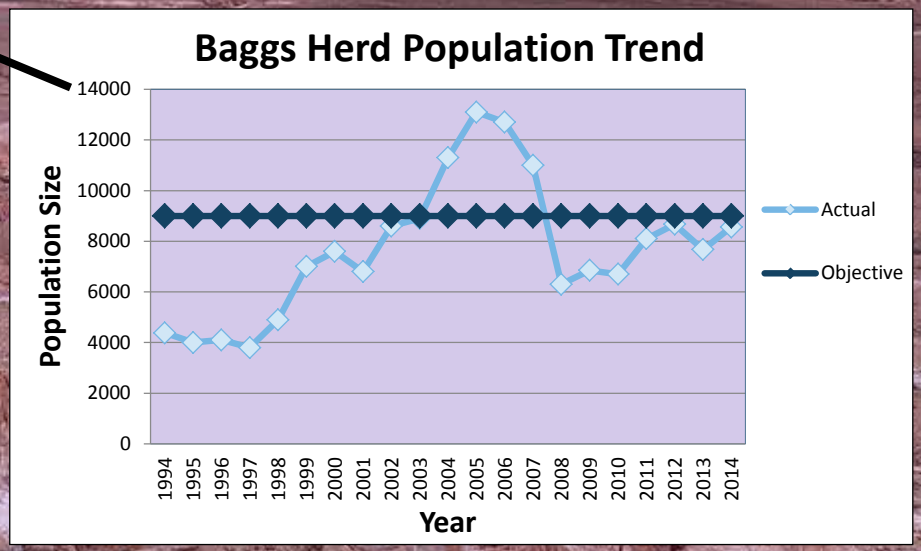
The Red Desert

- Experienced some similar declines
- Frequently below objectives for over 20 years

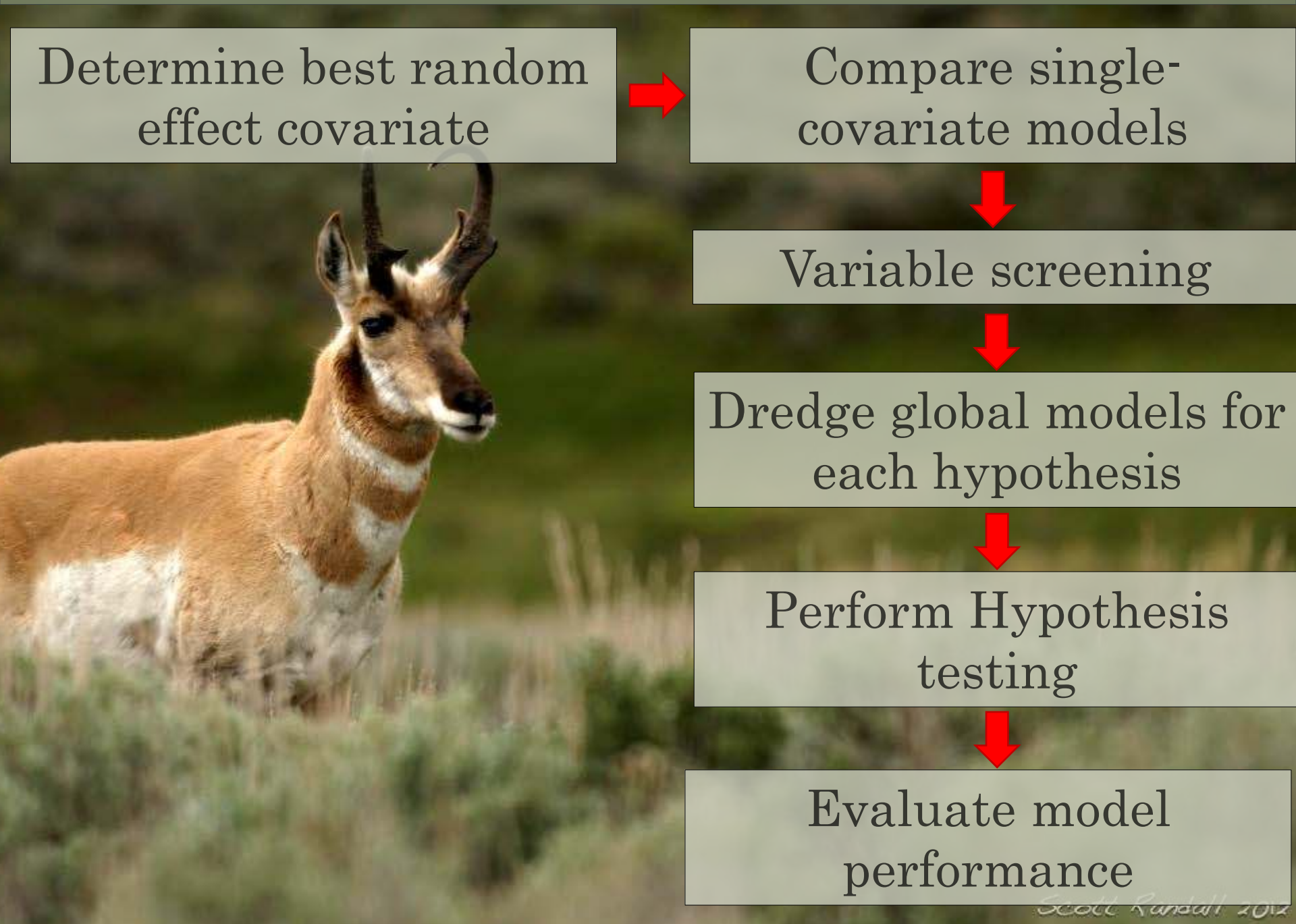






Jansen Gunderson

Modeling approach



Determine best random effect covariate

→

Compare single-covariate models

↓

Variable screening

↓

Dredge global models for each hypothesis

↓

Perform Hypothesis testing

↓

Evaluate model performance

Random Effect Coefficient

Model Name	K	AICc	Delta AICc	Model Likelihood	AICc Weight	Log Likelihood	Cumulative Weight
Study Area	1	256.68	0.00	1.00	0.40	-127.34	0.40
Year + Study Area	2	258.50	1.82	0.40	0.16	-127.25	0.55
Individual + Study Area	2	258.62	1.94	0.38	0.15	-127.31	0.70
Year	1	258.75	2.07	0.36	0.14	-128.37	0.85
Individual	1	259.37	2.69	0.26	0.10	-128.69	0.95
Individual + Year	2	260.75	4.07	0.13	0.05	-128.37	1.00

<u>Variable Screening</u>

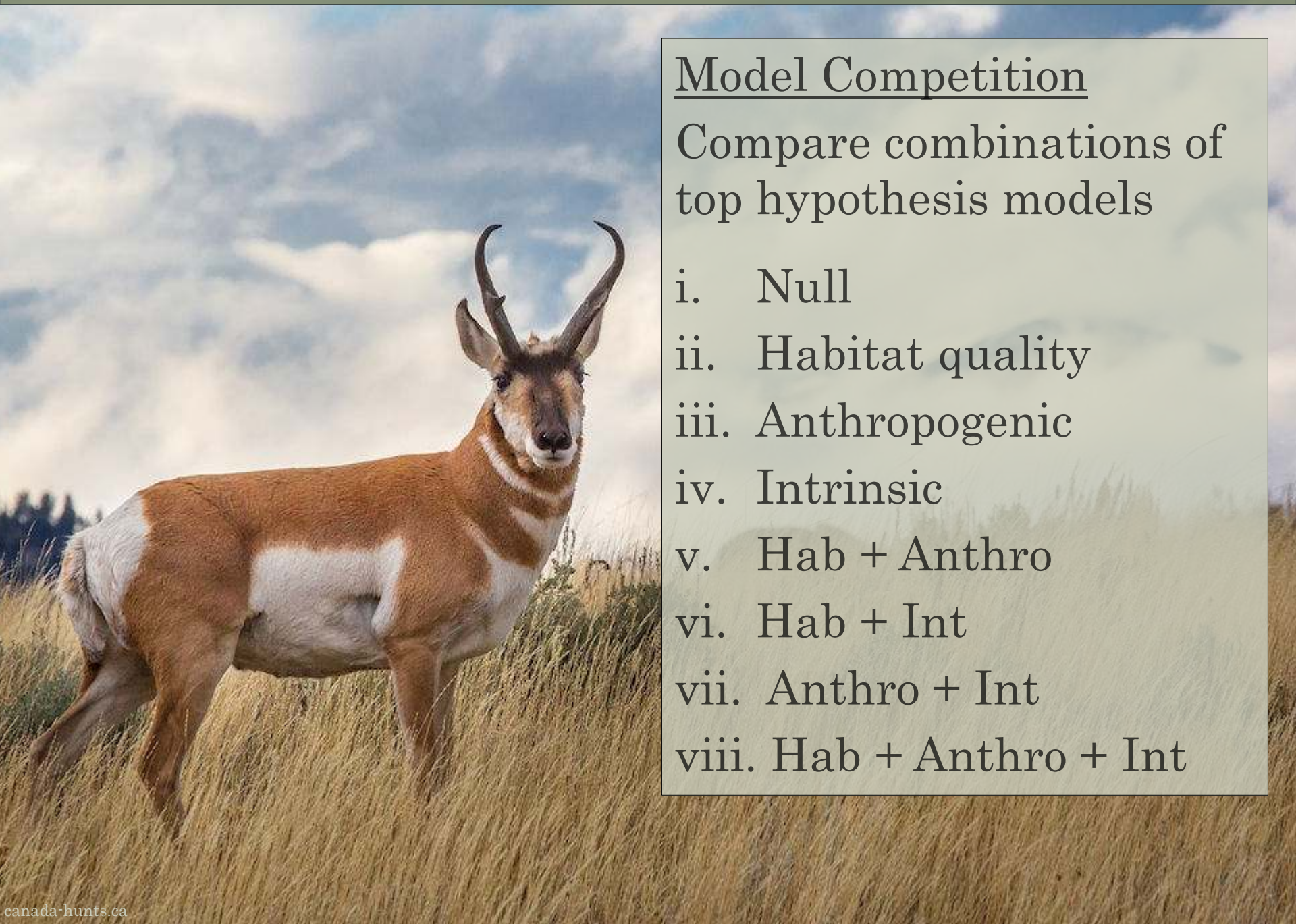
Identify collinear variables ($r \geq 0.6$)

Non-Collinear Covariates ranking above the null model

- Total terrain ruggedness for the week
- Total distance to roads for the week
- Total fence density at the 5km scale for the week
- Total distance to wells for the week
- Total distance to water for the week
- Variation in snow depth during the previous winter
- Sacrosciatic ligament depth
- Proportion time spent in sagebrush during the previous winter
- Estimated Age

Global models

- Create global model for each hypothesis
- Dredge through global models



Model Competition

Compare combinations of top hypothesis models

i. Null
ii. Habitat quality
iii. Anthropogenic
iv. Intrinsic
v. Hab + Anthro
vi. Hab + Int
vii. Anthro + Int
viii. Hab + Anthro + Int

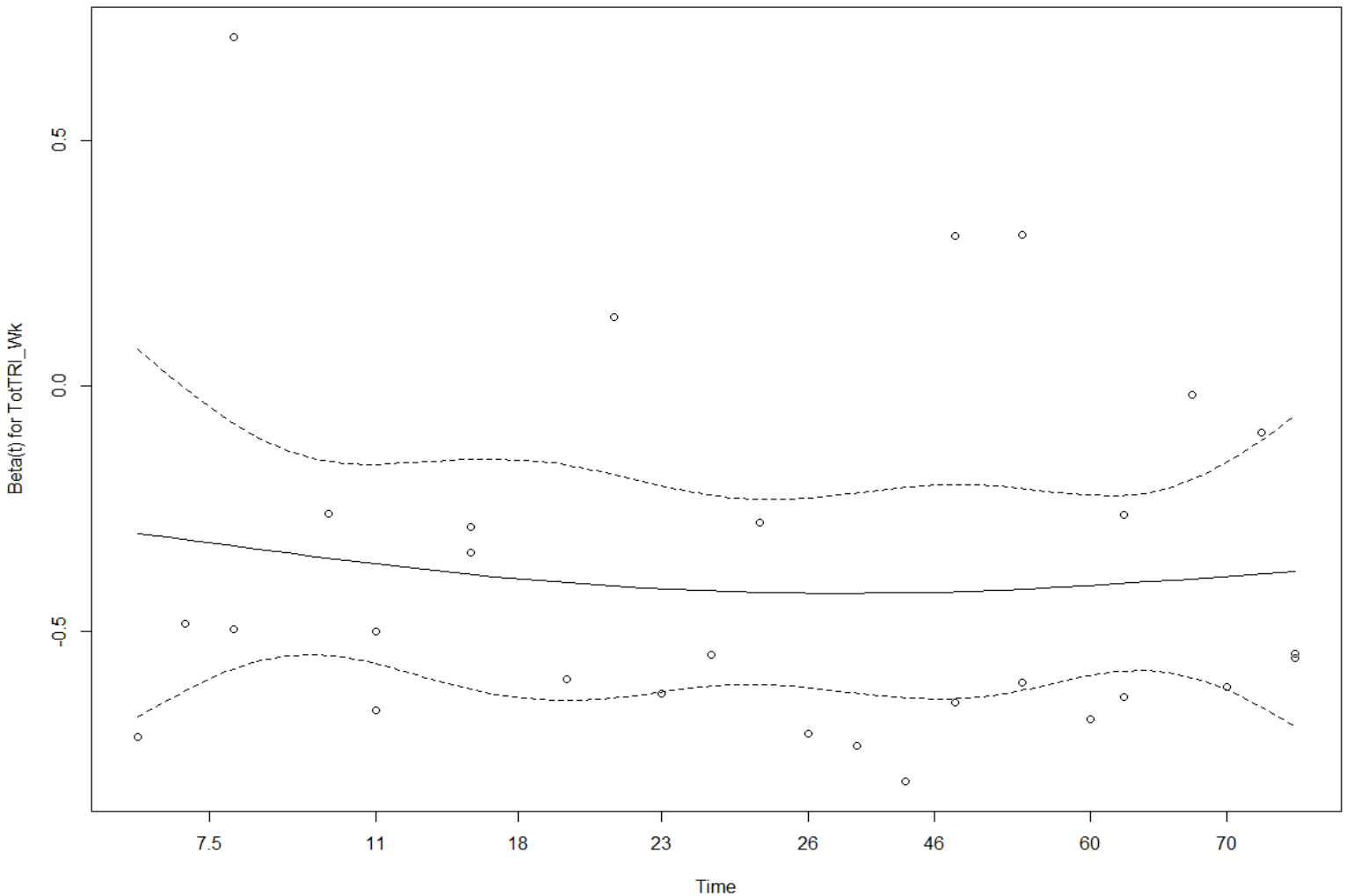
Hypothesis Testing

Model	K	AICc	Delta AICc	Model Likelihood	AICc Weight	Log Likelihood	Cumulative Weight
Habitat	4	178.52	0.00	1.00	5.05	-85.26	0.51
Habitat + Intrinsic	5	179.56	1.04	0.60	0.30	-84.77	0.81
Anthro. + Habitat	6	181.38	2.86	0.24	0.12	-84.68	0.93
ALL THREE	7	182.41	3.89	0.14	0.07	-84.19	1.00
Anthro.	3	233.21	54.69	<0.001	<0.001	-113.60	1.00
Anthro + Intrinsic	4	234.24	55.72	<0.001	<0.001	-113.12	1.00
Intrinsic	2	255.05	76.53	<0.001	<0.001	-125.52	1.00
NULL	1	256.68	78.16	<0.001	<0.001	-127.34	1.00

Summary of final model

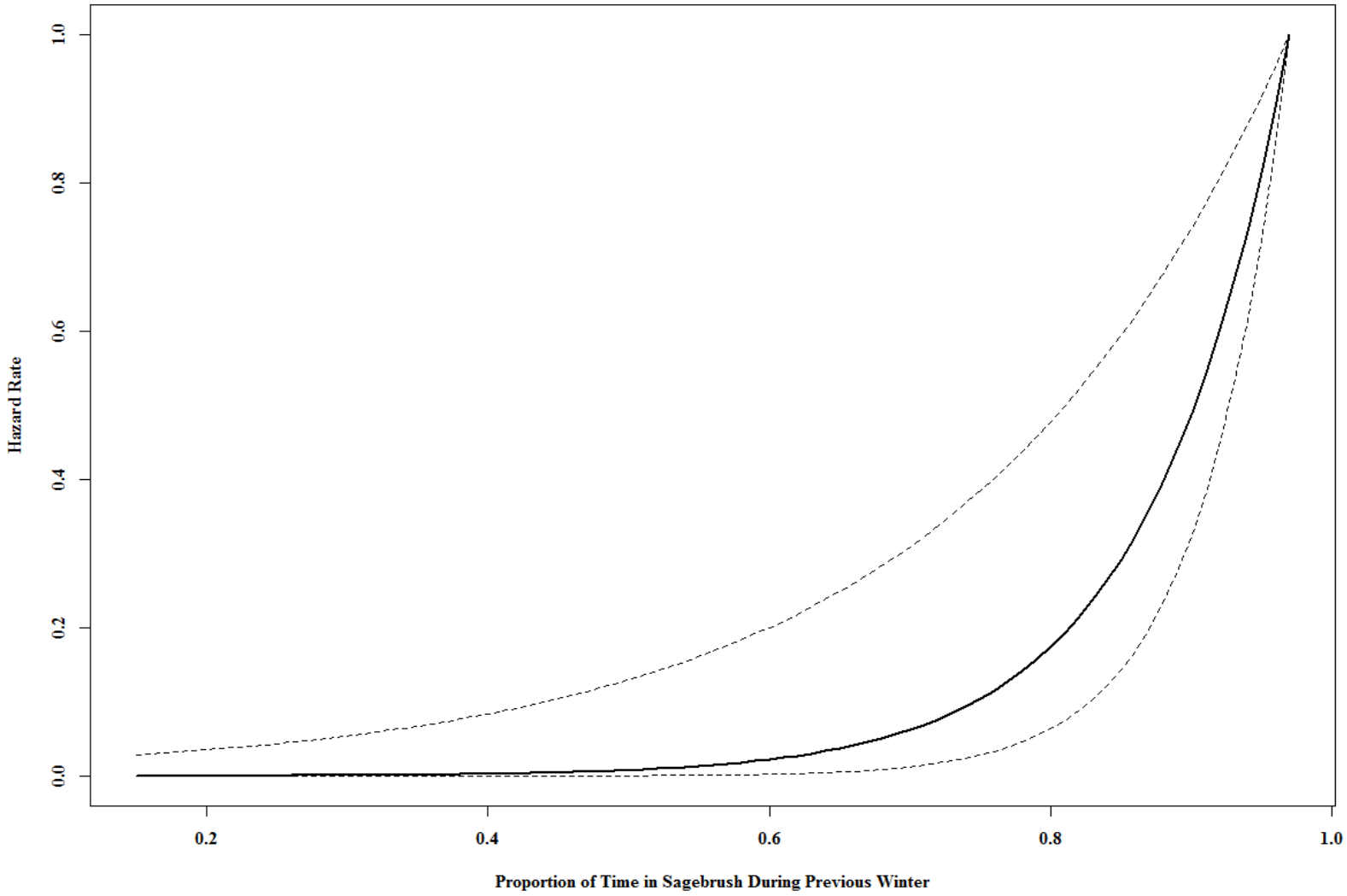
Covariate	Coefficient	Standard Error	Hazard ratio [exp (coefficient)]	95% Lower Confidence Limit	95% Upper Confidence Limit	P-value
Proportion time sage previous winter	10.29	4.13	29,361.60	8.98	96,475,534	0.01
Variation in snow depth previous winter	0.18	0.10	1.20	0.98	1.46	0.08
Total terrain ruggedness for the week	-0.43	0.06	0.65	0.58	0.73	<0.001

Schoenfeld Residuals



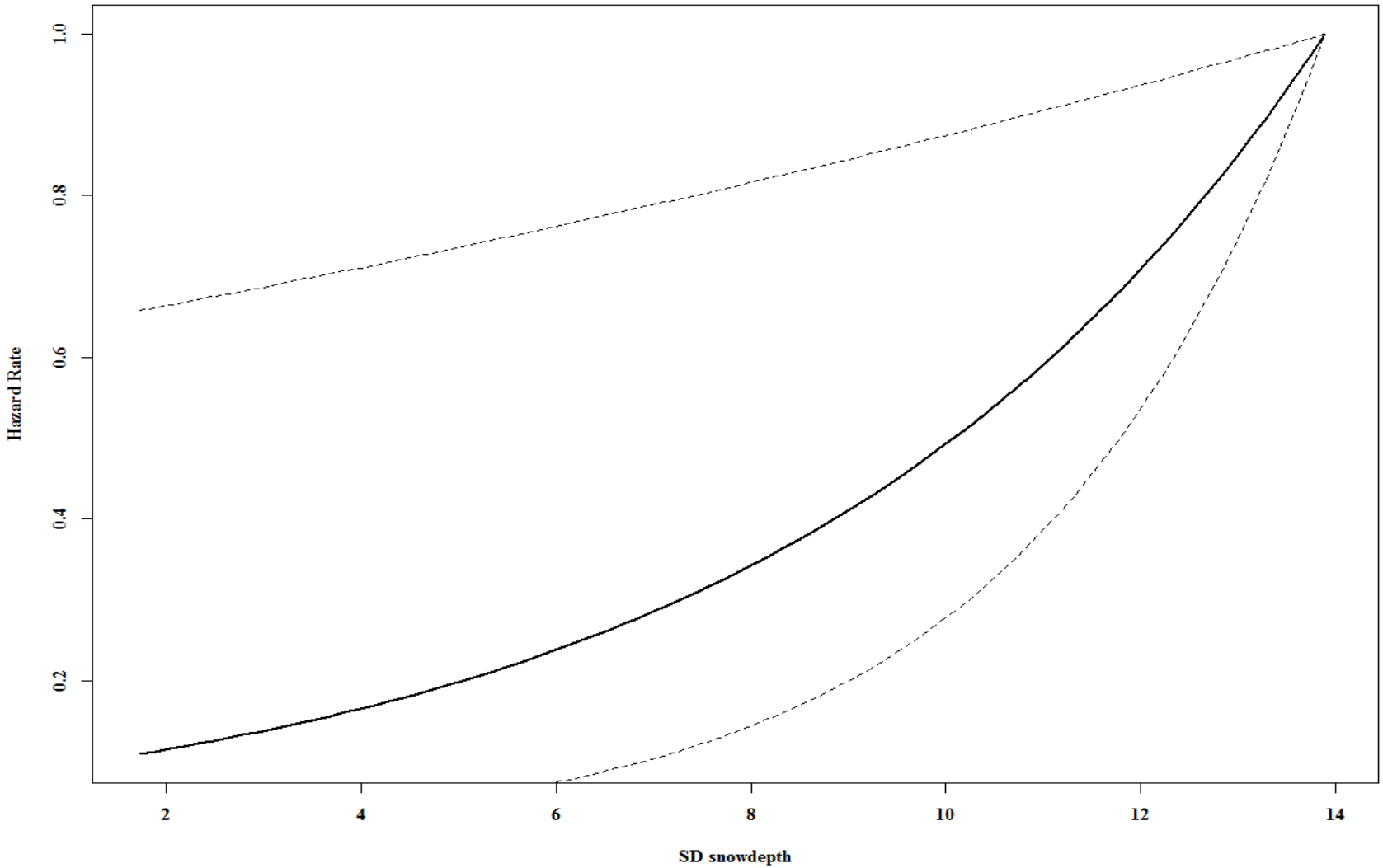
Hazard Plots

Proportion time in sage the previous winter



Hazard Plots

Variation in snow depth the previous winter



Hazard Plots

Total terrain ruggedness for the week