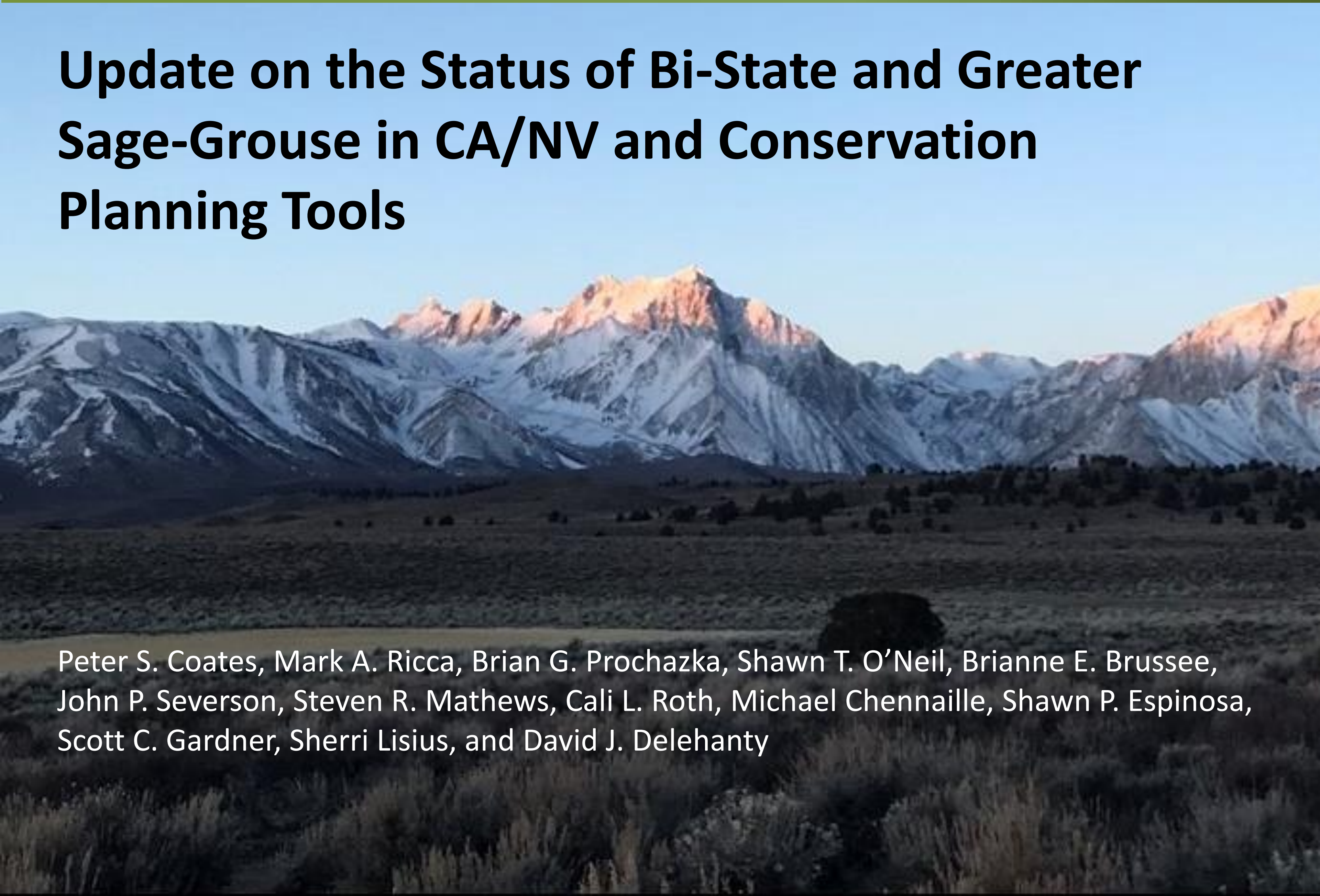
Update on the Status of Bi-State and Greater Sage-Grouse in CA/NV and Conservation Planning Tools



Peter S. Coates, Mark A. Ricca, Brian G. Prochazka, Shawn T. O'Neil, Brianne E. Brussee, John P. Severson, Steven R. Mathews, Cali L. Roth, Michael Chennaille, Shawn P. Espinosa, Scott C. Gardner, Sherri Lisius, and David J. Delehanty

OVERVIEW

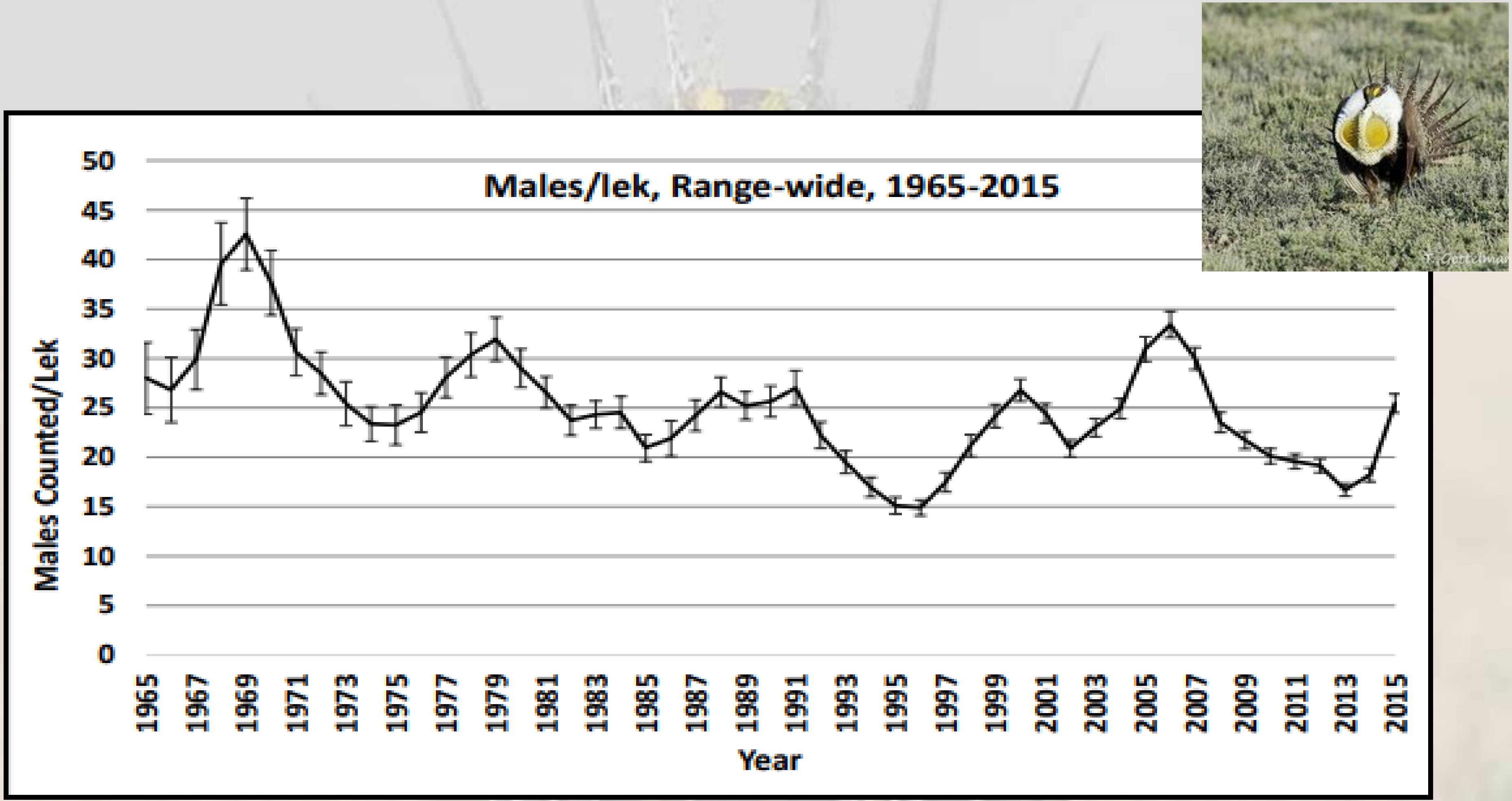
Population Modeling (Integrated Population Model)

- **Trends and Abundance Estimation (Cyclicity)**
- **Early-warning system**
- **Examples of using population model to inform management actions**

Habitat Modeling (Conservation Planning Tool)

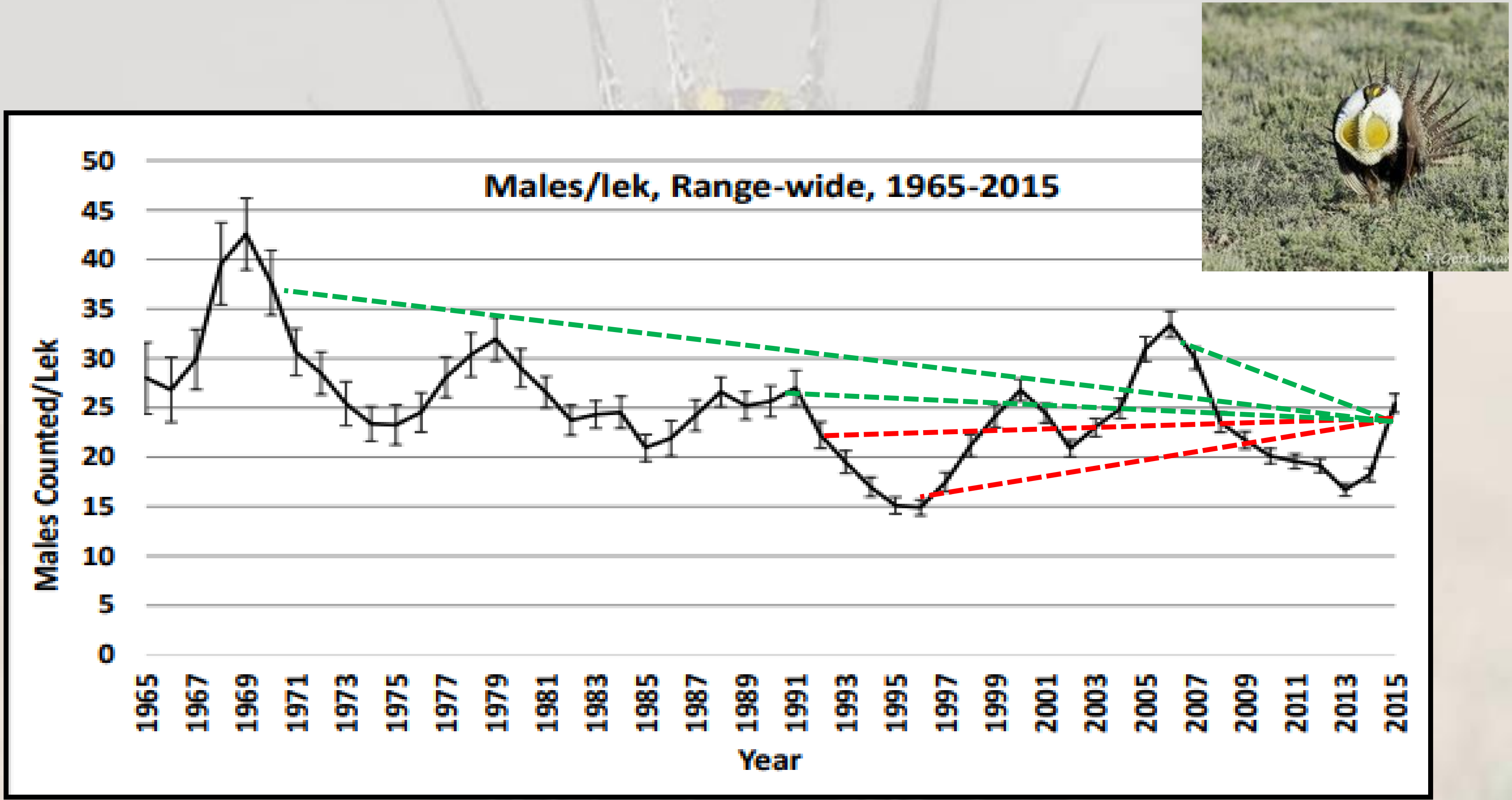
- **Seasonal, Life-Stage, and Space Use Mapping**
- **Distributional Modeling**
- **Conservation Planning Tool (CPT)**
- **Example of Wildfire and Conifer Treatment**

CYCLICAL TRENDS IN ABUNDANCE



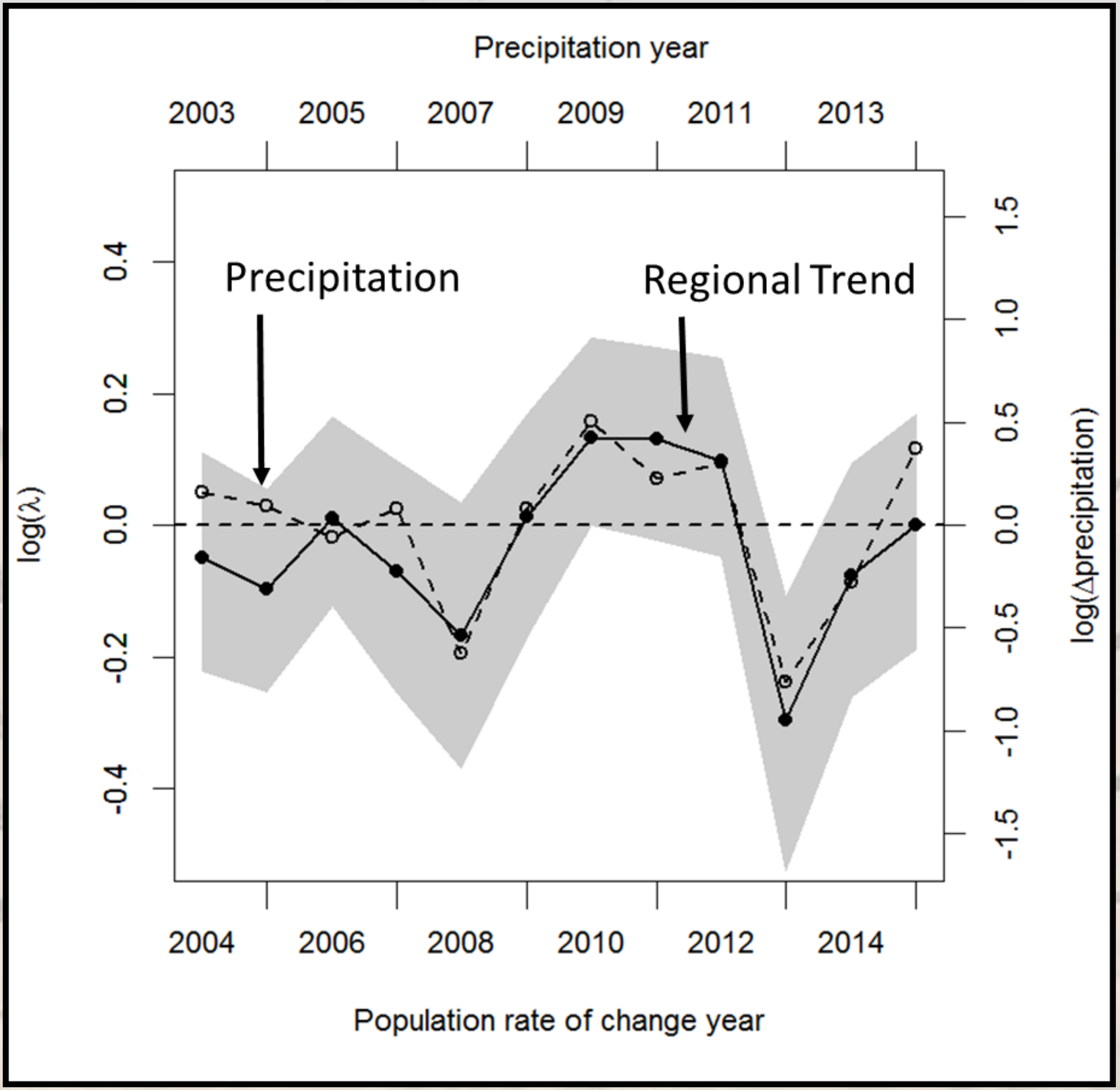
WAFWA (2015). Greater sage-grouse population trends: an analysis of lek count databases 1965–2015.

CYCLICAL TRENDS IN ABUNDANCE



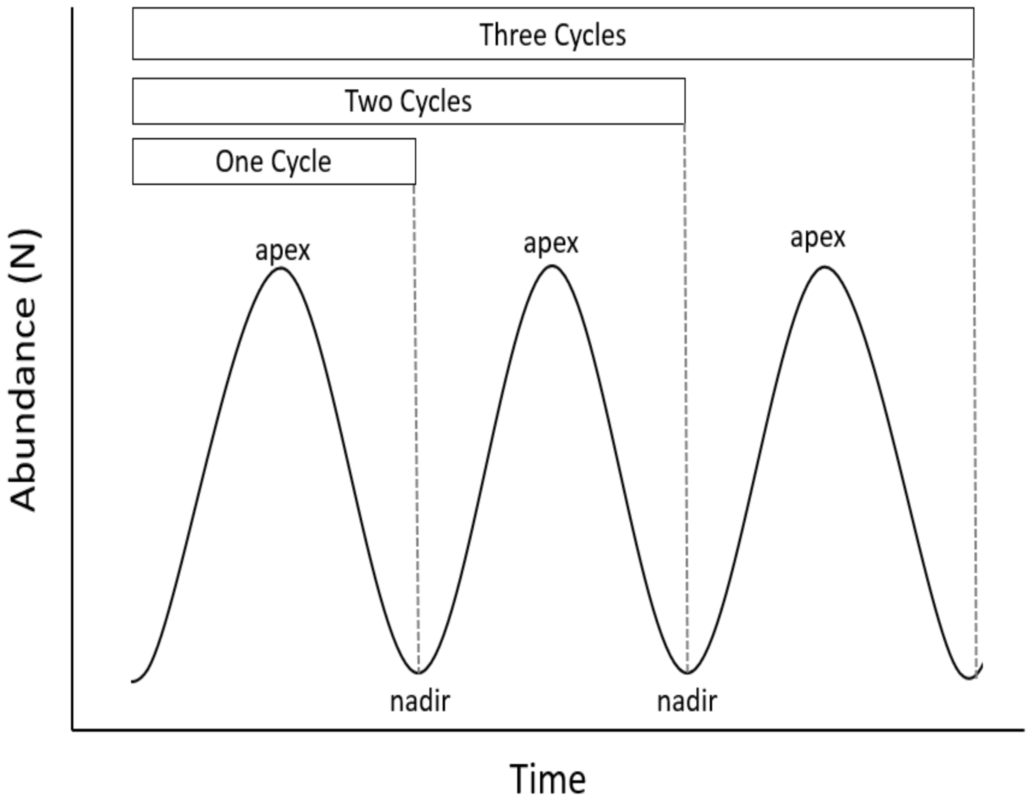
WAFWA (2015). Greater sage-grouse population trends: an analysis of lek count databases 1965–2015.

BI-STATE IPM

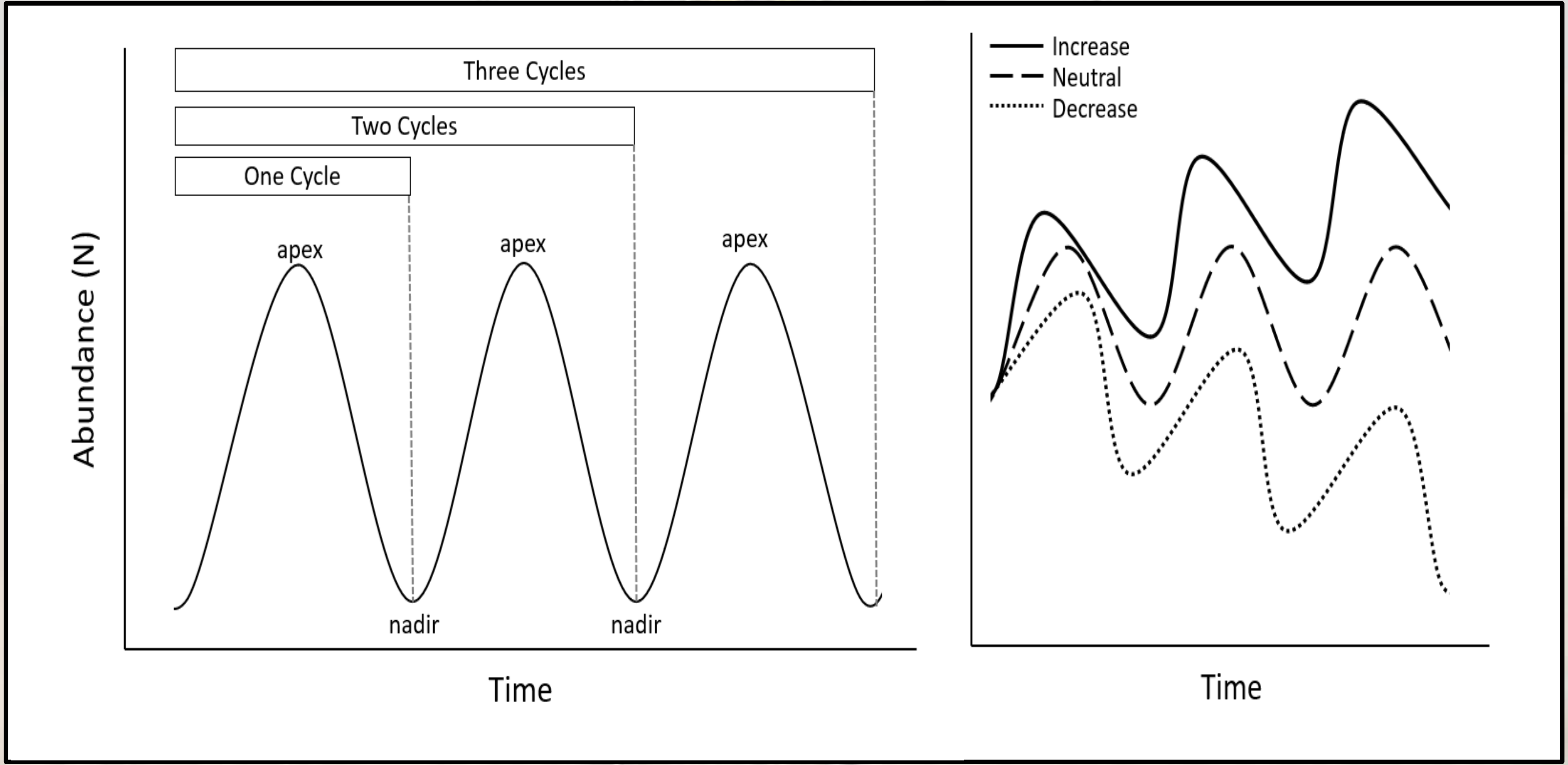


Coates et al.2018, The Auk

CYCLICAL TRENDS IN ABUNDANCE



CYCLICAL TRENDS IN ABUNDANCE



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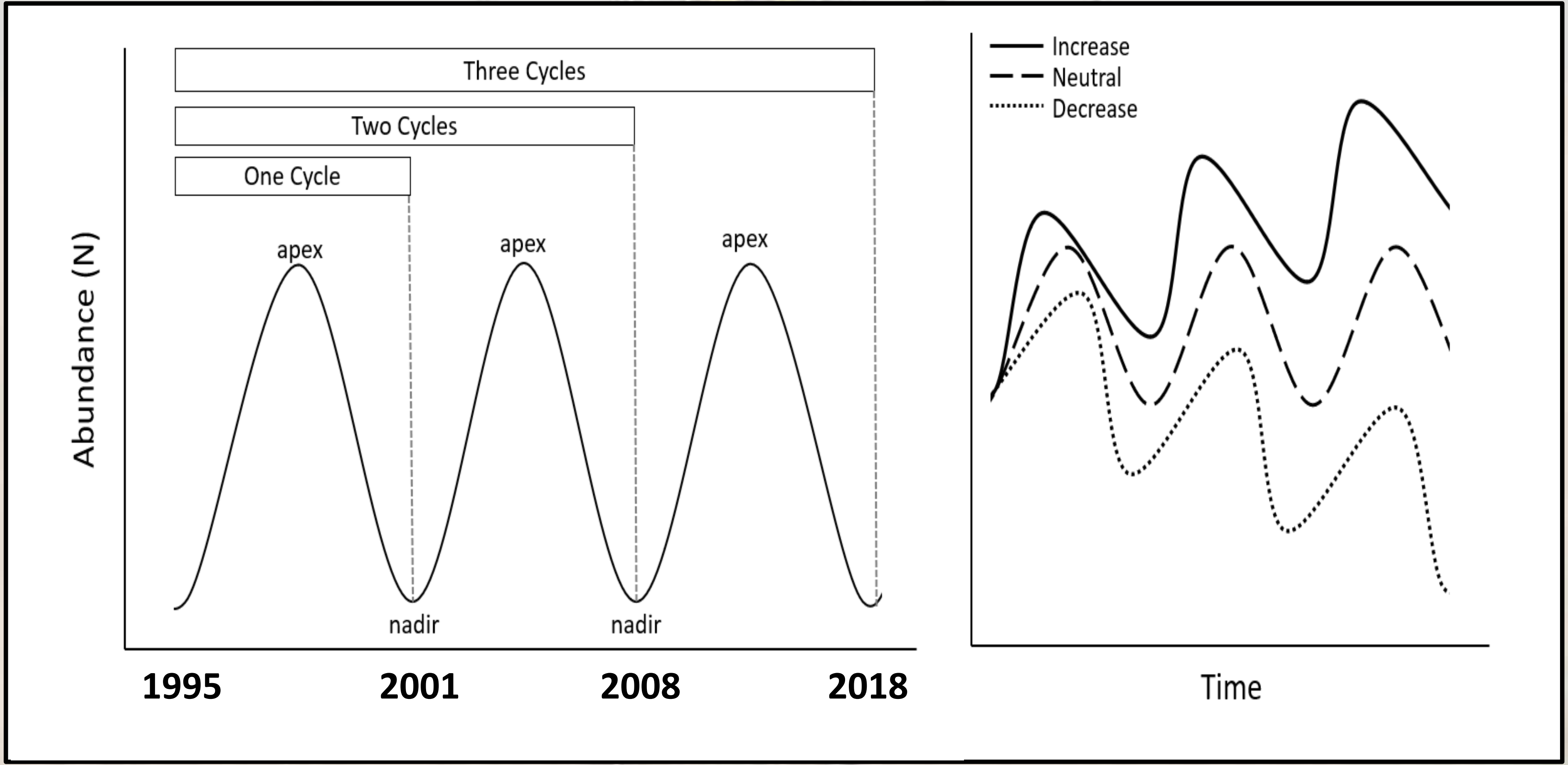
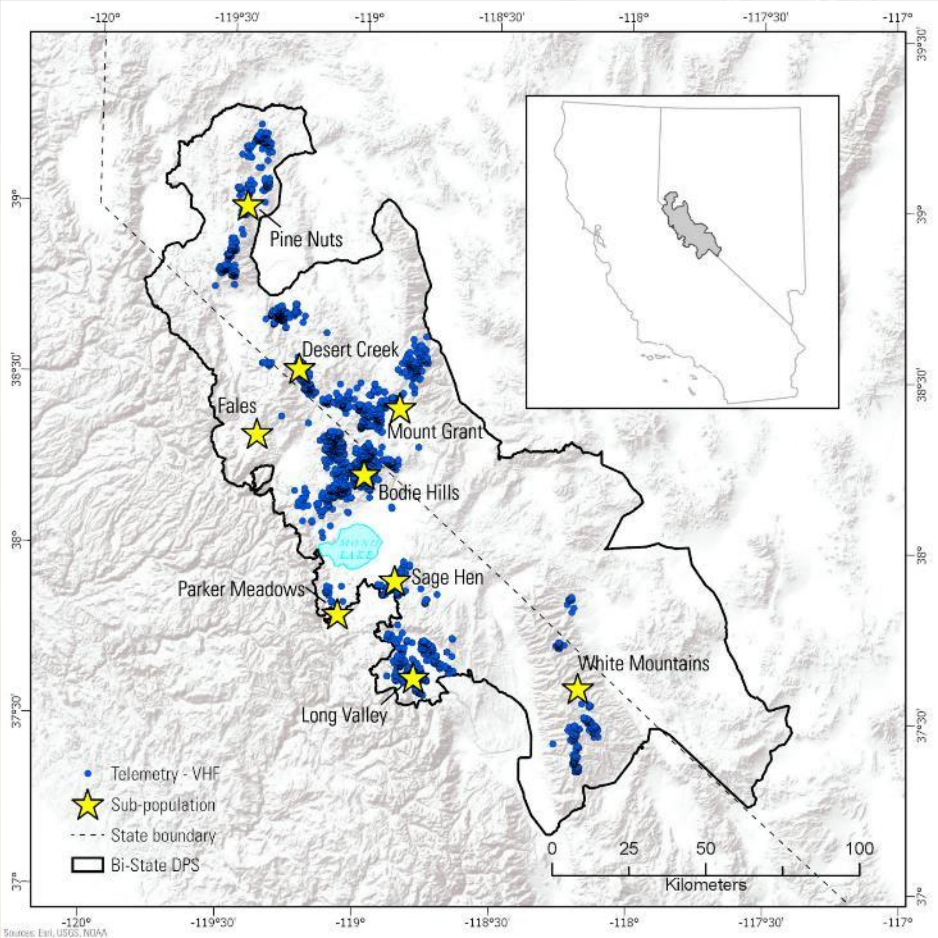


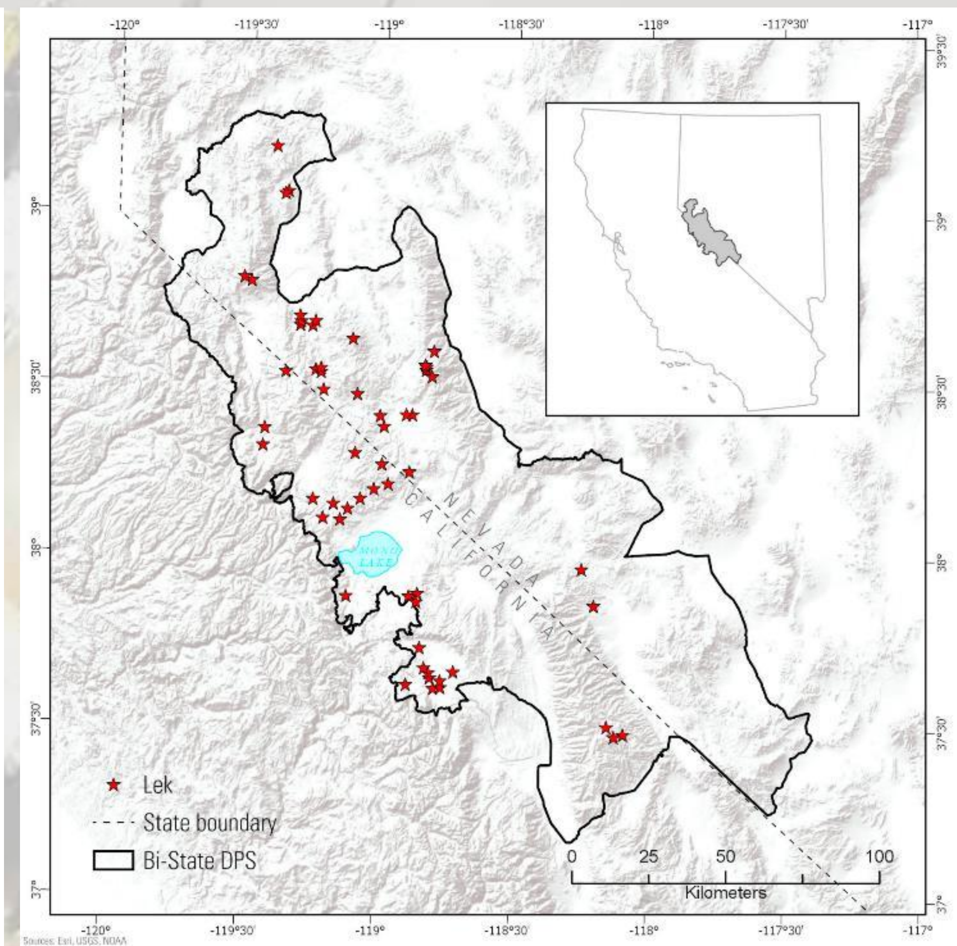
DATA SOURCES

Bi-State Distinct Population Segment

Telemetry Locations



Lek Survey Data



Coates et al. 2020. Open-File Report 2019-1149

IPM STRUCTURE

Demographic Data

State Process

Abundance (N_t)

Survival (φ) **and Fecundity** (γ)

Abundance (N_{t+1})

$$L_P(\mathrm{N} \mid \varphi, \gamma)$$

Lek Count Data

Observation Process

$$y_{t+1} = Pois\ (N_{t+1})$$

or

$$y_{t+1} = N_{t+1} + \varepsilon_{t+1}$$
$$\varepsilon_{t+1} = Norm(0, \sigma_y^2)$$

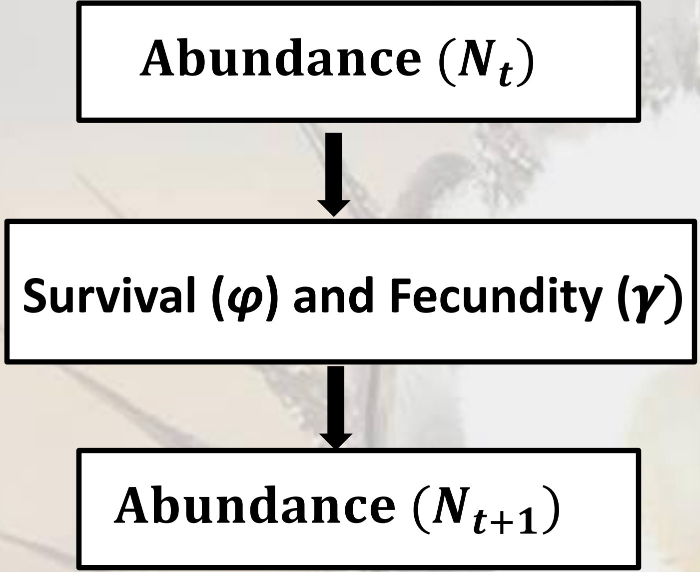
$$L_o(\mathbf{y} \mid \mathrm{N}, \sigma_C^2)$$

Reference: Kéry and Shaub 2012

IPM STRUCTURE

Demographic Data

State Process



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Survival (φ) and Fecundity (γ)

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or

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$$\varepsilon_{t+1} = Norm(0, \sigma_y^2)$$

T. Gettelman

Joint Likelihood

$L_{SS}(\mathbf{y} \mid \mathrm{N}, \phi, \gamma)$

Reference: Kéry and Shaub 2012

IPM STRUCTURE

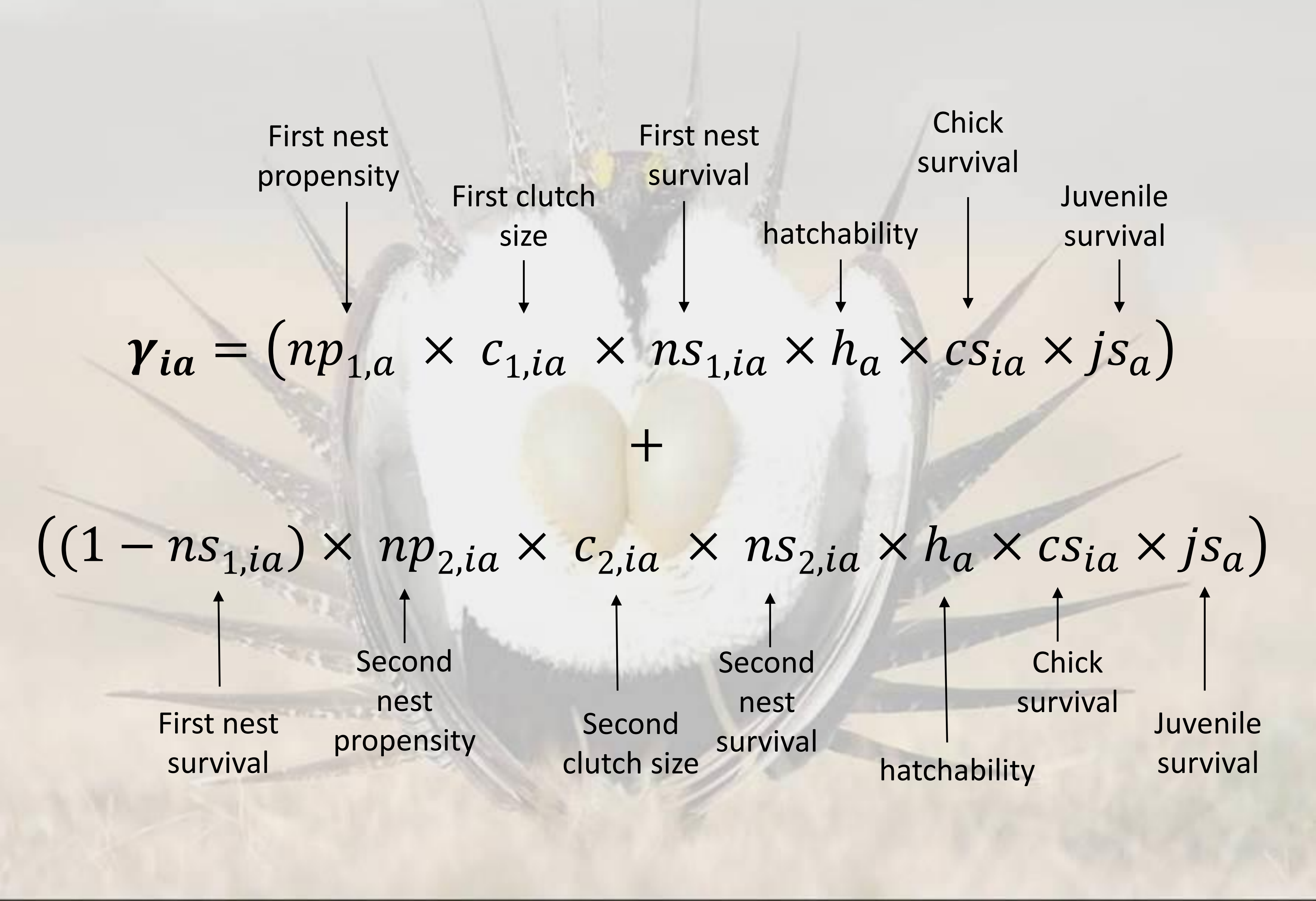
Fecundity Equation (subcomponent parameters)

$$\boldsymbol{\gamma_{ia}} = \left(np_{1,a} \times c_{1,ia} \times ns_{1,ia} \times h_a \times cs_{ia} \times js_a\right)$$

$$+$$

$$\left((1 - ns_{1,ia}) \times np_{2,ia} \times c_{2,ia} \times ns_{2,ia} \times h_a \times cs_{ia} \times js_a\right)$$

IPM STRUCTURE



First nest propensity

First clutch size

First nest survival

hatchability

Chick survival

Juvenile survival

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$$+$$

$$((1 - ns_{1,ia}) \times np_{2,ia} \times c_{2,ia} \times ns_{2,ia} \times h_a \times cs_{ia} \times js_a)$$

First nest survival

Second nest propensity

Second clutch size

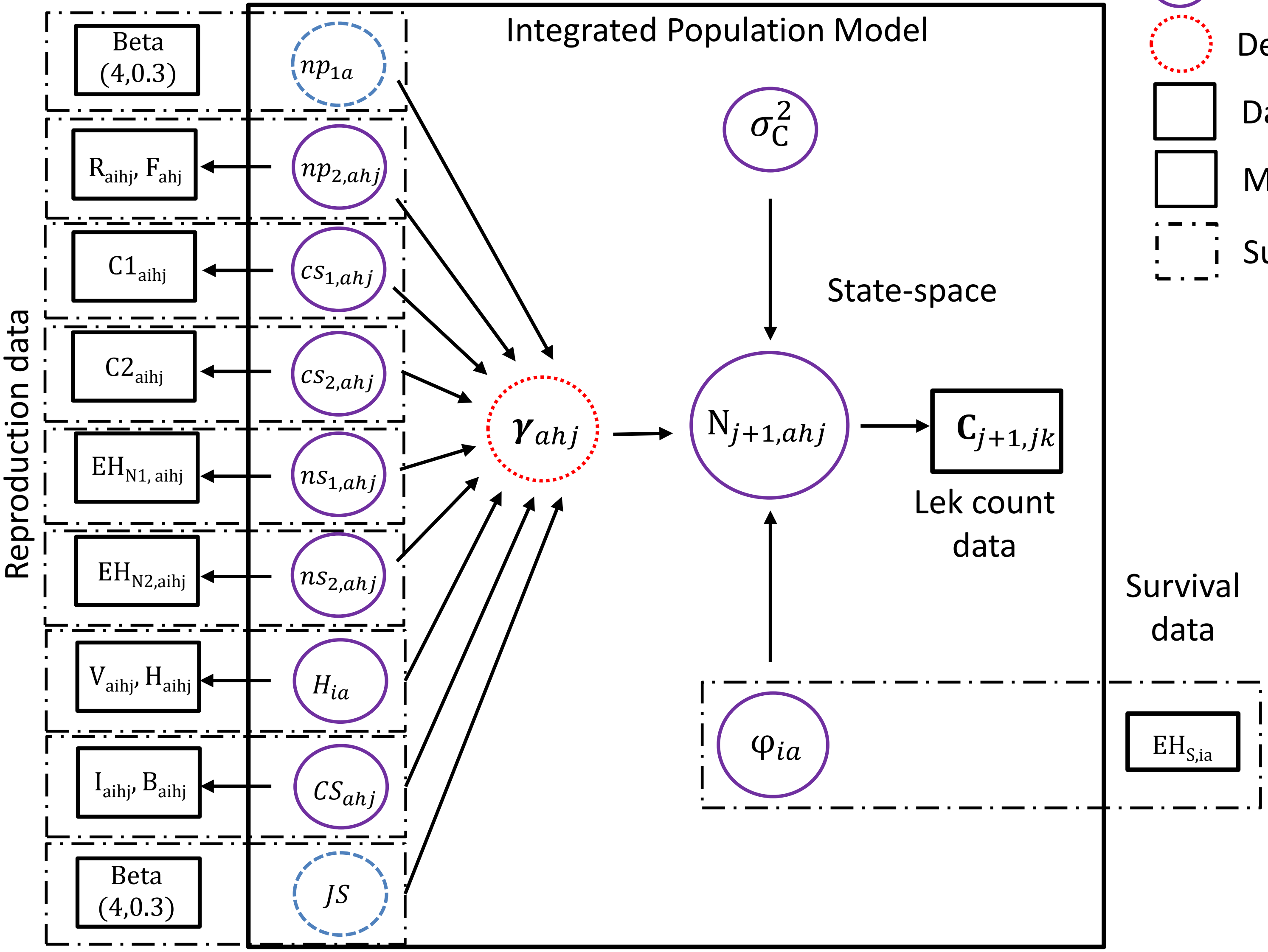
Second nest survival

hatchability

Chick survival

Juvenile survival

IPM STRUCTURE



Reproduction data

Beta (4,0.3)

np_{1a}

R_{aihj}, F_{ahj}

$np_{2,ahj}$

$C1_{aihj}$

$cs_{1,ahj}$

$C2_{aihj}$

$cs_{2,ahj}$

$EH_{N1, aihj}$

$ns_{1,ahj}$

$EH_{N2,aihj}$

$ns_{2,ahj}$

V_{aihj}, H_{aihj}

H_{ia}

I_{aihj}, B_{aihj}

CS_{ahj}

Beta (4,0.3)

JS

Integrated Population Model

σ_C^2

State-space

γ_{ahj}

$N_{j+1,ahj}$

$C_{j+1,jk}$

Lek count data

Survival data

φ_{ia}

$EH_{S,ia}$

◌ Informative prior

○ Estimated Parameter

◌ Derived Parameter

☐ Data (small box)

☐ Model (large box)

▭ Subcomponent model

Data vectors and matrix

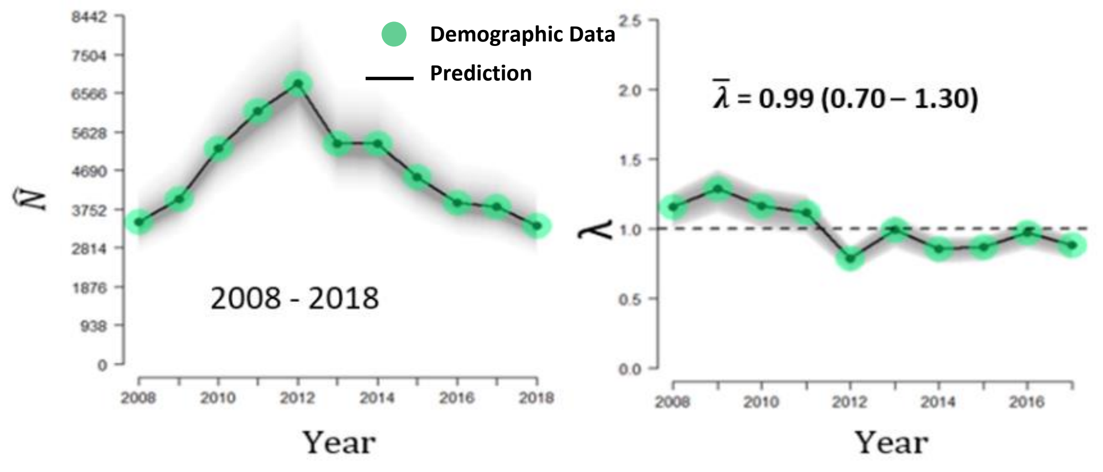
C, R, F, C1, C2, EH_{N1}, EH_{N2}, V, H, I, B, EH_S

a = age
i = individual
h = site
j = year
k = lek

CYCLICAL TRENDS IN ABUNDANCE

One Cycle (2008 – 2018)

- $\bar{\lambda}$ = 0.99 (0.70 - 1.30)
- **10.5% decrease over 10 years**



Coates et al. 2020. Open-File Report 2019-1149

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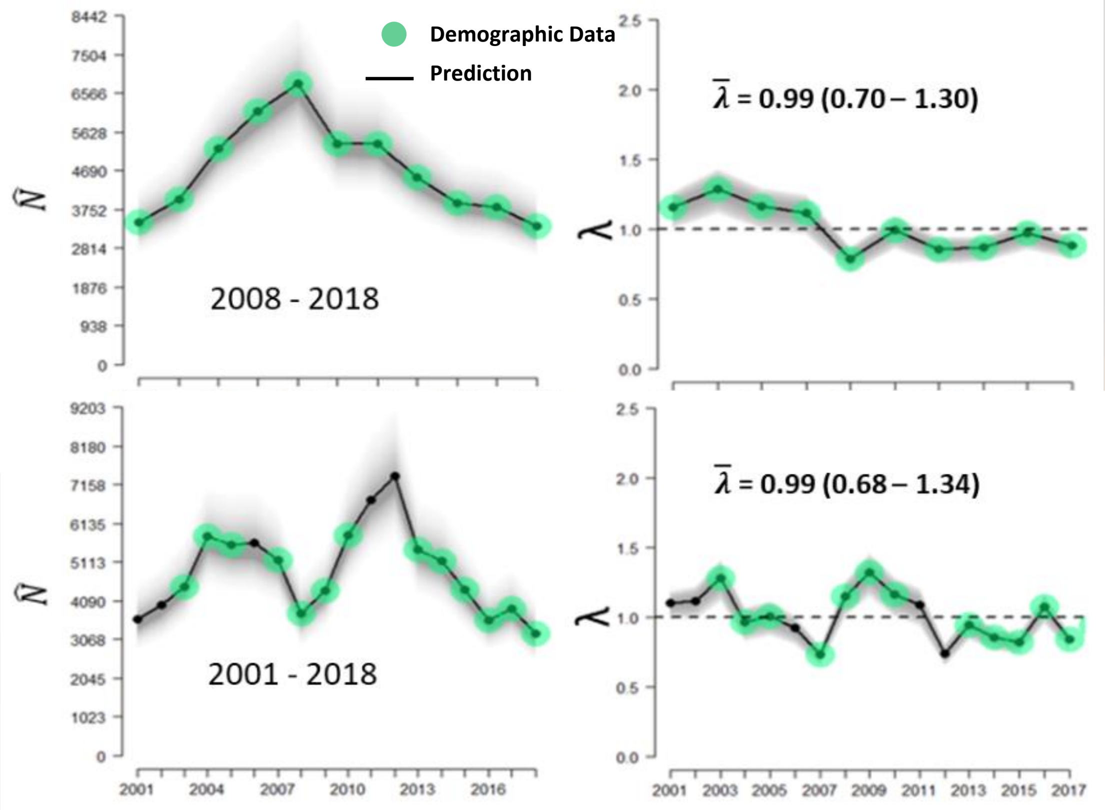
Two Cycle (2001 – 2018)

- $\bar{\lambda}$ = 0.99 (0.68 - 1.34)
- **16.6% decrease over 17 years**



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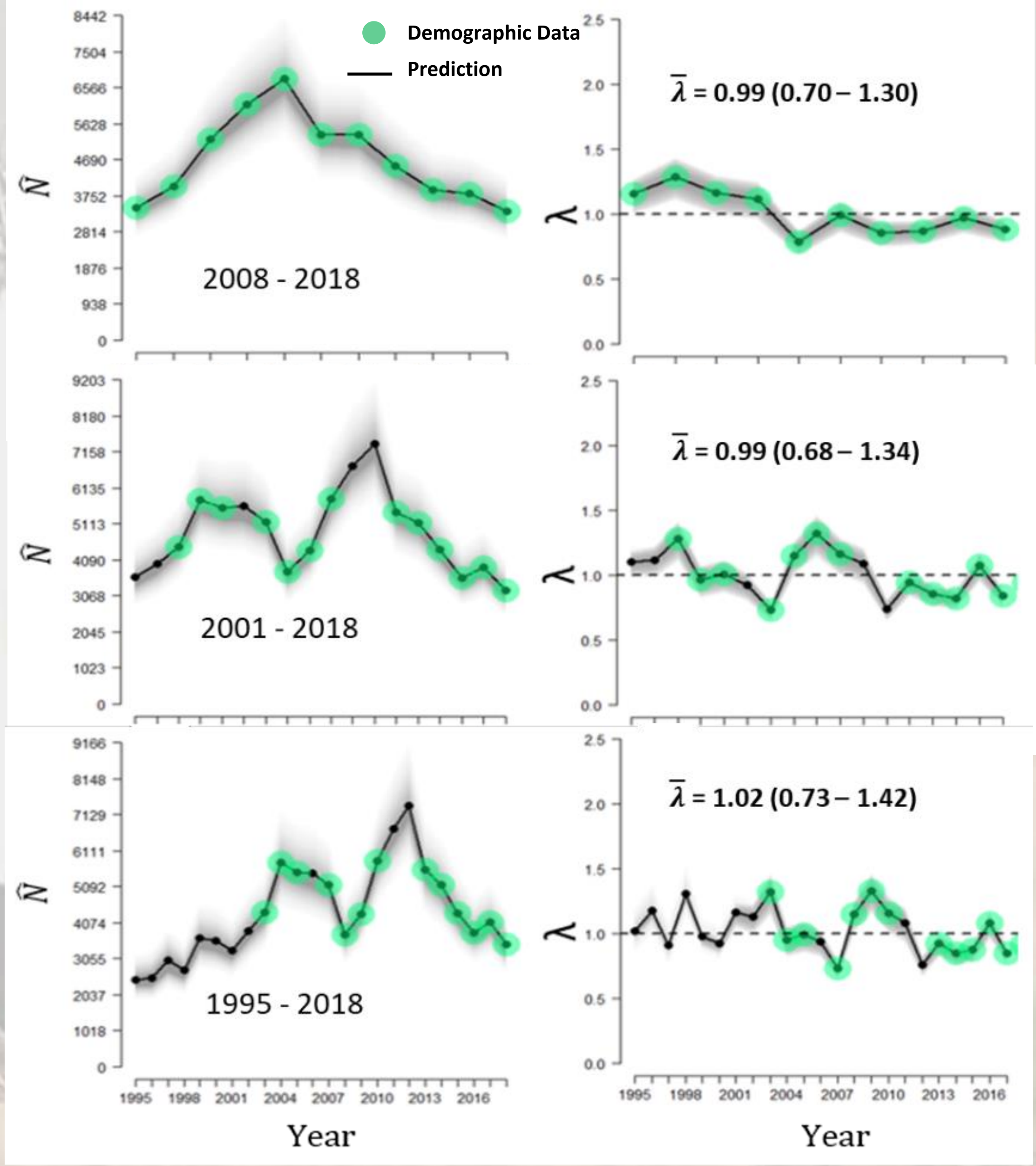
Three Cycle (1995 – 2018)

- $\bar{\lambda}$ = 1.02 (0.73 - 1.42)
- **60% increase over 23 years**



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CYCLICAL TRENDS IN ABUNDANCE

	1995 - 2018				2001 - 2018				2008 - 2018		
Subpopulation*	Median	Lower CRI	Upper CRI		Median	Lower CRI	Upper CRI		Median	Lower CRI	Upper CRI
Bi-State DPS	1.018	0.737	1.418		0.989	0.677	1.343		0.988	0.704	1.304
Pine Nuts PMU	na	na	na		na	na	na		0.835	0.234	1.94
Desert/Fales PMU	0.999	0.59	1.641		0.955	0.457	1.387		0.947	0.441	1.361
Fales	0.999	0.59	1.641		0.984	0.539	1.525		0.965	0.544	1.397
Desert Creek	na	na	na		0.939	0.348	1.499		0.938	0.337	1.535
Bodie PMU	1.07	0.76	1.758		1.029	0.74	1.457		1.061	0.783	1.471
Mt. Grant PMU	na	na	na		na	na	na		0.989	0.551	1.536
S. Mono PMU	0.995	0.677	1.421		0.982	0.656	1.4		0.961	0.681	1.344
Sagehen	0.916	0.282	1.964		0.844	0.18	1.819		0.834	0.222	1.658
Long Valley	0.996	0.676	1.427		0.986	0.655	1.433		0.96	0.68	1.361
Parker Meadows	na	na	na		0.968	0.254	7.16		1.048	0.361	5.814
White Mtns PMU	na	na	na		na	na	na		0.85	0.343	1.957
Great Basin	0.99	0.92	1.04		0.97	0.85	1.1		0.94	0.92	0.97

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Coates et al. 2020. Open-File Report 2019-1149

CYCLICAL TRENDS IN ABUNDANCE

		95 percent Credible Interval			
Subpopulation*	Median	Lower	Upper	Prop. of DPS	Percent Extirpation Probability
Bi-State DPS	**3305**	2247	4683	1.00	1.1
Pine Nuts PMU	33	0	73	0.01	69.7
Desert Creek/Fales PMU	447	218	750	0.14	9.0
Fales	121	54	208	0.04	38.4
Desert Creek	325	163	542	0.10	23.4
Bodie Hills PMU	**1521**	1181	1941	0.46	2.4
Mount Grant PMU	374	205	619	0.11	24.6
South Mono PMU	885	634	1214	0.27	3.8
Sagehen	20	0	75	0.01	74.8
Long Valley	**818**	614	1053	0.25	7.9
Parker Meadows	48	21	86	0.01	64.3
White Mountains PMU	45	9	86	0.01	75.1

Coates et al. 2020. Open-File Report 2019-1149

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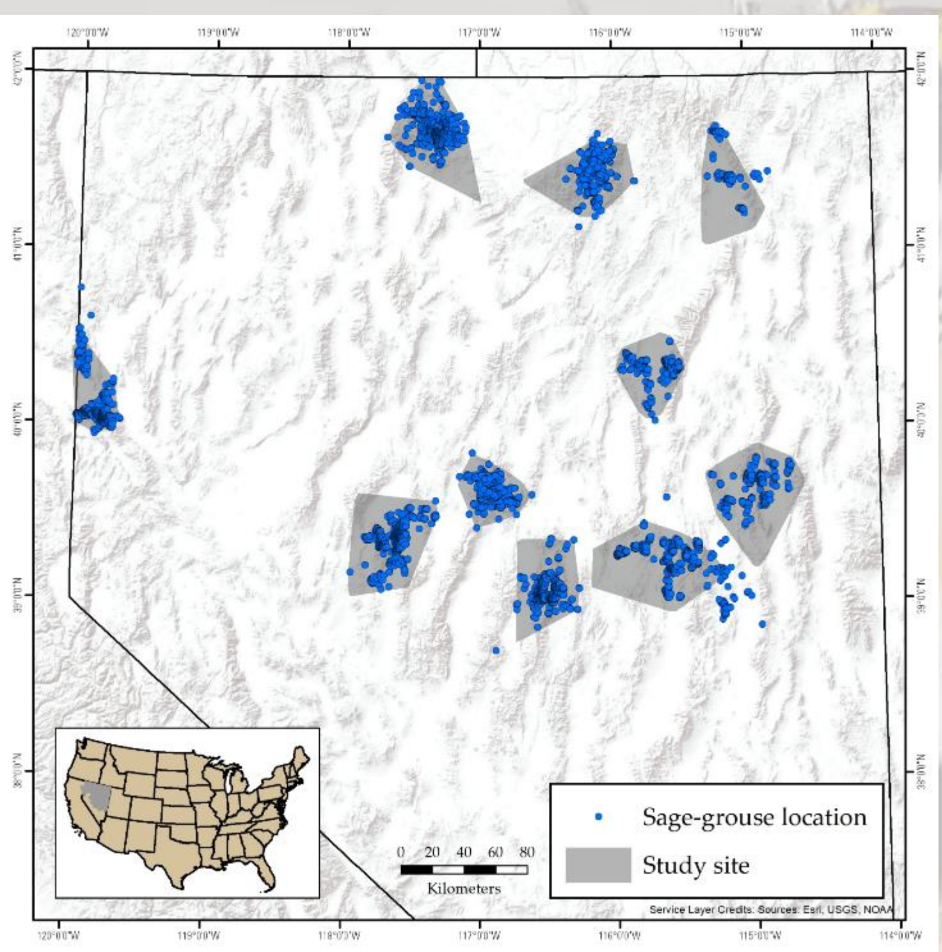
White Mountains PMU	45	9	86	0.01	75.1

Coates et al. 2020. Open-File Report 2019-1149

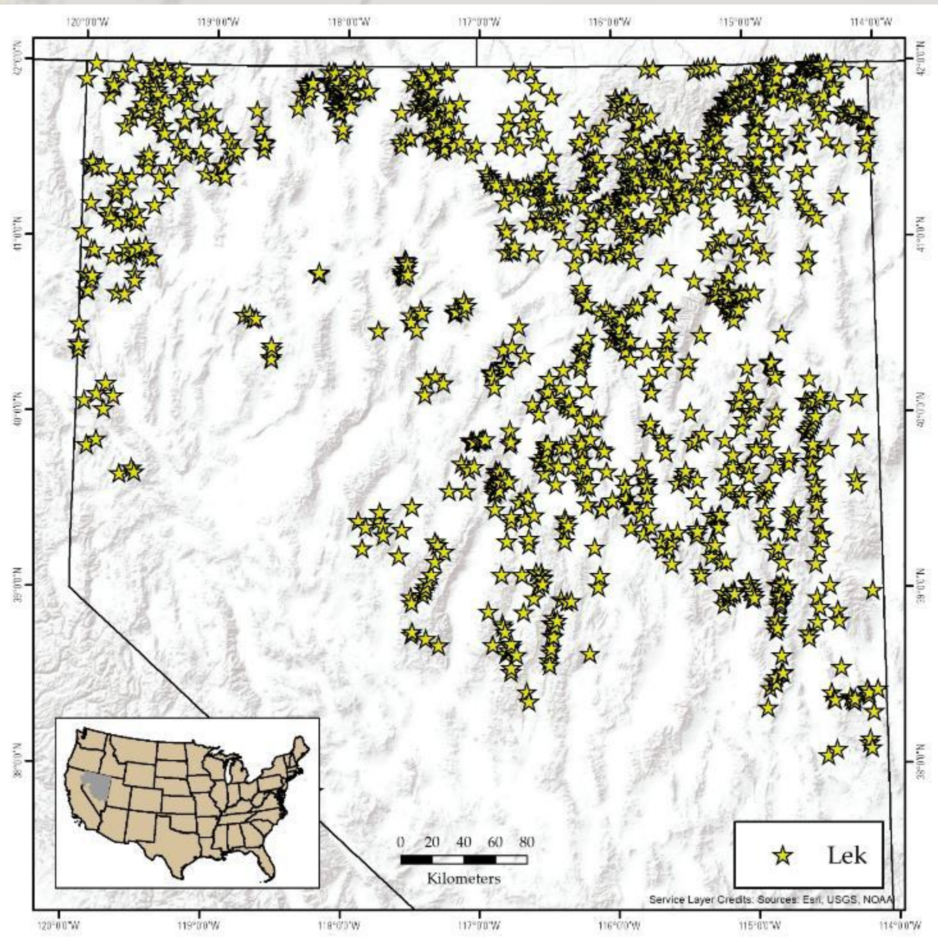
DATA SOURCES

Nevada State-Wide Data

Telemetry Locations



Lek Survey Data



Coates et al. 2020. Open-File Report 2019-1149

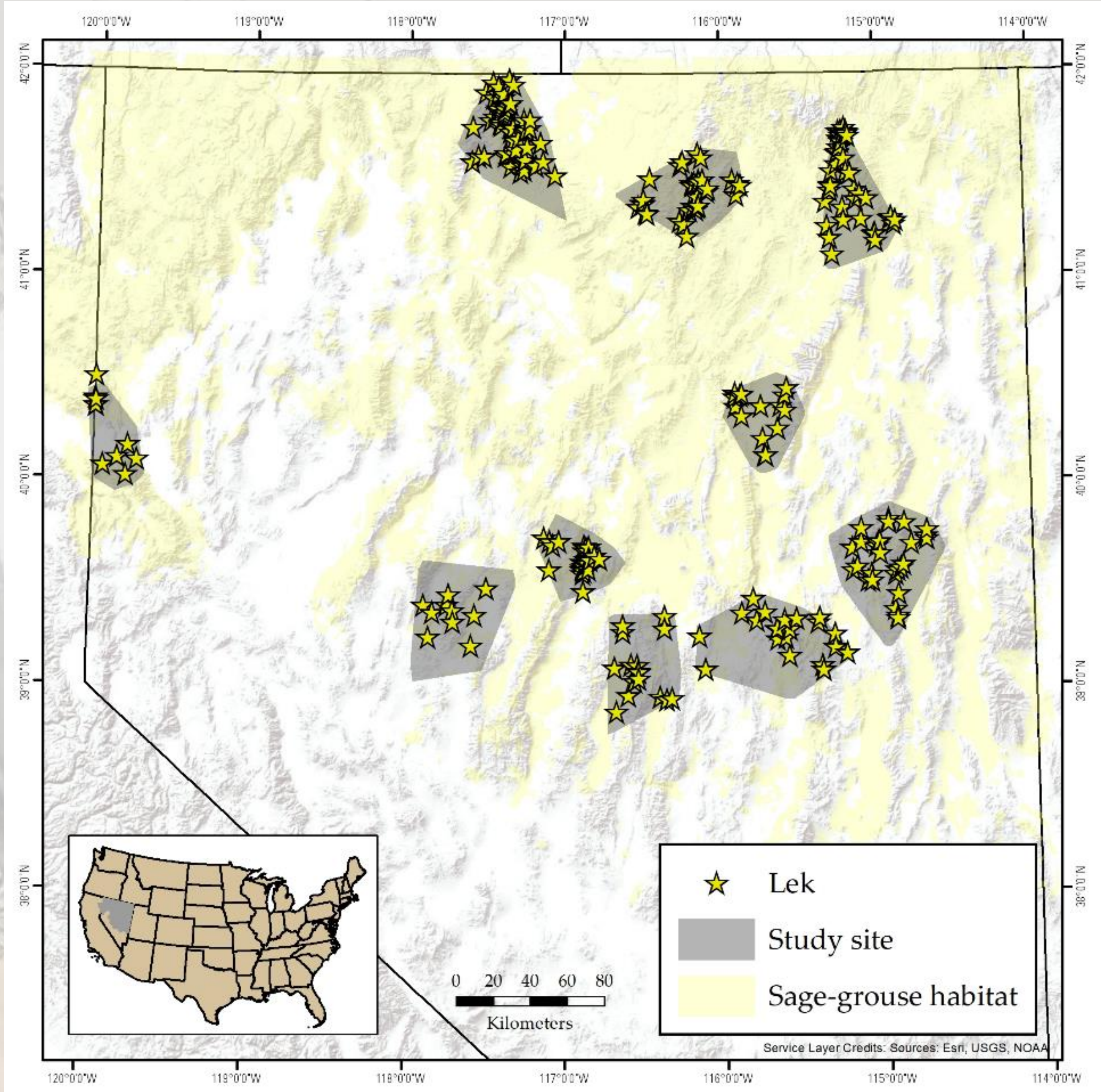
NEVADA-WIDE IPM (RESTRICTED)

Objectives:

Estimate population trends for Nevada and California

Compare trends to Bi-State population

- Study sites (n = 10)
- Years (survey, n = 23; telemetry, n = 2-10)
- Leks (n = 225)
- Females (n = 612)
- Nests (n = 775)
- Broods (n = 283)



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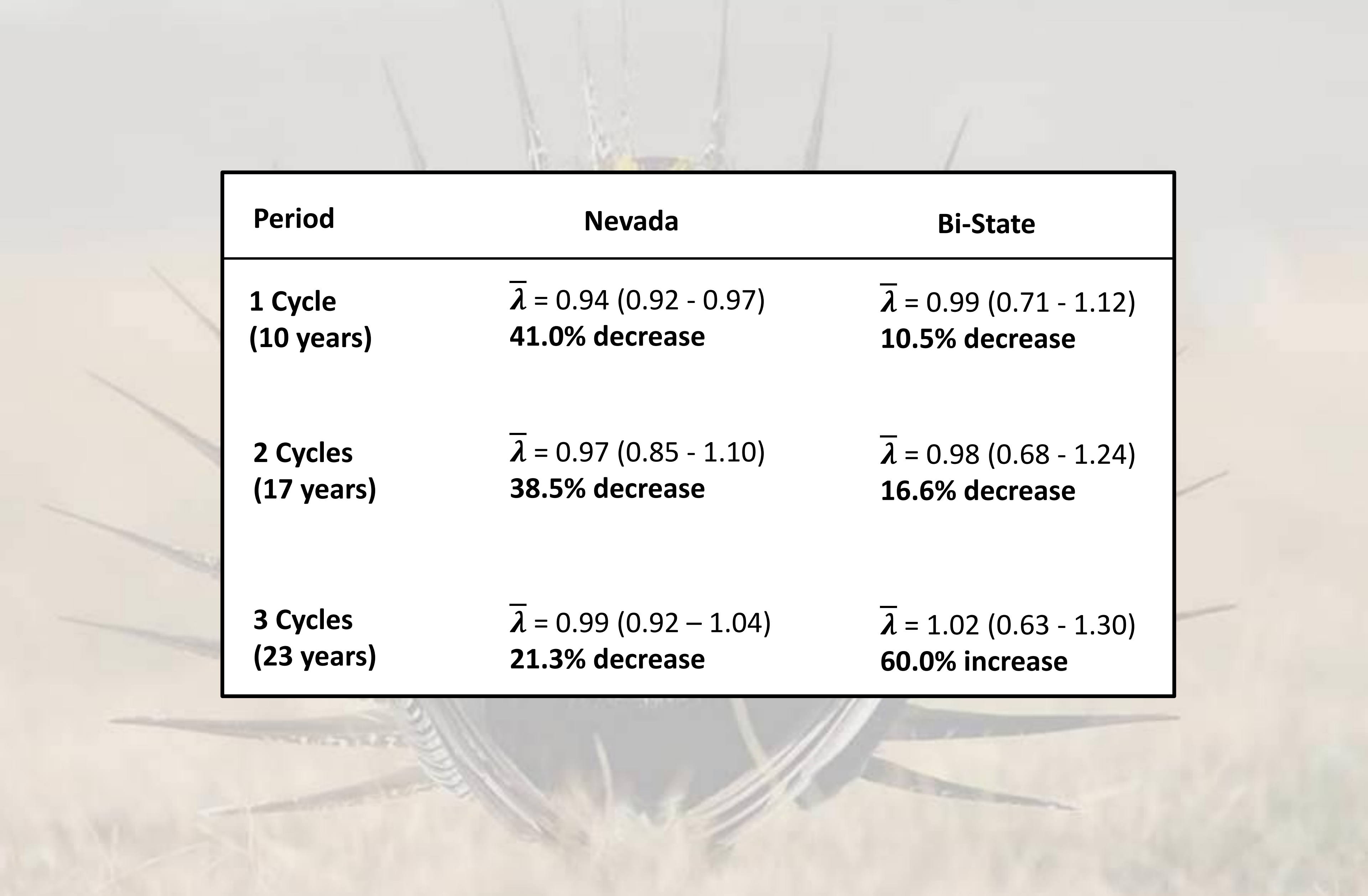
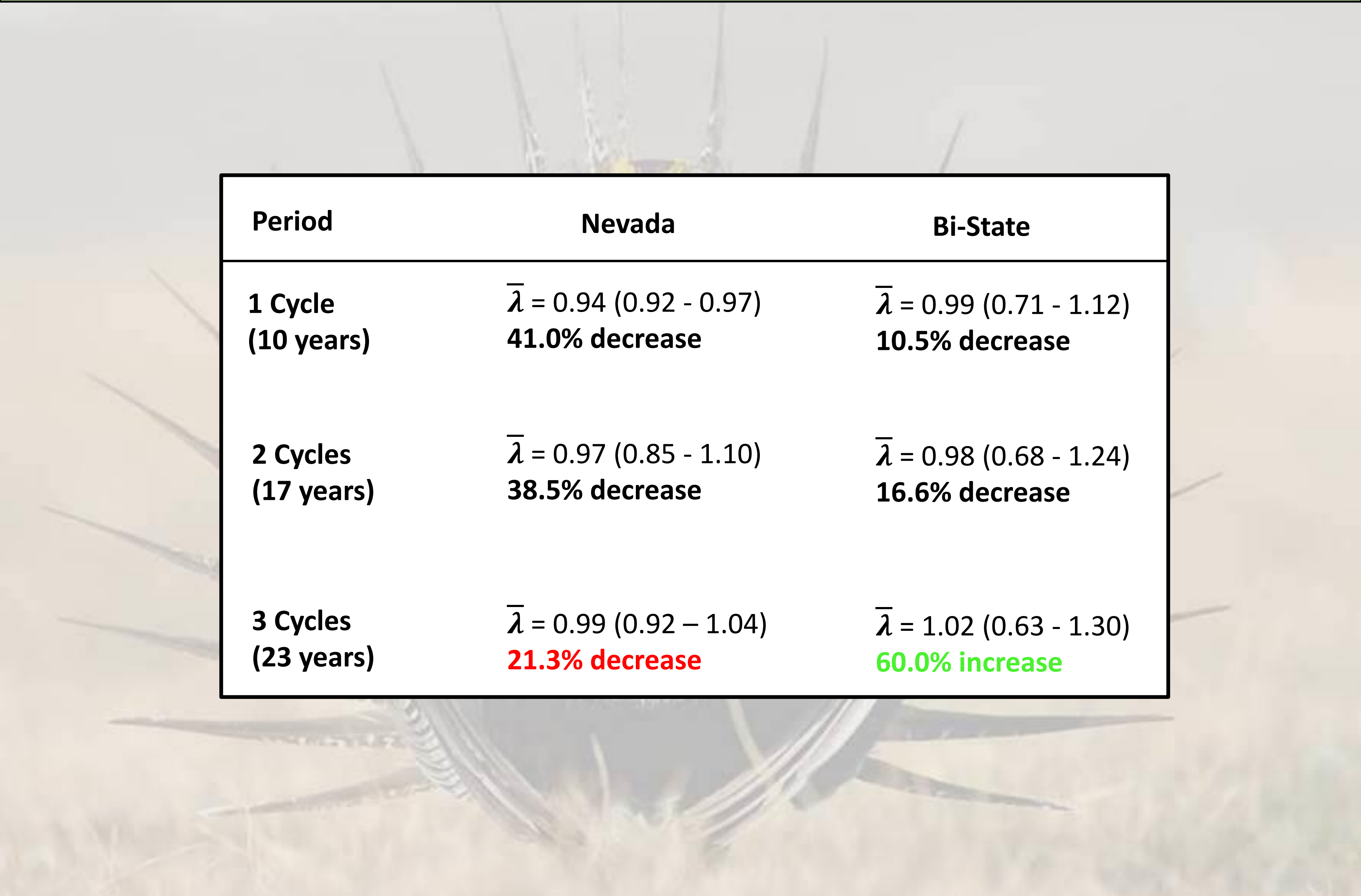


Period	Nevada	Bi-State
1 Cycle (10 years)	$\bar{\lambda}$ = 0.94 (0.92 - 0.97) **41.0% decrease**	$\bar{\lambda}$ = 0.99 (0.71 - 1.12) **10.5% decrease**
2 Cycles (17 years)	$\bar{\lambda}$ = 0.97 (0.85 - 1.10) **38.5% decrease**	$\bar{\lambda}$ = 0.98 (0.68 - 1.24) **16.6% decrease**
3 Cycles (23 years)	$\bar{\lambda}$ = 0.99 (0.92 – 1.04) **21.3% decrease**	$\bar{\lambda}$ = 1.02 (0.63 - 1.30) **60.0% increase**

Coates et al. 2020. Open-File Report 2019-1149

CYCLICAL TRENDS IN ABUNDANCE



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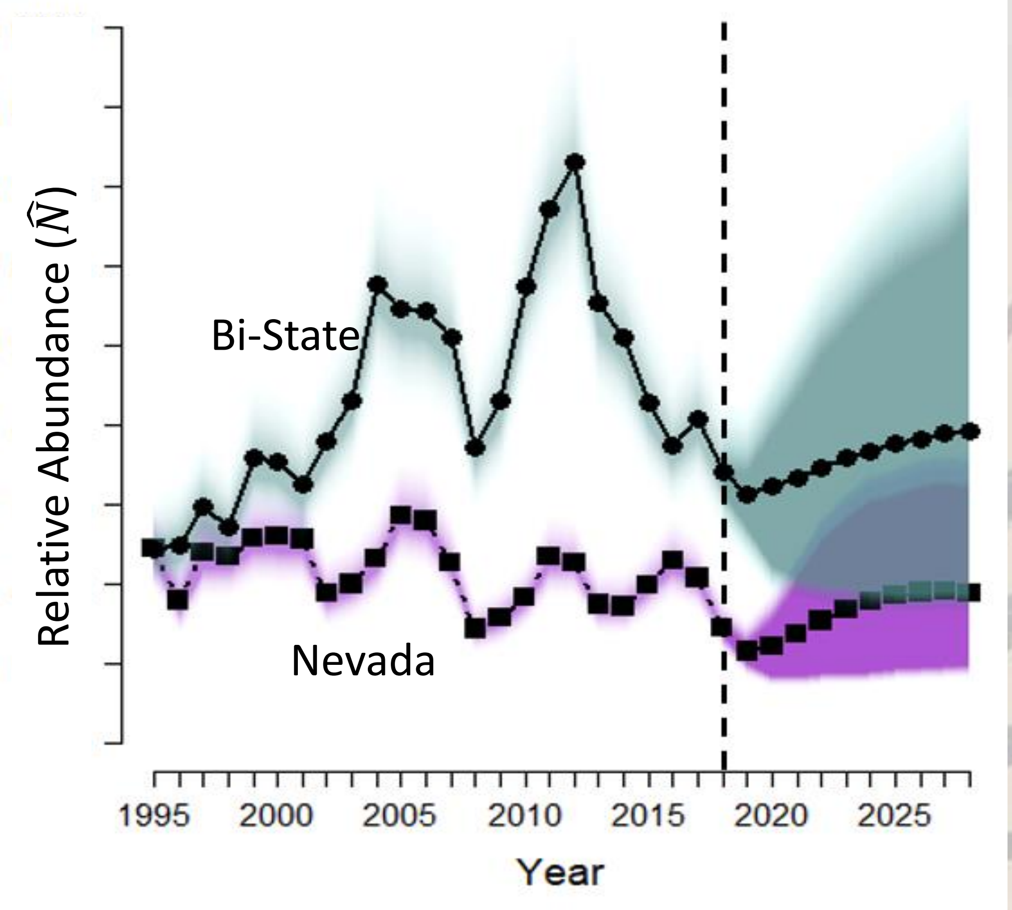
REGIONAL COMPARISONS



Coates et al. 2020. Status of Bi-State Sage-Grouse. Open File Report

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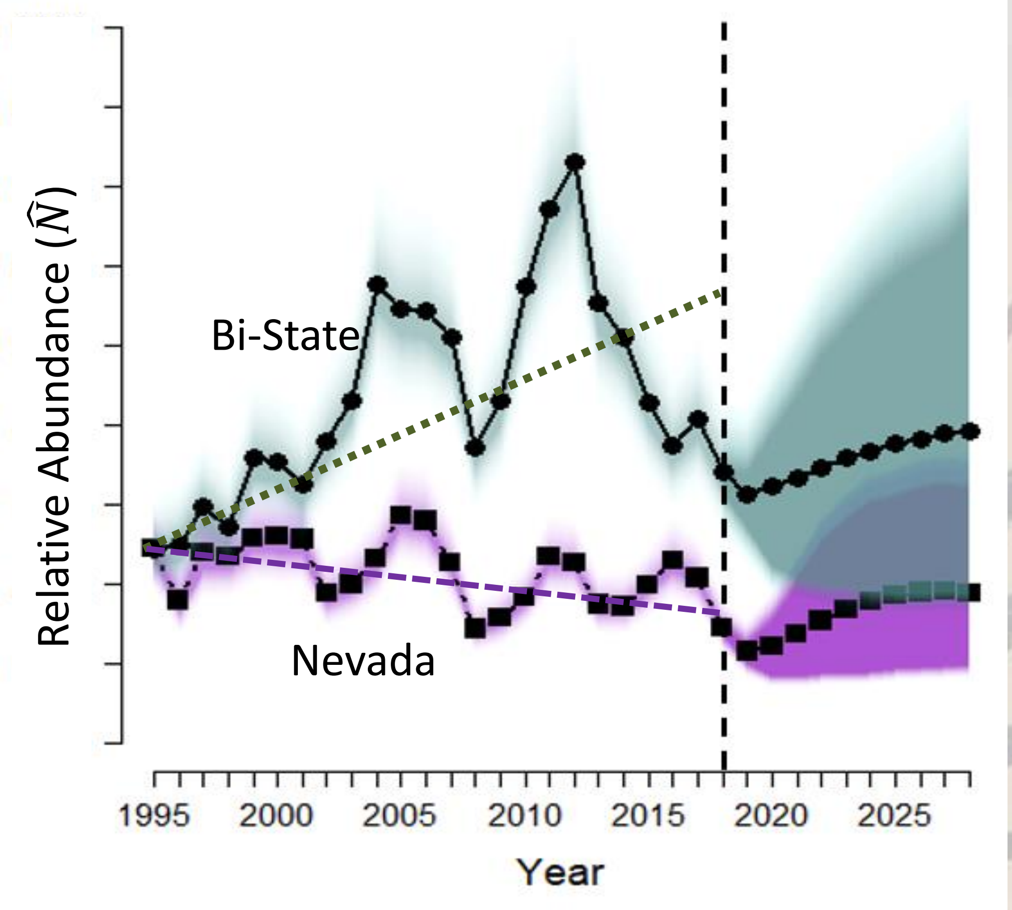
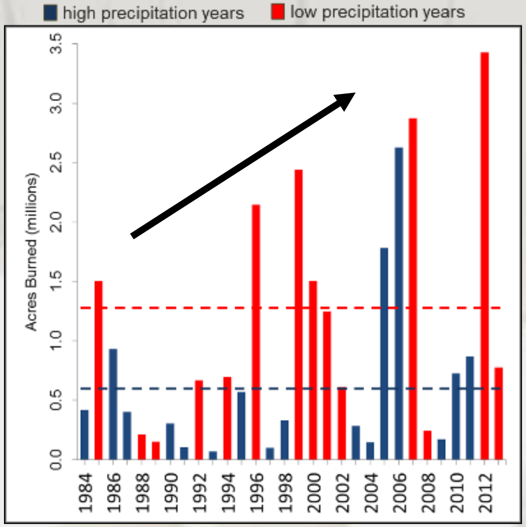


Coates et al. 2020. Status of Bi-State Sage-Grouse. Open File Report

Explanations: Wildfire and Invasive Grass

Prepared in cooperation with the U.S. Fish and Wildlife Service

Long-Term Effects of Wildfire on Greater Sage-Grouse—Integrating Population and Ecosystem Concepts for Management in the Great Basin



Coates et al. 2016. Proceedings of National Academy of Science 113: 12745–12750

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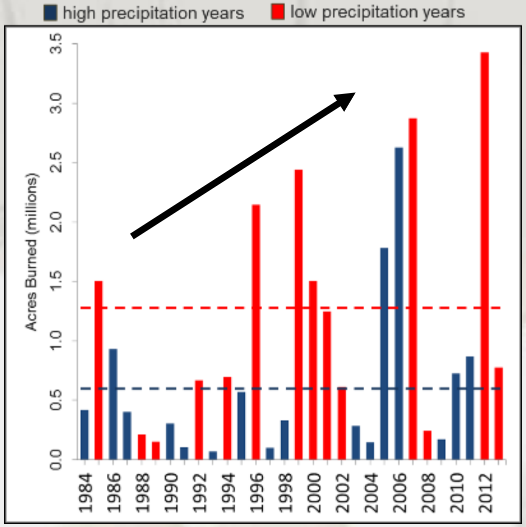

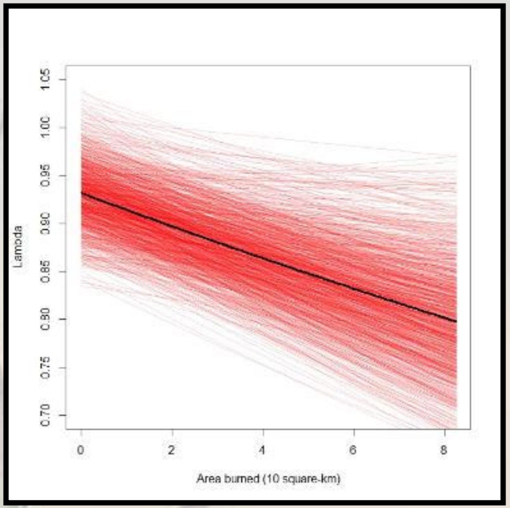

A 10-km^2 increase in burned area decreased lambda by approximately **2.1%**

Coates et al. 2016. Proceedings of National Academy of Science 113: 12745–12750

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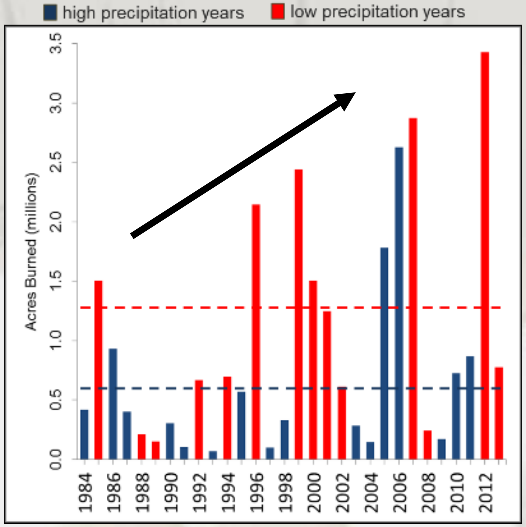

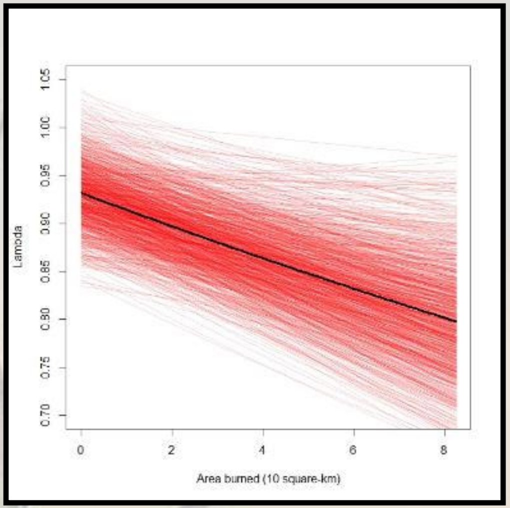

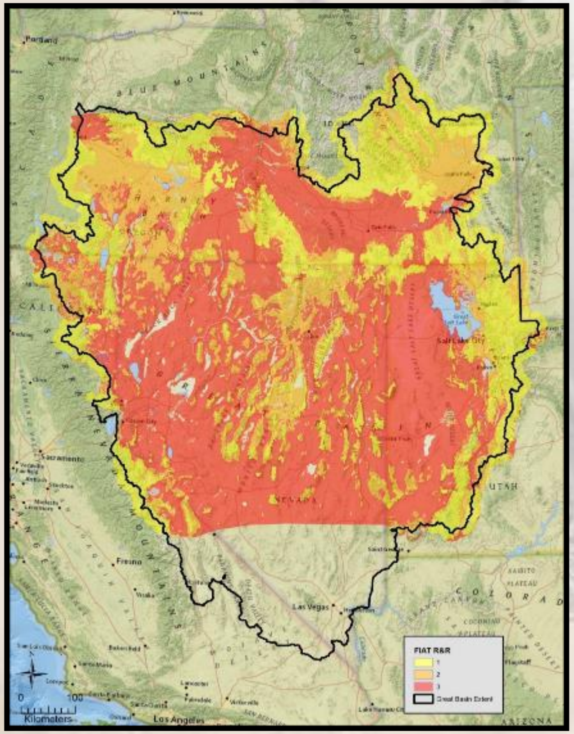

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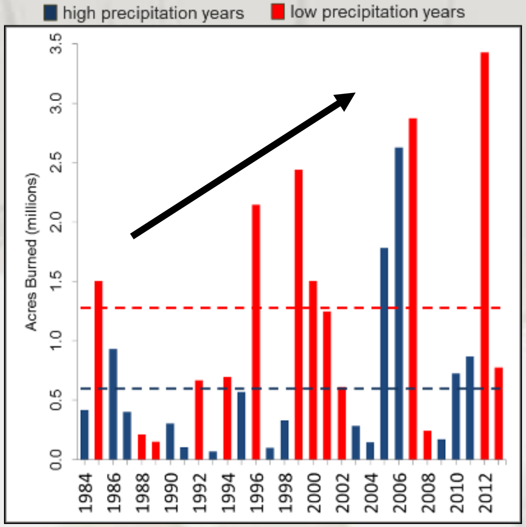
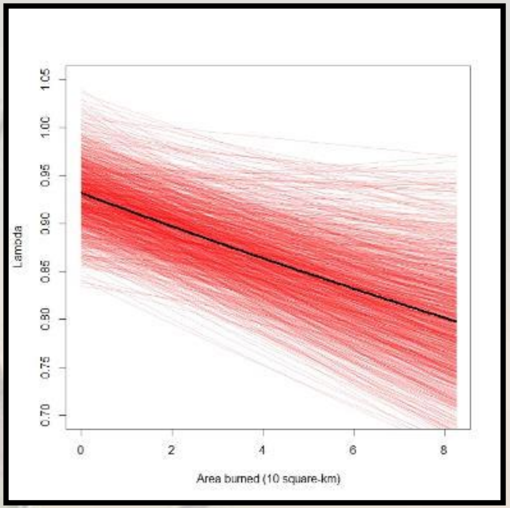
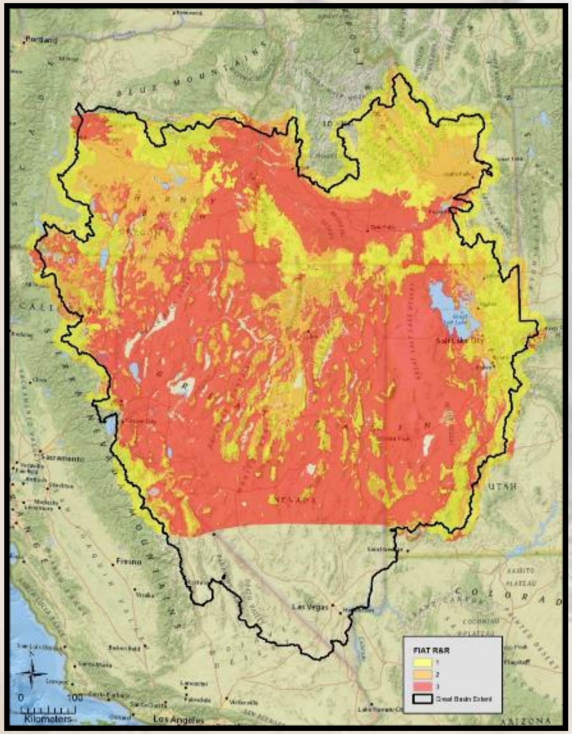
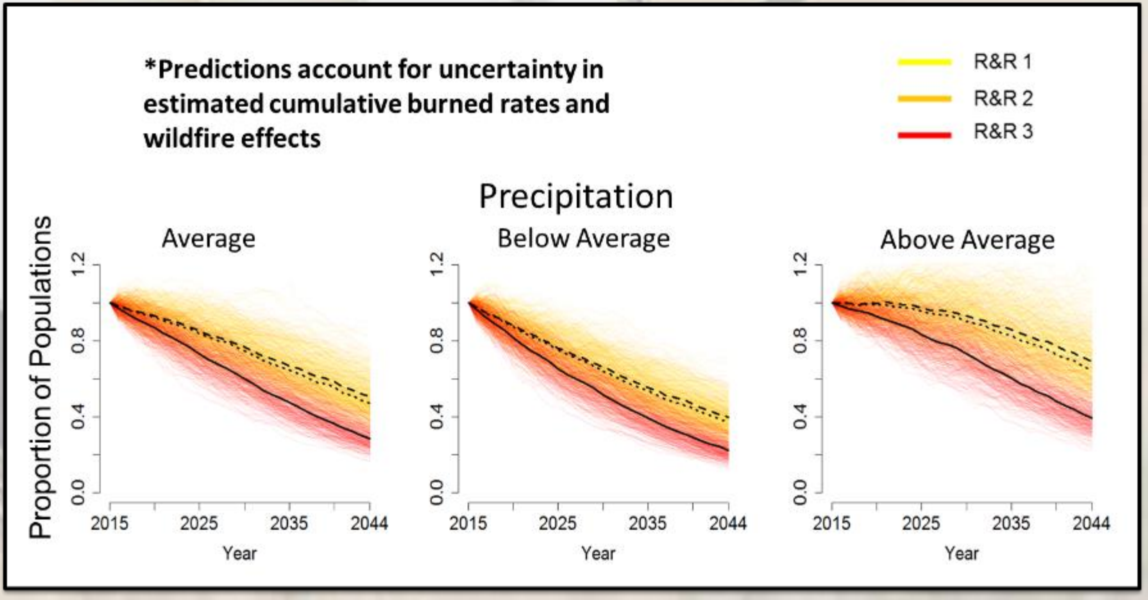
Long-Term Effects of Wildfire on Greater Sage-Grouse—Integrating Population and Ecosystem Concepts for Management in the Great Basin





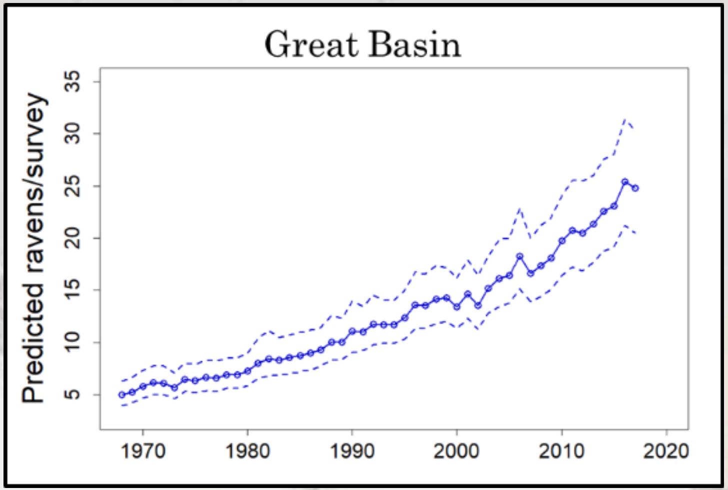




*Predictions account for uncertainty in estimated cumulative burned rates and wildfire effects

Coates et al. 2016. Proceedings of National Academy of Science 113: 12745–12750

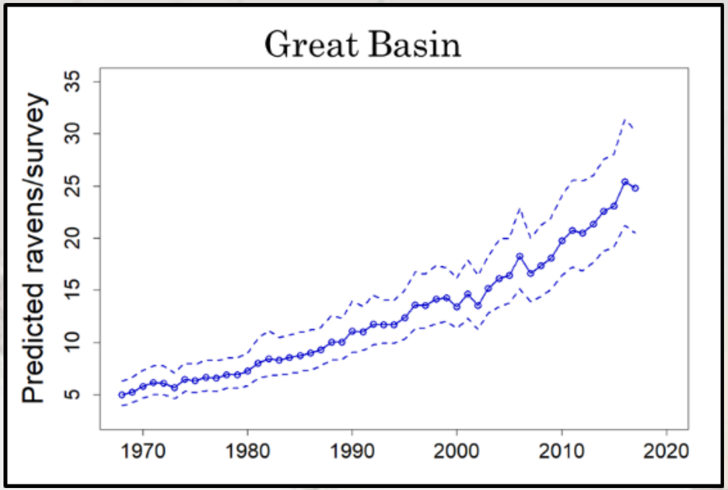
Explanations: Increasing Raven Populations

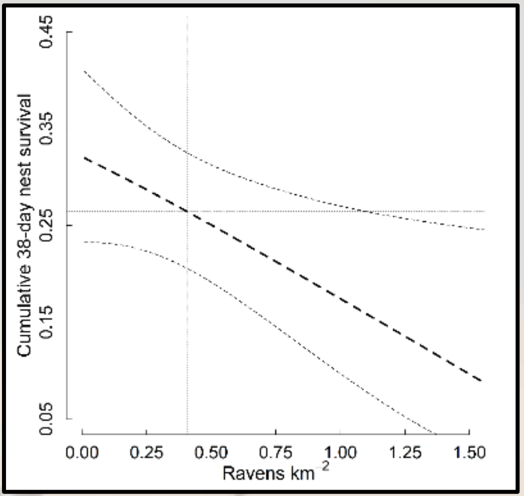


Ravens have experienced population increases by ~350% since 1970s

BBS Data; Sauer et al. 2019

Explanations: Increasing Raven Populations



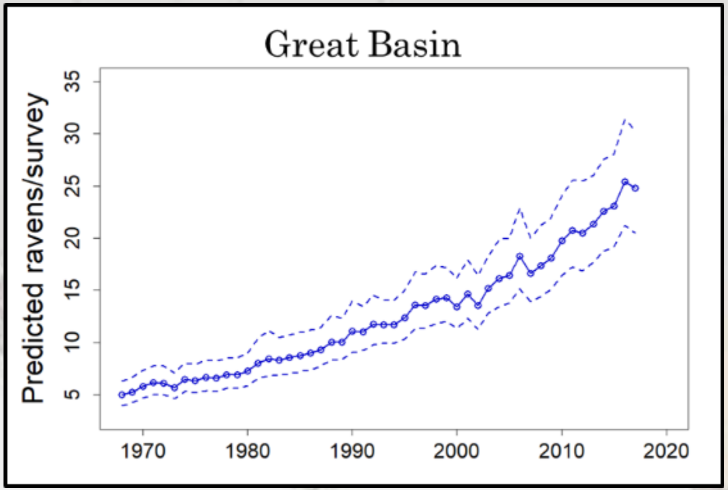


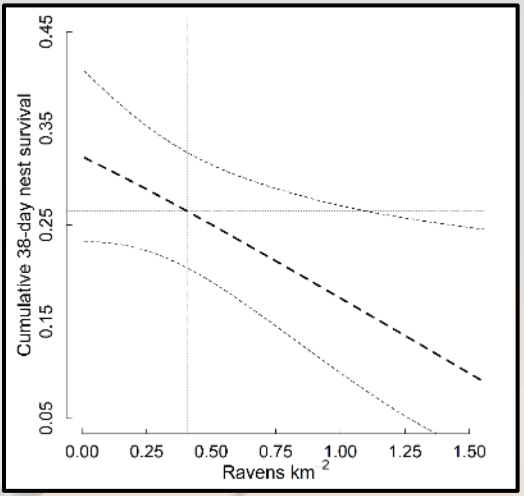
Ravens have experienced population increases by ~350% since 1970s

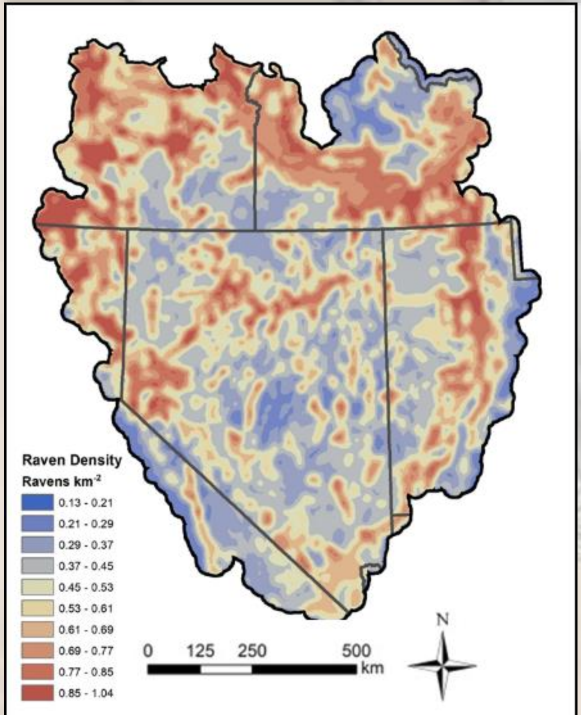
Ecological threshold ~0.4 ravens km^{-2}

Coates et al. 2020. Biological Conservation 243: 108409

Explanations: Increasing Raven Populations

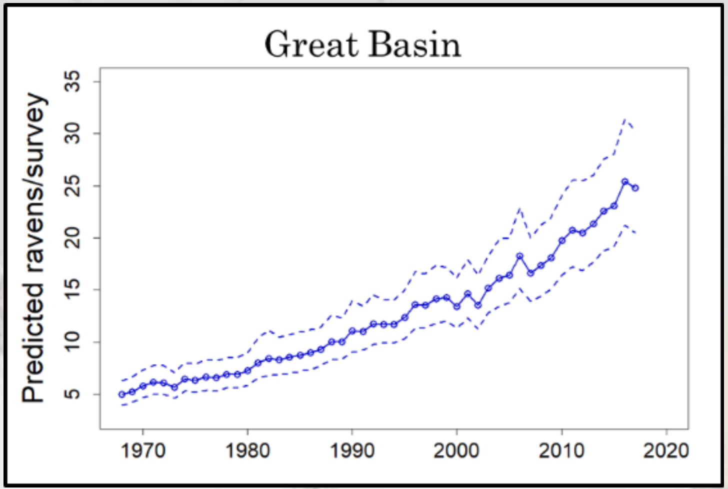


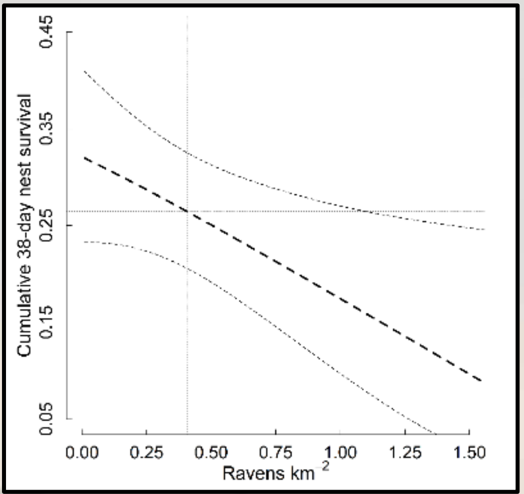


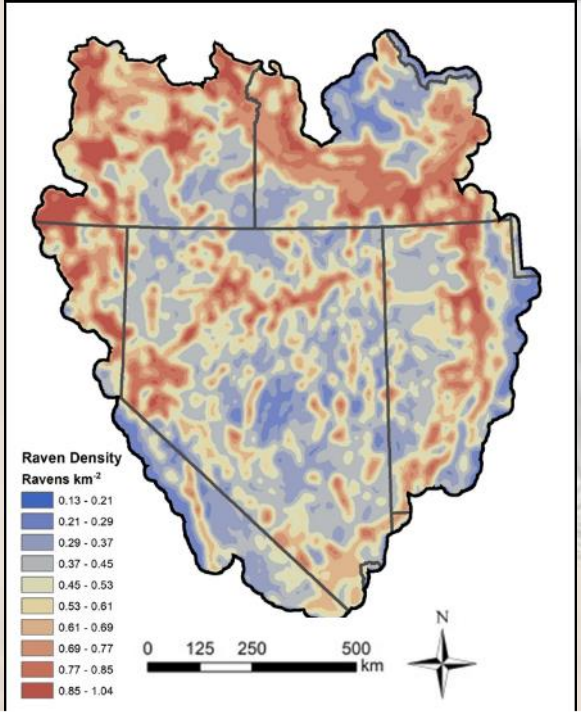


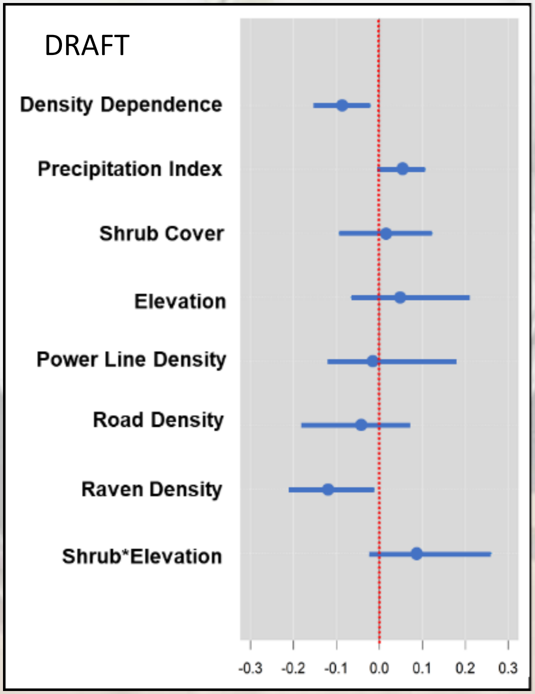
Coates et al. 2020. Biological Conservation 243: 108409

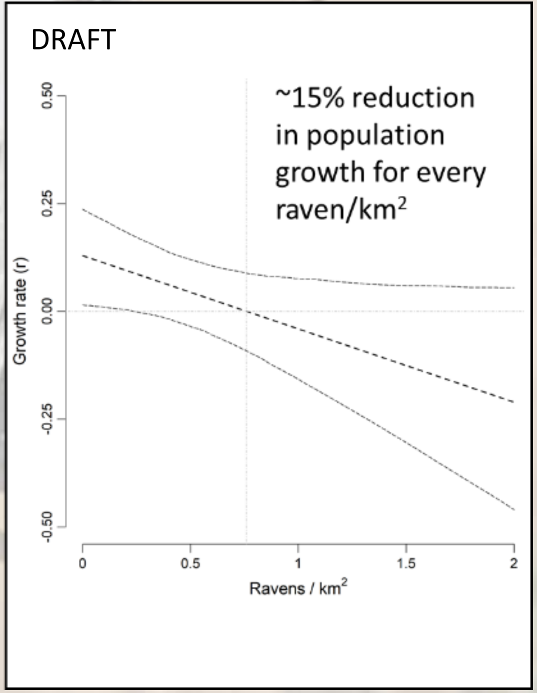
Explanations: Increasing Raven Populations







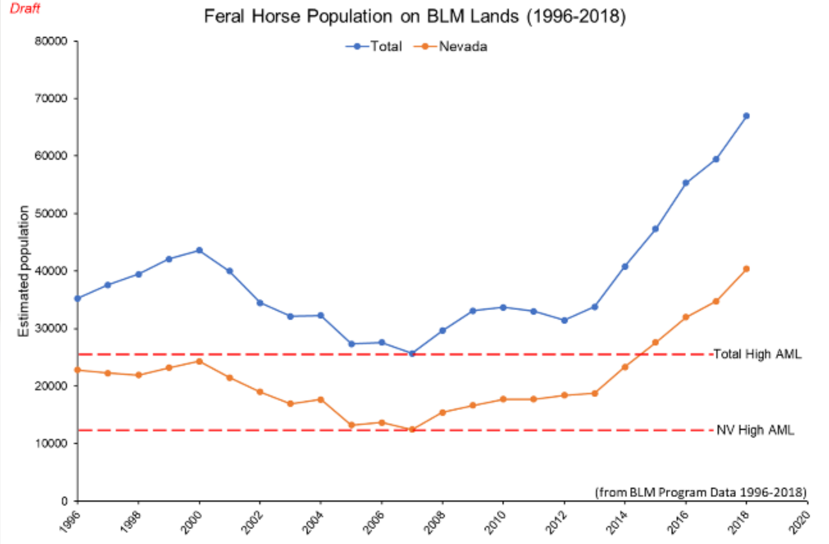

DRAFT


DRAFT

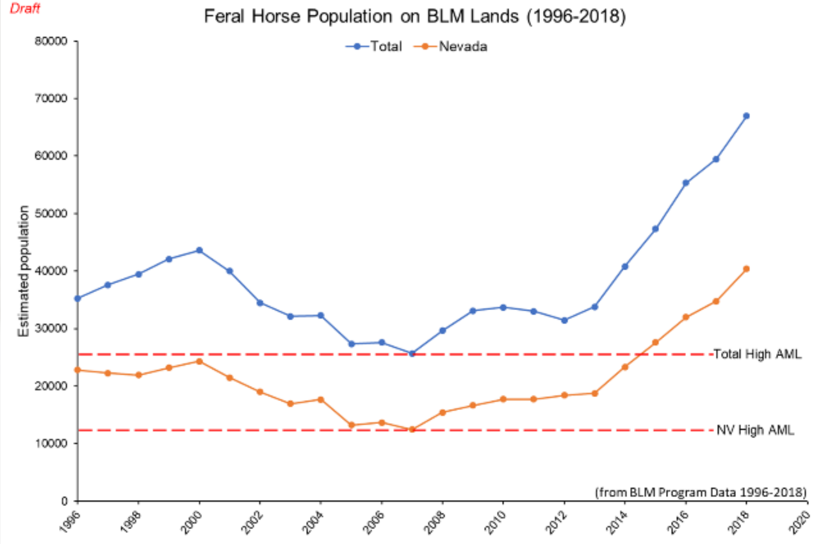
~15% reduction in population growth for every raven/km^2

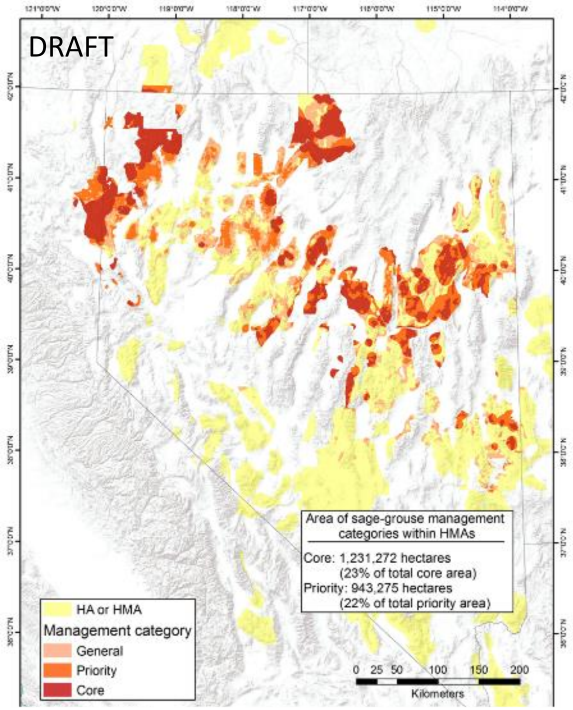
Preliminary Information—Subject to Revision. Not for Citation or Distribution

Explanations: Increasing Raven Populations



Explanations: Increasing Raven Populations



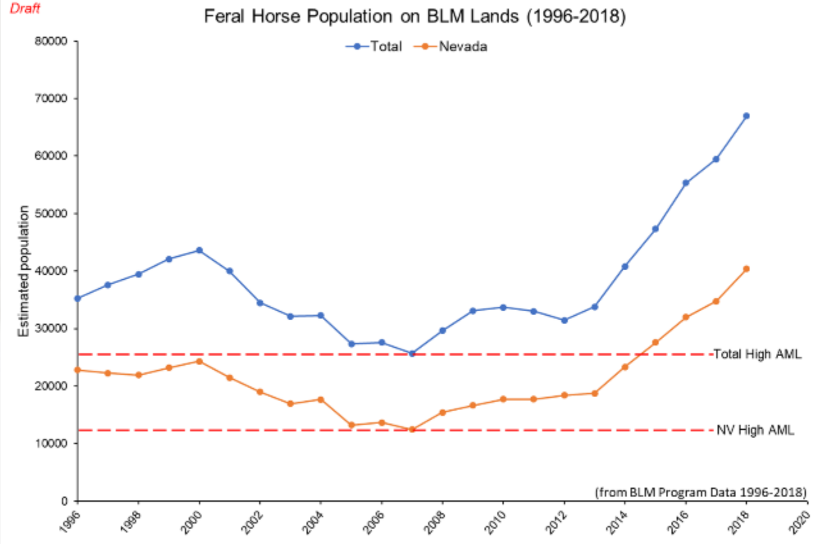


Area of sage-grouse management categories within HMAs

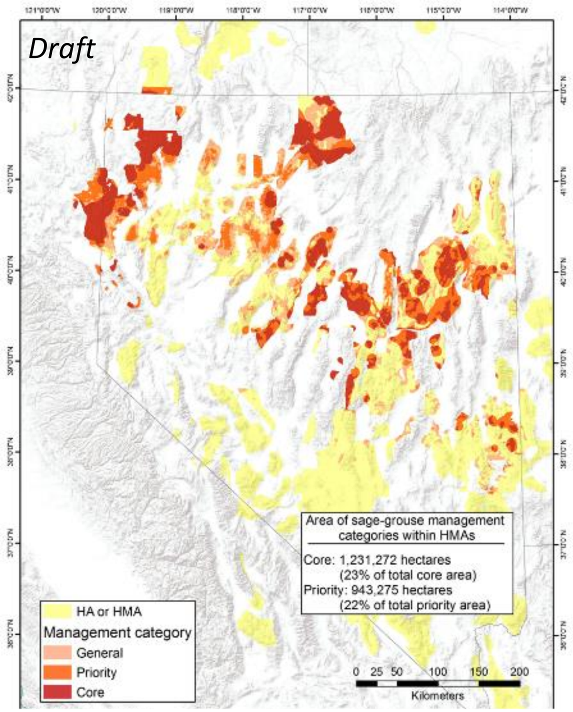
Core: 1,231,272 hectares
(23% of total core area)
Priority: 943,275 hectares
(22% of total priority area)

Preliminary Information—Subject to Revision. Not for Citation or Distribution

Explanations: Increasing Feral Horse Populations



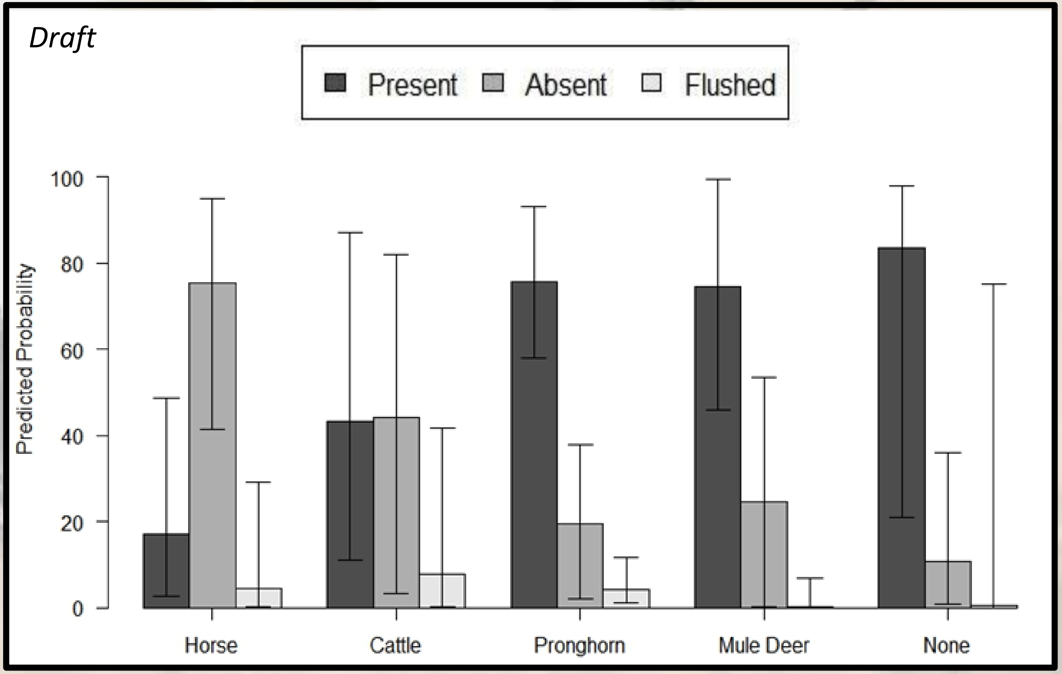
Probability of sage-grouse absent on active lek with horse was ~75%, which was nearly 5 times greater than no ungulates



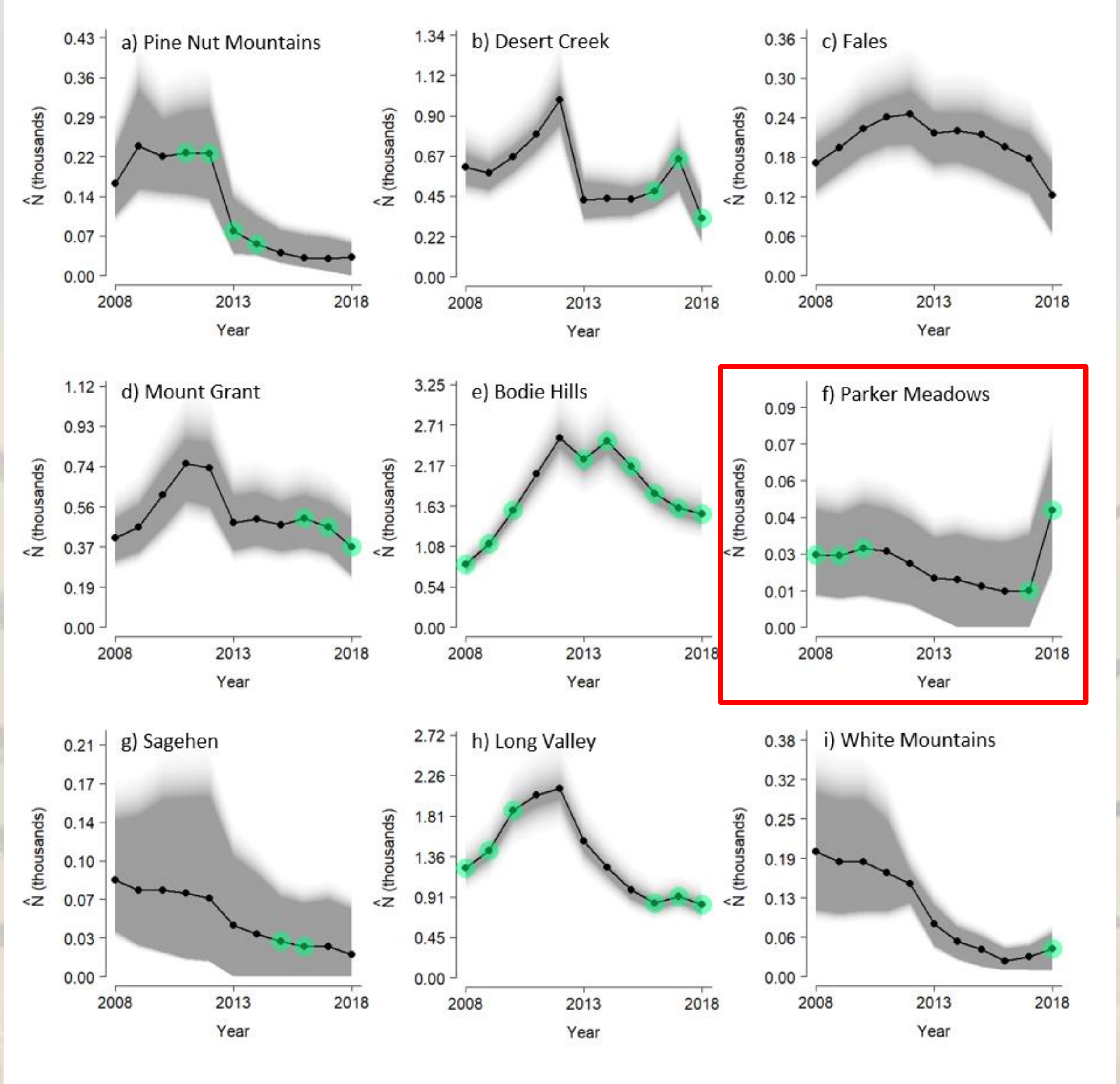
Area of sage-grouse management categories within HMAs

Core: 1,231,272 hectares (23% of total core area)

Priority: 943,275 hectares (22% of total priority area)

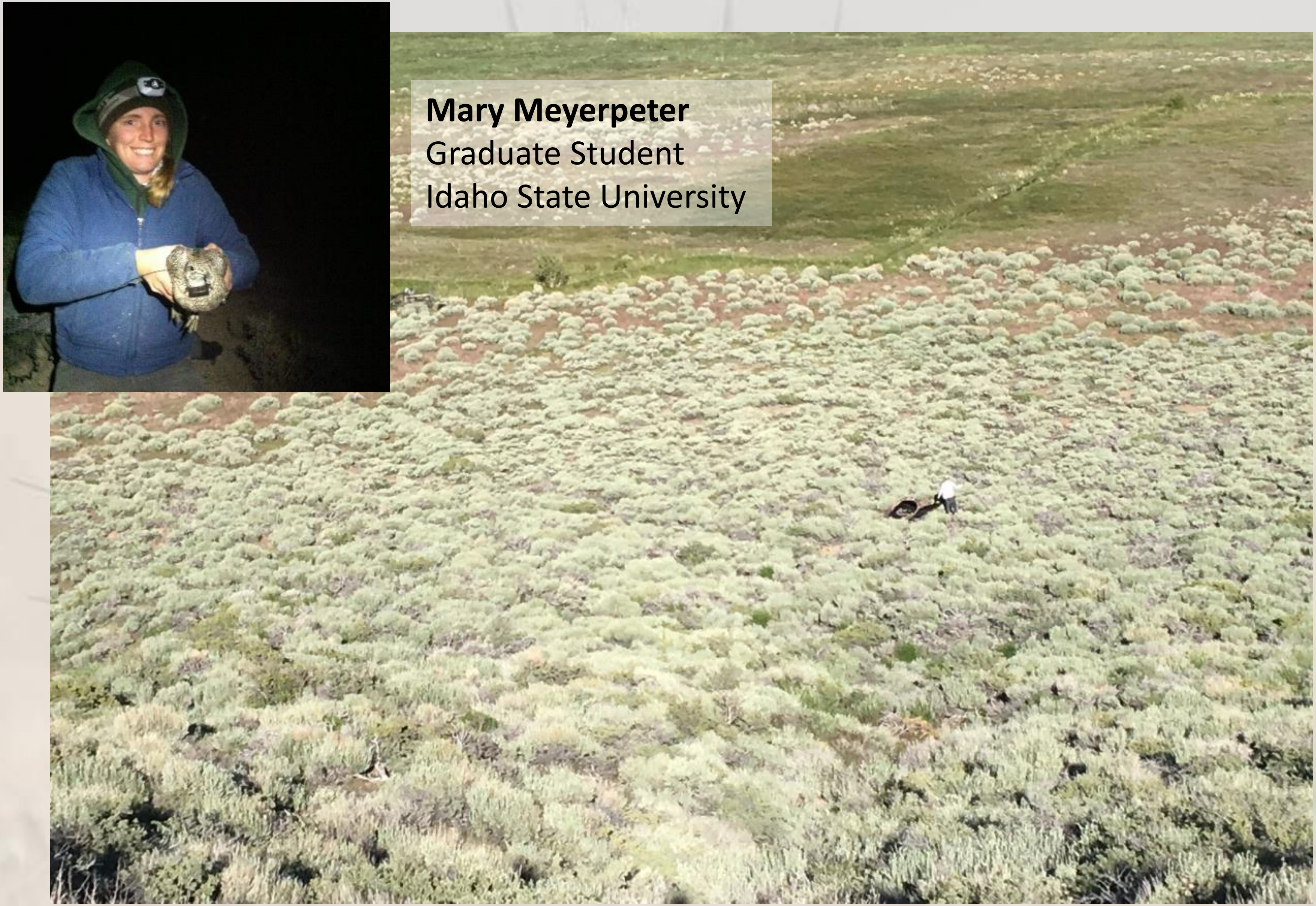


CYCLICAL TRENDS IN ABUNDANCE



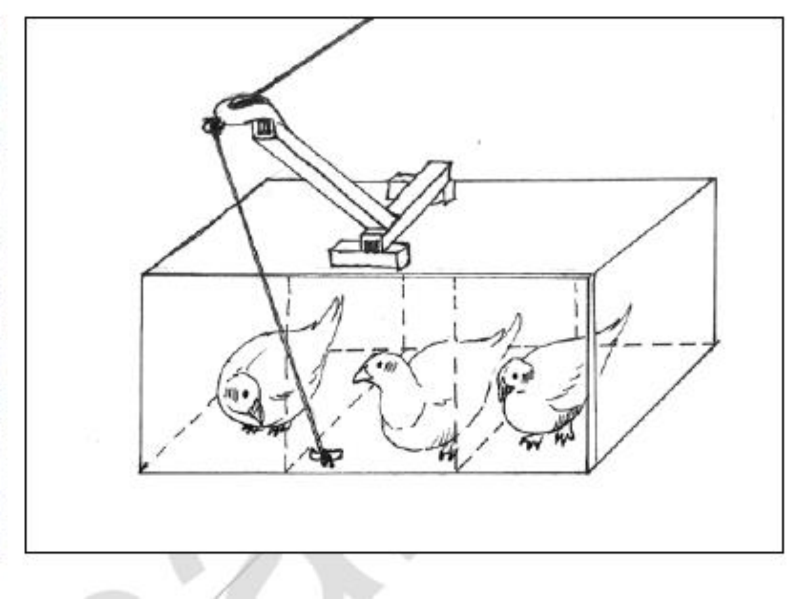
Coates et al. 2020. Open-File Report 2019-1149

Translocation Program to Rescue Parker Meadows Population



Mary Meyerpeter
Graduate Student
Idaho State University

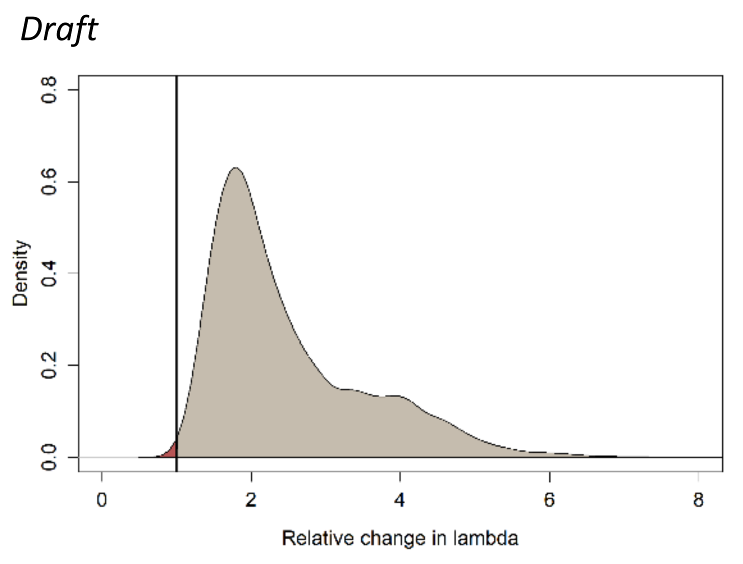
Translocation Methods



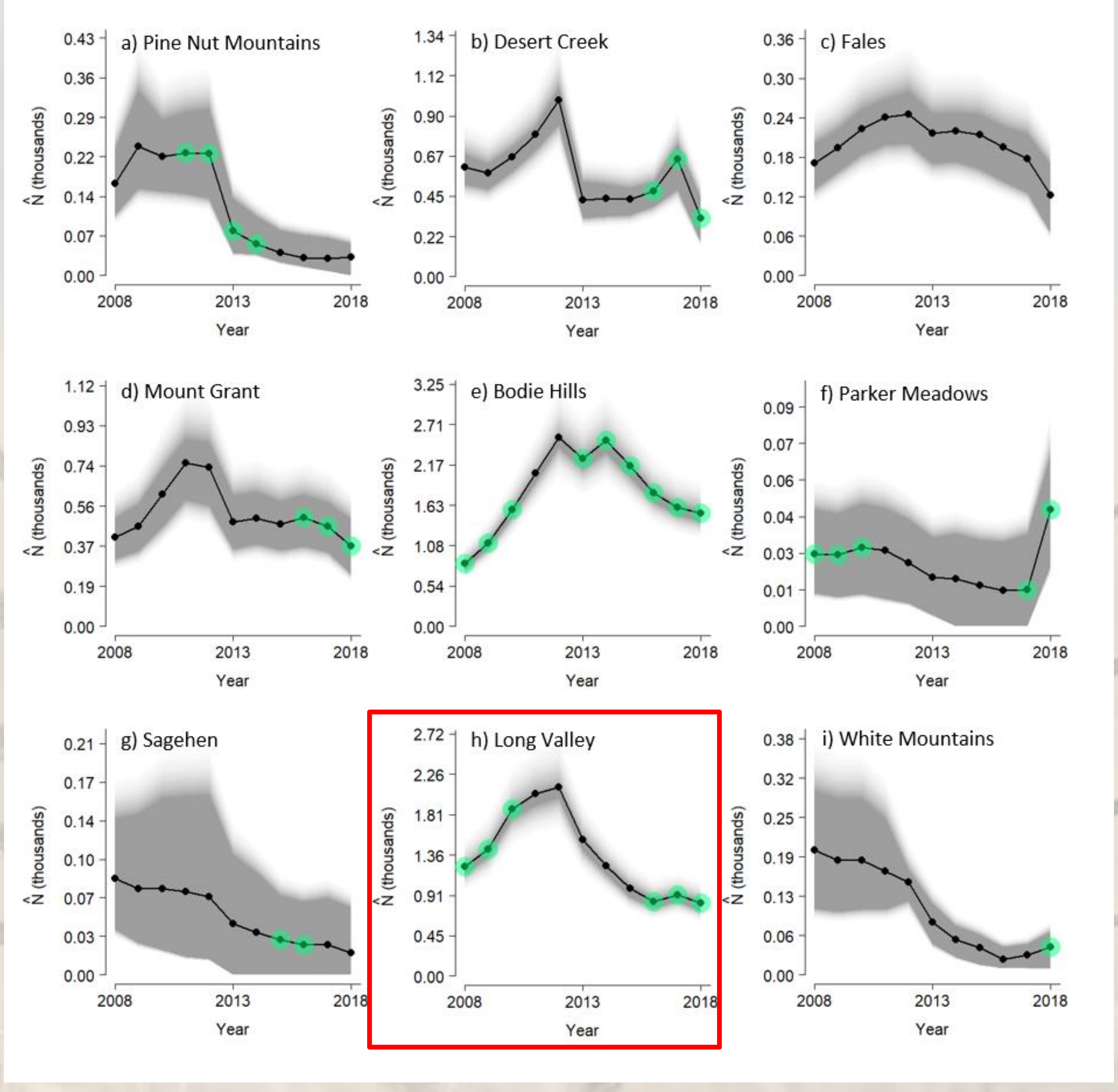
Before-After Control-Impact Study Design

Draft	Before Translocation (2001-2016)	Translocation Years (2017-2019)
Treatment	0.931 (CRI 0.479-1.435)	1.671 (CRI 0.771-3.787)
Control	0.970 (CRI 0.648-1.297)	0.889 (CRI 0.481-1.255)

- Used demographic data from n=495 female sage-grouse and n=429 lek counts
- Control sites - LV, SA, JA, FA, WM
- Population growth rate increased 114% at Parker Meadow relative to control sites (R_BACI=2.143)

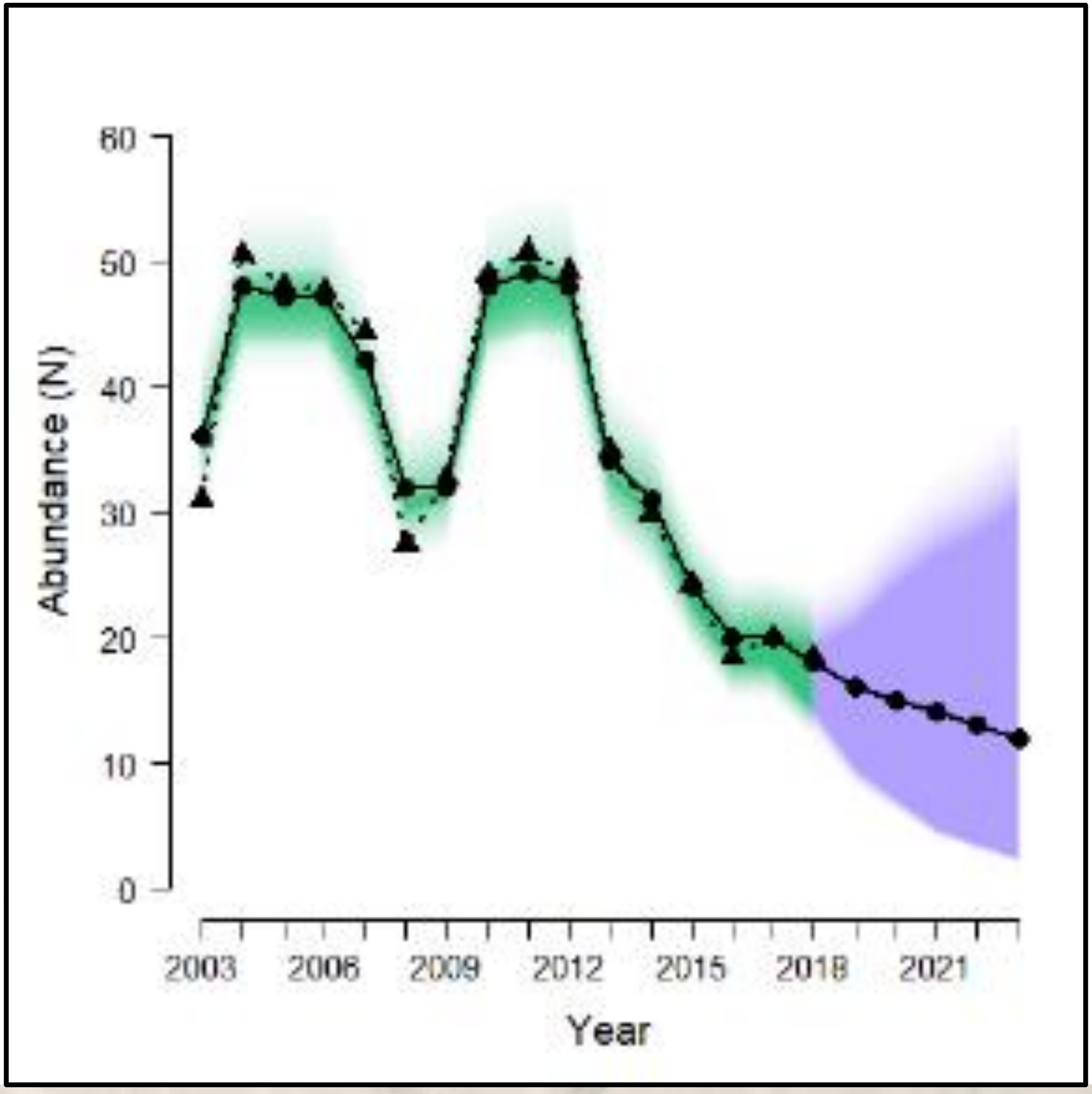


CYCLICAL TRENDS IN ABUNDANCE



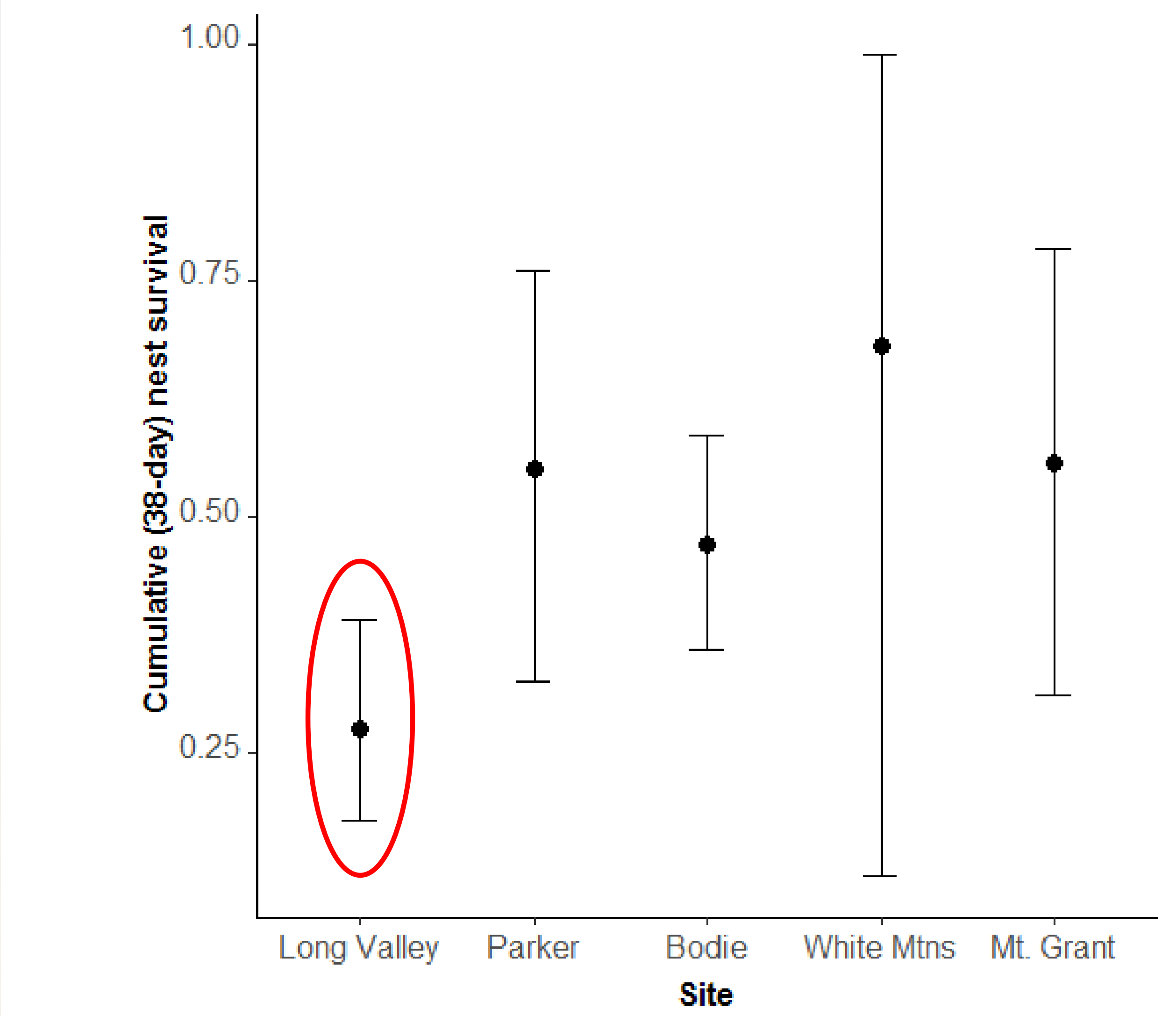
Coates et al. 2020. Open-File Report 2019-1149

CYCLICAL TRENDS IN ABUNDANCE



Coates et al. 2020. Open-File Report 2019-1149

Nest Survival Low in Long Valley

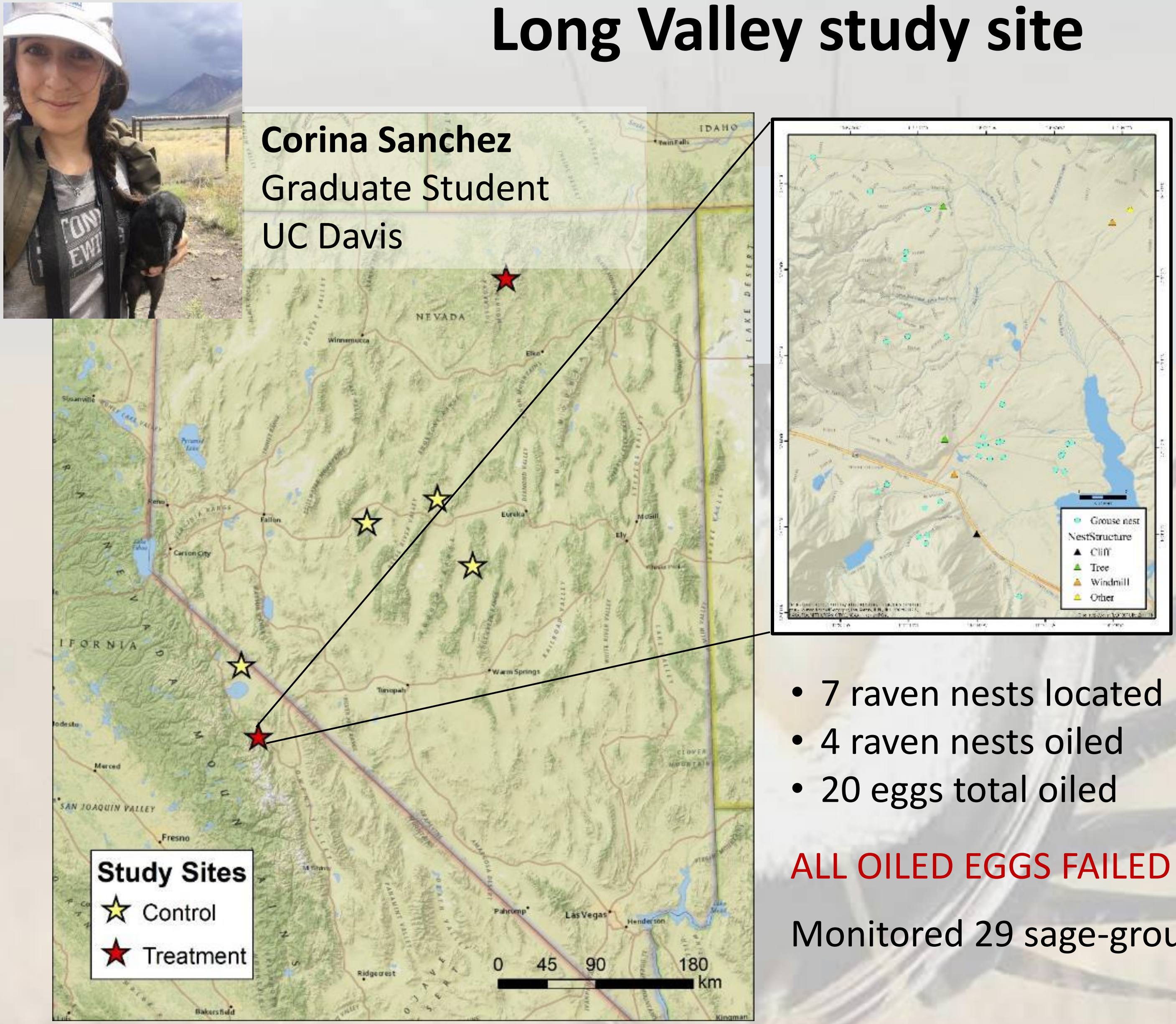


Long Valley
Raven Density

~0.63 ravens km^{-2}

Mathews et al. 2018. Open-File Report 2018–1177

Long Valley study site



Corina Sanchez
Graduate Student
UC Davis

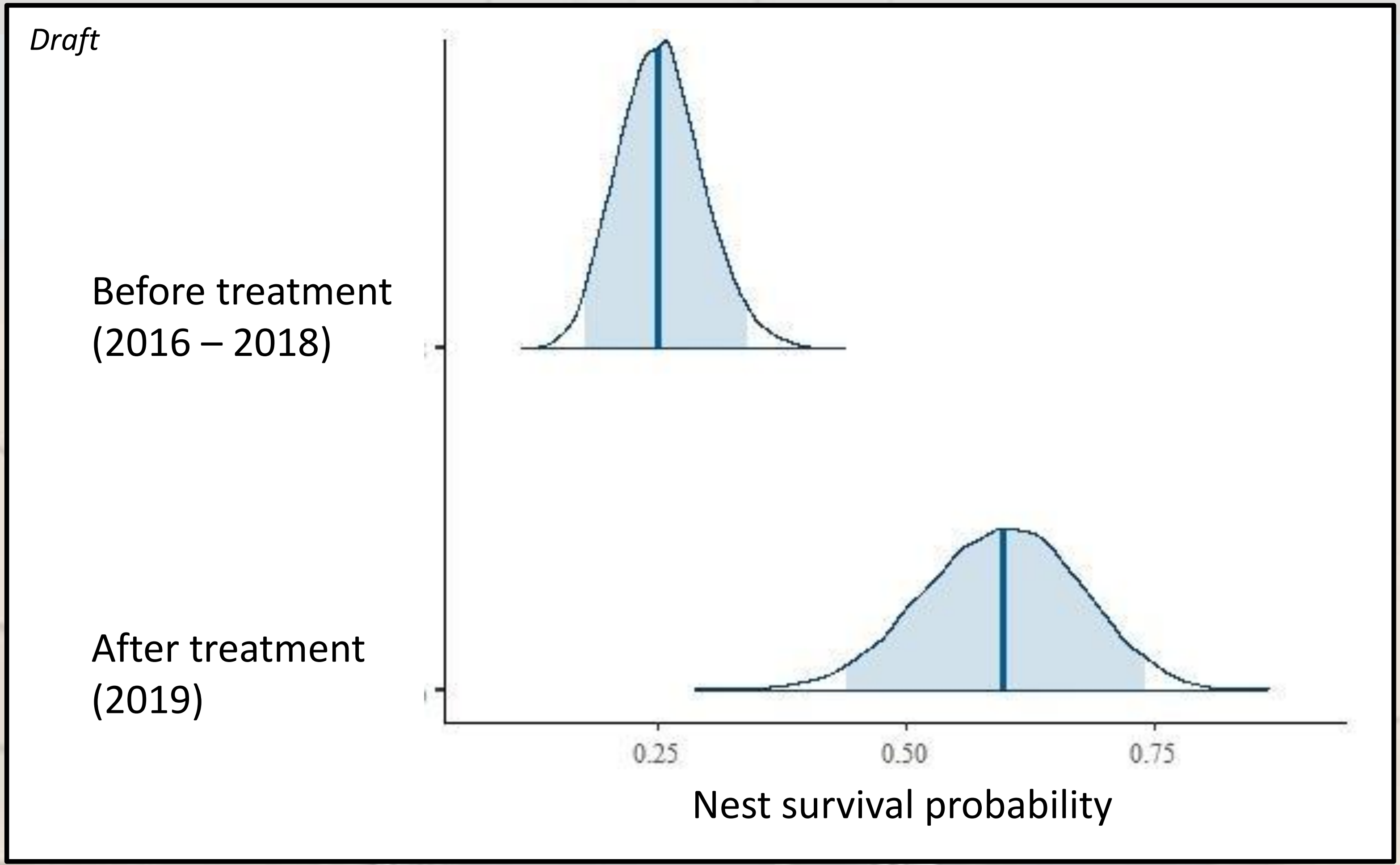
- 7 raven nests located
- 4 raven nests oiled
- 20 eggs total oiled

ALL OILED EGGS FAILED

Monitored 29 sage-grouse nests

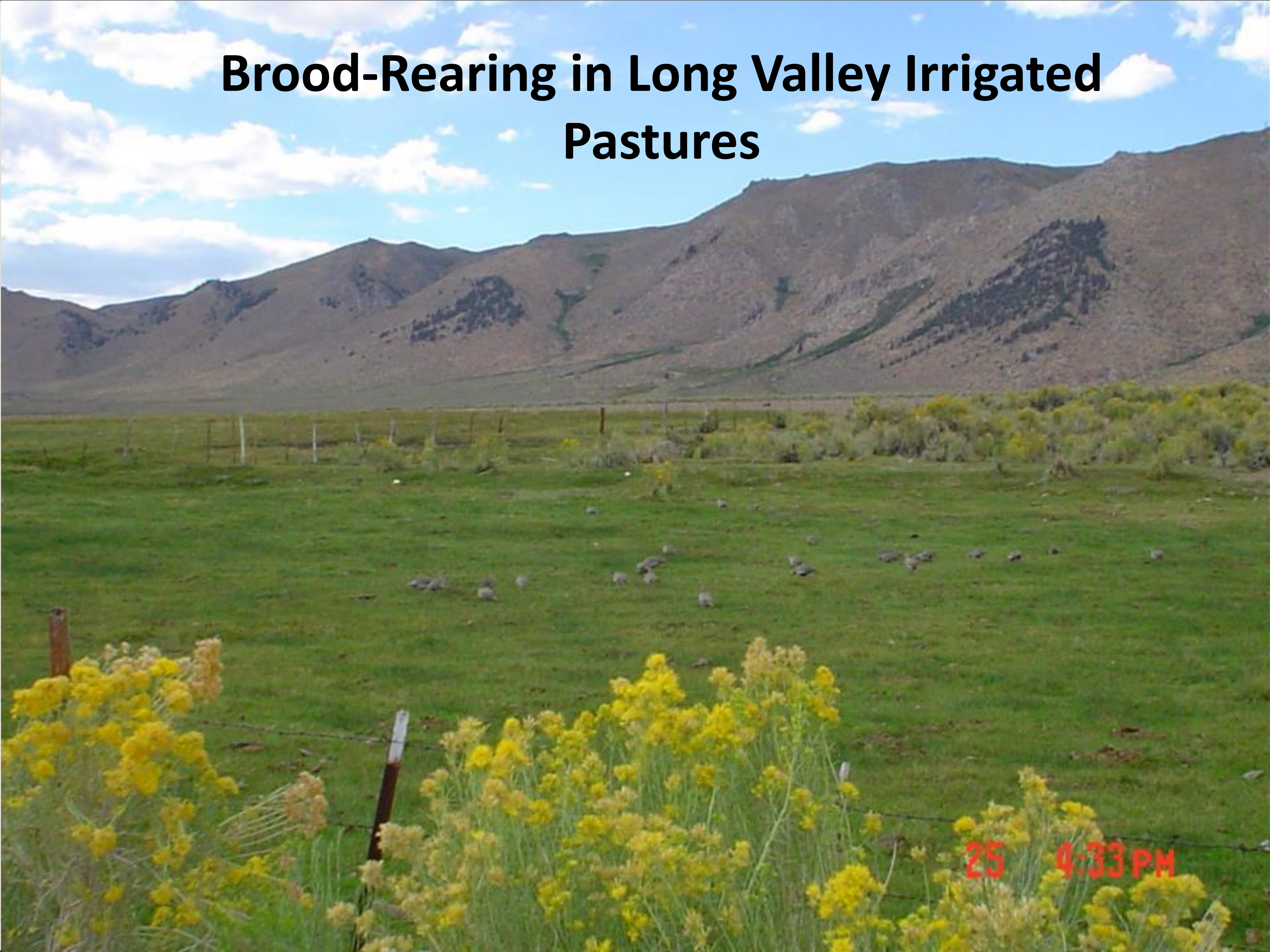
Oil application using drone

Impacts to sage-grouse

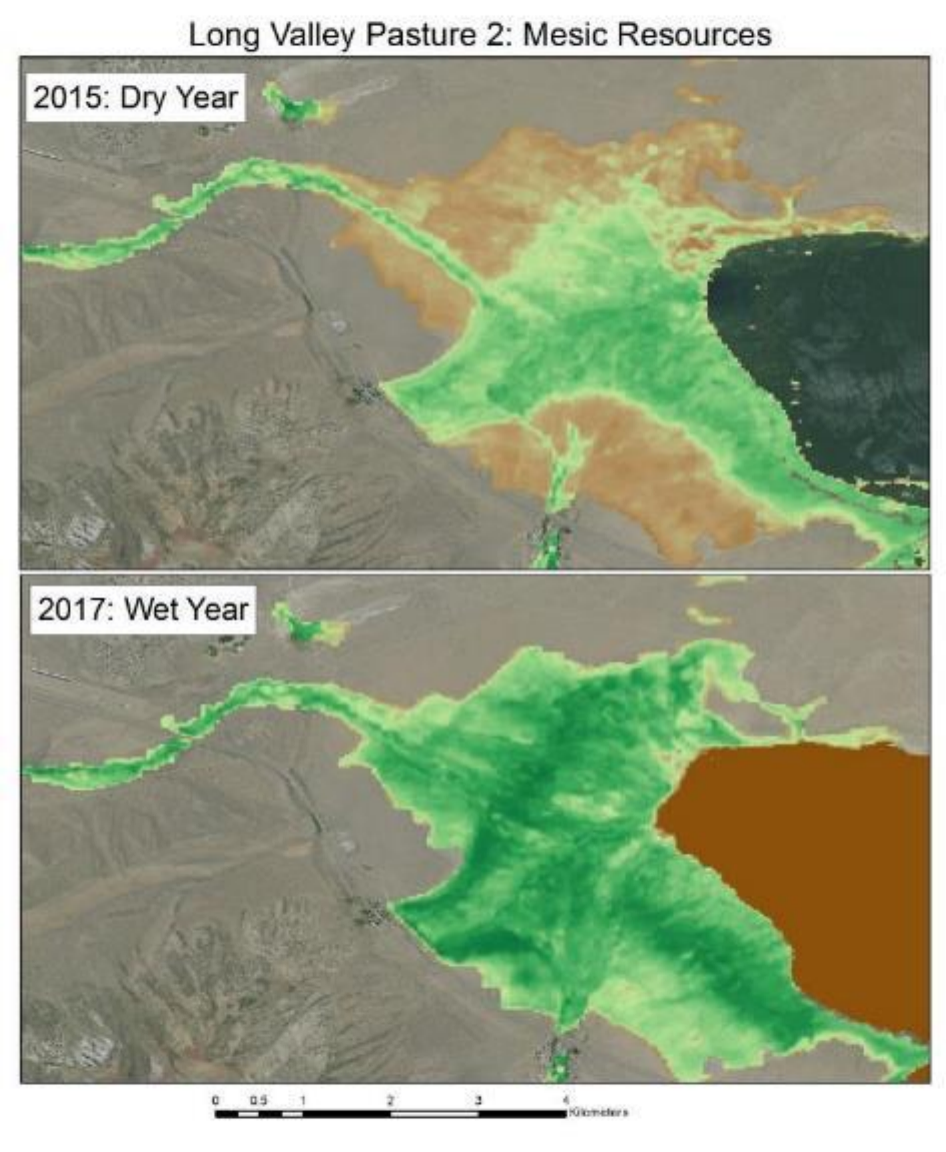


Probability of nest survival 2.4 times higher following treatment.
No differences observed at control sites.

Brood-Rearing in Long Valley Irrigated Pastures

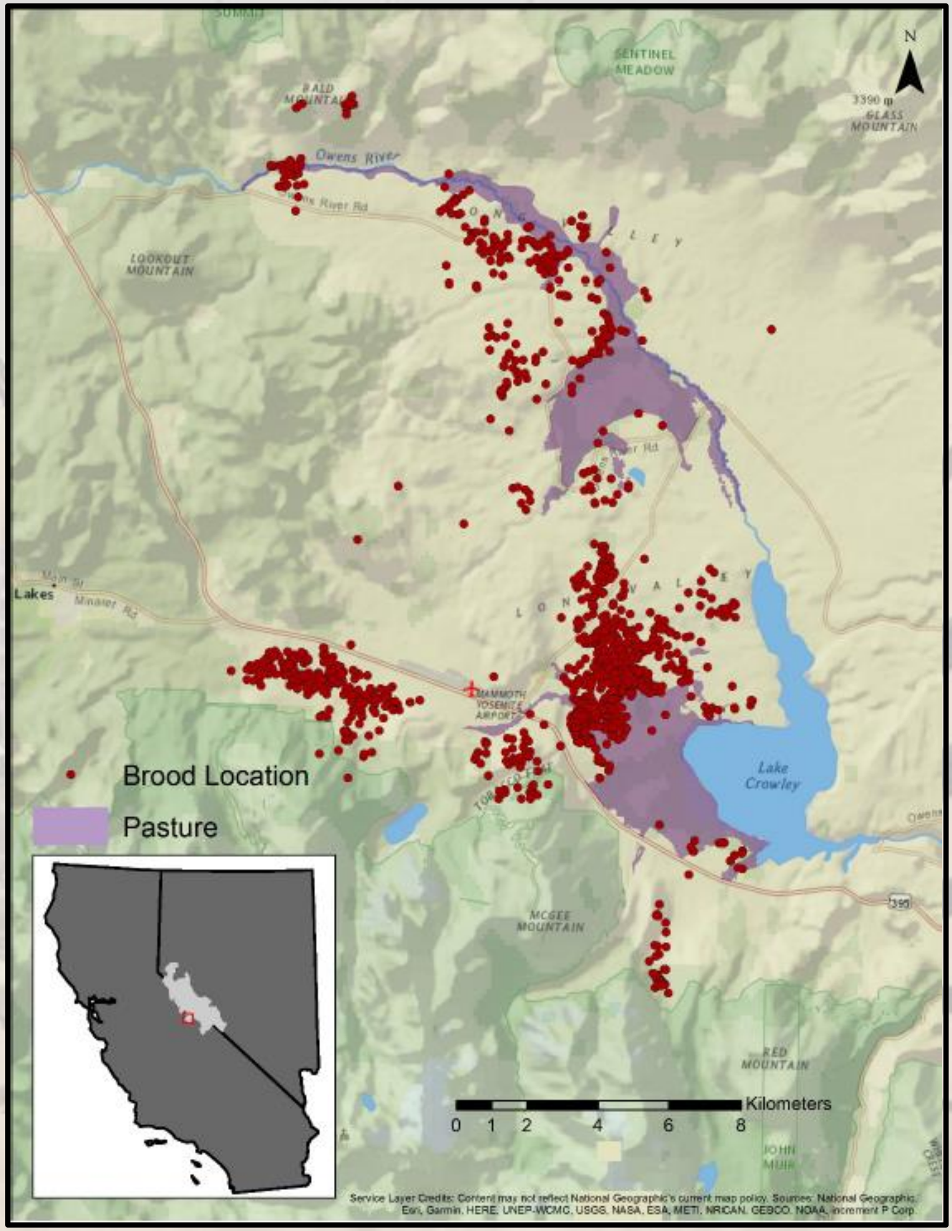


Science Actions: Water Management of Mesic Habitat



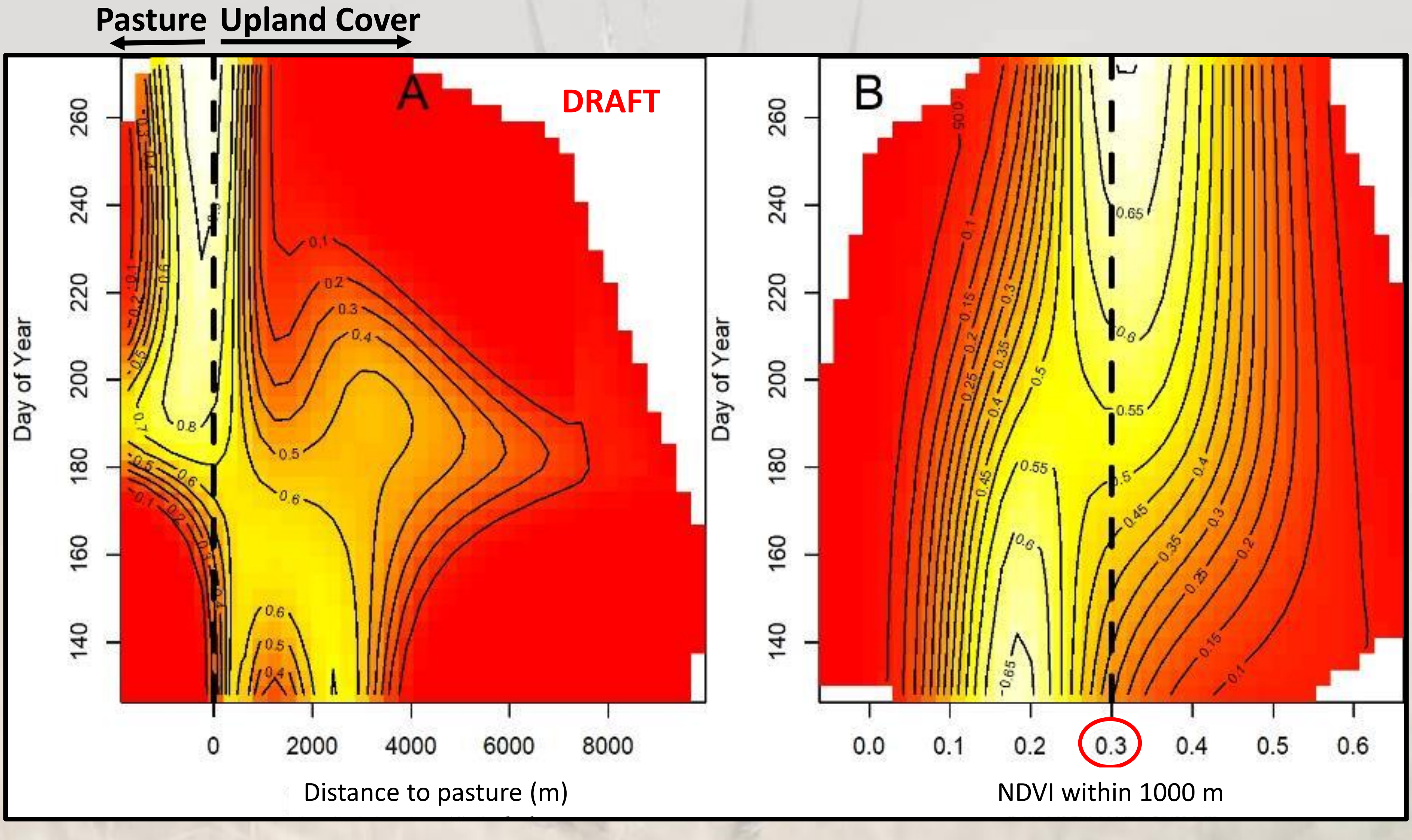
Long Valley Pasture 2: Mesic Resources

Science Actions: Water Management of Mesic Habitat



Coates et al. 2020. Open-File Report 2019-1149

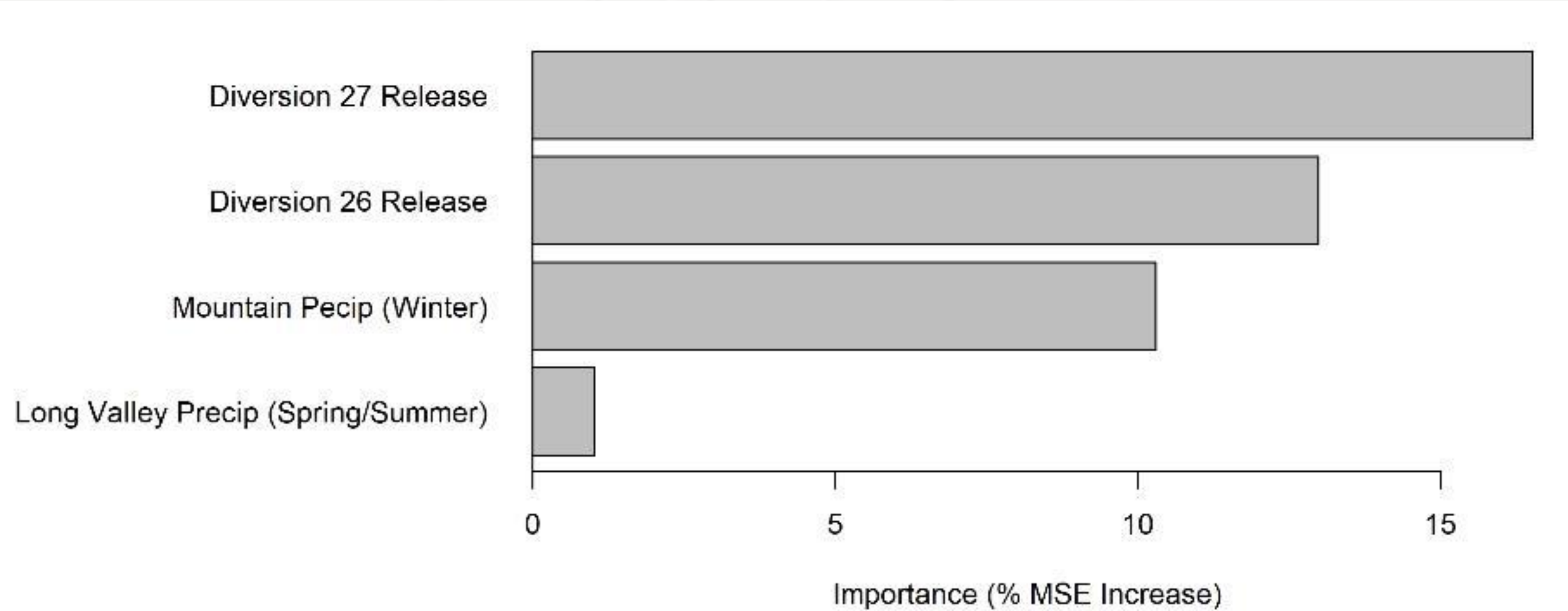
Seasonal Distance & Greenness Effects on Selection (All)



Coates et al. 2020. Open-File Report 2019-1149

Science Actions: Water Management of Mesic Habitat

What factors are associated with greenness of Convict Meadow Edge?



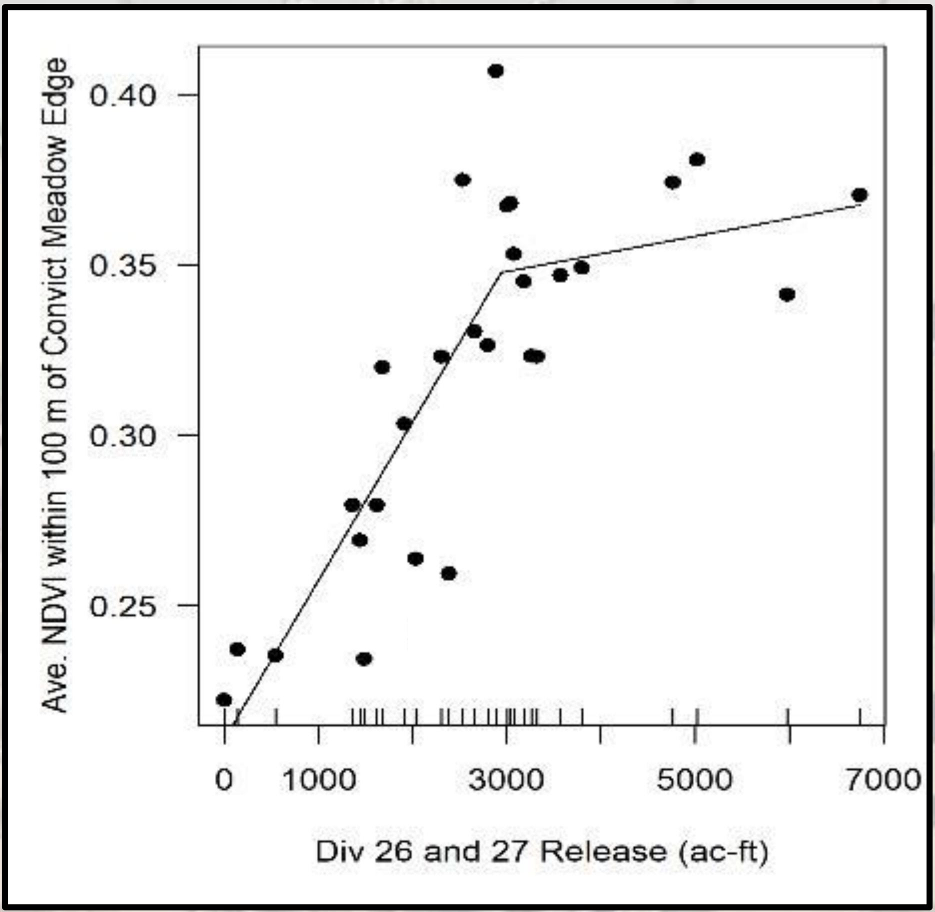
- Diversion releases most important
- Diversion releases correlated with each other and with Mountain Precip

Winter Precipitation (Jan-April in mountains of Owens River Watershed)
Spring/Summer Precipitation (May-Aug in Long Valley)

Coates et al. 2020. Open-File Report 2019-1149

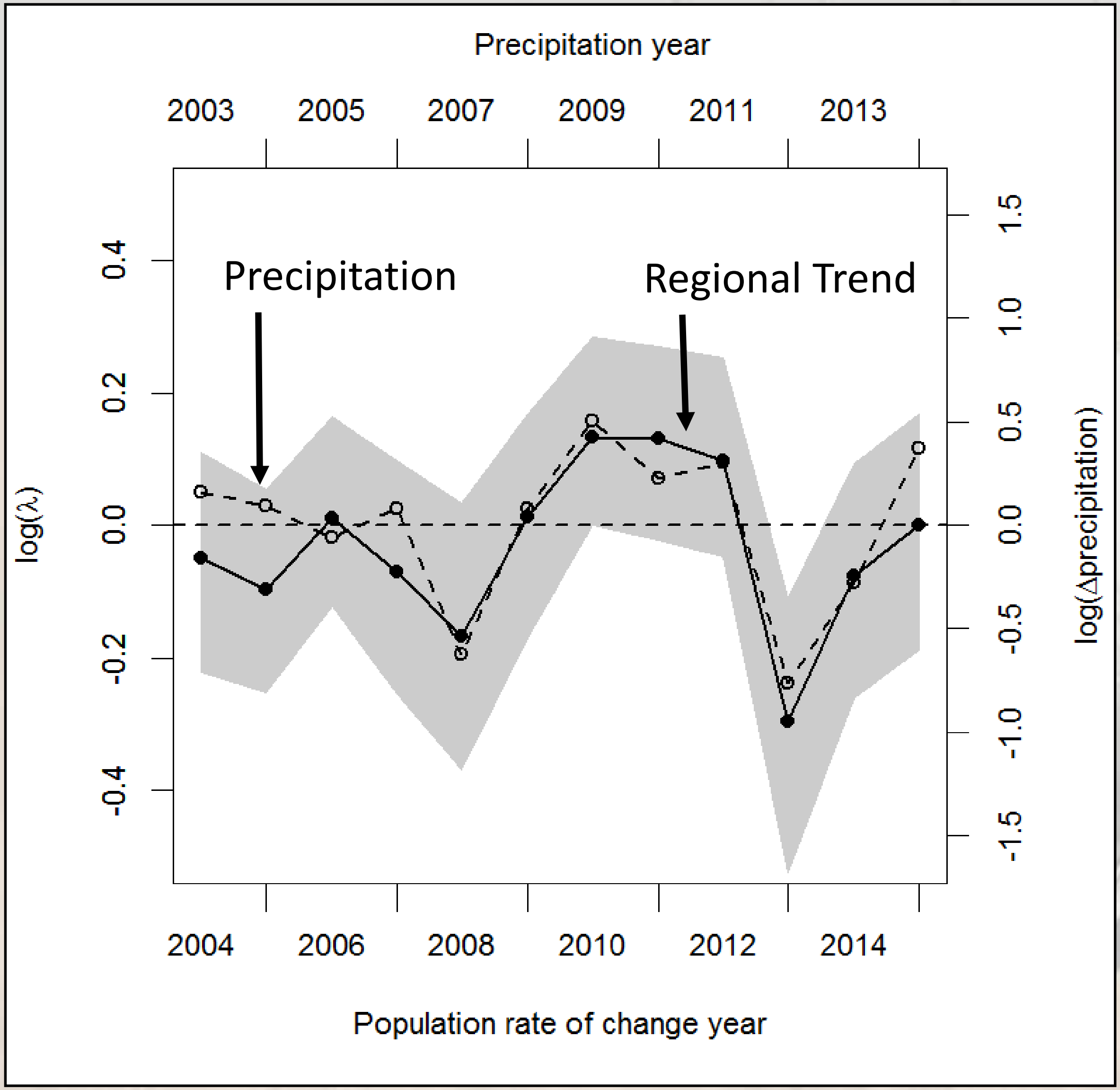
Water Management of Mesic Habitat

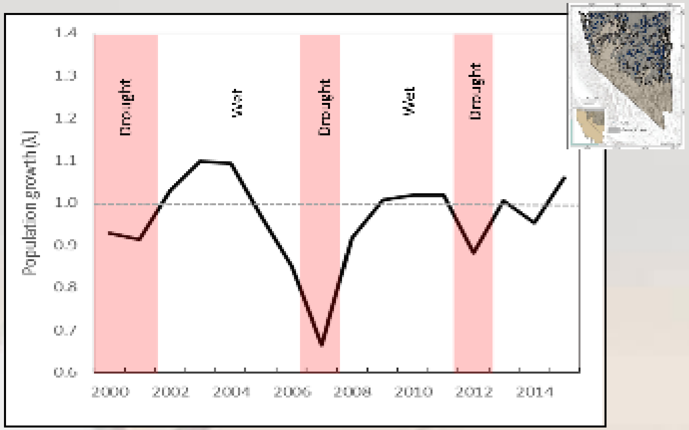
How are diversion releases are associated with greenness of Convict Pasture edge?



Coates et al. 2020. Open-File Report 2019-1149

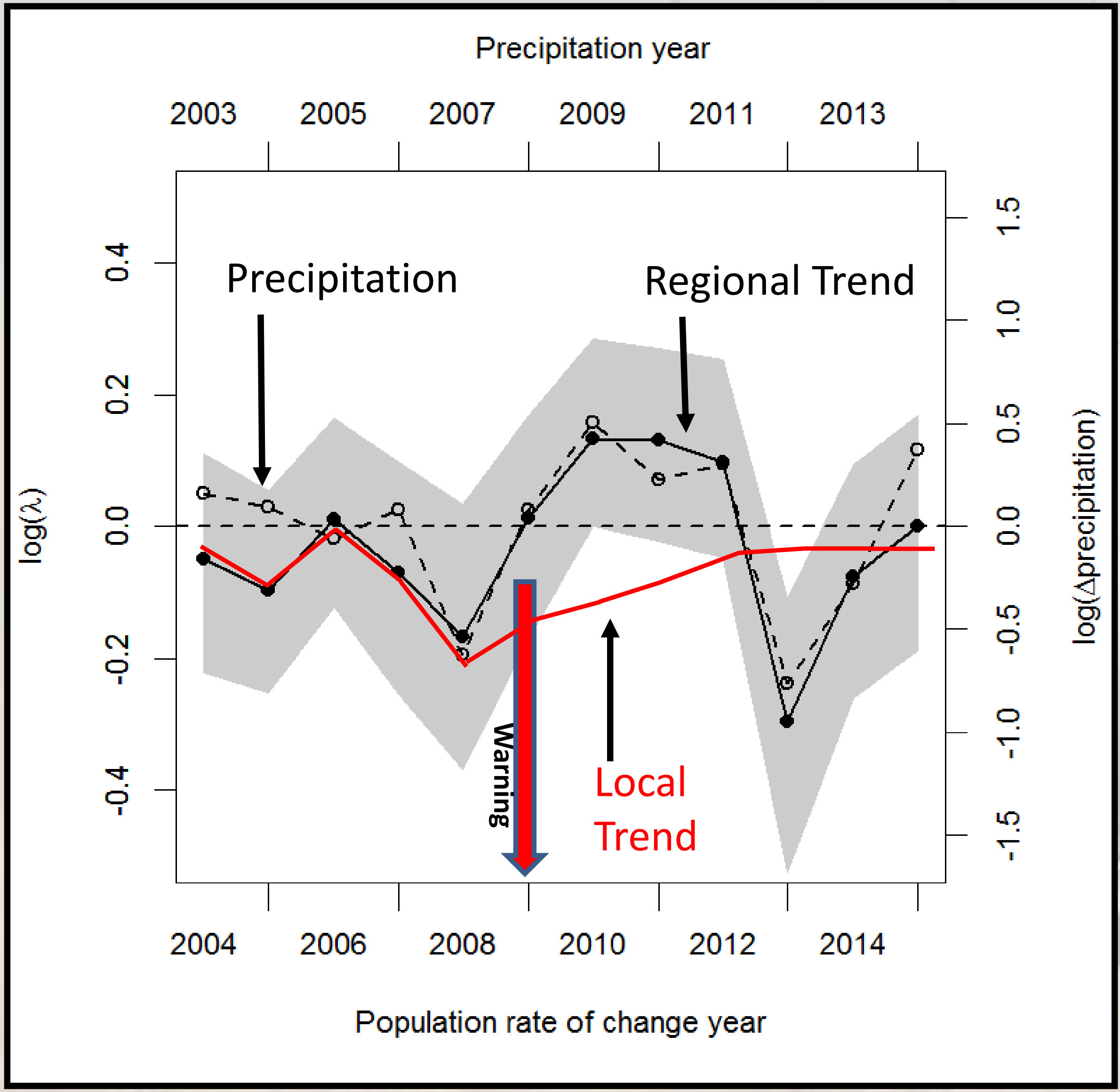
Bi-State IPM: Precipitation Effects





Coates et al. 2018. Auk 135: 240–261

Separating Manageable Threats from Climatic Threats



Contrast regional and local trends to signal local populations with lower than expected population performance

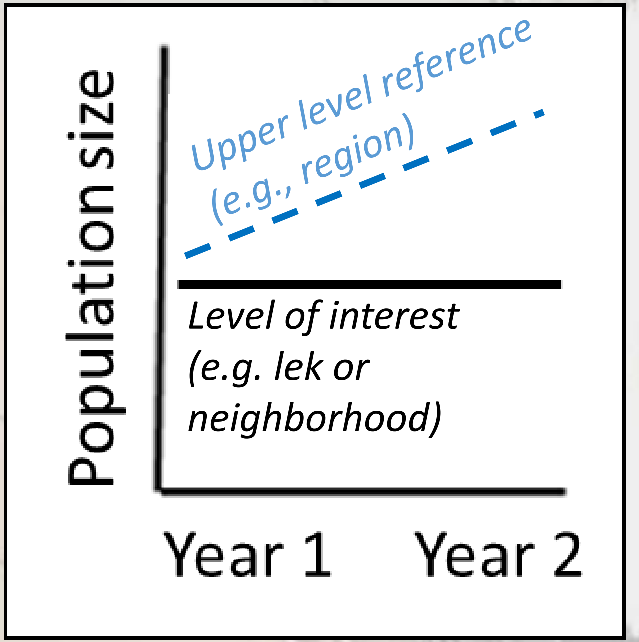
Criteria:

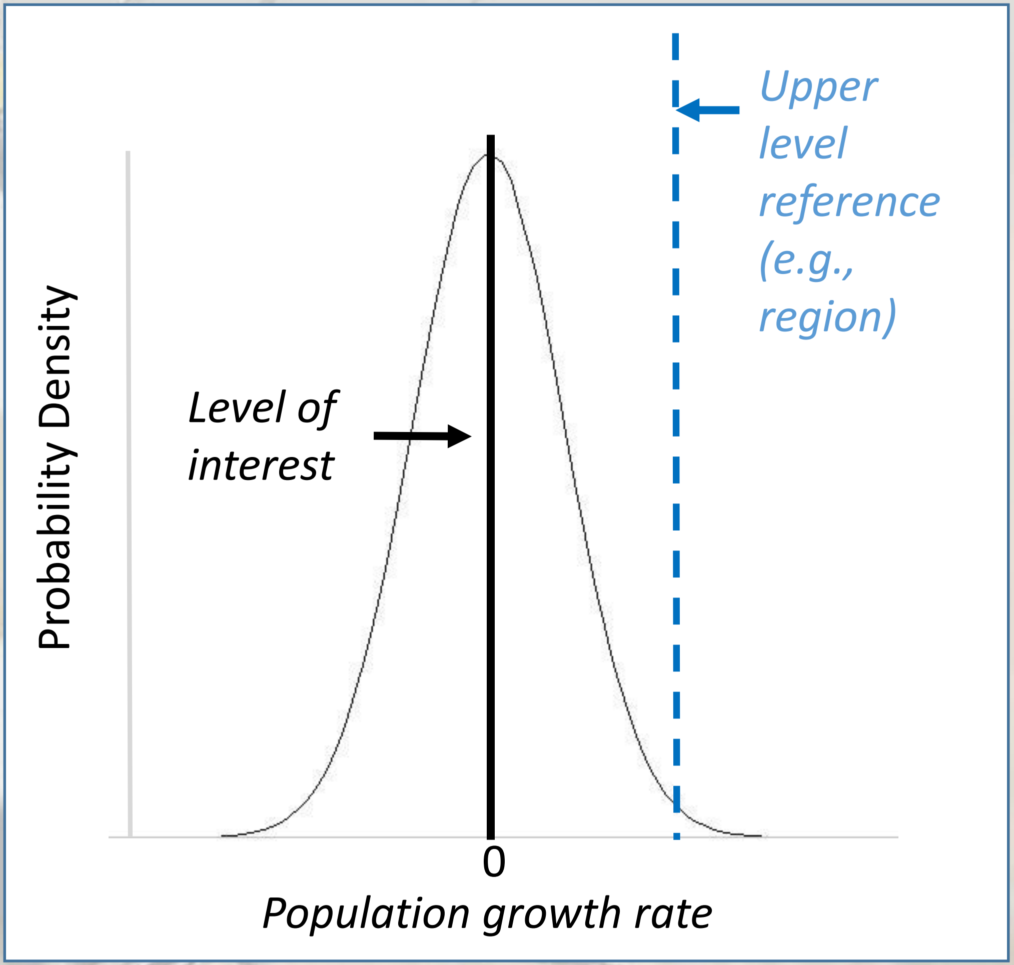
- Declining Trend
- Decoupling from Larger Spatial Scale

Coates et al. 2018. Auk 135: 240–261

Early Warning System - Comparison among hierarchical scales

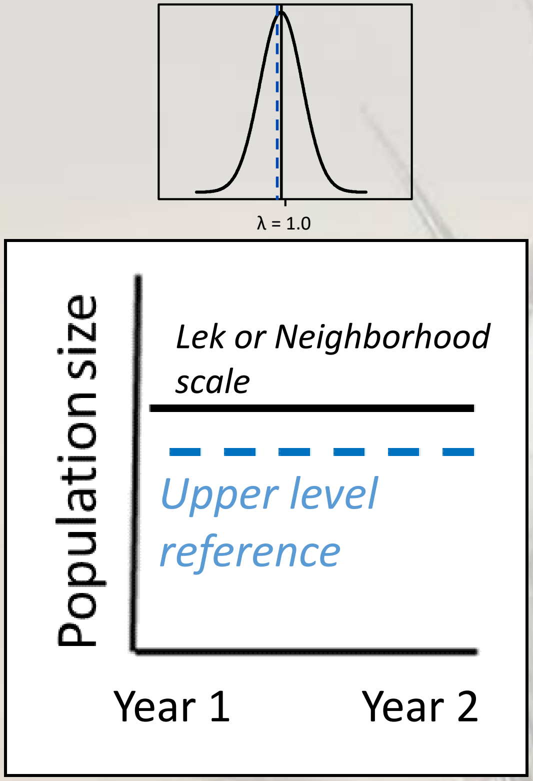
Thresholds for Stability and Decoupling



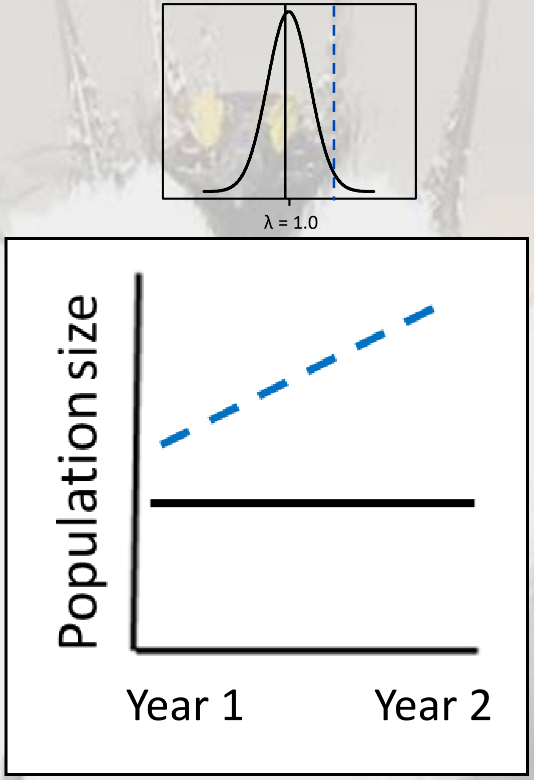


Estimated Growth Rates → **Spatial Threshold** Stable or Decouple → **Warning** → **Temporal Threshold** → **Signal** Soft or Hard

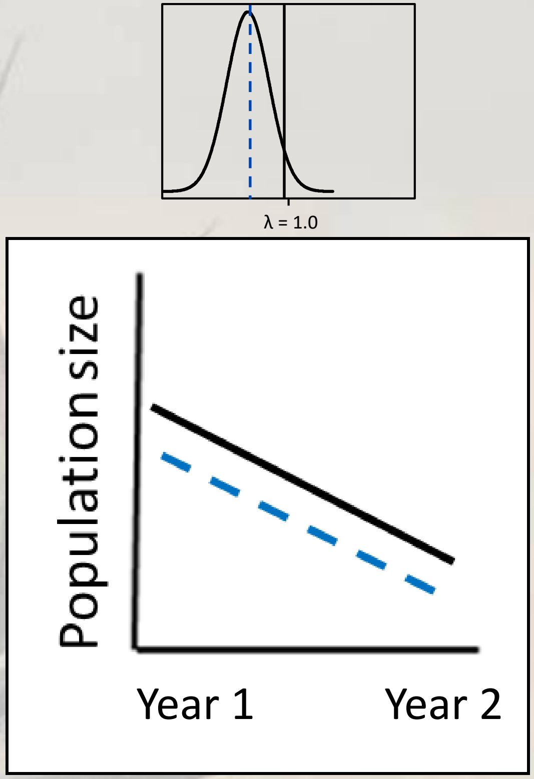
Early Warning System –
Must Cross Both Thresholds to Activate Warnings



Stable: Yes
Decoupled: No
=
No Warning



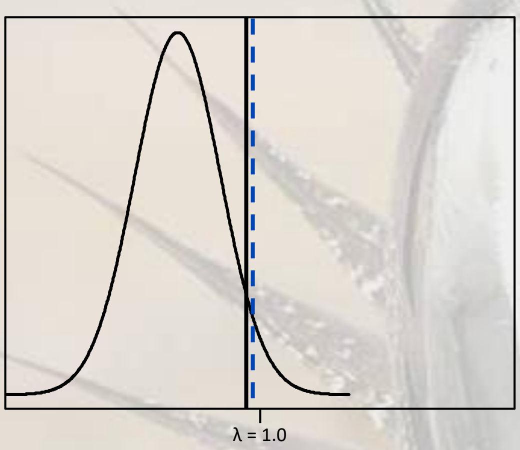
Stable: Yes
Decoupled: Yes
=
No Warning

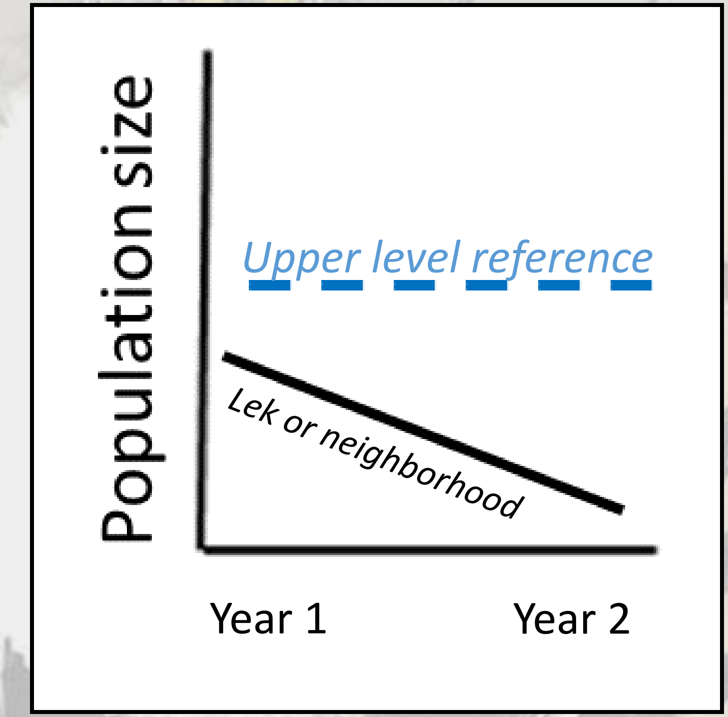


Stable: No
Decoupled: No
=
No Warning

Estimated Growth Rates → **Spatial Threshold** Stable or Decouple → **Warning** → **Temporal Threshold** → **Signal** Soft or Hard

Early Warning System –
Crossing Destabilizing and Decoupling Thresholds to Activate Warnings





Stable: No
Decoupled: Yes

II

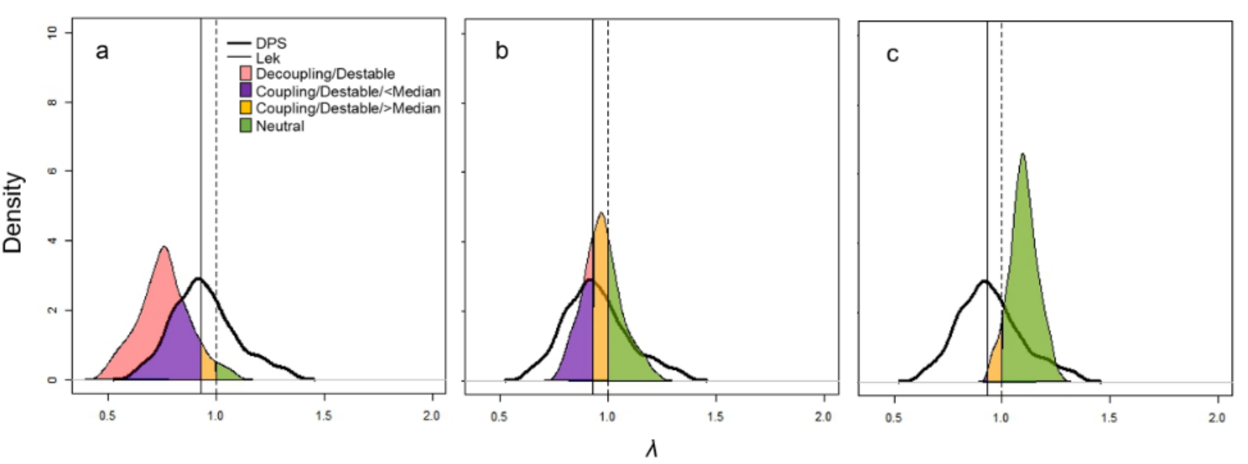
Warning

Estimated Growth Rates → **Spatial Threshold** Stable or Decouple → **Warning** → **Temporal Threshold** → **Signal** Soft or Hard

SIGNALS

Hierarchical framework with early warning system

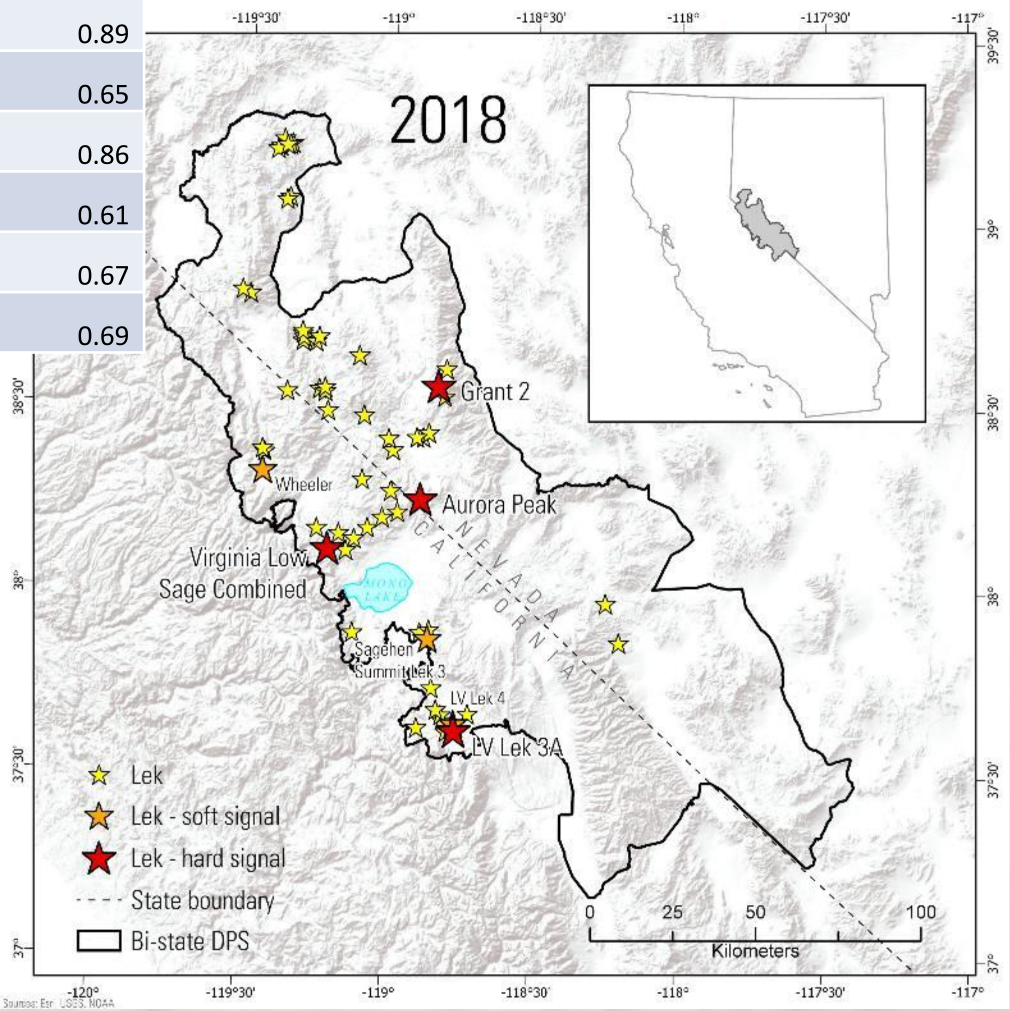
- Estimate $\hat{\lambda}$ at leks, PMUs (cluster), and Bi-State region
- Nested hierarchical model which allows for inferences across different spatial scales
- Identifying decoupling and declining trends at different spatial scales



Coates et al. 2020. Open-File Report 2019-1149

SIGNALS

Subpopulation	Lek	Signal	$\hat{\lambda}$
Fales	Wheeler	soft	0.83
Bodie Hills	Virginia/Little Sagebrush	hard	0.89
Mount Grant	Grant 2	hard	0.65
Mount Grant	Aurora Peak	hard	0.86
Sagehen	Sagehen Summit Lek 3	soft	0.61
Long Valley	LV Lek 3A	hard	0.67
Long Valley	LV Lek 4	soft	0.69



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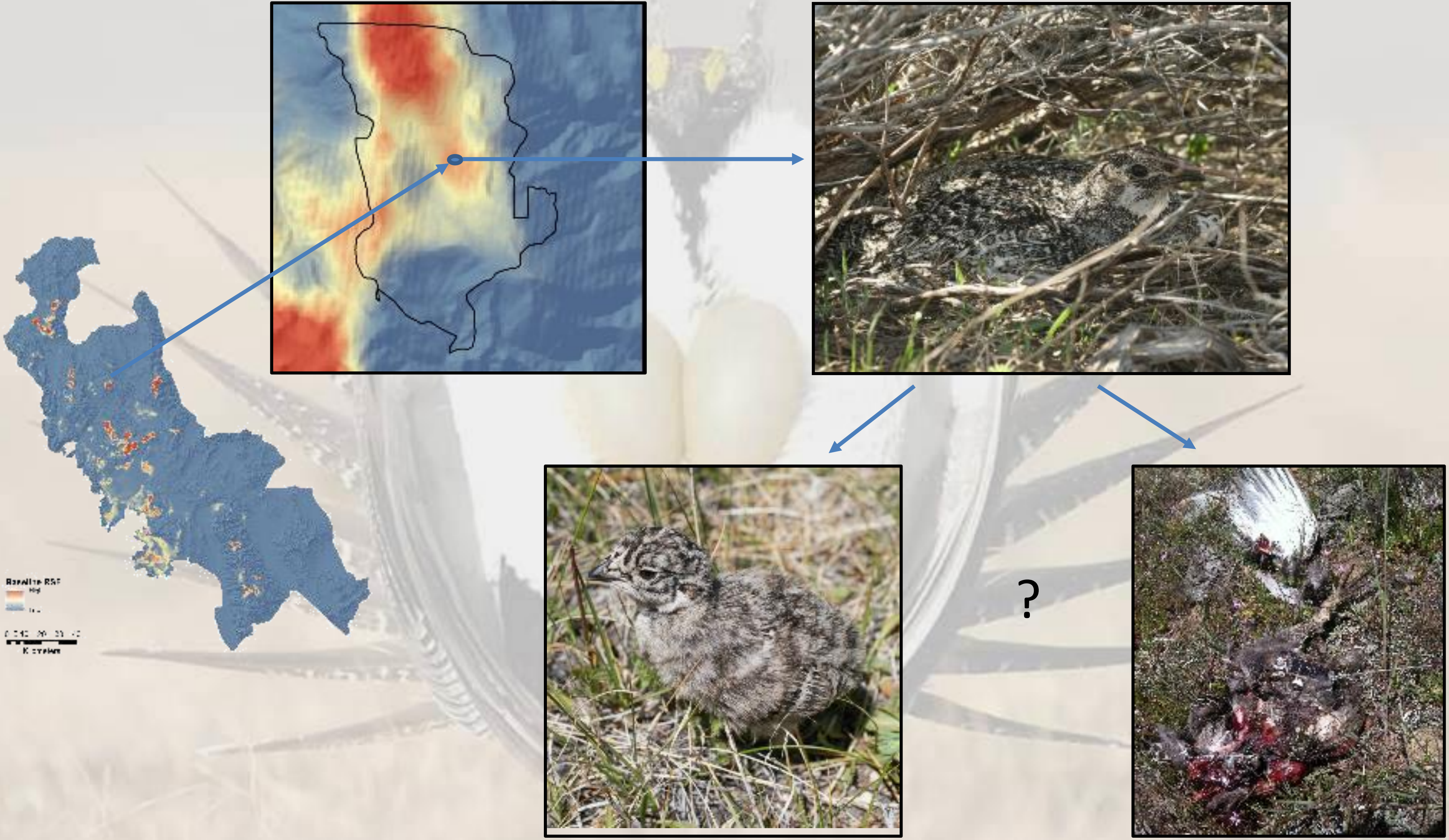
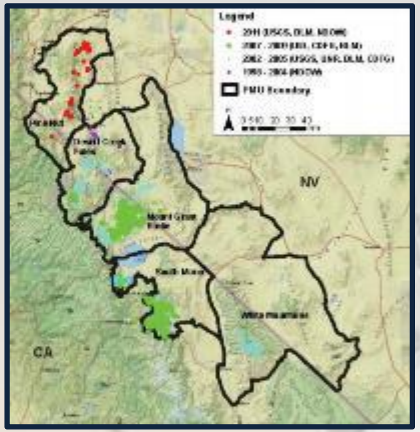
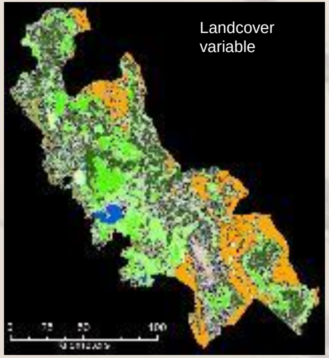
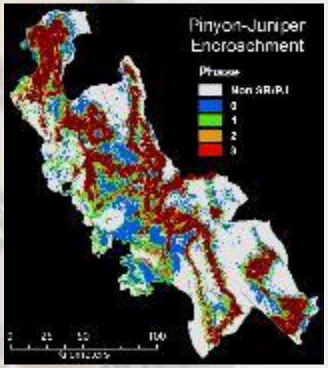
Habitat Mapping
Conservation Planning Tools

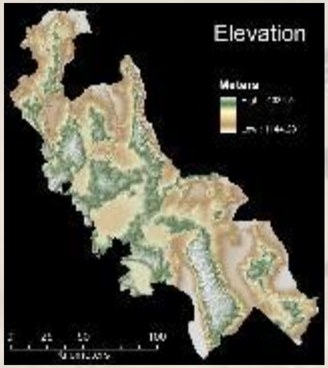


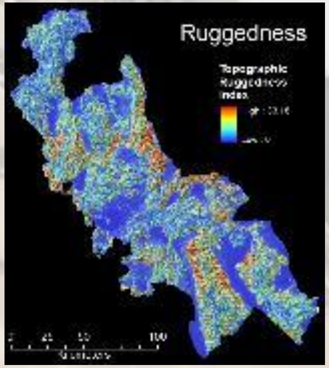
Original Habitat Analyses and Mapping

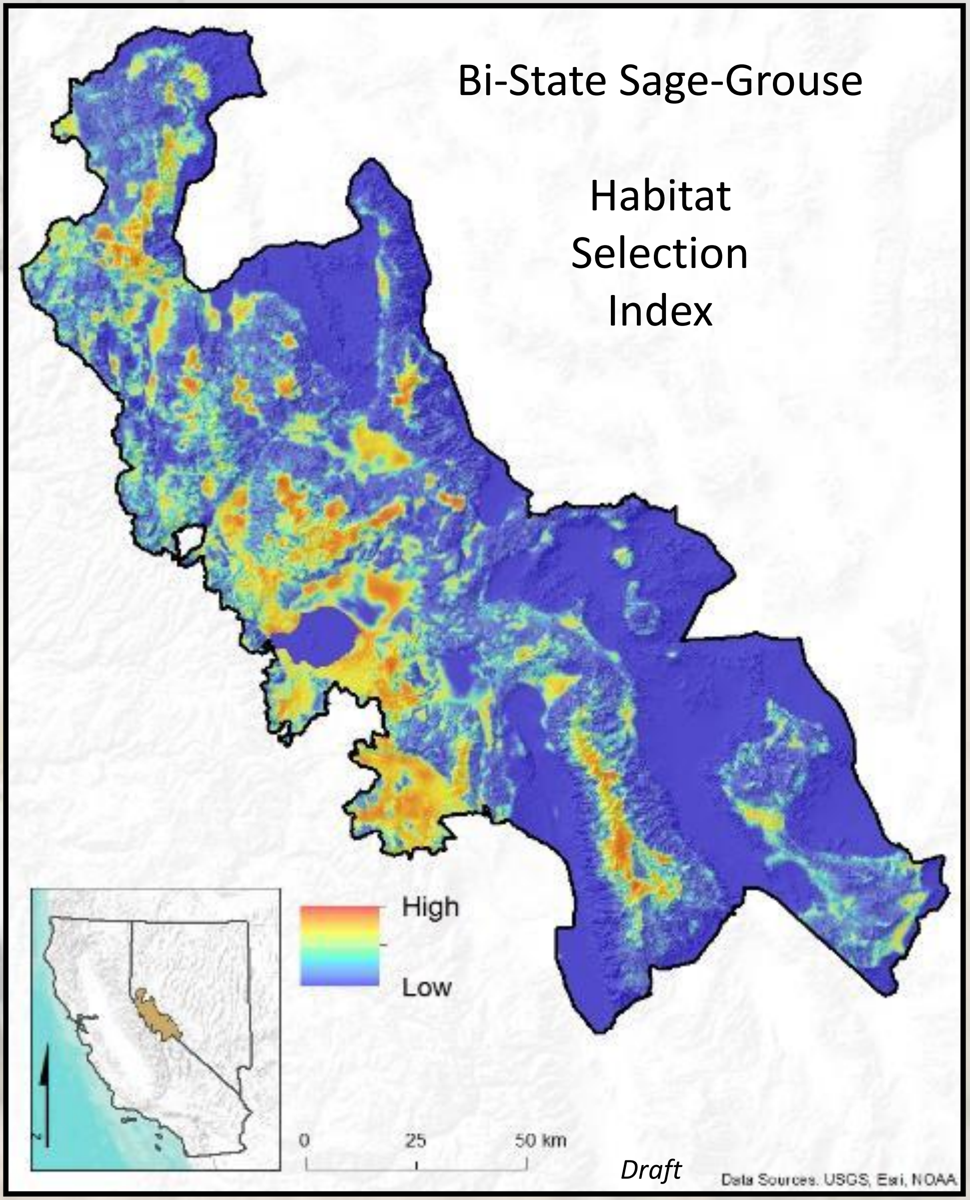




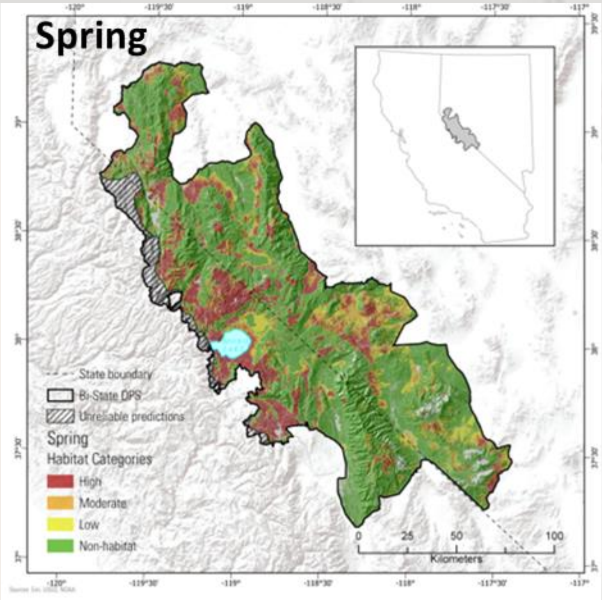






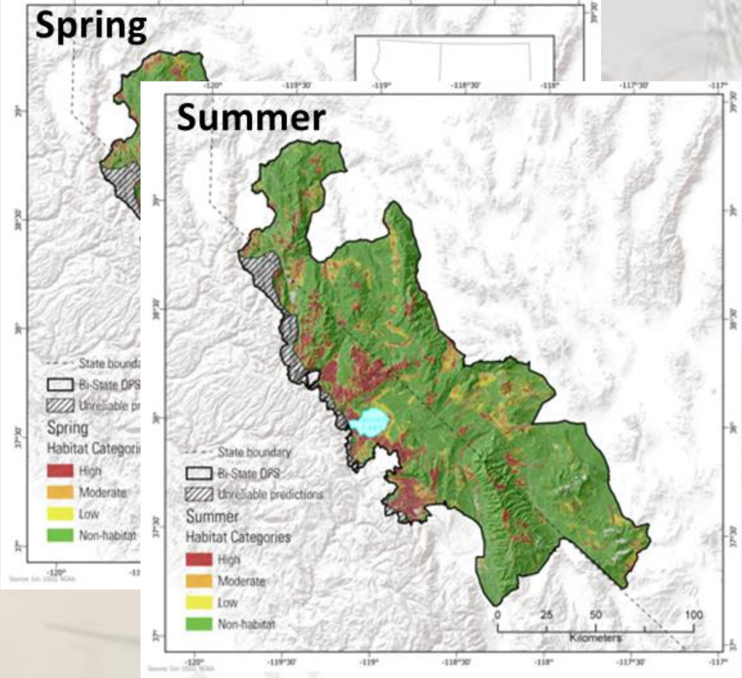


Updated Seasonal Habitat Maps



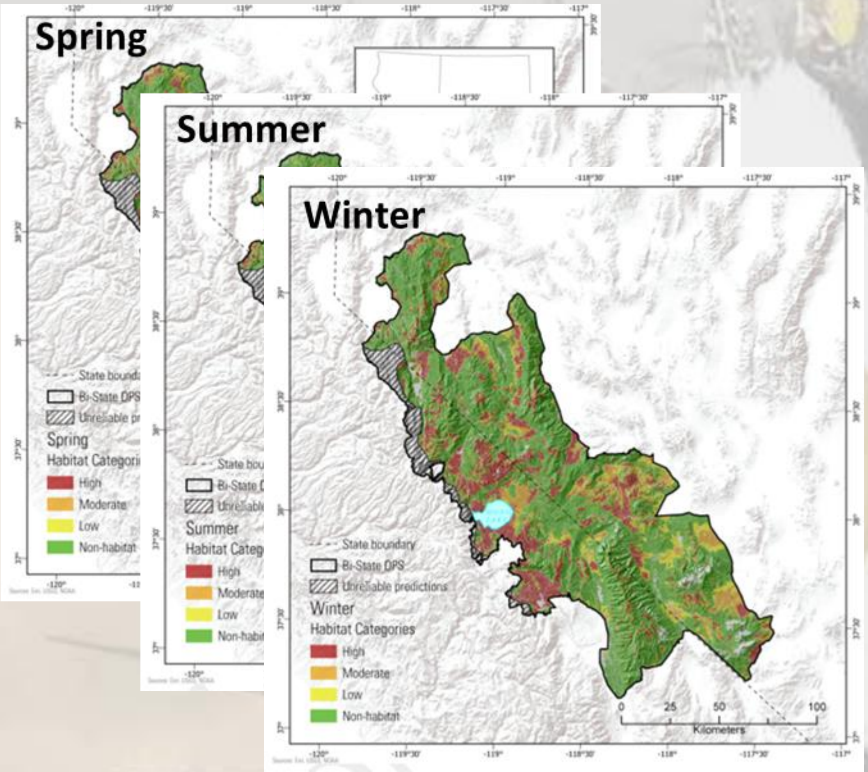
Coates et al. 2020. Open-File Report 2019-1149

Updated Seasonal Habitat Maps



Coates et al. 2020. Open-File Report 2019-1149

Updated Seasonal Habitat Maps



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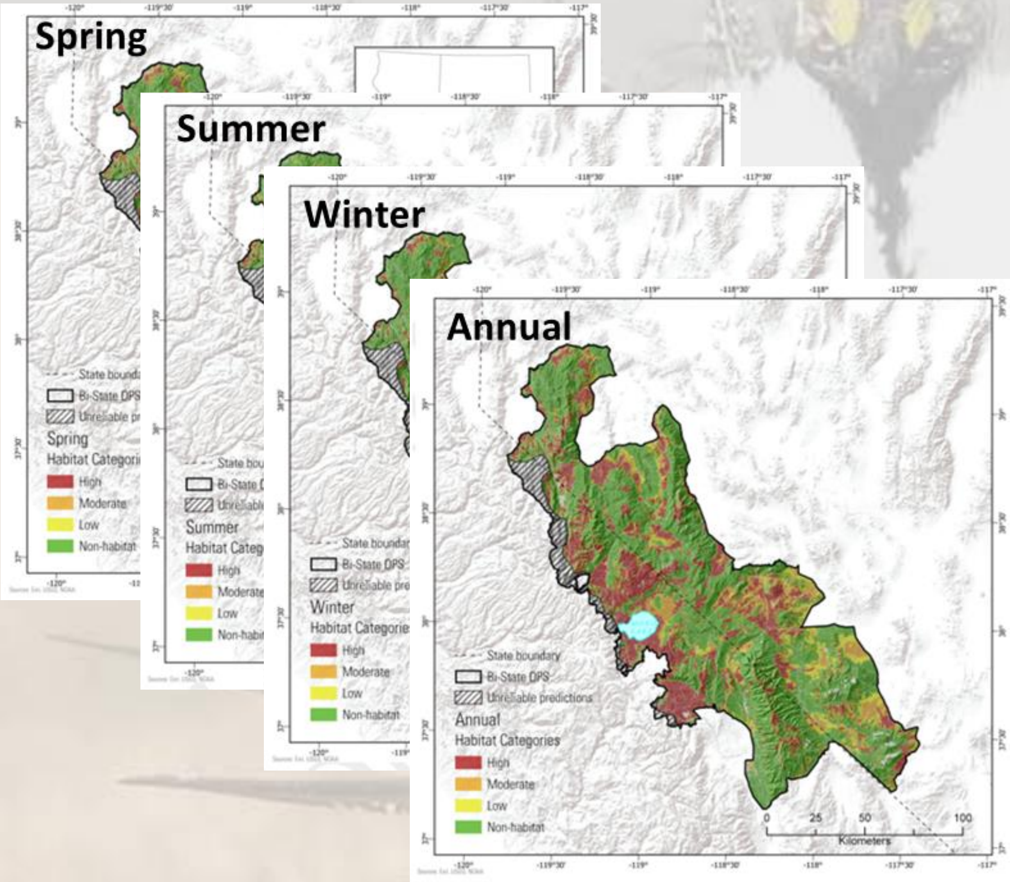
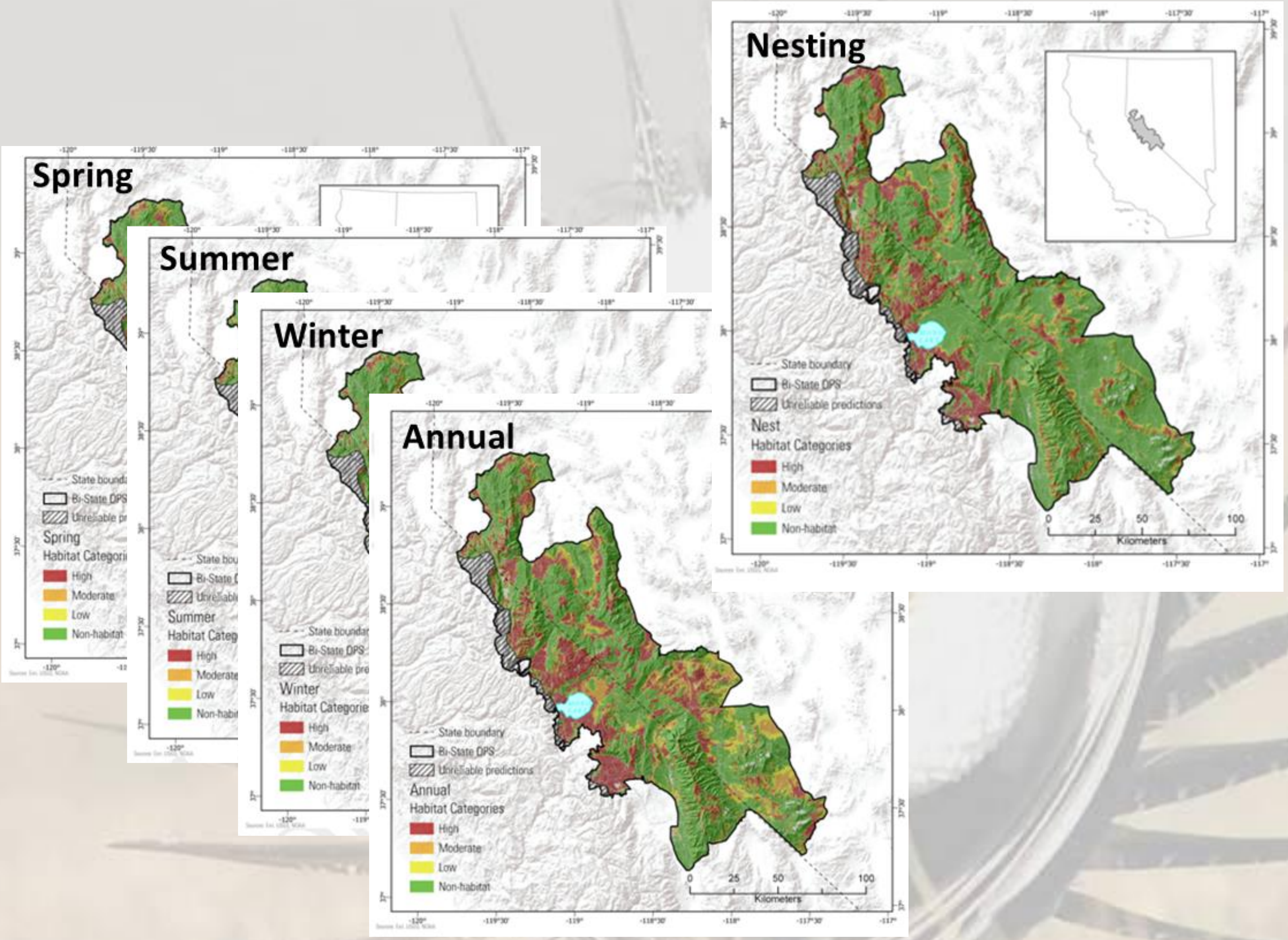
Updated Seasonal Habitat Maps



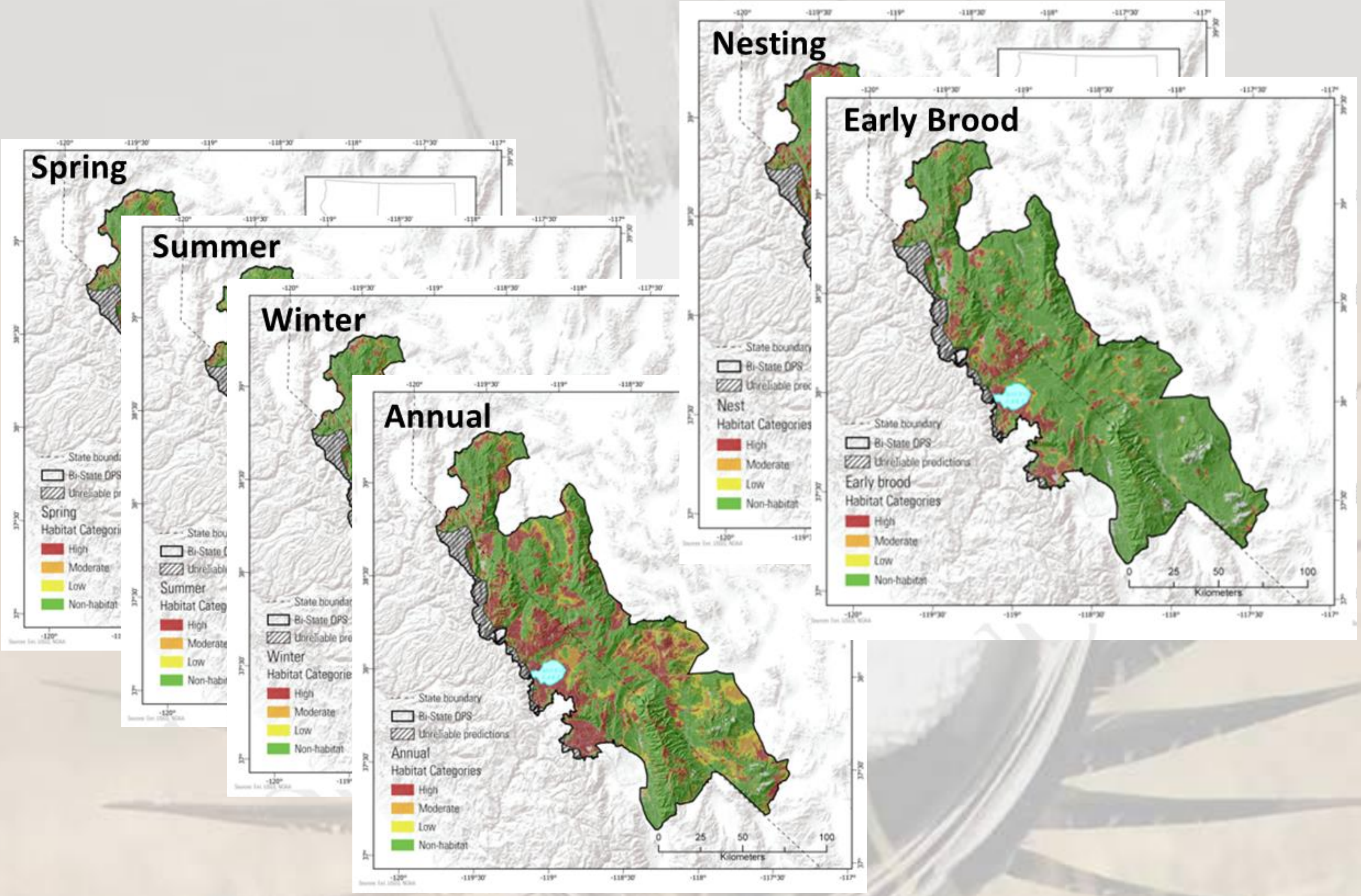
Coates et al. 2020. Open-File Report 2019-1149

Updated Seasonal Habitat Maps



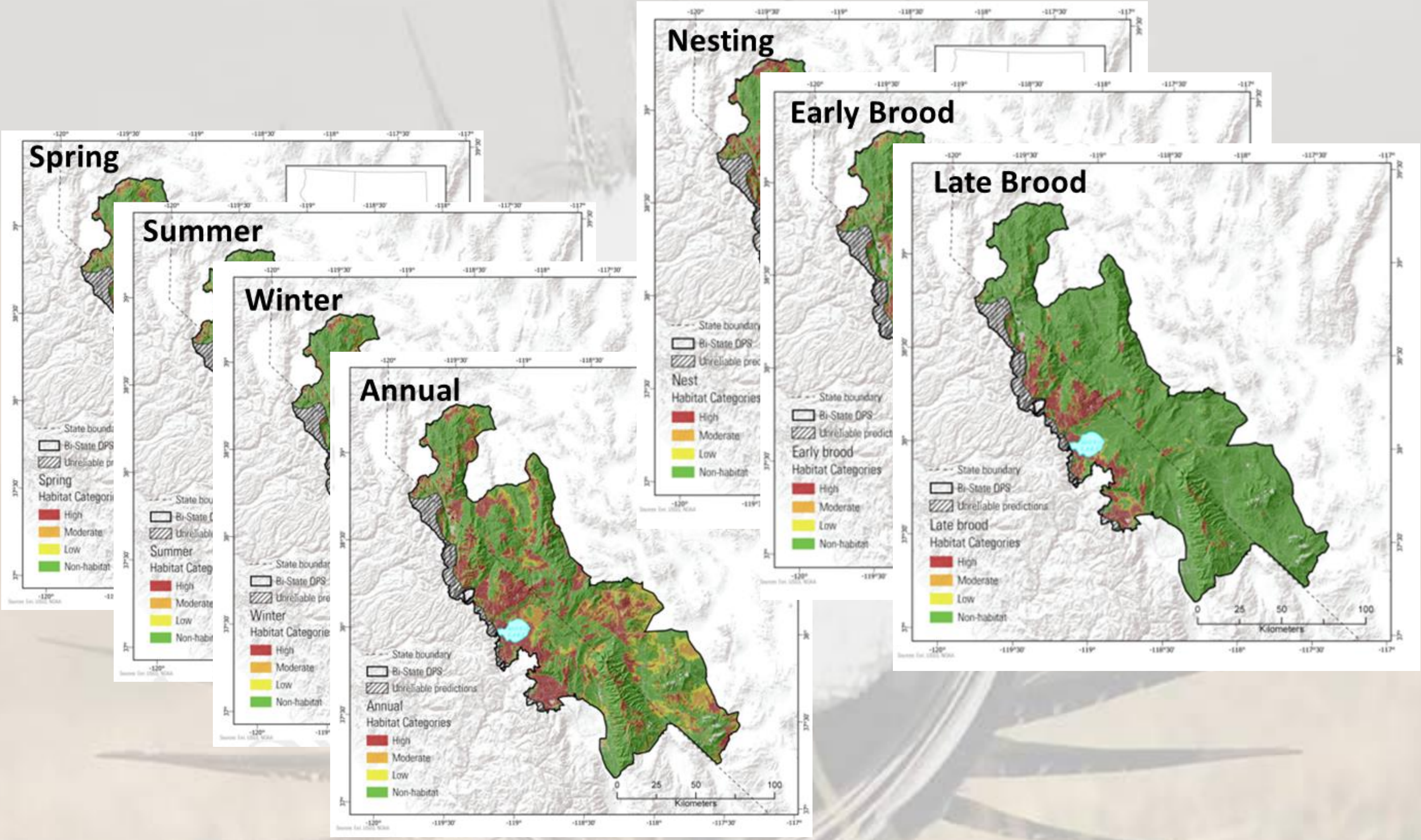
Coates et al. 2020. Open-File Report 2019-1149

Updated Seasonal Habitat Maps



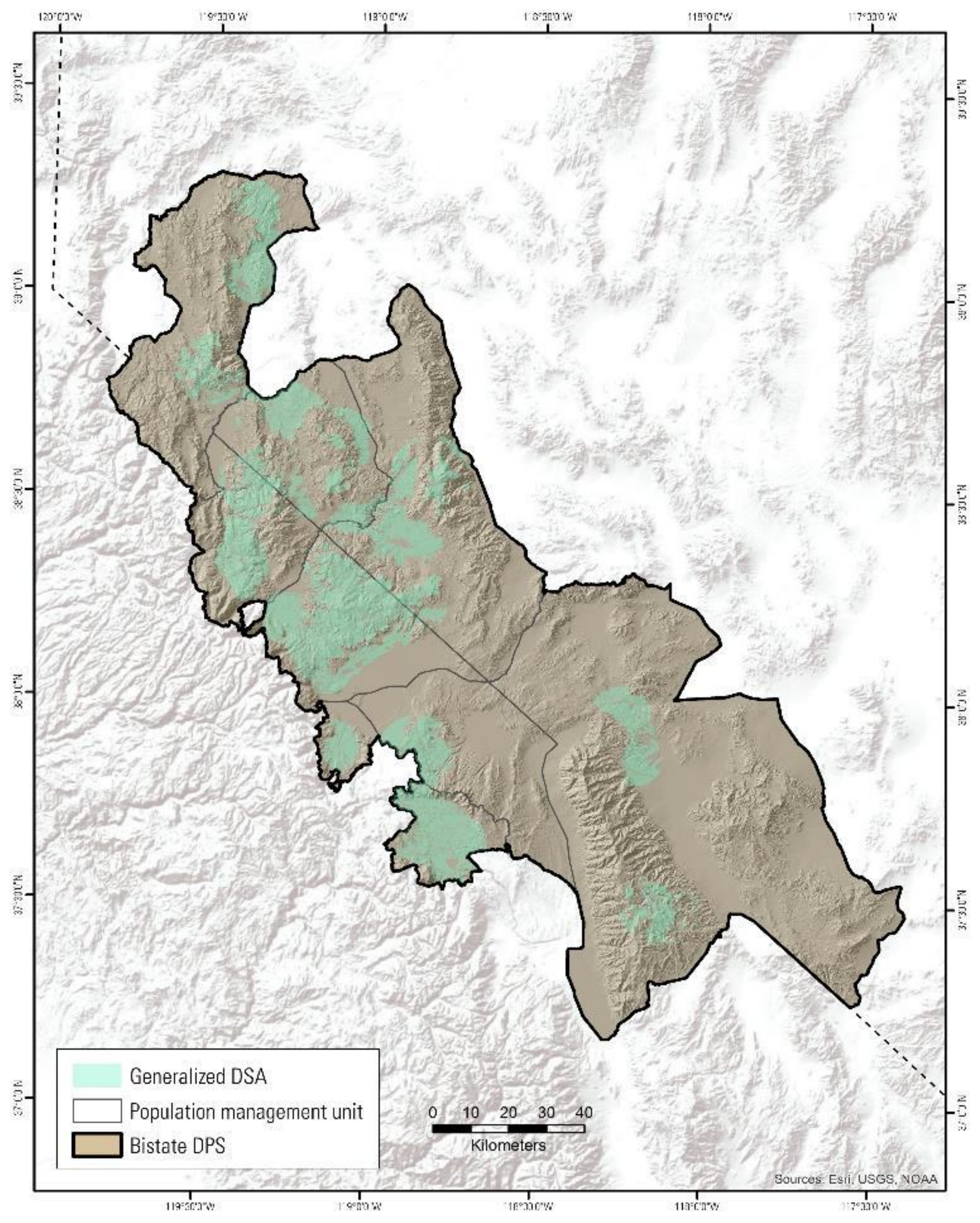
Coates et al. 2020. Open-File Report 2019-1149

Updated Seasonal Habitat Maps



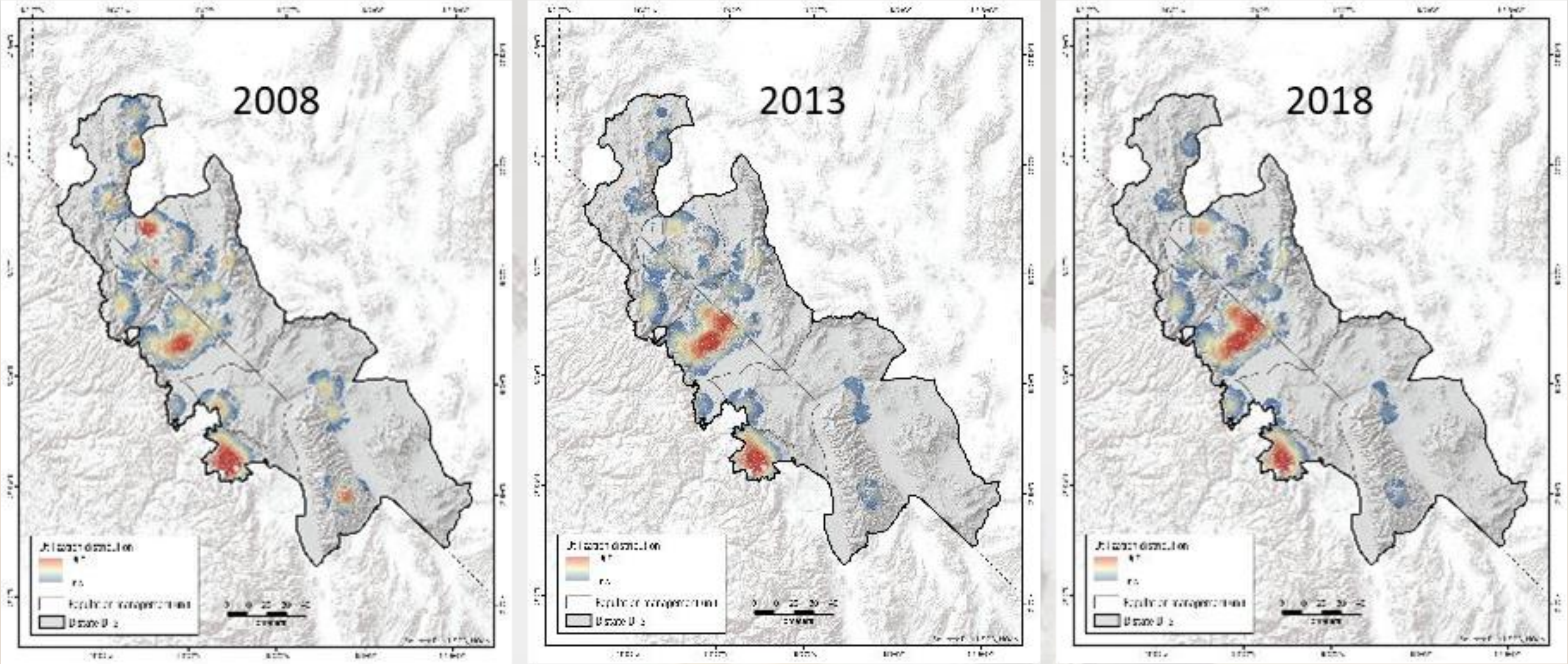
Coates et al. 2020. Open-File Report 2019-1149

DSA ANALYSIS



Coates et al. 2020. Open-File Report 2019-1149

DISTRIBUTIONS



Distribution is decreasing annually (~2,312 ha annually)

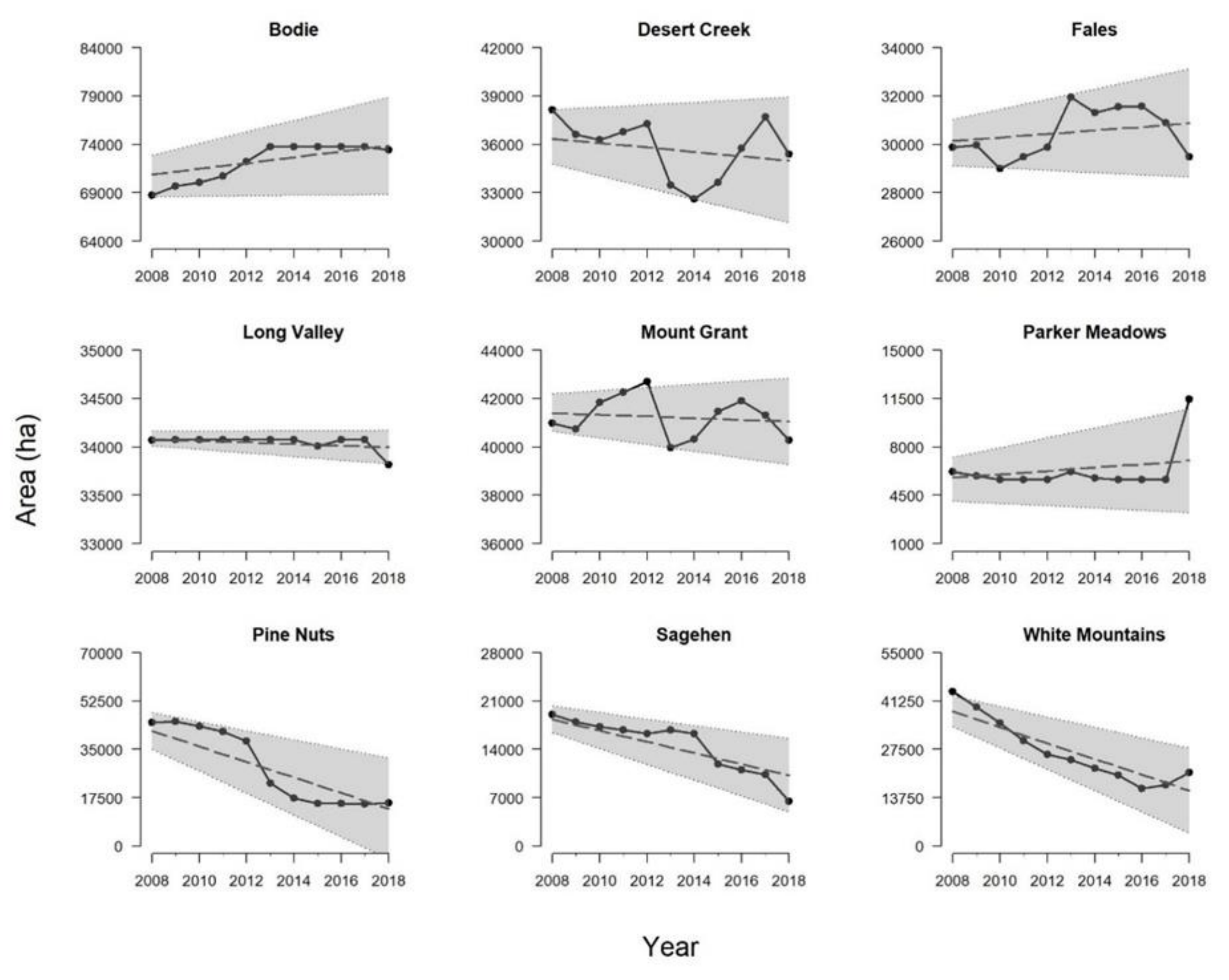
Redistribution of sage-grouse from peripheral populations to Bodie Hills core population

Notably precipitous in Pine Nuts and White Mountains

Coates et al. 2020. Open-File Report 2019-1149

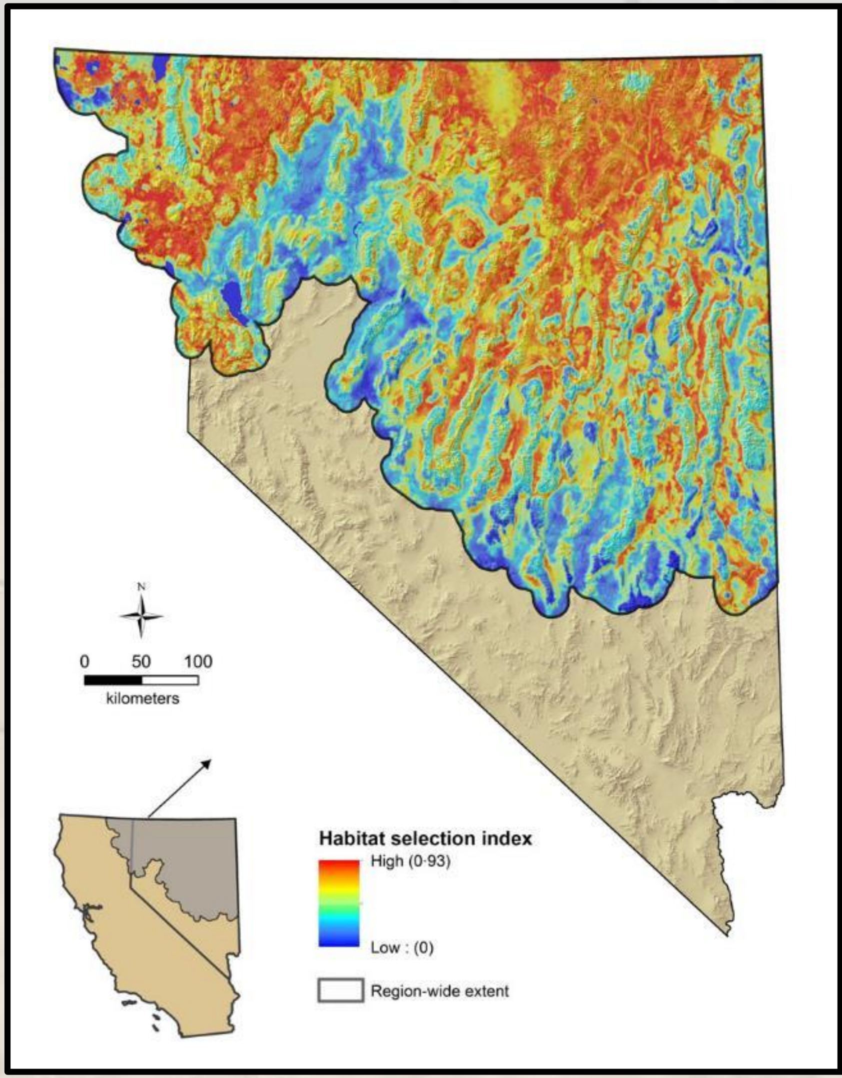
DISTRIBUTIONS

99th percentile of distribution

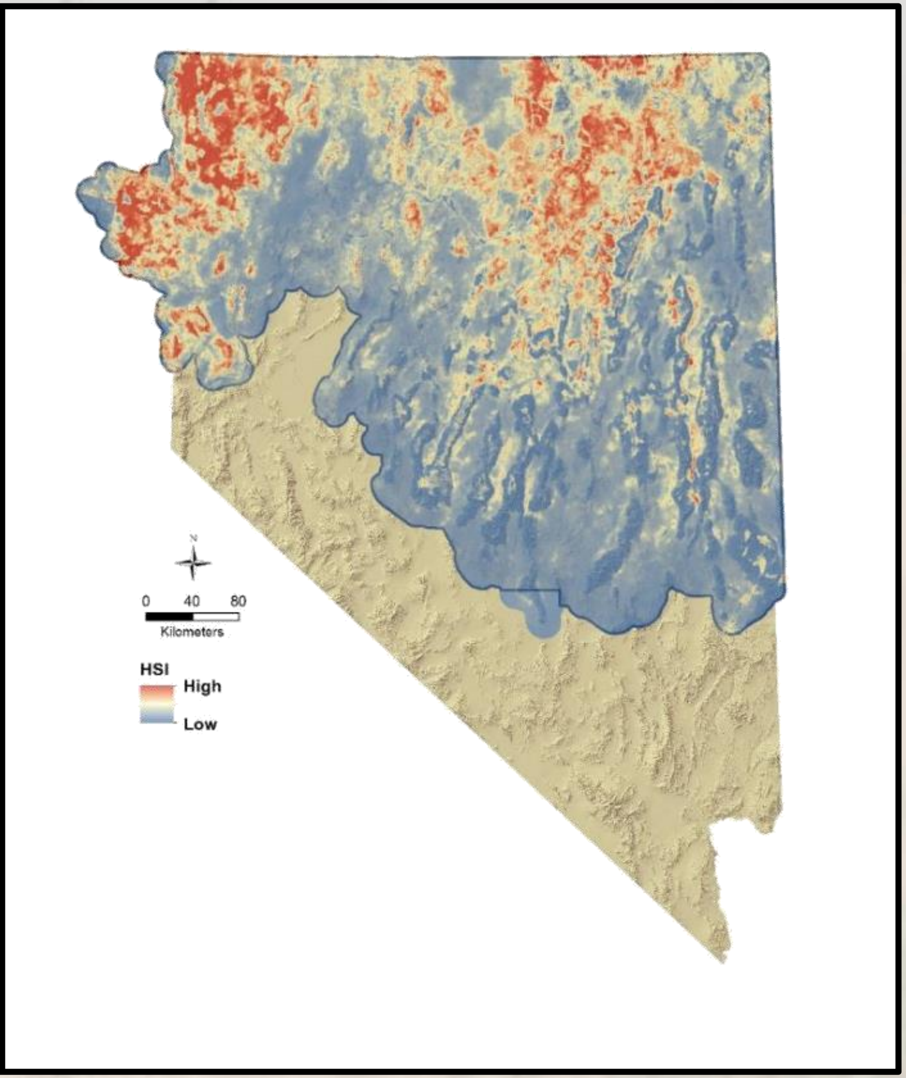


Coates et al. 2020. Open-File Report 2019-1149

Annual HSI
2014 Product

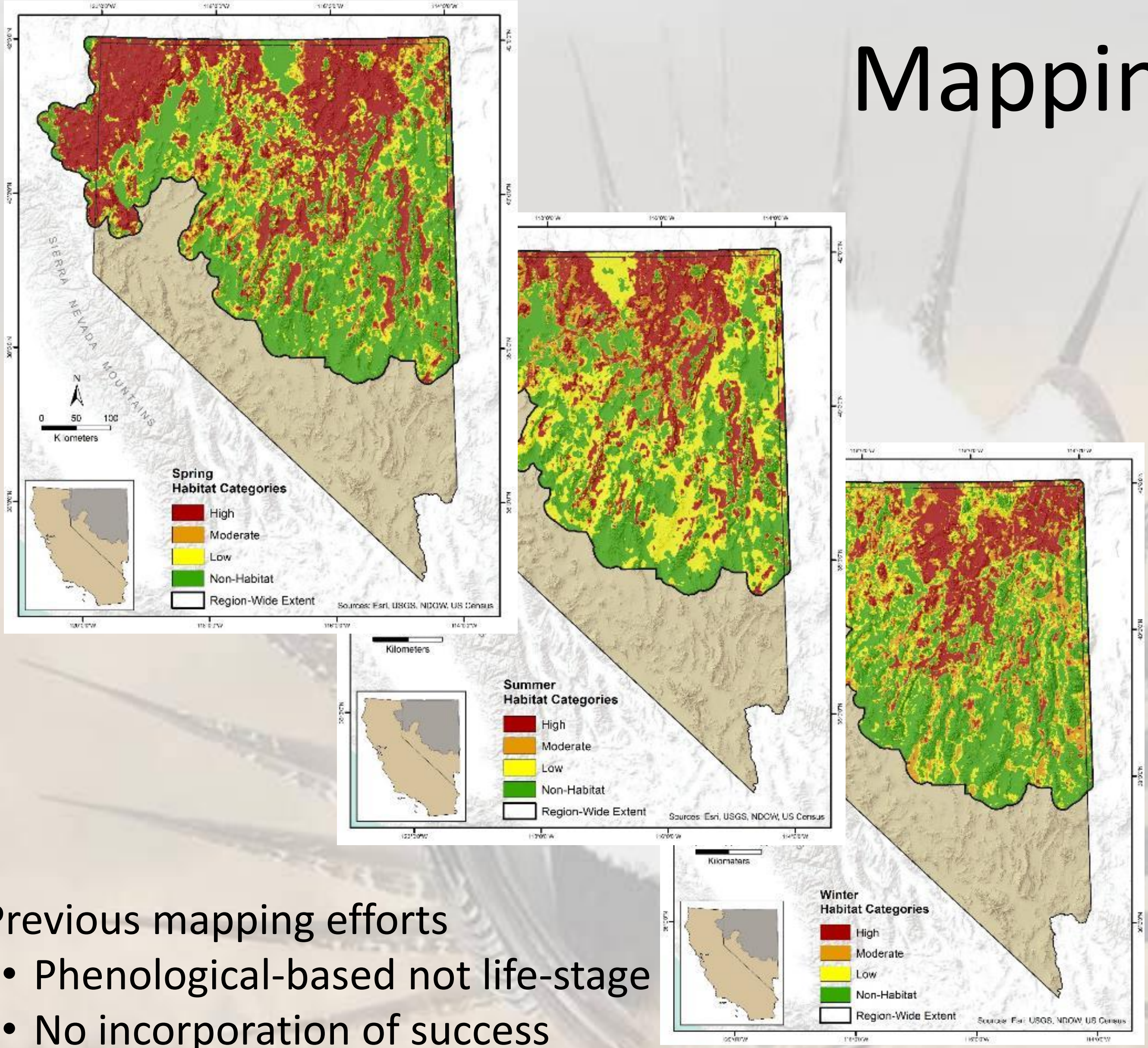


Annual (Seasonal-based) HSI
2016 Product



Coates et al. 2014, 2019

State-Wide Seasonal Mapping



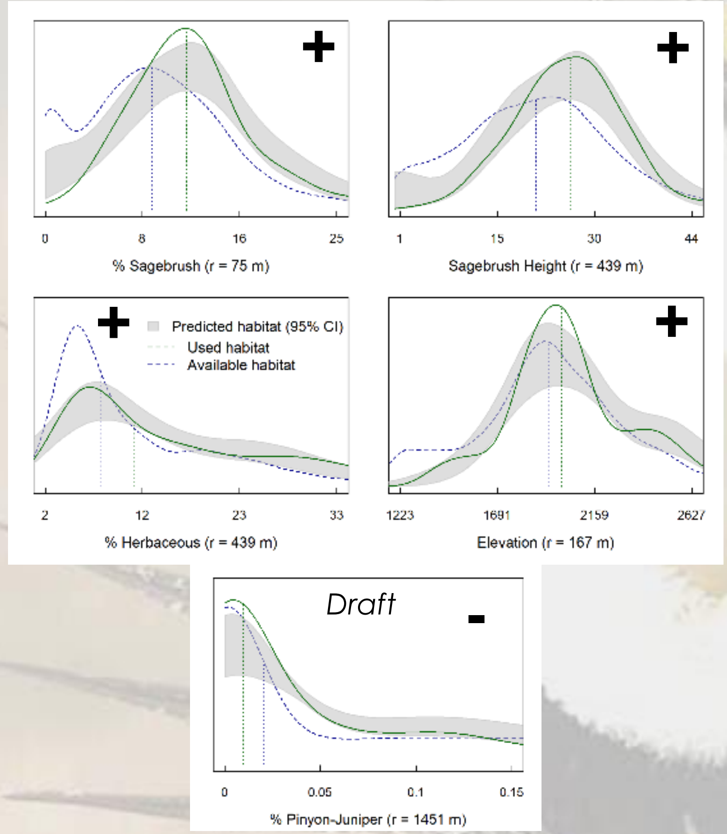
Previous mapping efforts

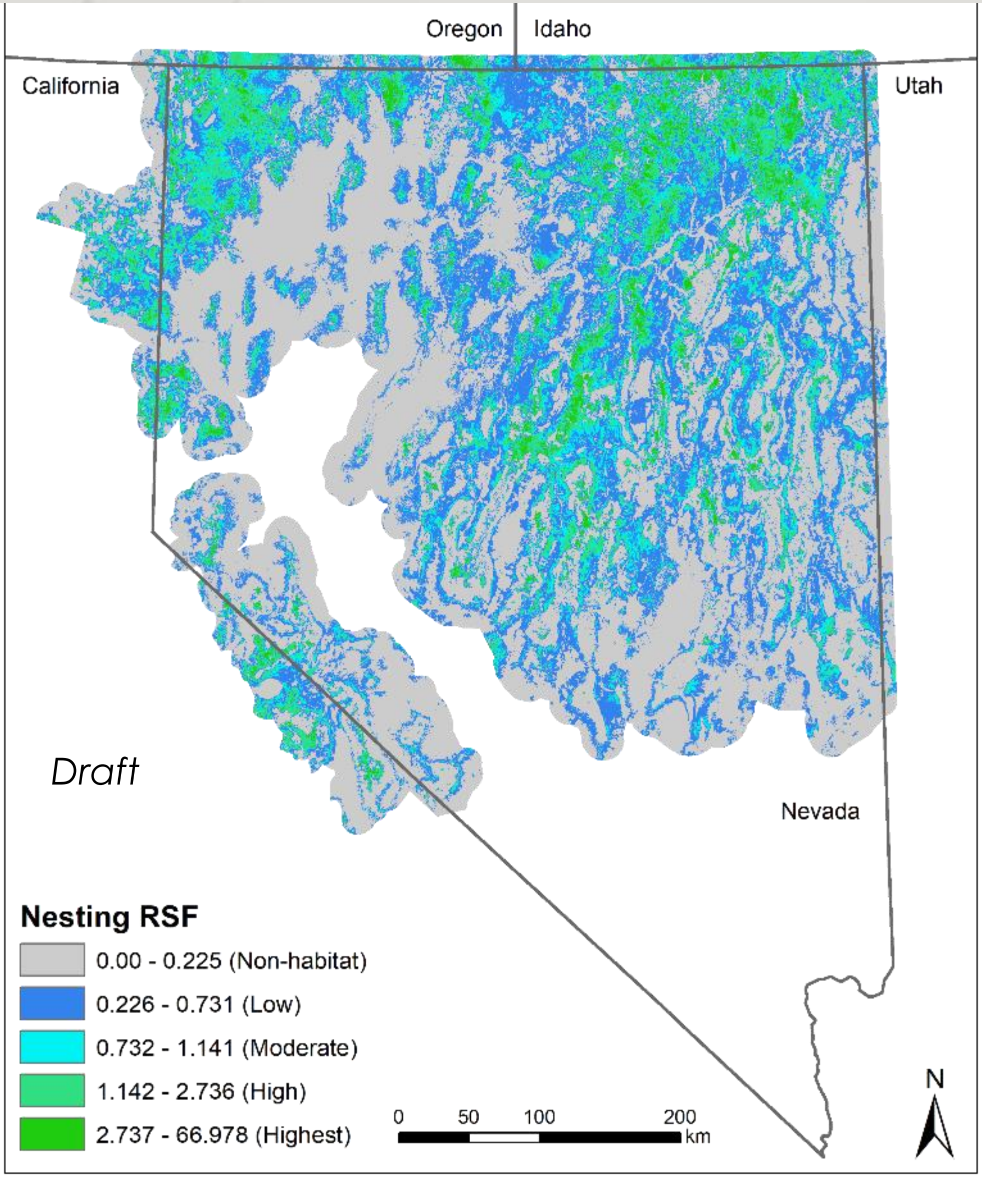
- Phenological-based not life-stage
- No incorporation of success

Coates et al. 2019. Ecology and Evolution 10: 104–118

Nest Life Stage Mapping

Selection

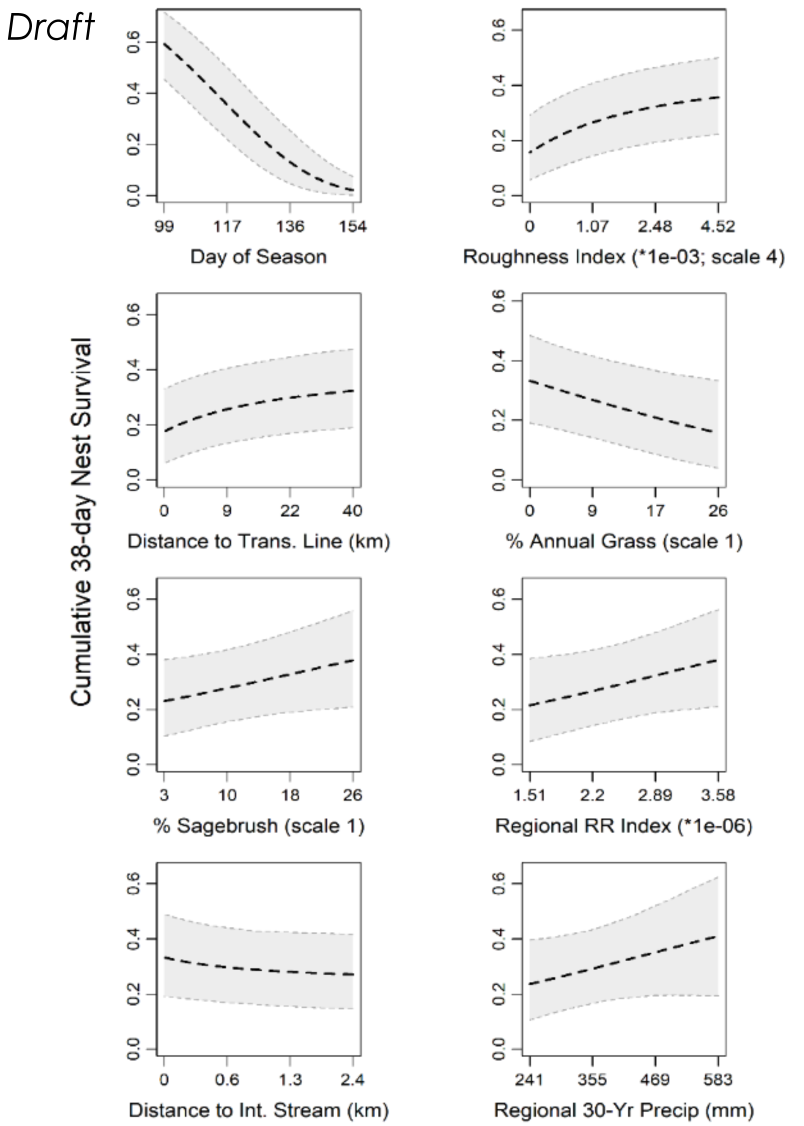


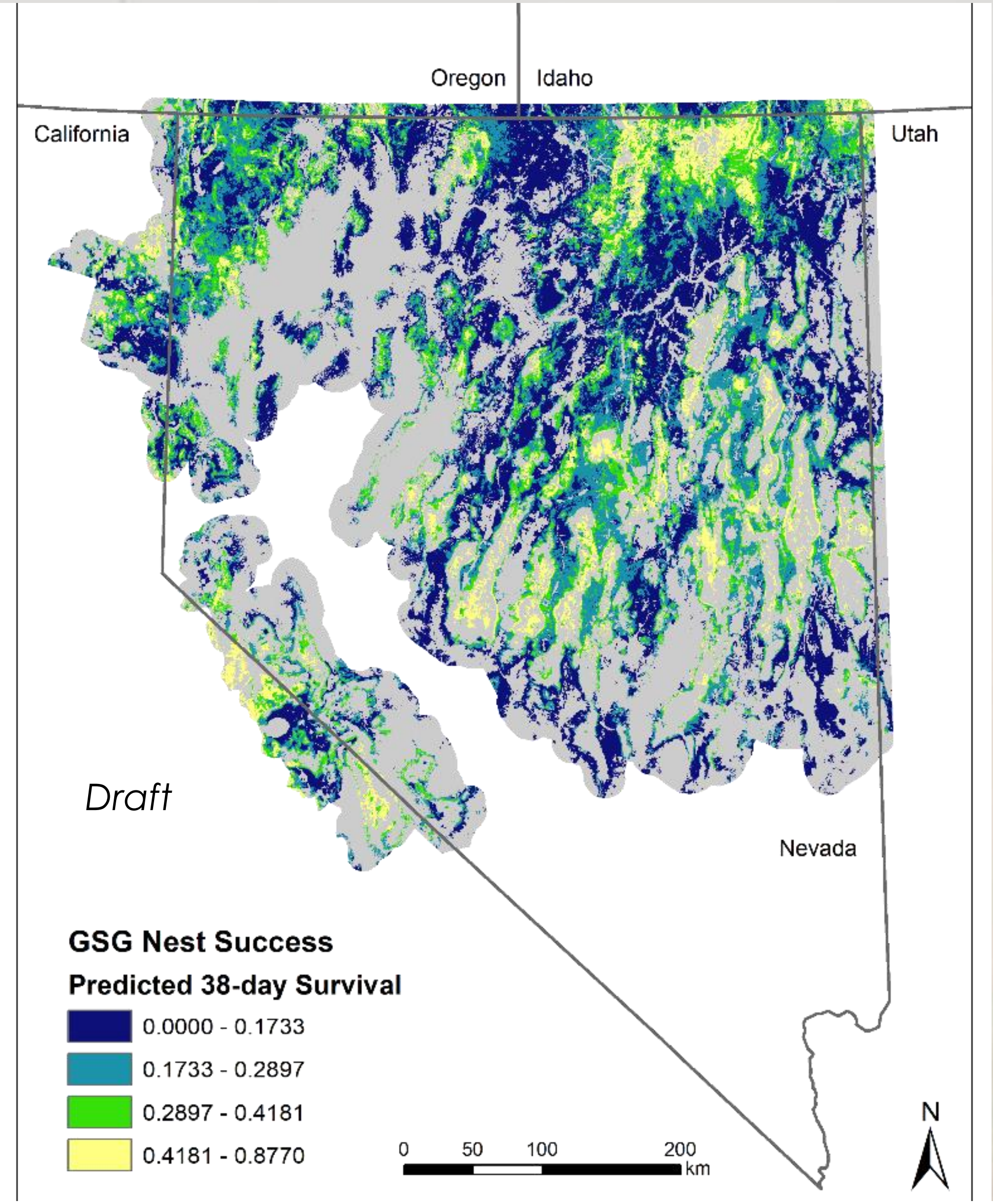


Preliminary Information—Subject to Revision. Not for Citation or Distribution

Nest Life Stage Mapping

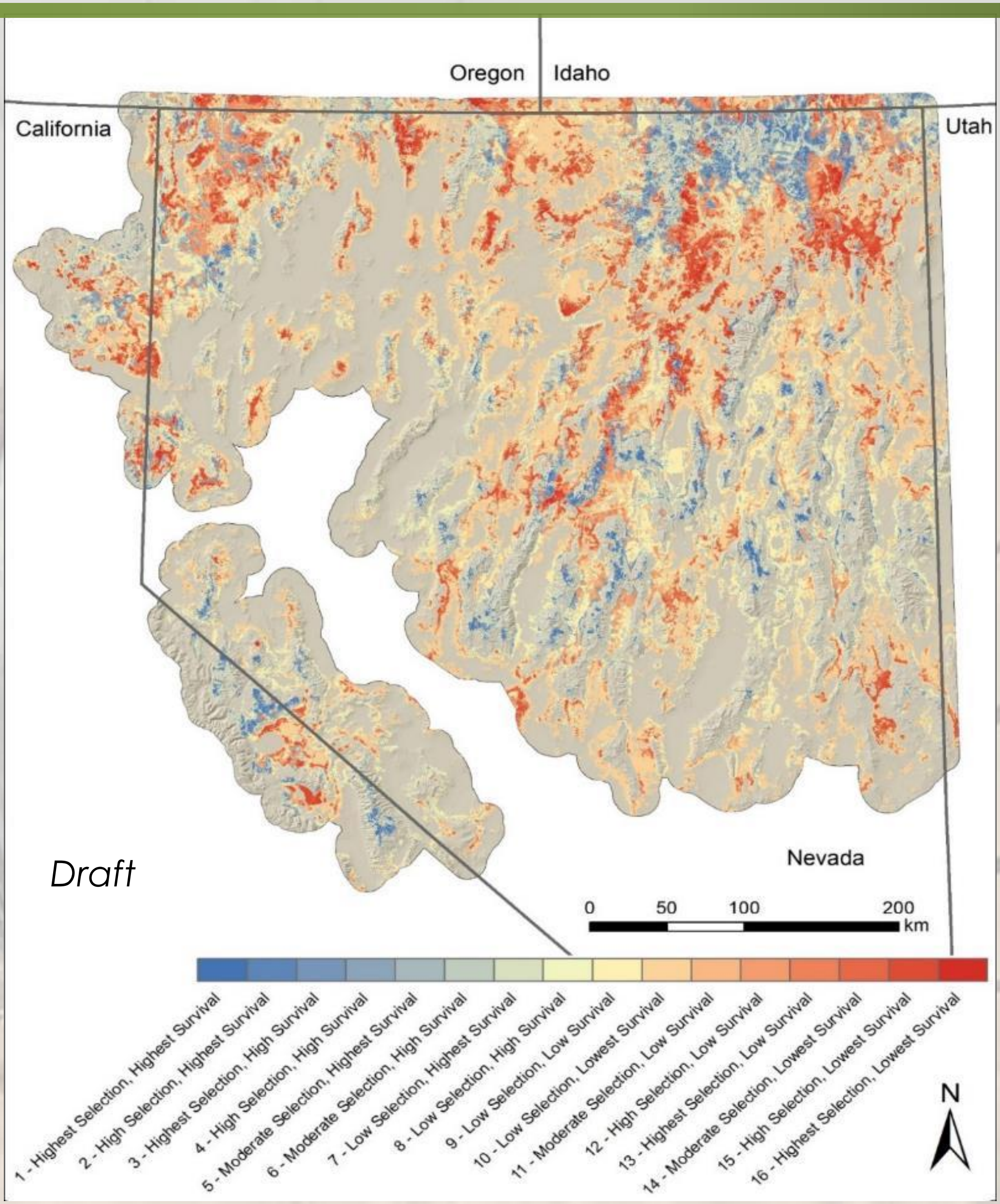
Survival





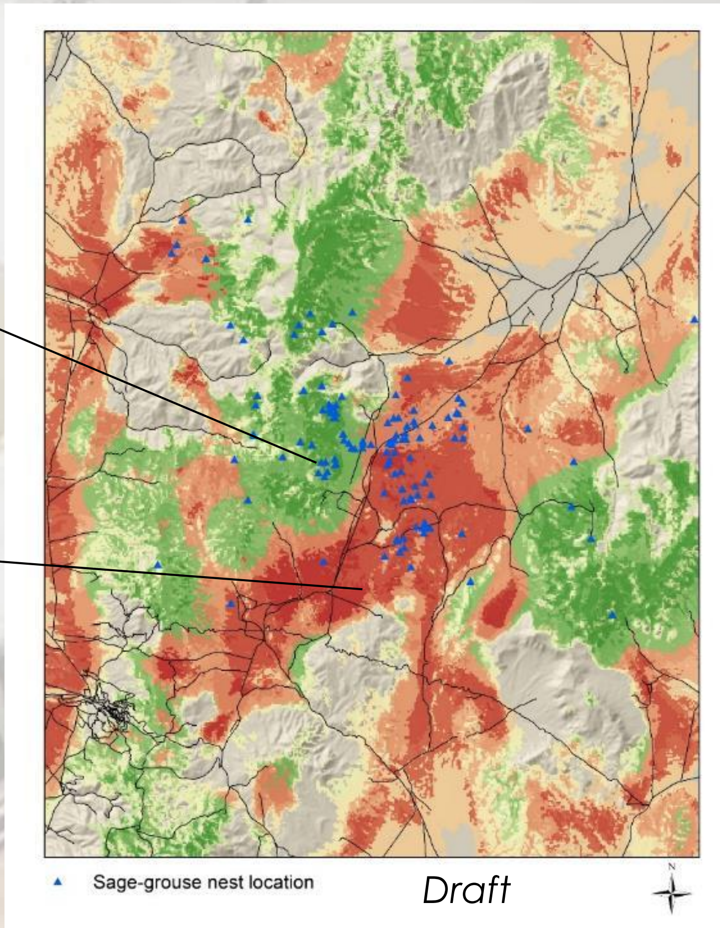
Nest Life Stage Mapping

Nesting “Source-sink” Map



Nest Life Stage Mapping

Integrating nest site selection with nest survival can help to prioritize habitat management efforts

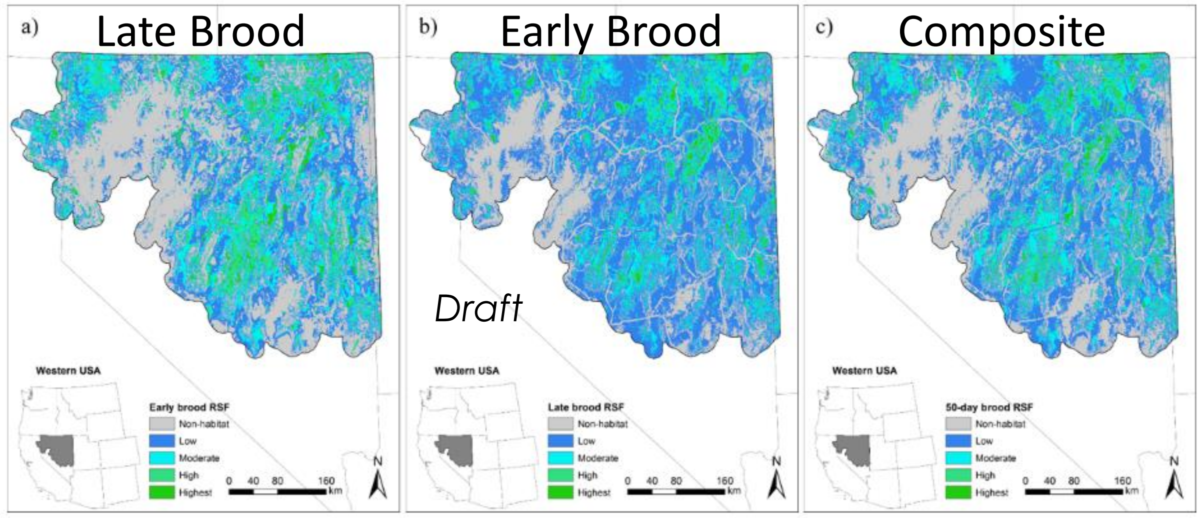


Higher elevation, greater sagebrush cover, no annual grass component, fewer ravens

Less topographic roughness, lower quality sagebrush cover, annual grass component, greater raven density

Brood Life Stage Mapping

Selection:



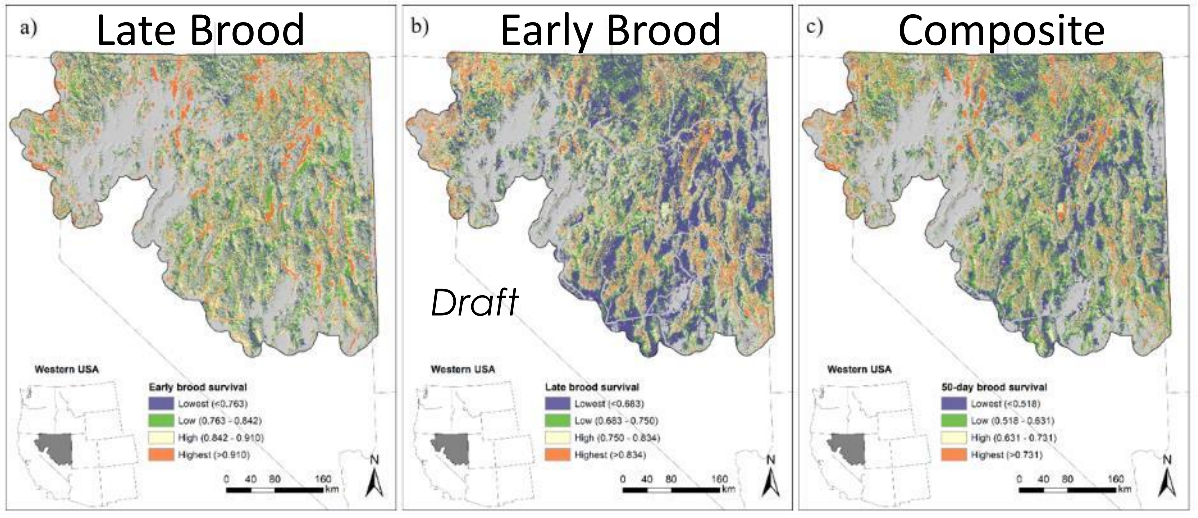
a) Late Brood

b) Early Brood

c) Composite

Draft

Survival:

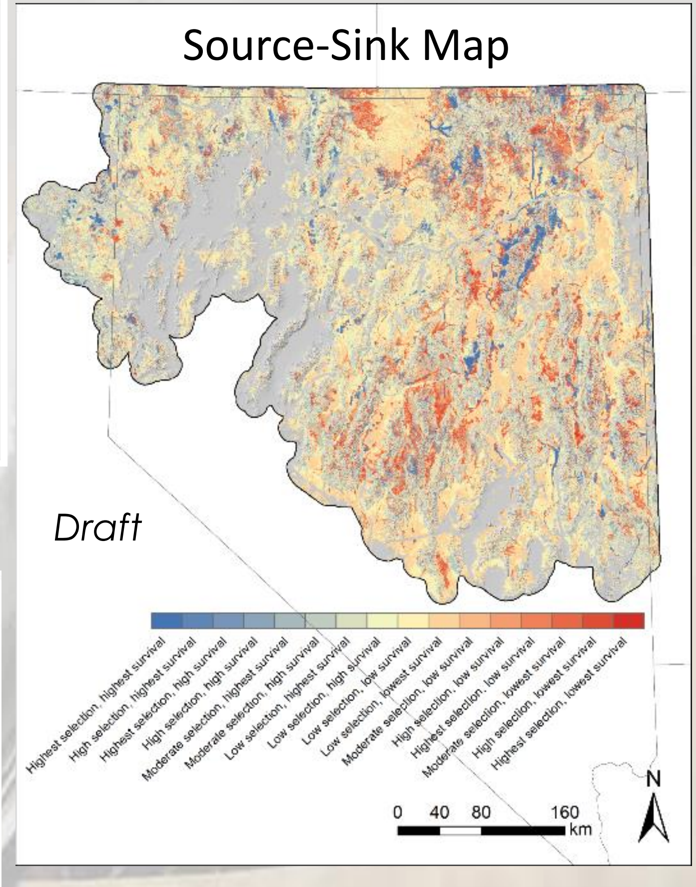


a) Late Brood

b) Early Brood

c) Composite

Draft



Source-Sink Map

Draft

Preliminary Information—Subject to Revision. Not for Citation or Distribution

Conservation Planning Tool

What is it?

Ecological Applications, 28(4), 2018, pp. 878–896
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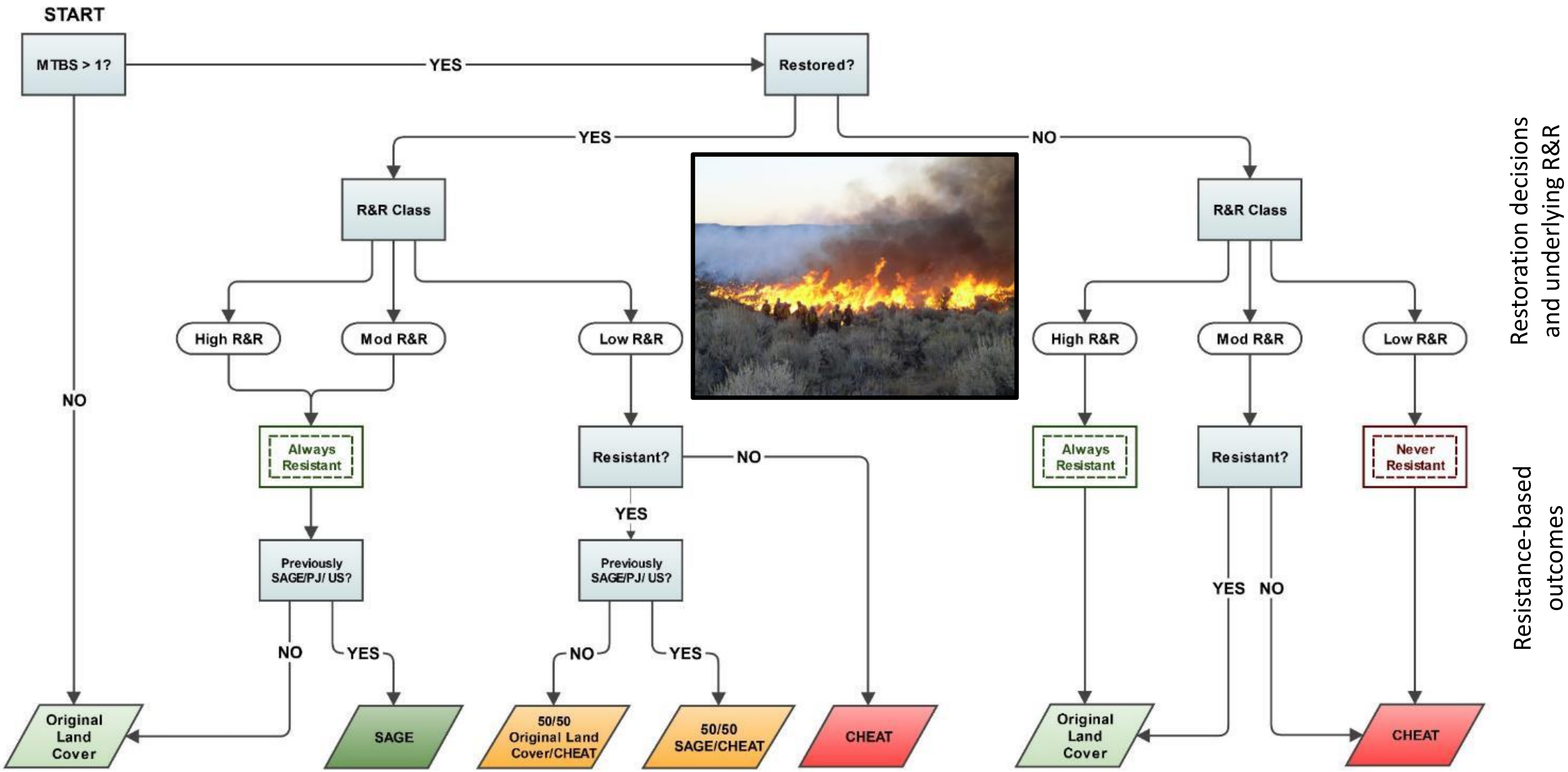
A conservation planning tool for Greater Sage-grouse using indices of species distribution, resilience, and resistance

Mark A. Ricca,[1,8] Peter S. Coates,[1] K. Benjamin Gustafson,[1] Brianne E. Brussee,[1] Jeanne C. Chambers,[2] Shawn P. Espinosa,[3] Scott C. Gardner,[4] Sherri Lisius,[5] Pilar Ziegler,[6] David J. Delehanty,[7] and Michael L. Casazza[1]

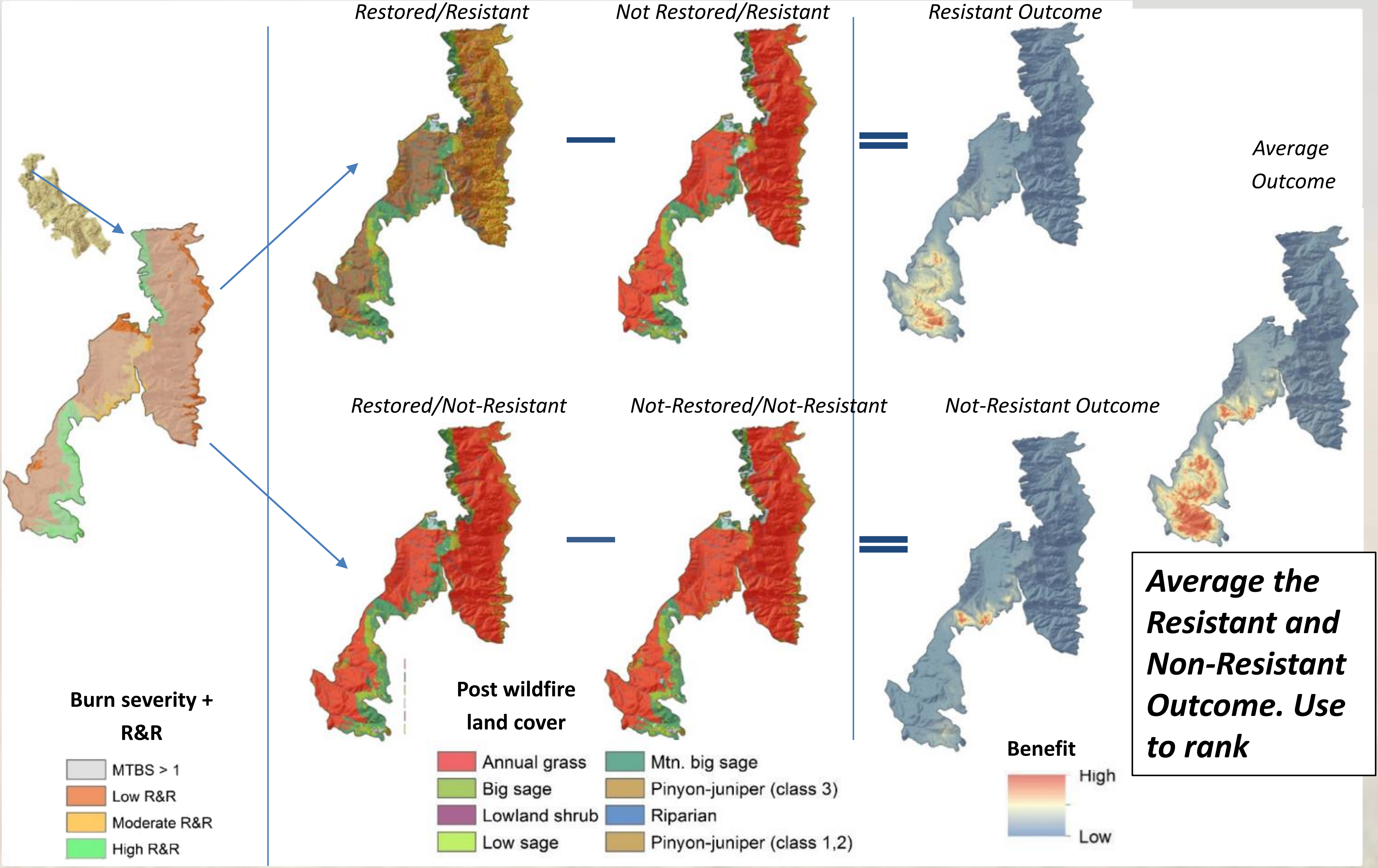
A data-driven decision support tool that measures predicted ecological benefits to sage-grouse (or other species) through simulated management or treatment-related changes in a habitat suitability or linked survival while accounting for landscape abundance and space use patterns of sage-grouse and underlying sagebrush ecosystem processes.

Decision Tree Model



Ricca et al. 2018. Ecological Applications 28: 878–896

Basic Fire CPT Steps: Bison Fire Example

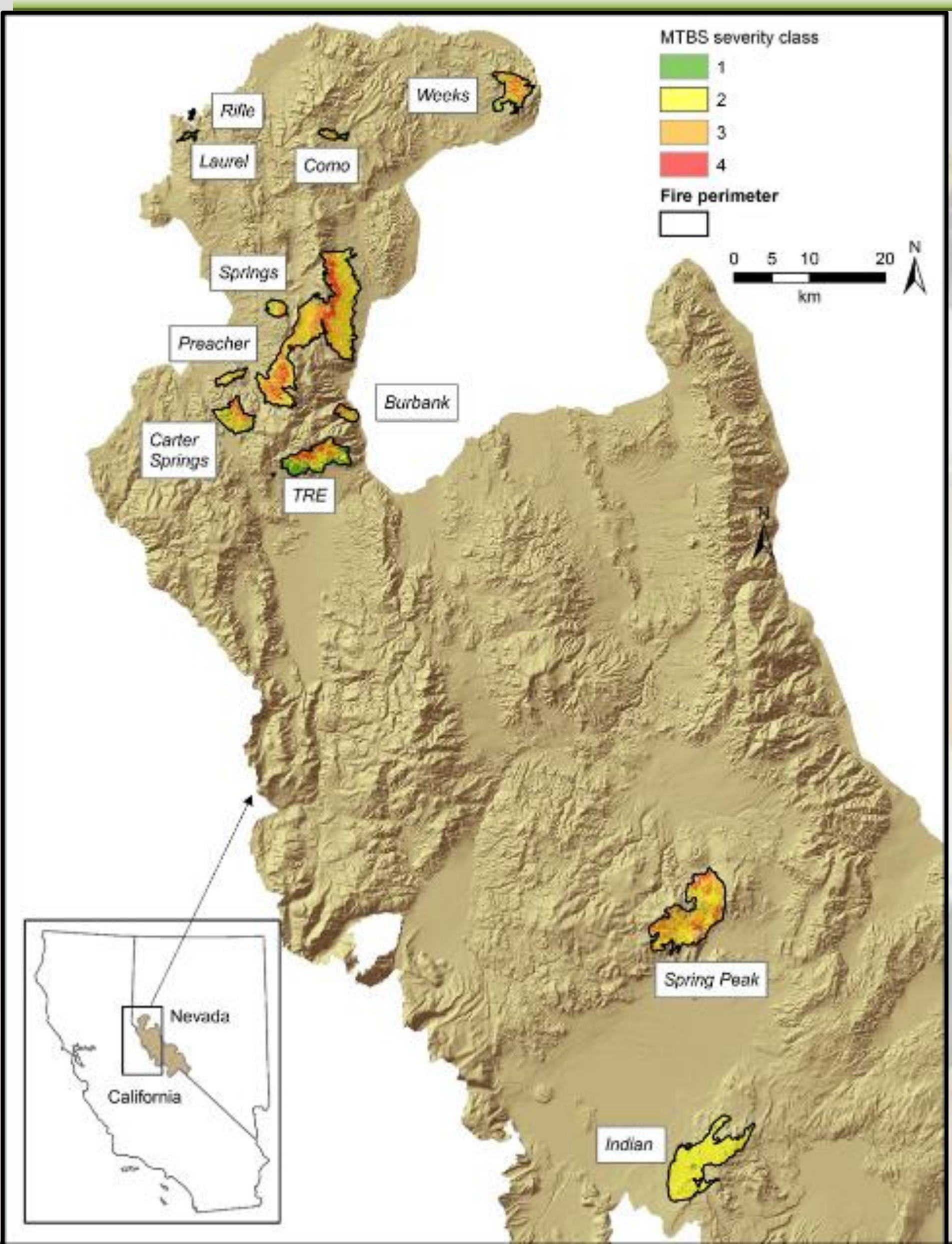


Average the Resistant and Non-Resistant Outcome. Use to rank

Ricca et al. 2018. Ecological Applications 28: 878–896

Post-fire conservation planning tools

Decision Tree Model: Identifying the 'best' burns to restore

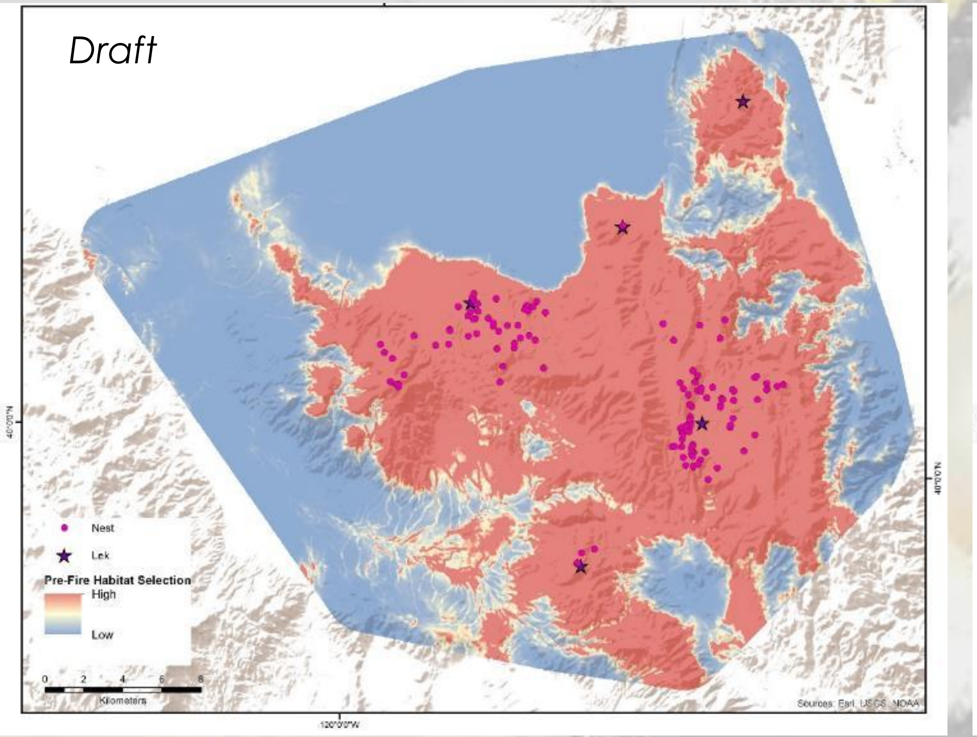


Fire	Area burned (ha)	Average ΔGBI / ha	Cumulative ΔGBI / ha	rank [a]
Spring Peak	5759	25.49	0.61	1 (1,1)
TRE	2471	8.75	0.81	2 (2,3)
Indian	5089	5.16	0.94	3 (3,2)
Como	311	0.96	0.96	4 (4,6)
Bison	9657	0.66	0.98	5 (5,4)
Carter Springs	1400	0.65	0.99	6 (6,5)
Burbank	450	0.19	1.00	7 (7,7)
Preacher	435	0.09	1.00	8 (8,8)
Springs	483	0.07	1.00	9 (9,9)
Laurel	130	0.00	1.00	10 (10,10)
Rifle	50	0.00	1.00	11 (11,11)
Weeks	1563	0.00	1.00	12 (12,12)

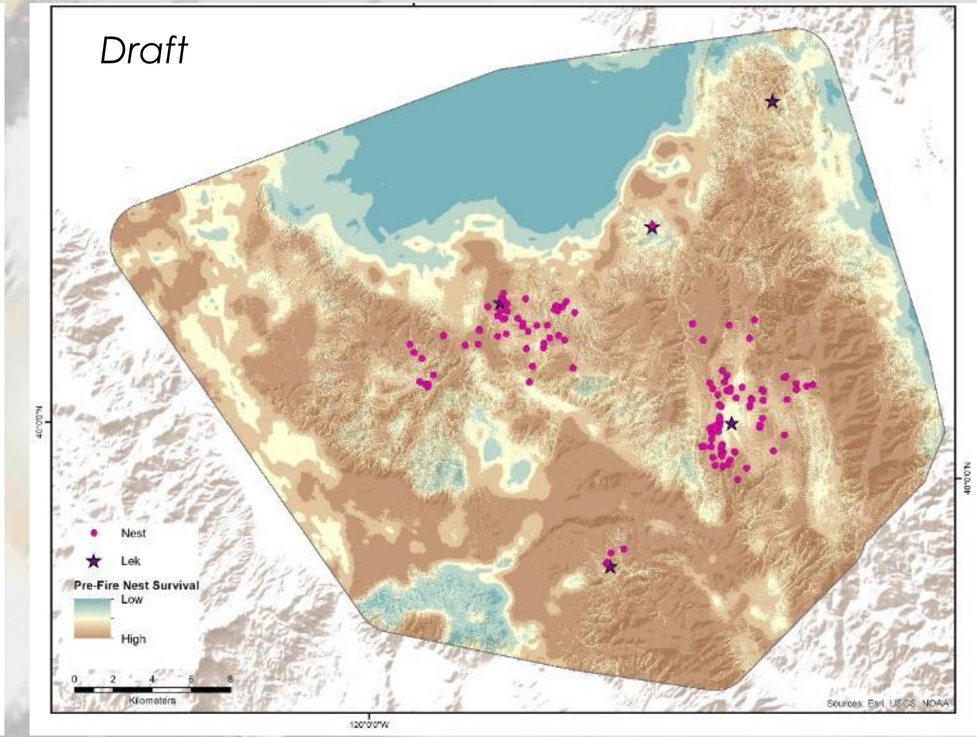
Ricca et al. 2018. Ecological Applications 28: 878–896

Post-fire conservation planning tools

Incorporating Life-Stage Projections



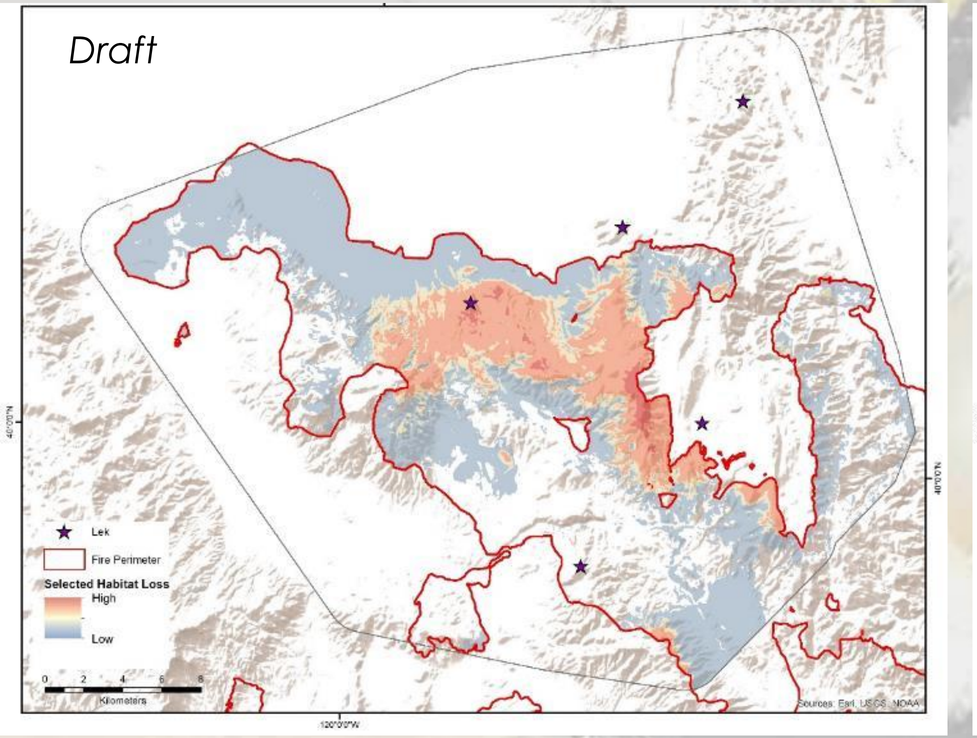
Pre-fire nest selection



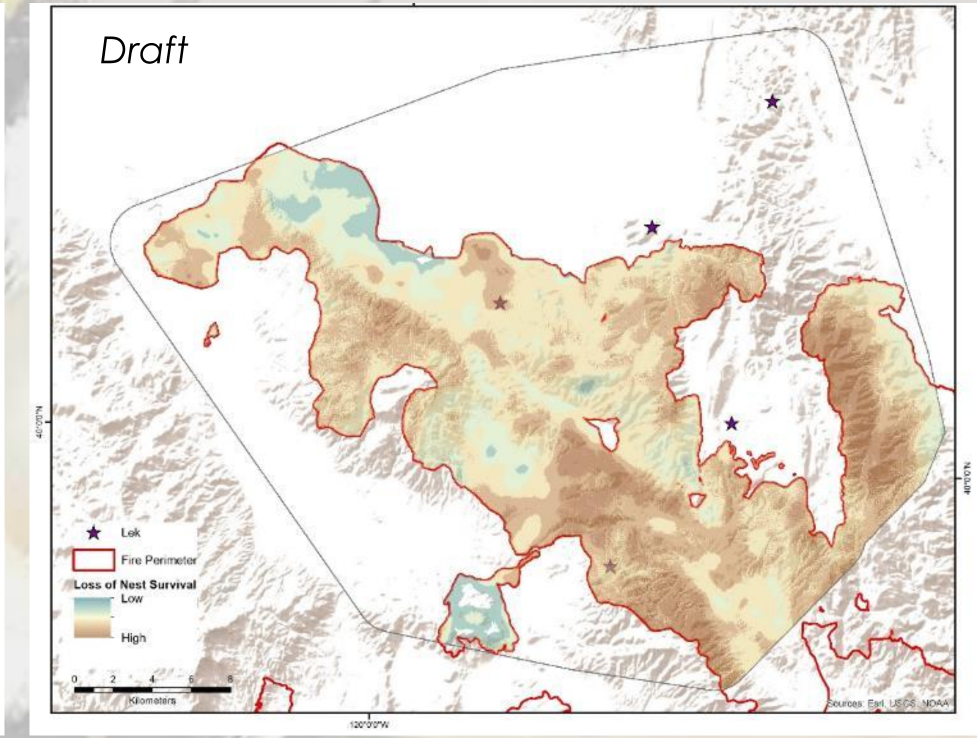
Pre-fire nest survival

Post-fire conservation planning tools

Incorporating Life-Stage Projections



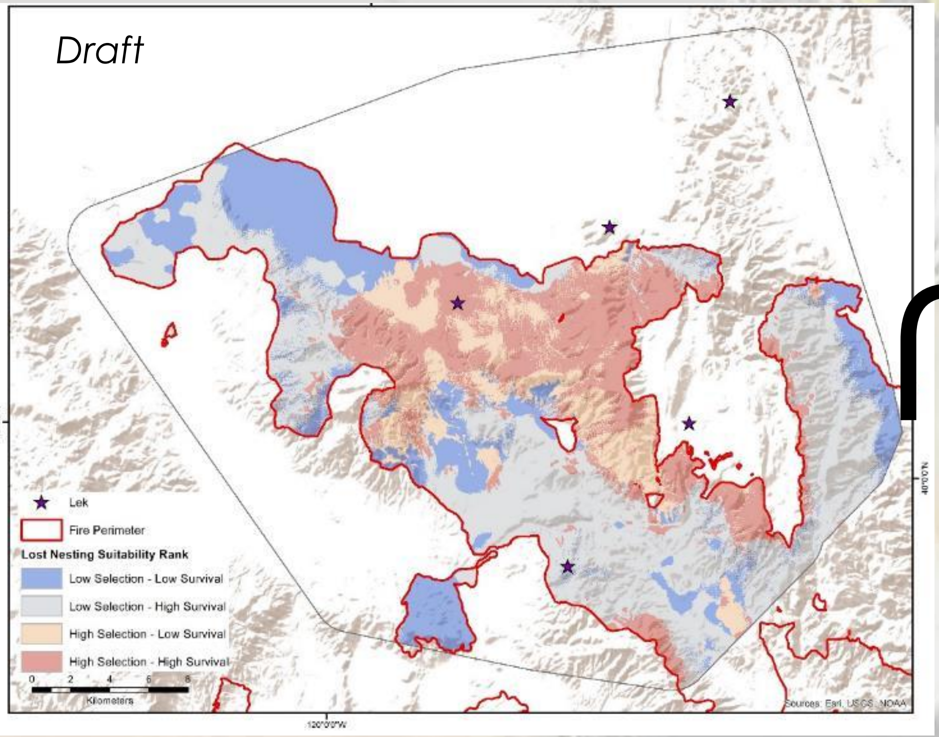
Loss of selected nesting habitat



Loss of habitats that increase nest survival

Post-fire conservation planning tools

Incorporating Life-Stage Projections



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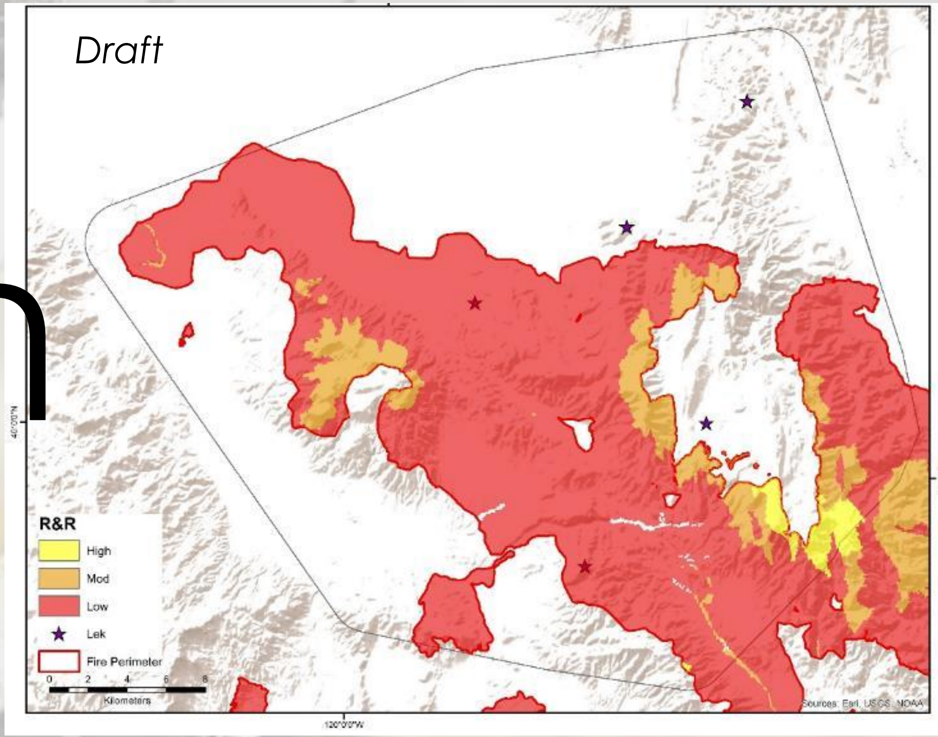
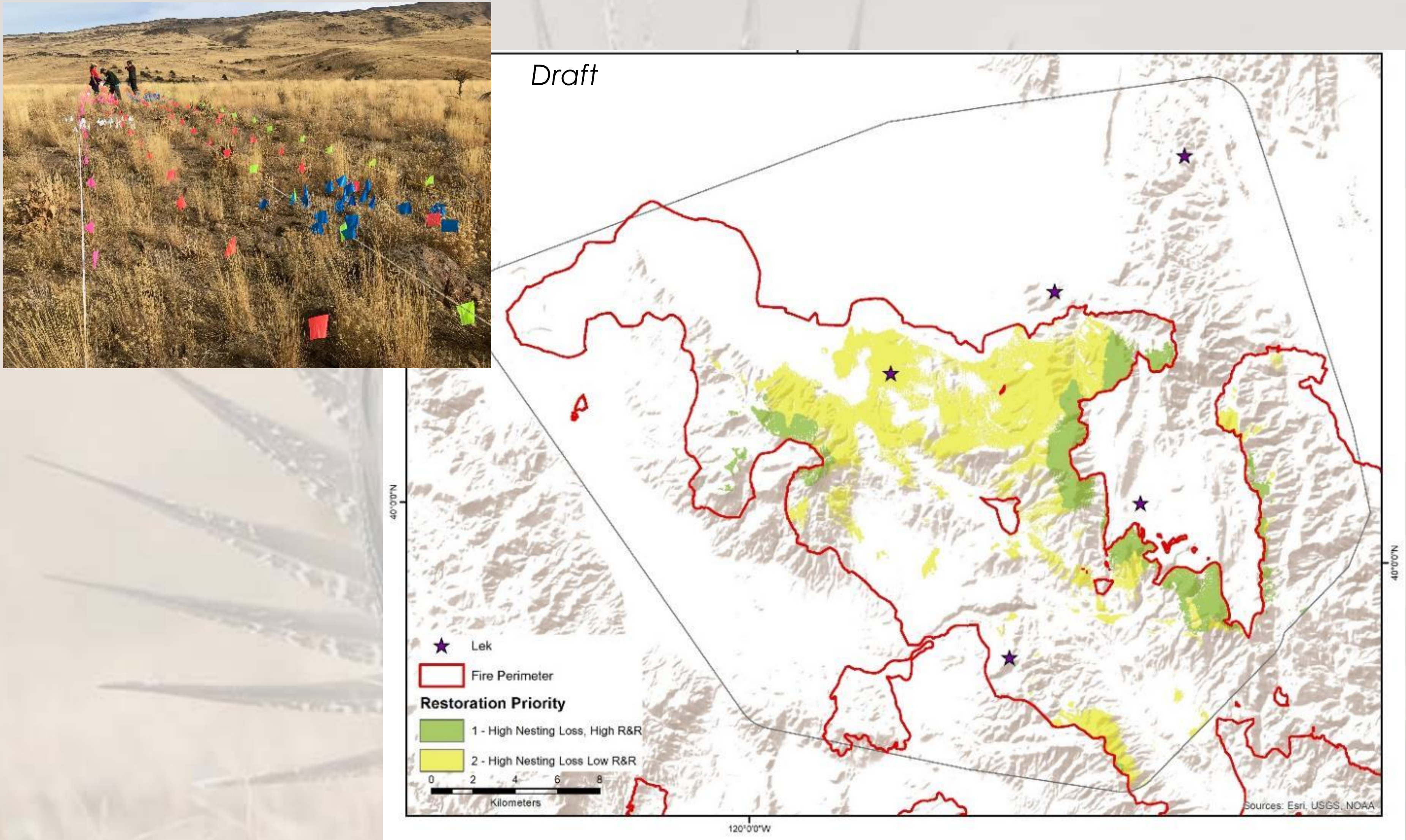


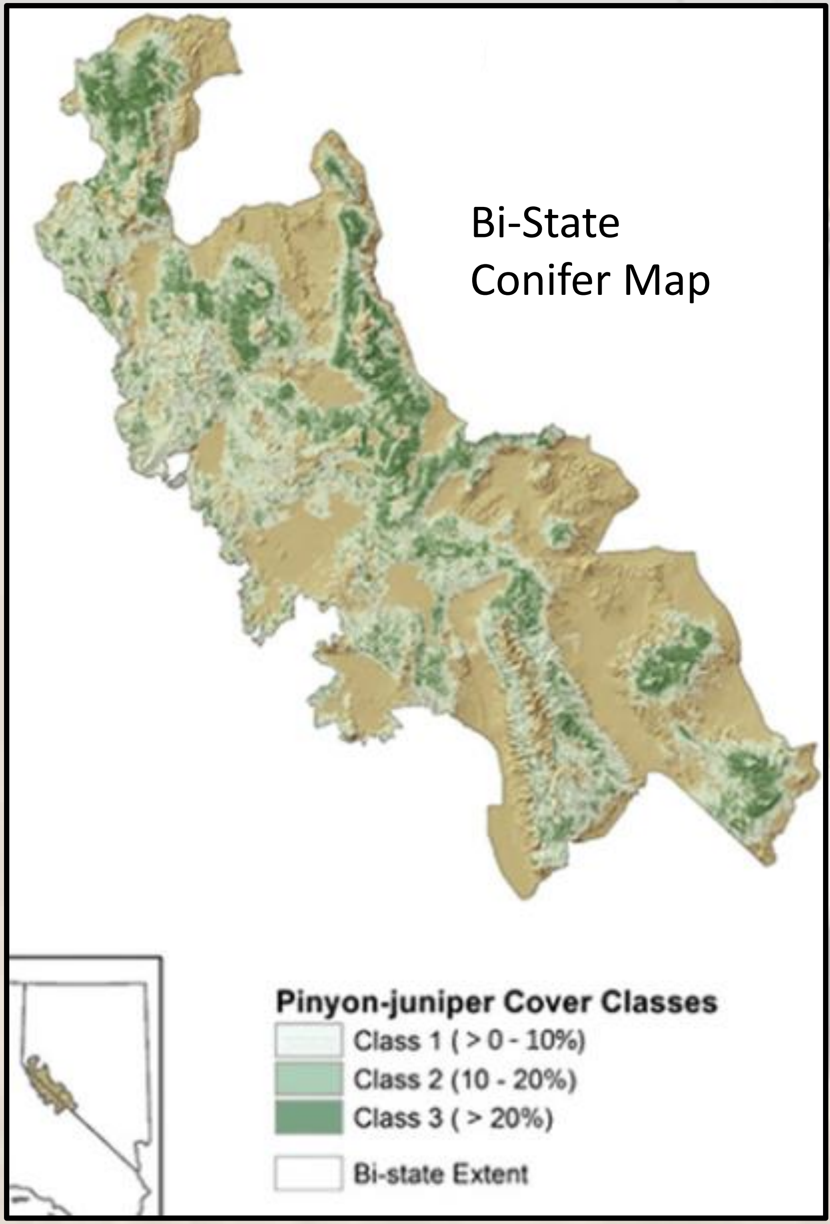
Preliminary Information—Subject to Revision. Not for Citation or Distribution

Post-fire conservation planning tools

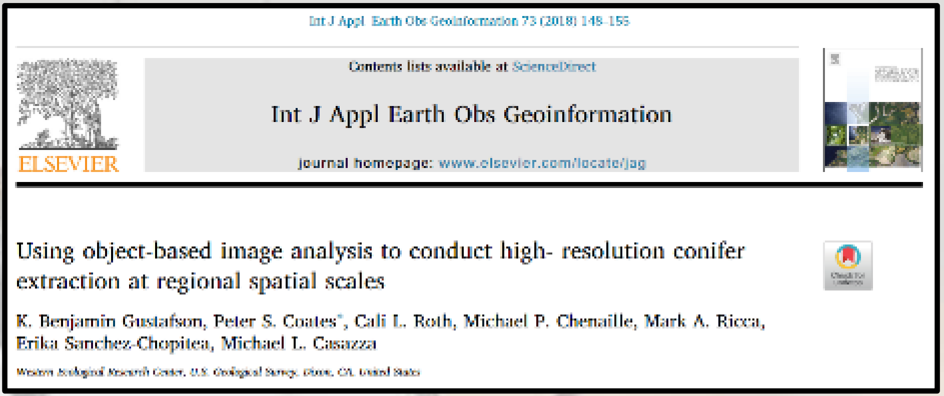
Incorporating Life-Stage Projections



Conservation Planning Tool – Conifer Treatment



Bi-State Conifer Map



Int J Appl Earth Obs Geoinformation 73 (2018) 148–155

Contents lists available at ScienceDirect

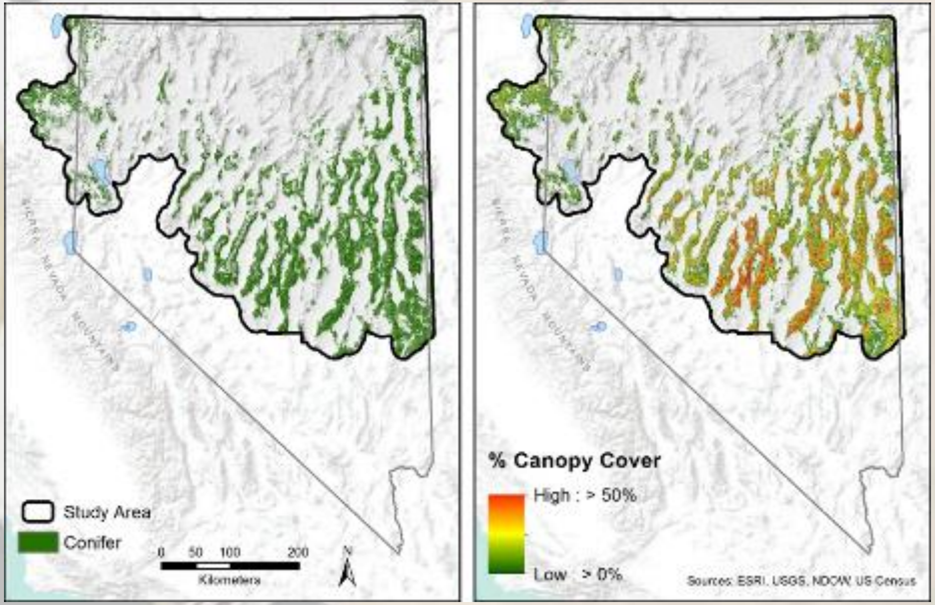
Int J Appl Earth Obs Geoinformation

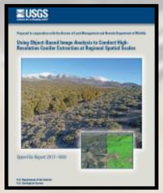
journal homepage: www.elsevier.com/locate/jag

Using object-based image analysis to conduct high- resolution conifer extraction at regional spatial scales

K. Benjamin Gustafson, Peter S. Coates*, Cali L. Roth, Michael P. Chenaille, Mark A. Ricca, Erika Sanchez-Chopitea, Michael L. Casazza

Western Ecological Research Center, U.S. Geological Survey, Dixon, CA, United States





Overall accuracy = 84.3% (field and image based)

1- m^2 and conifer class maps available for download at: https://www.sciencebase.gov/catalog/item/59160b60e4b044b359e32e67

Conservation Planning Tool – Conifer Treatment

ELSEVIER

Rangeland Ecology & Management

Volume 70, Issue 1, January 2017, Pages 25–38

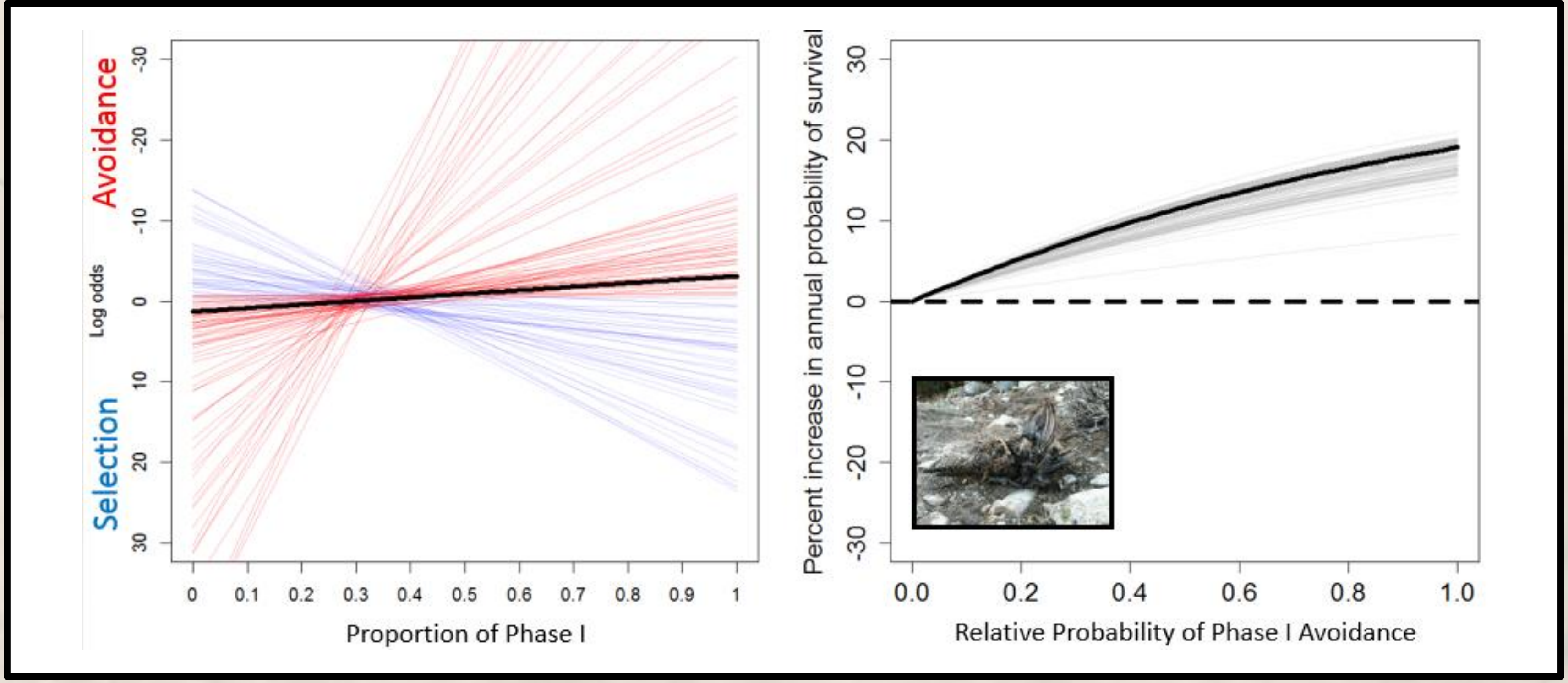
Cover image

Pinyon and Juniper Encroachment into Sagebrush Ecosystems Impacts Distribution and Survival of Greater Sage-Grouse ☆ ☆☆

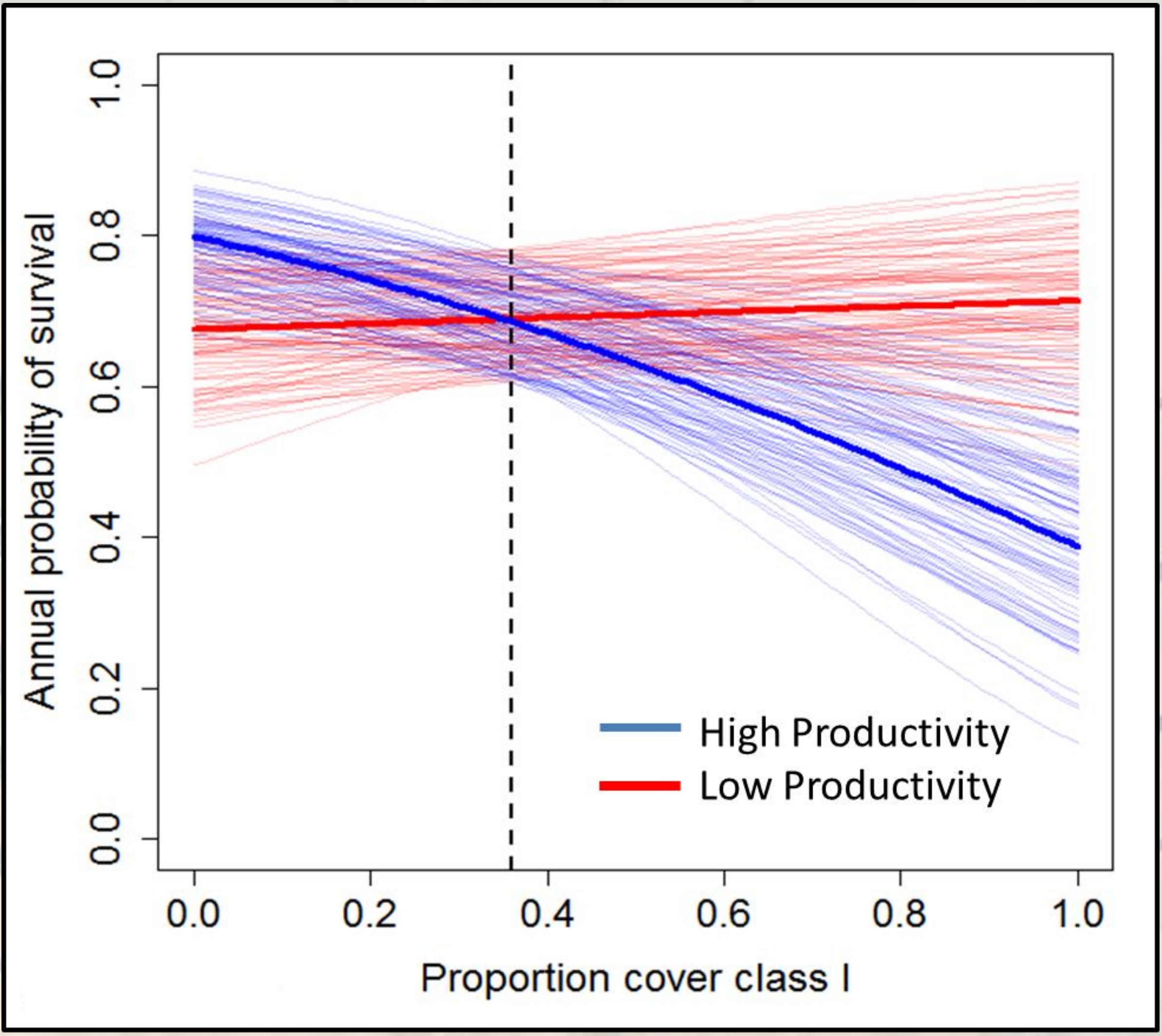
Peter S. Coates[a], Brian G. Prochazka[a], Mark A. Ricca[a], K. Ben Gustafson[a], Pilar Ziegler[b], Michael L. Casazza[a]

- **50% probability of selection was ~30% of Cover Class 1 (or ~1.5% actual tree cover)**

- **Full avoidance increased annual survival by ~20%**



Productive Areas with Sparse PJ have Higher Mortality Risk

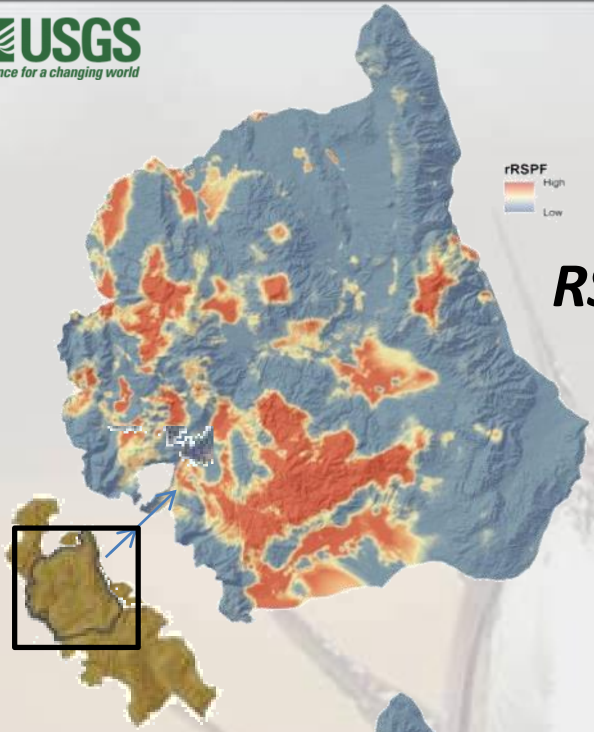


Coates et al. 2017. Rangeland Ecology and Management 70: 25–38

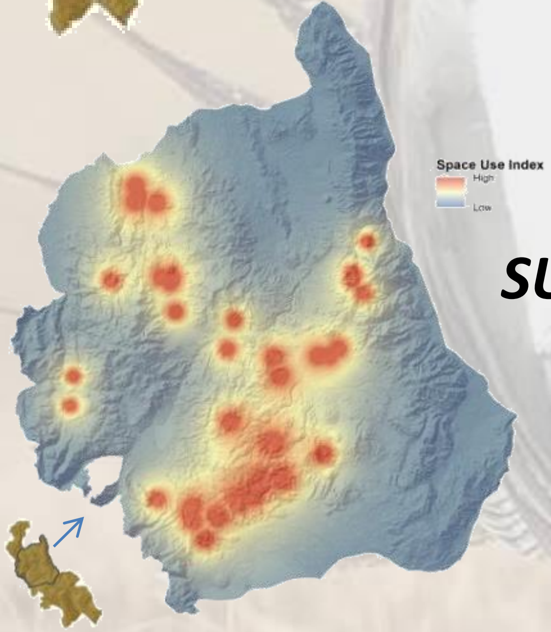
Credit: Jeremy Maestas, USDA-NRCS

Sage-Grouse Ecological Currency

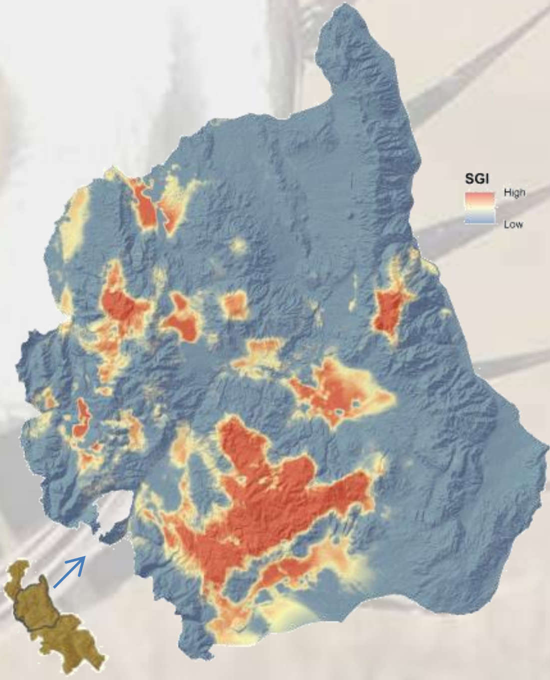
$$RSF \times SUI = SGI$$



RSF



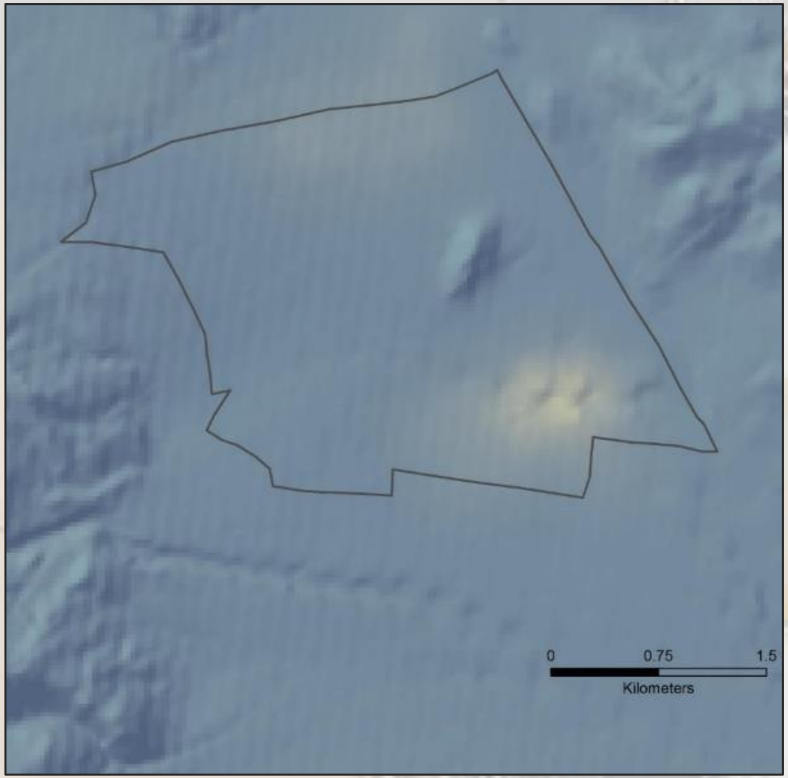
SUI



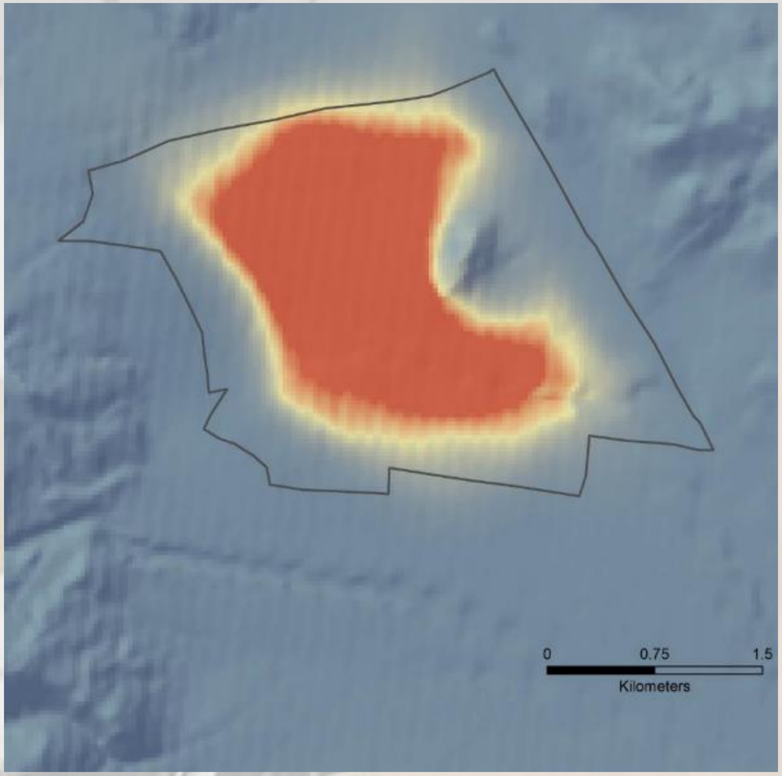
Sage-Grouse Index (SGI)

Ricca et al. 2018. Ecological Applications

Conservation Planning Tool – Conifer Treatment



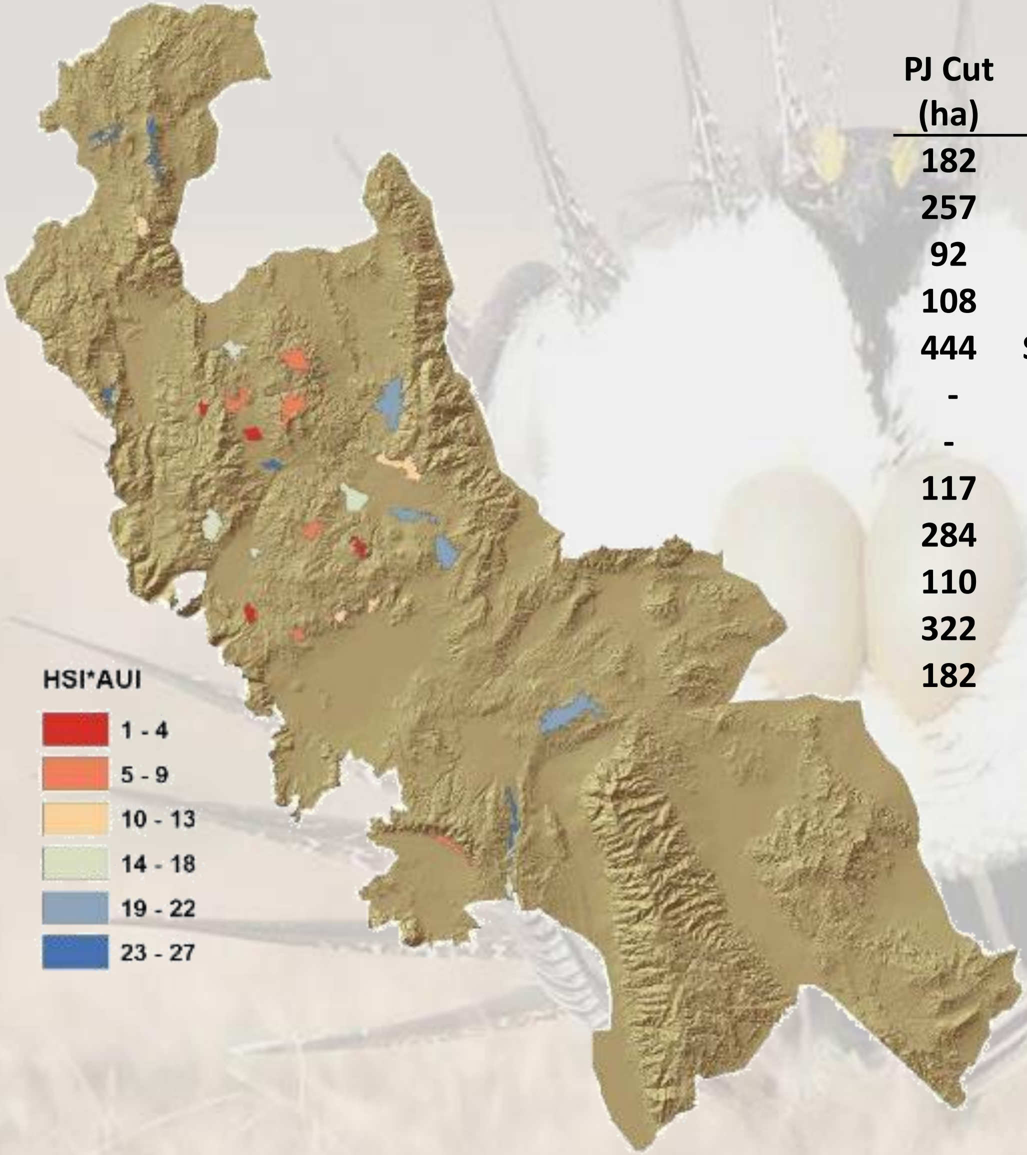
Pre-Treatment Habitat Selection



Post-Treatment Habitat Selection

Ricca et al. 2018. Ecological Applications 28: 878–896

Conservation Planning Tool – Conifer Treatment

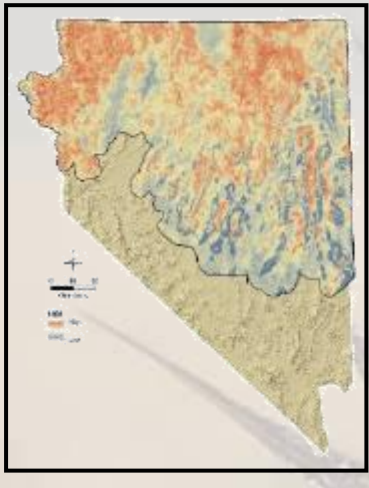


PJ Cut (ha)	Σ Cost	Rank (HSI* AUI)	GBI (HSI*AUI)	Total
182	$ 78,890	1	4.832	35%
257	$ 110,999	2	1.452	45%
92	$ 39,854	3	1.252	54%
108	$ 46,859	4	1.248	63%
444	$ 192,147	5	1.151	71%
-	-	-	-	-
-	-	-	-	-
117	$ 50,635	23	0.011	100%
284	$ 122,675	24	0.006	100%
110	$ 47,560	25	0.003	100%
322	$ 139,099	26	0.000	100%
182	$ 78,618	27	0.000	100%

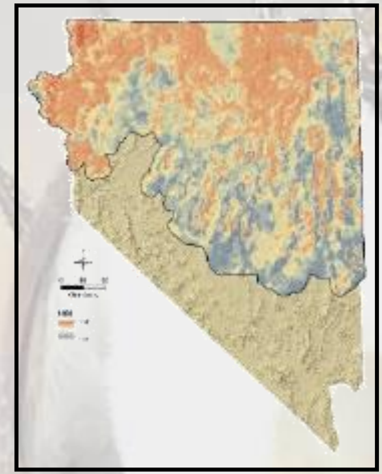
Ricca et al. 2018. Ecological Applications 28: 878–896

Conservation Planning Tool – Conifer Treatment

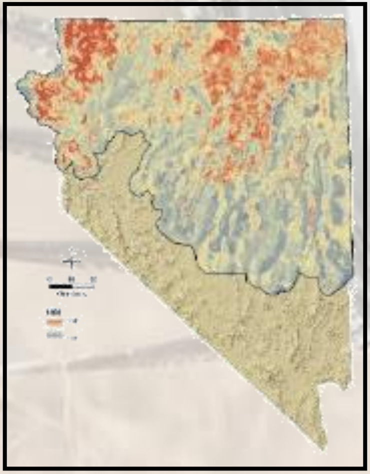
Spring



Summer

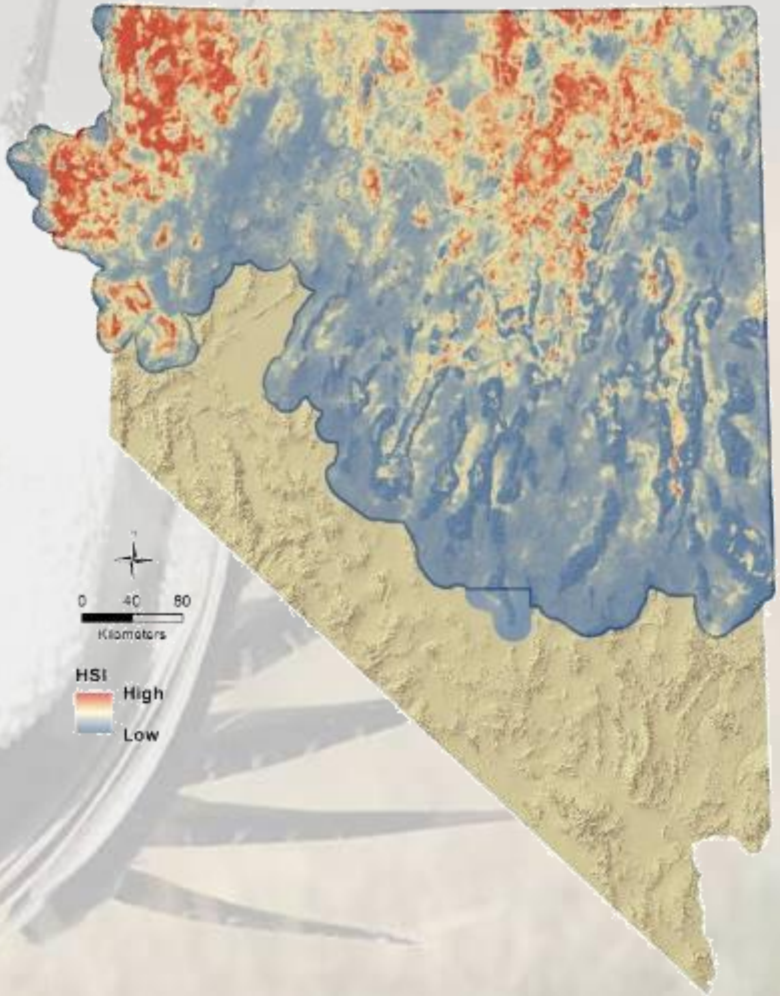


Winter



Π

Annual



Coates et al. 2019. Ecology and Evolution 10: 104–118

Conservation Planning Tool – Conifer Treatment Updated

<u>User Inputs</u>

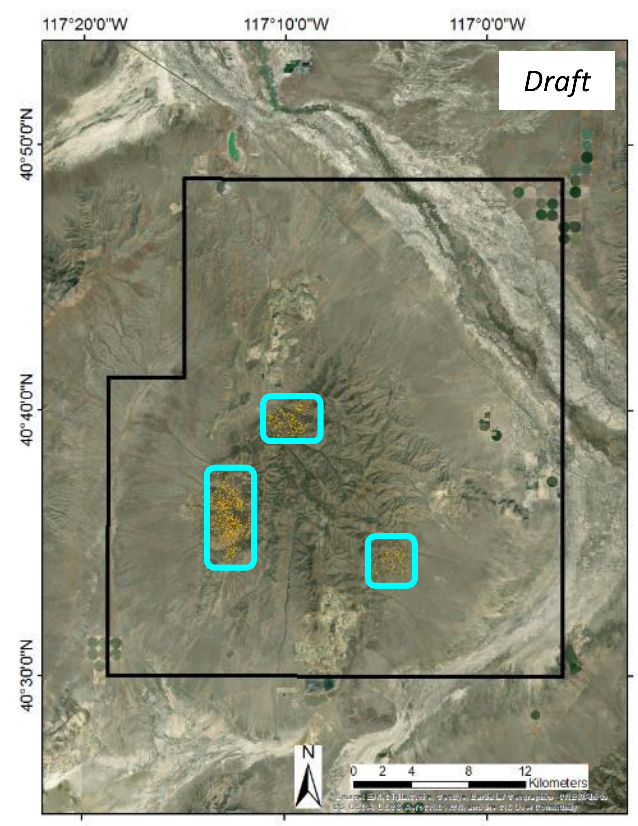
- **Candidate Treatment Polygons (Drawn | Imported)**
- Disturbance Level (High | Low)
- Cost per ha (Default = $432)

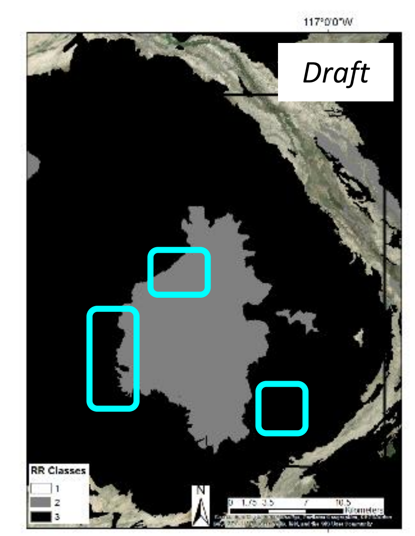
<u>Model Inputs</u>

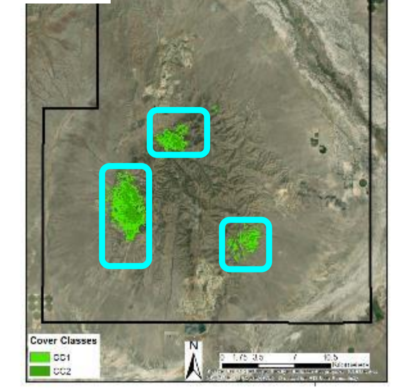
- RSF coefficients
- LC neighborhoods
- Annual Grass Invasion Layer (High | Low)
- Sagebrush Recovery Layers (30 & 50 years)

<u>Deliverables</u>

- Seasonal HSIs
- Annual Composite HSI
- Projected HSI
- GBI Rank Shapefile







Polygons can be drawn on maps of RR or PJ Phase

Conservation Planning Tool – Conifer Treatment Updated

User Inputs

- Candidate Treatment Polygons (Drawn | Imported)
- **Disturbance Level (High | Low)**
- Cost per ha (Default = $432)

Model Inputs

- RSF coefficients
- LC neighborhoods
- Annual Grass Invasion Layer (High | Low)
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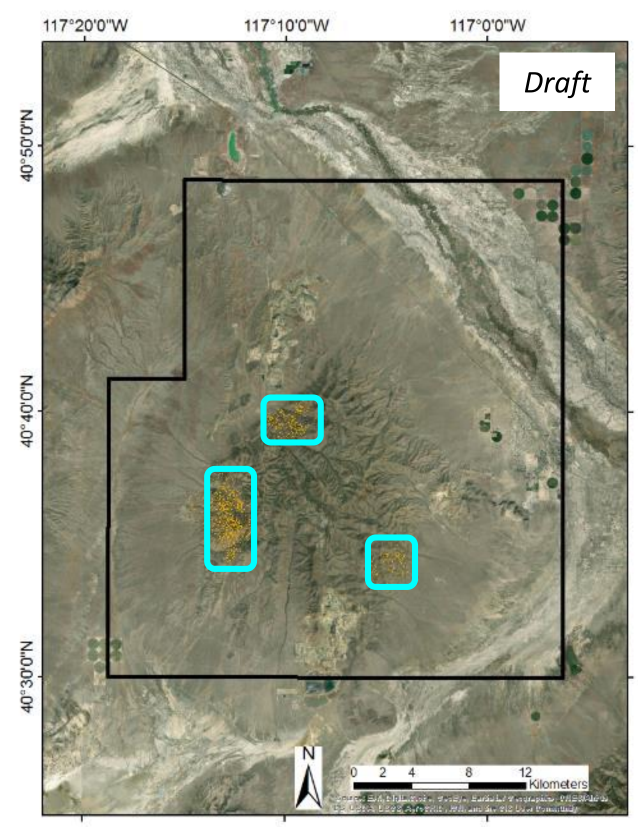

Conservation Planning Tool – Conifer Treatment Updated

User Inputs

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Model Inputs

- RSF coefficients
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- Annual Grass Invasion Layer (High | Low)
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Deliverables

- Seasonal HSIs
- Annual Composite HSI
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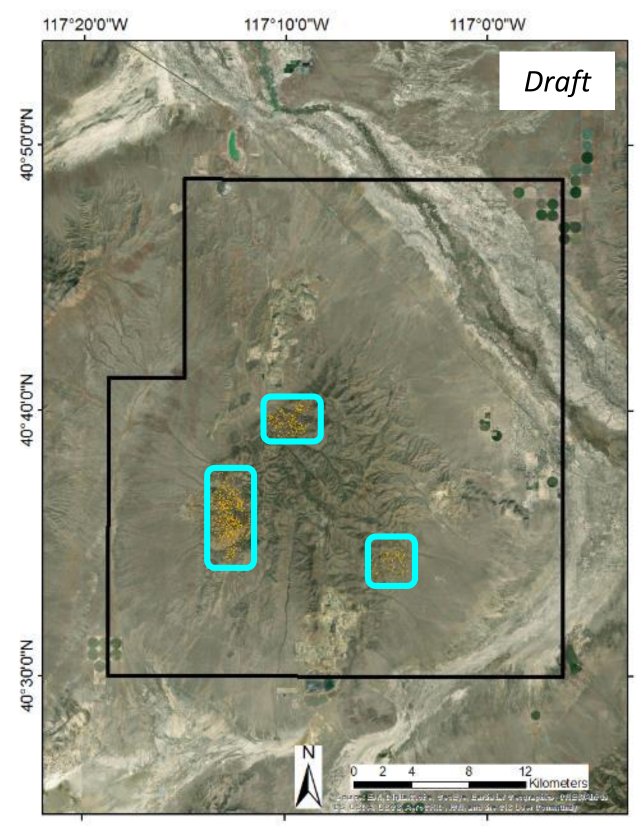
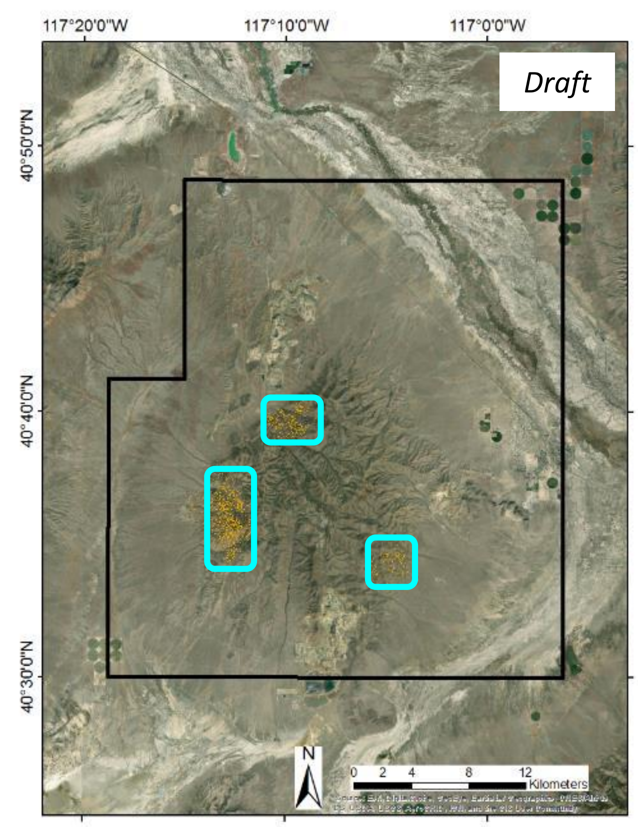


Conservation Planning Tool – Conifer Treatment Updated

Cover Class Inputs

- “CC1”, “CC2”, “CC1 and CC2” – for low cover class removal (habitat restoration)
- “CC3”, “CC2 and CC3” – high cover class removal (thinning, fuel load reduction)
- “All” – non-specific treatment

Future direction: risk of annual grass invasion higher in CC3



Preliminary Information—Subject to Revision. Not for Citation or Distribution

Conservation Planning Tool – Conifer Treatment Updated

User Inputs

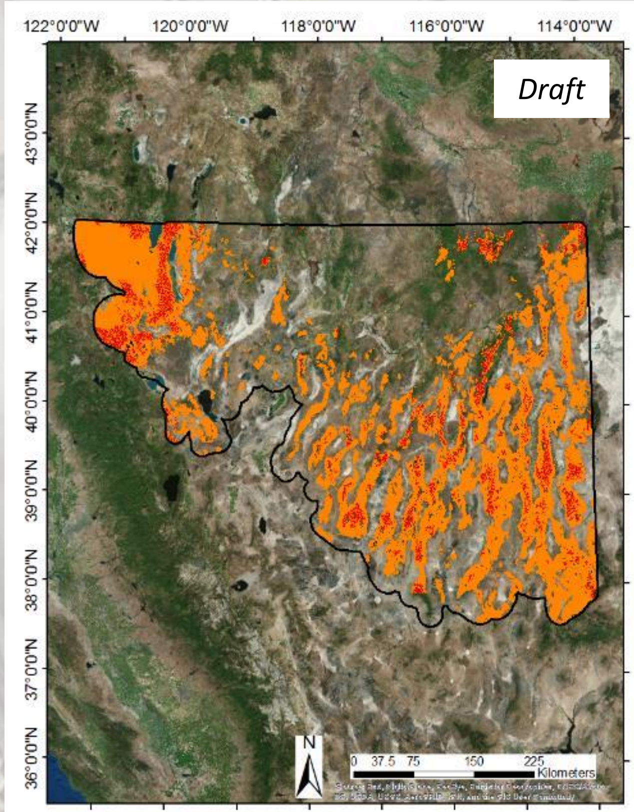
- Candidate Treatment Polygons (Drawn | Imported)
- Disturbance Level (High | Low)
- Cost per ha (Default = $432)

Model Inputs

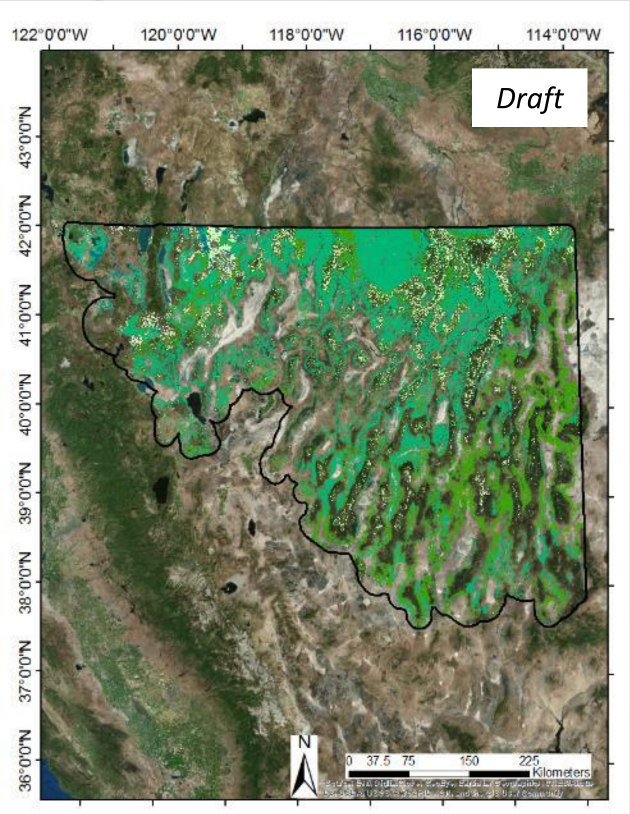
- **RSF coefficients**
- **LC neighborhoods**
- ***Annual Grass Invasion Layer (High | Low)***
- ***Sagebrush Recovery Layers (30 & 50 years)***

Deliverables

- Seasonal HSIs
- Annual Composite HSI
- Projected HSI
- GBI Rank Shapefile



Annual Grass Invasion



Sagebrush Recovery

81 site x season x time HSI surfaces (plus hydrographic region correction) 'post-cut'

Conservation Planning Tool – Conifer Treatment Updated

User Inputs

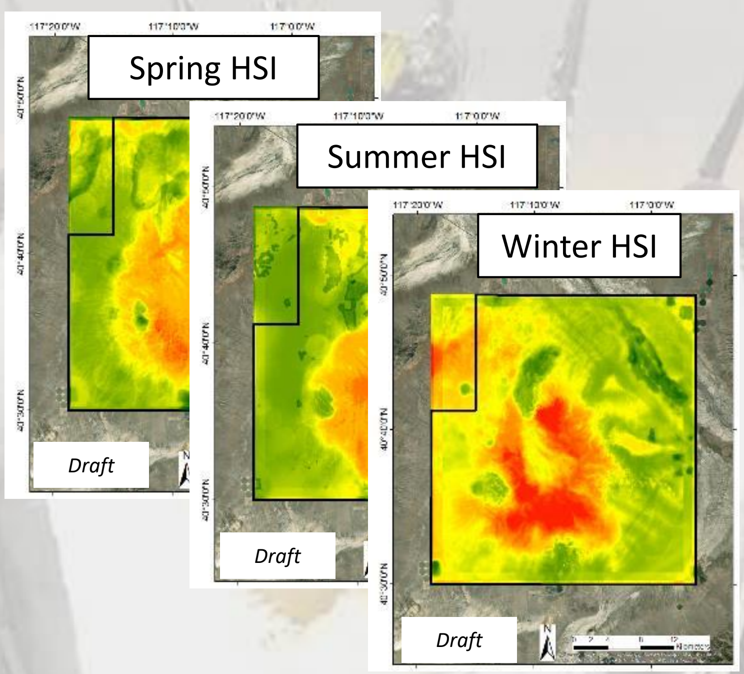
- Candidate Treatment Polygons (Drawn | Imported)
- Disturbance Level (High | Low)
- Cost per ha (Default = $432)

Model Inputs

- RSF coefficients
- LC neighborhoods
- Annual Grass Invasion Layer (High | Low)
- Sagebrush Recovery Layers (30 & 50 years)

Deliverables

- **Seasonal HSIs**
- Annual Composite GBI
- Projected GBI
- GBI Rank Shapefile



Conservation Planning Tool – Conifer Treatment Updated

User Inputs

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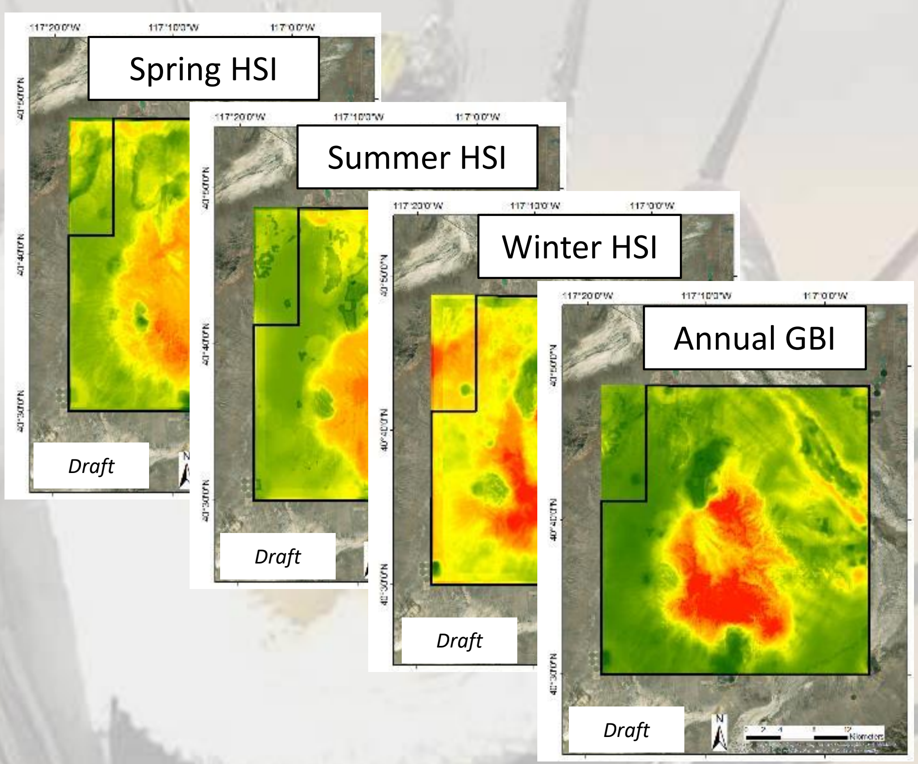
Deliverables

- Seasonal HSIs
- **Annual Composite GBI**
- Projected GBI
- GBI Rank Shapefile



Conservation Planning Tool – Conifer Treatment Updated

<u>User Inputs</u>

- Candidate Treatment Polygons (Drawn | Imported)
- Disturbance Level (High | Low)
- Cost per ha (Default = $432)

<u>Model Inputs</u>

- RSF coefficients
- LC neighborhoods
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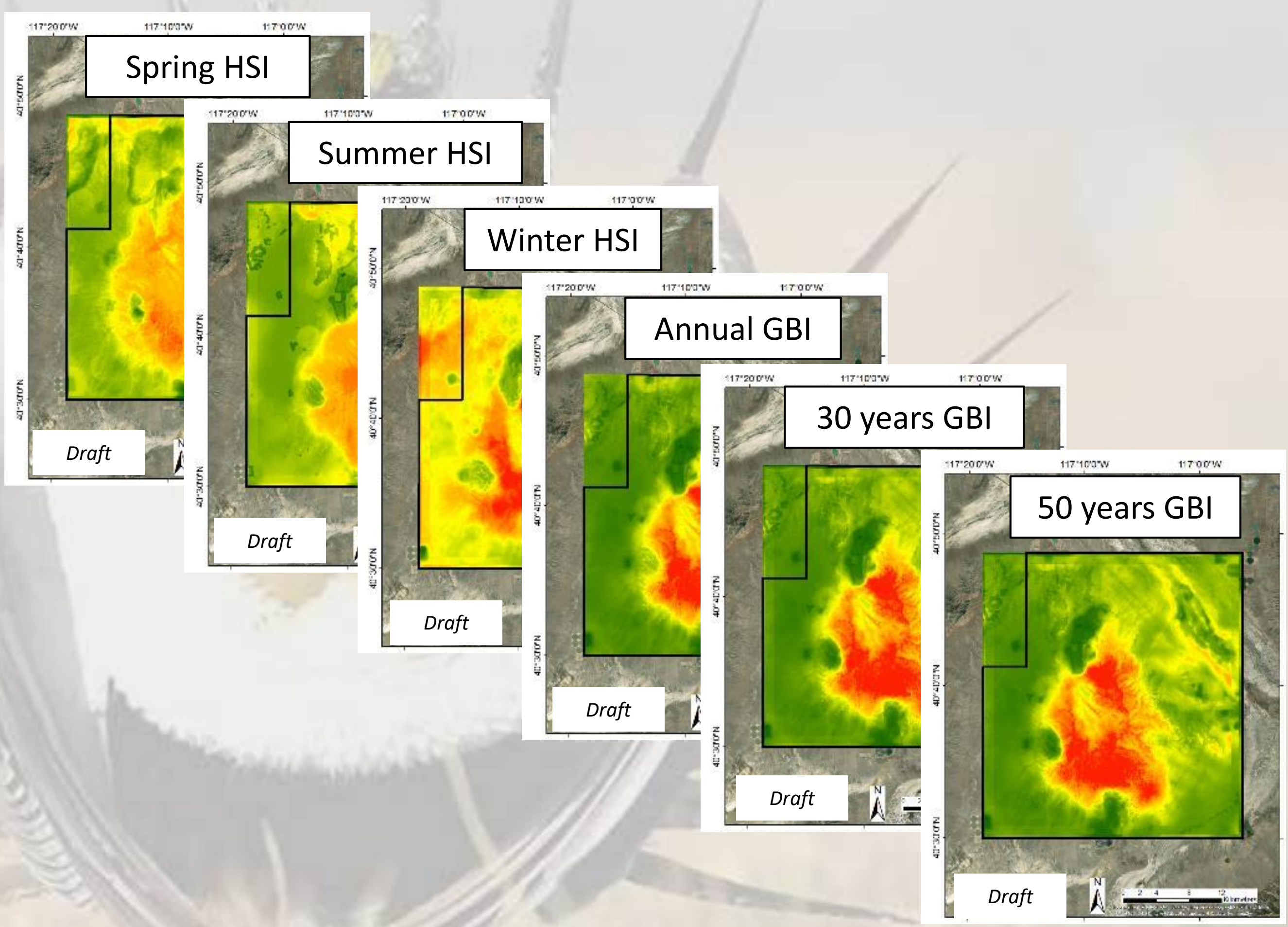
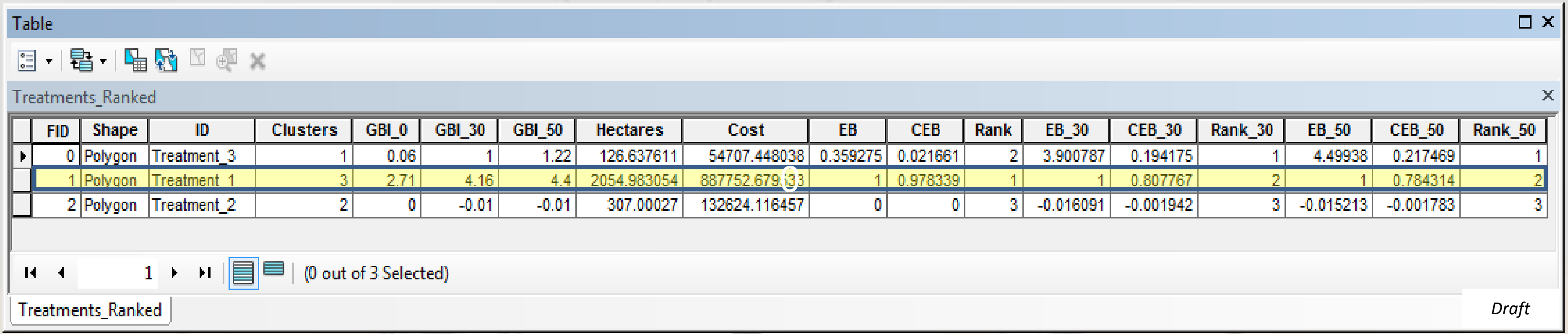
<u>Deliverables</u>

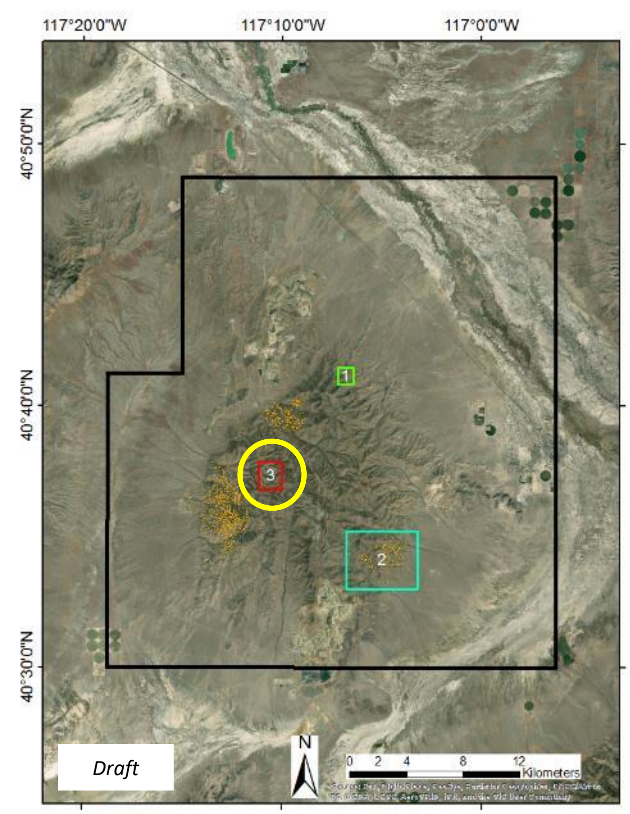
- Seasonal HSIs
- Annual Composite GBI
- **Projected GBI**
- GBI Rank Shapefile



Conservation Planning Tool – Conifer Treatment Updated



FID	Shape	ID	Clusters	GBI_0	GBI_30	GBI_50	Hectares	Cost	EB	CEB	Rank	EB_30	CEB_30	Rank_30	EB_50	CEB_50	Rank_50
0	Polygon	Treatment_3	1	0.06	1	1.22	126.637611	54707.448038	0.359275	0.021661	2	3.900787	0.194175	1	4.49938	0.217469	1
1	Polygon	Treatment_1	3	2.71	4.16	4.4	2054.983054	887752.679[illegible]33	1	0.978339	1	1	0.807767	2	1	0.784314	2
2	Polygon	Treatment_2	2	0	-0.01	-0.01	307.00027	132624.116457	0	0	3	-0.016091	-0.001942	3	-0.015213	-0.001783	3



Model Inputs

- RSF coefficients
- LC neighborhoods
- Annual Grass Invasion Layer (High | Low)
- Sagebrush Recovery Layers (30 & 50 years)

Deliverables

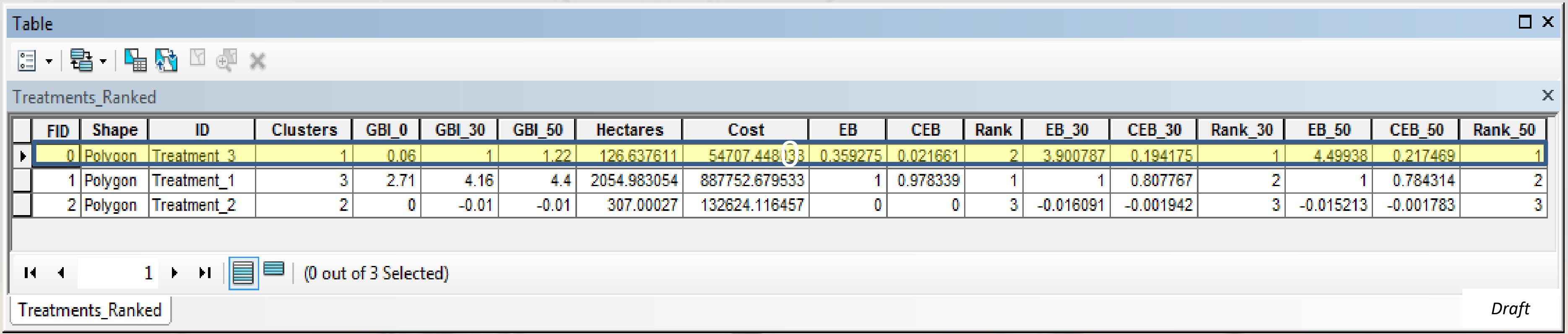
- Seasonal HSIs
- Annual Composite HSI
- Projected HSI
- **GBI Rank Shapefile**

GBI Rank Shapefile

Immediate Best Benefit

Preliminary Information—Subject to Revision. Not for Citation or Distribution

Conservation Planning Tool – Conifer Treatment Updated



FID	Shape	ID	Clusters	GBI_0	GBI_30	GBI_50	Hectares	Cost	EB	CEB	Rank	EB_30	CEB_30	Rank_30	EB_50	CEB_50	Rank_50
0	Polygon	Treatment_3	1	0.06	1	1.22	126.637611	54707.448[illegible]33	0.359275	0.021661	2	3.900787	0.194175	1	4.49938	0.217469	1
1	Polygon	Treatment_1	3	2.71	4.16	4.4	2054.983054	887752.679533	1	0.978339	1	1	0.807767	2	1	0.784314	2
2	Polygon	Treatment_2	2	0	-0.01	-0.01	307.00027	132624.116457	0	0	3	-0.016091	-0.001942	3	-0.015213	-0.001783	3

1 (0 out of 3 Selected)

Treatments_Ranked

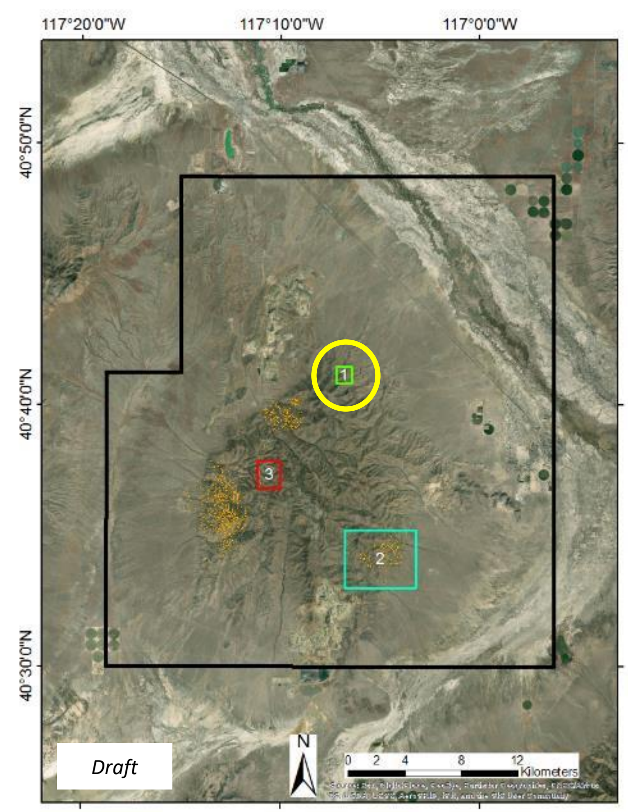
Draft

<u>Model Inputs</u>

- RSF coefficients
- LC neighborhoods
- Annual Grass Invasion Layer (High | Low)
- Sagebrush Recovery Layers (30 & 50 years)

<u>Deliverables</u>

- Seasonal HSIs
- Annual Composite HSI
- Projected HSI
- **GBI Rank Shapefile**



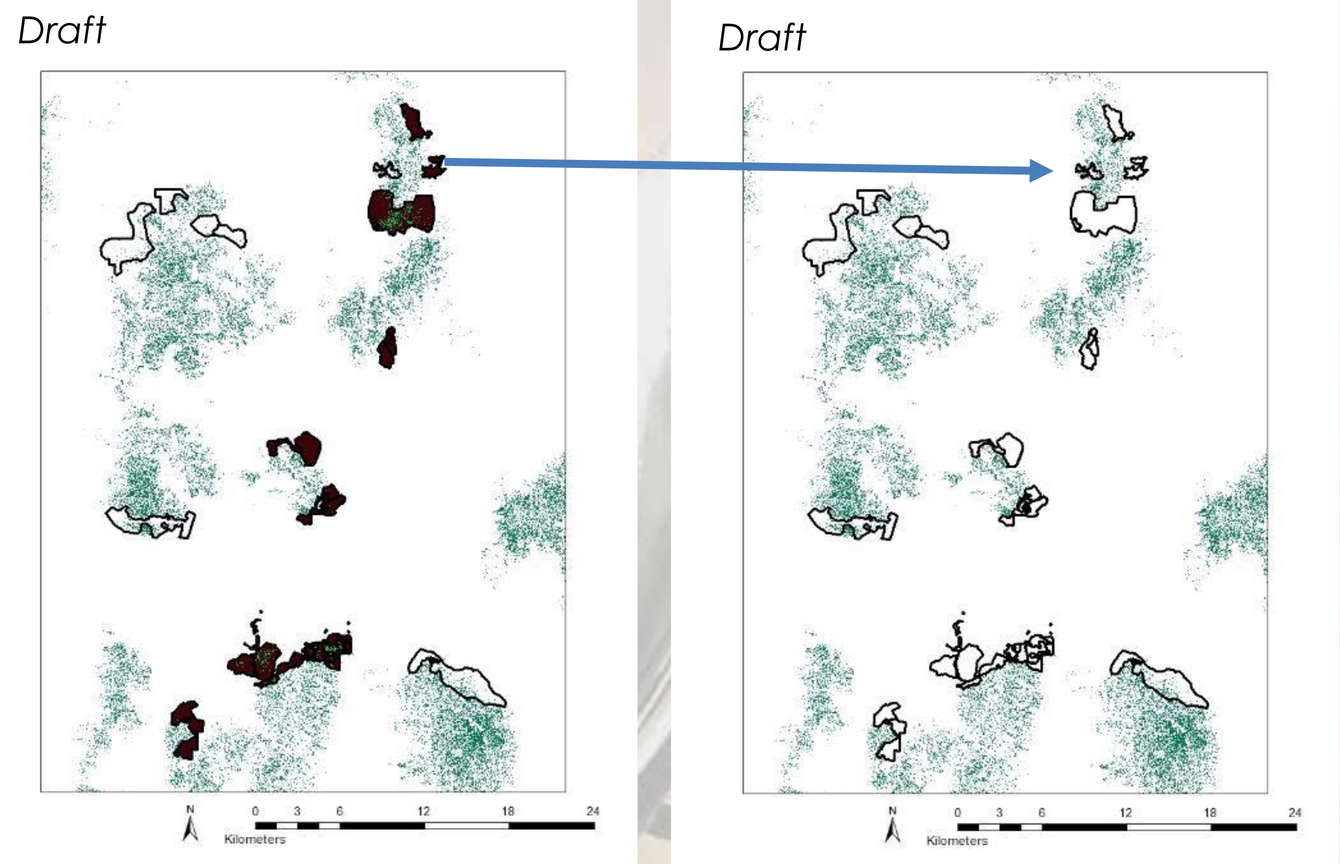
GBI Rank Shapefile

Immediate Best Benefit

Conservation Planning Tool – Conifer Treatment Updated

- **Flexibility** with cover class selection promotes **targeted management planning**
- PJ layer can be **updated** to reflect past treatments and reset baseline HSIs
- Spatial processing and tool parameterization is entirely **automated**

Completed cuts can be used to update PJ binary



Conclusions and Next Steps

- Continued and additional monitoring of sage-grouse and other focal sagebrush species at appropriate scales to inform science-based management decisions
- Increase the extent of scenario-based conservation planning tools to better predict outcomes for focal species
- Continue to overcome challenges with incorporating best-available-science into current management practices and policy

T. Gettelman, USGS

Sagebrush Ecosystem Council
Sagebrush Ecosystems Technical Team
Technical Advisory Committee – Bi-State
Local Area Working Group – Bi-State
Tribal Natural Resource Committee – Bi-State
Executive Oversight Committee – Bi-State

Nevada Department Of Wildlife
California Department of Fish and Wildlife
Bureau of Land Management
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Natural Resource Conservation Service
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Resource Concepts, Inc.