

Greater Sage-Grouse and Pinyon-Juniper:

Overview of Science and Decision Support Applications

Photo: Bob Wick (BLM)

Peter S. Coates, Cali L. Weise, Brian G. Prochazka, and Seth Dettenmaier
U. S. Geological Survey, Western Ecological Research Center



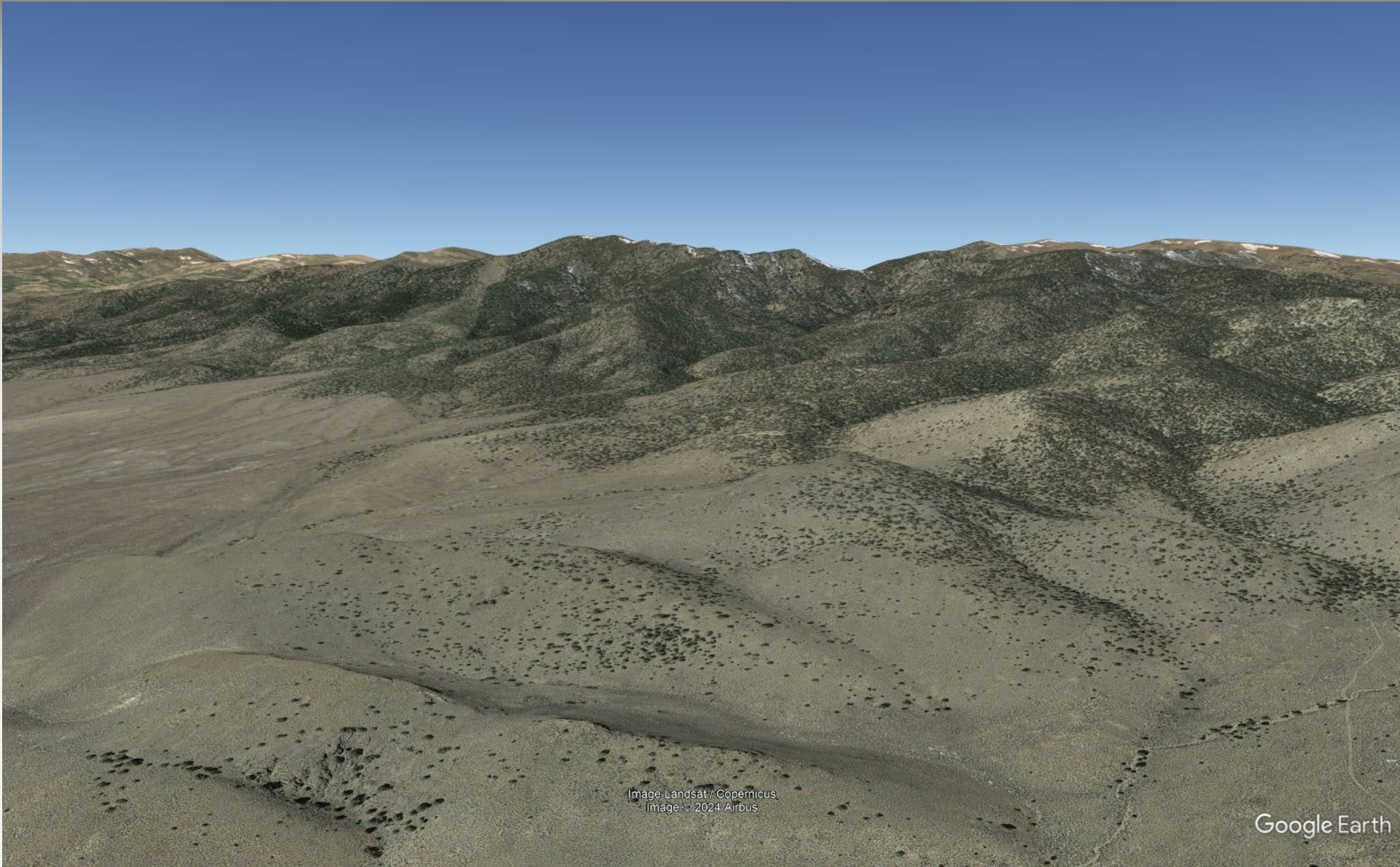


Image Landsat / Copernicus
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Google Earth

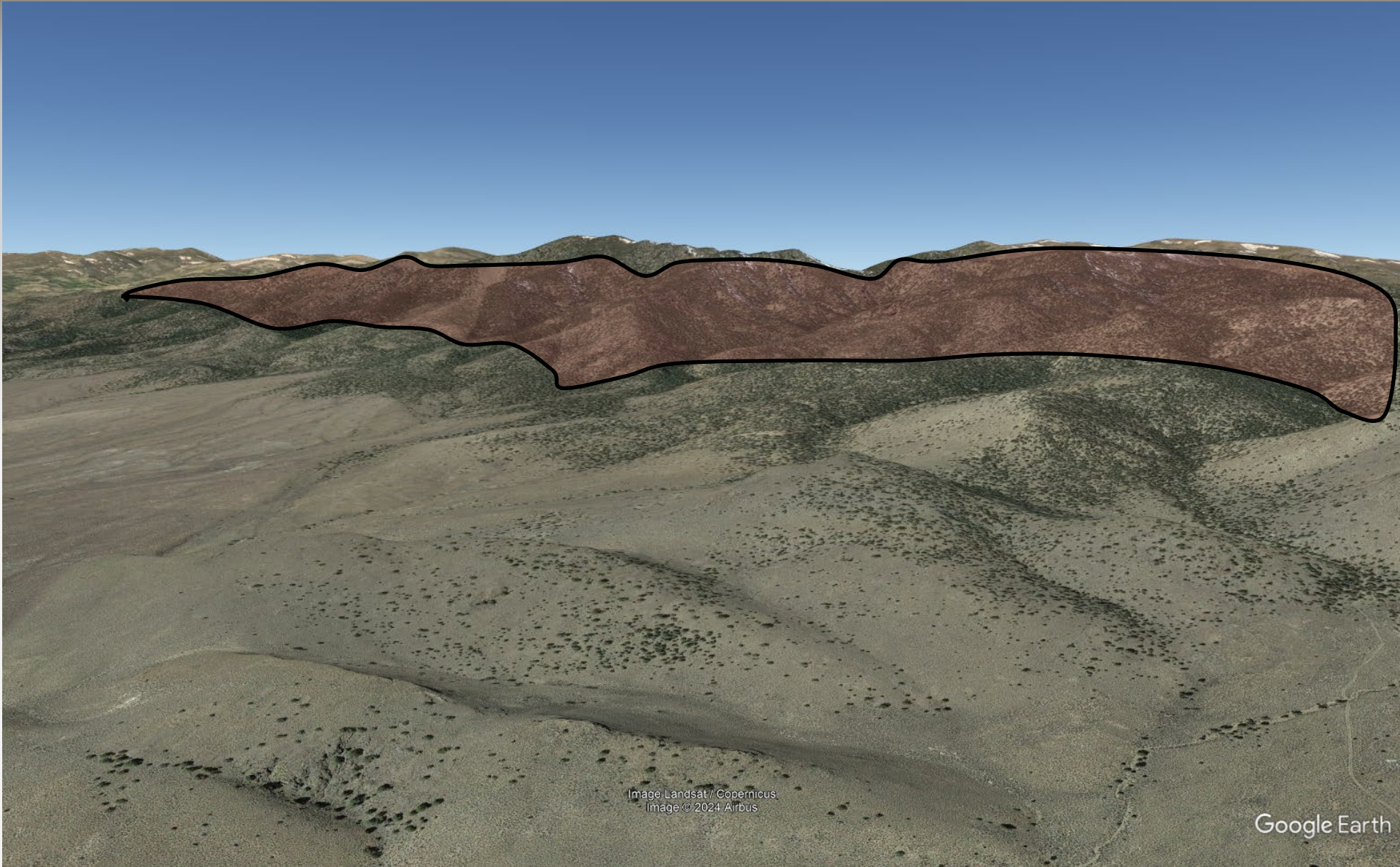


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Woodland Expansion into Sagebrush Ecosystems

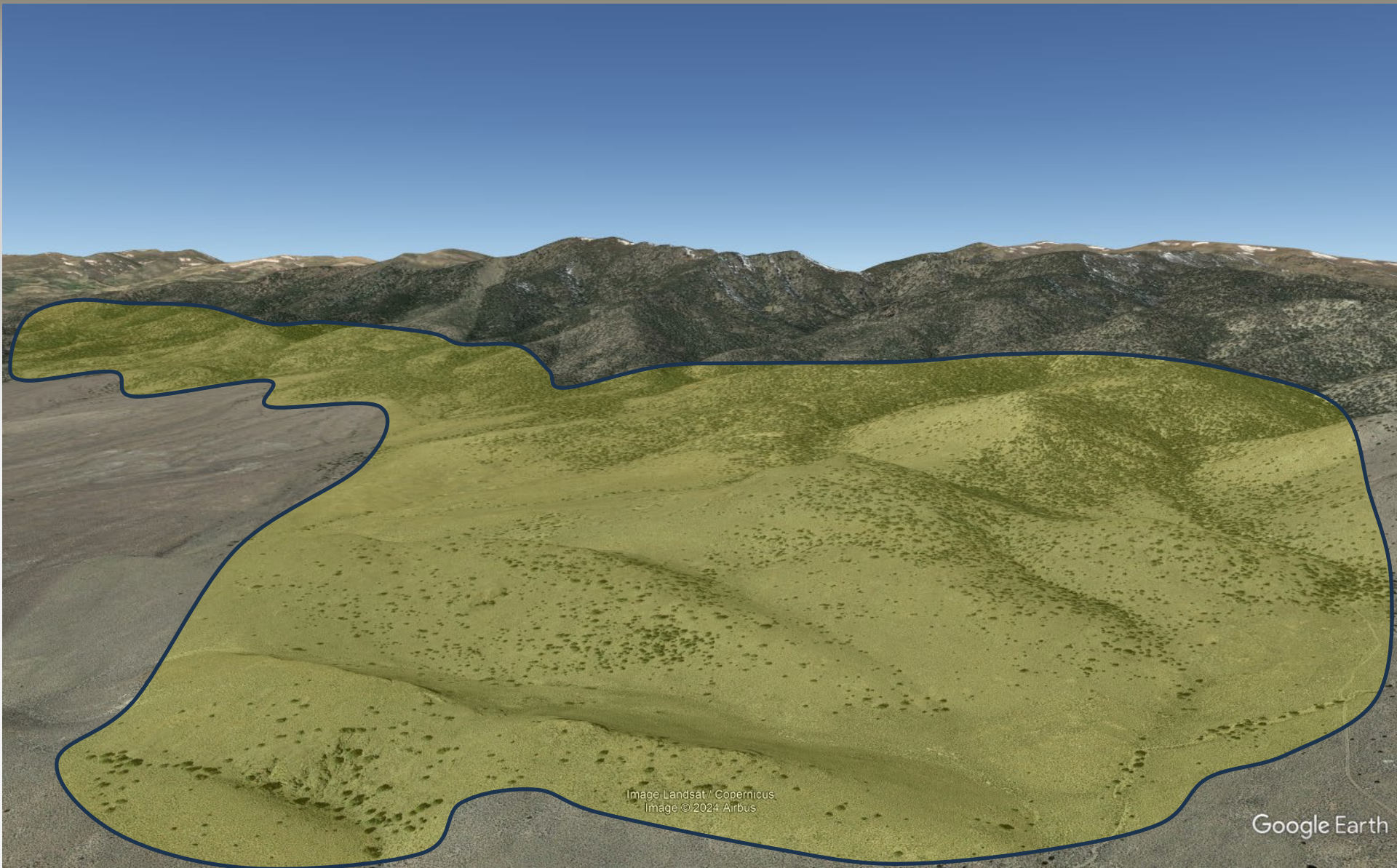


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Woodland Expansion into Sagebrush Ecosystems

- ~2/3 of pinyon and juniper cover is relatively early age class
- 90% expansion has occurred in sagebrush ecosystems
- 0.4 – 1.5%/year
- 2 to 6 times more PJ today than during the 1800s

Image Landsat / Copernicus
Image © 2024 Airbus

Google Earth

Woodland Expansion into Sagebrush Ecosystems

- **Intensive grazing – wildfire suppression**
- **Conducive climate conditions**
- **Re-establishment of historically cleared woodlands**

Image Landsat / Copernicus
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Woodland Expansion into Sagebrush Ecosystems

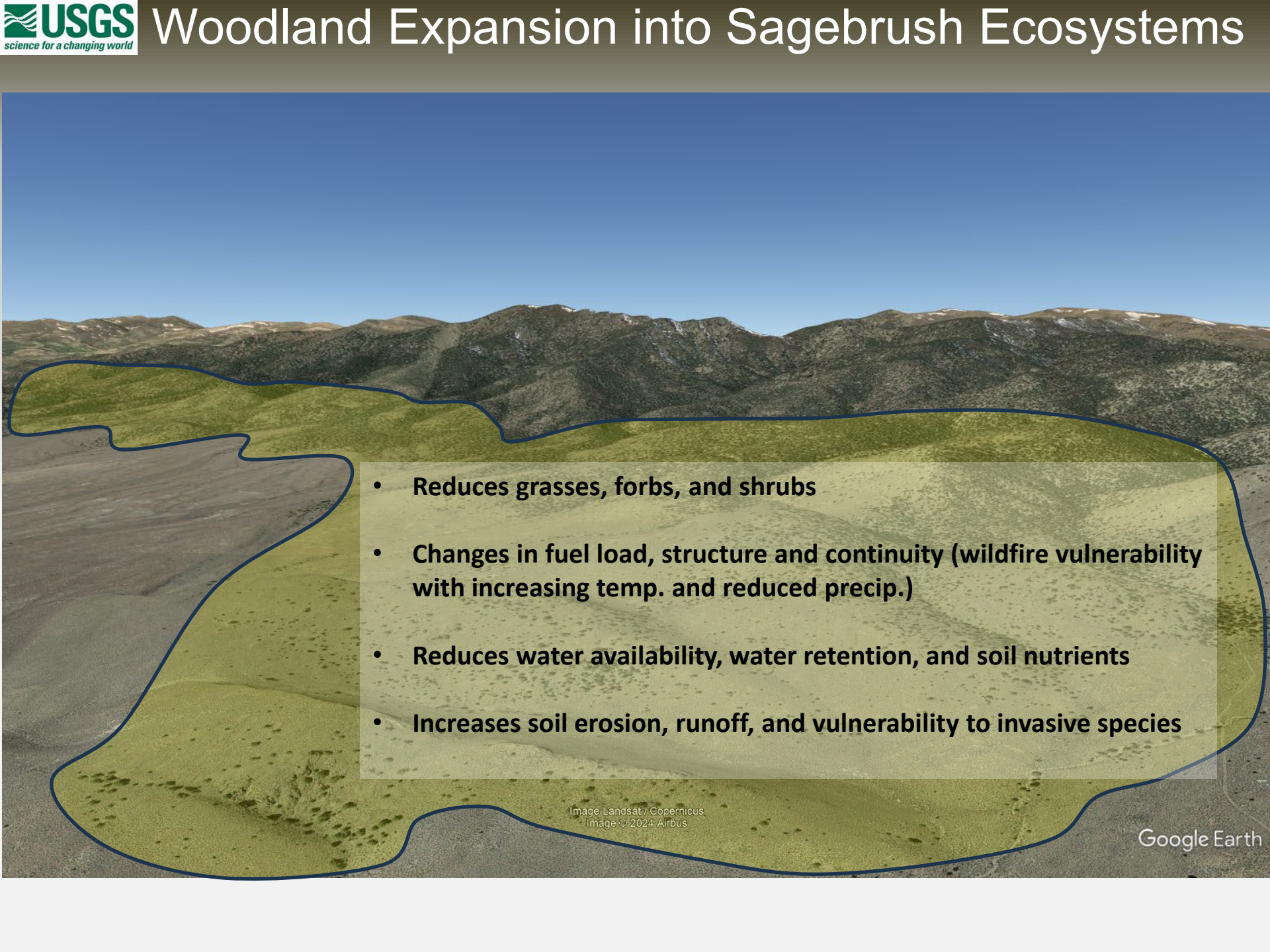
- 
- Reduces grasses, forbs, and shrubs
 - Changes in fuel load, structure and continuity (wildfire vulnerability with increasing temp. and reduced precip.)
 - Reduces water availability, water retention, and soil nutrients
 - Increases soil erosion, runoff, and vulnerability to invasive species

Image Landsat / Copernicus
Image © 2024 Airbus

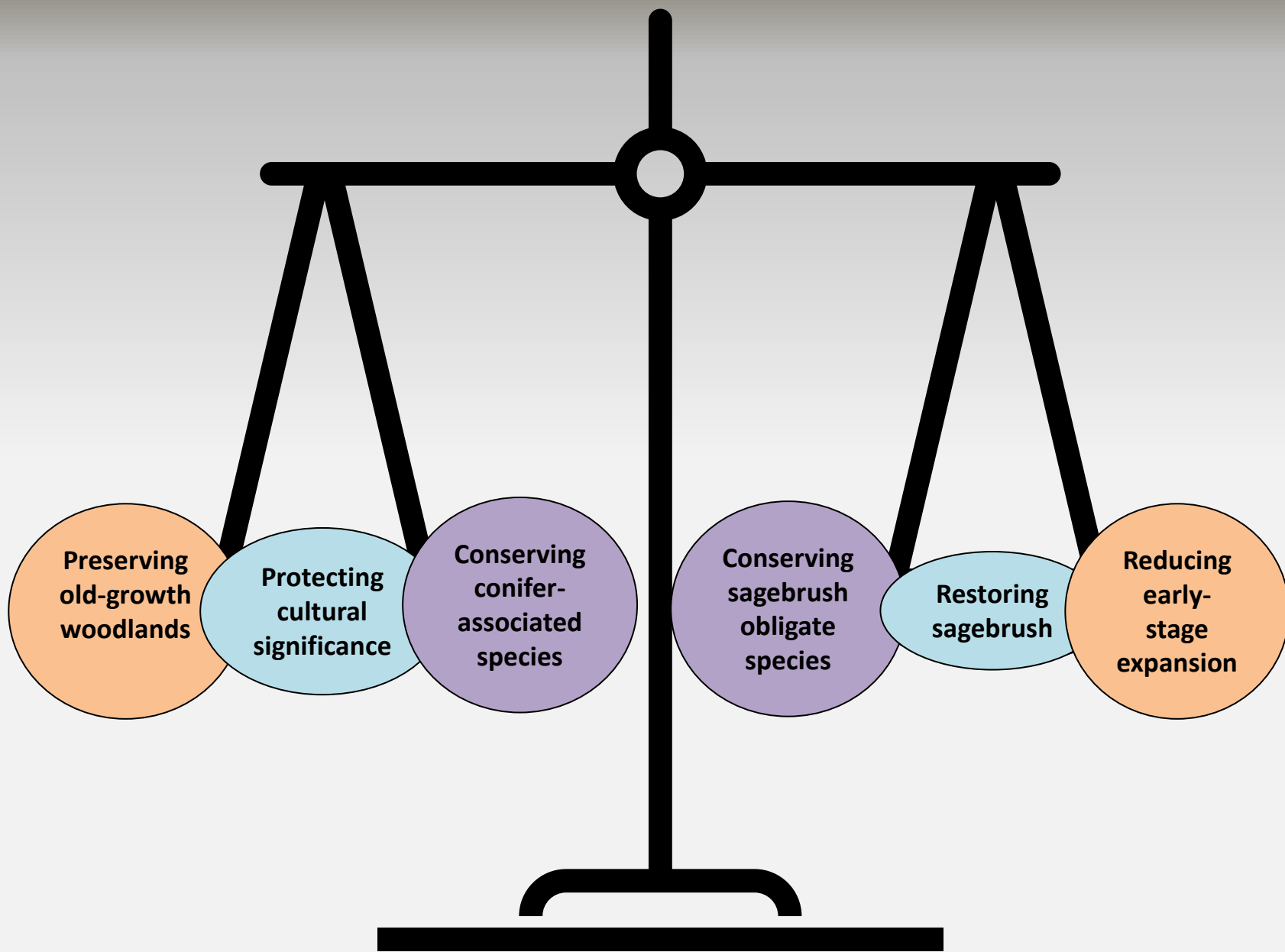
Google Earth

Woodland Expansion into Sagebrush Ecosystems

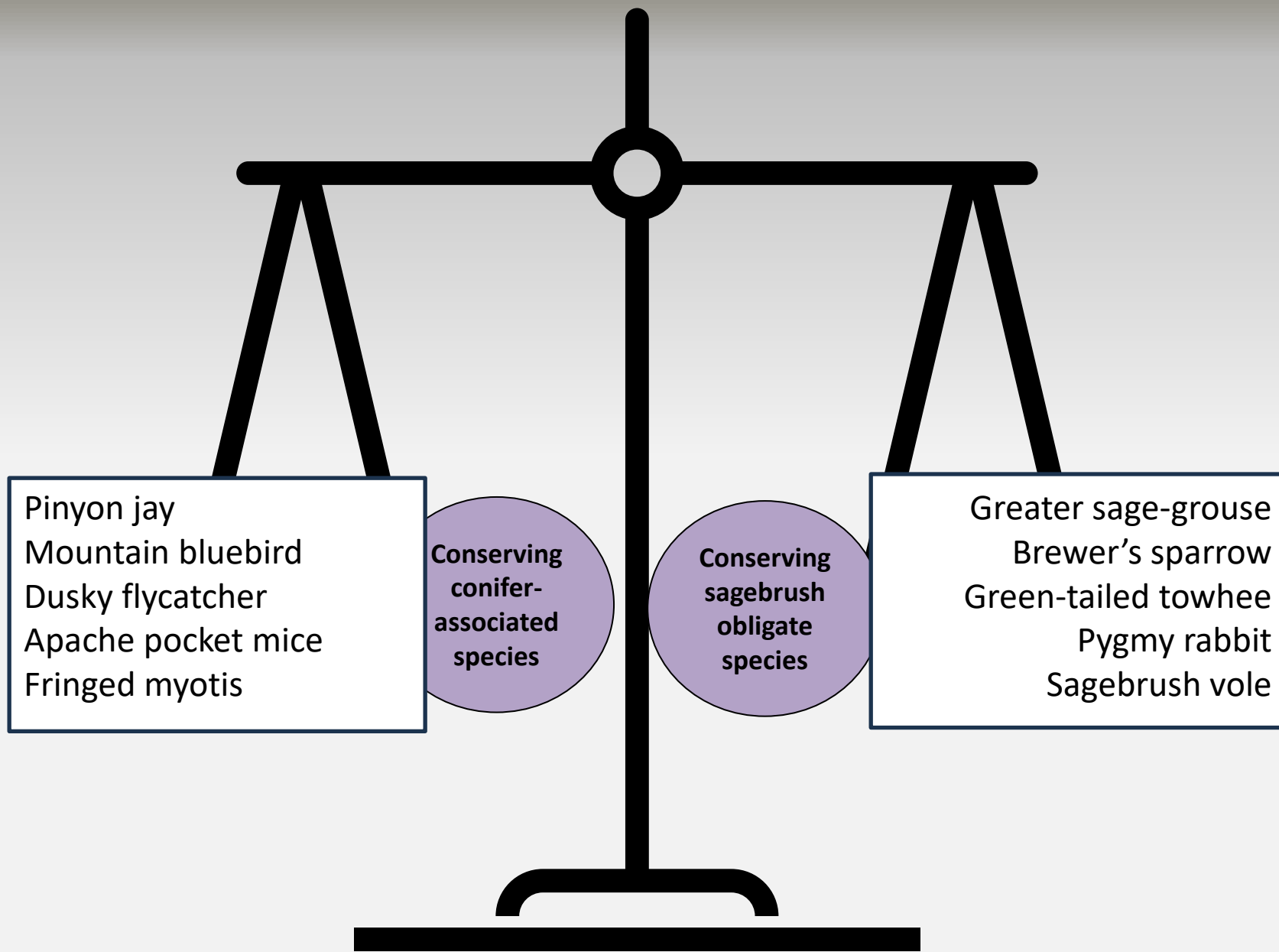


From Olsen et al. 2021, Ecosphere
Photo Credit: BLM Prineville District

Balancing Management Objectives



Wildlife Management Focus

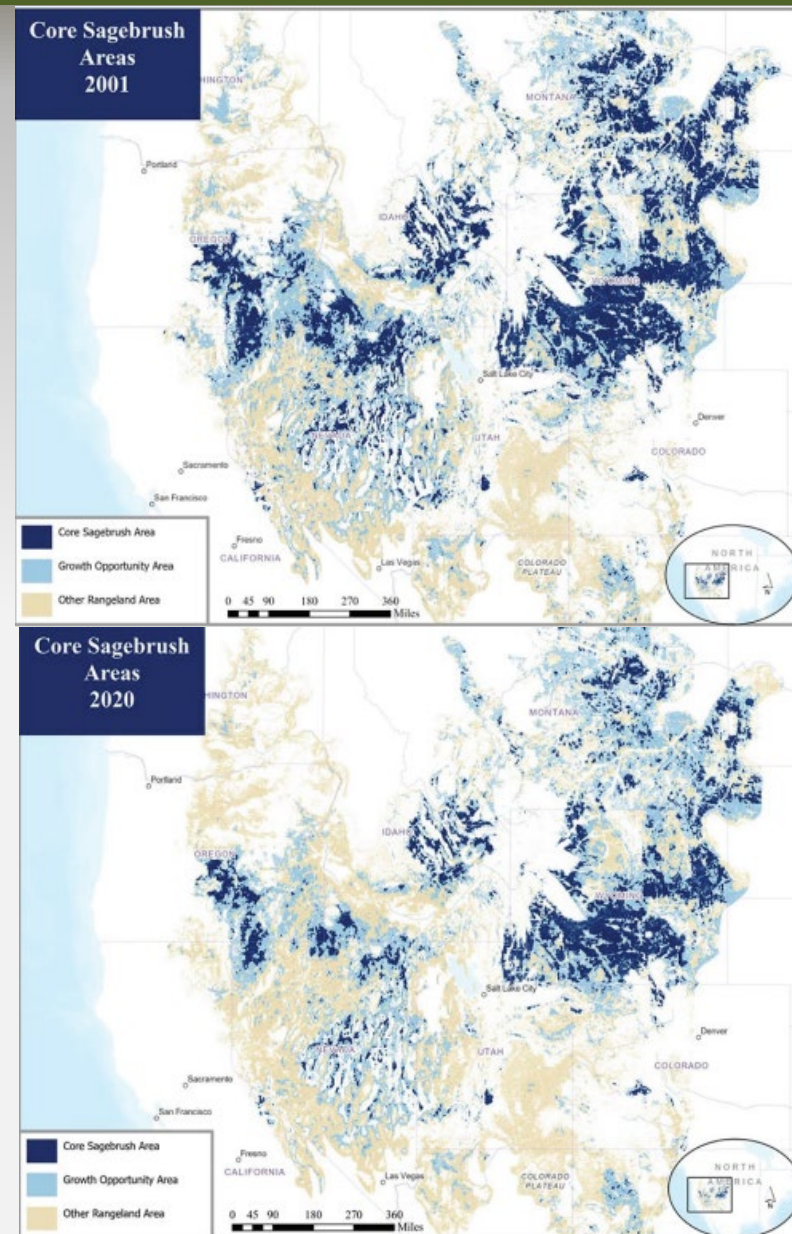
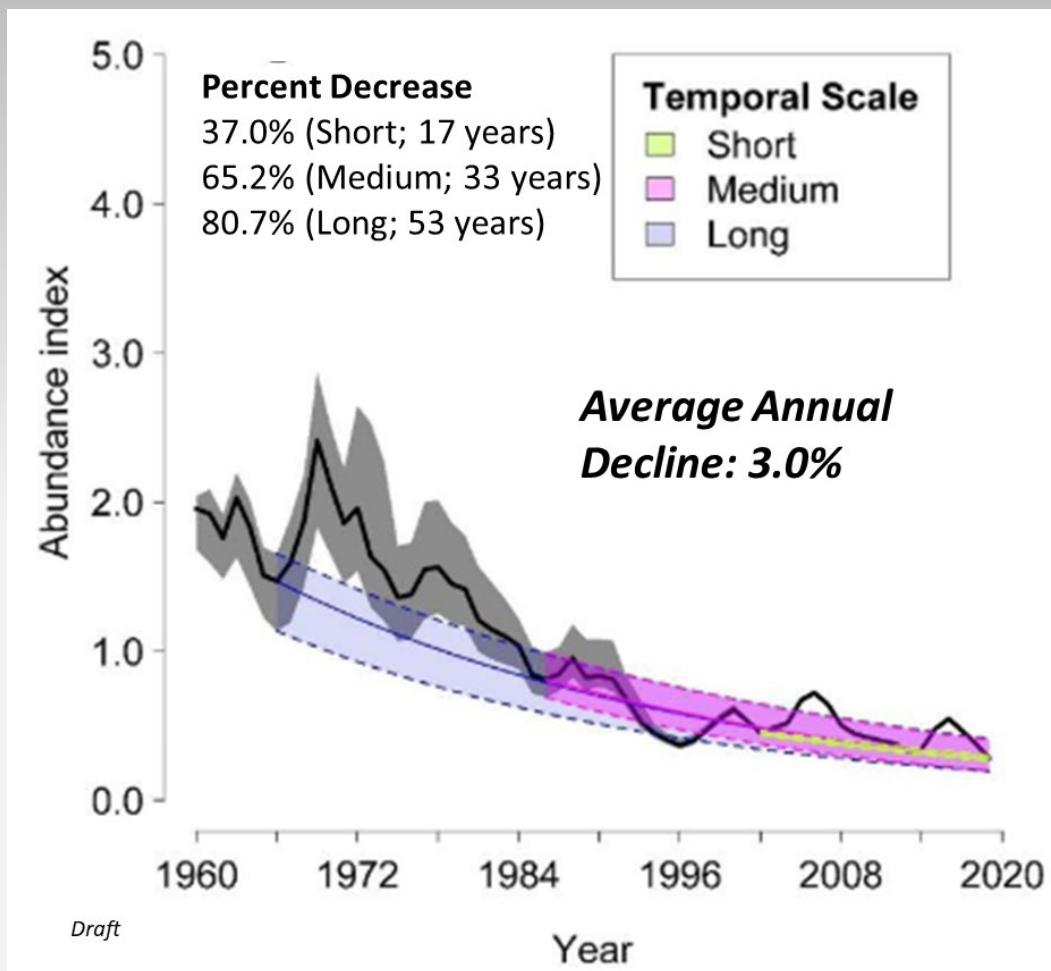


The Canary in a Coal Mine



Photo: Bob Wick (BLM)

80% Loss of Sage-Grouse Since 1960s





H. Copeland



Scott Shaff, USGS



R. Arkle

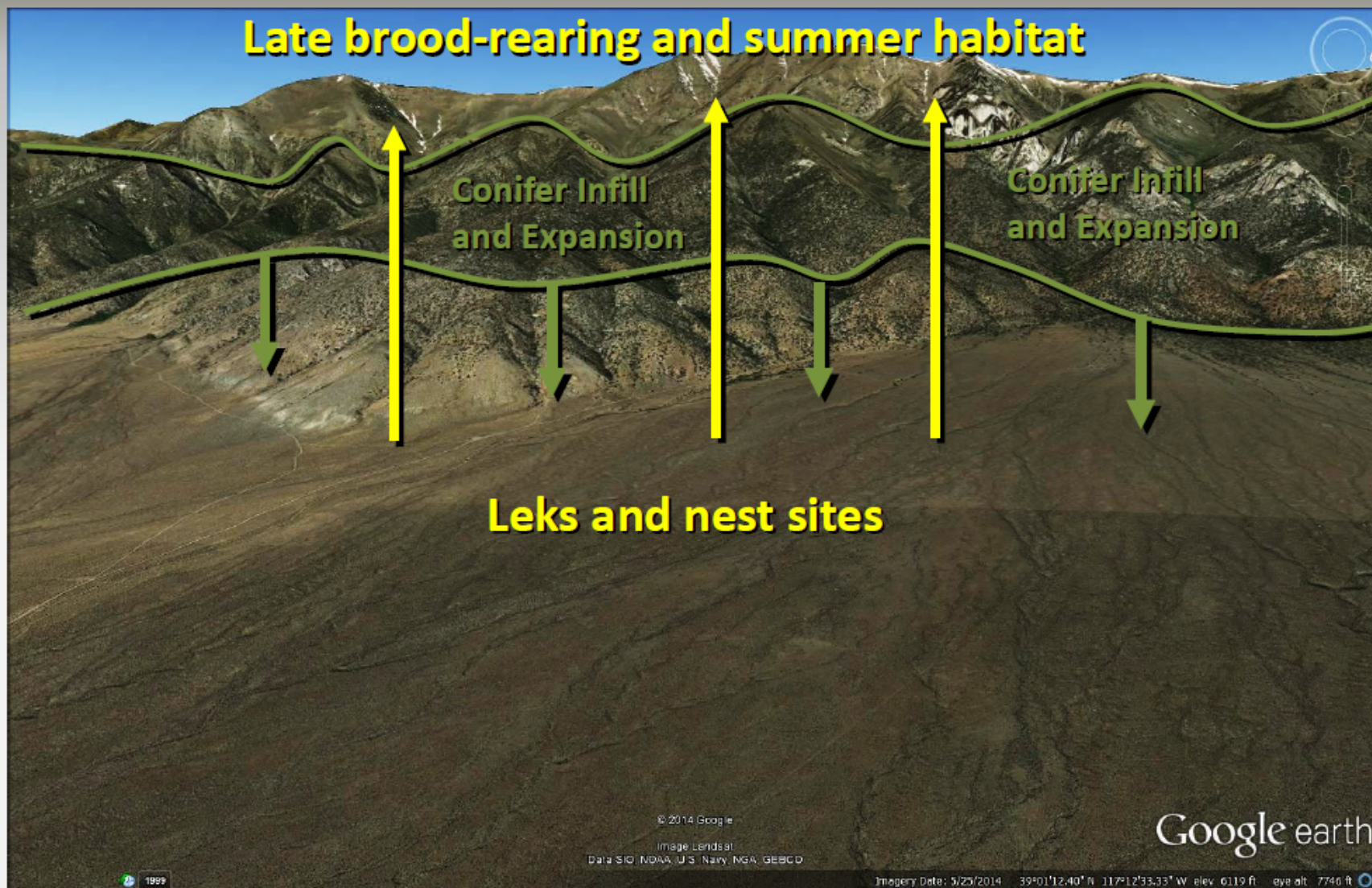


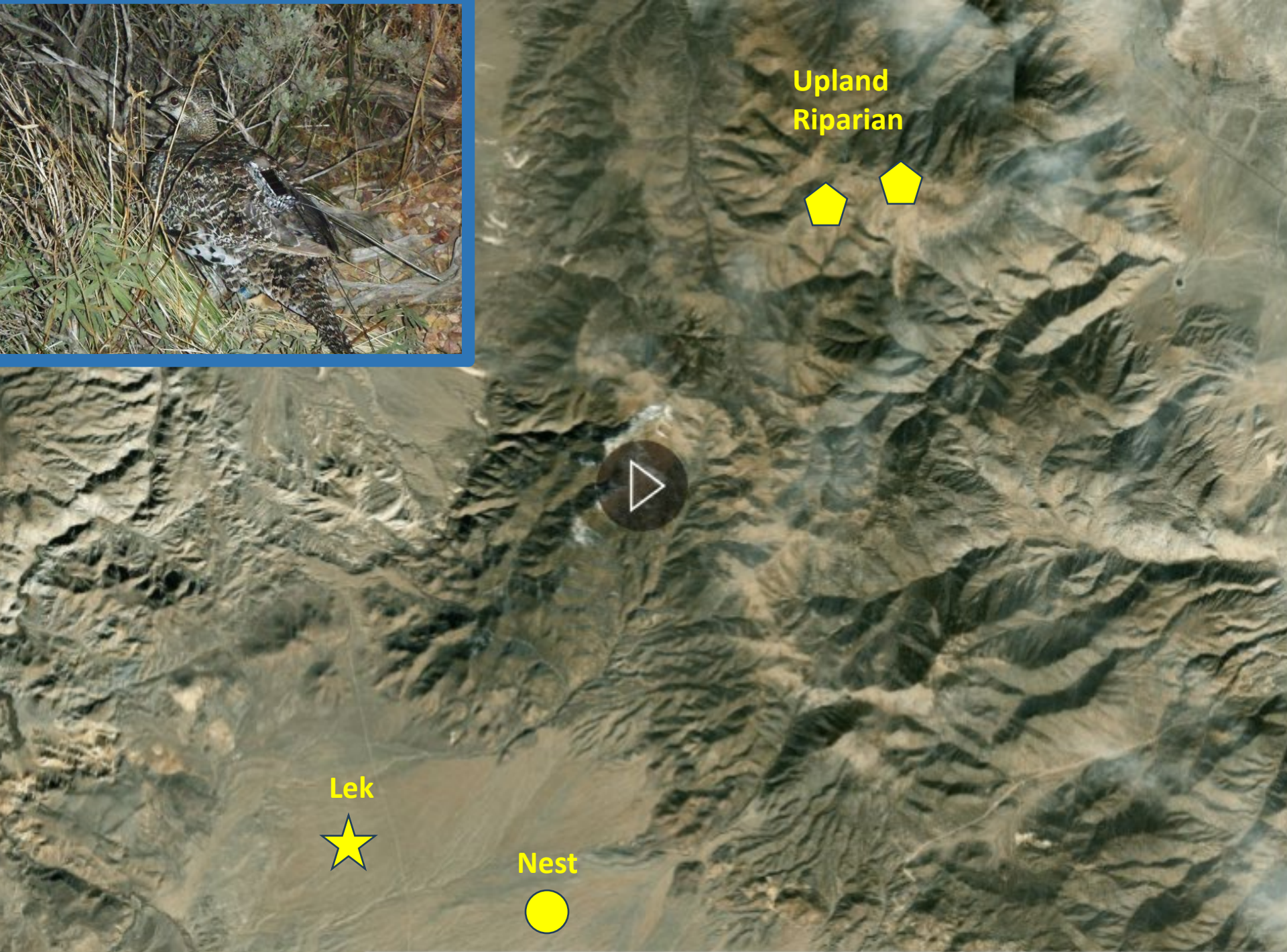
G. Vyn

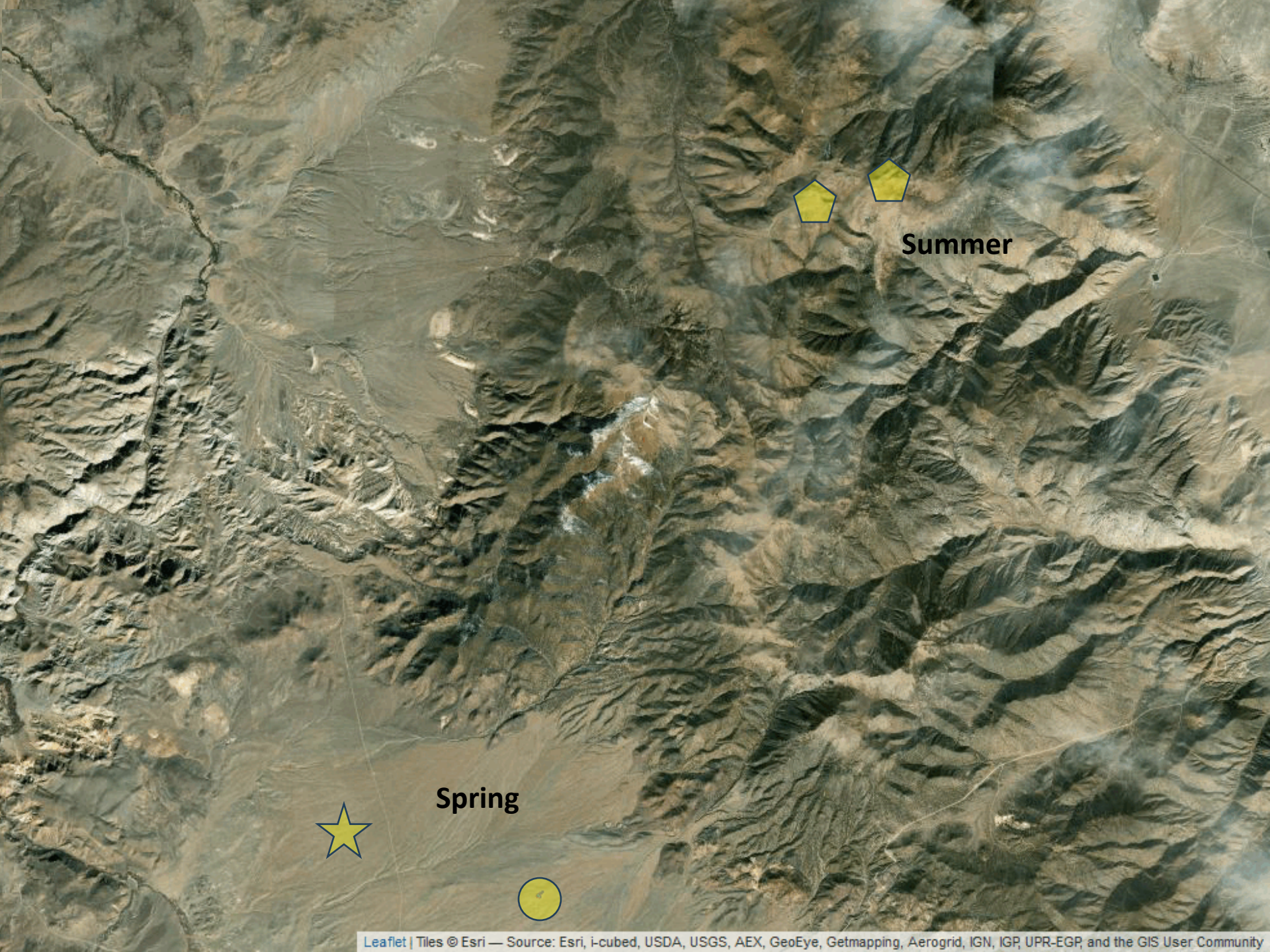


M. Schoede

Through the Lens of a Sage-Grouse



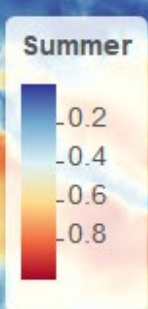
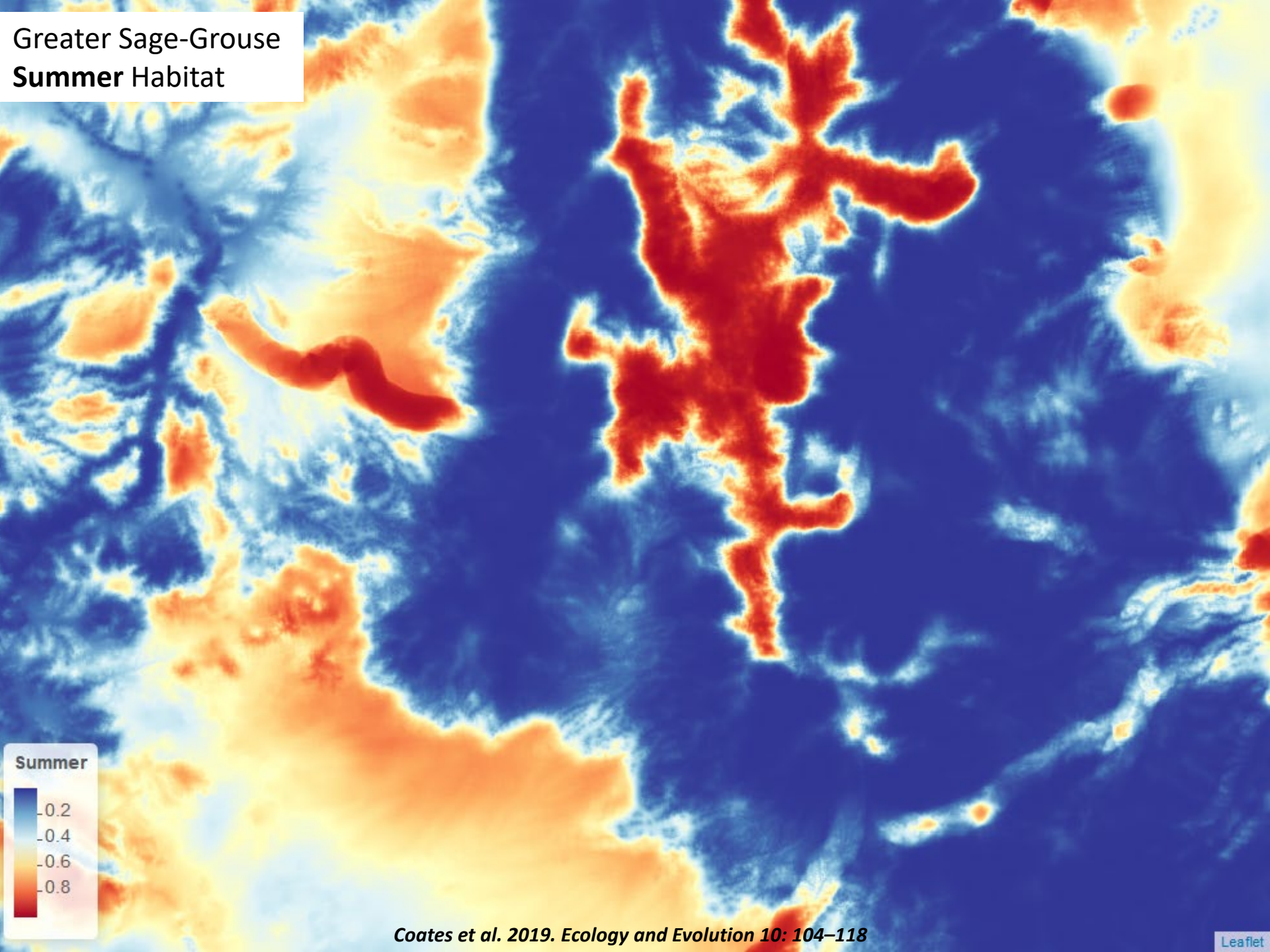




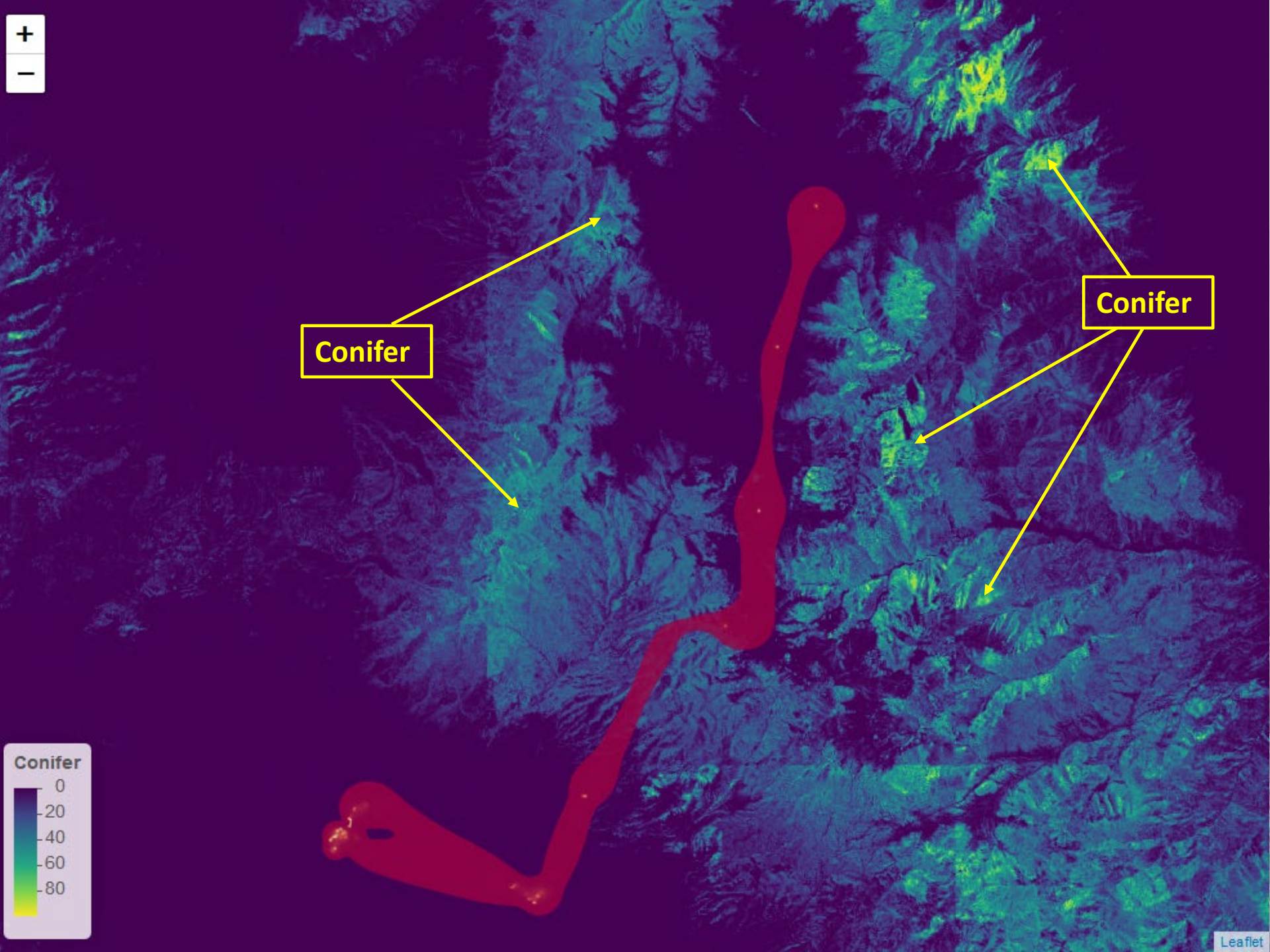
Spring

Summer

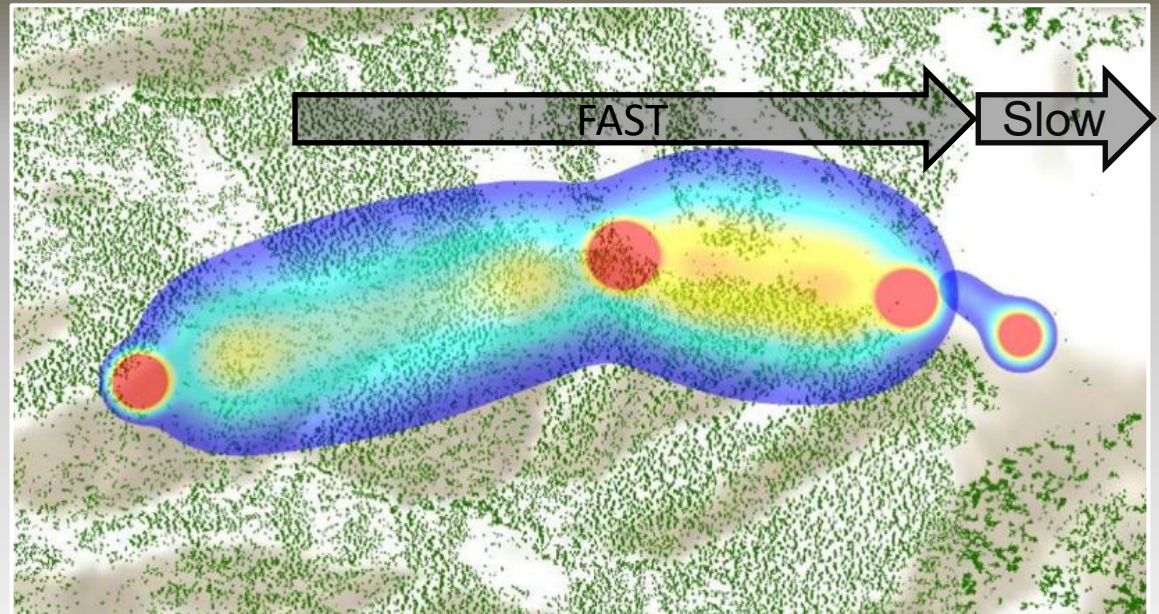
Greater Sage-Grouse Summer Habitat



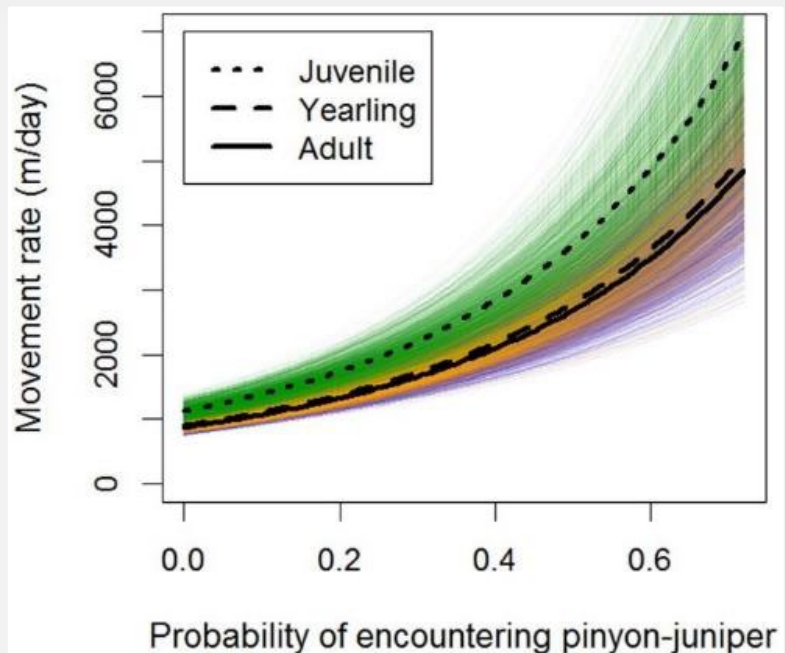
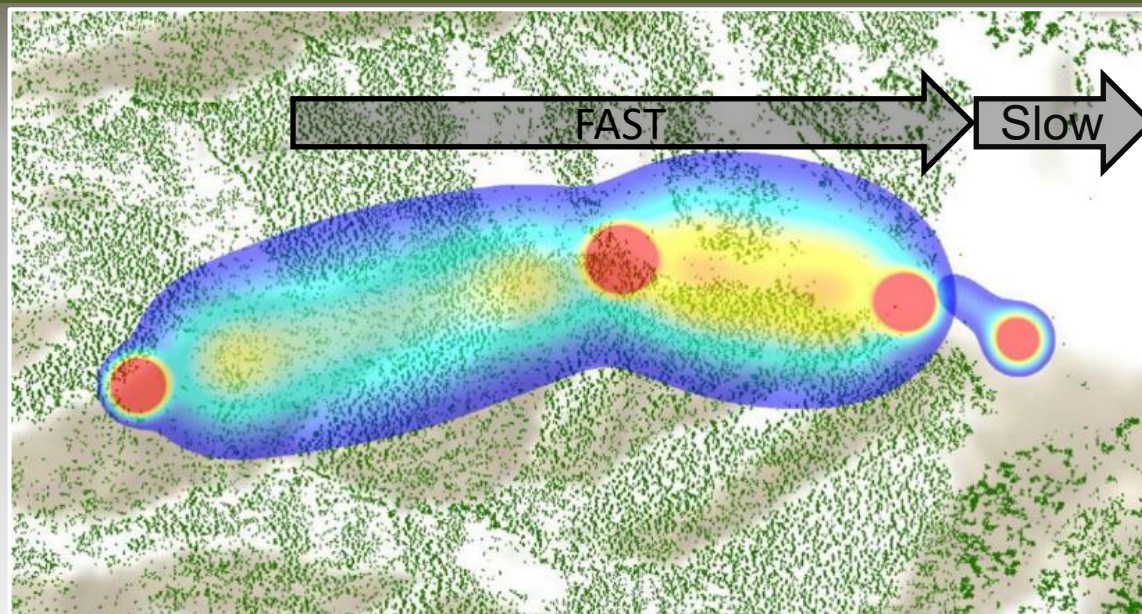
Coates et al. 2019. Ecology and Evolution 10: 104–118



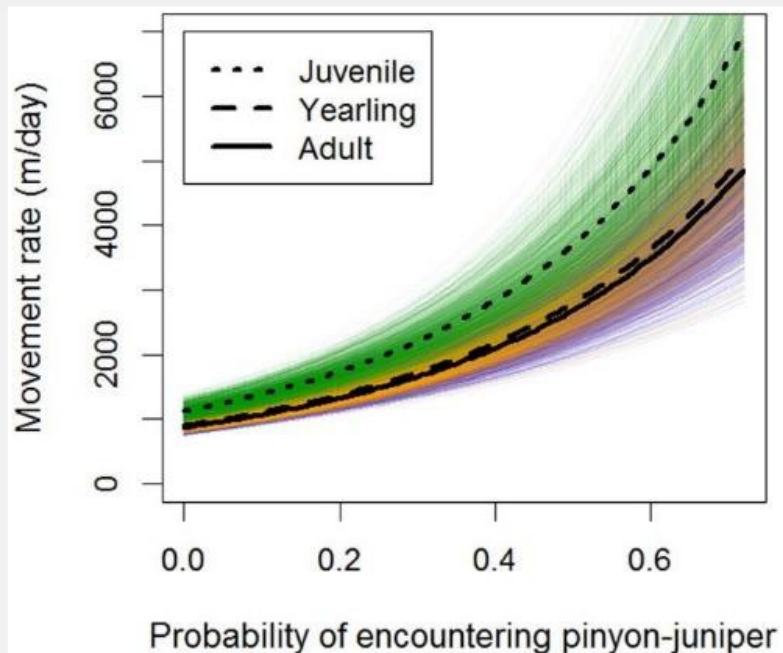
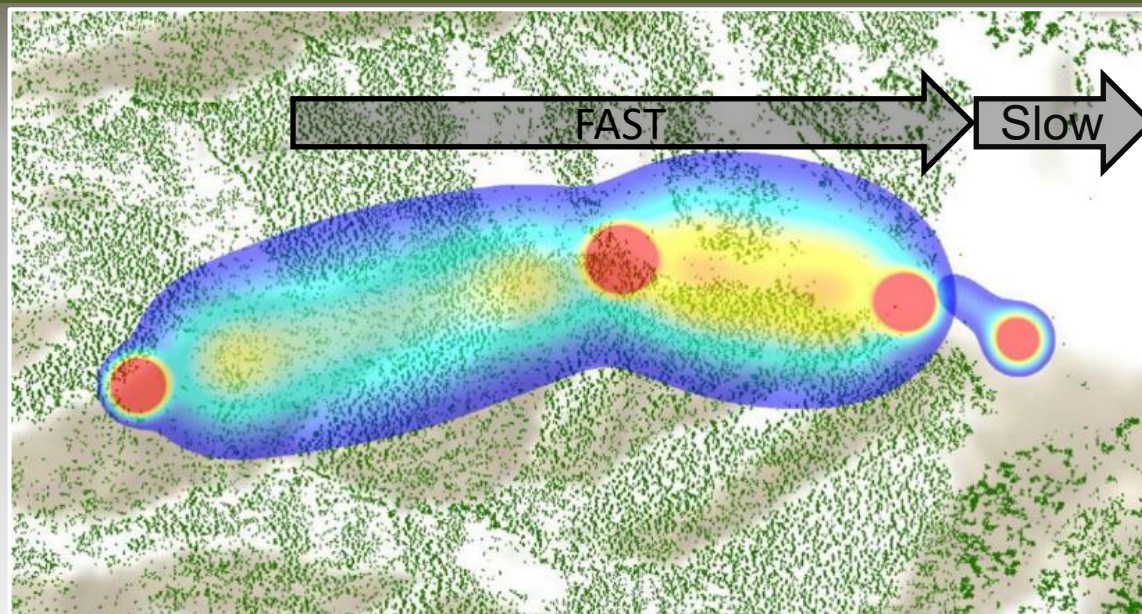
Conifer Effects on Survival?



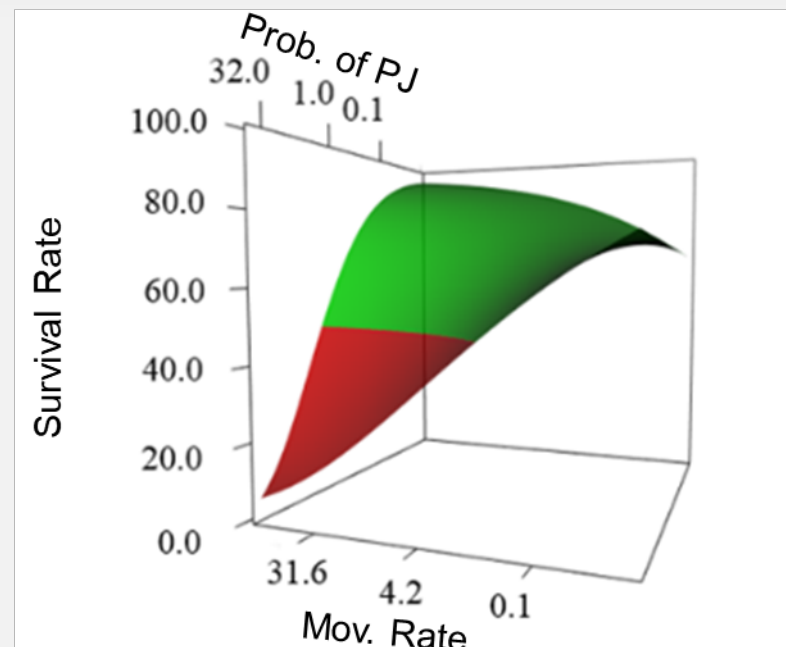
Pinyon-Juniper => Increased Movement



Pinyon-Juniper => Increased Movement => Reduced Survival

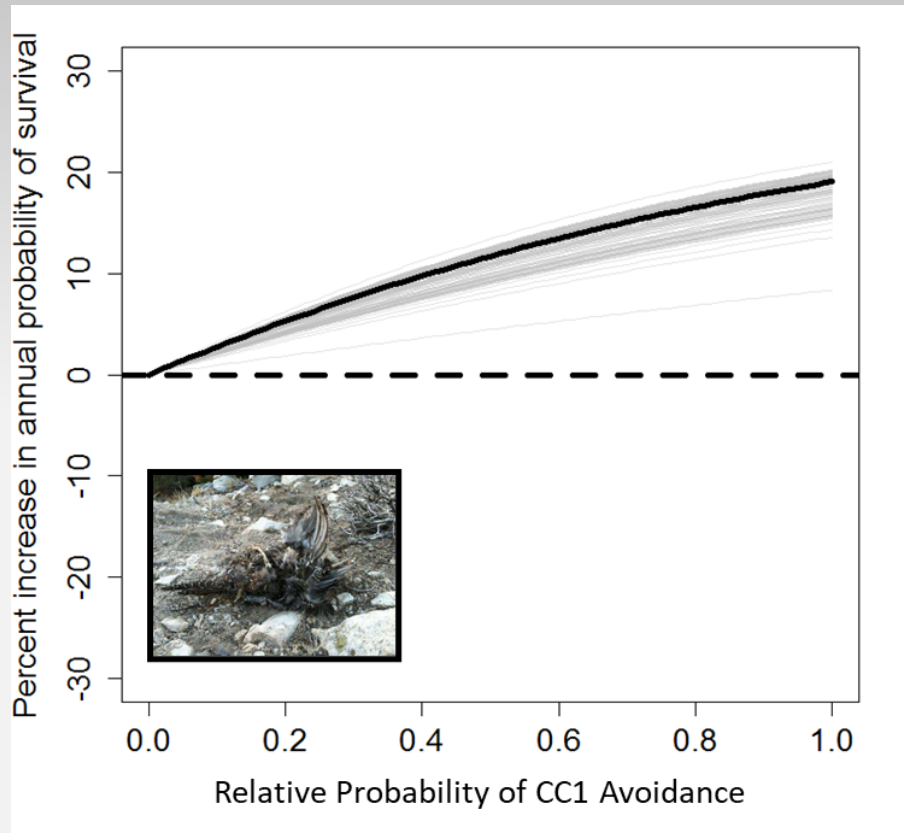


Prochazka et al. 2017

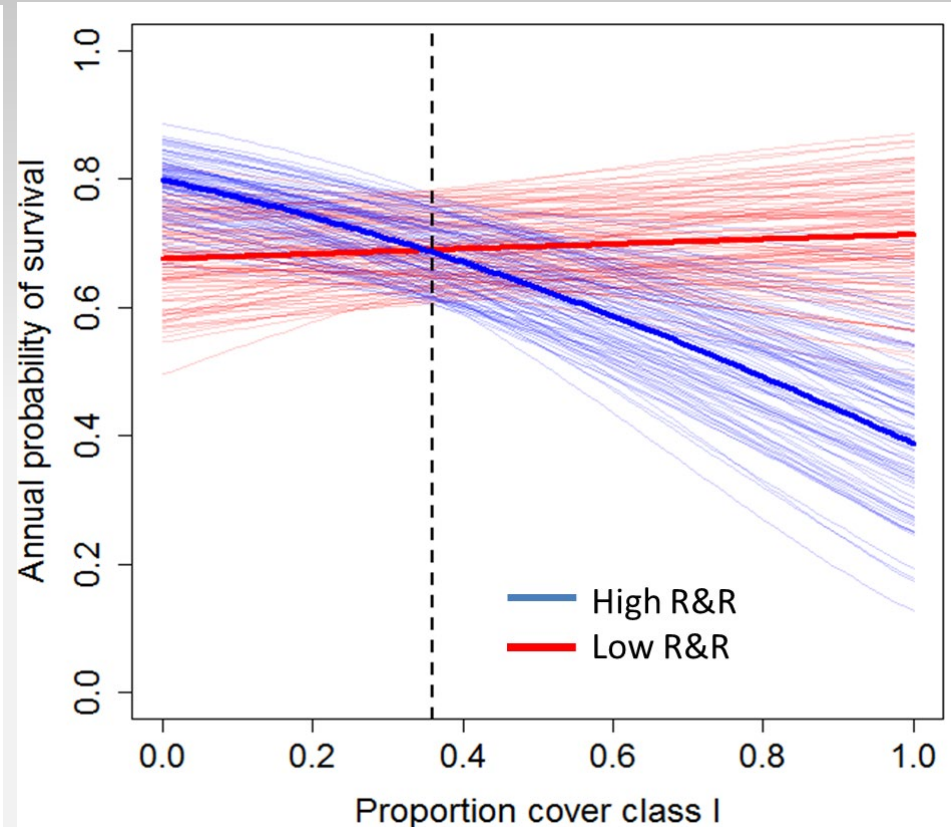


Prochazka et al. 2017

Increased moisture with sporadic conifer decreases survival of sage-grouse by up to 20% annually

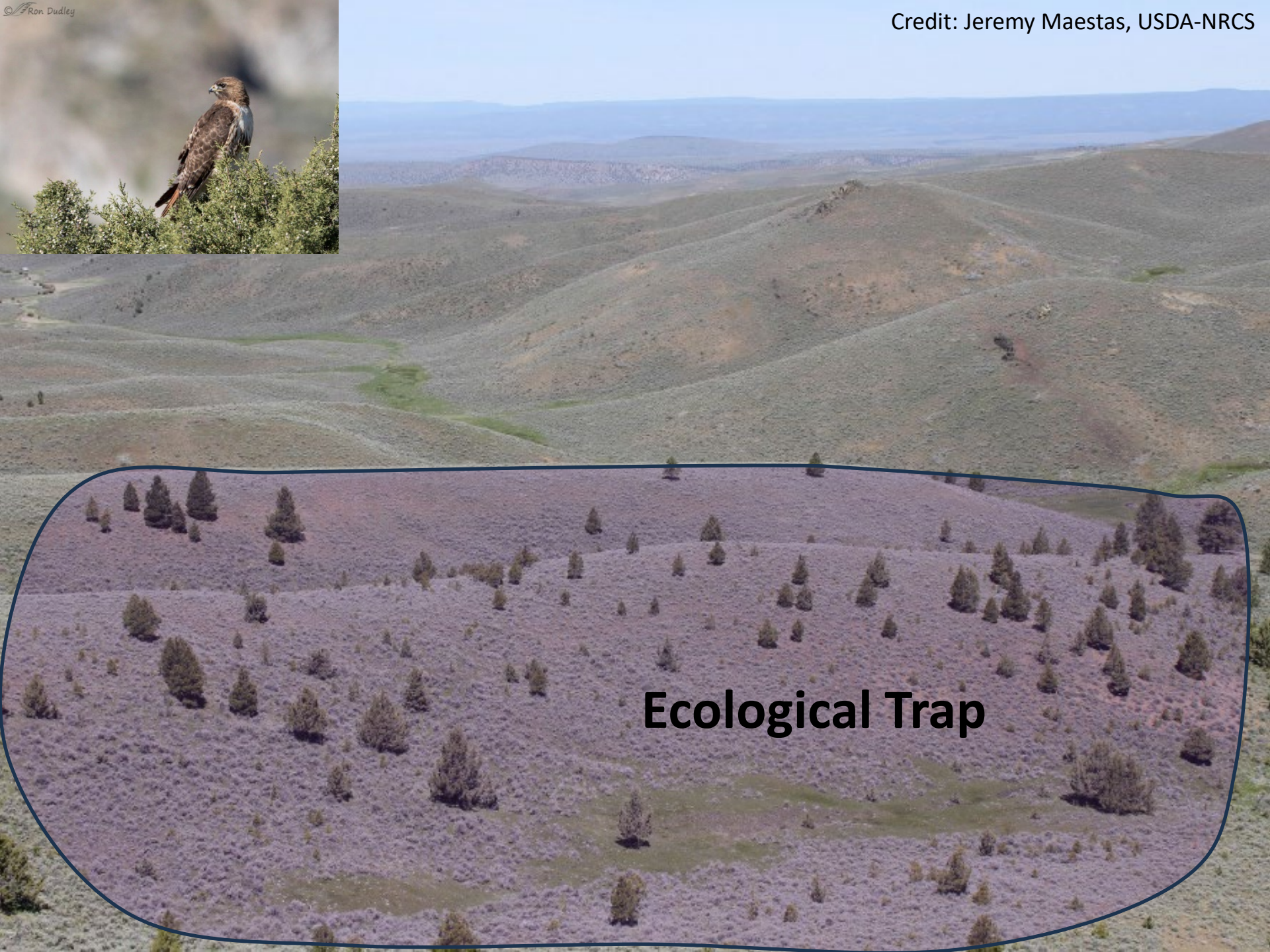


Coates et al. 2017

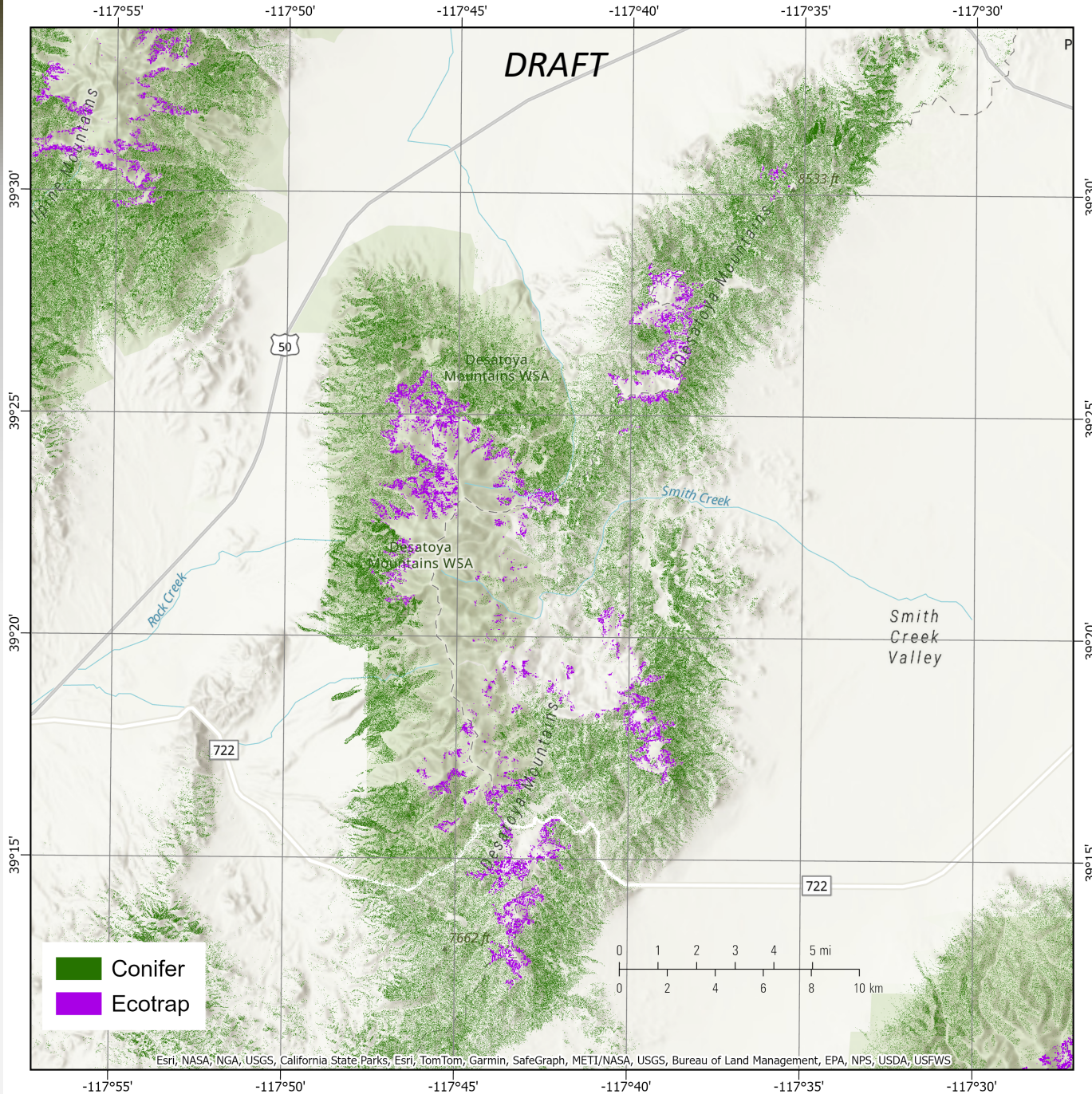


Coates et al. 2017



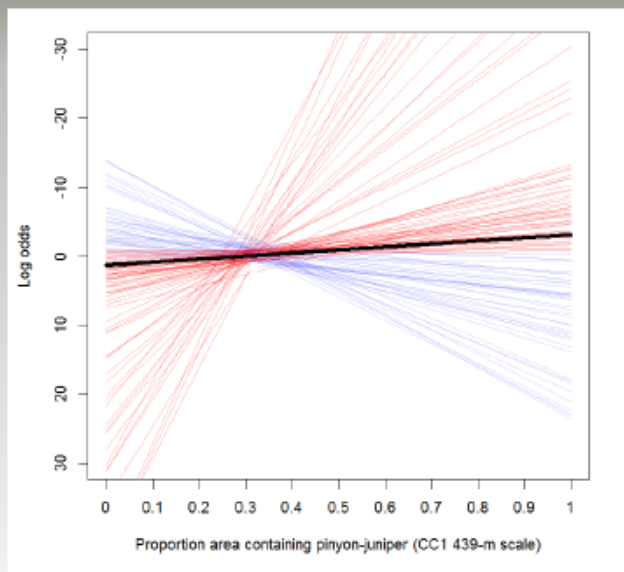


Ecological Trap

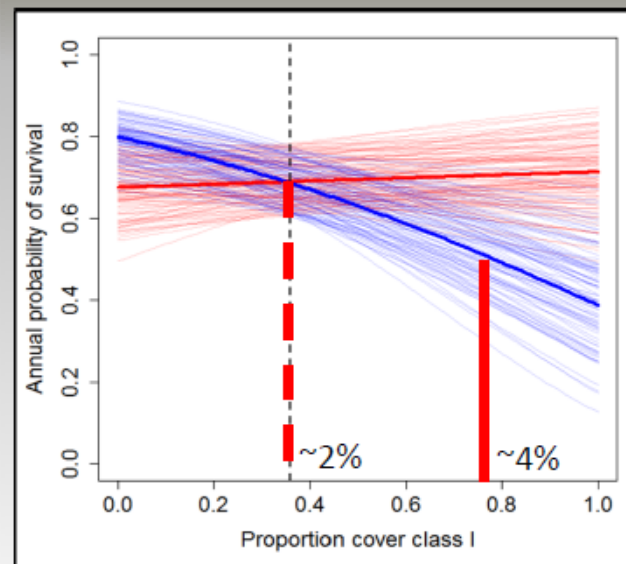


Preliminary Information—Subject to Revision. Not for Citation or Distribution

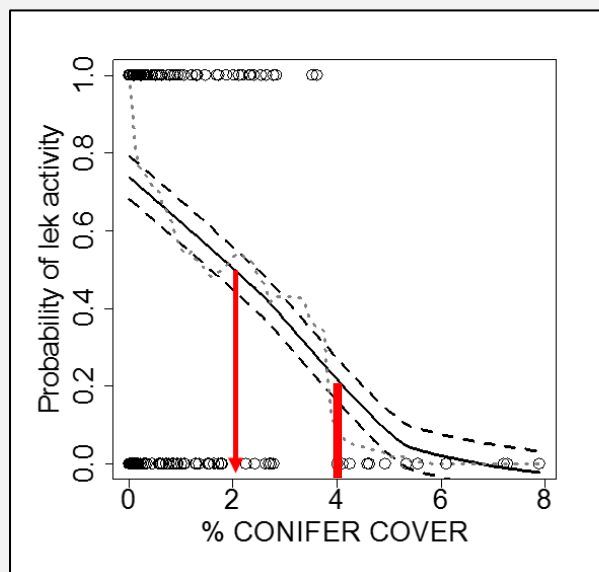
Common Threshold 2-4% (or less)



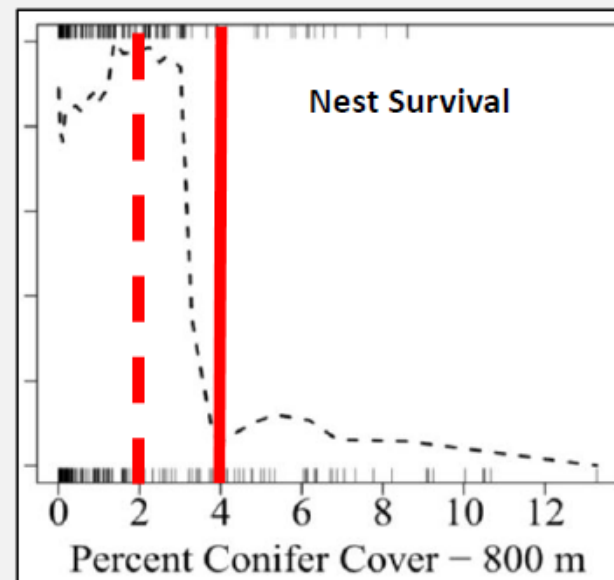
Coates et al. 2017



Coates et al. 2017

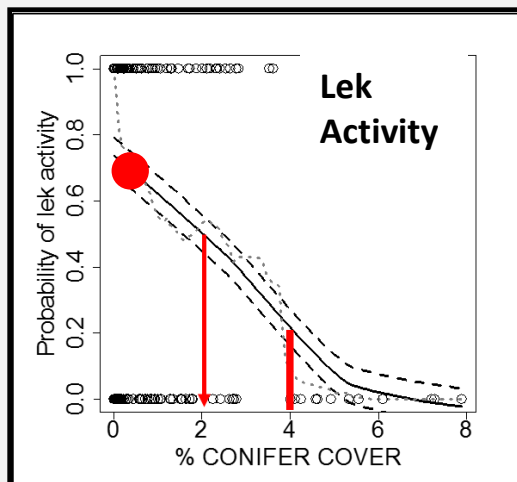
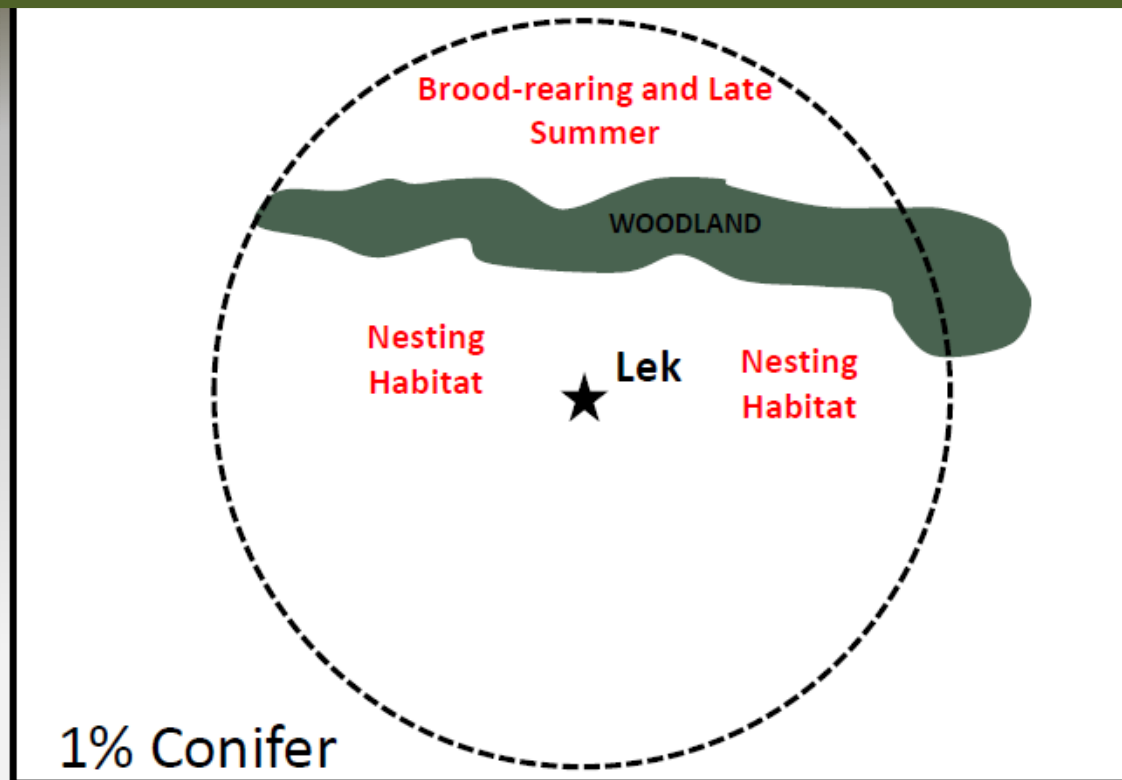


Baruch-Mordo et al. 2013.

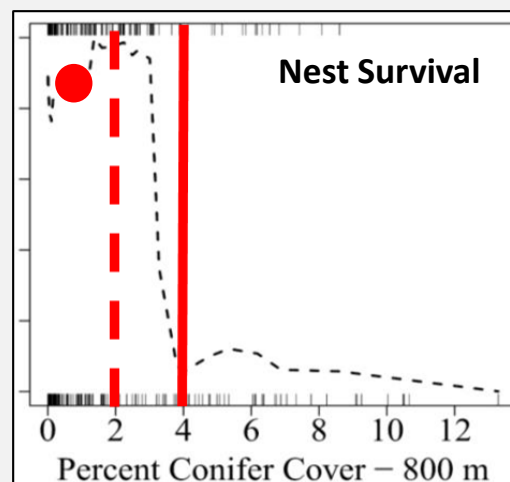


Severson et al 2017

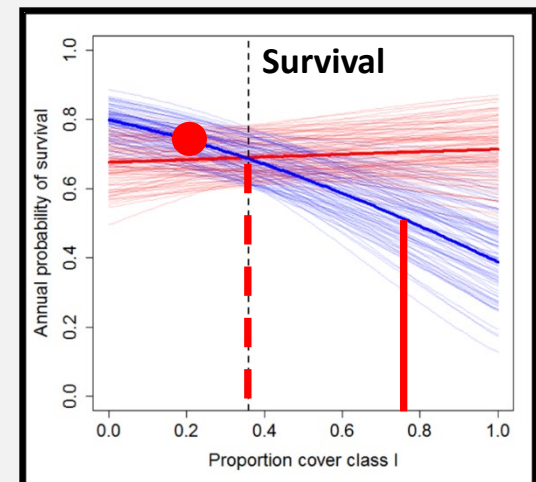
Example of Predicted Effects



Baruch-Mordo et al. 2013

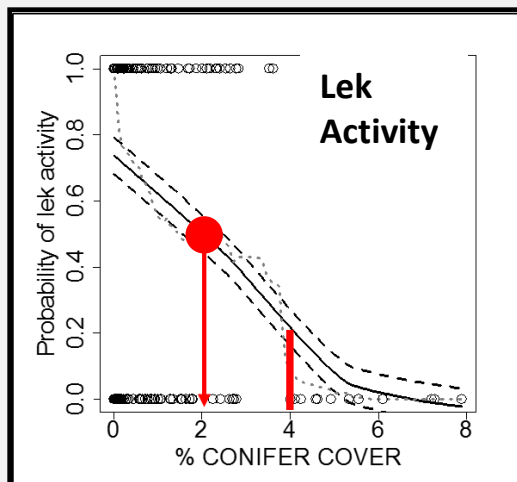
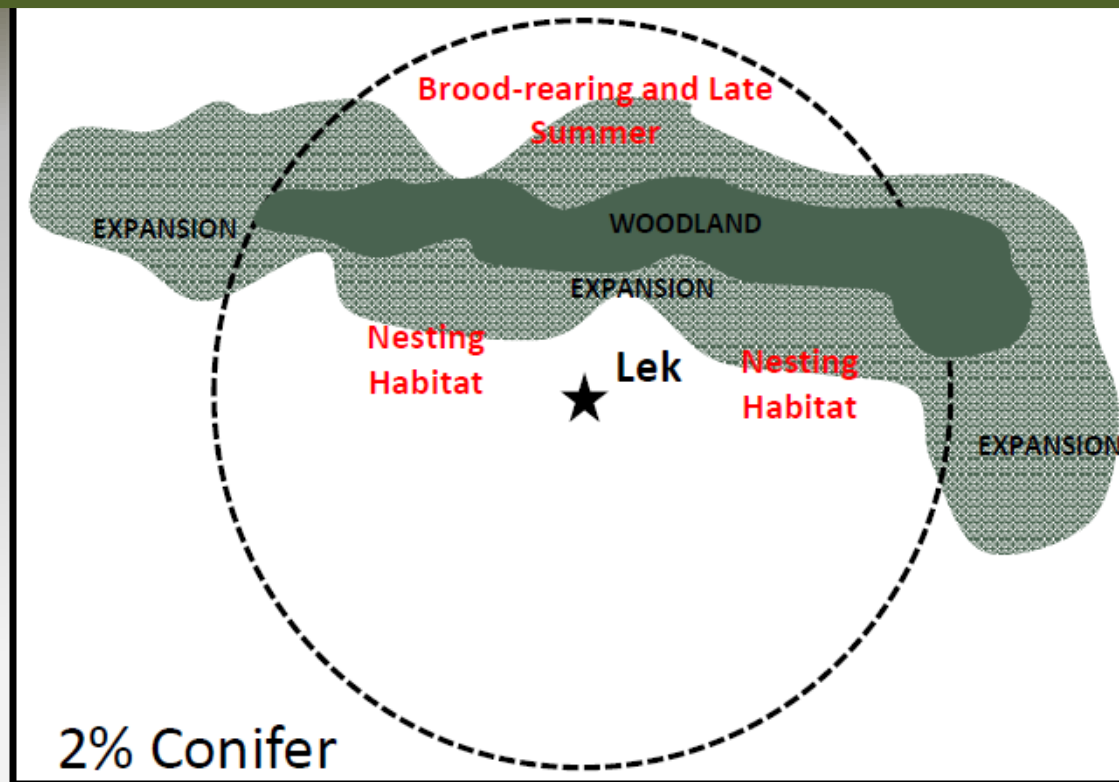


Severson et al 2017

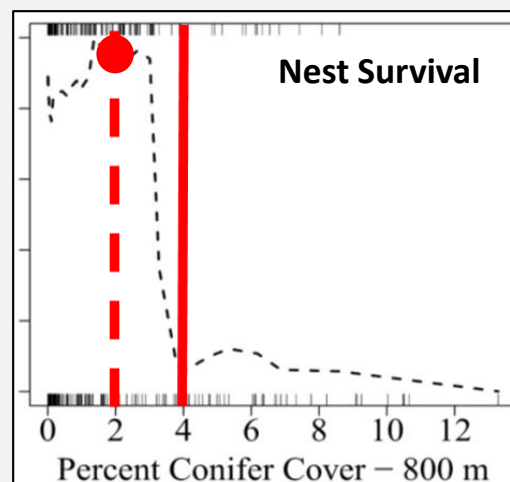


Coates et al. 2017

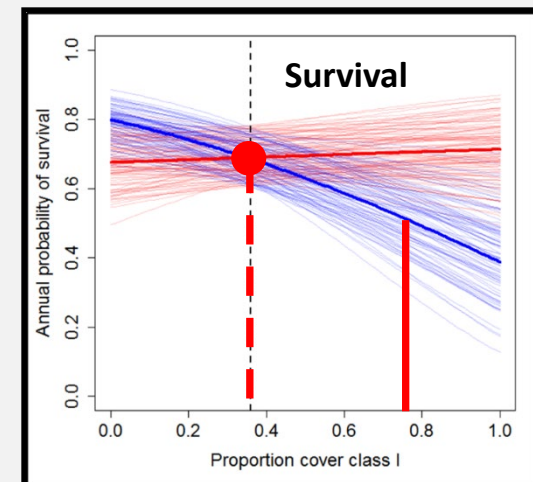
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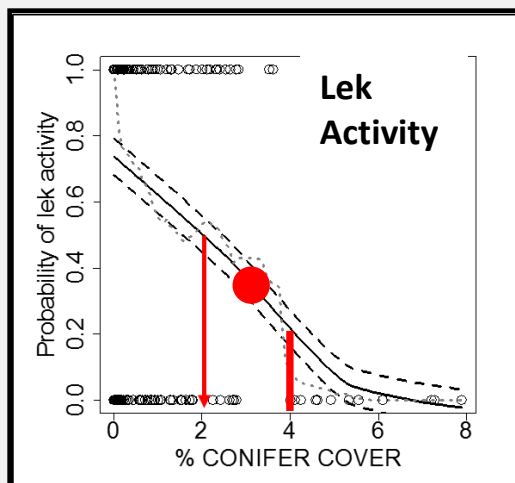
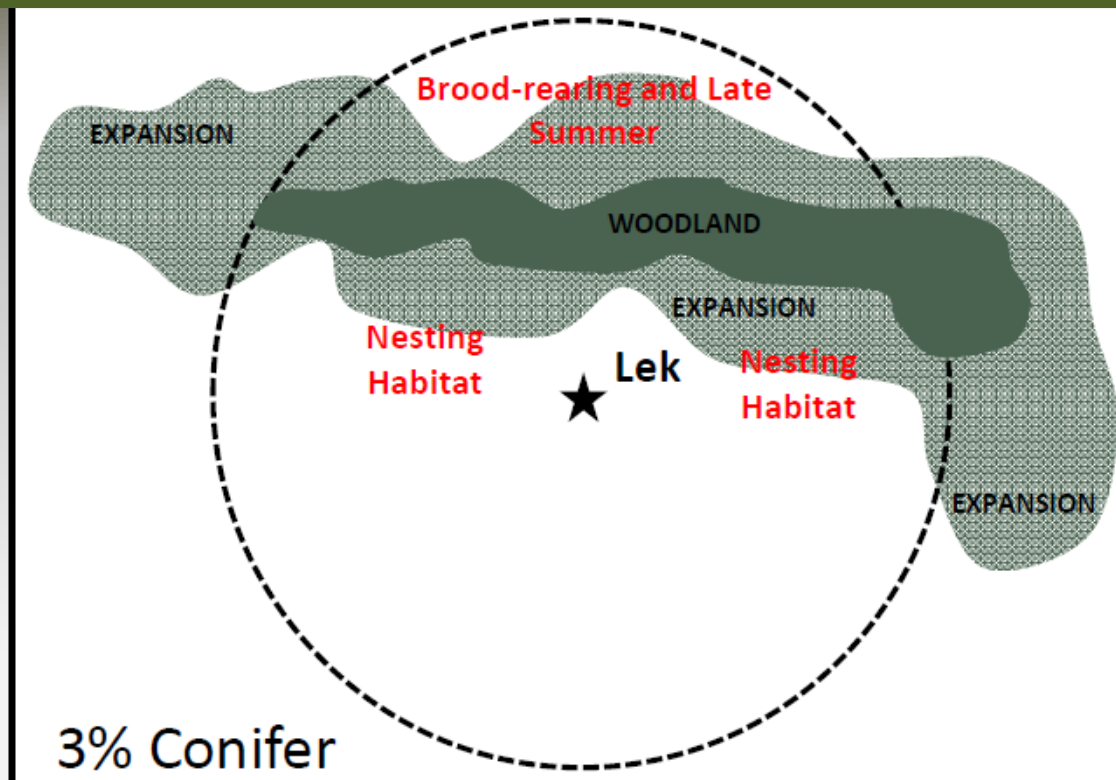


Severson et al 2017

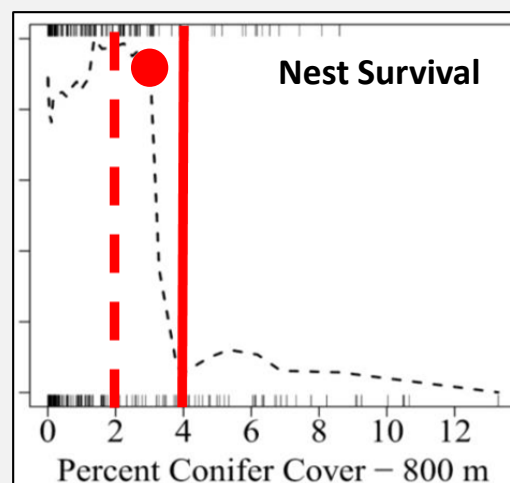


Coates et al. 2017

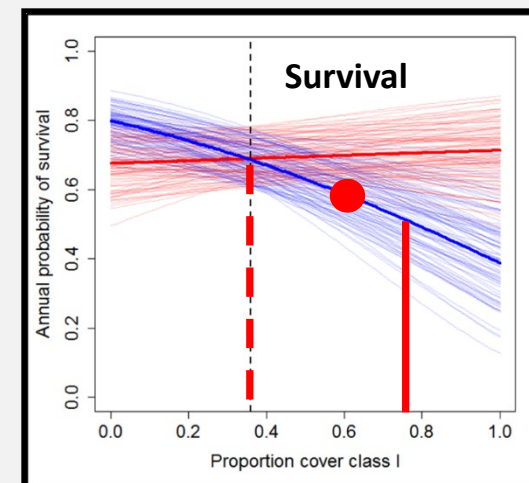
Example of Predicted Effects



Baruch-Mordo et al. 2013

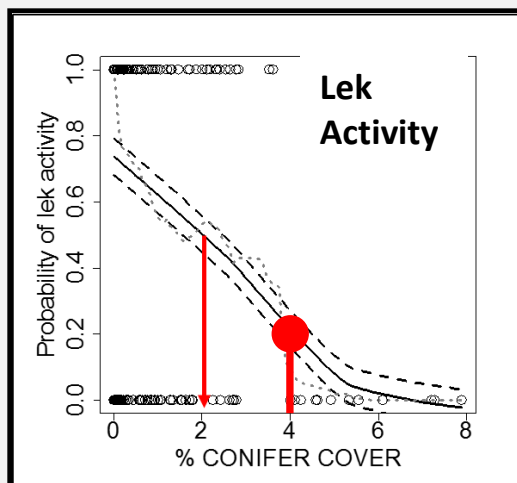
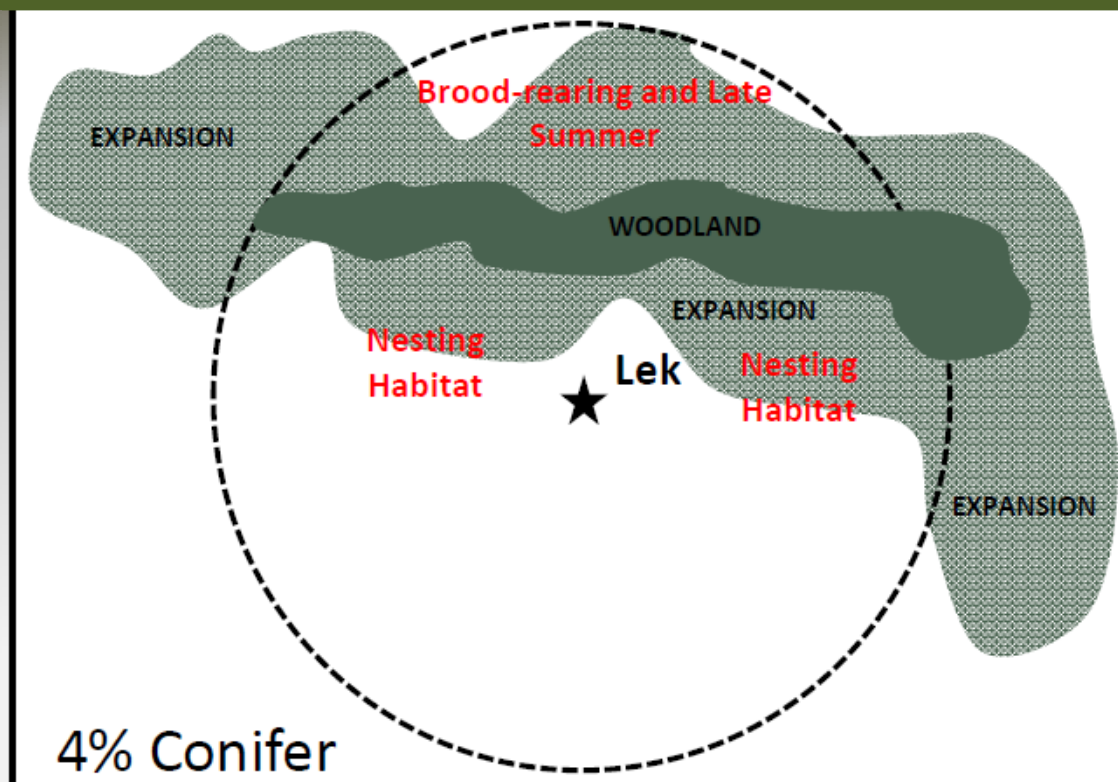


Severson et al 2017

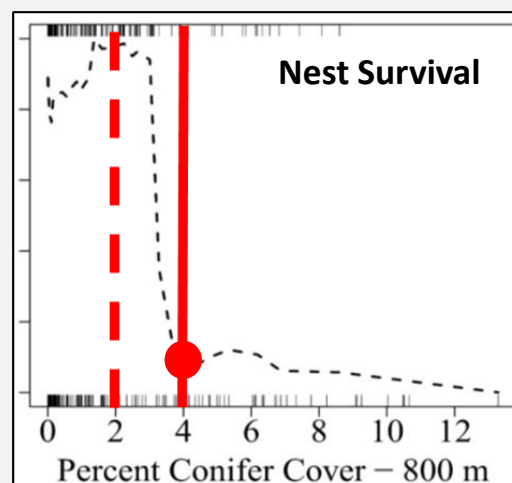


Coates et al. 2017

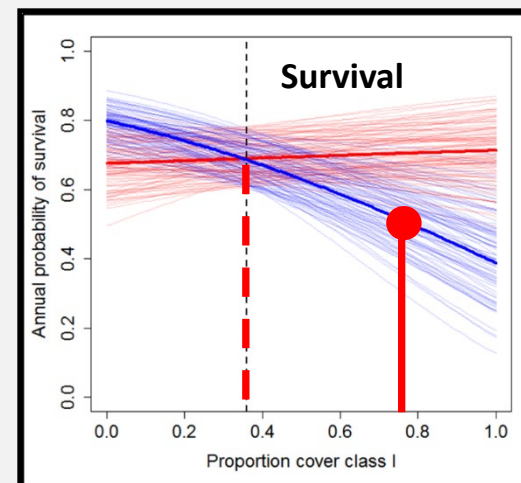
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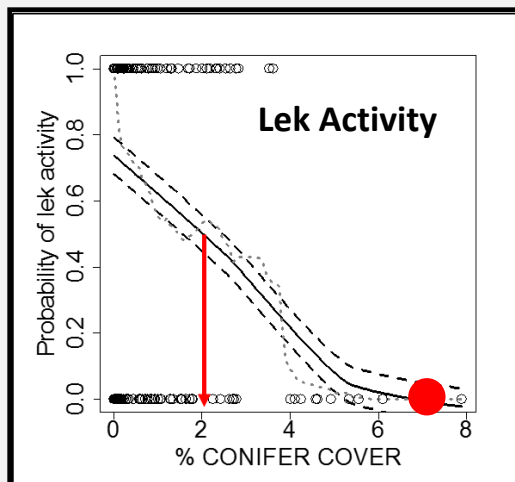
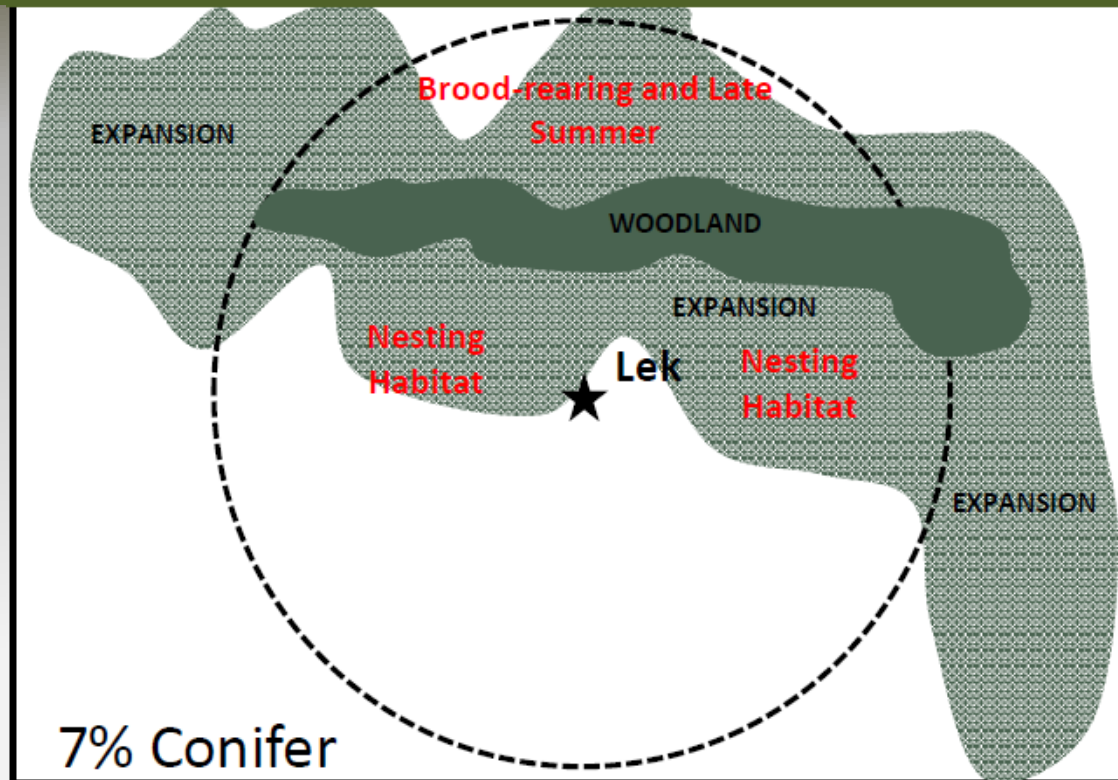


Severson et al 2017

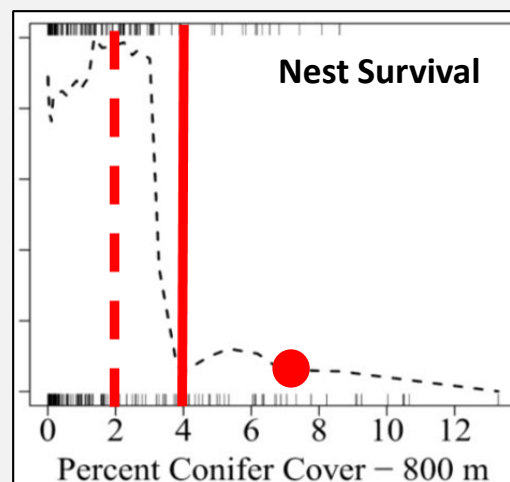


Coates et al. 2017

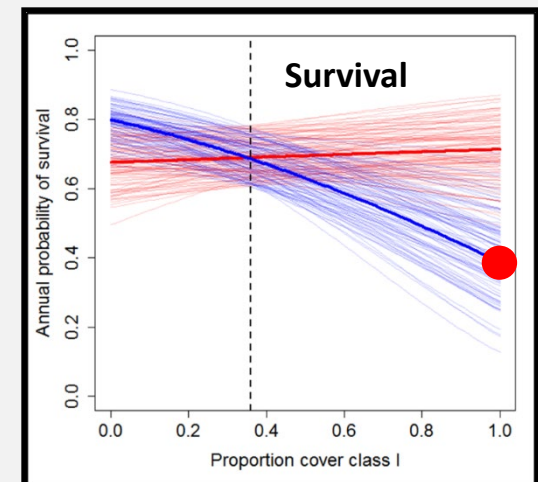
Example of Predicted Effects



Baruch-Mordo et al. 2013



Severson et al 2017



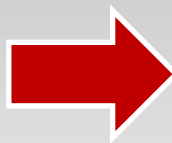
Coates et al. 2017

Does Removing Expansion Conifers Improve Sage-Grouse Population Performance?

Pre-Treatment



Post-Treatment



Pre-Treatment



Post-Treatment



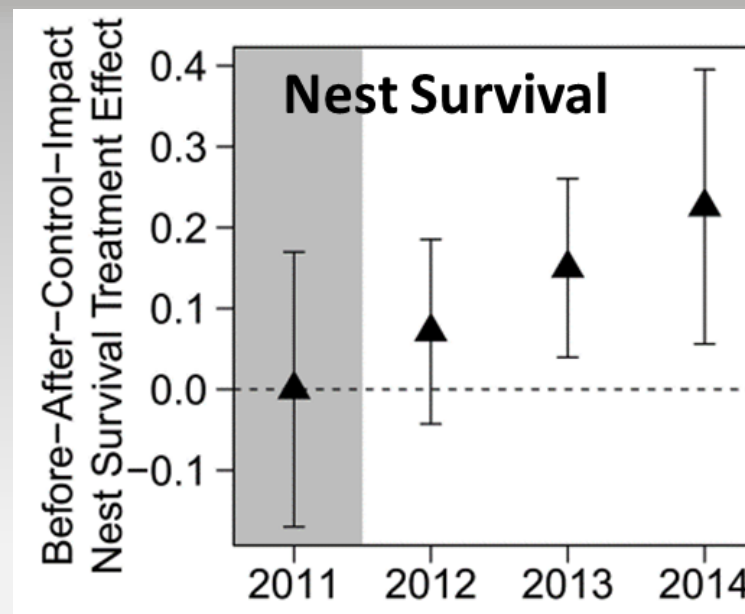
- **Recommended in habitat guidelines (Connelly et al. 2000)**
- **Very little direct research (USFWS 2015)**

Removal Increases Nest Survival and Female Survival

3-yr post-treatment

Nest Survival

17.8% increase



Severson et al. 2017

Removal Increases Nest Survival and Female Survival

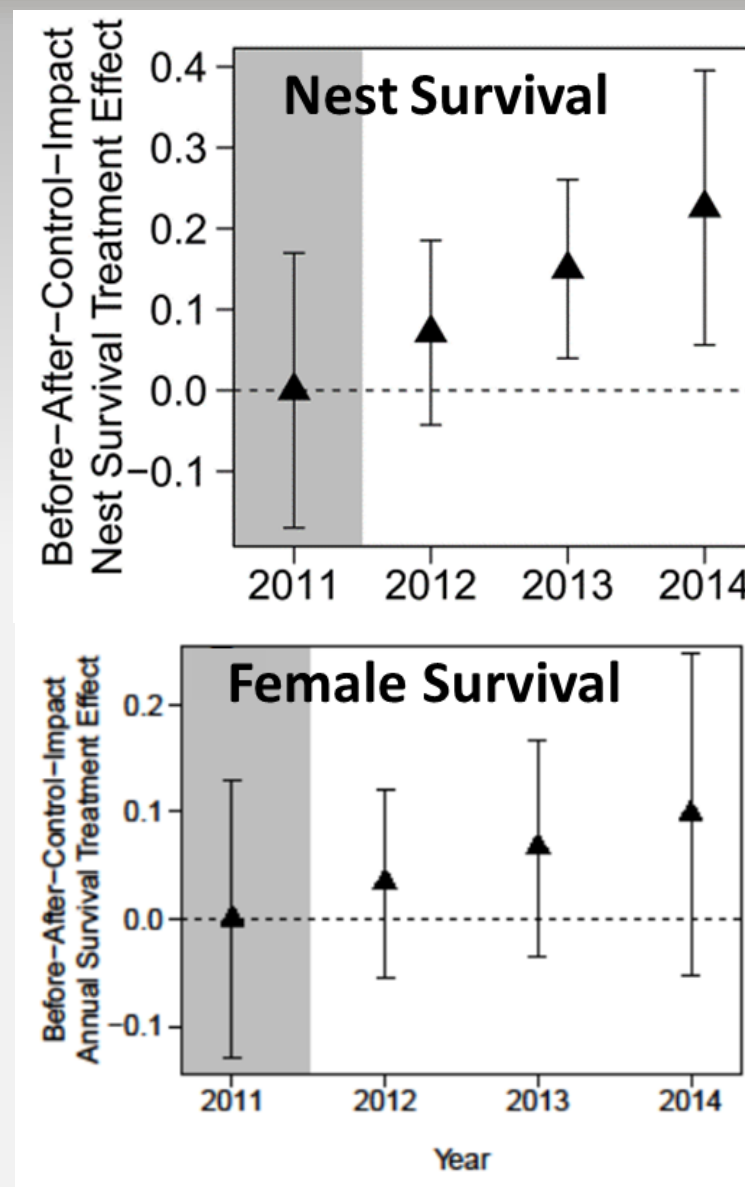
3-yr post-treatment

Nest Survival

17.8% increase

Female Survival

6.6% Increase



Removal Increases Nest Survival and Female Survival

3-yr post-treatment

Nest Survival

17.8% increase

Female Survival

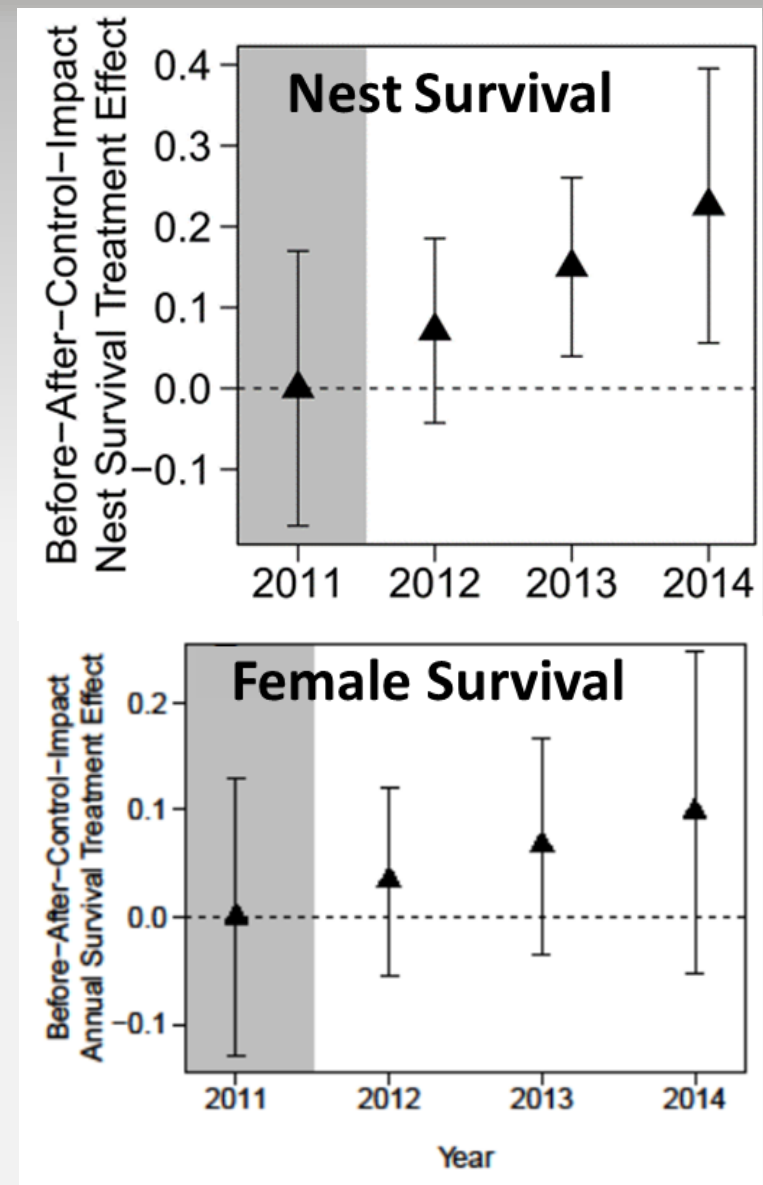
6.6% Increase

Population Growth (λ)

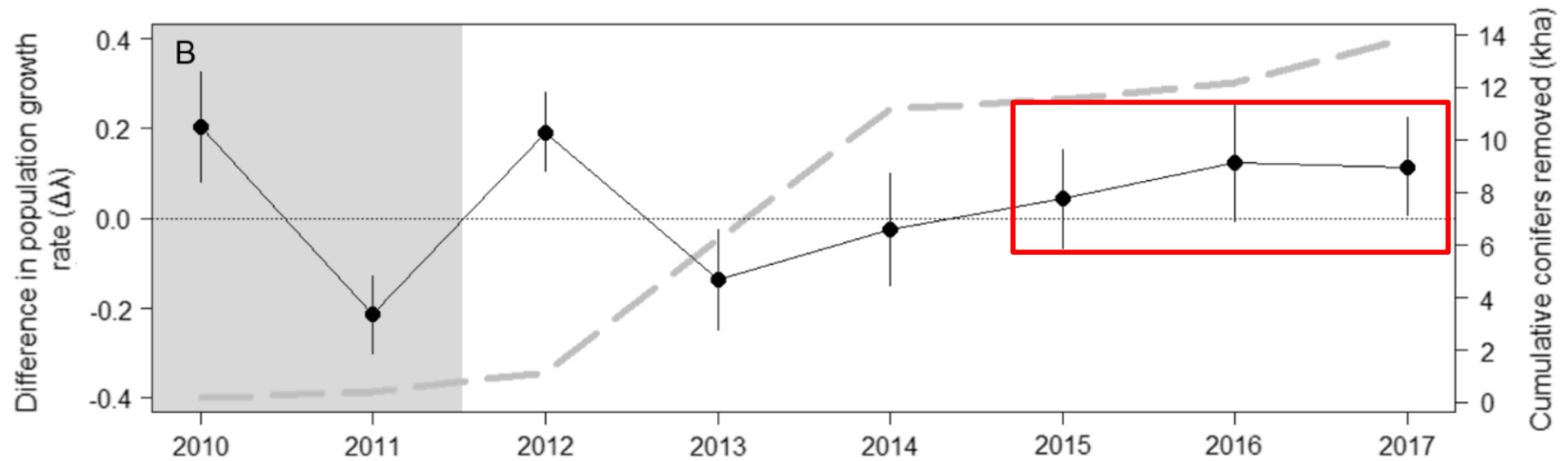
Control: 0.97 (0.79-1.19)

Treat: 1.21 (0.96-1.51)

24% increase in λ

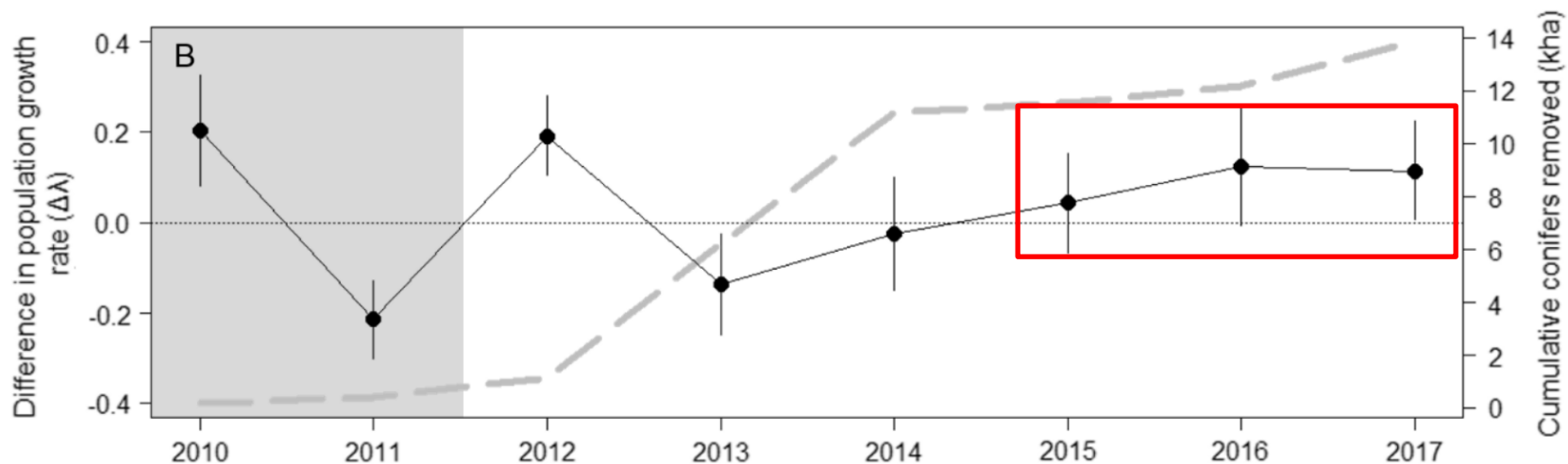


Removal Increases Population Growth Rates

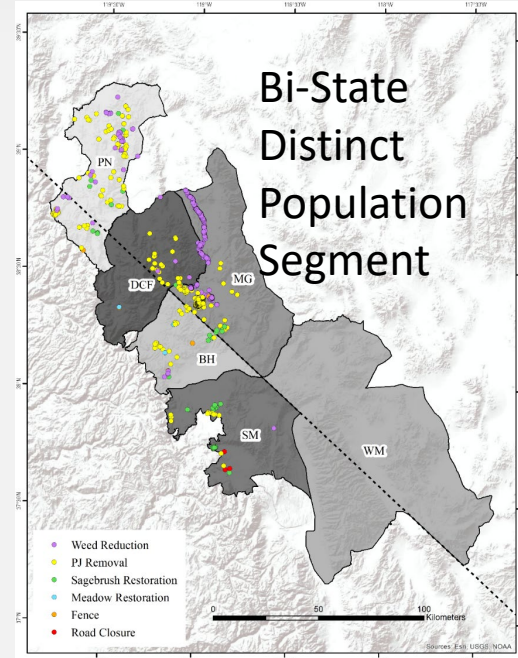
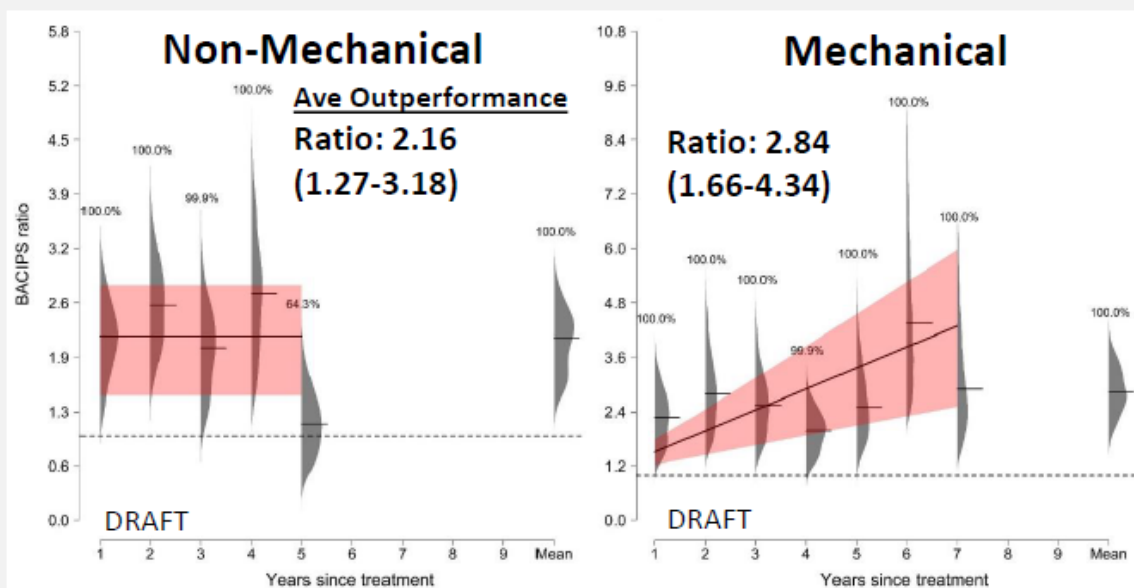


Olsen et al. 2021, Ecosphere

Removal Increases Population Growth Rates



Olsen et al. 2021, Ecosphere



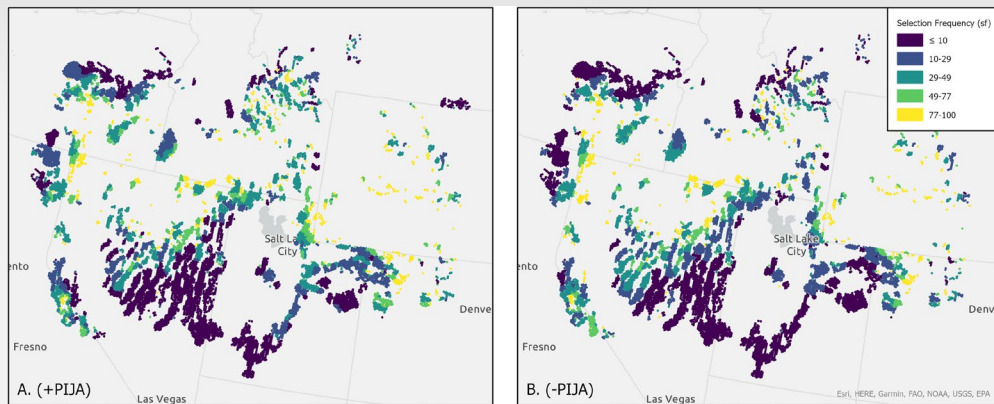
Preliminary Information—Subject to Revision. Not for Citation or Distribution

Balancing Management Objectives Quantitative Tools

Decision support tools can improve access to data and predict outcomes to inform on-the-ground management plans

Balancing Management Objectives through Decision Support Tools

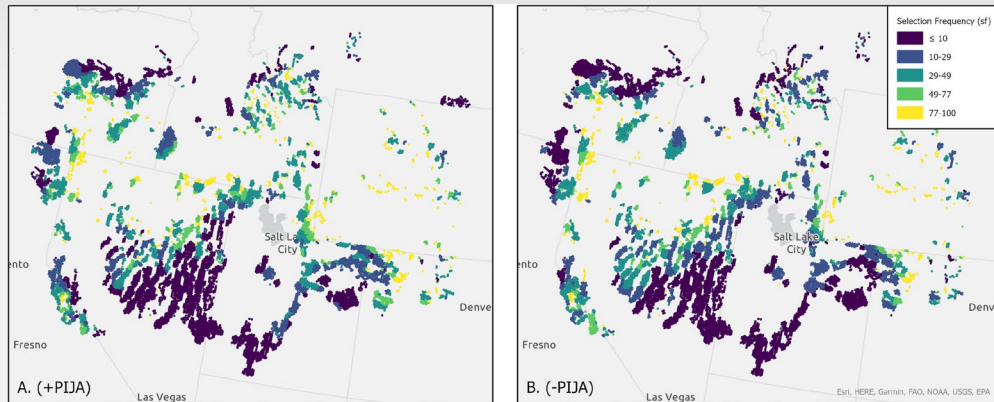
Conifer removal optimizations for sage-grouse and other sagebrush-obligate songbirds based on selection frequency
(Reinhardt et al. 2013)



Jason R. Reinhardt, Jason D. Tack, Jeremy D. Maestas, David E. Naugle, Michael J. Falkowski, Kevin E. Doherty (2023). Optimizing Targeting of Pinyon-Juniper Management for Sagebrush Birds of Conservation Concern While Avoiding Imperiled Pinyon Jay, Rangeland Ecology & Management

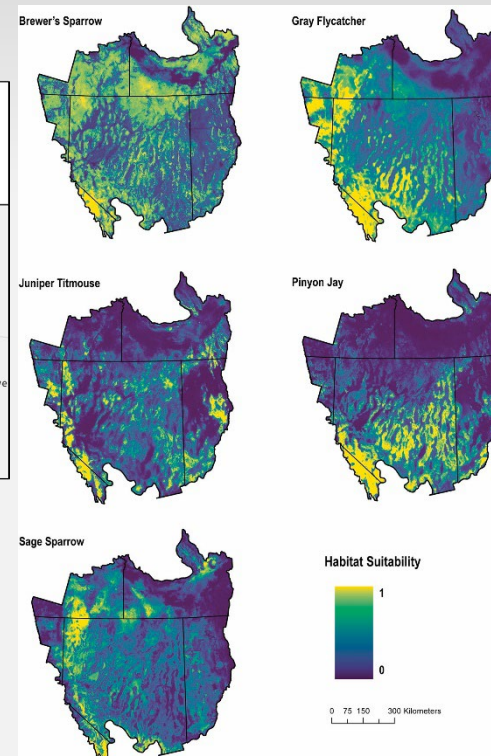
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Simulated change in habitat suitability across the study area with wholesale conifer removal (Zeller et al. 2021)



Zeller et al. 2021 Targeting conifer removal to create an even playing field for birds in the Great Basin. Biological Conservation.

Conifer Planning Tool


Simulates understory recovery and quantifies predicted change in sage-grouse habitat suitability following conifer management in sagebrush ecosystems.

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. CASAZZA¹

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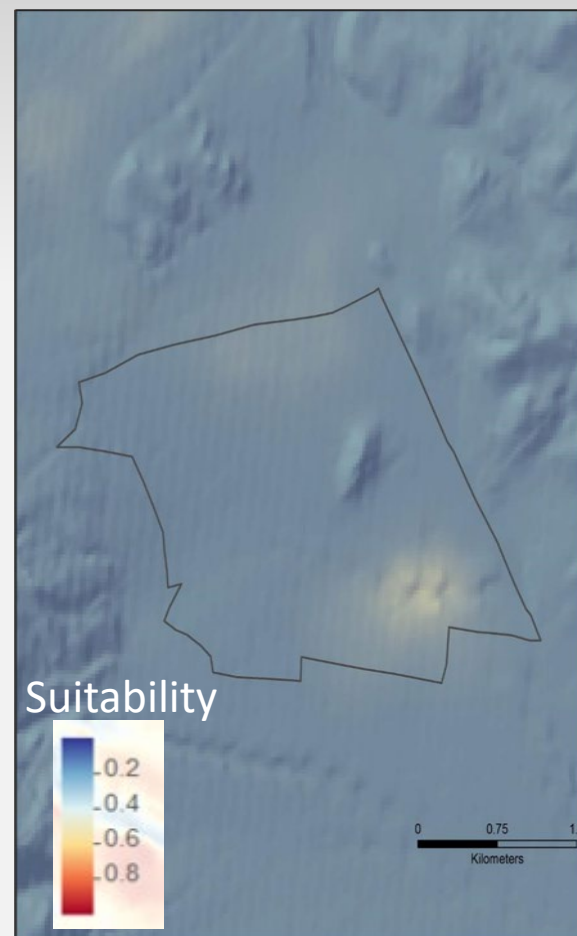
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1. User defines treatment sites



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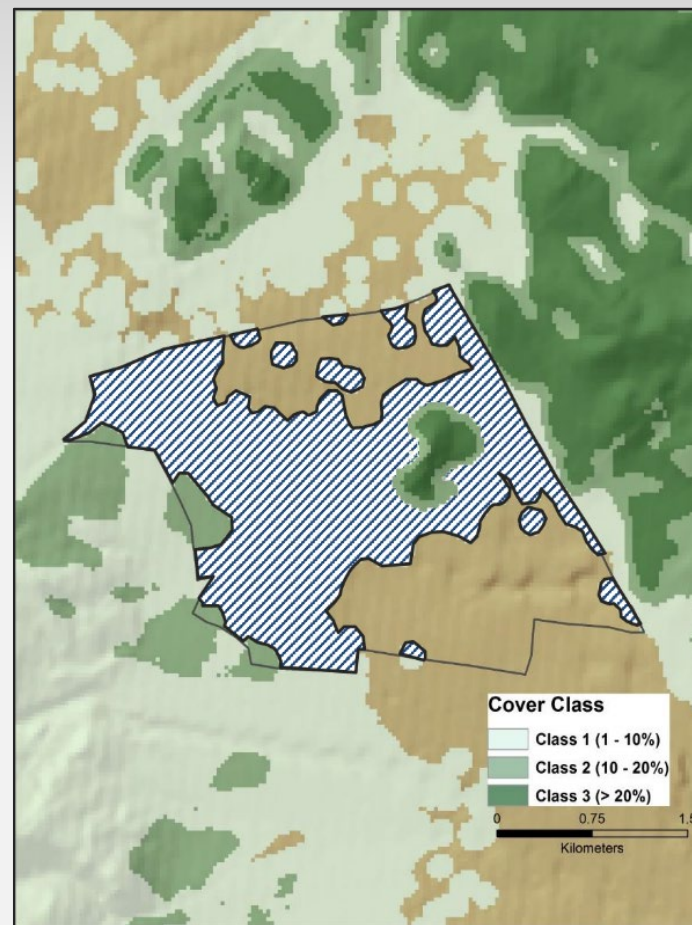
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1. User defines treatment sites
2. User defines pinyon-juniper woodland phase



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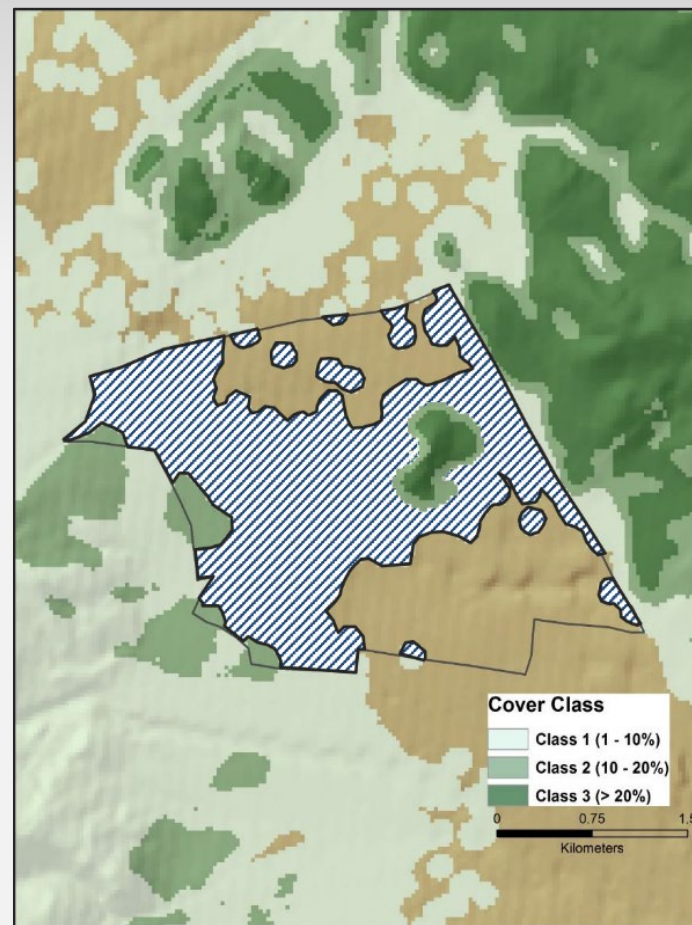
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1. User defines treatment sites
2. User defines pinyon-juniper woodland phase
3. Simulate pinyon-juniper removal, sagebrush recovery, and annual grass invasion



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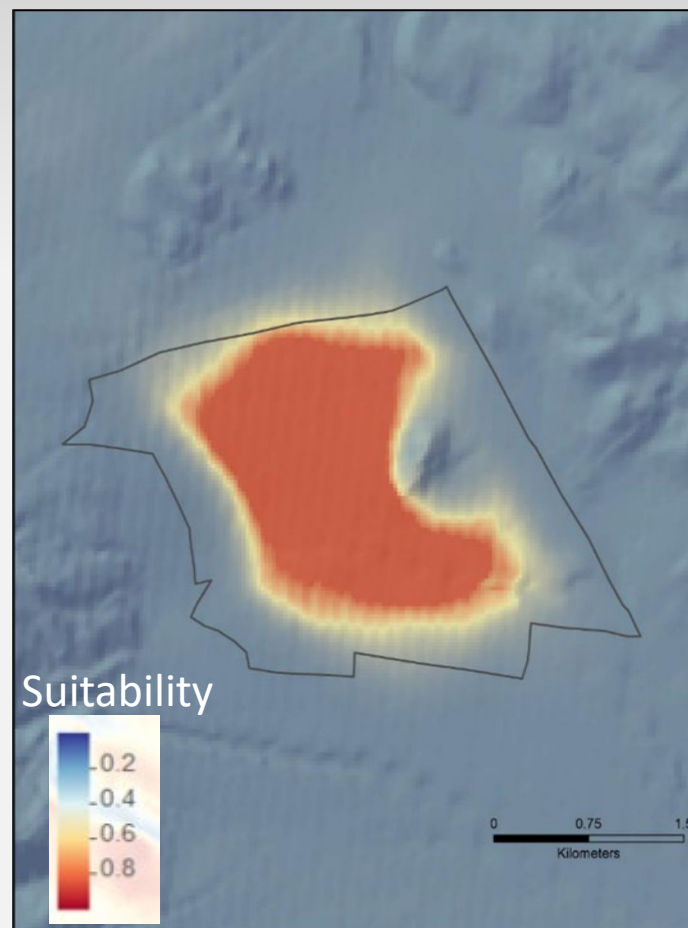
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1. User defines treatment sites
2. User defines pinyon-juniper woodland phase
3. Simulate pinyon-juniper removal, sagebrush recovery, and annual grass invasion
4. Calculate change in pre- and post-habitat suitability



Conifer Planning Tool

Simulates understory recovery and quantifies predicted change in sage-grouse habitat suitability following conifer management in sagebrush ecosystems.

Ecological Applications, 28(4), 2018, pp. 878–896

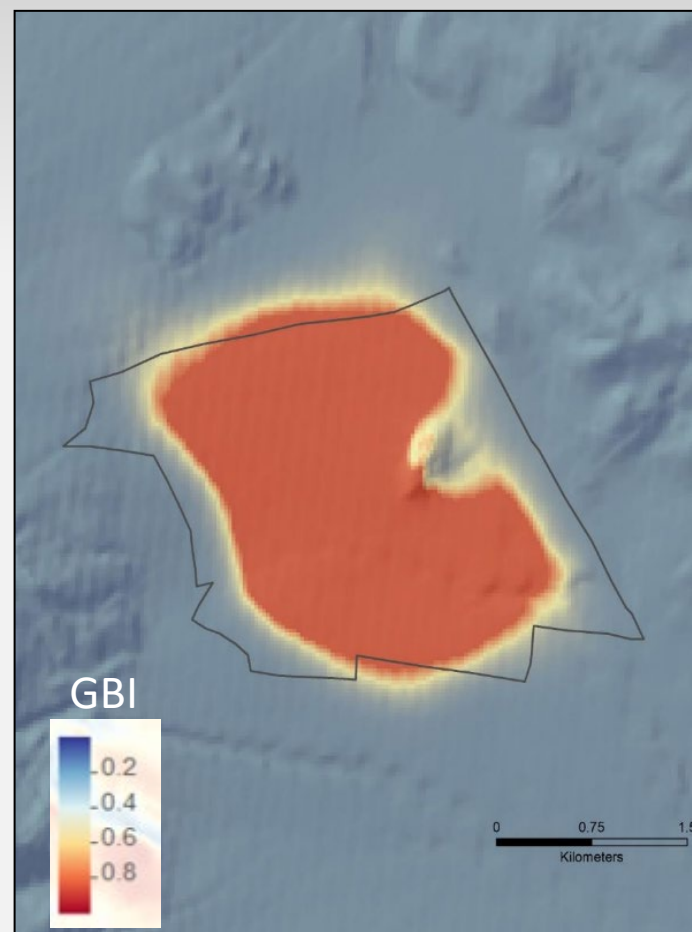
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A conservation planning tool for Greater Sage-grouse using indices of species distribution, resilience, and resistance

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. CASAZZA¹

1. User defines treatment sites
2. User defines pinyon-juniper woodland phase
3. Simulate pinyon-juniper removal, sagebrush recovery, and annual grass invasion
4. Calculate change in pre- and post-habitat suitability
5. Weight by sage-grouse use



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3. Simulate pinyon-juniper removal, sagebrush recovery, and annual grass invasion
4. Calculate change in pre- and post-habitat suitability
5. Weight by sage-grouse use
6. Rank sites by total improvement to sage-grouse habitat and/or cost effectiveness

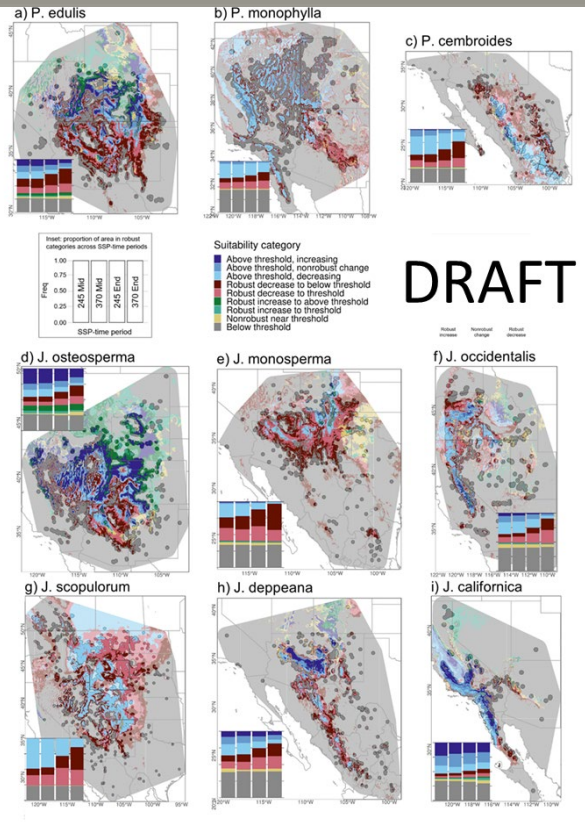
PJ Cut (ha)	Σ Cost	Rank (HSI* AUI)	GBI (HSI*AUI)	Total
182	\$ 78,890	1	4.832	35%
257	\$ 110,999	2	1.452	45%
92	\$ 39,854	3	1.252	54%
108	\$ 46,859	4	1.248	63%
444	\$ 192,147	5	1.151	71%
-	-	-	-	-
-	-	-	-	-
117	\$ 50,635	23	0.011	100%
284	\$ 122,675	24	0.006	100%
110	\$ 47,560	25	0.003	100%
322	\$ 139,099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

Conifer Planning Tool

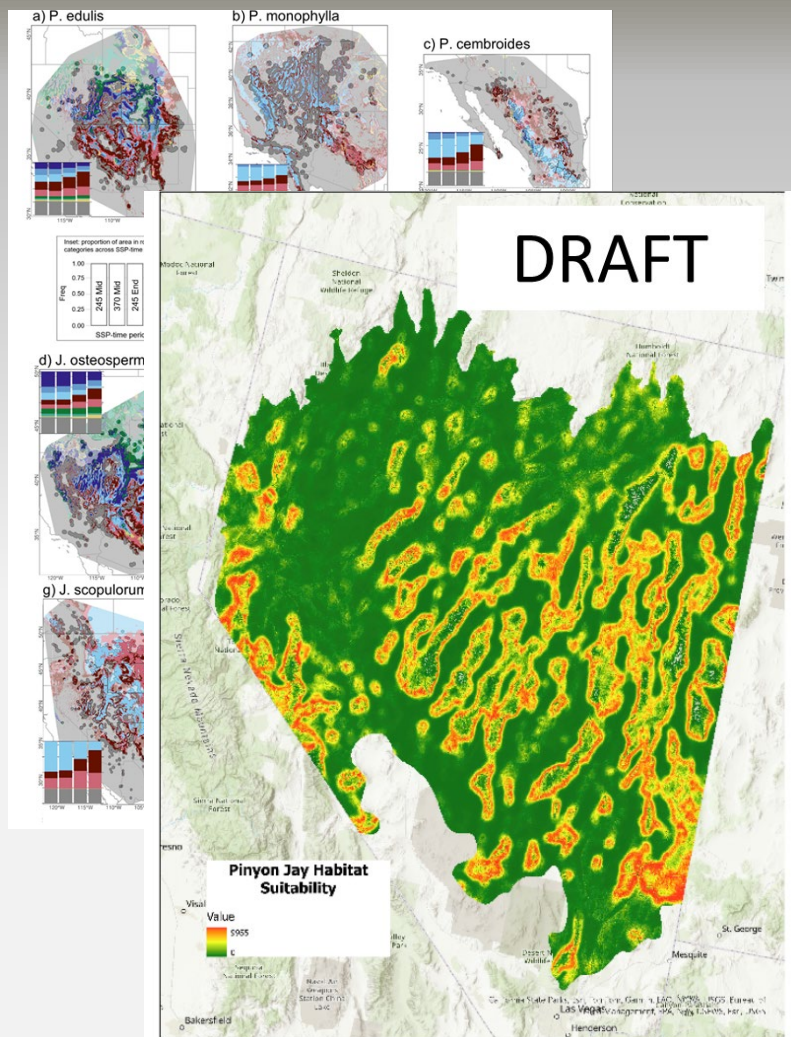
Ongoing and future objective:

- Costs to inclusion mature pinyon-juniper woodlands

DRAFT



Conifer Planning Tool

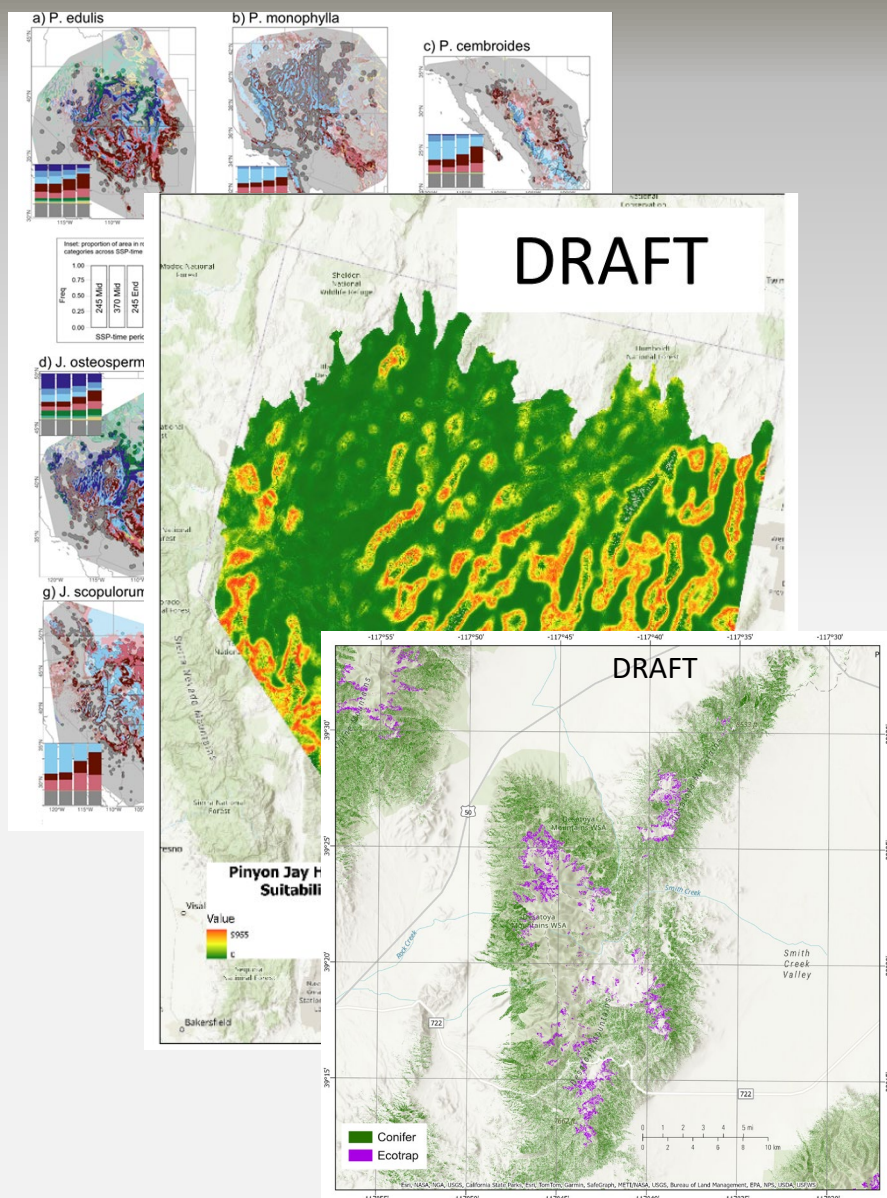


Ongoing and future objective:

- Costs to inclusion mature pinyon-juniper woodlands
- Use CPT to identify areas to protect woodland species' habitat suitability
- Sites ranked by maximizing benefit/minimizing impact to multiple species

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

Conifer Planning Tool

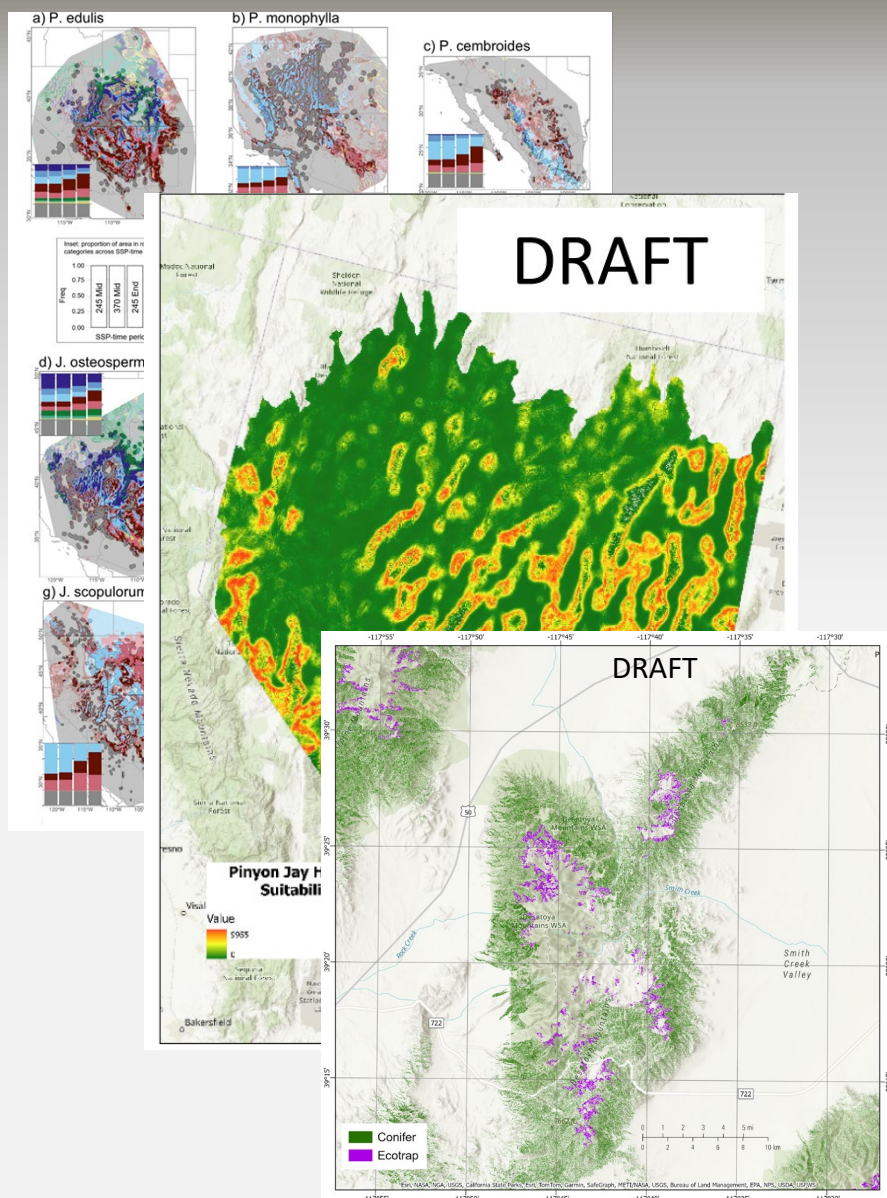


Ongoing and future objective:

- Costs to inclusion mature pinyon-juniper woodlands
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- Sites ranked by maximizing benefit/minimizing impact to multiple species
- Incorporate ecological traps

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Conifer Planning Tool



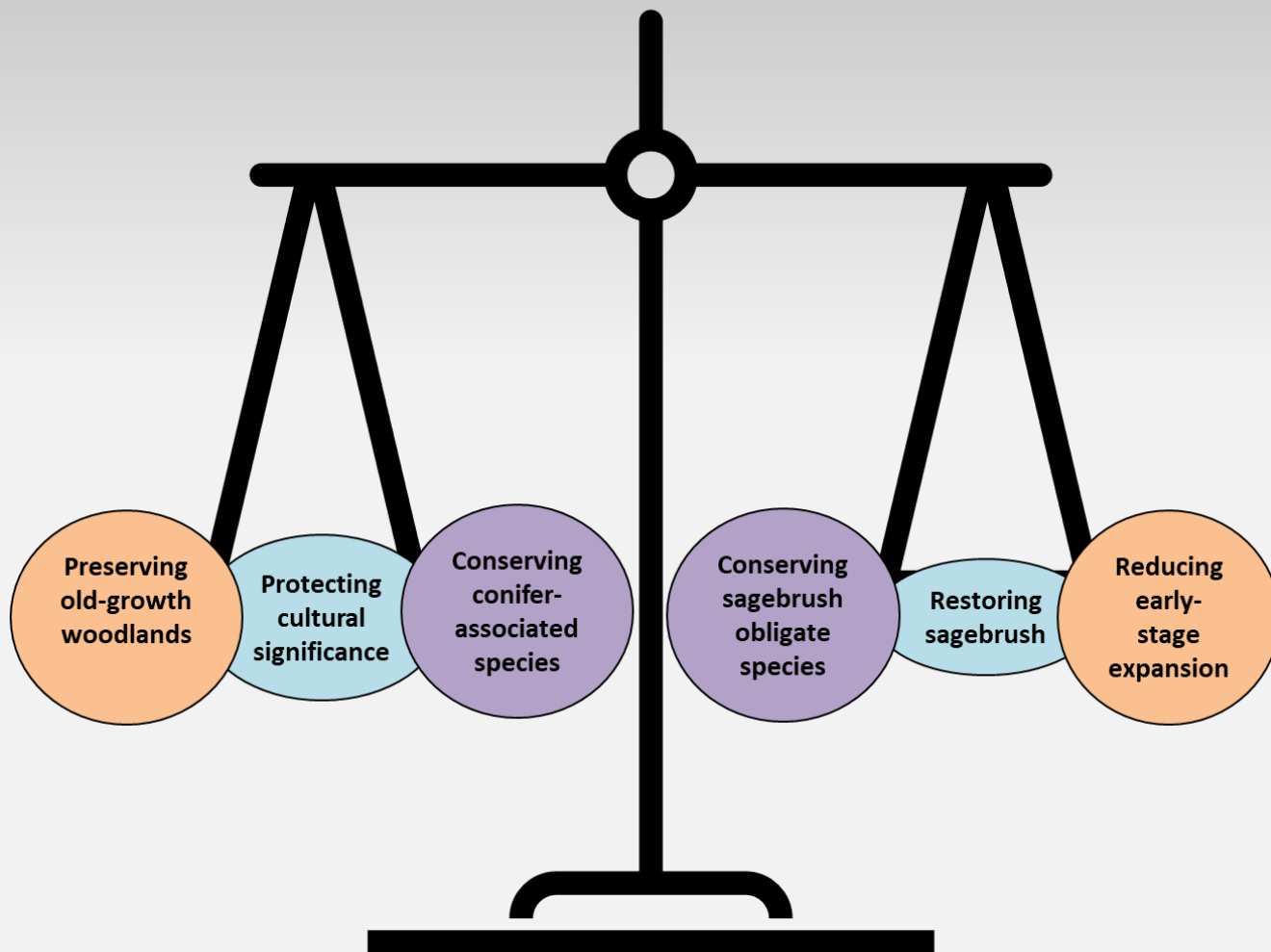
Ongoing and future objective:

- Costs to inclusion mature pinyon-juniper woodlands
- Use CPT to identify areas to protect woodland species' habitat suitability
- Sites ranked by maximizing benefit/minimizing impact to multiple species
- Incorporate ecological traps
- Predict expansion/contraction under different climate change scenarios
- Simulate pinyon-juniper restoration (seeding, planting)

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Take-Away Messages

- Managers face challenges and complexity in decisions aimed at preserving existing woodlands while reducing adverse impacts of expansion
 - holistic approach that meets different management objectives



Take-Away Messages

- **Managers face challenges and complexity in decisions aimed at preserving existing woodlands while reducing adverse impacts of expansion**
 - holistic approach that meets different management objectives
- **Expansion adversely affects sagebrush ecosystem function (e.g., water availability, soil nutrients, carbon cycles, and vegetation composition)**



Photo: Jason Hollinger

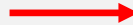
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Photos: BLM Lakeview District

Take-Away Messages

- **Managers face challenges and complexity in decisions aimed at preserving existing woodlands while reducing adverse impacts of expansion**
 - holistic approach that meets different management objectives
- **Expansion adversely affects sagebrush ecosystem function (e.g., water availability, soil nutrients, carbon cycles, and vegetation composition)**
- **Sage-grouse are a bellwether for sagebrush ecosystems and conifer expansion reduces habitat quality and adversely affect movements, demographic rates, and population growth**
- **Removal of early-stage trees in expansion areas has been shown to improve sage-grouse population performance**
- **Quantitative conifer planning tools can help inform decisions that balance preservation and restoration of both ecosystems**
 - CPT can account for costs (cultural and ecological) and benefits of removing trees expanding into sagebrush ecosystems

Acknowledgements

Bi-State Technical Advisory Committee; Local Area Working Group; Executive Oversight Committee; Tribal Natural Resource Committee

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Nevada Department Of Wildlife

California Department of Fish and Wildlife

US Fish and Wildlife Service

Natural Resource Conservation Service

University of Nevada Reno

Idaho State University

University of Idaho

University of California, Davis

Tribal Communities



Questions?



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